July - December 2025 Volume 34 Issue 2
PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW

Official Publication of Medicolegal Association of Maharashtra

Editor-in-chief
Dr Ravindra Deokar

Associate Editors
Dr Sadanand Bhise
Dr Sachin Patil

MULTISPECIALITY, MULTIDISCIPLINARY, NATIONAL
PEER REVIEWED, OPEN ACCESS, MLAM (SOCIETY) JOURNAL
Indexed with Scopus (Elsevier)

Editorial Office Address
Department of Forensic Medicine & Toxicology, Third Floor, Mortuary Building, Lokmanya Tilak Municipal Medical College & LTMG Hospital, Sion, Mumbai, Maharashtra, India. Pin-400 022. Email id: mlameditor@gmail.com Phone: 022-68660000/ +91-9423016325.

Medicolegal Association of Maharashtra- Executive Committee 2025-2027

PRESIDENT

Dr Satin Meshram

SECRETARY

Dr Amol Shinde

Advisors

Dr K D Chavan Dr S C Mohite Dr M D Karmarkar

Dr K U Zine Dr H V Godbole Dr A K Batra

Vice-President

Dr Amit Patil

Joint Secretary

Dr M V Sonawane

Treasurer

Dr Rahul R Wagh

Editor-in-chief

Dr Ravindra B Deokar

Associate Editors

Dr Sadanand S Bhise Dr Sachin S Patil

Executive Committee Members

Dr R S Bangal Dr Sandeep S Kadu Dr Rajesh C Dere

Dr G S Chavan Dr I L Khandekar Dr M E Bansode

Dr N P Zanjad Dr V P Meshram Dr A B Sapate Dr B G phalke

Co-opted Members

Dr Sunil Kadam Dr P R Sabale Dr Pravin Tayade

Dr Ranjit Tandale Dr S H Anande Dr Ashish Pathak Dr Rutuja Kanekar

---

Bank Account Details

Bank Account Name: Medicolegal Association of Maharashtra
Account No. 50292010017478 **IFSC Code-** CNRB0015029
MICR: 400015219 **Bank:** CANARA Bank Byculla II **Branch:** Byculla II, Mumbai.
MLAM MEMBERSHIP FEES: Rs. 4000/-
Website: http://www.mlam.in

Secretariat Office Address
Department of Forensic Medicine & Toxicology, P. A. Government Medical College Baramati, Maharashtra, India. Pin-413133.
Email id: mlamsecretary@gmail.com Mobile No. +91-9423421455.

Journal of Forensic Medicine Science and Law

PRINT ISSN: 2277-1867 **ONLINE ISSN**: 2277-8853

Editorial Board

Editor-in-chief

Dr Ravindra Deokar

Professor (Additional)

Department of Forensic Medicine & Toxicology,

Lokmanya Tilak Municipal Medical College & LTMG Hospital, Sion, Mumbai-400 022

Contact No. +91-9423016325 Email: mlameditor@gmail.com

http://www.mlam.in/editorialboard.htm

Associate Editors

Dr Sadanand Bhise

Dean

Dr VN Govt. Medical College, Solapur.

Maharashtra, India. 413003

Contact No. +91-9503757487

Dr Sachin Patil

Professor (Additional)

Department of Forensic Medicine & Toxicology

Seth G S Medical College & KEMH, Mumbai. 400012

Contact No. +91-8108609282

Editorial Board Members

Dr A P Singh (UK), Dr Iqroop Singh Chopra (UK), Dr UJS Bedi (UK), Dr Amandeep Sodhi (USA), Dr Anand B Gaikwad (Australia), Dr Ruta Bhargava (US), Dr Niranjan Kavadi (US), Dr T Nataraja Moorthy (Malaysia), Dr Zenab Yusuf Tambawala (UAE), Dr T K Bose (Kolkata), Dr Richa Chaudhari (UP), Dr Amol Shinde (Maharashtra), Dr Vikas Meshram (Rajasthan), Dr Swapnil Akhade (Raipur, Chhattisgarh), Dr Abhishek Das (West Bengal), Dr Anamika Nath (Assam), Dr Atul Keche (Bhopal, Madhya Pradesh).

Editors Emeritus

Dr Rajendra Bangal

Past Editor

Dr Mandar Karmarkar

JFMSL- Scientific Committee

National Advisory Board

Dr S D Nanandkar, Dr P G Dixit, Dr S C Mohite, Dr K D Chavan, Dr R C Dere, Dr V V Pillay, Dr Anil Agarwal, Dr Kalpesh Shah, Dr P C Vyas, Dr Mukesh Yadav, Dr Adarsh Kumar, Dr Vina Vaswani, Dr C B Jani, Dr Cyriac Job, Dr Rajiv Joshi, Dr Sanjay Gupta, Dr Arun M, Dr Gautam Biswas, Dr Nagesh KR, Dr Mabalesh Shetty, Dr Madhu Ghodkirekar, Dr Harish Dasari, Dr Tanuj Kanchan, Dr H M Pathak, Dr Kisan Khade, Dr B H Tirpude, Dr Kailash Zine, Dr Manish Shrigiriwar, Dr Anil Batra, Dr Sandeep Kadu, Dr Vipul Ambade, Dr Naresh Zanjad, Dr O Gambhir Singh, Dr S K Dhattarwal, Dr Uday Basu Roychowdhury, Dr T K Naidu, Dr Pratik Ratogi, Dr Mohammed Iliyas Sheikh, Dr P K Tiwari, Dr Manish Nigam, Dr K Padmakumar, Dr Dayanand Gannur, Dr Suresh Kumar Shetty, Dr Amit Patil, Dr Pragnesh Parmar, Dr Seema Sutey, Dr Vinod Chaudhari

International Advisory Board

Dr Shashank Shettar (US), Dr Siddharth Virani (UK), Dr Aurelio Luna (Spain), Dr Eva Montanari (Italy), Prof. Dr Thomas Keller (Austria), Dr Nursen Turan Yurtsever (Turkey), Dr Valery Gunas (Ukraine), Dr Raul Tambade (Australia), Dr Sandeep Biraris (US), Dr Vikrant Landge (US), Dr Geetanjali Pai (US), Dr A P Singh (UK), Dr Abhishek Parashar (Nepal)

Reviewer Board Members

Dr Ajit Malani, Dr Virendar Pal Singh, Dr Atul Keche, Dr Hemant Kukde, Dr Pawan Sable, Dr Nilesh Tumram, Dr Ganesh Niturkar, Dr Utsav Parekh, Dr Ranjit Tandle, Dr Hitesh Chawla, Dr Pratik Tarvadi, Dr H. Khartade. Dr Haneil D'Souza, Dr Kalpesh Zanzrukiya, Dr Raviraj KG, Dr Mohit Chauhan, Dr Senthil Kumaran, Dr Deepali Kale, Dr Parthvi Khandar, Dr Vinita Margod, Dr Dhananjay Mankar.

Website: http://www.mlam.in

Editorial Office Address

Department of Forensic Medicine & Toxicology, Third Floor, Mortuary Building, Lokmanya Tilak Municipal Medical College & LTMG Hospital, Mumbai, Maharashtra, India. Pin-400 022. Email id: mlameditor@gmail.com Phone: 022-68660000 (M): +91-9423016325.

Instruction to Author:

1. Aims and Scope

Journal of Forensic Medicine Science and Law (**JFMSL**) is an official scientific publication of Medicolegal Association of Maharashtra. The basic ideology of publication of this journal is based on the objectives of MLAM. It is a biannual, multidisciplinary, Multispeciality, National, peer reviewed MLAM (society) journal published as a medium for the advancement of scientific knowledge of forensic medicine, allied sciences and law.

The contents of the journal are in the form of Original research articles, Commentary, Review articles, Case reports, Letters to editor, Short communication, Medical quiz and any other form of publication with the approval by the editorial board. All manuscripts are required to be submitted only online in Microsoft word file format on email ID: mlameditor@gmail.com .

Articles should be typed in **single space, Calibri font (letter size 11 for body of text and headings and sub-headings in bold with size 11).** Manuscript should conform to the general instructions (Vancouver style) "Uniform requirements for manuscripts submitted to biomedical journals" (1994), Lancet 1996, V2, 1-4 and Annals of Internal Medicine 1988, 108:258- 265. The submitted manuscripts should be accompanied by a statement / certificate undersigned by all listed authors in authorised copyright format. Copy of format of certificate by Authors can be obtained from editorial office of Journal of Medicolegal Association of Maharashtra. All submitted articles are reviewed by editorial board, specialists and subjected to double blind peer review system. The Editorial board reserves the right to ask for revision in the manuscripts according to reviewers comments and to make final decision on acceptance.

2. Ethics and Policy in Clinical Study:

Human studies should have been conducted in accordance with the principals of the declaration of Helsinki (1964, revised in 1975 and 1983). Animal experiments should have been performed as per the guide lines of CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animals). Also, see www.cpcsea.com while submitting papers on clinical trials. The authors are requested to ensure that all requirements of appropriate regulatory bodies have been complied with. The authors should submit copy of Ethical approval of the study obtained from Institutional Ethical Committee in case of original research articles.

3. Units of Measurement:

All Measurements must be expressed in metric system and / or the system International „Units" (SI)

4. Submission Format:

Submit as **single manuscript word file** including title page, abstract, keywords, and main article manuscript text (Introduction, material & methods, Results, discussion, conclusion, recommendations/ suggestions, references –Vancouver style). Add tables and figure as an attachment separately and also in manuscript file at relevant places. Various ready formats available on website http://www.mlam.in/journal.htm

An abridged version is outlined below:

Title Page (Page 1): Page 1 should include the following

Type of paper: Original Research article, Review article, Short communication, Case report, Letter to the editor, etc.

Title: Title of the Article (About 10-12 words). If more add running Title of less than 12 words.

Author details: Full name of the authors along with their Degrees, Designations, Departments, and Institution and National affiliation. Complete address of the corresponding author & all other authors along with E-mail address & contact number (preferably WhatsApp). Number of pages in the manuscript, Number of Photographs, Number of Figures, Number of Tables, Acknowledgement, ethical clearance, Conflict of interest, funding & author contributor-ship declaration.

Abstract (Page 2): It should contain factual and comprehensive summary of the entire paper in not more than 200 words. It should be a **structured** and should include Introduction/background/aims, material and methods, results and conclusions of paper. At the end of the abstract 3-5 **key words** are required to be endorsed for indexing purpose.

Manuscript main Text (Page 3 onwards): The main text should be arranged in the following sequence:

Introduction: It should contain the review, aim of the study and its rationale. **Materials and methods:** This should include sufficient details so that the reader can understand how the results were obtained. **Results:** Should be presented in proper sequence. Statistical methods used for analysis should be stated in brief.

Discussion: Should include the relationship of the results with the hypotheses tested as outlined in aims and objectives and the findings of the study compared with those reported by other workers.

Conclusion: Should be completely supported by the data in the text.

Acknowledgments: Contribution that fall short of authorship should be included here. Please do not hesitate acknowledging some one's contributions in your research.

Case Report: The reports should be limited to 1500 words and should be described in the following sequence : Abstract with key words, Introduction, Clinical summary, Pathological findings, Management and outcome of case, Discussion, Recommendations and References.

Figures: Figures should be cited in the text and numbered sequentially with Arabic numerals. A brief descriptive legend should be provided with each figure. Photographs of identifiable persons must accompany the consent of the individual. Illustrations from already published articles / books, the permission of author and the publisher must accompany each illustration. In addition, all figures should be submitted separately in "jpg" format with good resolution and figure legends in word file along with manuscript.

Tables: Tables should be numbered as they appear in the text and each table should have a short title. The data given in the table should be clear and logical. It should supplement and not duplicate information present in the text.

Proof: Proof will be sent to the corresponding authors who should be carefully checked and returned to Editorial office within two days of the receipt. Accepted manuscript by Editorial Board will not be returned.

Reprints: Authors desirous of reprints of the published articles may approach the Editorial Office. The reprints will be provided at nominal printing cost.

References:

References should be endorsed as laid out in International Committee of Medical Journal Editors 1997; 126:36-47. References should be arranged in Vancouver style conforming to the pattern of NLM in Index Medicus. Responsibility of accuracy of references will rest entirely with the authors. References should be listed in the order as they appear in the text. They should be indicated by Arabic numerals. For example: 1,2 and so on as superscript. For correct abbreviations of the journal please refer to last Index Medicus. Names of one word journals and unindexed journals should be written in full form. Number of references should not be more than 5 for letters to editor, 10 for case reports, 20 for original articles and 25 for a review articles.

Some of the sample references are as given below :

a. **Journals:** Jain R, Awasthi A, Basappa A. Hematological profile of leukemias, Int J of Hemat 2006; 10:104-106. Kurien D, Khandekar LL, Dash S et al. Cytodiagnosis of hydatid disease presenting with Horner"s Syndrome A case report. Acta Cytol 2001; 45: 74-78.

b. **Books and Monograph:** Anemia, In: Cotran RS, Kumar V, Collins T. Robbins Pathologic Basis of Disease. 6th ed. Singapore. WB Saunders Company, 1999: 1300-1321. Wetzler M, Bloomfield CD. Acute and chronic myloid leukemia . In: Harrison"s Principles of Internal Medicine. 14th ed. Fauci AS, Braunwald E, Isselbacher K, et al, Eds McGrawHill, New york, 1998; 684-695.

c. **Conferences Proceedings:** Vivian VL, Editor. Child abuse and neglect; A medical community response. Proceedings of the First AMA National Conference on child Abuse and Neglect 1984; Mar 30-31; Chicago: American Medical Association, 1985.

Advertising policy: The Journal accepts display & classified advertising. For details write us on- mlameditor@gmail.com

Manuscript Handling Charges: Rs. 5000/- Foreign Author: Rs. 10000/- (Additional charges for Fastrack publication/ added tables, figures, etc.)

Subscription Charges: Individual: Rs. 5000/- Institutional: Rs. 9000/- Agency (Third Party): Rs. 10000/- (with 10% Agency Discount).

For further details contact to:

Editorial Office Address: Department of Forensic Medicine, Third Floor, Library building, LTMMC and LTMG Hospital, Sion, Mumbai, State: Maharashtra, India Pin: 400022 WhatsApp: +91-9423016325.
Email: mlameditor@gmail.com Website: www.mlam.in

Publisher Details: Dr Ravindra Deokar, Editor-in-Chief, JFMSL, MLAM. Department of Forensic Medicine, LTM Medical College and LTMG Hospital, Sion, Mumbai, State: Maharashtra, India Pin: 400022
Phone: 022-68660000 WhatsApp: +91-9423016325.

Published by(Co-owner): Medicolegal Association of Maharashtra (MLAM), Maharashtra, India.

Printed by:
Nisar Stationary & Printing house, Bandra (E), Mumbai-400051.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW

(Official Publication of Medicolegal Association of Maharashtra)

PRINT ISSN: 2277-1867 ONLINE ISSN: 2277-8853 Email.id: mlameditor@gmail.com

Mobile: +91 9423016325

Journal of Forensic Medicine Science and Law – Review Process

http://www.mlam.in/journal.htm

Journal of Forensic Medicine Science & Law (JFMSL) follows all standard norms of double blind peer review process. Appropriate confidentiality maintained with complete anonymity in regards to the article review process. Declaration of conflict of interest, if any is mandatory for every reviewer prior to accept articles for review. The researchers/ authors need to submit the manuscript files abiding the JFMSL author guidelines as a complete manuscript word file on email – mlameditor@gmail.com

- Average time for initial editorial review – 02 to 03 days.
- Average time for Blind review process – 07 to 15 days.
- Average time for acceptance of article after revision – 30 days.

The detailed steps in review process is as follows-

1. Initial submission of article in accordance with norms at par 'JFMSL- author guidelines' (http://www.mlam.in/journal.htm)

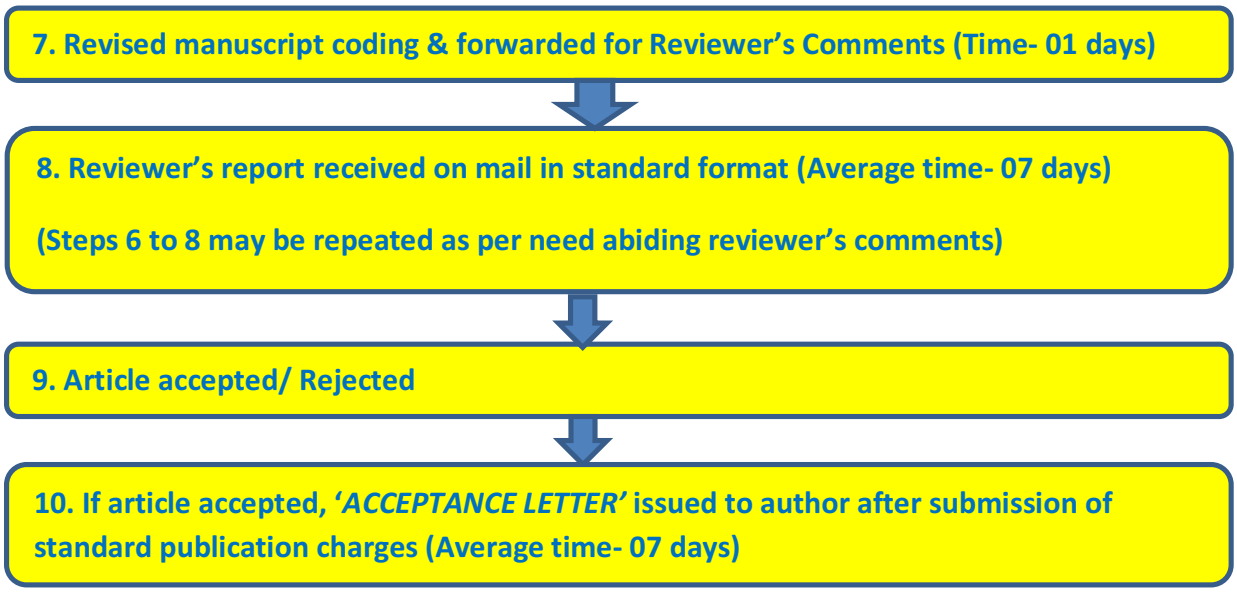
2. Initial Editorial technical review for language, format & submission abiding JFMSL author guidelines (Average time- 02 to 03 days).

3. Article passed through Editorial review downloaded and given a specific code maintaining anonymity of authors (Average time- 01 days).

4. Coded file of Article & standard 'JFMSL-reviewer form' forwarded to 03 to 05 independent reviewer (at least one international reviewer & one out of the state) for blind review abiding standard norms with maintaining confidentiality (Average time- 01 days).

5. Reviewer's report received on mail in standard format (Average time- 07 days)

6. Revised manuscript submission abiding Reviewer's Comments (Time- 03 days)



Aims and Scope

Journal of Forensic Medicine Science and Law (**JFMSL**) is an official scientific publication of Medicolegal Association of Maharashtra. The basic ideology of publication of this journal is based on the objectives of MLAM. It is a biannual, multidisciplinary, multispeciality, National, peer reviewed MLAM (society) journal published as a medium for the advancement of scientific knowledge of forensic medicine, allied sciences and law. The contents of the journal are in the form of Original research articles, Commentary, Review articles, Case reports, Letters to editor, Short communication, Medical quiz and any other form of publication with the approval by the editorial board. All manuscripts are required to be submitted only online in Microsoft word file format on email ID: mlameditor@gmail.com.

Submission Format: An abridged version is outlined below:

1. **Copyright Form (available on website -** http://www.mlam.in/journal.htm under author guidelines).
2. **Covering letter.**
3. **Complete Manuscript file with author details including title page, all tables & figures.**
4. **Manuscript file without author details.**
5. **Additionally- all figures as separate JPG image files with figure numbers.**

Articles should be typed in single space, Calibri font (letter size 12 for body of text and headings and sub-headings in bold with size 12).

Title Page (Page 1) Page 1 should include the following **Type of paper:** Original Research article, Review article, Short communication, Case report, Letter to the editor, etc. **Title** of the Article (About 10-12 words). If more add running Title of less than 12 words. Full name of the authors along with their Degrees, Designations, Departments, and Institution and National affiliation, contact number & email id of all authors. Number of pages in the manuscript, Number of Photographs, Number of Figures, Number of Tables. Complete address of the corresponding author along with E-mail address & contact number (preferably whatsapp). Declaration of author on contributor ship of authors, conflict of interest, Ethical clearance, etc.

All rights reserved with Editorial Team, JFMSL, MLAM.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW

(Official Publication of Medicolegal Association of Maharashtra)

PRINT ISSN: 2277-1867 ONLINE ISSN: 2277-8853 Email.id: mlameditor@gmail.com

Mobile: +91 9423016325

REVIEWER LIST

The list of reviewers collaborating with the journal is as follows –

#	First name and Last name	Affiliation	Country	Email
1	Dr Kalpesh Shah	Professsor & Head, FMT, GCS MC, Ahmedabad, Gujrat. Former Dean & Professor, B. J. Medical College & Civil Hospital, Ahmedabad, Gujrat, India.	India	drkalpeshashah@yahoo.com
2	Dr Shailesh C Mohite	Dean & Professor, HBTMC & Dr RN Cooper Hospital, Juhu, Mumbai, Maharashtra, India.	India	sm_fm_66@yahoo.com
3	Dr V V Pillay	Professor & Head of Forensic Medicine and Medical Toxicology in Amrita School of Medicine (Amrita VishwaVidyapeetham), Cochin.	India	drvvpillay@gmail.com
4	Dr Cyriac Job	Professor and Head, Department of Forensic Medicine & Toxicology, GMC, Manjeri, Kerala.	India	job@yahoo.co.in
5	Dr Anil Agarwal	Professor and Head, Department of Forensic Medicine & Toxicology, MAMC, New Delhi.	India	anilaagrwal@gmail.com
6	Dr P C Vyas	Senior Professor & Head, Department of Forensic Medicine & Toxicology, Dr S N Medical College, Jodhpur, Rajasthan – 342003.	India	Pcvyas28@gmail.com
7	Dr Chetan B Jani	Professor, FMT, GCS Medical College, Ahmedabad	India	fm.chetan@gmail.com
8	Dr P G Dixit	Professor, Department of Forensic Medicine & Toxicology, Symbiosis Medical College for Women Pune, Maharashtra. 412115.	India	pgdixit2008@gmail.com
9	Dr Rajesh C Dere	Professor and Head, Department of Forensic Medicine & Toxicology, LTTMC, Mumbai, Maharashtra, India.	India	dr.rajeshdere@gmail.com
10	Dr Ajit Malani	Professor and Head, Department of Forensic Medicine & Toxicology, AIIMS, Udaypur.	India	ajit_malani@rediffmail.com
11	Dr Tanuj Kanchan	Professor (Additional),Department of Forensic Medicine & Toxicology, AIIMS, Jodhpur	India	tanujkanchan@yahoo.com
12	Dr Manish Nigam	Professor and Head, Department of Forensic Medicine & Toxicology, Sri Aurobindo Institute of Medical Sciences, Indore, Madhya Pradesh.	India	jointeditorjiafm@gmail.com
13	Dr Adarsh Kumar	Professor, FMT, AIIMS New Delhi, India	India	dradarshk@gmail.com
14	Dr G M Krishna Rao	Professor and Head, Department of Forensic Medicine & Toxicology Santhiram Medical College, Nandyal, Andhra Pradesh.	India	gmkrishnarao@gmail.com
15	Dr Zenab Yusuf Tambawala	Specialist Senior, Department of Obstetrics and Gynaecology Dubai Hospital, Dubai, UAE.	UAE	zentambawala@gmail.com
16	Dr Kisan Khade	Professor & Head, Department of Forensic Medicine & Toxicology, DY Patil Medical College, Navi Mumbai, Maharashtra.	India	kisan.khade@gmail.com

#	First name and Last name	Affiliation	Country	Email
17	Dr Manish Shrigiriwar	Professor & Head, Department of Forensic Medicine & Toxicology, AIIMS, Nagpur, Maharashtra.	India	drmanishshrigiriwar@aiimsnagpur.edu.in
18	Dr Anil Batra	Professor and Head, Department of Forensic Medicine & Toxicology, GMC, Akola.	India	akkbatra@yahoo.co.in
19	Dr Pragnesh Parmar	Additional Professor & Head, Department of Forensic Medicine & Toxicology, AIIMS, Bibanagar, Telangana – 508126.	India	drprag@gmail.com
20	Dr Mohan Pawar	Professor & Head, Department of Forensic Medicine 7 Toxicology, PIMS & Rural Medical College, Loni, Ahmednagar, Maharashtra.	India	pravaraforensicon2019@gmail.com
21	Dr Mabalesh Shetty	Professor and Head, Department of Forensic Medicine & Toxicology K.S. Hegde Medical Academy, Mangalore.	India	drmabs@yahoo.co.in
22	Dr Seema S Sutay	Professor & HOD, Department of Forensic Medicine & Toxicology, GMC, Khandwa, Mandya Pradesh.	India	dr_seemasutay@rediffmail.com
23	Dr Atul Keche	Associate Professor, Department of Forensic Medicine & Toxicology, AIIMS, Bhopal, Madhya Pradesh, India.	India	dratul73keche@rediffmail.com
24	Dr Mukesh Yadav	Principal & Professor, GAMC, Banda, Uttar Pradesh (UP), India.	India	drmukesh65@gmail.com
25	Dr P K Tiwari	Senior Professor, FMT, Principal and Controller, GMC Chittorgarh, Rajasthan	India	drpktiwari96@gmail.com
26	Dr Madhu Ghodkirekar	Professor, Department of Forensic Medicine & Toxicology, GMC, Goa.	India	madhughodkirekar@gmail.com
27	Dr Kailash U Zine	Professor &Head,Department of Forensic Medicine & Toxicology, Government Medical College, Aurangabad, Maharashtra.	India	kailashzine@gmail.com
28	Dr Vipul Ambade	Professor and Head, Department of Forensic Medicine & Toxicology, Shri. V N Government Medical College Yavatmal, Maharashtra.	India	vipulambade@rediffmail.com
29	Dr Sandeep Kadu	Professor and Head, Department of Forensic Medicine, PDVVP Medical College, Ahmednagar, Maharashtra, India.	India	dr.sandeepkadu@gmail.com
30	Dr Rajesh Bangal	Professor and Head, Department of Forensic Medicine & Toxicology, SKN Medical College, Pune, Maharshtra, India.	India	rbangal@gmail.com
31	Dr Dayanand G Gannur	Professor & Head, Department of Forensic Medicine & Toxicology Shri B M Patil Medical College, Hospital & Research centre, Bijapur, Karnataka.	India	dayanandgannur@gmail.com
32	Dr Ajay Shendarkar	Professor & Head, Department of Forensic Medicine & Toxicology, MGM medical College, Navi Mumbai, Maharahtra.	India	ajayshendarkar@yahoo.com
33	Dr Mandar Karmarkar	Principal, Bharati Vidyapeeth Deemed University Medical College, Pune, Maharashtra.	India	mdkarmarkar@gmail.com
34	Dr Dhananjay Mankar	Associate Professor, School for Health Management, Tata Institute of Social Sciences, Chembur, Mumbai, Maharashtra.	India	dhananjaymk23@gmail.com
35	Dr Ranjit M Tandle	Professor & Head, Department of Forensic Medicine & Toxicology, SMBT Medical College, Got, Nashik, Maharashtra.	India	ranjit_tandle@rediffmail.com
36	Dr H G Kukde	Additional Professor. Department of Forensic Medicine & Toxicology, LTMMC, Mumbai, Maharashtra.	India	hkukde@gmail.com
37	Dr Mahadev Bansude	Associate Professor, Department of Forensic Medicine & Toxicology, GMC, Latur	India	bansude_mahadev@rediffmail.com

#	First name and Last name	Affiliation	Country	Email
38	Dr Dhiraj Buchade	Professor, Department of Forensic Medicine & Toxicology, MAMC, New Delhi. 110002	India	dhirajfmt@gmail.com
39	Dr Pawan Sable	Professor (Additional), Department of Forensic Medicine & Toxicology, TNMC, Mumbai, Maharashtra.	India	25.pawan@gmail.com
40	Dr Ganesh Niturkar	Associate Professor, Department of Forensic Medicine & Toxicology, GMC, Aurangabad, Maharashtra.	India	niturkarg@gmail.com
41	Dr Amol Shinde	Professor & Head, Department of Forensic Medicine & Toxicology, GMC, Baramati, Maharashtra, India.	India	dramolbshinde@yahoo.co.in
42	Dr Hitesh Chawala	Associate Professor, Department of Forensic Medicine & Toxicology SHKM Medical College, Haryana.	India	drhiteshchawala@rediffmail.com
43	Dr Abhishek Das	Associate Professor & Head, Department of Forensic Medicine & Toxicology, Jhargram GMC & Hospital, Jhargram, West Bengal.	India	abhishek.das.forensic@gmail.com
44	Dr Girish Tasgaonkar	Associate Professor, Department of Forensic Medicine & Toxicology, Seth G S Medical College &KEM Hospital, Parel, Mumbai	India	drgirish.tasgaonkar7@gmail.com
45	Dr Nilesh Tumram	Dean and Professor & Head, Department of Forensic Medicine & Toxicology, GMC, Nandurbar, Maharashtra, India.	India	ntumram@gmail.com
46	Dr Utsav Parekh	Assistant Professor, Department of Forensic Medicine & Toxicology, AIIMS Rajkot, Gujarat. 360110	India	dr.utsav.parekh@gmail.com
47	Dr Pratik Tarvadi	Professor & Head, Department of Forensic Medicine, GMERS Medical College & Research Centre, Dharpur, Gujrat.	India	drpratiktarvadi@gmail.com
48	Dr Santosh Bhosle	Associate professor, VNFGMC, Yavatmal, Maharashtra	India	santoshbhosle09@gmail.com
49	Dr Deepali Kale	Assistant Professor, OBGY, Wadia Maternity Institute, Mumbai, Maharashtra.	India	deepalikale13@gmail.com
50	Dr Manoj Gupta	Sailee Hospital & Adroit Consultancy Medicolegal Services, Mumbai, Maharshtra.	India	Drmdg1973@gmail.com
51	Dr K Padmkumar	Professor, Jubilee Mission Medical College & Research Institute, Thrissur, Kerala.	India	drpkfmt@gmail.com
52	Dr Sachin Sonawane	Associate Professor, FMT, HBTMC, Juhu, Mumbai, Maharashtra.	India	sachinsonawane105@gmail.com
53	Dr Vinod Chaudhari	Additional Professor, FMT, JIPMER, Pondicherry, India.	India	drvinodchaudhari@gmail.com
54	Dr Manoj Parchake	Associate Professor, FMT, Seth GSMC & KEMH, Mumbai, Maharashtra.	India	manoj.prchake@gmail.com
55	Dr Vinita Murgod	Reader, Oral & Maxillofacial Pathology & Microbiology, Sarawati Dhanvantari Dental College & Hospital, Parbhani, Maharashtra.	India	drvinita.murgod@gmail.com
56	Dr Shashank Tyagi	Assistant Professor, FMT, Seth GSMC & KEMH, Mumbai, Maharashtra.	India	Shankstag011@yahoo.in
57	Dr Amit Patil	Professor and Head, Department of Forensic Medicine, AIIMS, Patna, Buhar.	India	Dramp1976@gmail.com
58	Dr M. Ziyauddin G. Saited	Professor, SAL Institiute of Medical Sciences, Ahmedabad, Gujrat, India. 380060	India.	dr.ziya.saiyed@gmail.com

#	First name and Last name	Affiliation	Country	Email
59	Dr Sanjay Gupta	Professor & Head, FMT, All India Institute of Medical Sciences (AIIMS), Rajkot, Gujrat.	India.	drsanjaymdfm@gmail.com
60	Dr Richa Choudhury	Professor & Head, FMT, Dr RML Institute of Medical Sciences, Lucknow, Uttar Pradesh, India.	India.	Drricha_c@hotmail.com
61	Dr Nagesh K R	Professor & Head, FMT, Father Mullar Medical College, Kankanady, Manglore, Karnataka, Inia. 575002	India.	anandgaik01@gmail.com
62	Dr Anand Pal Singh	St. Johns house hospital, priory group. Diss, Co Norfolk UK.	UK	alsingh67@yahoo.ie
63	Dr. UJS Bedi	Consultant Psychiatrist, Berkshire Healthcare NHS Foundation Trust, UK	UK	usbedi@hotmail.com
64	Dr Sandeep R Biraris	Orthopaedic Centre of the West 2122 East Highland Ave Ste 100 Phoenix, AZ 85016 USA	US	sandeepb143@yahoo.com
65	Dr Niranjan Kavadi	University of Oklahoma, Oklahoma City, USA	US	drkniranjan@gmail.com
66	Shashank S. Shettar	University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, Country: USA.	US	ShashankShashank-Shettar@ouhsc.edu
67	Dr Abhishek Parashar	Lecturer, Department of Forensic Medicine, Maharajgunj Medical Campus, Institute of Medicine, Kathmandu, Nepal.	Nepal	drabhishekparashar@gmail.com
68	Dr Vikrant Landge	Memorial Hospital, Sitwell, Oklahoma, USA.	US	vikrant.landge@gmail.com
69	Dr Geetanjali Pai	MD AAHIVS Memorial Hospital, Sitwell, Oklahoma, USA.	US	dr.paigg@gmail.com
70	Dr Ruta Bhargava	Hospitalist, Internal Medicine, Saint Banaras Medical Centre, Livingston NJ 07039, US.	US	drrutabendre@gmail.com
71	Dr Siddharth Virani	Shoulder & Elbow Surgery, East Kent Hospitals NHS Foundation Trust Pluto House, Ashford, Kent, UK.	UK	Siddharth.virani@nhs.net
72	Dr Rahul Tambade	ICU Gold Coast University Hospital, Australia.	Australia.	dr.rahultambade@gmail.com
73	Dr Anand B. Gaikwad	Consultant Radiologist, Southcoast Radiology, Australia.	Australia.	anandgaik01@gmail.com
74	Dr Arun M	Professor & Head, Department of Forensic Medicine & Toxicology, JSS Medical College, Mysuru, Karnataka – 570015.	India	arunmohanram@gmail.com
75	Dr T K Bose	Professor & Head, Department of Forensic Medicine & Toxicology, JIMSH, Budge Budge, Kolkata, India. 700137	India	drtapasbose@gmail.com
76	Dr O Gambhir Singh	Professor & Head, Department of Forensic Medicine, AIIMS Kalyani, West Bengal. 741245.	India	drgambhirsingh@gmail.com
77	Dr S K Dhattarwal	Professor, Department of Forensic Medicine & Toxicology, Postgraduate Institute of Medical Sciences, Rohtak, Haryana- 124001.	India	drskdhattarwal@gmail.com
78	Dr Uday Basu Roychowdhury	Professor & Head, Department of Forensic Medicine, Midnapore Medical College, West Bengal- 721101.	India	udayfsm@gmail.com
79	Dr T K Naidu	Professor & Head, Department of Forensic Medicine, Prathima Institute of Medical Sciences, Mukkrampura, Karimnagar, Telangana – 505001.	India	tekyamnaidu@gmail.com
80	Dr Prateek Rastogi	Professor & Head, Department of Forensic Medicine & Toxicology, Kasturba Medical College, Mangalore, Karnataka- 575001.	India	Prateek.rastogi@manipal.edu

#	First name and Last name	Affiliation	Country	Email
81	Dr Gautam Biswas	Professor & Head, Department of Forensic Medicine, Dayanand Medical College & Hospital, Ludhiyana, Punjab- 141001.	India	gautamdmc@rediffmail.com
82	Dr Mohammed Iliyas Sheikh	Professor & Head, Department of Forensic Medicine, SMIMER, Surat, Gujrat.	India	drmiliyas@gmail.com
83	Dr B Suresh Kumar Shetty	Professor, Department of Forensic Medicine & Toxicology, Kasturba Medical College, Mangalore, Karnataka- 575001.	India	Suresh.shetty@manipal.edu
84	Dr Harshwardhan Khartade	Assistant Professor, Department of Forensic Medicine & Toxicology, GMC Nagpur.	India	Harshwardhan.khartade@gmail.com
85	Dr Haneil L D'Souza	Associate Professor, Department of Forensic Medicine & Toxicology Kasturba Medical College, Mangalore, and District Medicolegal Consultant (Govt. of Karnataka), Karnataka- 575001.	India	hanihere@gmail.com
86	Dr Vikas Meshram	Associate Professor & Head, Department of Forensic Medicine & Toxicology, AIIMS Jodhpur, Rajashtan.	India	Drvpm26@gmail.com
87	Dr Kalpesh Zanzrukiya	Associate Professor & Head, Department of Forensic Medicine & Toxicology, SBKS MI & RC, Sumandeep Vidyapeeth, Vadodara, Gujrat.	India	Kalpeshzrk1987@gmail.com
88	Dr Raviraj KG	Associate Professor, Department of Forensic Medicine & Toxicology, St. Peter's Medical College, Hospital and Research Institute, Hosur, Tamil Nadu.	India	drkgraviraj@gmail.com
89	Dr Mohit Chauhan	Assistant Professor, Department of Forensic Medicine & Toxicology, Lady Hardlinge Medical College & Associated Hospitals (CHS & MHFW GOI), New Delhi.	India	Maahi474@gmail.com
90	Dr Senthil Kumaran	Assistant Professor & Head, Department of Forensic Medicine & Toxicology, AIIMS Mangalgiri, Andhra Pradesh.	India	Srsenthilkumaran84@gmail.com
91	Dr Rajiv Joshi	Professor, Department of Forensic Medicine, GGS Medical College, Faridkot, Punjab, India.	India	drrajivacme@gmail.com
92	Dr Ashutosh Potdar	Professor & Head, Department of Forensic Medicine, SSPM Medical College, Sindhudurg, Maharashtra, India.	India	drashpot@gmail.com
93	Dr Mallikarjun Ballur	Professor & Head, Forensic Medicine, KLE JGMM Medical College, Hubli, Karnataka, India.	India	drmallikarjunballur@gmail.com
94	Dr Swatoi Sonawane	Professor & Head, Forensic Medicine, Dr D Y Patil Medical College, Navi Mumbai, Maharashtra, India.	India	drswatifm@gmail.com
95	Dr Shweta Patel	Associate Professor, Forensic Medicine & Toxicology, GMERS Medical College, Panchmahal, Godhra, Gujrat, India.	India	drshwetafmt@gmail.com
96	Dr T Nataraja Moorthy	Professor of Forensic Sciences, Faculty of Health and Life Sciences, Managemnent and Science University, Sha Alam, Selangor, Malaysia.	Malaysia	natrajamoorthy@rediffmail.com

Common Guidelines to reviewer:

1. Fill out the review form with your comments, providing a rating for each aspect of the article. You may also make comments on the research publication/review article by simply highlighting your comments in yellow; or by typing your comments in red font.
2. All research publication/review article/Case Study submitted to **The Journal of Forensic Medicine, Science and Law (JFMSL)** are subject to peer review and it is **mandatory to reviewers to maintain confidentiality of the review process.** Submission of declaration on statement of conflict of interest is mandatory before accepting the article for review.
3. Reviewer requested to submit the review report in 03 working days.
4. After complete editing, rename file with Code **number of article - reviewer's name** and send it to mlameditor@gmail.com

JOURNAL OF FORENSIC MEDICINE, SCIENCE AND LAW

(Official Publication of Medicolegal Association of Maharashtra)
PRINT ISSN: 2277-1867 ONLINE ISSN: 2277-8853 Email.id: mlameditor@gmail.com
Mobile: +91 9423016325

Date: / /20

To,
The Editor in Chief,
Journal of Forensic Medicine Science and Law
(Official Publication of Medicolegal Association of Maharashtra)
Website: http://www.mlam.in Email id: mlameditor@gmail.com
Editorial Office: Department of Forensic Medicine & Toxicology, Third Floor, Library Building, Seth G S Medical College & KEM Hospital, Mumbai- 400012
Contact No. 022-24107620/ 022-24107000. Mobile: +91-9423016325

Subject: **Annual subscription** of **Journal of Forensic Medicine Science and Law**- Official publication of Medicolegal Association of Maharashtra (MLAM).

I/We, am/are interested to become annual subscribers to the **Journal of Forensic Medicine Science and Law**- Official publication of Medicolegal Association of Maharashtra (MLAM) from the current year.

Details of Subscriber-

Individual/ Institutional	
Name	
Address: (Copy of the journal will be sent on this address)	
Pin code	
Contact No.	
Email	

Yearly Subscription fees: Biannual Journal(yearly two copies- Issue1 & Issue 2)- **(Year 2025).**

Individual (MLAM member)	**Rs. 5000/-**	(Rs. Five thousand only)
Institutional/ Individual (Non-member)	**Rs. 9000/-**	(Rs. Nine thousand only)
Third Party Agency (10% agency discount)	**Rs. 10000/-**	(Rs. Ten Thousand only)

Account Details:

Bank Account Details
Bank Account Name: Medicolegal Association of Maharashtra
Account No. 50292010017478 **IFSC Code-** CNRB0015029
MICR: 400015219 **Bank:** CANARA Bank Byculla. **Branch:** Byculla II, Mumbai.
Mode of Payment: Payment can be done as online transfer- IMPS/NEFT/Quick transfer.

Payment Details:

Transaction Id		
Date		

The subscription form copy & payment details sent on mail- mlameditor@gmail.com
Kind request to send the copies on the above-mentioned address.

Seal **Signature of Authority**

COPYRIGHT FORM

To,

The Editor-in-Chief

Journal of Forensic Medicine Science & Law (JFMSL)-

An official publication of **Medicolegal Association of Maharashtra (MLAM).**

I, the undersigned, DR**. …….**

hereby declare that the manuscript entitled-

_____

_____

submitted for publication to **Journal of Forensic Medicine Science & Law (JFMSL)** is not send to any other journal or magazine for Publication or in process of review with any other journal or magazine or is not published as full article or partly in any journal or magazine or in any medium either in the form of print or electronic.

The work submitted by the author is original & completed under supervision of first/corresponding author. All the other authors also actively participated in concerned work.

We give written consent for publication in **Journal of Forensic Medicine Science & Law (JFMSL).** We do not have any conflict of interest by any mean. The content mentioned in the said manuscript by words, in the form of charts or table or figures are original from authors & no part is in the form of reproducible or copied or by any means conflicting.

S. No	Name of Author	Designation & Affiliation	Mobile No. & Email	Signature with date
1				
2				
3				
4				
4				

Corresponding author details:

Name: DR. ……

Designation:

Affiliation:

Email:

Contact number:

Name of the Institution where work is completed:

Source of support:

CONFLICT OF INTERESTS:

ETHICAL CLEARANCE:

Ethical Clearance/ Ethics Statement:

Author/S Contributor Ship Statement:

Signature

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW

(Official Publication of Medicolegal Association of Maharashtra)

PRINT ISSN: 2277-1867 ONLINE ISSN: 2277-8853 Email.id: mlameditor@gmail.com

Mobile: +91 9423016325

Kindly join to **Reviewer Board** of **Journal of Forensic Medicine Science and Law** (an official Publication of Medicolegal Association of Maharashtra). Please fill the **consent form** and send the Form (scan copy) along with your **CV** to email Id: mlameditor@gmail.com. With your consent, your name will be added in the Editorial Board of this journal on website, print & online version of this Journal.

MEMBER FORM (REVIEWER BOARD)

PARTICULARS	DETAILS
Name	
Qualifications	
Designation	
Department / Institution	
Specializations	
Area of Interest	
Publication Details- Citations (Add separate sheet, if needed)	
Year of Editing / Review Experience	
Correspondence Address	
Email Id	
Contact Details	
Experience of the Editor/Reviewer/ Advisory Board, if any.	
Recommended By (Name of faculty from MLAM/IAFM EC MEMBER/ Editorial Board)	

I, ... do hereby give my consent for **Journal of Forensic Medicine Science and Law** to include me as a member of **Editorial Board & Reviewer Board.**

Date: .....

Signature with seal

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
Volume 34, Issue 2, July-December 2025
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Table of Contents

Editorial	1	**Need of Establishing Mini Forensic Science Laboratories at Every Tertiary Care Institutions** Ravindra B Deokar, Sachin S Patil	Pg. 01-03
Original Research Article	2	**Injury Profiles and Pain Perception in a Mass Pilgrimage Gathering: An Observational Study from Mahakumbh 2025** Purushottam Kumar, Suyash Singh, Mukul Sharma, Yogendra Velicharla, Kumari Shaloo, Deepak Rajput	Pg. 04-10
	3	**Evaluation of Mechanical Injuries in Cases of Assault Registered at Tertiary Care Hospital in Central India** Kavita Ram Deshpande, Indrajit Khandekar	Pg. 11-16
	4	**Sexual Dimorphism from Mandibular Canine Index in Autopsied Bodies – A Pilot Study** Girish Tasgaonkar, Vina Vaswani, Ravindra Deokar, Neelkamal Battu, Harish Pathak, Amrita Vijayan	Pg. 17-22
	5	**Study on Pattern and Characteristics of Medico legal Cases in Casualty of Chettinad Hospital and Research Institute, Kelambakkam** Shreeyaa Vijay, Alwin Raj, Raja Sekhar Uppu, Shazil Maria Sibi	Pg. 23-27
	6	**Histopathological Features of Abrasions- An Autopsy Study** Shailesh C Mohite, Prasad V Bhatanglikar, Vinaya B Shah, Sneha P Janjal	Pg. 28-34
	7	**Clinicopathological Alterations in Oral Tissues Following Pesticide Poisoning: An Autopsy-Based Evaluation** Vidya M, Shweta Kumbhojkar, Punnya Angadi, Dhivagar K	Pg. 35-42
Case Series	8	**Tracing the Tracks: a Case Series on Patterned Injuries** Ankit Jain Pandey, Ankita Khamele, Mahendra Sharma, Bajrang K Singh	Pg. 43-46
Review Article	9	**Ensuring Inclusive Justice for Women with Mental Disabilities Victimized by Sexual Violence: a Feminist Disability Studies Approach** Marzellina Hardiyanti, Aga Natalis	Pg. 47-51

	10	**Ethical Reflections on IVF- Ownership Issues of Gametes and Embryos, an Indian Perspective** Anjankar A J, Ajay N Keoliya, Sudhir V Ninave, Pawan Wankhade	Pg. 52-56
	11	**From Hippocratic Oath to Digital Sovereignty: Legislating Patient Data Rights and Protection in Nigeria and India** Chinyere C Ogah, Chuks Molokwu, Princess Chinyere Ngene, Victor C Aneke, Hemen P Faga	Pg. 57-62
	12	**Decoding Criminal Symbolism: Integrating Forensic Semiotics, Linguistics and Behavioural Profiling in Investigation** Rajneesh Kumar, Gurminder Kaur, Ankit Anand, Hrishikesh Manu, M Shamima Parveen	Pg. 63-69
	13	**The Borrowed Servant Doctrine: A Scientific Legal Review with Special Reference to Indian Medical Case Law** Sachin S Patil, Ravindra B Deokar, Rajesh C Dere	Pg. 70-75
Short Communication	14	**Executive Summary of the XXVII Annual State Conference of Medicolegal Association of Maharashtra (MLAM)- FORENSICON 2025** Amol Shinde, Manoj Patekar, Ashish Pathak	Pg. 76-82
	15	**Speaking for the Dead: The Evolution of Verbal Autopsy** Rahul M Band, Madhusudan R Petkar, Sadhana V Lakhute	Pg. 83-84

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867

ONLINE ISSN: 2277-8853

Editorial

Need of Establishing Mini Forensic Science Laboratories at Every Tertiary Care Institutions

Ravindra B Deokar[a*], Sachin S Patil[b]

[a]Professor (Additional), Department of Forensic Medicine & Toxicology, Lokmanya Tilak Municipal Medical college & LTMG Hospital, Sion, Mumbai-400022. Orcid Id: 0000-0003-1539-1035.
[b]Professor (Additional), Department of Forensic Medicine & Toxicology, Seth G S Medical college & KEM Hospital, Parel, Mumbai-400012.

1. Introduction

In recent years, with transformative advancement in Forensic Medicine and toxicology, there is enhanced scope, precision and efficiency of medicolegal investigations.[1,2] Abiding the technological development and innovations leading Innovative analytical methods helpful for criminal investigations.[3,4] Forensic science laboratories plays crucial role in the criminal investigation system and facilitate collection, analysis and interpretation of physical evidence from crime scenes as well as from the human body examined at hospital before and after death.

In many cases necessary sample preservation and sending the sample for further examination is the integral part of the medicolegal examination at hospitals. There are well set hospital laboratories under department of biochemistry, pathology and microbiology who dealt with analysis and processing of antemortem samples from the patient at hospitals. The samples preserved during autopsy (Postmortem examination) and antemortem examination generally sent to Forensic Science Laboratory as there is no well-developed bed-side analytical laboratories at hospitals which facilitate easy and speedy analysis and further immediate interpretation by forensic experts to aid in criminal investigation. There is need of establishing and developing such mini- forensic laboratory under department of Forensic Medicine at every tertiary care institutions which facilitates the speedy and précised sample analysis at Hospital level. Creating such facilities will increase the future avenues and scope to forensic expert and aid in administering speedy and timely justice.[5, 6]

2. Forensic Medicine & Toxicology:

The tertiary care institution is having Forensic Medicine and Toxicology department under medical college and the forensic experts catering various medicolegal services at the hospitals besides the routine academic work in medical college. It includes antemortem services, post-mortem services and expert advises/ opinions. It involves examining living individuals (cases of injury, sexual assault, alcoholics, addiction, poisoning, age estimation, etc.) and deceased person with collection of biological and other sample helpful as evidence in civil or criminal cases. Various subfields includes Forensic Pathology, Clinical Forensic Medicine, Forensic Psychiatry and Clinical Psychology, Forensic Toxicology including Clinical Toxicology, Forensic Odontology and Forensic Radiology. Besides multiple avenues in improving the forensic services, due to insufficient manpower and other resources these services are

How to cite this article: Deokar RB, Patil SS. Need of Establishing Mini Forensic Science Laboratories at Every Tertiary Care Institutions. J Forensic Med Sci Law. 2025;34(2):1-3. doi: 10.59988/jfmsl.vol.34issue2.1

***Corresponding author**: Dr Ravindra B Deokar, Professor (Additional), Department of Forensic Medicine, Lokmanya Tilak Municipal Medical College & LTMG Hospital, Sion, Mumbai, Maharashtra, India- 400022. Email: ravideo803@gmail.com (M): +91-9423016325.

Article Info: **Received on:** 10.07.2025; **Accepted on:** 25.08.2025. doi: 10.59988/jfmsl.vol.34issue2.1

not well developed.

At present, the main focus at Government medical institution given to autopsy services and some institution providing the clinical Forensic Medicine services as Examination of survivor/accused of sexual assault. The other antemortem medicolegal services generally dealt by casualty medical officer or the speciality expert from Medicine, Surgery, Obstetrics and Gynaecology, paediatrics or super-speciality expert as per need. The Forensic Radiology services are in primitive stage and very few institution started virtual autopsy centre of excellence. Even, Forensic Toxicology services (Poison Information centre, Clinical toxicology, analytical toxicology, etc.) not well developed in most of the medical institutions in India. Very few institutions providing Forensic Odontology medicolegal services which is also in primitive stage and having key issue of expert manpower recruitment.[7]

In many states like Maharashtra, private medical institutions are not given authorization to conduct postmortem examinations and hence, it affects the start of new postgraduate courses in Forensic Medicine leading to scarcity of required forensic experts with increasing medicolegal work. In coming days, more emphasis to be given on starting the most of the core medicolegal services at tertiary care medical institutions through forensic experts catering quality medicolegal services. This will give increased visibility, acceptability, respect, dignity and positive social recognition to the Forensic Experts.

3. Forensic Science Laboratories

The forensic Science Laboratories established to provide for scientific analysis of physical, chemical, biological and digital evidence which is useful for criminal investigations and judicial proceedings. It deals with application of science and technology to aid in detection and investigation of crime. Core functions of Forensic Science Laboratories (FSL) are mainly includes collection, examination, analysis and facilities the interpretation of the biological and other evidence samples by medical officers to link the suspects to victims, crime scenes or criminal acts. It provides the unbiased scientific opinion based on analytic results to assist investigation agencies, police and courts. It facilitates the fact-based decision in important civil and criminal matters. FSLs provides wide range of services in the country such as DNA typing, toxicological analysis, fingerprinting, trace evidence analysis and digital evidence analysis.[8] FSL experts delivers talk with scientific updates their innovative ideas in various scientific gatherings of medicolegal associations.[9-11]

In Maharashtra, we have one (01) Divisional Forensic Science Laboratory at Mumbai, Seven (07) Regional Forensic Laboratories (Nagpur, Pune, Chattrapati Sambhajinagar, Nashik, Amaravati, Nanded & Kolhapur) and five (05) Mini-Forensic Science Laboratories (Chandrapur, Ratnagiri, Dhule, Thane & Solapur). The wide range of analytical services provided through these laboratories with different sections such as Toxicology, Biology, DNA, General Analytical and Instrumentation (Narcotics & Explosives), Prohibition & Excise, Ballistics, Tape Differentiation & Speaker Identification, Psychology, Cyber Forensics and Wild-life DNA Sections. However, considering the large volume of samples from all parts of Maharashtra, the result are generally delayed with waiting period of three (03) months to two (02) Years or more. Also, many times thee is time delay and break in chain of custody from collection of sample to the end test. This leads to negative results in large number of cases.[6, 12]

4. Need of Establishing Mini-Forensic Science Laboratories at every Tertiary Care Institution

In consideration with the huge pendency affecting the timely justice and to facilitate speedy and timely collection and analysis of biological and other evidences collected at tertiary care centres is important. For this, a Mini-Forensic Laboratory (may be named as **Bed-side Forensic Science Laboratory**) can be established to analyse the collected sample immediately at the bed-side at the tertiary care institution under Department of Forensic Medicine of the medical college. The Mini-Forensic Laboratory established at Medical institutions under Forensic Medicine may include followings sections on priorities

a. Forensic Toxicological Analysis.
b. Forensic Biological Analysis
c. DNA Analysis.
d. Cybercrime & Digital Forensic Analytical Services.
e. Forensic Psychological analysis.

5. Merits of establishing Mini-Forensic Science Laboratories at Hospitals

1. **Faster medico-legal investigations:** These labs permit speedy analysis of biological samples (blood, tissues, toxicology), shortening delays in serious crime cases.
2. **Better evidence Preservation:** Handling evidence (DNA, fluids, and trace materials) within the hospital reduces contamination risks and maintains chain of custody.
3. **Reduced burden on central labs:** Centralized forensic labs often face backlogs. Mini labs decentralize workload, improving efficiency and turnaround time.
4. **Enhanced teaching and training:** Medical students and residents gain hands-on exposure to forensic science, strengthening fields like forensic medicine and pathology.
5. **Support in emergency and disaster situations:** In mass casualty events or disasters, on-site labs help in quick identification and analysis.
6. **Strengthening legal system:** Timely forensic reports improve conviction rates and reduce delays in judicial proceedings.

6. Conclusions:

With scientific and technological advancement, starting such facility at tertiary care institutions is need of Hour. This will help for speedy, precise, quality analysis, reporting, interpretation and further aid in administration of justice in court of law.

References:

1. Eriksson A. Forensic pathology. In: Freeman MD, Zeegers MP, editors. Forensic Epidemiology: Principles and Practice. 1st ed. London: Academic Press; 2016. p. 151–177.doi:10.1016/B978-0-12-404584-2.00006-9. ISBN 9780124045842.
2. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research - Ethical aspects. J Forensic Med Sci Law. 2024; 33(1):1-4.
3. Deokar RB, Dere RC, Patil SS. Looking at Recent Evolution in Toxicology through Legal Lens. J Indian Acad Forensic Med. 2025; 47(1):7-11. doi:10.1177/09710973251371356
4. Deokar RB, Dere RC, Patil SS. Genomics and Precision Medicine in Forensic Medicine. J Indian Acad Forensic Med. *2025; 47(2): 123-5.* doi:10.1177/09710973251381715
5. Singh S. Forensic Science in the 21st Century: Innovations, Challenges, and Future Perspectives. J Forensic Allied Sci. 2025; 1(1): 17–23. https://doi.org/10.5281/zenodo.16868643
6. Directorate of Forensic Science Laboratories. [Cited on 20 December 2025]. Available from: https://dfsl.maharashtra.gov.in/
7. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law. 2023; 32(2):1-3.
8. Bardale R. Principles of Forensic Medicine & Toxicology. 2nd ed. New Delhi: Jaypee brothers Medical Publisher (P) Ltd; 2017. P. 407-8.
9. Dere RC, Kukde HG, Deokar RB, Patil SS, Kumar NB. Executive summary of the XXIV State Annual conference of Medicolegal Association of Maharashtra (MLAM): Forensicon 2021. J Forensic Med Sci Law 2022;31(1):84-88.
10. Varma NM, Pawar MN, Deokar RB. Executive Summary of the Forensicon 2022 - 25th Annual State Conference of Medicolegal Association of Maharashtra (MLAM). J Forensic Med Sci Law 2023;32(2):80-84.
11. Mohite S, Sukhdeve R, Sonawane S, Deokar R, Kolle S, Hinnawi S. Executive Summary of the XXVI Annual State Conference of Medicolegal Association of Maharashtra (MLAM) - Forensicon 2023. J Forensic Med Sci Law. 2024;33(2):73-78. doi: 10.59988/jfmsl.vol.33issue2.13
12. Sharma BR. Forensic science in India: status and challenges. J Indian Acad Forensic Med. 2013; 35(1):1–4.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Original Research Article

Injury Profiles and Pain Perception in a Mass Pilgrimage Gathering: An Observational Study from Mahakumbh 2025

Purushottam Kumar[a], Suyash Singh[b], Mukul Sharma[c*], Yogendra Velicharla[d], Kumari Shaloo[e], Deepak Rajput[f]

[a]Research Assistant, [b]Associate Professor, [e]Junior Research Assistant, Department of Neurosurgery; [c]Assistant Professor, [d]Senior Resident, Department of Forensic Medicine and Toxicology; [f]Additional Professor, Department of General Surgery, All India Institute of Medical Sciences, Raebareli, UP, India. Pin 229405.

Article Info

Received on: 24.07.2025
Accepted on: 11.10.2025

Key words
Mahakumbh,
Emergency medical services,
Mass gathering,
Injury,
Pilgrimage.

Abstract

Introduction: At mass gatherings, the dense congregation of individuals presents notable public health challenges, particularly concerning injury occurrences and the pain management of the pilgrims. **Material & Methods:** Objective of the study is to study the injury characteristics in pilgrims, and to follow pattern of injury incidence during pilgrimage, during Maha Kumbh a mass gathering. It is prospective study where pilgrims were followed for a complete duration of Maha Kumbh 2025. **Results:** Thousands of injuries of occurred during the Maha Kumbh Mela 2025, Uttar Pradesh, out of which 250 have been reported at AIIMS Emergency Medical camp. 59 out of the 250 (23.6%) were included to our study as per our inclusion and exclusion criteria. The most common occurred injury type was Laceration, representing 71.18% of all injury. The mean pain severity was 6.32 while the low and high pain severity was 0 and 10 respectively. The most frequent pain type produced by the injury wounds was sharp pain, 54.24% while throbbing was the least representing 1.69%. **Conclusion:** There is the need of robust triage systems, injury surveillance, and first-aid preparedness to mitigate health risks and strengthen public health response during large-scale religious gatherings.

1. Introduction

Forensic "Gathering of more than a specified number of persons at definite location for a specific purpose for a defined period of time" is defined as mass gathering by the World Health Organization (WHO). The Maha Kumbh Mela is recognized as one of the largest mass gatherings globally, attracting millions of pilgrims to the confluence of the Ganges and Yamuna rivers in India, and expose to a range of health risk.[1-3] The large number of peoples attending a mass gathering makes planning and management of the event a substantial task. It is a mass Hindu pilgrimage of faith in which Hindus from all over the world gather to have a dip in a sacred river.[4] While the event holds profound spiritual significance, the dense congregation of individuals presents notable public health challenges, particularly concerning injury occurrences[5] and the

How to cite this article: Kumar P, Singh S, Sharma M, Velicharla Y, Shaloo K, Rajput D. Injury Profiles and Pain Perception in a Mass Pilgrimage Gathering: An Observational Study from Mahakumbh 2025. J Forensic Med Sci Law. 2025;34(2):4-10. doi: 10.59988/jfmsl.vol.34issue2.2

***Corresponding author:** Dr Mukul Sharma, Assistant Professor, 4th floor, Medical College, AIIMS Raebareli, 229405, U.P. Email: mukul.med@gmail.com (M): +91 7750924984.

management of associated pain. By walking bare foot to the river that involves a considerable injury-risk. The prevention of injuries together with catastrophic stampedes and drowning and fires requires controlling crowd numbers to safe levels. The Maha Kumbh Mela ranks as one of the biggest human gatherings worldwide yet researchers have paid minimal attention to its injury risk assessment. Several research studies have investigated injury risks in professional football matches in Germany and France[6-12] but no specific studies exist for the Maha Kumbh.

Research on mass gatherings has revealed different types of injuries which occur during such events. The analysis of event attendees shows that soft-tissue traumas and multi-trauma incidents along with lower limb injuries and head traumas occur most frequently. Marathon event analyses show different injury patterns and medical usage rates which demonstrate the requirement for detailed medical planning in large-scale events.[13] The massive scale of the Maha Kumbh Mela creates distinctive obstacles for both injury tracking and healthcare response. The literature emphasizes the necessity of organized injury surveillance and healthcare readiness for events that bring large crowds together. The Maha Kumbh Mela lacks specific research that investigates both injury patterns and the self-reported pain experiences of its pilgrims.

In the Indian context, Studies of injury patterns from different regions provide important information on the kinds of trauma experienced in diverse high-risk settings. The majority of two-wheeler accident victims had head and lower limb injuries, according to a research conducted in Agra by Gupta et al. and Talukhdar et al (2023).[14,15] This study also showed how external variables like traffic congestion, protective gear, and surface quality greatly affect the severity of injuries. In our study, pilgrims walking barefoot on uneven terrain during the Maha Kumbh showed identical damage patterns, especially affecting the lower limbs, despite the different method.

This comparison highlights how exposure to the environment and a lack of protective gear shape injury profiles in both huge religious gatherings and highway accidents. Our research targets the evaluation of reported injuries at outreach medical camps during the Maha Kumbh 2025. Our research combines image-based evaluations with validated questionnaire-based pain assessments to deliver a complete picture of health consequences from this mass gathering. The obtained insights will help develop better public health strategies and improve injury prevention measures and large-scale religious event management protocols.

2. Materials & Methods

This study was designed as a cross sectional and observational analysis carried out during the Maha Kumbh Mela 2025 in Prayagraj, India. The data was gathered from the pilgrims who visited the outreach health camps of AIIMS Raebareli in collaboration with the district sub central hospital Kanpur at Sector 20, Akhada wapasi marg, Jhusi, Prayagraj to provide first aid and primary care to attendees.

a. Participants and Sampling

All individuals who were able to give consent and had either a new injury complaint or visible trauma were included in the study. The exclusion criteria included chronic pain conditions, cognitive impairments, or unwillingness to give consent for image capture. Purposive sampling method was adopted to ensure representation of different types of injuries. A total of 1500 injured patients have been reported at the AIIMS Raebareli medical health camp, 59 patients (49 Males and 10 Females) have been included as per our study protocols. The final sample size was chosen based on the number of patients who were eligible to be included in the study and who attended the camps during the peak days of the mela.

b. Data Collection Tools

A standard data collection form served to gather information about participants. The survey instrument consisted of several sections which gathered information about participants' demographics (age and gender and place of origin), their injury type and cause (such as falls or stampedes or fatigue-related incidents), affected body areas and received medical treatment. A standard Numeric Rating Scale (0–10) measured subjective pain while the results were grouped into three pain severity categories.

c. Image-Based Analysis

Standardized photography guidelines were used to document injuries through the capture of bruise and contusion images. The analysis of images for color characteristics helped determine the probable age of the injury through color development stages (red/purple for acute and green/yellow for healing). The non-invasive image-based analysis technique supported medical examinations by validating the information from patient histories.

Table 1: Percentage Breakdown and Proportion Analysis of Injury Causes.

Cause of Injury	Occurance (in %)	P	95% CI	
			LL	UL
Walking barefoot	23.73%	0.2373	0.1465	0.361
Falls	22.03%	0.2203	0.1329	0.343
Pressing (Overcrowding)	10.17%	0.1017	0.0448	0.209
Burn by hot water/fire/other	10.17%	0.1017	0.0448	0.209
Road Traffic Accident	10.17%	0.1017	0.0448	0.209
Mirror/Knife/Scissor	6.78%	0.0678	0.0228	0.168
Bitten by Dog/Human	5.08%	0.0508	0.0126	0.146
Stoning	5.08%	0.0508	0.0126	0.146
Fight	1.69%	0.0169	0.0000	0.100
Other	6.78%	0.0678	0.0228	0.168

Table 2: Effect Size and Heterogeneity of Injury Causes.

			95% CI	
Measure	Level	Estimate	LL	UL
H^2	Overall	1.64055	1.1325	3.4208
I^2 (%)		2.55881	1.2443	11.3387
T		60.91930	19.6323	91.1807
T^2		0.04779	0.0189	0.1231
		0.00228	0.000358	0.0151

Table 3: Percentage Breakdown and Proportion Analysis Distribution of Injury Pattern.

Pattern of Injury	Occurance (in %)	P	95% CI	
			LL	UL
Laceration	71.18%	0.7119	0.5851	0.812
Incised Wound	13.56%	0.1356	0.0685	0.249
Burn	10.17%	0.1057	0.0448	0.209
Abrasion (Graze)	5.08%	0.0508	0.0126	0.146

LL: Lower Limb, **UL:** Upper Limb.

Table 4. Effect Size and Heterogeneity of Injury Pattern.

			95% CI	
Measure	Level	Estimate	LL	UL
H^2	Overall	6.0148	4.0644	27.10
I^2 (%)		34.4212	15.6715	700.42
T		97.0948	93.6190	99.86
T^2		0.2523	0.1672	1.15
		0.0636	0.0279	1.33

d. **Ethical Considerations**

The Institutional Ethics Committee of AIIMS Raebareli granted ethical approval for this study (Study/Protocol number: 2024-12-OTH-EXP-9). The researchers explained the research goals to participants while guaranteeing their information would remain confidential. All participants received written consent before they joined the study and before their images were recorded. The photographic data did not contain any identifiable personal information.

e. Data Analysis

The data entry process used Microsoft Excel for data cleaning before SPSS version 26 and Python conducted the analysis. The analysis included descriptive statistics to present demographic information along with injury types and pain scores. The research used Chi-square tests together with correlation analysis and regression modeling to study the relationships between injury characteristics and subjective pain experiences. The statistical significance threshold was set at $p < 0.05$.

3. Result

The study involved 59 participants whose mean age was 43 ± 17 with ages ranging from 8 to 80 years. Among them, 83.05% were male and 16.95% female. Breakdown injury cause can be seen in the **Table 1**. The majority of the injuries occurred due to walking (barefoot) (23.73%) (95% CI: 0.1456-0.361), followed by falls (22.03%) (95% CI: 0.1329-0.343), and road traffic accident (10.17%) (95% CI: 0.0448-0.209). **Table 2** presents the proportion of each injury cause, along with 95% confidence intervals. Heterogeneity statistics (Diamond Ratio, H^2, I^2, τ, and τ^2) indicate moderate to substantial variability in the proportions across injury causes, with an I^2 of 60.92%, suggesting considerable inconsistency not attributable to random chance.

Injury Pattern Distribution

As per the result shown in **Table 3**, lacerations represented the most frequent injuries (71.18%) (95% CI: 0.5851-0.812), while abrasion remained relatively low (5.08%) (95% CI: 0.0126-0.146). Heterogeneity measures shown in **Table 4**. Indicate extremely high variability in injury pattern proportions, with an I^2 value of 97.09%, suggesting that the observed variation is not due to sampling error alone. The large Diamond Ratio and H^2 values further support substantial heterogeneity among injury types. The lower limbs (foot, ankle, and calf) were the most commonly affected areas (55.93%), followed by upper limbs and the back.

Image-Based Color Analysis

Out of the total cases of visible injury (n = 59), the majority showed red to purple shades, suggesting acute-phase injuries (<24 hours). A smaller proportion demonstrated purple to yellow hues, indicative of subacute injury (48 hours - 3 days old). Acute-phase injuries had a statistically significant relationship with self-reported pain severity as the acute-phase injuries yielded higher pain scores ($p < 0.05$).

Pain Assessment

The mean pain score was 6.32, with 25.42% of participants reporting mild pain (0-3), 27.12% moderate pain (4-6), and 47.46% severe pain (7-10).

Sharp pain was the most common, with 52.24% cases, followed by dull pain with 32.20% instances. Burning pain was reported in 6.78% cases, while Tingling pain occurred in 3.4% cases, and Throbbing pain was the least reported, with just 1.69% case. Sharp and dull pain were the most frequently reported pain types and the three other pain sensations, burning, tingling, and throbbing, were infrequent. The analysis showed that there was a significant relationship between the type of injury and the level of pain ($p < 0.01$). The participants who had suspected fractures and muscle tears had higher pain scores compared to those with superficial injuries (ANOVA, $p < 0.05$).

Medical Intervention and Outcomes

Only first aid was required by 59 participants but 10 participants were sent to tertiary care centers for further evaluation. The results of logistic regression analysis showed that injury severity, pain score > 6 and swelling were predictors of referral ($p < 0.05$).

Gender and Injury Correlation

A chi-square test of independence was conducted to examine the association between gender and level or type of injury, and the result of the test has been shown in **table 5**. The results showed no significant difference in the level of injury between male and female subjects, (χ^2 (3, N=59) =2.17, p=0.538), yet females reported higher pain scores on the scale of 10, an average of 9.5.

Standardize residuals for each cell were examined to assess contributions to the overall chi-square statistics. All standardized residuals were within the range of ±1.17, indicating that no cell significantly deviated from expected frequencies. Thus, no post hoc analysis was required.

Table 5: Frequency distribution and Chi-square Test of Independence between Gender and Type of Injury.

Type of Injury					
Gender	**Laceration**	**Abrasion (Graze)**	**Burn**	**Incised Wound**	**Total**
Male	35	2	6	6	49
Female	7	1	0	2	10
Total	42	3	6	8	59
			Value	**df**	**p**
χ^2			2.17	3	0.538
χ^2 continuity correction			2.17	3	0.538
N			59		

4. Discussion

Mass gatherings such as the Maha Kumbh Mela pose significant public health challenges due to the massive influx of people, environmental exposures, and logistical complexities. The main objective of this study was to determine the nature of injuries and self-reported pain experienced by pilgrims during the Maha Kumbh 2025 which was complemented by image analysis of bruise appearance. The results provide information that can be helpful for designing measures for the prevention of injuries and their treatment in such crowded areas and highlight the need for careful planning for medical response in such events.

The most common cause of injury was walking barefoot (23.73%), followed closely by falls (22.03%), which is in line with previous studies that have been conducted at mass gatherings such as the Royal Agricultural Show (RAS)[5] and the Arbaeenia pilgrimage, where falls, fatigue, and surface irregularities were noted as some of the major causes of injury burden. Factors that may have contributed to the high rate of lower limb injuries in our study included environmental factors such as rough surface, high population density and long walking distance. One of the avulsed lacerated wounds is depicted in **fig. 1**.

Fig. 1: Avulsed lacerated wound of size 3cm x 2cm x bone deep exposing underlying soft tissue, ligament and bone, with fresh blood – over distal 3rd of right 2nd toe.



The most common injuries observed was laceration (71.18%), in line with the findings of Bissell et al. and others who also reported similar types of injuries in large gatherings. Less frequent injuries abrasion, and burn, had specific localized causes, which could have been related to close contact with animals or hot objects in the temporary tents or kitchens. The high incidence of lower limb injuries points to the physical exertion that is associated with walking for a long time, lack of protective shoes, and crowd incidents.

In this study, the use of image-based color analysis gave an innovative and objective way of determining the age of injuries. The majority of injuries presented red to purple discoloration which indicates recent trauma occurred less than 24 hours ago. The study confirms other research which

demonstrates that visual assessment tools improve both injury staging precision and management effectiveness. The statistical significance between injury color and pain intensity supports the use of this method as a practical clinical tool.

The pain assessment showed that 47.46% of participants experienced severe pain while sharp and dull pain emerged as the most prevalent types of pain. The pain patterns observed in our study matched the patterns described by Wideman et al.[16] in multimodal pain assessment models and demonstrated the diverse and complex nature of pain in acute trauma conditions. The results demonstrated strong correlations between pain types and their severities and the nature of injuries especially deep tissue damage and suspected fractures produced the highest pain scores. The findings indicate that pain evaluation needs structured assessment methods when treating numerous patients in low-resource health camps during mass gatherings. One of the fluid filled blister caused due to burn is depicted in **fig. 2**.

Fig. 2: Fluid filled blister of size 19cm x 8cm present over left ankle and foot.



The referral of 10 cases to tertiary care was based on pain scores above 6 and swelling as the primary indicators for referral. This shows the importance of early triage systems that consider symptom severity and clinical features to make decisions on referrals and to avoid congesting emergency facilities. The results that showed that the mean pain scores were slightly higher for the female participants, although not statistically significant in terms of injury severity, are consistent with previous findings that females are more sensitive to pain or report higher levels of pain or discomfort. In agreement with the retrospective analysis by Chitheer et al.[17], our study also highlights the importance of the onsite medical providers in the process of injury documentation and management. The types of injuries documented here include soft tissue injury, blunt force trauma, and superficial injuries which are consistent with the range of potential hazards in crowded, multi activity areas. Furthermore, the use of visual analytics in combination with self-reporting tools provided a more detailed picture of the consequences and acuteness of the injuries that pilgrims suffered.

The Maha Kumbh Mela stands apart from other large events because its religious ceremonies create distinct injury patterns. The spiritual practice of barefoot walking exists as a fundamental tradition for pilgrims because it represents their devotion and humility. The practice of walking barefoot on dangerous terrain with debris leads to elevated risks of foot injuries. Our study shows that the practice of walking barefoot resulted in numerous lower limb injuries and lacerations which directly caused these types of injuries. The mass bathing rituals at riverfront steps create special risks for participants. The combination of water accumulation and soap residue and excessive use at these areas makes them dangerous because they become slippery which results in more frequent falls and related injuries including contusions and abrasions. Additionally, the episodic surges in crowd density, especially during the lucky bathing seasons, produce high-pressure situations that are vulnerable to psychological distress, blunt injuries, and trampling. Given their cultural significance, these variables need the implementation of certain public health measures designed for these situations, such as installing protected walkways, anti-slip flooring next to ghats, and well-placed railings.

In this study, we have added new data on fresh injury epidemiology at the Maha Kumbh Mela and developed a mixed-methods approach which incorporates image-based assessment and pain measurement. These findings offer specific guidance for developing future policies and emergency readiness plans at Kumbh Mela events and comparable religious events. The observed injury patterns together with their risk factors enable the development of the following policy recommendations.

1. **Foot Protection Initiatives:** The establishment of affordable protective footwear stalls near entry points combined with spiritual practice-friendly educational programs would help decrease lower body injuries. The installation of 'barefoot-safe' zones with soft rubber mats or treated walkways throughout the area would help reduce the number of accidents.

2. **Ghats Safety Enhancements:** The installation of non-slip flooring and effective drainage systems at bathing ghats will help decrease the number of people who slip and fall. The combination of real-time foot traffic monitoring with timed entry pass systems for timed entry will help prevent excessive crowd density during peak religious ceremonies.
3. **Crowd Surge Management:** The implementation of crowd control systems with AI-based surveillance and real-time density monitoring will help prevent stampede incidents by optimizing barrier placement. Security and medical teams need to practice emergency exit and safe zone identification with clear markings for effective response.
4. **Onsite Medical Triage Protocols:** The development of rapid triage teams should include training for image-based diagnostic tools and pain assessment scales. The study showed that these diagnostic tools help medical staff identify between minor and severe injuries which leads to better resource management and reduced unnecessary hospital transfers.
5. **Culturally Adapted Health Communication:** The delivery of safety instructions should use faith leaders and local dialects and visual infographics to reach the community effectively. The implementation of culturally appropriate safety messages will help people from the community follow safety protocols.
6. **Set appropriate medicolegal protocols:** Such mass gatherings are the potential areas where mass emergencies may occur. Appropriate medicolegal measures and prompt services from forensic experts may needed considering the management of such disastrous situations.[18-20]

These targeted initiatives, which are influenced by both cultural customs and environmental realities, can greatly improve emergency response and injury prevention at the Kumbh Mela. In order to safeguard public health during major religious gatherings, the study emphasizes the value of context-aware planning that combines contemporary safety science with customary practices.

Limitation

The study delivers significant information about pilgrim injuries and pain perception at Maha Kumbh 2025 yet researchers need to recognize multiple study restrictions. The researcher's availability at the outreach camp restricted enrolment to only a limited number of participants. The researcher missed numerous injury cases because they had to handle multiple patients simultaneously during busy periods. The large size of the Maha Kumbh along with its multiple first aid posts and mobile foot patrols created conditions where numerous injured people received care elsewhere or avoided medical facilities altogether. The actual number of injuries might have been higher because people with minor injuries sought care at different facilities or did not seek medical help at all. People with non-visible or less severe injuries chose not to visit the health camp which resulted in selection bias. The study reveals important trends but the actual number of injuries that occurred during the event might exceed the reported figures because of these study restrictions.

The outreach camp where data were collected was located in close proximity to a major bathing ghat that was a high-density area with significant foot traffic and ritual activity. As a result, the camp population was skewed toward adult males and barefoot pilgrims engaging in ritual bathing practices. This demographic and behavioural concentration may have introduced selection bias, potentially overrepresenting lower limb injuries, lacerations, and falls due to wet or uneven surfaces. Other injury types or demographics (e.g., females, children, or elderly individuals not participating in bathing rituals) may have been underrepresented.

Importantly, as the study was restricted to a single medical site, the findings may not reflect the full range or distribution of injuries occurring across the entire Kumbh Mela, which spans multiple sectors, terrains, and population subgroups. Therefore, the generalizability of the results is limited.

5. Conclusion

The study highlights the healthcare challenges posed by mass gatherings like the Maha Kumbh Mela, where pilgrims face increased risks of injury from overcrowding, environmental strain, and prolonged exertion. Our findings reveals that lower limb and soft-tissue injuries emerged as the most prevalent, primarily caused by falls and extended walking. The integration of image-based color assessment with subjective pain evaluation proved effective in determining injury severity and estimating their age, enhancing clinical and forensic decision-making. These findings highlight the need for robust triage systems, injury surveillance, and first-aid preparedness to mitigate health risks and

strengthen public health response during large-scale religious gatherings.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

Source of funding: None to declare.

References:

1. Sanders AB, Criss E, Steckl P, Meislin HW, Raife J, Allen D. An analysis of medical care at mass gatherings. Ann Emerg Med. 1986; 15(5):515-9.
2. Friedman LJ, Rodi SW, Krueger MA, Votey SR. Medical care at the California AIDS Ride 3: experiences in event medicine. Ann Emerg Med. 1998; 31(2):219-23.
3. World Health Organization. International Health Regulations (IHR) and mass gatherings [Internet]. Geneva: WHO; [cited 2025 May 20]. Available from: http://www.who.int/ihr/ith_and_mass_gatherings/en/
4. Baranwal A, Anand A, Singh R, Deka M, Paul A, Borgohain S, et al. Managing the Earth's Biggest Mass Gathering Event and WASH Conditions: Maha Kumbh Mela (India). PLoS Curr [Internet]. 2015. doi: 10.1371/currents.dis.e8b3053f40e774e7e3fdbe1bb50a130d
5. Zeitz KM, Zeitz CJ, Kadow-Griffin C. Injury Occurrences at a Mass Gathering Event. Australas J Paramed. 2005; 3:1–10.
6. Fünten KAD, Faude O, Lensch J, Meyer T. Injury characteristics in the German professional male soccer leagues after a shortened winter break. J Athl Train.2014; *49*(6):786-93.
7. Faude, O., Meyer, T., Federspiel, B., & Kindermann, W. (2009). Injuries in elite German football-A media-based analysis. Deutsche Zeitschrift fur Sportmedizin. 2009; *60*(6), 139-44.
8. Bjørneboe J, Bahr R, Andersen TE. Gradual increase in the risk of match injury in Norwegian male professional football: a 6-year prospective study. Scand J Med Sci Sports. 2014; 24(1):189-96.
9. Bjørneboe J, Flørenes TW, Bahr R, Andersen TE. Injury surveillance in male professional football; is medical staff reporting complete and accurate? Scand J Med Sci Sports. 2011; 21(5):713-20.
10. Dauty M, Collon S. Incidence of injuries in French professional soccer players. Int J Sports Med. 2011; 32(12):965-9.
11. Hägglund M, Waldén M, Ekstrand J. Injury incidence and distribution in elite football--a prospective study of the Danish and the Swedish top divisions. Scand J Med Sci Sports. 2005; 15(1):21-8.
12. Hägglund M, Waldén M, Ekstrand J. Injuries among male and female elite football players. Scand J Med Sci Sports. 2009; 19(6):819-27.
13. Nguyen RB, Milsten AM, Cushman JT. Injury Patterns and Levels of Care at a Marathon. Prehosp Disaster Med. 2008; 23(6):519-25.
14. Gupta A, Singh G, Gupta P, Kumar A, Verma A. Pattern of Fatal Injuries Sustained by Two-Wheeler Riders Due to Road Traffic Mishap in Agra Region. J Forensic Med Sci Law. 2023; 32(1):25–31.
15. Talukdar R, Ropmay AD, Slong D, Patowary AJ. A Retrospective Study of Road Traffic Accident Cases Brought For Medico-Legal Autopsy at a Tertiary Care Hospital In Meghalaya. J Forensic Med Sci Law. 2023; 32(1):37-40.
16. Wideman TH, Edwards RR, Walton DM, Martel MO, Hudon A, Seminowicz DA. The Multimodal Assessment Model of Pain: A Novel Framework for Further Integrating the Subjective Pain Experience within Research and Practice. Clin J Pain. 2019; 35(3):212-21.
17. Chitheer A, Lami F, Radhi A, Arbaji A. Injuries Reported by Selected Health Facilities During the Arbaeenia Mass Gathering at Babel Governorate, Iraq, 2014: Retrospective Records Analysis. JMIR Public Health Surveill. 2020; 6(2):e10877.
18. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law 2023;32(2):1-3.
19. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research - Ethical aspects. J Forensic Med Sci Law. 2024;33(1):1-4. doi: 10.59988/jfmsl.vol.33issue1.1.
20. Amrita A, Deokar RB. Clinical Forensic Psychology: It's Emergence, Significance and Application in India. J Forensic Med Sci Law 2022;31(2):80-83.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Original Research Article

Evaluation of Mechanical Injuries in Cases of Assault Registered at Tertiary Care Hospital in Central India

Kavita Ram Deshpande[a], Indrajit Khandekar[b*]
[a]Assistant Professor, Forensic Medicine and Toxicology, BV (DTU) MC, Pune, Maharashtra, India. [b]Professor, Forensic Medicine and Toxicology, MGIMS, Sevagram, Maharashtra, India.

Article Info

Received on: 11.09.2023
Accepted on: 30.04.2024

Key words
Mechanical Injuries,
Assault,
Grievous,
Section 320 IPC.

Abstract

Introduction: Assault is one of the important preventable social health problems, always involving a risk of long term morbidity and mortality. It affects physical, mental and social health of an individual. This particular study was carried out to study physical effects of assault, particularly with reference to details of mechanical injuries. **Material and Methods:** A retrospective study was conducted at tertiary care hospital to evaluate mechanical injuries present in cases of assaults. Analysis of all, 319, cases of alleged assault registered at the hospital during the period from July 2016 to June 2018 was done based on type of mechanical injury, body part affected and severity as per S 320 IPC. **Results:** Out of 319 cases, contusions were present in 94 (29.47%, n=319) cases, followed by fractures in 91 (28.53%) and lacerations in 84 (26.33%) cases. Out of 319 cases, 184 (57.68%), 92 (28.84%) and 56 (17.55%) cases had injuries on head-neck-face, upper limbs and lower limbs respectively. In 162 (50.78%, n=319) cases, injuries were not grievous and 118 (36.99%, n=319) cases had grievous injuries as per S 320 IPC. **Conclusion:** The study indicates that contusion is seen in maximum number of cases. 'Head, neck and face' is the most targeted body part. The number of cases without grievous injury is more than the number of cases with grievous injury.

1. Introduction

Forensic Assault is a violent attack by one or more persons in an attempt to injure the other person or persons.[1]

Section 351 IPC (Indian Penal Code) defines 'Assault' as – Whoever makes any gesture, or any preparation intending or knowing it to be likely that such gesture or preparation will cause any person present to apprehend that he who makes that gesture or preparation is about to use criminal force to that person, is said to commit assault.[2]

Explanation- Mere words do not amount to an assault. But the words which a person uses may give to his gestures or preparation such a meaning as may make those gestures or preparations amount to an assault.

Section 350 IPC defines 'Criminal force' as whoever intentionally uses force to any person, without that person's consent, in order to the committing of any offence, or intending by the use of such force to cause, or knowing it to be likely

How to cite this article: Deshpande KR, Khandekar I. Evaluation of Mechanical Injuries in Cases of Assault Registered at Tertiary Care Hospital in Central India. J Forensic Med Sci Law. 2025;34(2):11-16. doi: 10.59988/jfmsl.vol.34issue2.3

***Corresponding author:** Dr Indrajit L Khandekar, Professor, FMT, MGIMS, Sevagram, Wardha, Maharashtra, India. Email: khandekar@mgims.ac.in (M): +91-9823029293.

fear or annoyance to the person to whom the force is used, is said to use criminal force to that other.[2]

As per the definition stated by World Health Organization (WHO) violence is the intentional use of physical force or power, threatened or actual, against oneself, another person, or against the group or community that either results in or has a high likelihood of resulting in injury, death, psychological harm, mal-development, or deprivation.[3] This is broad concept. Interpersonal violence is a type of violence. It is an intentional use of physical force or power by an individual or small group of individuals against another individual/s.[3] It encompasses physical, mental, emotional or sexual violence. Deprivation and neglect are also part of the same. After considering all these various terminologies, we have considered the dictionary meaning of word 'Assault' in present study to include or exclude the cases. The same is used in software of the institute prepared exclusively for medico-legal work.

Assault is one of the important preventable social health problems. There is always a risk of long term morbidity and mortality in cases of assault. It adversely affects physical, mental and social health of an individual. This particular study was carried out to study physical effects of assault, particularly with reference to details of mechanical injuries.

Aim and Objectives

To study the mechanical injuries in cases of assault with respect to

a. types of injuries based on causative object / force
b. body part affected
c. Severity- whether grievous or not based as per S 320 IPC.

2. Materials and Methods

This is a descriptive type of study, carried out under Clinical Forensic Medicine Unit (Hereafter will be labelled as CFMU) of tertiary care hospital in Central India. There were total 319 cases of assault registered during period of two years, from 01/07/16 to 30/06/18. These all 319 cases were analysed. The data was collected primarily from the software, specially designed for documentation of medico-legal cases under CFMU. In addition to this, data from 'Hospital Information System (HIS)' was considered for analysis of those 319 cases. This 'HIS' is an institutional 'Electronic Medical Record System'. Based on the data, case sheets were filled and further analysed by using Microsoft Office Excel Worksheet 2007.

Inclusion criteria:

All live cases of an alleged assault registered at the tertiary care hospital during the study period.

Exclusion criteria:

1. Cases of assaults brought dead
2. Assault due to any means other than mechanical force
3. Victims of sexual assault.

3. Observations and results

According to the institutional data, there were total 4969 medico-legal cases registered during the period of two years. Of these 4969 cases, in 319 cases, alleged victims of assault were brought to the hospital for management purpose. It means, live cases of assault comprise of 6.42% of total medico-legal cases. These 319 cases were evaluated on the basis of type of injury, body part affected, and severity of injuries.

Total 8 types of mechanical injuries were considered for study purpose based on their features and type of causative object / force- Abrasion, contusion, laceration, fracture, incised wound, stab wound, chop wound and other (eg. Stitched wound). As no case of 'firearm injury' was registered during the study period, it is not included in analysis.

Table 1: Type of injury wise distribution of cases, n=319.

Type of injury	Cases (No.)	Percentage (%)
Abrasion	62	19.44
Contusion	94	29.47
Laceration	84	26.33
Fracture	91	28.53
Incised wound	59	18.5
Stab wound	18	5.64
Chop wound	4	1.25
Other	54	16.93

As per the analysis done based on type of injury seen among total number of cases, contusion was present in 94 (29.47%, n=319) cases, as shown in **table 1**, followed by fracture and laceration in 91 (28.53%) and 84 (26.33%) cases, respectively. Chop wound was seen in 4 (1.25%) cases.

Table 2: Body part-wise distribution of cases (n=319).

Site of injury	No. of cases	Percentage (%)
Head Neck Face	184	57.68
Upper Limbs	92	28.84
Chest	20	6.27
Abdomen	18	5.64
Back	37	11.6
Lower Limbs	56	17.55
No part	33	10.34

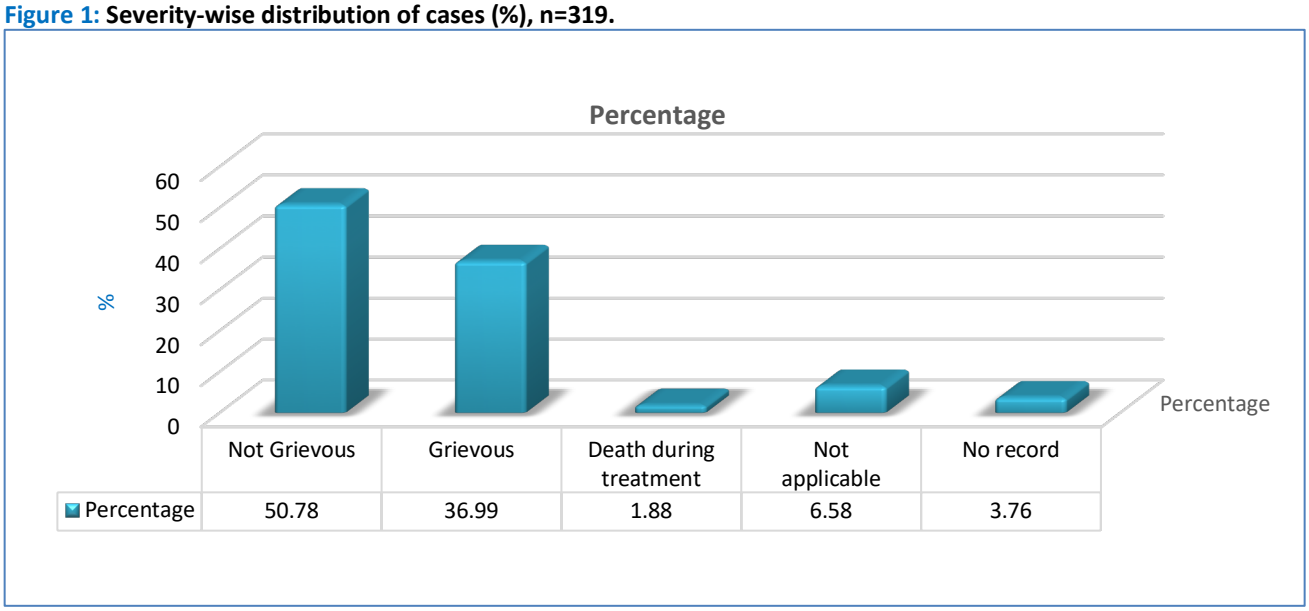
HNF: Head, Neck, Face; UL: Upper Limb; LL: Lower Limb

In another type of analysis, the number of cases was analysed with respect to the body parts affected as shown in **table 2**. Head-neck-face region was affected in 184 (57.68%, n=319) cases and upper limbs in 92 (28.84%, n=319) cases. The abdomen was affected in 18 (5.64%, n=319) cases. *Body parts are divided in 6 groups as follows- Head-neck-face (HNF), upper limbs (ULs), chest, abdomen including genitals (Abdo), back and lower limbs (LLs).

Table No. 3: Body part-wise distribution of injuries (n=851).

Body parts*	Abrasion	Contusion	Laceration	Fracture	Incised wound	Stab wound	Chop wound	Other	Grand Total
HNF	45	70	95	118	67	1	1	46	443
ULs	22	33	14	44	55	5	3	7	183
Chest	4	6	0	18	7	3	0	1	39
Abdomen	0	7	0	0	3	8	0	4	22
Back	6	18	0	2	12	5	0	6	49
LLs	17	28	13	34	10	5	0	8	115
Grand Total	94	162	122	216	154	27	4	72	851

Figure 1: Severity-wise distribution of cases (%), n=319.



Analysis of total number of injuries (n=851) with respect to body part affected was done. This analysis showed that total 443 injuries (52.56%, n=851) were present on head-neck-face region as shown in **table 3**. Upper limbs were affected with 183 (21.50%, n=851) injuries and lower limbs with 115 (13.51%, n=851) injuries. 22 (02.59%, n=851) injuries were present on the abdomen.

As per the analysis of type of injury with respect to total number of injuries (n=851), total number of fractures observed was 216 (25.38%, n=851) as shown in Table No. 3. Contusion and incised type of injuries were 162 (19.04%, n=851) and 154 (18.10%, n=851) in number, respectively. Stab injury and chop wound were 27 (03.17%, n=851) and 4 (00.47%, n=851) in number, respectively. Other' injuries were 72 (08.46%, n=851) in number which mainly included sutured wounds, where sutures are done at some other centre. Injuries were labelled either grievous or not grievous based on S 320 IPC [2,4] after due consideration of injury report, clinical examination, reports of radiological investigations and medical / treatment records

Out of 319 cases, 162 cases (50.78%, n=319) had injuries which were not grievous in severity while 118 (36.99%, n=319) cases had grievous injuries, as shown **in Figure 1**.

4. Discussion

Total number of cases considered for this study was 319 cases, registered during the study period of two years. Live cases of assault comprised of 6.42% of total medico-legal cases (n= 4969). This number differs from few other studies.[5,6] As per the study by Thube HR et al[5] "Out of 6870 medicolegal cases observed in casualty during the study period, maximum 37.5% were of assault cases." This study

was done in Mumbai. As per study by Haridas HV et al[6], out of total 12,789 medico-legal cases registered during a period of one year, 3697 cases (28.90%) were of assault. However, our observation is similar with the study by Farooqui JB et al.[7] According to Farooqui JB et al[7], "during the study period total 878 medico-legal cases were registered out of which 90 cases were of alleged assault that accounts for 9.75%". This study was conducted based on data of one year. As per the analysis done based on type of injury seen among total number of cases as shown in table No 1, contusion was present in maximum number of cases, followed by fracture and laceration. Chop wound was seen in lowest number of cases. This can be because of easy availability of hard, blunt type of weapons.

Our observations are similar with the studies by Steen K et al[8] and Subba SH et al.[9]

In a study by Steen K et al[8], injuries were analysed based on specific diagnosis code system which differs from the classification of injuries used in the present study. In present study, classification of injuries used was based on nature of causative force / object.

In a study by Subba SH et al[9], though the contusion was observed in maximum number of cases, the second most common was incised wound, seen in 25.7% cases unlike the present study wherein the incised wound was seen in 59 (18.5%) cases.

Our observation differs from studies by Niraj K et al[10] and by Herbst CI et al[11] in which abrasion was seen in maximum number of cases. In the study by Niraj K et al[10], fracture of skull and fracture / dislocation of other bones were separately considered while analysing the injuries. In the study by Herbst CI et al[11] cases of community assault were studied with contusion and tram-line bruises considered as two different types of injuries.

Our observation also differs from study by Thube HR et al[12] in which laceration was seen in maximum number of cases. In this study by Thube HR et al, contusion and swelling were considered separately.

When the number of cases was analysed with respect to the body parts affected as shown in table No. 2. Head-neck-face region was affected in maximum number of cases followed by upper limbs. The abdomen was affected in the least number of cases.

Our observation is consistent with the study by Subba SH et al.[9] Studies by Niraj K et al[10] and by Kokatanur CM et al[13] differ from our observations. In a study by Niraj K et al[10], upper limbs were affected in maximum number of cases followed by head-neck-face region. In a study by Kokatanur CM et al[13], though the face was the most frequently targeted region, second most was the chest region.

In the present study, in an analysis of total number of injuries with respect to body part affected, the head-neck-face was the most affected body part followed by upper limbs and then lower limbs. Abdomen was the least affected body part.

This is similar with the studies by Patel DJ[14] and by Swarnkar M et al.[15] However, in the study by Swarnkar M et al[15], the second most common body region affected was trunk. In both types of analysis done on the basis of site of injury, head-neck-face region was the most frequently targeted region. This can be attributed to the fact that head-neck-face is one of the vital parts of the body and also easily accessible.

The difference with the study by Kokatanur CM et al[13], can be due to the fact that the study by Kokatanur CM et al[13] was based on fatal cases of assault. As per the analysis of type of injury with respect to total number of injuries, fracture was the most frequently observed injury followed by contusion and incised wound. Chop wound was the lowest in number.

Our observations differ from few studies.[12, 13, 14] In a study by Thube HR et al[12], laceration was the most commonly observed injury followed by abrasion. In a study by Kokatanur CM et al[13], the commonest injury observed was chop wound and contusion was the least observed injury. In a study by Patel DJ[14], stab wound was the most commonly observed injury, followed by incised / chop wound.

The study by Kokatanur CM et al[13] and the study by Patel DJ[14], both were done in fatal cases of assault which justifies the predominance of chop wound and stab wound, respectively. The difference in observation and predominance of injuries over head-neck-face during present study can be attributed to making use of reports of radiological investigations in present study to document skull fractures. According to S 320 IPC which defines Grievous hurt, the majority of cases in present study were not grievous in severity as shown in chart No. 1. However, 6 (01.88%, n=319) cases were not considered for severity as those cases succumbed to death while under treatment.

In 21 (06.58%, n=319) cases, the opinion regarding severity of injury was not applicable as there were no injuries present on external and internal examination. There were 12 (03.76%, n=319) cases with no opinion available about severity. This is mainly

attributed to cases which were referred to some other hospital or for patients who went on their own to some other hospital against medical advice. In such cases, where the treating doctor was not in a position to assess severity of the injury at the time of initial examination, he was also not in a position to give a final opinion about the severity due to unavailability of subsequent medical records.

There are studies[8, 12, 15, 16] with similar observation, though the categorization or nomenclature is different. This categorization varies country to country depending on local guidelines. In a study by Johansen VA et al[16], they had used 3 categories, with increasing severity- assault, inflicting bodily harm and inflicting serious bodily harm. Similarly, in the study by Steen K et al[8], they had used the Abbreviated Injury Scale 1990 Revision (3) and Shepherd's injury severity scale to analyze the severity of injury. Sometimes the survivor & accused brought for medicolegal examination also sustained certain mechanical injuries.[17,18] There were insightful discussions at medicolegal gatherings on such important topic.[19,20]

5. Conclusion

Conclusions drawn from the present study are as follows:

1. Contusion was seen in maximum number of cases followed by fracture and laceration.
2. The maximum number of injuries were fractures.
3. 'Head, neck and face' region, one of the most vital body parts, was the most frequently affected body part.
4. In majority of cases, injuries were not grievous in severity, As per S 320 IPC.

Further scope:

This kind of study should be carried out at various other centres simultaneously to understand the physical impact of assault on a larger scale and thereby to take preventive steps.

Ethical Consideration: This is a retrospective study done based data available at the tertiary care hospital. No human being is involved as subject.

Conflict of Interest: None to declare.

Source of funding: None to declare.

Contributor ship of Author: All authors equally contributed.

Acknowledgment: Dr. B. H. Tirpude, Professor and Head, Dept. of Forensic Medicine and Toxicology, Mahatma Gandhi Institute of Medical Sciences, Sevagram, Wardha, Maharashtra, India

References:

1. Revised & updated Illustrated Oxford Dictionary. 1st ed. India: Dorling Kindersley Limited and Oxford University Press; 2006.
2. Section 351 Indian Penal Code. [Cited on 20th September 2023]. Available from: https://www.indiacode.nic.in/show-data?actid=AC_CEN_5_23_00037_186045_1523266765688&orderno=391#:~:text=Whoever%20makes%20any%20gesture%2C%20or,said%20to%20commit%20an%20assault
3. Mercy JA, Hillis SD, Butchart A, Bellis MA, Ward CL, Fang X. Interpersonal violence: Global Impact and Paths to Prevention. In: Mock CN, Nugent R, Kobusingya O, et al., editirs. Injury Prevention and Environmental Health. 3rd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2017 Oct 27. Chapter 5. DOI: 10. 1596/978-1-4648-0522-6_ch5.
4. Karmarkar MD. Medical Certificates and Medico-legal Reports in Undergraduate Teaching. J Forensic Med Sci Law. 2017; 26(1):1-3.
5. Thube HR, Chikhalkar BG, Nanandkar SD. Analysis of various aspects of assault cases attended in Emergency Department of Government Hospital Mumbai. J Forensic Med Sci Law. 2014; 23(2):20-6.
6. Haridas SV, Pawale DA. A retrospective study of pattern of clinical medico-legal cases registered at tertiary health care centre in Kolhapur district. J Forensic Med Sci Law. 2014; 23(2):40-7.
7. Farooqui JB, Chavan KD, Datir SB. Retrospective study of pattern of mechanical injuries amongst victims of assault at Pravara Rural Hospital, Loni. J Forensic Med Sci Law. 2011; 20(2):25-31.
8. Steen K, Hunskaar S. Medical consequences of violence: a two-year prospective study from a primary care accident and emergency department in Norway. Scand J Prim Health Care. 2002; 20(2):108–12.
9. Subba SH, Binu VS, Menezes RG, Kumar V, Rana MS. Physical assault related injuries in Western Nepal – A hospital based retrospective study. J Forensic Leg Med. 2010; 17(4):203–8.
10. Niraj K, Singh A, Singh RKP. Pattern of Mechanical Injuries of Fatal Interpersonal Violence Cases in a Tertiary Care Centre. J Indian Acad Forensic Med. 2015; 37(4):381-4.
11. Herbst CI, Tiemensma M, Wadee SA. A 10-year review of fatal community assault cases at a regional forensic pathology facility in Cape Town, South Africa. S Afr Med J. 2015; 105(10):848-52.
12. Thube HR, Chikhalkar BG, Nanandkar SD. A Prospective Study of Injury Pattern in Victim of Assault Attended in South Mumbai Government Hospital. J Indian Acad Forensic Med. 2015; 37(1):37–40.

13. Kokatanur CM, Chidanand PS, Havanur B, Devadass PK. Study of Weapons Related to Mechanical Injuries In Fatal Assault Cases Autopsied at Victoria Hospital. J Indian Acad Forensic Med. 2015; 37(2):144-7.
14. Patel DJ. Analysis of homicidal deaths in and around Bastar region of Chhattisgarh. J Indian Acad Forensic Med. 2012; 34(2):139-42.
15. Swarnkar M, Pal G, Lilhare S. Assault and self-harm injuries: pattern, severity and etiology of injuries in victims attending emergency department of teaching hospital in central India. Int Surg J. 2016; 3(3):1618-22.
16. Johansen VA, Wahl AK, Weisaeth L. Assaulted victims of nondomestic violence in Norway – injury, crime characteristics and emotions during the assault. Scand J Caring Sci. 2008; 22(3):445-54.
17. Patil SS, Deokar RB, Dere RC. Medicolegal Aspects of Examination of Accused of Sexual Offences. J Forensic Med Sci Law. 2024;33(1):65-70. doi: 10.59988/jfmsl.vol.33issue1.12
18. Pande PVS et al. Survivors of Child Sexual Violence in India and Their Search for Justice: A Case Series and Review of Literature. J Forensic Med Sci Law 2023;32(2):63-69.
19. Varma NM, Pawar MN, Deokar RB. Executive Summary of the Forensicon 2022 - 25th Annual State Conference of Medicolegal Association of Maharashtra (MLAM). J Forensic Med Sci Law 2023;32(2):80-84.
20. Mohite S, Sukhdeve R, Sonawane S, Deokar R, Kolle S, Hinnawi S. Executive Summary of the XXVI Annual State Conference of Medicolegal Association of Maharashtra (MLAM) - Forensicon 2023. J Forensic Med Sci Law. 2024;33(2):73-78. doi: 10.59988/jfmsl.vol.33issue2.13

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Original Research Article

Sexual Dimorphism from Mandibular Canine Index in Autopsied Bodies – A Pilot Study

Girish Tasgaonkar[a], Vina Vaswani[b], Ravindra Deokar[c], Neelkamal Battu[d*], Harish Pathak[e], Amrita Vijayan[f]

[a]Associate Professor, [d]Odontologist Consultant, [e]Professor & Head, [f]Junior Resident 3, FMT, Seth G.S. Medical College and KEM Hospital, Maharashtra India. Professor, FMT, Yenepoya Medical College (Deemed to be University), Manglore, Karnataka, India. 575018. [c]Professor (Additional), FMT, Lokmanya Tilak Municipal Medical College & LTMG Hospital, Mumbai, Maharashtra, India.

Article Info

Received on: 30.09.2025
Accepted on: 25.10.2025

Key words
Forensic odontology, Sexual dimorphism, Mandibular Canine Index (MCI).

Abstract

Background: Teeth are pivotal in forensic identification due to their resilience and unique characteristics. This study investigates the sexual dimorphism of mandibular canines which is crucial for identifying decomposed or mutilated remains. **Materials and Methods:** Sixty autopsied individuals, aged 20 to 50 years, from a Mumbai tertiary center, were examined. Digital Vernier calipers measured mandibular inter-canine distance and mesiodistal crown width of canines. **Results:** A significant sexual dimorphism was found in inter-canine distance ($p = 0.036$) and mesiodistal crown width of canines (right: $p = 0.011$, left: $p = 0.001$). Males showed larger dimensions than females. The MCI achieved 76.66% accuracy in sex determination, with higher predictability for males (73.33%) than females (80%). Logistic regression models reached up to 90% accuracy, emphasizing the effectiveness of MCI in sex prediction. **Discussion:** Mandibular canines proved reliable for sex determination in forensic contexts, aligning with previous studies. Population-specific variations and limitations such as age- related changes highlight the need for cautious interpretation. **Conclusion:** This study preliminarily confirms mandibular canines as valuable tools in forensic sex determination. Future research should focus on expanding sample sizes and refining methodologies to further strengthen forensic odontology practices.

1. Introduction

Teeth are one of the strongest and toughest substances in the human body. Often, when a decomposed, charred, skeletonized, mutilated body is recovered, teeth become one of the most crucial pieces of evidence to help identify that person. Human dentition is also a good indicator of the life, culture, food, and adaptation process of the past and present human populations through dental morphology, dental disease, dental modifications, and many more. The evolution of teeth transformed human canines into smaller and incisiform, losing their sexual and social function and are used

How to cite this article: Tasgaonkar G, Vaswani V, Deokar RB, Battu N, Pathak H, Vijayan A. Sexual Dimorphism from Mandibular Canine Index in Autopsied Bodies – A Pilot Study. J Forensic Med Sci Law. 2025;34(2):17-22. doi: 10.59988/jfmsl.vol.34issue2.4

***Corresponding author:** Dr Neelkamal Battu, Odontologist, Seth G.S. Medical College and KEM Hospital, Maharashtra India. (M) : +91 9167088680. Email id : neelkamalbattu@kem.edu

primarily for tearing food. The evolution of the human canine is influenced by the biomechanical environment of the masticatory apparatus, making it an "exaptation" rather than a functional adaptation. The human canine has evolved from being a tool for sexual selection to a functional tooth adapted to the biomechanical demands of the masticatory apparatus. In modern humans, the canine's role is less about tearing food and more about fitting into the complex dynamics of the masticatory system. Understanding the evolutionary history of the canine can help inform dental practices and the treatment of dental anomalies.[1]

In forensics, human canine teeth are of extreme significance. Owing to the morphology and position of canine in the oral cavity it shows least incidence of caries. It is referred to as cornerstone of mouth.[2] Various studies have been conducted in contemporary human populations, the permanent molar crowns are larger in males than females.[3] Permanent canines begin mineralizing shortly after birth and require approximately 6 years to create enamel and 14 years to complete the root. It was seen that canines in males weighed more than of females. They concluded that although amounts of enamel were similar in males and females, the dentine present was more in males than females. [4,5] Studies on odontometrics in relation to gender variances have found that canine with mandible have shown significant dimorphism amongst other teeth, being smaller in females than in males.[4,6] In terms of age-related tooth extractions, the mandibular canines are one of the last teeth to be removed since they are less prone to caries damage and periodontal disease.

Mandibular canine index (MCI) is a fascinating little dental metric that has been used by forensic anthropologists and odontologists as a parameter for analysis of sex. Several research has been conducted taking into consideration the maxillary and the mandibular canine index. The inference drawn from the studies was mandible exhibits more sexual dimorphism than the maxilla. It is the ratio of the maximum mesiodistal width of the canine, and the inter-canine distance measured from tip to tip of canines. Due to their location in the jaw, canines are also better able to endure catastrophic damage like air disasters, storms, or conflagrations. These results suggest that the canines in mandible may be contemplated as crucial for personal identity.[7] Hence, mandibular canine index may be determined for the purposes of our study.

2. Material and Methods

A total of 60 autopsied bodies, distributed from 20 to 50 years of age between males and females were included for study. The ethical approval has been obtained by Institutional Ethics Committee at authors institution with vide approval number IEC(II)/OUT/918/2022. The work was done in tertiary center, Mumbai. Digital caliper was used for taking measurements which were as follows-

- Mesiodistal crown width of left mandibular canine
- Mesiodistal crown width of right mandibular canine.
- Mandibular inter-canine distance.

Samples with mal-aligned, absence of anterior teeth, crowding, decay, and restorative treatment were excluded from the study. The present study ventured to record the measurements in deceased subjects unlike most of studies which have taken living subjects into consideration. In the deceased to open the oral cavity for examination, it involves multiple examiners for reflecting lower lip, recording & noting measurements. Each autopsied body was examined by two competent personnel to overcome inter-observer error.

The ratio of the maximum mesiodistal (MD) width of the canine and the inter-canine distance (ICD) is referred to as mandibular canine index.

Mandibular canine index (MCI) =

$$\frac{\text{Mesiodistal crown width of mandibular canine}}{\text{Inter-canine distance.}}$$

Computation of sexual dimorphism: It have been done as per formula specified by Garn etal. [3] Standard MCI was used for differentiating male & female. It was calculated by method given by Rao et al.[10] The data was analyzed using the statistical analysis package of IBM SPSS 26.0. It is used to find out differences between male & female for various parameters, unpaired t-test was used. A logistic regression analysis is done to predict outcome variables. The MCI, Standard MCI estimation was done on an MS Excel spreadsheet.

3. Observation and Results

The study investigated the sexual dimorphism in mandibular canines among 60 autopsied individuals (30 males, 30 females), aged 20 to 50 years. The descriptive statistics of the mandibular canine parameters and the Mandibular Canine Index (MCI)

are shown in **table 1**. Significant differences were observed in inter-canine distance and mesiodistal crown width between males and females. Males exhibited larger dimensions in all measured parameters. Specifically, the mean inter-canine distance was 27.196 mm in males and 26.117 mm in females, with a significant p-value of 0.036.

Table 1: The descriptive statistics of the mandibular canine parameters and the Mandibular Canine Index (MCI).

Parameters	Sex	Mean	SD	t-stat	P value
Inter-canine Distance	Male	27.196	1.955	2.149	0.036
	Female	26.117	1.931		
Right Canine MD	Male	6.216	0.462	2.642	0.011
	Female	5.874	0.537		
Left canine MD	Male	6.223	0.458	3.483	0.001
	Female	5.774	0.537		
Right MCI	Male	0.228	0.020	4.217	0.000
	Female	0.205	0.022		
Left MCI	Male	0.230	0.018	-1.113	0.270
	Female	0.235	0.021		

Table 2: Percentage of sexual dimorphism calculated using the formula provided by Garn et al.

Sexual Dimorphism	Percentage (%)
Right Canine	5.82
Left Canine	7.77

Table 3: Sex predictability using the Standard Mandibular Canine Index (MCI = 0.217).

Gender	Number of Cases	Cases Correctly Identified	Accuracy (%)
Male	30	22	73.33
Female	30	24	80.00
Total	60	46	76.66

Table 4: Shows the sex predictability by logistic regression analysis.

Gender	Predicted Model	Percentage Correct
Male	28	93.3
Female	26	86.7
Total	90	90

The mesiodistal width of the right canine was 6.216 mm in males and 5.874 mm in females (p = 0.011), while the left canine showed 6.223 mm in males and 5.774 mm in females (p = 0.001). The right Mandibular Canine Index (MCI) was higher in males (0.228) compared to females (0.205), with a p-value of 0. The left MCI did not show a significant difference between sexes. Sexual dimorphism was more pronounced in the left canine (7.77%) compared to the right canine (5.82%) **table 2**. The MCI demonstrated a 76.66% accuracy in sex determination, with 73.33% predictability for males and 80% for females **table 3**. Logistic regression models incorporating multiple odontometric parameters achieved up to 90% accuracy in predicting sex **table 4**, highlighting the robustness of combining different measurements for higher accuracy. The binary logistic regression equation obtained after statistical analysis (**table 5**) for predicting sex (λ) is λ=20.35−9.251×Left Canine Width+162.785×Left CI+ 5.436×Right Canine Width−157.506×Right CI.

4. Discussion

Teeth are often used for identification purposes in forensic investigations and other scenarios where identifying individuals is crucial. In mass disasters, such as plane crashes or natural disasters, identifying victims can be challenging due to physical trauma.Teeth are often one of the most durable elements of the body, capable of withstanding harsh environments. Determining sex of the deceased narrows the search to great extent. Research studies have shown potential use of Mandibular Canine Index (MCI) in sex determination from teeth. The research into variation of tooth size and other distances among teeth in the mouth cavity is known as odontometrics. It is simple, dependable, low-cost, and straightforward to measure. Studies with respect to stature estimation have also been conducted taking into consideration the inter-molar, inter-premolar and inter-canine distance.[9]

In humans, one area where sexual dimorphism can be observed is in the dentition, including the mandibular canines. The process of amelogenesis is sex linked and hence the formation of teeth is influenced by enamel & dentine development. It occurs for higher duration of time in males leading to larger teeth size in both permanent and temporary teeth.[9,10] As represented in **Table 1**, all odontometrics like canine width & inter-canine distance were larger in males than females. Similar findings are seen in studies conducted by Patel et al, Rao et al, Soundarya et al Magar et al and Baheti MJ et al. [6,8,11, 12,13] However, in research by Boaz et al they have done study on South Indian population, 100 subjects comprising of 50 male & 50 females, it was concluded that females are having larger mandibular canine width than male. [14,15]

From statistics observations mentioned in **table 1**, all parameters, inter-canine distance, right & left canine mesiodistal width, right MCI are significant while left MCI is not significant. Various investigators studied canines for greater degree of

sexual dimorphism than other teeth. Canines have also shown a prominent level of resistance to postmortem examination. Regarding sexual dimorphism, left canine showed sexual dimorphism 7.77% compared to right canine 5.82%. It was estimated using the Garn et al. formula.[3] Similar findings where the left canine had the most sexual dimorphism than the right was found in several studies, [7,10, 12,16-19] while study done by Barmate et al showed opposite results.[15] While Kumavat et al [20] found that right & left canine had showed 5.53%, 5.42%, respectively. Also, N Vishwakarma et al found right canine having maximum dimorphism 12.51% than left 10.15%.[21]

Table 5: The variables used in the logistic regression analysis

Variables in equation	B	S.E.	Wald	df	Sig.	Exp(B)
Left Canine Width	-9.251	3.522	6.901	1	.009	.000
Left CI	162.785	76.636	4.512	1	.034	4.972E+70
Right Canine Width	5.436	2.876	3.573	1	0.59	229.499
Right CI	-157.506	68.055	5.357	1	.021	.000
Constant	20.350	7.800	6.808	1	.009	688669418.471

The mandibular canine index (MCI) was formulated in the 1980s by Rao et al. It is based on the increased differences in sexuality shown by canines with mandibles. MCI is statistically higher in males compared to females about canine dimorphism. In our study, left MCI is greater in females. Male & female were distinguished by use of standard MCI. It was calculated by method given by Rao et al.[8] The present study shows sex predictability from standard MCI is 76.66%. It is like other studies which have showed results between 75-80 %. Kumavat et al have done study on Maharashtra population and found 79.66% accuracy.[20] Bakkannawar SM et al[22] and Paramkusam et al[7] have shown 75% & 78.3% sex prediction through MCI in South Indianpopulation. Patel RA et al[6] and Gandhi N et al[17] have met 78.75% & 79.03% accuracy in their study. Magar et al observed that sex determination accuracy by MCI index was 83.8% in males and 87.2% in females in North Saudi Sakaka population.[12] R Iqbal et al[23] have done study on Uyghur population and found 77% sexpredictability. In a study conducted by Narang et al on North Indian population, the results showed that MCI could predict sex determination as 68% in males and 67.6% in females.[24]

However, it's important to note several caveats and limitations regarding the mandibular canine index. Population variation plays a significant role as the index varies among different populations, meaning that what might be indicative of sex in one populationmay not be applicable to another. Secondly, individual variation is a factor since mandibular canine indices for males and females overlap significantly, which lowers the accuracy of sex detection. Additionally, age can affect the size and shape of teeth, potentially affecting the mandibular canine index over time. Lastly, ancestry and genetics can also influence tooth morphology, further complicating the use of this method for sex determination.

A.B. Acharya et al[25] discovered a sex predictability of 50.74%. Furthermore, AM Silva et al[26] have done investigation on the Portuguese people & stated that MCI had 54.2% accuracy. As stated, for a variety of reasons, our findings do not correspond to this research. A.B. Acharya et al[25] performed logistic regression analysis of their data on right canine MD, inter-canine width & MCI. Sex estimation accuracy was found 65.7%, 61.8% and 50.2%, respectively. Similarly, in a study conducted by Atreya et al in Nepalese population, it was found that MCI has poor sex predictability (57.5 to 62.5%). It concluded that sex determination should be done using other methods and that MCI should be cautiously used in Nepalese population.[27] Coberly in her study exhibited that 37% of males and 44% of females were sorted correctly using the standard MCI, for a 40% overall accuracy.[28] Various mandibular parameters have been used over years for determining the sex. The measurement of antegonial depth from radiographical examination has proved to be significant in determining the sex.[29] The morphometric parameters of bicondylar breadth, bimental breadth, bigonial breadth, coronoid breadth and height, maximum and minimum ramus breadth and height can also to taken into consideration for determining sex.[30]

The present study examined four models for sex predictability using logistic regression analysis (LRA). The first model analyzed only the right canine index and achieved 75% accuracy. The second

model is made up of right canine index and left canine width. It shows the same 75% sex predictability. The third one considered the right canine index, left canine breadth, and left canine index. Sex accuracy has improved to 86.7%. The fourth model, which considered four variables: left canine breadth, right canine breadth, right canine index & left canine index demonstrated a greater 90% sex prediction. As a result, we chose the fourth and final model for the highest sex correctness using LRA. We can say that LRA can be used for sex estimation, but we will need more sample size around 100-125 forgood result statistical point of view.

Limitation of study

This study has been done on dead individuals in our institute. Therefore, sample size was limited according to number of autopsies, age group and sex. Medico legal expert must exercise caution while using this method for estimating sex.

5. Conclusion

This study underscores the significance of mandibular canines in forensic odontology, particularly for sex determination in unidentified bodies. Our findings affirm that male mandibular canines show larger dimensions compared to females, with significant differences in inter-canine distance and mesiodistal crown width. The study's use of the Mandibular Canine Index (MCI) proved a sex predictability accuracy of 76.66%, aligning with prior research findings. Logistic regression analysis further enhanced sex predictability to 90% when incorporating multiple Odontometrics parameters, showing the robust potential of combining various measurements for higher accuracy.

However, several limitations call for consideration. The variability of the mandibular canine index across different populations highlights the need for population-specific standards. Additionally, individual variation, age-related changes, and genetic factors can influence tooth morphology, affecting the accuracy of sex determination. Future research should focus on expanding the sample size and including diverse populations to refine the predictive models and enhance the reliability of odontometric methods in forensic applications. In conclusion, the mandibular canine index, coupled with logistic regression analysis, can be used as preliminary valuable tool in forensic science for sex determination. However, it is not solely reliable and can be used in addition to other indices for sex determination.

The study's method and findings contribute to the broader understanding of dental dimorphism and its practical applications in forensic investigations. Further research with increased sample size and refinement of these techniques will continue to improve their accuracy and reliability, ultimately aiding in the identification of unknown individuals in various forensic scenarios.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

Source of funding: None to declare.

References:

1. Picq P. The human canine. J Dentofac Anom Orthod. 2010;13(1):4–10.
2. Noyes FB. Wheeler'S Dental Anatomy, Physiology, and Occlusion. JAMA. 1922;79:1760–2.
3. Garn SM, Lewis AB, Kerewsky RS. Sex differences in tooth size. J Dent Res. 1964;43:306.
4. Schwartz GT, Dean MC. Sexual dimorphism in modern human permanent teeth. Am J Phys Anthropol. 2005;128(2):312–7.
5. Stroud JL, Buschang PH, Goaz PW. Sexual dimorphism in mesiodistal dentin and enamel thickness. Dentomaxillofac Radiol. 1994;23:169–71.
6. Patel RA, Chaudhary AR, Dudhia BB, Macwan ZS, Patel PS, Jani YV. Mandibular canine index: A study for gender determination in Gandhinagar population. J Forensic Dent Sci. 2017;9:135–43.
7. Paramkusam G, Nadendla LK, Devulapalli RV, Pokala A. Morphometric analysis of canine in gender determination: Revisited in India. Indian J Dent Res. 2014;25:425–9.
8. Rao NG, Rao NN, Pai ML, Kotian MS. Mandibular canine index: a clue for establishing sex identity. Forensic Sci Int. 1989;42:249–54.
9. Vijayan A, Jayarajan J, Fathima Jaleel BN. Significance of mandibular canine index in sex determination. Int J Forensic Odontol. 2019;4:54–8.
10. Kapila R, Nagesh KS, Iyengar AR, Mehkri S. Sexual dimorphism in human mandibular canines: a radiomorphometric study in South Indian population. J Dent Res Dent Clin Dent Prospects. 2011;5(2):51-4.

11. Soundarya N, Jain VK, Shetty S, Akshatha BK. Sexual dimorphism using permanent maxillary and mandibular incisors, canines and molars: An odontometric analysis. J Oral Maxillofac Pathol. 2021;25(1):183-8.
12. Magar SS, Magar SP, Hadi O, Al Turqik F, Alanazi NS, Albilasi RM. Mandibular canine index: A reliable predictor for gender identification using study cast in north Saudi Sakaka population. Egypt J Hosp Med. 2020;78(2):253–6.
13. Baheti MJ, Gharat NV, Toshniwal NG. Importance of Maxillary and Mandibular Intercanine Distance in Sex Determination In Maharashtra Population. J Forensic Med Sci Law. 2014;23(2):7-13.
14. Boaz K, Gupta C. Dimorphism in human maxillary and mandibular canines in establishment of gender. J Forensic Dent Sci. 2009;1:42–4
15. Barmate NS, Bhalerao V, Hinawi S, Sahare P. Mandibular Canine Index: A Tool For Sexual Dimorphism. J Forensic Med Sci Law. 2022;31(2):23-7.
16. Ayoub F, Shamseddine L, Rifai M, Cassia A, Diab R, Zaarour I, et al. Mandibular canine dimorphism in establishing sex identity in the Lebanese population. Int J Dent. 2014;2014:1–6.
17. Gandhi N, Jain S, Kahlon H, Singh A, Gambhir RS, Gaur A. Significance of mandibular canine index in sexual dimorphism and aid in personal identification in forensic odontology. J Forensic Dent Sci. 2017;9:56–60.
18. Sivakumar N, Bansal D, Narwal A, Kamboj M, Devi A. Gender determination analysis using anthropometrical dimensions of 2D:4D, foot index and mandibular canine index. J Oral Maxillofac Pathol. 2020;24:510–6.
19. Singh SK, Gupta A, Padmavathi B, Kumar S, Roy S, Kumar A. Mandibular canine index: A reliable predictor for gender identification using study cast in Indian population. Indian J Dent Res. 2015;26:396–9.
20. Kumawat RM, Dindgire SL, Gadhari M, Khobragade PG, Kadoo PS, Yadav P. Mandibular canine: a tool for sex identification in forensic odontology. J Forensic Dent Sci. 2017;9:109.
21. Vishwakarma N, Guha R. A study of sexual dimorphism in permanent mandibular canines and its implications in forensic investigations. Nepal Med Coll J. 2011;13(2):96–9.
22. Bakkannawar SM, Manjunath S, Nayak VC, Kumar GP. Canine index – a tool for sex determination. Egypt J Forensic Sci. 2015;5:157–61.
23. Iqbal R, Jhang S, Mi C. Reliability of mandibular canine and mandibular canine index in sex determination: a study using Uyghur population. J Forensic Leg Med. 2015;33:9–13.
24. Narang RS, Manchanda AS, Malhotra R, Bhatia HS. Sex determination by mandibular canine index and molar odontometrics: a comparative study. Indian J Oral Sci. 2014;5:16–20.
25. Acharya AB, Angadi PV, Prabhu S, Nagnur S. Validity of the mandibular canine index (MCI) in sex prediction: reassessment in an Indian sample. Forensic Sci Int. 2011;204:e1–4.
26. Silva AM, Pereira ML, Gouveia S, Tavares JN, Azevedo A, Caldas IM. A new approach to sex estimation using the mandibular canine index. Med Sci Law. 2015;55(1):1–6.
27. Atreya A, Shrestha R, Tuladhar LR, Nepal S, Shrestha R, Sah SK. Sex predictability by using mandibular canine index. J Nepal Health Res Counc. 2020;17(4):501–5.
28. Coberly S. A validation study of the mandibular canine index method of sexual assessment using two decedent American populations. New Fla J Anthropol. 2020;1(1):14–27.
29. Anuja P, Doggalli N, Kumar PG, Peeran S, Rudraswamy S, Kalgeri S.Age Estimation and Sex Determination using Antegonial Depth in Indian Population - A Retrospective Study. J Forensic Med Sci Law. 2024;33(2):5-9.
30. Das S, Das A, Biswas S, Chakraborty P, Roy SK, Ghanty D. Sexing of Dry Mandibles of Eastern Indian Population Using Discriminant Function Analysis. J Forensic Med Sci Law. 2024;33(1):18-26.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Original Research Article

Study on Pattern and Characteristics of Medico Legal Cases in Casualty of Chettinad Hospital and Research Institute, Kelambakkam

Shreeyaa Vijay[a], Alwin Raj[a], Raja Sekhar Uppu[b*], Shazil Maria Sibi[a]
[a]CRMI; [b]Professor, Department of Forensic Medicine, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, - 603103.

Article Info

Received on: 15.04.2025
Accepted on: 10.10.2025

Key words
Medico-legal cases,
Road traffic accident (RTA),
Poisoning,
Burns,
Occupational injury.

Abstract

Introduction: Medico-legal cases represent a crucial nexus between healthcare and legal accountability, requiring meticulous documentation and prompt medical intervention. These cases, encompassing traumatic incidents such as road traffic accidents, assault and poisoning demand both urgent care and legal intervention. This study seeks to investigate the incidence, patterns and demographic profiles of medico-legal cases at a tertiary care hospital, providing valuable insights for preventive strategies and enhanced medico-legal practices. **Materials And Methods:** This retrospective analysis was undertaken to examine the medico-legal cases documented in the Casualty of Chettinad Hospital and Research Institute, Kelambakkam, over six months, from January 1, 2024, to June 30, 2024, a total of 629 cases were registered out of which 479 were males and 150 were females. **Results:** The analysis showed that the maximum number of cases were road traffic accidents (RTAs) accounting for 48.6 %, followed by accidental injuries which include workplace injuries, machine cuts and dog bites accounting to 15.4%, followed by poisoning (13.9%). Assault and fall from height showed a higher incidence in the 21-30 age group, while burns primarily affected the 0-10 age group. **Conclusion:** Implementing targeted public awareness campaigns for 21–30-year-olds focusing on road safety and mental health, designing gender-specific interventions addressing men's high-risk occupational injuries and women's vulnerability to domestic violence can reduce the morbidity and mortality in these MLCs.

1. Introduction

A Medico-legal case is any medical case with a legal implication. It can be defined as a case of injury or ailment, in which investigations by the law-enforcing agencies are essential to fix the responsibility regarding the causation of the said injury or ailment.[1] These cases encompass a range of incidents, including assaults, vehicular accidents and other traumatic events, all of which require immediate and comprehensive assessment by healthcare professionals.

How to cite this article: Shreeyaa V, Raj A, Uppu RS, Sibi SM. Study on Pattern and Characteristics of Medico legal Cases in Casualty of Chettinad Hospital and Research Institute, Kelambakkam. J Forensic Med Sci Law. 2025;34(2):23-27. doi: 10.59988/jfmsl.vol.34issue2.5

***Corresponding author:** Dr Raja Sekhar Uppu, Professor, Department of Forensic Medicine, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India- 603103. **Email:** rajasekhar.uppu@gmail.com, (M): +91-9849381288.

The examination of medico-legal cases (MLCs) in the casualty of Chettinad Hospital and Research Institute, Kelambakkam, serves as an essential gateway to understanding the complexities of injuries within the community. In the context of rising violence and trauma, particularly against vulnerable population such as women and children, there is a need to understand the profile of medico legal cases. The Medico-legal aspects of any case must always be secondary to the life-saving treatment of a patient.[2] Moreover, the integrity of medico-legal documentation is paramount, as precise and thorough medico-legal reports (MLRs) play a critical role in judicial proceedings. Incorrect or incomplete medico-legal reports may trigger a pause or delay in legal proceedings and patients' rights could be violated.[3] This study aims to delineate the patterns and characteristics of MLCs presenting at our institute, scrutinizing the nature of injuries, victim demographics, and the incidence of various MLC types.

By employing a robust analytical framework, we seek to reveal insights that may inform targeted interventions and reinforce the medical infrastructure necessary for addressing these pressing challenges. This investigation not only endeavors to illuminate the distinctive features of MLCs but also aims to appraise the quality of medico-legal documentation, ultimately paving the way for enhanced policy development and resource utilization in the management of medico-legal cases within our healthcare framework.

Aims and Objectives:

1. To identify trends in the frequency and types of medico-legal cases over a specified period.
2. To analyze the demographic distribution of medico-legal cases in terms of age, sex, and other relevant factors.
3. To identify and categorize different types and patterns of medico-legal cases presented to the casualty at Chettinad Hospital and Research Institute.
4. To examine the nature and underlying causes involved in medico-legal cases.

2. Material and Methods

This retrospective study was conducted to analyze the medico-legal cases registered in the casualty of Chettinad Hospital and Research Institute, Kelambakkam, over six months, from 1st January 2024 to 30th June 2024.

Inclusion Criteria: All cases that were classified as medico-legal in the MLC register of casualty and were treated as either outpatients or inpatients at Chettinad Hospital and Research Institute during the study period were included. The study included both male and female patients across all age groups, provided they met the criteria for a medico-legal case.

Exclusion Criteria: Cases not identified as medico-legal or those with incomplete or unclear documentation were excluded from the study.

Data Collection and Variables: Data for the study were extracted from the hospital's MLC register. Data were systematically entered into a pre-designed proforma for analysis. The data collected were processed and analyzed using Microsoft Excel, with observations presented in the form of frequency tables, graphs and charts.

Statistical Analysis: The data were analyzed using descriptive statistics to determine trends and patterns in the demographic and clinical profiles of the cases. The findings were then compared with similar studies to identify any notable differences or similarities.

Ethical Considerations: Ethical approval for the study was obtained from the Institutional Human Ethics Committee of Chettinad Hospital and Research Institute [IHEC-I/3203/24]. The study ensured the confidentiality and anonymity of all patient data. Informed consent was not required as this was a retrospective study based on hospital records.

3. Results

A comprehensive analysis was conducted on 629 cases documented in the Casualty of Chettinad Hospital and Research Institute from 1st January 2024 to 30th June 2024. Of these, 479 cases (76.2%) were male patients, while 150 cases (23.8%) were female. The data has been tabulated and meticulously examined across various parameters, including age (**Table 1**), time of the incident, incident location, underlying causes in poisoning and hanging cases, marital status (**Table 2**), educational attainment (**Table 3**), brought to the hospital by (**Table 4**), potential correlation with alcohol consumption (**Table 5**) and domiciliary status (**Table 6**).

There were 6 male brought dead cases reported during the study period. All of them were brought by relatives and the place of death for all the cases was home. The majority were married and from urban areas. Consumption of alcohol was associated with only one case.

Table 1: Depicts the distribution of cases across different age groups.

CASE TYPOLOGIES	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61-70	71 - 80	81 - 90	Total
Poisoning	14	18	26	12	11	5	1	0	1	88
Hanging	0	0	1	0	0	1	0	0	0	2
Assault	0	8	40	16	11	4	2	0	0	81
Fall from height	3	7	10	7	4	0	0	0	0	31
Burns	4	2	2	1	0	0	0	1	0	10
Cutthroat	0	1	0	0	0	0	0	0	0	1
Hesitation cuts	0	0	1	0	0	0	0	0	0	1
Accidental injuries	4	15	38	21	10	6	2	1	0	97
Brought dead	1	0	1	1	1	2	0	0	0	6
RTA	15	58	100	60	35	24	12	2	0	306
Others	1	4	0	0	0	1	0	0	0	6
Total	42	113	219	118	72	43	17	4	1	629

Table 2: Marital status distribution with gender.

Marital Status	Married	Unmarried	Divorced	Widow	Not known	Total
Male	211	254	1	10	3	479
Female	95	51	1	2	1	150

Table 3: Educational status and gender distribution.

Education	Primary	Secondary	Diploma	Graduate	PG	Illiterate	Not known	Total
Male	74	147	63	119	12	58	6	479
Female	15	48	11	59	3	5	9	150

Table 4: Distribution of patients brought by others, stratified by gender.

Brought by	Police	Relative	Friend	Co - worker	Stranger	Self	Not known	Total
Male	7	230	121	88	19	8	6	479
Female	0	112	21	9	4	4	0	150

Table 5: Association between alcohol use and gender.

Associated With Alcohol	Yes	No	Not known	Total
Male	56	420	3	479
Female	1	149	0	150

Table 6: Domiciliary status distribution by gender.

Domiciliary	Urban	Rural	Not known	Total
Male	405	72	2	479
Female	116	34	0	150

4. Discussion

It is evident from **Table 1** that the maximum number of cases was of Road Traffic Accident (RTA) amounting to 306 cases (48.64%), which may be attributed due to the location of the hospital near highway. This finding was similar to study done by Avinash H et al.,[4] Garg V et al.,[5] Haridas SV et al.,[6] Saxena A et al.,[7] Timsinha S et al.,[8] Trangadia MM et al.,[9] Yatoo GH et al.,[10] etc. RTA peaked in the age group of 21-30 years, which coincide with the study done by Avinash H et al., [4] Garg V et al., [5] Trangadia MM et al.,[9] Malik Y et al.,[11] Hussaini SN et al.,[12] Yadav A et al.,[13] etc. The majority of victims in RTA cases were male, which can be attributed to their higher engagement in outdoor work and travel, which is in accordance with the study done by Trangadia MM et al.,[9] Yatoo GH et al.,[10] Hussaini SN et al.,[12] Jagtap et al.,[14] etc. Accidental injuries (workplace injuries, machine cuts, dog bites) were most concentrated in the 21-30 age group. Poisoning cases showed relatively uniform distribution across different age groups but were highest in the age group of 21-30 years. The most frequently encountered toxins include organophosphates (OPC), phenol, cockroach chalk, rat poison, cough syrup, paint thinner, tablets such as paracetamol, thyronorm, escitalopram, melatonin, as well as sodium hypochlorite and sodium hydroxide, listed in descending order of incidence. Assault cases were predominantly concentrated in the 21-30 age group with a sharp decline after age 40 years. Fall from height incidents were most common in the 21-30 age group with no cases reported in individuals older than 50 years. Burn cases had the highest incidence observed in children and decreased progressively with age. Electrocution cases have a bimodal distribution. Various types of medicolegal cases brought to casualty in tertiary care centres and even there are increased chances of violence against doctors at casualty.[15] There is great scope of research in this field

with day by day increasing use of artificial intelligence.[16]

In current study, most common time of occurrence of medico-legal cases is evening hours, which shows a strong correlation with the rush hour. The afternoon was peak time for accidental injury followed by RTA cases. The incidences of poisoning and assault cases were more during nights.

Notably while home incidents account for only 16.3% of males and constitute a substantial 40% of female cases, suggesting divergent risk profiles between genders. Work-related incidents display the most striking disparity, with males experiencing incidents at a rate fourteen times higher than females, potentially reflecting occupational exposure differentials. Most of the cases are preventable by proper awareness and implementation of rules. Strict implementation of traffic rules can decrease the number of road traffic accidents.

The most common cause for suicidal attempt in females is due to family problems followed by love failure and harassment. In Males, it is due to alcohol addiction, financial problems, accidental poisoning and a sense of isolation. Equal distribution is seen in cases where exam failure was the cause of committing suicide.

It is evident from **Table 2** that, the majority of males involved in MLC were unmarried and constituted the largest group, suggesting a potential correlation with age-related factors and risk behaviors. Married females have the highest representation, potentially reflecting different societal or familial dynamics influencing Medico-legal incidents.

In correlation with **Table 3**, male patients have a broader distribution across all educational levels and female patients show a higher proportion in the graduate category, though the overall educational attainment is generally lower compared to males. Illiteracy is more prominent among males than females, which may suggest a need for targeted education-based prevention efforts, particularly for those with lower educational levels.

From **Table 4**, relatives are the most common individuals bringing patients to the hospital in both genders. Friends brought more male patients to the hospital. Co-workers brought more male patients compared to females, which could indicate different social or occupational dynamics. Police involvement in bringing the cases to the hospital is minimal for both genders. Self-transport is rare but more common among males compared to females.

From **Table 5**, a significant portion of cases involving male patients is associated with alcohol consumption, suggesting a potential link between alcohol use and Medico-legal cases. Whereas, in female patients, an extremely low association with alcohol which might be due to societal norms.

Based on **Table 6**, the majority of victims were from urban areas than rural areas, which implies that people living in urban areas are more prone to RTA, industrial hazards and other factors due to the busy lifestyle and industrialization of cities compared to rural areas. This conclusion is in accordance with the study done by Saxena A et al.[7] Romana M et al.[17] The handling of medicolegal cases at tertiary care Centre through a specialized Clinical Forensic Medicine unit is need of hour.[18] reforms, and generation of India-specific research. Forensic nursing cre has one of the important role in handling the medicolegal cases at casualty and it has the potential to transform India's medico-legal framework at emergency healthcare management by improving victim-centered care and strengthening judicial outcomes.[19] Medicolegal documentation maintaining accurate records adhering legal standards, obtaining informed consent and ensuring data security are important in managing medicolegal emergencies at casualty.[20]

5. Conclusion

Based on our study it was observed that young working males are common candidates involved in a Medico-Legal Cases. Implementing targeted public awareness campaigns for youth focusing on road safety and mental health, developing and enforcing workplace safety protocols can minimize the number of men involved in such incidents. Strengthening of employee wellness programs including mental health assessments to address psychological factors in injury may play an important role in minimizing the incidents at workplace.

Domestic violence prevention initiatives for middle-aged adults can reduce such incidents in females. Prioritizing fall prevention for the elderly through physical therapy programs and environmental modifications to improve home safety and conduct regular health screenings for older adults may be useful in reducing the incidence of such cases. Continuous monitoring of injury data and integrating preventive measures across sectors, from

enhanced traffic safety to violence reduction initiatives and ensuring collaboration between public health agencies, law enforcement, community organizations and healthcare providers to formulate and implement preventive strategies to emerging pattern of medico-legal cases across all demographics is the need of the hour.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

Source of funding: None to declare.

References:

1. Jayapalan VK. Practical Medico-Legal Manual, 1st Edition, Indian Academy of Forensic Medicine. 1988: 26.
2. Reddy KSN. The Essentials of Forensic Medicine and Toxicology. 34th Edition, New Delhi: Jaypee Publishers; 2017. P-2.
3. Mohammed M, Abdullah A, Rashed S, Faisal F, Alzahrani, Saleh M et al., Characteristics of Medico-Legal Cases and Errors in Medico-Legal Reports at a Teaching Hospital in Saudi Arabia. Open Access Emerg Med. 2021; 13: 521–6.
4. Avinash H, Pravir B, Ruchira R. Study of medico-legal cases admitted at tertiary care hospital. IPIJFMTS. 2020; 5(1):1-4.
5. Garg V, Verma SK. Profile of medico legal cases at Adesh institute of medical Sciences and research Bhatinda Punjab. J Indian Acad Forensic Med. 2010; 32(2):150-2.
6. Haridas SV, Pawale DA. A Retrospective Study of Pattern of Clinical Medico-Legal Cases Registered at Tertiary Health Care Centre in Kolhapur District. J Forensic Med Sci law. 2014; 23(2).
7. Saxena A, Kumar V, Chaudhary SR, Singh J, Awasthi S. Pattern of Medico-legal Cases in the Casualty Department of Teaching Hospital, Bareilly, Uttar-Pradesh. J Indian Acad Forensic Med. 2015; 37(4):338-40.
8. Timsinha S, Manjarikar S, Baral MP, Ranjitkar M. Profile of Pattern of Medico-Legal Cases in the Casualty of a Teaching Hospital of Western Region of Nepal. J Indian Acad Forensic Med.2015; 37(1):46-9.
9. Trangadia MM, Mehta RA, Rada NH, Gupta BD. Profile of medico-legal cases in tertiary care hospital in Jamnagar, Gujarat: Retrospective study of one year. J Res Med Dent Sci.2014; 2(4): 57-62.
10. Yatoo GH, Jalali S, Malik A, Khan A. Profile and pattern of medico-legal cases attending tertiary care hospital in North India. Int J Med Pharm Sci. 2015; 5(5): 1-8.
11. Malik Y, Chawla R, Sharma G, Malik P, Singh R, Tripathi A. Profile of Medico-legal Cases in Casualty of a Rural Medical College of Haryana. J Indian Acad Forensic Med. 2013; 35 (4):367-8.
12. Hussaini SN, Kulkarni CS, Batra AK. Profile of Medico-Legal; cases coming to Casualty of Government Medical College, Akola. J Forensic Med Sci Law. 2013; 22(2).
13. Yadav A, Singh NK. Pattern of Medico-legal Cases in rural Area of Faridabad, Haryana. J Indian Acad Forensic Med. 2013; 35 (1):60-2.
14. Jagtap N, Patekar MB. Study on Pattern of Medicolegal Cases in Casualty of Government Medical College Kolhapur Maharashtra. IP Int J Forensic Med Toxicol Sci 2021; 6(3):75-77.
15. Deokar RB, Patil SS. Violence Against Doctors: Prevention, Administrative and Legal Recourse. J Forensic Med Sci Law 2023;32(1):1-3.
16. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research - Ethical aspects. J Forensic Med Sci Law. 2024;33(1):1-4. doi: 10.59988/jfmsl.vol.33issue1.1
17. Romana M, Iff A, Farah R, Maqbool A. Medico Legal Cases at Tertiary Care Hospital, Rawalpindi. Pak J Med Sci. 2017; 33(4): 926–930.
18. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law 2023;32(2):1-3.
19. Patil SS, Deokar RB, Dere RC. Forensic Nursing: A Review of its Evolution and Scope with Special Reference to India. J Forensic Med Sci Law. 2025;34(1):50-54. doi: 10.59988/jfmsl.vol.34issue1.10
20. Rautji R, Dingre N, Karmarkar M, Deshpande K. Legally Safe Medical Documentation: Ensuring Compliance and Patient Protection. J Forensic Med Sci Law. 2024;33(2):79-81. doi: 10.59988/jfmsl.vol.33issue2.14

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Original Research Article

Histopathological Features of Abrasions- An Autopsy Study

Shailesh C Mohite[a], Prasad V Bhatanglikar[b], Vinaya B Shah[c*], Sneha P Janjal[d]
[a]Dean, [b]Former Resident, FMT; TNMC, Mumbai, Maharashtra, India. [c]Professor (Additional), [d]Assistant Professor; Pathology, HBTMC & Dr Cooper Hospital, Mumbai, Maharashtra, India.

Article Info

Received on: 12.12.2024
Accepted on: 01.11.2025

Key words
Abrasions,
Trauma,
Wound,
Histopathology,
Post-Mortem.

Abstract

Background: The extent of skin injury can range from an abrasion to more serious situations like laceration. Because of the uncertain and variable results of the naked eye examination of the wound it is important to study these injuries microscopically. **Materials and Methods:** A prospective 2 years study was carried out consisting of 104 cases with abrasions which were examined from the deceased along with control skin samples at the mortuary of the Medical College and Hospital run by Municipal Corporation of Greater Mumbai, Maharashtra. **Results:** Out of 104 cases, railway accident cases (n=52, 50%) were the highest. Males (n=93) were affected more than females (n=11). Younger age group was affected more (21-30 years and 30-40 years age group). The average duration for the formation of reddish brown scab is within a range of 6-48 hours. Neutrophilic infiltration increases from 1 hour and reaches peak (n=30, 28.84 %) in 24-30 hours. Mononuclear cells infiltration reaches peak (n= 17, 16.34 %) at 36-72 hours. Twelve cases out of 104 showed presence of mast cells and majority of the cases (n=6) were in 5 days duration group. Fibrosis was seen in 21 cases and majority of the cases (n=15) were seen in 5 days duration group. **Conclusion:** Even though the gross appearance provides an approximate age of wound, histopathology remains the mainstay for the definitive diagnosis. Hence, the importance of microscopic examination of wounds cannot be over emphasized and is very helpful in the administration of medico legal cases.

1. Introduction

The history of trauma parallels the history of the evolution of man. With his aggressive instincts, creative ability and endless ambition to conquer the environment without any regards to the price he has to pay to achieve his goals.

The term trauma refers to an injury inflicted by force on a living tissue. It also applies to emotional and mental stress that results into a disorganized psychic or behavioural state.[1] Literally, the word trauma means a deeply distressing or disturbing experience, emotional shock following a stressful event or a physical injury, which may be associated with physical shock, and sometimes, leads to long-term neurosis. The origin of the word trauma is from the Greek word, which means 'wound'. The word 'injury' means an instance of being injured, or the fact of being injured, or harmed or damage.[1] Indian Penal Code (IPC) (Section 44) has defined injury as any harm, whatever illegally caused to any person

How to cite this article: Mohite SC, Bhatanglikar PV, Shah VB, Janjal SP. Histopathological Features of Abrasions- An Autopsy Study. J Forensic Med Sci Law. 2025;34(2):28-34. doi: 10.59988/jfmsl.vol.34issue2.6

***Corresponding author:** Dr. Vinaya B Shah. Professor (Additional), Department of Pathology, H.B.T Medical College and Dr. R. N Cooper hospital, Mumbai. (M): +91- 9869058584. Email: vinayabshah@gmail.com

in body, mind, reputation or property. Section no 319 of IPC states that a person is guilty of causing 'hurt' whoever causes bodily pain, disease or any infirmity to any person. Hence, hurt or injury can be caused without causing any wound but wound will invariably cause hurt and injury.

The forensic aspect of trauma deals with an accurate description of injury, assessment of its severity and its interpretation in relation to the law in force at the time.[1] It is a challenging task for investigating agency to reveal the mystery and for judiciary to award a deterrent sentence to the guilty. The circumstances become more complex when such exercise also involves socio-economic factors in addition to medico legal components of the case.[2] In a case of death by physical violence there is always one major point to be determined by the forensic pathologist: whether the injuries were inflicted before death (ante mortem) or after it (post mortem).[3] For the reconstruction of events, it is important to time the wound which means to estimate the interval between trauma and death.[3]

Like any other body part, skin is also affected by injury. The extent of injury can range from an abrasion to more serious situations like laceration. Loss of integrity of large portion of the skin may lead to major disabilty or even death. Because of the uncertain and variable results of the naked eye examination of the wound it is important to study these injuries microscopically. In forensic practice, it is necessary to evaluate the causal relationship between death and any wound.[4] In this study we have attempted to examine the histopathology of the abrasions at different time intervals with the help of special stains.

2. Materials and methods

This two years prospective study was carried out on the dead bodies with well demarcated injury and were received for medico legal autopsy at the mortuary of the Medical College and Hospital run by Municipal Corporation of Greater Mumbai, Maharashtra.

Inclusion Criteria: It includes the cases in which the time of infliction of the injury is known.

Exclusion Criteria:

1. Cases where the injuries are infected.
2. Cases suffering from other associated debilitating diseases and chronic illness like diabetes, peripheral vascular diseases, and septicemia.
3. Decomposed bodies.

A total of 104 cases with abrasions were examined from the deceased along with control skin samples. The history regarding causation of wounds and survival period was taken from the police, the relatives and the hospital records. For the study, after recording all general particulars of the deceased, gross examination of the abrasion was done and photograph of that abrasion was taken for record. Skin sample of size 2cm X 1cm X 0.5 cm from the site of abrasion and a sample of normal skin from the site of central incision made during the medico legal autopsy was taken and preserved in 10% formalin for histopathological examination. The time limit for medico legal autopsies varies with circumstances related with the case and it has been performed at the earliest after obtaining required documents (i.e. inquest report, statement of relatives etc.) from the investigating officer of the case. The abrasions were grouped into three different time intervals:

1. Injuries up to 2 days of survival: they are further divided into interval of 6 hours, from 0 to 48 hours.
2. Injuries of duration 2-5 days of survival: they are further divided into time interval of 24 hour.
3. Injuries of duration more than 5 days of survival.

The abrasions were categorized into the above mentioned groups with the help of a colorimetric scale NNDV (Nuzzolese, Neri, Di Vella).

Fixation and staining: The tissues were kept for 24 hrs in the 10 % neutral buffered formalin for fixation. The paraffin blocks were made and 5 micron thick sections were cut by microtome as per the standard technique. They were then stained with Haematoxylin and Eosin, Van Gieson's connective tissue stain, Toluidine blue stain techniques. The control sections were also subjected to the same procedure and techniques.

3. Results

In the present study the maximum number of cases were observed in the survival period of 0-6 hrs (n=60, 57.69%) followed by the survival period of > 5 days (n=17, 16.34 %). The minimum number of cases were observed in the survival period of two to three days (n=3, 2.88 %) and two cases (1.92 %) in 24-30 hrs. Out of 104 cases, railway accident cases (n=52, 50%) were highest followed by road traffic accident cases (RTA, n=34, 32.69 %). Fall from the height cases were 13 (12.5%). Hanging and building collapse cases were 2 (1.92%) while one case was of physical assault (0.96%). **Table no 1 and 2** give a detailed distribution of cases in relation with different survival time and

cause wise distribution of abrasions respectively. It was observed that the number of cases involving the males (n=93, 89.42%) were more than females (n=11, 10.57%) and the maximum number of cases were observed in the age group of 21-30 years (n=37, 35.57%) followed by the age group of 31-40 years (n=24, 23.07%). The minimum number of cases were observed in the age group of less than ten years (n=2, 1.92%). **Table no 3** describe age group wise distribution of cases.

Table no 1: Distribution of total cases according to the survival time.

Sr.no	Survival Time	Total	Percentage (%)
1	0-6 hrs	60	57.69
2	6-12 hrs	7	6.73
3	12-18 hrs	1	0.96
4	24-30 hrs	2	1.92
5	30-36 hrs	1	0.96
6	36-42 hrs	1	0.96
7	42-48 hrs	1	0.96
8	2-3 days	3	2.88
9	3-4 days	5	4.8
10	4-5 days	6	5.76
11	>5 days	17	16.34
Total		104	100

Table no 2: Cause wise distribution of cases.

Sr. No	Cause of Abrasion	No of Cases	Percentage (%)
1	Railway accident	52	50
2	Road traffic accident	34	32.69
3	Fall from height	13	12.5
4	Physical assault	1	0.96
5	Hanging	2	1.92
6	Building collapse	2	1.92
Total		104	100

Table no 3: Showing age wise distribution of cases.

Age group (years)	Number of cases	Percentage (%)
<10	2	1.92
11-20	7	6.73
21-30	37	35.57
31-40	24	23.07
41-50	14	13.46
51-60	12	11.53
61-70	4	3.84
>71	4	3.84
Total	104	100

Out of 104 cases, 60 cases which were in 0-6 hrs duration, of which abrasions in 53 cases (88.34%) were reddish in colour with bleeding and oozing and in seven cases (11.66 %) they showed reddish brown scab with dried blood. Seven out of 104 cases (6.73%) which were observed in 6-12 hrs duration group, abrasions in four cases (57.14%) were reddish in colour with oozing and slight bleeding, while in three cases (42.86%) they showed reddish brown scab with dried blood. One case (0.96%) was observed in 12-18 hrs duration group and abrasion in that case (100%) showed reddish brown scab with dried blood.

Figure 1: A) Skin with mild inflammatory infiltrate with few mast cells (H&E 40x). B) and C) Toluidine blue highlighting the mast cells with magenta granules within cytoplasm (0-6 hours). D) Skin with dense fibrosis (H&E, 40x) E) EVG stain highlighting the fibrosis (beyond 5 to 7 days), inset showing fibrous band, brown in colour.

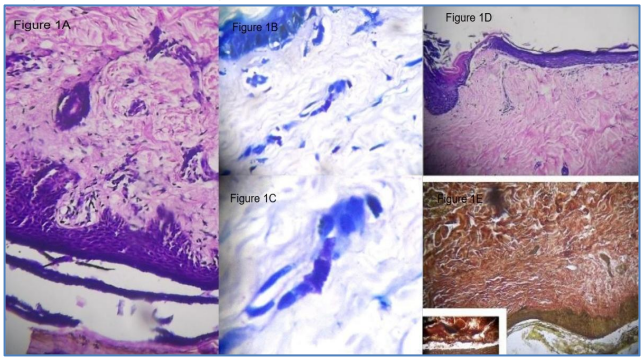
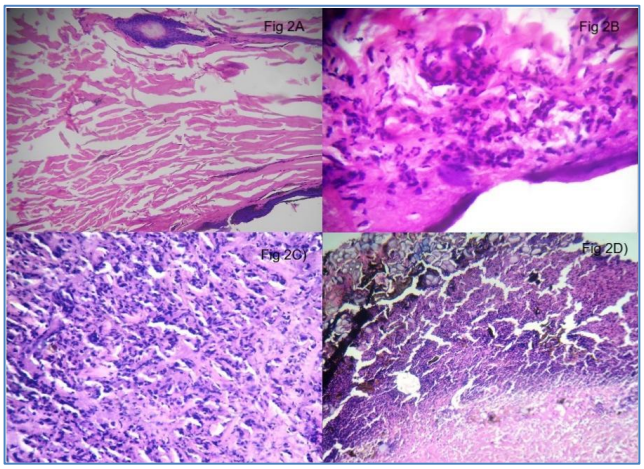


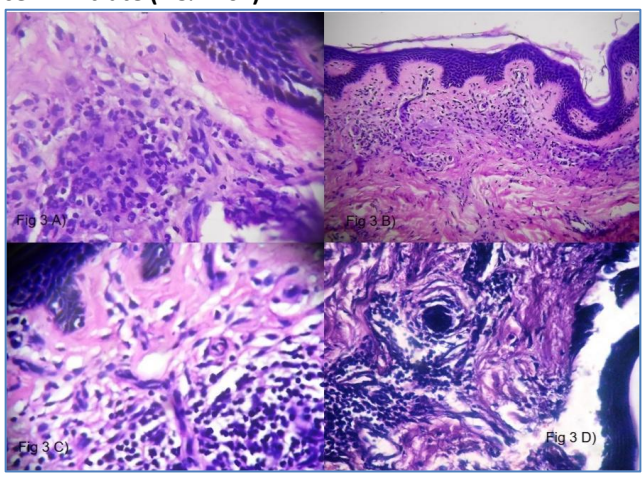
Figure 2: A) Skin with denuded epithelium with no inflammatory infiltrate (0-1 hour) H&E 40x. B) Skin with focal ulceration and underlying neutrophils (6-12 hours) H&E 40x. C) Moderate infilttration of neutrophils (12-24 hours) H&E 40x. D) Ulcerated skin with severe neutrophils admixed with extraneous material (24-30 hours) H&E 40x.



In 30-36 hrs, 36-42 hrs and 42-48 hrs duration group only one case (0.96%) was observed and abrasions in all these three groups (100%) showed reddish brown scab with dried blood. Out of three (2.88%) cases observed in 2-3 days duration group, abrasions in all the cases (100%) showed hard, brown scab. Out of five cases (4.8%) observed in 3-4 days duration group, abrasion in one case (20%) showed hard, brown scab, in two cases (40%) they showed hard brownish black scab and in two (40%) cases they showed partial shedding of the scab. Out of six cases (5.76%) observed in four to five days duration group, abrasion in one case (16.7%) showed hard, brown scab, in two cases (33.3%) they showed hard,

brownish black scab and in three cases (50%) they showed partial shedding of the scab. Out of 17 cases (16.34%) observed in more than five days duration group, abrasion in three cases (17.64%) showed hard black scab, in three cases (17.64%) they showed partial shedding of the scab, in four cases (23.52%) they showed complete shedding of the scab and in seven cases (41.17%) they showed depigmented skin.

Figure 3: A) Skin with underlying mixed inflammatory infiltrate (H&E 40x) B) Skin with mild mononuclear cell infiltrate (H&E 40x) C) Skin with moderate mononuclear cell infiltrate (H&E 40x) D) Skin with severe mononuclear cell infiltrate (H&E 40x)



Microscopically findings are shown in **Fig. 1-3**. Microscopically, hemorrhage was observed in 16 (15.38%) out of 104 cases. Out of 16 cases, 11 cases (10.57%) were observed in 0-6 hrs duration group, three cases (2.88%) were observed in 6-12 hrs duration group, one case each (0.96%) was observed in 42-48 hrs duration group and 4-5 days duration group. The presence of hemorrhage was probably due to bleeding and oozing in the abrasions within a range of 0-12 hrs of survival time period. Two cases (1.92%) which were observed beyond 42 hrs of survival time period also showed hemorrhage. Thus, the removal of scab could explain the presence of hemorrhage on microscopy.

In the present study, neutrophils were observed in 30 out of 60 cases (50%) in 0-6 hrs duration group, and thereafter in all the cases up to 5 days duration. The remaining 30 cases showed denudation of epithelium with no inflammation. The abrasions in these cases were in less than 60 minutes. The neutrophils were observed in all 17 cases (100%) of more than five days duration group. In the present study, mononuclear cells (MNC) were not observed in all 60 cases in 0-6 hrs duration group. They were observed in all 7 cases (100%) in 6-12 hrs duration group, one case (100%) in 12-18 hrs group duration group and thereafter in all cases up to 5 days. They were observed in all 17 cases (100%) in more than 5 days duration group. Table no 7 gives the distribution of MNCs (mild, moderate and severe) according to the time interval.

Out of 104 cases, fibrosis was seen in 21 cases (20.19%). Out of these 21 cases, 15 cases (14.42%) were observed in more than five days duration group and three cases (2.88%) in 4-5 days duration groups. Two cases (1.92%) were observed in 3-4 days duration group and one case (0.96%) was observed in 2-3 days duration group. Mast cells were seen in 12 cases (11.53%). Six out of these 12 cases (5.76%), were observed in more than five days duration group. Two cases (1.92%) were observed in the survival period of 3-4 days while one case each (0.96%) was observed in survival period of 0-6 hrs, 6-12 hrs, 36-42 hrs and in 4-5 days.

In the present study, time range for the appearance of physical and microscopic inflammatory changes in abrasions were as follows. Bleeding was observed only during 0-6 hrs duration. Oozing was observed during 0-12 hrs and maximum abrasions showed oozing during 0-6 hrs. Dried blood was observed during 6-48 hrs, maximum abrasions showed dried blood during 12-18 hrs. Reddish colored abrasions with bleeding and oozing were observed from 0-12 hrs. Reddish brown scab with dried blood was observed from 6-48 hrs. Hard brown scab was observed from 2-5 days and hard brownish black scab was observed from 3-5 days. Hard black scab was observed from fifth day onwards. Partial shedding was observed from 3-4 days. Complete shedding was observed from 6-7 days onwards. Depigmented skin was observed from seventh day onwards.

Mild polymorphic infiltration was observed from 1-2 hours, which became severe in 24-30 hrs and then started decreasing from 30-36 hrs up to 48 hrs. Mononuclear cells infiltration appeared at 6-12 hrs. Moderate increase in mononuclear cells count was observed at 12-18 hrs. Significant increase in mononuclear cells count was observed at 36-48 hrs and remains as plateau in 2-3 days. They started decreasing from third day till fifth to seventh day. Collagen started appearing after 48 hrs onwards of infliction of injury and becomes dense beyond 5-7 days. Mast cell degranulation was observed at 0-6 hrs.

4. Discussion

In the present study, maximum number of cases were observed in 0-6 hours duration group (n=60, 57.69%). This is similar to a study conducted by Vinay et al in which 40 cases were in 0-12 hours duration.[5] Railway accident cases were highest (n=52, 50%) followed by RTA, (n=34, 32.69%). This is because local trains are most commonly used by the commuter for transport in metropolitan cities. Also, increasing population, overcrowding, poorly maintained roads, breaking traffic rules and lack of awareness among the people add to this. Study conducted by Vinay et al, found that RTA constituted majority of cases (89 cases out of 101, 75.4%), 10 cases due to fall from height and one case each due to railway injury and assault.[5]

Number of cases involving the males were more than females. This observation is consistent with Sandhu SS et al and Vinay et al.[5,6,7] Sandhu et al found that out of 150 cases, 129 were males (86%) and 21 were females (14%).[6] Vinay et al found that 89 cases (88.1%) were males and 12 cases (11.9 %) were females.[5] This is mainly due to Male: Female ratio in our country. In most of the families, males only are the source of income. Lack of education among females and more aggressive behaviour among males also contribute to this. The maximum number of cases were observed in the age group of 21-30 years (n=37, 35.57%) followed by the age group of 31-40 years (n=24, 23.07%). This observation is consistent with the study of Sandhu SS et al and Vinay et al.[5,6] Sandhu SS et al found that maximum cases (n=62%, 41.34%) were in 21-30 years followed by 31-40 years (n=36, 24%) age group.[6] Vinay et al found 51 cases in the age group of 21-40 years.[5] The reason behind this is that the younger age group is more energetic, earning hands in most families and thus prone to injuries. Other factors include changing lifestyle, ambitious behaviour and extreme level of competition.

a. Gross:

In the present study, bleeding was observed in 0-6 hours and oozing in 0-12 hours. These observations are consistent with the findings in the textbook of Nandy A, Mukherjee JB, Rao N, Vij K, Reddy KSN, Sandhu SS et al, Sharma et al and not consistent with the study of Kumar L et al.[6, 8-14] In the present study, dried blood was observed during 6-48 hours but maximum abrasions showed dried blood during 12-18 hours. This is consistent with the finding in the textbook of Mukherjee JB, Rao N, Vij K, Reddy KSN and study of Sandhu SS et al.[6, 9-12] In the present study, reddish coloured abrasions were observed from 0-12 hours, maximum abrasions showed reddish coloured abrasion during 0-6 hours. These observations are consistent with findings in the textbook of Nandy A, Modi JP, Mukherjee JB, Dikshit PC, Vij K and study of Sandhu SS et al, Sharma et al and not consistent with the findings in the textbook of Pillay VV, Rao N, Reddy KSN and study of Kumar L et al.[6,8-18]

Reddish brown scab with dried blood was observed from 6-48 hours, maximum abrasions showed reddish brown scab with dried blood during 18-48 hours. These observations are consistent with the findings in the textbook of Rao N, Bardale R and study of Sandhu SS et al.[6, 10, 18] Hard, brown scab was observed from 2-5 days, maximum abrasions showed hard brow scab during 2-3 days. These observations are consistent with the findings in the textbook of Nandy A, Modi JP, Dikshit PC, Rao N, Sharma et al, Vij K, Bardale R, Reddy KSN and not consistent with the findings in the textbook of Mukherjee JB and Kumar L et al.[8-16, 18] Hard, black scab was observed from the fifth day onwards, maximum abrasions showed hard black scab during 5-6 days. These observations are consistent with findings in the textbook of Nandy A, Dikshit PC, Vij K, Bardale R, Reddy KSN and not consistent with the findings in the textbook of Pillay VV and Kumar L et al.[8, 11, 12, 14, 16-18]

In the present study, partial shedding was observed from 3-4 days onwards, maximum abrasions showed partial shedding on 5-7 days. These observations are consistent with the findings in the textbook of Nandy A, Modi JP, Mukherjee JB, Parikh CK, Dikshit PC, Vij K, Bardale R, Reddy KSN and study of Sandhu SS et al, Sharma et al and not consistent with the study of Kumar L et al.[6,8,9. 11-16,18] Complete shedding was observed from 6-7 days onwards, maximum abrasions showed complete shedding on 7-8 days. These observations are consistent with the findings in the textbook of Mukherjee JB, Pillay VV, Vij K, Bardale R, Reddy KSN and study of Sandhu SS et al and not consistent with the study of Kumar L et al.[6, 9, 11, 12,14,17,18] In the present study, depigmented skin was observed from seventh day onwards, maximum abrasions showed depigmented skin during 7-10 days. These observations are consistent with the findings in the textbook of Nandy A, Mukerjee JB, Dikshit PC, Pillay VV, Vij K, Bardale R, Reddy KSN and study of Sandhu SS et al and not consistent with the study of Kumar L et al.[6, 8, 9. 11, 12, 14, 16-18]

b. Microscopy:

In the present study, neutrophils started appearing from first hour but appreciable number of neutrophils appeared from 6-12 hours which is consistent with findings of Robertson I and Hodge PR, Mukherjee JB, Pillay VV, Vij K, Bardale R, Reddy KSN and study of Sharma et al.[9,11-13,17-19] Significant increase in the number of neutrophils was seen in 24-30 hours which is consistent with the findings of Dann L, Glucksmann A and Tansley K, Vizian CB and Matoltsy AG, Vij K and not consistent with findings of Robertson I and Hodge PR, Bardale R and Reddy KSN as they observed this at 4-12 hours.[11, 12, 18-21] In the present study, mononuclear cells were observed in 6-12 hours which is consistent with the findings of Mukherjee JB, Dikshit PC, Sharma et al, Bardale R, Reddy KSN and not consistent with the findings Vij K as they observed this at 24-48 hours.[9,11-13,16,18]

In the present study, it was observed that the number of mononuclear cells increased significantly at 48 hours. This is consistent with the findings of Vij K, Sharma et al and not consistent with the findings of Bardale R and Reddy KSN as they observed this at 12-24 hours.[11-13,18] Special stain Toluidine blue is a basic thiazine metachromatic stain with a high affinity for acidic tissue components. It is used to enhance the visualization of subtle injuries, particuarly abrasions, that may not be easily detectable to the naked eye. When applied to tissue samples, toluidine blue selectively binds to nucleic acids in damaged cells. This binding highlights areas of cell injury, making abrasions more visible, under microscopic examination. Toluidine blue was used to stain mast cells (the mast cells were observed as metachromatic pink coloured cells with blue background). The mast cell degranulation was observed from 35 minutes i.e 0-6 hours of infliction of abrasion which was consistent with the findings of Reddy KSN and Sharma et al.[12, 13]

Elastic van Gieson (EVG) stain combines two dyes: Elastic fibers are stained black or dark brown. Collagen fibers are stained red or pink. This staining pattern allows for the detailed examination of tissue architecture and the identification of structural disruptions caused by trauma such as abrasions. EVG stain when applied to abrasion samples highlights disruption of elastic and collagen fibers in the dermis, indicating extent of tissue damage. In our study, tissue sections stained with EVG stain highlighted collagen fibres as red too brown fibres. In the present study, collagen formation was observed by 2-3 days (48 hours onwards) and it became dense beyond 5-7 days. This is consistent with the findings of Vij K, Bardale R, Reddy KSN, Sharma et al and not consistent with Dann L, Glucksman A and Tanlsey K, Robertson I and Hodge PR as they observed collagen formation by the fifth day.[11-13, 18, 20] The histopathological changes will be helpful to measure the age of abrasion more accurately, but further research is needed. Also, using the artificial intelligence there are future scope for research & innovation.[22-25]

5. Conclusion:

There are various factors influencing the healing of wounds like nutrition status and immunity of individual, presence of comorbidities, infection and age. Routinely, the age of wound is calculated using the available information from the textbooks and existing literature. Also, there is always some sort of observer variation. Even though the gross appearance provides an approximate age of wound, histopathology remains the mainstay for the definitive diagnosis. Hence, the importance of microscopic examination of wounds cannot be over emphasized and is very helpful in the administration of medico legal cases. Also, further studies with larger sample sizes along with Immunohistochemistry will surely help in improving wound dating accuracy.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

Source of funding: None to declare.

References:

1. Dogra TD, Rudra A. Lyon's Medical Jurisprudence and Toxicology: Laws. 11th ed. Delhi: Law House, Delhi; 2005.
2. Prajapati P., Sheikh MI, Patel S. A study of homicidal deaths by mechanical injuries in Surat, Gujrat. J Indian Acad Forensic Med. 2010; 32(2):134-8
3. Tedeschi CG, Tedeschi LG, Eckert WG, editors. Forensic Medicine: Environmental hazards. Philadelphia, United States of America: W B Saunders Co; 1977.
4. Singer AJ, Clark RA. Cutaneous wound healing. N Engl J Med. 1999; 341(10):738-46. doi: 10.1056/NEJM199909023411006.
5. Vinay J, Harish S, Mangala GSR, Hugar BS. A Study on Postmortem Wound Dating by Gross and Histopathological Examination of Abrasions. Am J Forensic Med Pathol. 2017; 38(2):167-73.

6. Sandhu SS, Gorea RK, Gargi J, Garg A. Age estimation of injury from abrasion- A clinical study from north India. J Punjab Acad Forensic Med Toxicol. 2009; 9: 76–80.
7. Kumar DA, Ghormade P, Akhade S, Sarma B. Analysis of Injury Characteristics in Victims of Interpersonal Violence: Clinical Forensic Medicine Unit Perspective in a Tertiary Care Centre. J Forensic Med Sci Law. 2023; 32(2):4-8.
8. Nandy A. Mechanical Injuries. In: Principles of Forensic Medicine including Toxicology. 3rd ed. Howrah: New Central Book Agency (P) Ltd; 2014 (Reprint). p. 340-6
9. Mukherjee JB. Forensic Medicine and Toxicology by Karmakar RN. 5th ed. Kolkata: Academic Publishers; 2015. pp no 226-31.
10. Rao NG. Trauma, Injury and Wound. In: Textbook of Forensic Medicine & Toxicology. 2nd ed. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.; 2012 (Reprint). p. 222-4
11. Vij K. Injuries by blunt force. In: Textbook of Forensic Medicine and Toxicology Principles and Practice. 3rd ed. New Delhi: Elsevier; 2005 (Reprint). pp no 326-31.
12. Reddy KSN, Murty OP. Mechanical Injuries. In: The Essential of Forensic Medicine and Toxicology. 35th ed. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd; 2022. pp no. 133-7.
13. Sharma A, Dikshit PC, Aggrawal A, Mandal AK. A postmortem study of histopathological findings to determine the age of abrasion and laceration. J. Forensic Med Toxicol. 2010; 27(1):43-6.
14. Kumar L, BV C, Agarwal SS, Bastia BK. Age Related Changes in Mechanical and Thermal Injuries-A Post Mortem Study. J Indian Acad Forensic Med. 2011; 33(2):55-7.
15. Modi JP. Injuries by Mechanical Violence. In: Kannan JK, editor. A textbook of Medical Jurisprudence and Toxicology. 25th ed. Gurgaon: LexisNexis; 2016. pp no. 593-7
16. Dikshit PC. Mechanical Injuries. Textbook of Forensic Medicine and Toxicology. 2nd ed. New Delhi: Peepee Publisher; 2014. pp no. 163-8, 178-9.
17. Pillay VV. Modern Medical Toxicology. 4th ed. India: Jaypee Brothers Medical Publishers (P) Ltd; 2023. pp no. 151-4.
18. Bardale R. Principles of Forensic Medicine and Toxicology. 3rd ed. India: Jaypee Brothers Medical Publishers (P) ltd; 2011.
19. Robertson I, Hodge PR. Histopathology of healing abrasions. Forensic Sci. 1972; 1(1):17-25. doi: 10.1016/0300-9432(72)90145-8.
20. Dann L, Glücksmann A, Tansley K. The Healing of Experimental Wounds Treated with Epicutan. Br J Exp Pathol. 1941; 22(2):70–5.
21. Matoltsy AG, Viziam CB. Further observations on epithelialization of small wounds. J. Invest. Dermatol. 1970; 55(1):20-5.
22. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research - Ethical aspects. J Forensic Med Sci Law. 2024;33(1):1-4. doi: 10.59988/jfmsl.vol.33issue1.1
23. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law 2023;32(2):1-3.
24. Varma NM, Pawar MN, Deokar RB. Executive Summary of the Forensicon 2022 - 25th Annual State Conference of Medicolegal Association of Maharashtra (MLAM). J Forensic Med Sci Law 2023;32(2):80-84.
25. Mohite S, Sukhdeve R, Sonawane S, Deokar R, Kolle S, Hinnawi S. Executive Summary of the XXVI Annual State Conference of Medicolegal Association of Maharashtra (MLAM) - Forensicon 2023. J Forensic Med Sci Law. 2024;33(2):73-78. doi: 10.59988/jfmsl.vol.33issue2.13

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Original Research Article

Clinicopathological Alterations in Oral Tissues Following Pesticide Poisoning: An Autopsy-Based Evaluation

Vidya M[a], Shweta Kumbhojkar[b*], Punnya Angadi[c], Dhivagar K[d]
[a]Postgraduate, [b]Reader, [c]Professor, Department of Oral Pathology, KLE Vishwanath Katti Institute of Dental Sciences, KAHER, Belagavi, Karnataka, India. [d]Assistant Professor, Department of Forensic Medicine & Toxicology, The Oxford Medical College, Hospital & Research Centre, Attibelle, Bengaluru, Karnataka, India.

Article Info

Received on: 18.10.2025
Accepted on: 04.11.2025

Key words
Pesticide poisoning, Postmortem changes, Oral manifestations, Histopathology, Degenerative changes.

Abstract

Introduction: Pesticide poisoning remains a major public health issue, especially in developing countries like India, where it accounts for 95% of fatal poisoning cases. According to the WHO, pesticides are the most common means of suicide, with millions of incidents reported annually. Both suicidal and homicidal incidents are worsened by easy access and low cost. The oral cavity is crucial to forensic investigations since oral intake is the most frequent exposure route. **Materials & methods:** This cross-sectional study evaluated clinical and histopathological changes in oral tissues caused by pesticide ingestion. Autopsied tissues of gingiva (n=22) and tongue (n=19) from pesticide-ingested deaths were compared with 10 control samples. **Results:** Gingiva showed statistically significant changes in epithelium (p value= 0.027) and connective tissue (p value= 0.003) with prominent degenerative changes. Clinically, aluminium phosphide and paraquat showed severe tissue alterations in the oral cavity. Notably, this is the first study to examine the postmortem histopathological changes of pesticide poisoning in gingiva. **Conclusion:** As the gingiva shows significant changes and it is easily accessible, it could be the tissue assessed for identifying toxic pesticide poisons. Oral autopsy is a vital forensic technique in medico-legal investigations for determining the cause of death in cases of insufficient body retrieval.

1. Introduction

Forensic Poisoning has emerged as a major non-communicable disease epidemic in the 21st century.[1] Pesticide poisoning, in particular, is a significant cause of morbidity and mortality, especially in developing countries.[2,3] In India, where nearly 75% of the population is engaged in agriculture, pesticide poisoning accounts for approximately 95% of poisoning-related fatalities.[3,4] According to World Health Organization estimates in 2020, pesticides remain the most common method of suicide worldwide, with an estimated 385 million cases of unintentional acute pesticide poisoning occurring annually, resulting in nearly 11,000 deaths.[5] Overall, poisoning constitutes 63% of all toxic exposures, affecting 65% of adults and 22% of pediatric cases.[6]

How to cite this article: Vidya M, Kumbhojkar S, Angadi P, Dhivagar K. Clinicopathological Alterations in Oral Tissues Following Pesticide Poisoning: An Autopsy-Based Evaluation. J Forensic Med Sci Law. 2025;34(2):35-42. doi: 10.59988/jfmsl.vol.34issue2.7

***Corresponding author:** Dr Shweta Kumbhojkar, Reader, Department of Oral Pathology, KLE Vishwanath Katti Institute of Dental Sciences, KAHER, Belagavi, Karnataka, India. Email ID: shwetavinayakkumbhojkar@gmail.com (M): +91- 9986794845.

Poisoning has become a prevalent non-communicable disease epidemic in the 21st century.[1] Pesticide Action Network (PAN) India, in a report released in March 2024, stated that 339 pesticide actives are registered under India's Insecticides Act, 1968, of which approximately 100 are herbicides (about 30%), and 118 are classified as Highly Hazardous Pesticides (HHPs).[7] n India, the most prevalent pesticides associated with deadly outcomes were organophosphates, aluminium phosphide, and paraquat. Oral ingestion is the most common route of pesticide exposure, followed by inhalation and skin contact.[8] Pesticide poisoning was previously accidental, but its widespread availability, low cost, and unrestricted sale have led to a rise in suicidal and homicidal incidents. Adolescents who attempt self-harm through ingestion tend to suffer more severe poisoning than young children, who are often exposed accidentally through ingestion, skin contact, or inhalation.[9,10]

The oral cavity is often regarded as a window to the body's internal changes, which reflects nearly all systemic variations resulting from disease, injury, or death.[11] Gingival tissue is one of the most accessible and structurally stable oral tissues, and its integrity during the early post-mortem period makes it particularly valuable for forensic assessment.[12] However, no previous study has explored its histological changes in pesticide-related deaths. Hence, the present study was undertaken to evaluate microscopic alterations in the gingiva, along with the tongue, in pesticide poisoning cases to aid in the forensic interpretation of the cause of death.

2. Materials and Methods

This cross-sectional study was conducted in the Department of Oral Maxillofacial Pathology and Oral Microbiology at KLE Vishwanath Katti Institute of Dental Sciences, in collaboration with the Department of Forensic Medicine & Toxicology at KLES, Dr. Prabhakar Kore Hospital & Medical Research Centre, after obtaining the approval from the institutional ethical committee. All fatal cases of pesticide poisoning, whether from deliberate or accidental ingestion, involving any age group or gender, that were brought to the Prabhakar Kore Hospital & Medical Research Centre between January and October 2024 were included in this study.

Study population: Regardless of age or gender, all deceased individuals with the history of poisoning consumption within a 15-hour period were included. Deaths from other causes and decomposing bodies were excluded. Deceased individuals, regardless of age or gender, who did not have a history of pesticide exposure provided the control samples.

Study group: Postmortem tissue samples were obtained from the deceased individuals with a history of pesticide ingestion (Gingiva; n=22, Tongue; n=19).

Control group: Postmortem tissue samples were collected from deceased individuals without a history of pesticide ingestion (n=10).

Consent: Those who met the qualifying requirements were only included in the study after their families gave their informed consent.

Data Retrieved from the Patient Charts and inquest forms: History regarding the type of pesticides and demographic details were retrieved from the patient charts. A total of 41 tissue samples - 22 from the gingiva and 19 from the tongue were analysed. The age of the individuals in the study group ranged from 15 months to 57 years, with a mean age of 30.75 ± 15.62 years, whereas the control group comprised individuals aged 18 to 55 years, with a mean age of 35.2 ± 10.6 years with a slight male predominance (56%). Organophosphorus compounds were the most common poison detected (63%), followed by paraquat (22%), zinc phosphide (5%), aluminium phosphide (5%), and Agroneem (5%).

Sample Collection: Photographs were taken both intra and extra orally prior to oral autopsy. Following this, tissue samples were collected from the gingiva & tongue. Samples were immediately preserved in formalin for 24 hours. Routine histopathological processing was done followed by Haematoxylin and Eosin (H & E) staining. No special stains or immunohistochemical (IHC) techniques were applied, as the study focused on general histopathological alterations. Three independent oral pathologists analysed the sections for the histopathological alterations in the study samples and control samples. To minimize observer bias, interobserver variability was addressed through the consensus method, wherein all three observers reviewed the slides collectively and arrived at a unanimous agreement on the final diagnosis and grading of histological features.

Clinical analysis: Extra and intraoral examinations were done to appreciate any changes that are induced by various pesticide poisons.

Histopathological analysis: The changes in the epithelium and connective tissue were assessed. Sequential analysis of the following histological

changes of the biopsies of all individuals were carried out as follows-

1. Epithelial changes
2. Shredding, Pseudoepitheliomatous Hyperplasia, Atrophy, Melanin, Intercellular Bridges.
   a. Cytoplasmic changes: Intracellular vacuolization, intracellular oedema, and intracellular oedema.
   b. Nuclear features: clumping of chromatin, presence/absence of distinct nuclear outline, karyolysis, pyknosis, karyorrhexis, vacuolation, and homogenization.
   c. Separation of epithelium and connective tissue.
3. Connective tissue changes
   a. Fibroblasts vacuolation, Shredding of fibres, Eosinophilia, Homogenisation, Presence of inflammation, Shrinkage.
4. Any other findings
   a. Degenerative changes of muscles, salivary gland, nerve tissues, blood vessels, adipose tissues.

The degree of histological changes in the post-mortem samples was correlated to various pesticide poisons. Data was tabulated in an Excel spreadsheet, followed by evaluation of Frequencies and percentages.

3. Results

On clinical examination, the oral cavity revealed various intraoral & extraoral manifestations due to consumption of pesticide poisons. Individuals who consumed paraquat had a necrotic ulceration on their lip with black eschar, bleeding, and external discoloration **(Fig. 1A).** Individuals with aluminium phosphide consumption exhibited a necrotic, discoloured, and ulcerated area along with the presence of sloughing, fibrosis, and tissue breakdown **(Fig. 1C).** Areas exhibiting mucosal blanching, especially on the labial mucosa, with a pale, fibrotic look, represent ischemic damage changes in people who consume zinc phosphide and organophosphorus compounds **(Fig. 1B & D).** Histopathological examination, analyzed for the postmortem changes induced by various pesticide poisons, showed prominent histopathological changes in epithelium, connective tissues, and their components in both gingiva and tongue samples compared to the controls.

Histopathological postmortem changes observed in gingiva due to pesticide ingestion: On examination, gingiva exhibited epithelial changes such as pseudoepitheliomatous hyperplasia, shredding **(Fig. 2A & B),** atrophy, prominent intercellular bridges, and melanin deposition in the basal layers of the epithelium. Intracellular vacuolization was observed in the cytoplasm. Likewise, nuclear changes such as clumping of chromatin, presence of distinct nuclear outline, karyolysis, pyknosis, karyorrhexis, vacuolation, homogenization, and melanin deposition are observed in the tissues of the gingiva **(Fig.2 C&D).**

Fig. 1A to D: Photomicrographs showing oral manifestations induced by various pesticide poisons. (A) Paraquat poisoning, (B) Organophosphorus poisoning, (C) Aluminium phosphide, (D) Zinc phosphide.

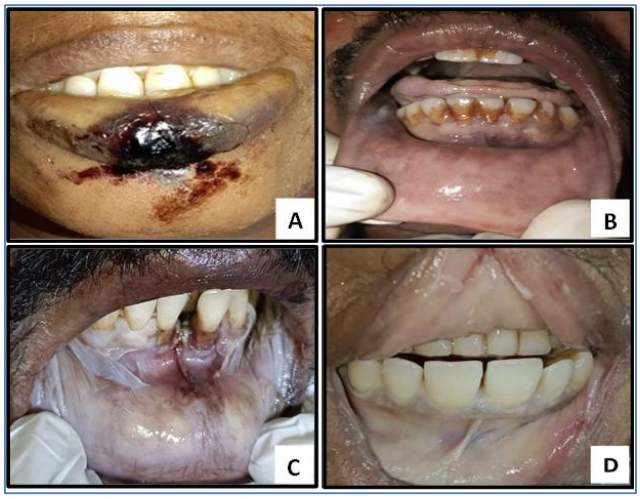
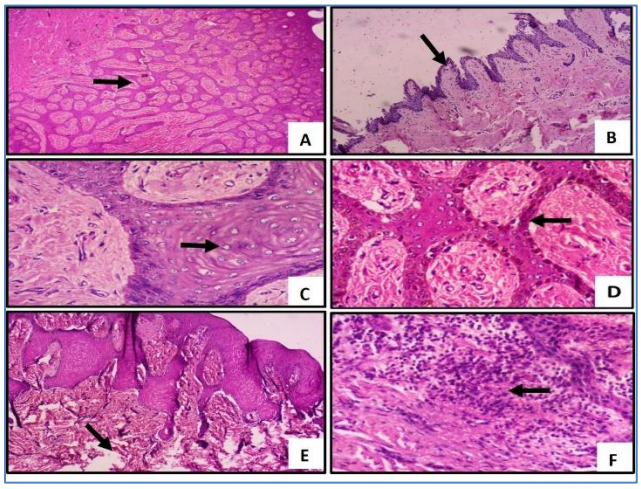


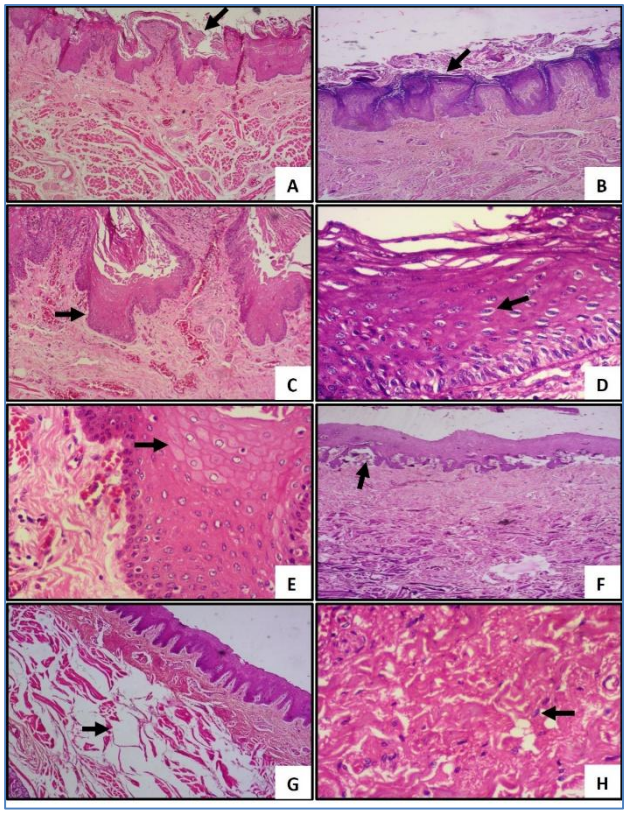
Fig. 2 A to F: Microscopic section of gingiva induced by pesticide poisons showing Pseudoepitheliomatous hyperplasia, Shredding (A&B). Cytoplasmic & Nuclear changes (C&D) Shredding of collagen fibres (E), Presence of inflammation (F).



Histopathological postmortem changes observed in the tongue due to pesticide ingestion: On examination, tongue exhibited almost similar histopathological changes compared to the gingiva. The epithelial changes include shredding, stripping **(Fig. 3A & B)**, pseudoepitheliomatous hyperplasia,

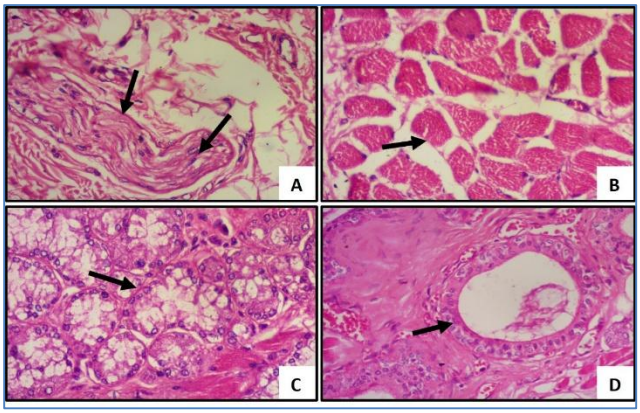
and prominent intercellular bridges **(Fig. 3C).** Cytoplasmic changes such as intracellular vacuolization, intracellular edema, & intercellular edema were observed in the cytoplasm. Likewise, nuclear changes such as clumping of chromatin, presence of distinct nuclear outline, karyolysis, pyknosis, karyorrhexis, vacuolation and homogenization were seen **(Fig.3D & E)**. Separation between epithelium & connective tissue **(Fig. 3F)** are also noted. In connective tissues, changes included shredding of collagen fibres **(Fig. 3G)**, vacuolization of fibroblasts **(Fig. 3H)**, embedding of the fibroblasts within the collagen fibers, eosinophilia, homogenization, and shrinkage along with chronic inflammation predominantly of lymphocytes.

Fig. 3 A to H: Microscopic section of tongue induced by pesticide poisons showing Stripping & Shredding of epithelium(A&B) pseudoepitheliomatous hyperplasia, prominent intercellular Bridges (C) Cytoplasmic changes & Nuclear changes (D & E) Separation between Epithelium & Connective tissue(F) Shredding of Connective tissue (G) vacuolisation of fibroblasts (H).



Degenerative changes observed in Connective tissue Components: Degenerative changes such as loss of architecture, vacuolization of the nucleus and cytoplasm of nerve fibers **(Fig. 4A)**, muscle fiber degeneration with loss of striations **(Fig. 4B)**, loss of architecture of the salivary gland acini along with vacuolization of acinar cells **(Fig. 4C).** Dilation of salivary ducts **(Fig. 4D)** and loss of architecture along with congestion & dilation of blood vessels were also noted. These changes were not found in control samples.

Fig. 4 A to D: Microscopic section of connective tissue components induced by pesticide poisons showing Degenerative changes such as loss of architecture, vacuolization of nucleus and cytoplasm of nerve fibers (Fig.4A), muscle fibres degeneration with loss of striations (Fig.4B), loss of architecture of the salivary gland acini along with vacuolisation of acinar cells (Fig.4C) Dilation of salivary ducts (Fig.4D).



However, on comparison with the control group, i.e., deceased individuals without a history of pesticide ingestion, gingiva samples showed statistically significant changes in both the epithelium (p= 0.027) and connective tissues (p = 0.003). Whereas, the tongue samples did not show many significant changes in epithelium and connective tissue compared to control samples but exhibited prominent degenerative changes in the connective tissue components **(Table 1).** An independent analysis was conducted to assess histopathological postmortem changes across various types of pesticide poisoning, aiming to determine the possibility of identifying specific pesticides. However, no statistically significant association was observed, possibly due to the unequal distribution of cases among the pesticide types **(Table 2).**

Statistical analysis: Statistical analysis was performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (frequency and percentage) were calculated, and group comparisons were done using the Chi-square test. A p-value < 0.05 was considered statistically significant. No correction for multiple comparisons was applied due to the limited number of comparisons. Three independent oral pathologists analysed the sections for histopathological alterations in both study and control samples. To minimize observer bias, interobserver variability was addressed through the

Table 1: Postmortem Histopathological Changes of Gingiva & Tongue in Pesticide Poisoning Cases. Note: F- Frequency, P – Percentage, X^2 - Chi-square, p – P value, *P<0.05 – Statistically significant.

Histological domain	Observed Changes	Gingiva				Tongue			
		Control Samples		Study Samples		Control Samples		Study Samples	
		F	P (%)	F	P (%)	F	P (%)	F	P (%)
1.Epithelium	Stripping	-	-	-	-	0	0	12	63.16
	Shredding	0	0	13	59.09	0	0	16	84.21
	Pseudoepitheliomatous hyperplasia	10	90	14	63.64	1	8	11	57.89
	Atrophy	0	0	8	36.36	0	0	11	57.89
	Melanin	6	55	18	81.82	-	-	-	-
	Intercellular Bridges	6	55	14	63.64	2	17	9	47.37
		X^2 - 10.90, p - 0.027*				X^2 - 3.315, p - 0.345			
2.Nucleus	Chromatin clumped	2	18	18	81.82	2	17	7	36.84
	Karyolysis	9	81	19	86.36	6	50	17	89.47
	Karyorrhexis	4	36	16	72.73	6	50	16	84.21
	Pyknosis	6	55	12	54.55	3	25	12	63.16
	Nuclear Outline	11	100	21	95.45	12	100	19	100.00
	Intracellular Vacuolization	8	72	17	77.27	7	58	11	57.89
	Intranuclear vacuolisation	-	-	-	-	7	58	15	78.95
	Homogenization	0	0	12	54.55	0	0	12	63.16
	Intercellular Edema	-	-	-	-	2	17	12	63.16
	Intracellular Edema	-	-	-	-	1	8	14	73.68
		X^2 - 9.98, p - 0.125				X^2 -9.024, p - 0.4349			
3.Separation of Epithelium &Connective Tissue		0	0	0	0	0	0	7	36.84
4.Connective Tissue	Fibroblast embedded within collagen fibres	2	18	19	86.36	-	-	-	-
	Vacuolization of fibroblast	6	55	12	54.55	5	42	17	89.47
	Shredding of Fibres	0	0	12	54.55	0	0	9	47.37
	Eosinophilia	0	0	4	18.18	0	0	7	36.84
	Homogenization	0	0	17	77.27	0	0	7	36.84
	Presence of inflammation	8	73	10	45.45	0	0	7	36.84
	Shrinkage of Connective tissue	0	0	14	63.64	0	0	9	47.37
		X^2 - 25.23, p - 0.003*				X^2 - 9.655, p - 0.085			
5. Any Other Findings	Muscles	-	-	-	-	4	33	14	73.68
	Salivary Gland	-	-	-	-	0	0	8	42.11
	Nerve Tissue	-	-	-	-	4	33	14	73.68
	Blood Vessels	-	-	-	-	4	33	18	94.74
	Adipose Tissue	-	-	-	-	1	8	9	47.37
		-				X^2 - 4.112, p - 0.390			

consensus method, wherein all three observers reviewed the slides collectively and arrived at a unanimous agreement on the final diagnosis and grading of histological features.

4. Discussion

This study underscores the importance of clinical and histopathological examination in evaluating postmortem changes due to pesticide ingestion. Our study is the first to examine the postmortem histopathological changes from autopsied tissue samples of gingiva with ingested pesticide poisoning. In cases of poisoning, post-mortem histopathological examinations are typically conducted on systemic organs such as the stomach, liver, and kidneys. These analyses help confirm the cause of death through qualitative and quantitative tests, as these organs are primarily involved in the absorption and elimination of the poison.[13]

However, in cases where only a partially recovered body is available, analysing systemic effects becomes challenging due to the loss of vital organs. In such situations, the oral cavity, being the first organ to come into direct contact with ingested poisons and one of the most protected areas, plays a crucial role. Histological examinations help assess tissue cell conditions and architecture, as exposure to chemicals or physical factors, including death, can lead to structural alterations in the tissues.[14]

Gingiva and tongue, being potential sources of tissue samples, were utilized for histopathological examination in individuals who had consumed pesticides in our study. These tissues remain stable against environmental effects because of their placement within the oral cavity, which is normally shielded from external influences. Control samples comprised oral tissues from deceased individuals who had not ingested with pesticides.

Table 2: Postmortem Histopathological Changes in Gingiva & Tongue Induced by Specific Pesticides.

Histological domain	Features	Gingiva					Tongue				
		OPC	PQ	ZP	AP	AG	OPC	PQ	ZP	AP	AG
1.Epithelium	Stripping	-	-	-	-	-	8	2	0	1	1
	Shredding	9	5	1	0	0	8	4	2	2	0
	Pseudo- epitheliomatous hyperplasia	7	3	2	1	1	6	2	2	0	1
	Atrophy	5	2	0	0	1	6	3	1	1	0
	Melanin	8	6	2	1	1	-	-	-	-	-
	Intercellular Bridges	8	3	1	1	1	5	1	1	1	1
		X^2 - 5.95, **p** - 0.99					**X^2** – 9.88, **p** - 1.00				
2. Nucleus	Chromatin Clumped	10	4	2	1	1	4	0	1	1	1
	Karyolysis	10	5	2	1	1	9	4	2	1	1
	Karyorrhexis	9	4	2	1	0	8	4	1	2	1
	Pyknosis	6	2	3	1	0	7	2	1	1	1
	Nuclear Outline	11	5	3	1	1	10	4	2	2	1
	Vacuolization	9	3	3	1	1	10	4	2	2	1
	Homogenization	6	4	1	1	0	6	2	1	2	1
	Intercellular Edema	-	-	-	-	-	6	2	1	2	1
	Intracellular Edema	-	-	-	-	-	6	4	2	1	1
		X^2 - 5.41, **p** - 1.00					**X^2** – 4.28, p - 1.00				
3. Separation of Epithelium & Connective Tissue		-	-	-	-	-	4	1	1	1	0
		-					**X^2** – NA, **p** - NA				
4. Connective Tissue	Fibroblast embedded within collagen fibres	9	6	3	0	1	-	-	-	-	-
	Vacuolization of fibroblasts	8	1	2	1	0	9	3	2	2	1
	Shredding of fibres	7	4	1	0	0	5	3	0	1	0
	Eosinophilia	2	1	0	1	0	3	1	2	1	0
	Homogenization	10	3	2	1	1	4	1	2	1	0
	Presence of inflammation	5	2	1	1	1	3	3	0	1	0
	Shrinkage	7	5	1	0	1	5	2	1	1	0
		X^2 - 14.3, **p** - 0.9					**X^2** - 9.70, **p** - 0.97				
5. Any Other Findings	Muscles	-	-	-	-	-	7	2	2	2	1
	Salivary Gland	-	-	-	-	-	5	1	1	1	0
	Nerve Tissue	-	-	-	-	-	10	1	2	2	0
	Blood vessels	-	-	-	-	-	10	3	2	2	1
	Adipose Tissue	-	-	-	-	-	6	2	0	1	0
		-					**X^2** – NA, **p** - NA				

Note: X^2 - Chi-square, p – P value, OPC – Organophosphorus Compound, PQ – Paraquat, ZP – Zinc Phosphide, AP – Aluminium Phosphide, AG – Agroneem $^*P<0.05$ – Statistically significant.

In the present study, organophosphorus poisoning emerged as the most prevalent type of pesticide used. Organophosphates block acetylcholinesterase, leading to excess acetylcholine and cholinergic toxidrome, affecting nicotinic, muscarinic, and CNS receptors. Symptoms appear rapidly through inhalation, ingestion, or skin absorption, and prolonged exposure can cause respiratory failure and death.[15-17] In contrast, Paraquat primarily targets the lungs and kidneys, accumulating in cells through energy-dependent transport. It generates reactive oxygen species, leading to alveolitis, pulmonary fibrosis, and renal tubular necrosis. It causes direct damage on contact with the mucosal lining of stomach or intestines and mouth.[18] Agroneem (Azadirachtin), derived from neem seeds, disrupts insect growth by inhibiting ecdysone. Though mainly an insecticide, human exposure can trigger vomiting, metabolic acidosis, leucocytosis, encephalopathy, and organ damage, with fatal cases showing fatty liver infiltration and mitochondrial dysfunction.[19] Similarly, Aluminium phosphide (ALP) poisoning has severe systemic effects. It releases phosphine gas upon ingestion, which inhibits oxidative phosphorylation, causing cellular hypoxia, circulatory collapse, and multi-organ failure. Unlike Agroneem, which disrupts metabolism gradually, Aluminium phosphide leads to rapid cardiovascular failure.[20] Zinc phosphide, a common rodenticide, also generates phosphine gas upon ingestion. Once absorbed into the bloodstream, it affects the liver and lungs, leading to metabolic disruption and respiratory failure, similar. However, its activation depends on stomach acid.[21]

Clinical examination in our study indicated that poisoning from Paraquat and Aluminium phosphide resulted in more severe toxic effects, causing notable mucosal changes in the oral cavity, including ulceration, erosion, and sloughing due to their direct contact toxicity, generation of reactive oxygen species or phosphine gas, and systemic oxidative or hypoxic injury to metabolically active tissues.[16,18] The

histopathological alterations observed—such as epithelial shredding, cytoplasmic vacuolization, nuclear pyknosis, and karyorrhexis—reflect a common underlying mechanism of oxidative stress–induced cellular injury. Pesticides such as organophosphorus compounds, paraquat, and aluminium phosphide generate reactive oxygen species (ROS), which cause mitochondrial dysfunction, lipid peroxidation, and protein denaturation, ultimately leading to cellular degeneration and necrosis. These effects disrupt epithelial integrity and connective tissue architecture, producing the characteristic degenerative and inflammatory changes noted in the present study. [22] The connective tissues also exhibited shredding of collagen fibers, vacuolization of fibroblasts, embedding of fibroblasts within collagen fibres, eosinophilia, homogenization, and shrinkage of connective tissues when compared to the control samples. Similarly, Satyanarayanan et al., who investigated the histopathological effects of chlorinated hydrocarbon pesticides on the tissues of common carp, reported shrinkage of connective tissue in the kidney.[23] Although conducted in fish, these findings are relevant as they support the universal mechanism of oxidative stress–induced structural damage, which is also evident in mammalian and human tissues. Separation between the epithelium and connective tissue was also observed, likely resulting from the degradation of basement membrane proteins, including laminin and collagen IV, caused by oxidative stress induced by organophosphate pesticides.[24]

Degenerative changes in the connective tissue components were observed in all pesticide poisoning cases. Congestion and dilation of blood vessels found are due the degeneration and damage to the endothelial cells.[25] The present study showed degeneration and loss of striations in muscle fibres. These results were comparable to those of Wecker L et al who investigated the histological effects of the organophosphate pesticide Parathion on human skeletal muscle fibres. The study found that the diaphragm and intercostal muscles in particular showed signs of nerve ending necrosis and degeneration. The muscle fibre necrosis is attributed to prolonged inhibition of cholinesterase (ChE) by organophosphates, leading to acetylcholine (AcH) accumulation and excessive muscle stimulation, causing cell damage.[26] The present study also showed degeneration and loss of architecture of the salivary gland acini along with vacuolization of acinar cells. All the specimens of ingested poisons revealed loss of architecture and vacuolization of nucleus and cytoplasm of nerve fibres. These results are comparable to those of Sowmiya et al.[8] However, no degenerative alterations were seen in the control samples. Even though the current study found significant changes in the epithelium and connective tissue, as well as degenerative changes in connective tissue components that support the identification of the cause of death, the distribution of the specific pesticide poisons is not equal, making it impractical to identify specific pesticide poisons through histopathological changes. Future studies with balanced sample distribution and molecular correlation could help identify diagnostic markers for specific poisons. There are various studies on toxicology and great future scope in the toxicological research.[27,28] With technological advancement and innovative approaches the Forensic toxicology is evolving and helpful to aid in administration of justice.[29,30]

5. Conclusion

The postmortem histopathological alterations of pesticide poisoning in gingiva are examined for the first time in our study. Both the gingiva and tongue have noticeable histopathological alterations. When compared to normal tissues, gingiva exhibited more pronounced alterations than tongue in cases of pesticide ingestion. Ingestion of pesticides also caused degenerative alterations in connective tissue components. Organophosphorus compound was found to be the most common pesticide compared to the other poisons. Clinically, aluminium phosphide and paraquat showed severe alterations in the oral cavity. Since the gingiva is readily accessible and exhibits notable alterations, it could be the tissue assessed for the detection of harmful pesticide poisons. In situations of inadequate body retrieval, oral autopsy serves as a crucial forensic tool for establishing the cause of death, highlighting its significance in medico-legal investigations. Future studies with larger, multi-centric sample sizes are recommended to strengthen statistical power and validate the diagnostic value of oral tissues in pesticide poisoning cases.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.

Source of funding: None to declare.

References:

1. Kandasamy G, Ramasamy K. Retrospective autopsy analysis on pattern of fatal cases of poisoning. MedPulse. Int J Forensic Med. 2019; 9(2):22–4.
2. Varghese P, Erickson TB. Pesticide poisoning among children in India: The need for an urgent solution. Glob Pediatr Health. 2022; 9: 2333794X221086577.
3. Aghera VJ, Pipaliya KN, Dabhi DM, Mangal HM, Varu PR, Manvar PJ. Study of gross mucosal findings of stomach in cases of fatal poisoning: An autopsy study. J Indian Acad Forensic Med. 2014; 36(1):26–30.
4. Awasthi PM, Verma S, Dev R, Bajpai A. Trend of fatal poisoning in Kanpur: A two-year autopsy-based study. Int J Res Med Sci. 2018; 6: 259–63.
5. Moebus S, Boedeker W. Case fatality as an indicator for the human toxicity of pesticides—a systematic scoping review on the availability and variability of severity indicators of pesticide poisoning. Int J Environ Res Public Health. 2021; 18(16):8307.
6. Mittal C, Singh S, Kumar-M P, Varthya SB. Toxicoepidemiology of poisoning exhibited in Indian population from 2010 to 2020: a systematic review and meta-analysis. BMJ open. 2021; 11(5):e045182.
7. Pesticide Action Network (PAN) India. Highly Hazardous Pesticides and Weedicides in India: Status and Concerns. PAN India; 2024. Available from: https://www.pan-india.org/
8. Rao RS, Vinesh E, Rajkumar C, Nichat P, Karthick BP, Chandra G, et al. Histopathological changes in oral tissues induced by pesticide poisoning: a pilot study. J Contemp Dent Pract. 2022; 22(11):1302-7.
9. Singh SP, Aggarwal AD, Oberoi SS, Aggarwal KK, Thind AS, Bhullar DS, et al. Study of poisoning trends in North India—a perspective in relation to world statistics. J Forensic Leg Med. 2013; 20(1):14–8.
10. Ahmad A, Chaudhry SH, Farooq U, Waheed I, Junaid A, Ali A. Pattern of self-poisoning and toxicity in suicidal deaths presenting for autopsy at a teaching hospital of the cosmopolitan city of Pakistan. J Ayub Med Coll Abbottabad. 2023; 21(1):55–60.
11. Arthanari A, Doggalli N, Arun M, Rani S. Oral manifestations of poisons in view of forensic odontology: A review. Medico Legal Update. 2020; 20(4):7–13.
12. Yadav AB, Angadi PV, Kale AD, Yadav SK. Histological assessment of cellular changes in postmortem gingival specimens for estimation of time since death. J Forensic Odontostomatol. 2015; 33(1):19–26.
13. Sutay SS, Tirpude BH. Pattern of histopathological changes of liver in poisoning. J Indian Acad Forensic Med. 2008; 30(2):63–8.
14. Adhikari SK, Chowdhuri S, Mukhopadhyay P. A study on the histopathological changes in cases of pesticide poisoning and proposed diagnostic algorithm. Indian J Forensic Med Toxicol. 2021; 15(2):96–102.
15. Robb EL, Regina AC, Baker MB. Organophosphate toxicity [Internet]. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing; 2025 Jan [updated 2023 Nov 12; cited on 18 Apr 2025]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK558981/
16. Chaudhari VA, Das S, Devnath GP. Fatal suicidal poisoning: A record-based study in South India. J Forensic Med Sci Law. 2022; 11(2):547–52.
17. Manigandaraj G, Visnu RJ, James RJ. Profile of Deaths due to Poisoning, Autopsied in Chennai – A Cross Sectional Study. J Forensic Med Sci Law. 2025; 34(1):10-15. doi: 10.59988/jfmsl.vol.34issue1.3
18. Gawarammana IB, Buckley NA. Medical management of paraquat ingestion. Br J Clin Pharmacol. 2011; 72(5):745–57.
19. Iyyadurai R, Surekha V, Sathyendra S, Paul Wilson B, Gopinath KG. Azadirachtin poisoning: A case report. Clin Toxicol (Phila). 2010; 48(8):857–8.
20. Agrawal VK, Bansal A, Singh RK, Kumawat BL, Mahajan P. Aluminum phosphide poisoning: Possible role of supportive measures in the absence of specific antidote. Indian J Crit Care Med. 2015; 19(2):109–12.
21. Dolan E, Güzel A, Çiftçi T, Aycan E, Çelik F, Çetin B, et al. Zinc phosphide poisoning: A case report. Hum Exp Toxicol. 2008; 27(4):341–3.
22. Torres-Sánchez ED. Impacts of pesticides on oral cavity health and ecosystems: A review. Environ Sci Pollut Res Int. 2023; 30(3):5982–90.
23. Satyanarayanan S. Histopathological changes due to some chlorinated hydrocarbon pesticides in the tissues of *Cyprinus carpio*. IOSR J Pharm. 2012; 2(6):60–6.
24. Ghaneialvar H, Razi M, Malekinejad H, Moayeri A, Sadeghi N, Najafi G. The protective effect of alpha-lipoic acid on the expression of collagen IV, renal function, and oxidative stress induced by diazinon in the renal parenchyma of rats. Environ Sci Pollut Res Int. 2021; 28(6):6789–98.
25. El-Bendary HM, Shaker MH, Saleh AA, Negm SE, Khadey ME, Hosam Eldeen FA. Histopathological changes associated with exposure of male mice to profenofos and chlorpyrifos. Annu Res Rev Biol. 2014; 4(5):766–77.
26. Wecker L, Mrak RE, Dettbarn WD. Evidence of necrosis in human intercostal muscle following inhalation of an organophosphate insecticide. J Environ Pathol Toxicol Oncol. 1985; 6(2):171–5.
27. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law 2023;32(2):1-3.
28. Deokar RB, Patil SS. Research Publication: Forensic Perspective. J Forensic Med Sci Law. 2024;33(2):1-4.
29. Keche AS, Bhargava DC, Vidua RK, Keche HA. Environmental Toxicology- Introduction & Legislation. J Forensic Med Sci Law. 2024;33(2):51-56. doi: 10.59988/jfmsl.vol.33issue2.9
30. Deokar RB, Dere RC, Patil SS. Looking at Recent Evolution in Toxicology Through Legal Lens. J Indian Acad Forensic Med. 2025;47(1):7-11.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Case Series

Tracing the Tracks: a Case Series on Patterned Injuries

Ankit Jain Pandey[a*], Ankita Khamele[b], Mahendra Sharma[c], Bajrang K Singh[d]
[a]Assistant Professor, [b]Postgraduate Resident, [c]Demonstrator, [d]Professor & Head, Department of Forensic Medicine and Toxicology, MGM Medical College Indore, Madhya Pradesh, India.

Article Info

Received on: 04.09.2025
Accepted on: 04.11.2025

Key words
Accident,
Homicide,
Patterned injuries,
Suicide.

Abstract

BACKGROUND: Patterned injuries are those that bear the shape, size, and contour of the impacting object. Identification and interpretation of patterned injuries while conducting medico-legal examinations of victims of assault, rape, torture, etc. or of the deceased during autopsy are of great importance because these injuries give us an idea about the causative weapon/object and manner of death. **MATERIALS and METHOD**: The authors have presented a case series of three cases that came for postmortem examination in the department of forensic medicine and toxicology. **OBSERVATION:** The cases in our study show patterned injuries caused by blunt force trauma in accidental, homicidal, and suicidal deaths. **CONCLUSION:** These cases will be helpful in understanding the type of injuries, the object involved, and the resulting patterns, which will further aid in identifying the weapon or object of offense and thus providing justice to the deceased and their family.

1. Introduction

Forensic Patterned injuries over victims are frequently observed in all manners of death like accidental, homicidal or suicidal and they also provide insight on the type of weapon or object utilized and the mechanism behind it.[1]

The patterned injuries may be caused by either the impact of a weapon/object on the body or by impact of the body on a patterned surface/object. Patterned injuries can be seen in any case, irrespective of it being a suicidal, homicidal, or accidental case.

Patterned injuries can be classified or subdivided on the basis of forces involved: i) Blunt force injuries are the most common type of patterned injuries involving patterned abrasion, patterned contusion, patterned or signature fracture over the skull, etc. seen in cases of RTA, burn, hanging, assault. ii) Sharp force injuries involving stab wounds with different shapes on the basis of different weapons involved like single edged or double edged knives, screw drivers, scissors, etc. iii) Firearm injuries involving contact entry wounds, shotgun entry wounds by wads and pellets, etc. causing muzzle imprints, abrasion collars and tattooing effects. iv) Other miscellaneous patterns like filigree burn in lightning, crocodile burn in electrocution etc. [2-5]

2. Case Findings

In recent study we have shown the importance of different types of patterned injuries caused by blunt force trauma.

How to cite this article: Pandey AJ, Khamele A, Sharma M, Singh BK. Tracing the Tracks: a Case Series on Patterned Injuries. J Forensic Med Sci Law. 2025;34(2):43-46. doi: 10.59988/jfmsl.vol.34issue2.8

***Corresponding author:** Dr Ankit Pandey Jain, Assistant Professor, Department of Forensic Medicine and Toxicology, MGM Medical College Indore, Madhya Pradesh, India. Email: ankitjainpandey23@gmail.com (M): +91-7838322642.

Case 1:

A case of a 32 year old male was brought for autopsy with an alleged history of a road traffic accident during the celebration of the Holi festival. As per history, the victim was under the influence of alcohol and suddenly fell down and came under the truck tyre. On external examination, reddish patterned contusion in form of 04 zigzag-shaped linear contusions present over the right side of chest and abdomen, horizontally placed and parallel to each other with an equal gap in between, appears to be the pattern of a tyre mark.

Figure 1: Tyre mark (Patterned contusion).



On internal examination, underlying 2nd to 9th ribs of the right side were found fractured in the mid axillary line with ecchymosis of surrounding muscles and tissue. Multiple contusions were present over the posterolateral aspect of the right lung. The diaphragm was found ruptured over right side. The liver was found ruptured, separated and moved up in to the right side of the chest cavity through ruptured diaphragm with effusion of blood in the surrounding region. The right kidney was also found lacerated and separated from all its attachments with effusion of blood in the surrounding region. All the internal organs were found pale. Opinion regarding the cause of death is given as shock and haemorrhage as a result of multiple injuries present over the body. Injuries present over the body are found consistent with the alleged history.

Case 2:

A case of a 28 year old male was brought for autopsy with an alleged history of assault. As per history, the deceased came home under the influence of alcohol and had an argument with his wife and left the home again; after a few hours, he returned back and became unconscious. His family members then brought him to casualty department, where he was declared brought dead and the body was sent for post mortem examination.

On external examination, the left eye was found blackened; multiple rail-patterned bluish contusions were present over upper and lower back region of various lengths and positions and over posterior aspect of right arm region. Multiple diffuse deep-seated contusions were present over posterior aspect of right arm and forearm region, right upper and lower back region and both buttocks region. 03 Lacerated wounds present lower limbs 02 over left leg region and 01 over right leg region. All the internal organs were found pale. Final opinion regarding cause of death will be given after getting histopathology reports and chemical analysis reports of preserved material. Injuries present over body were caused by hard and blunt object and homicidal in nature.

Figure 2: Multiple rail-patterned bluish contusions.



Figure 3: Ligature mark on Neck & Ligature material.



Case 3:

A case of a 38 year old male was brought for autopsy with alleged history of hanging. As per history, the deceased hanged himself in his own home by using the rope after having some argument with his family members. On external examination, ligature material was present insitu around neck as a

nylon rope; cyanosis was present over the nails of both hands and both ear lobules. The ligature mark over the neck was well pronounced and had an imprint of the ligature material. All the internal organs were congested, petechial hemorrhages were present over inner aspect of scalp.

3. Discussion

In case no. 1 of the road traffic accident, a patterned contusion injury was present over the right side of the chest and abdomen, which resembled the shape of the vehicle tyre present in the picture provided by the investigating officer (Figure 1). External patterned injury and underlying internal injuries were found consistent with the alleged history of a road traffic accident and were also helpful in determining the type and nature of the causative object as a tyre of a heavy vehicle. Similarly, there are other patterned injuries occurring during vehicular accidents that help in determining the causative object that impacted the deceased, like patterned contusions by the seatbelt with underlying intrathoracic and intra-abdominal injury and patterned injuries by the headlight rim, grill, bumper, etc.[6] Patterned injuries are also helpful in determining the mechanism and possible chain of events in injury causing and their manners, which will aid in recreating the crime scene.

A similar case study done by Xiao N. et al., showing how tyre marks imprint injury present over the body, helped them in reconstructing the crime scene and also identifying the vehicle that caused it.[7] Also, a case study done by K.V. Satish et al. shows that patterned abrasions present over the chest and abdomen help in confirming the causative object which is a washing machine in this case.[8]

In Case no. 2 of assault, multiple rail-patterned bluish contusions were noted over the back region and right arm region during autopsy, whose dimensions were found consistent with the dimensions of the cylindrical rod provided by the investigating officer at the time of the weapon query. So, in this case, also with the help of patterned injury, we are able to identify the weapon of offense (**Figure 2**). The injury due to a pliable weapon appears as two parallel lines of bruising with an undamaged zone in the center like a railway track.[9] Injuries caused by hard, blunt, and heavy objects like wooden planks, cricket bats etc. show more diffused and deep-seated contusions. The hard, blunt, and flexible object like a belt will also produce patterned contusion injuries, even a buckle of a belt can cause imprint contusions over the victim's body. Six penny bruises over the neck region in cases of throttling can be helpful in determining the manner of death, as they're an impression of the fingers of the assailant. So the objects with different properties will produce different kinds of patterned injuries. Even a photograph of the injury can be helpful in identifying the object/weapon of offense by superimposition.[10]

In homicidal cases, these kinds of patterned injuries will also be helpful in preventing the misleading of cases by changing the weapon of offense. A case report by Zugibe FT. et al. also showed the importance of patterned injuries and their meticulous study in identifying and correlating the weapon of offense.[11]

In Case no. 3 of hanging, the depression of skin over neck region was caused by the plies of nylon rope, forming the imprint abrasion, which helped in identifying the ligature material used for hanging. (Figure 3). Similarly, different ligature material will have different types of impressions, like a dark indented ligature mark in cases of cable wires; ligature mark in the case of belt will be broad and resemble its shape; a hard designed border of a cloth will form an imprint of the border, etc. Many times ligature material does not come with the body in an insitu state and later on it will be sent for medico-legal examination to determine whether the ligature mark present over the neck region could be caused by the given ligature material or not. So, in such a situation, the patterned ligature mark will be extremely helpful in identifying the ligature material used during hanging. The study done by Karmakar SN et al., also depicts the importance of patterned abrasion marks in hanging cases when it comes to correlating them with the provided ligature material.[12] The most common ligature material used for the hanging is nylon rope as per study by Khan et al in their study.[13] There were cases with mechanical asphyxia presented and discussed at Forensic conferences.[14,15] The study done by Maheshwari et al., shown the antemortem histopathological changes in addition to morphological findings.[16]

Similar to the term 'res ipsa loquitur", a Latin phrase meaning "the thing speaks for itself", patterned injuries also often speak for themselves by revealing the identity of the causative weapon or object through their distinctive shape and characteristics. From the faint impression of a shoe sole on skin to the precise outline of a cylindrical rod, patterned injuries hold within them the potential to

unravel the enigma of a crime scene. They are the silent witness, the unspoken testimony that can link a victim to a perpetrator, a weapon to a wound, and a sequence of events to a narrative of trauma.

4. Conclusion

Patterned injuries are important postmortem findings that help in determining the weapon/object of offense and help in understanding the mechanism behind it, as seen in **case no. 1**. Many hit-and-run cases or planned accident cases can be solved if patterned injuries are present over the body by correlating them with the causative object or vehicle in this case.

The significance of patterned injuries extends beyond the area of forensic medicine, touching a broader aspect of social and legal implications of a violent crime, as seen in **case no. 2.** The autopsy surgeon should be more careful and focused when homicidal patterned injuries are present over the victim's body because sometimes the postmortem examination report is the only evidence that reflects the intention of the accused, links the injuries with the weapon recovered from the accused and determines the manner of death.

The autopsy surgeon should identify and describe in detail about the patterned ligature mark injury over the neck region in case of hanging because it's helpful in linking with ligature material, especially when crime scene or ligature material is altered, as seen in **case no. 3.**

The autopsy surgeon should not neglect such findings, and a thorough and detailed examination of such injuries must be performed during medico-legal examination of injuries and autopsy. The location, direction, and dimensions of these injuries should be noted properly and accurately, as sometimes it is the mere crucial link between the injuries on the victim and the causative agent, which will aid in reconstruction of the crime scene, identification of the object, and determination of the manner and cause of death.

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.
Source of funding: None to declare.

References:

1. Mohan R. Patterned bruising caused by an automobile tyre: an accurate guide to the mechanism of injury. S Afr J Surg. 2016;54(1):49-50.
2. Little D. Patterned injuries. J R Coll Pathol Aust. 2011;43(1):32-4.
3. Kumar DA, Ghormade P, Akhade S, Sarma B. Analysis of Injury Characteristics in Victims of Interpersonal Violence: Clinical Forensic Medicine Unit Perspective in a Tertiary Care Centre. J Forensic Med Sci Law. 2023; 32(2):4-8.
4. Vaddi K, Murthy KV, Band RM, Sapate AB, Petkar MR, Ghangale AL. A Study of Unnatural Deaths in Adolescent Age Group in a Tertiary Care Centre, Hyderabad, Telangana. J Forensic Med Sci Law. 2024; 33(2):10-14. doi: 10.59988/jfmsl.vol.33issue2.3
5. Gupta A, Singh G, Gupta P, Kumar A, Verma A. Pattern of Fatal Injuries Sustained by Two Wheeler Riders Due to Road Traffic Mishap in Agra Region. J Forensic Med Sci Law. 2023; 32(1):25-31.
6. Rao VJ. Patterned injury and its evidentiary value. J Forensic Sci. 1986;31(2):768-72.
7. Xiao N, Sheng-Dong L, Xue Z, Yan-Geng Y, Fu Z, Wei-Dong Z. Surface tyre imprints caused by a motorcycle collision rather than by being run over. Med Sci Law. 2018;58(2):1-5.
8. Satish KV, Nadaf A, Mugadlimath A. A rare case report of death in a washing machine with patterned injuries to trunk. J Forensic Med Sci Law. 2013; 22(2):1-5.
9. Aggrawal A. Textbook of forensic medicine and toxicology. 2nd ed. New Delhi: Arya Publishing Company; 2024. pp. 233-7.
10. Spitz DJ. Unrecognised fatal liver injury caused by a bicycle handlebar. Am J Emerg Med. 1999;17(3):244.
11. Zugibe FT, Costello J, Breithaupt M. Identification of a killer by a definitive sneaker pattern and his beating instruments by their distinctive patterns**.** J Forensic Sci. 1996;41(2):310-3.
12. Karmakar SN, Tumram NK, Dixit PG. Descriptive analysis of ligature composition in correlation with Patho-Anatomic findings in neck region due to hanging fatalities. J Forensic Biomech. 2022; 13:390.
13. Khan S, Husain BN, Quazi S, B.H. Tirpude BH. Autopsy-Based Demographical Profile of Hanging Victims In A Rural Area of Central India. J Forensic Med Sci Law 2022;31(2):19-22.
14. Dere RC, Kukde HG, Deokar RB, Patil SS, Kumar NB. Executive summary of the XXIV State Annual conference of Medicolegal Association of Maharashtra (MLAM): Forensicon 2021. J Forensic Med Sci Law 2022;31(1):84-88.
15. Mohite S, Sukhdeve R, Sonawane S, Deokar R, Kolle S, Hinnawi S. Executive Summary of the XXVI Annual State Conference of Medicolegal Association of Maharashtra (MLAM) - Forensicon 2023. J Forensic Med Sci Law. 2024;33(2):73-78. doi: 10.59988/jfmsl.vol.33issue2.13
16. Maheshwari D, Pate RS, Ghadge MR, Bari V. Morphological and Histopathological Changes in the Structure of the Neck in Cases of Hanging: A Comprehensive Review. J Forensic Med Sci Law. 2025;34(1):33-37. doi: 10.59988/jfmsl.vol.34issue1.7

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Review Article

Ensuring Inclusive Justice for Women with Mental Disabilities Victimized by Sexual Violence: a Feminist Disability Studies Approach

Marzellina Hardiyanti[a], Aga Natalis[a*]
[a]Faculty of Law, Universitas Diponegoro, Jalan dr. Antonius Suroyo, Tembalang, Semarang City, Central Java 50275, Indonesia.

Article Info

Received on: 10.10.2025
Accepted on: 22.10.2025

Key words
Inclusive Justice Access;
Women with Mental Disabilities;
Sexual Violence;
Feminist Disability Studies;
Mental Health Rights.

Abstract

Introduction: Sexual violence remains a critical issue disproportionately affecting women, particularly those with mental disabilities. These women face increased vulnerability due to cognitive and psychological limitations often exploited by perpetrators. Although Indonesia's 1945 Constitution and Law No. 12 of 2022 on Sexual Violence guarantee equal rights, implementation gaps persist. **Discussion**: Using a Feminist Disability Studies approach, this study explores barriers to justice for women with mental disabilities who experience sexual violence. Intersectional discrimination—arising from gender and disability—renders them perceived as unreliable or incapable of reporting. Research shows that women with disabilities are four times more likely to experience sexual violence. Limited access to legal aid, psychological support, and inclusive communication further marginalizes them. **Conclusion**: The study underscores the urgent need for inclusive justice mechanisms integrating legal, psychological, and social services. Strengthening institutional capacity and gender-sensitive frameworks is essential to ensuring justice, recovery, and empowerment for women with mental disabilities.

1. Introduction

Sexual violence, deeply rooted in gender bias, affects both women and men, but women—especially those with mental disabilities—are more vulnerable due to gender inequality and psychosocial limitations.[1]

In Indonesia, the 1945 Constitution guarantees rights to health, equality, and protection from violence (Articles 28H, 28D, 28G). Law No. 17 of 2023 on Health and Law No. 12 of 2022 on Sexual Violence Crimes affirm the rights of individuals, including those with disabilities, ensuring equal legal standing for their testimonies. These provisions demonstrate Indonesia's commitment to protecting all citizens, particularly those with long-term impairments.[2-4]

The perception of women with disabilities

How to cite this article: Hardiyanti M, Natalis A. Ensuring Inclusive Justice for Women with Mental Disabilities Victimized by Sexual Violence: a Feminist Disability Studies Approach. J Forensic Med Sci Law. 2025;34(2):47-51. doi: 10.59988/jfmsl.vol.34issue2.9

***Corresponding author:** Aga Natalis**,** Faculty of Law, Universitas Diponegoro, Jalan dr. Antonius Suroyo, Tembalang, Semarang City, Central Java 50275, Indonesia. Email: aganataliss@lecturer.undip.ac.id

as weak and helpless heightens their vulnerability to sexual violence, as perpetrators often assume they will not report the abuse. Victims are frequently blamed and held responsible for the violence they endure. Studies show that women with disabilities are four times more likely to experience sexual violence than those without disabilities, with 11.1% reporting assaults by non-spousal perpetrators. According to Komnas Perempuan, gender-based violence (GBV) cases peaked in 2021 with 338,496 incidents, marking a 50% increase from 2020. Reports of sexual violence against women with disabilities varied over the years: 57 cases in 2017 and 2018, 69 in 2019, 87 in 2020, 77 in 2021, and 44 in 2022. Despite the fluctuations, the persistence of such violence highlights the continued vulnerability of women with disabilities.[5]

As a member of the Task Force for the Prevention and Handling of Violence in Higher Education Institutions, the author notes that women with mental disabilities require special attention due to their psychological instability when recounting traumatic events. One case involved a victim with Psychoaffective Disorder, Dissociative Identity Disorder, and Borderline Personality Disorder, who was sexually assaulted while semi-conscious in a hospital.[6-7] The perpetrator exploited her condition, highlighting the need for a feminist disability perspective to ensure justice and protection. This paper examines the accessibility of inclusive rights for such victims through a gender justice framework, focusing on mental health recovery and law enforcement's role in applying gender-sensitive, inclusive approaches.

2. The Urgency of Fulfilling Inclusive Access for Women with Mental Disabilities as Victims of Sexual Violence

a. Legal Obligations and Gaps

Sexual violence remains a critical public health issue, affecting millions annually through non-consensual acts such as coercion, intimidation, and abuse.[8-10,11,12,13] While factors like gender, age, and race have been explored in research, the vulnerability of individuals with disabilities—especially women with mental disabilities—remains underexamined. In Indonesia, the 1945 Constitution ensures rights to health, equality, and protection from violence, extending to individuals with disabilities. Law No. 17 of 2023 on Health and Law No. 12 of 2022 on Sexual Violence Crimes affirm the legal standing of testimonies from individuals with disabilities, reflecting a commitment to safeguarding their rights. However, the systemic challenges in addressing the unique needs of these individuals persist.

The Convention on the Rights of Persons with Disabilities (CRPD), ratified by Indonesia in 2011, mandates equal protection and participation for people with disabilities, including preventing and addressing sexual violence. This is further reinforced by the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW). Despite these legal frameworks, cases like the 2022 sexual assault of a 23-year-old woman with intellectual disabilities in Jember highlight gaps in protection and rehabilitation efforts.[14] These cases underscore the need for comprehensive protection, including accessible reproductive health education and stronger collaboration between parents, educators, and authorities. Effective prevention and response require sensitivity, accessibility, and equality in support services and legal protection for women with mental disabilities.

b. Statistical Trends and Systemic Failures

The incidence of violence against women and children with disabilities has steadily increased. In 2023, the National Commission on Violence Against Women (Komnas Perempuan) reported 105 cases of violence against women with disabilities, up from 72 in 2022. These included 40 cases involving women with mental disabilities, 33 with sensory disabilities (vision, hearing, speech), 20 with intellectual disabilities, and 12 with physical disabilities. In 2021, Simfoni Perlindungan Perempuan dan Anak recorded 987 cases of violence against children with disabilities, with sexual violence being the most prevalent, accounting for 591 cases. The data suggests that many instances of sexual violence against women with mental or intellectual disabilities remain unreported, reflecting a deeper, systemic issue that goes unaddressed.[14]

This situation is compounded by the societal marginalization and patriarchy that women with disabilities face, particularly those with mental or intellectual disabilities, making them more vulnerable to sexual violence. A case observed by the researcher, involving a woman with borderline personality disorder (BPD), dissociative identity disorder (DID), and schizoaffective disorder, highlights the severity of the issue. The victim was assaulted in a hospital while in a semi-conscious state, with her mental condition partially contributing to the crime. Psychological states, including trauma responses and coping

mechanisms, are often exploited by perpetrators, leading to heightened vulnerability. This phenomenon underscores the need for comprehensive support systems and gender-sensitive protection for women with mental disabilities.

c. Case Analysis: Sexual Violence in Medical Contexts

The study by Rose Gholami Mazinan et al.[15] highlights that Borderline Personality Disorder (BPD) is a significant mental health condition, with a community prevalence estimated at up to 2.7%. The researchers assessed dissociative experiences in sexual contexts using a modified version of the German questionnaire Fragebogen zu dissoziativen Symptomen (FDS), which is based on the Dissociative Experience Scale (DES). Risky sexual behavior was evaluated through the Sexual Risk Survey (SRS), comprising 23 items categorized into five distinct groups: SRS Uncommitted (sexual interactions with unknown, untrusted, or unattached partners), SRS Risky (engagement in risky sexual acts such as unprotected vaginal or oral sex), SRS Impulsive (impulsive and spontaneous sexual encounters), SRS Intentional (purposeful participation in risky sexual activities), and SRS Anal (engagement in risky anal sex). Participants were asked to report how frequently they engaged in these sexual behaviors over a 12-month assessment period, using an open-ended format for their responses. This instrument has undergone forward-backward translation from English to German and has demonstrated high reliability, with Cronbach's α values of 0.88 or higher for all subscales, except for SRS Anal, which has a Cronbach's α of 0.69. Individuals diagnosed with BPD often have a history of sexual abuse, which may increase the likelihood of experiencing sexual dysfunction.[16]

The study's findings indicate that the researcher's expertise is supported by evidence showing that borderline personality disorder (BPD) can lead to impulsive sexual behaviour, potentially creating situations that increase vulnerability to sexual violence. Mental health and disability remain major global issues, including in Indonesia, where individuals with disabilities often face discrimination and human rights violations due to societal perceptions of weakness. According to Article 1(1) of Law No. 8 of 2016, persons with disabilities—whether physical, intellectual, sensory, or mental—have the right to participate fully in society. Similarly, Law No. 19 of 2011 emphasizes protection from torture, violence, and exploitation, while safeguarding the physical and mental integrity of persons with disabilities. Despite these legal protections, stigma and marginalisation persist, limiting access to education, employment, and public services. Therefore, ensuring inclusive rights for women survivors with mental disabilities who experience sexual violence requires strengthening support systems, counselling services, and legal enforcement, while imposing stricter penalties on perpetrators to address the complex trauma endured by victims.

3. The Feminist Disability Approach in Protecting Women with Mental Disabilities Who Are Victims of Sexual Violence

In Indonesia, the protection of sexual violence victims, including those with mental disabilities, is governed by Law No. 12 of 2022 on Criminal Acts of Sexual Violence and supported by the CEDAW, which aims to eliminate discrimination against women.[17] Despite these legal frameworks, cases of sexual violence remain prevalent, particularly affecting women with mental disabilities who face greater vulnerability. Such violence not only involves physical acts but also threats and coercion, often leading to deep psychological trauma and long-term mental health issues like PTSD, depression, and anxiety. Addressing this issue requires a feminist disability perspective that challenges the traditional medical view of disability and promotes inclusive recognition of women with disabilities. Feminist disability studies emphasize the importance of validating disabled identities, confronting stigma, and fostering narratives that affirm the social and political value of individuals with disabilities.[18-19]

According to Rosemarie Gerland-Thomson[20], feminist disability studies prioritizes the social implications of physical, mental, and emotional differences rather than concentrating on medical diagnoses or specific limitations. This perspective highlights how such bodies are frequently assigned stigmatizing and exclusionary meanings within society. This approach illustrates that, akin to social categories like "people of colour" or "queer," the term "disabled" includes a diverse range of experiences and identities, yet is simplistically consolidated as a group perceived as defective. Disability should be viewed not only as a biological condition but also as a social construct that leads to various forms of political, economic, and social discrimination.

Women and girls with disabilities face heightened risks of violence, including sexual and gender-based violence (SGBV), as a result of early discrimination, limited access to reproductive health education, and compounded discrimination stemming from both gender and disability. During armed conflict, this condition worsens as individuals frequently lose access to their community, familial support, educational opportunities, health services, and mobility aids like wheelchairs or prosthetics. The lack of access increases their susceptibility to various forms of violence, including physical, psychological, sexual, and financial, while simultaneously presenting considerable obstacles to reporting incidents and achieving justice.[21]

Instances of sexual violence against women with mental disabilities necessitate focused consideration, especially regarding the services available to support them in addressing their situations. This includes a spectrum of assistance, from counselling and legal advocacy to rehabilitation and the development of mental resilience, aimed at facilitating their reintegration into society and reducing the likelihood of recurring mental trauma.

Social services informed by intersectional feminism guarantee that the initiatives developed by social workers effectively meet the multifaceted needs of children affected by domestic violence, considering variables such as race, class, social experience, and cultural background. By adopting an intersectional feminist perspective, social workers can create interventions that are both culturally attuned and tailored to address the unique needs of individuals and families. This approach acknowledges the intricate nature and interplay of multiple factors that contribute to domestic violence. This perspective aims to foster the development of sustainable solutions that can significantly enhance the well-being of children and their families.[22,23]

To translate feminist disability studies (FDS) theory into practice within legal and social institutions, it is essential to highlight the intersection of gender and disability in the development of policies and interventions. Legal frameworks like Law No. 12 of 2022 on Criminal Acts of Sexual Violence should acknowledge not only the physical and emotional consequences of sexual violence but also incorporate a thorough understanding of the socio-political obstacles encountered by women with disabilities. The policy must adopt an inclusive framework that recognizes the varied experiences of disability, guaranteeing that legal services are accessible to women with mental disabilities and specifically designed to meet their unique requirements.[24,25] Social institutions and legal professionals need to undergo training aimed at recognizing the specific vulnerabilities faced by these women.[26,27] This training should ensure that victim support services effectively integrate feminist disability perspectives. This entails the development of systems that recognize and uphold the dignity, autonomy, and agency of women with disabilities. In the healthcare institution, sound and legally safe medical documentation is utmost important.[28]

Furthermore, social workers and legal advocates need to work together in creating services that are informed by trauma and inclusive of disabilities. These services should not only address immediate legal solutions but also encompass long-term psychological support, rehabilitation, and the process of reintegrating individuals into society. Integrating FDS theory into practical applications allows institutions to develop responses to sexual violence that are both equitable and effective, thereby empowering women with disabilities to experience dignity and justice.

4. Conclusion

Women with mental disabilities who experience sexual violence face multifaceted challenges, compounded by both their mental health conditions and the trauma of abuse. While Indonesia has ratified international conventions and enacted national laws, such as Law No. 12 of 2022 on Sexual Violence Crimes, the implementation of these protections remains inadequate. Accessibility barriers, limited support services, and the lack of inclusive mechanisms contribute to many cases going unreported, representing the “iceberg phenomenon” of hidden injustices. Stigma, discrimination, and insufficient protective measures deepen the suffering of these women.

A feminist disability and intersectional approach is crucial, recognizing that disability is not only a medical issue but also a social construct that leads to marginalization, particularly for women facing dual discrimination. Effective protection requires comprehensive services—including counseling, legal support, rehabilitation, and mental health recovery—that are tailored to the cultural, social, and psychological needs of victims. By integrating feminist disability studies with inclusive practices, it is possible to empower, support, and

ensure justice for women with mental disabilities who have experienced sexual violence, facilitating their recovery and reintegration into society with the dignity and respect they deserve.

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.
Source of funding: None to declare.

References:

1. Armstrong EA, Gleckman-Krut M, Johnson L. Silence, power, and inequality: An intersectional approach to sexual violence. Annu Rev Sociol. 2018; 44(1):99-122.
2. Natalis A. Breaking the Silence: Gender Power Imbalances, Stealthing, and the Fight for Sexual Autonomy. J Forensic Med Sci Law. 2024;33(2):68–72.
3. Natalis A, Surayda HI. Overcoming Legal Barriers: Ensuring Justice for Persons with Disabilities Victimized by Sexual Violence. Rev Direito Sex. 2024; 5(1):163-95.
4. Susilowati CM, Frans MP. Interpreting power, grooming, and deception in sexual violence cases: a hermeneutic study on legal challenges in Indonesia. Int J Semiotics Law. 2025; 38(3):1061-78.
5. Azhari MY, Halim A. Domestic Workers' Rights and Legal Protection in Indonesia. Media Iuris. 2021;4(2):173.
6. de Aquino Ferreira LF, Queiroz Pereira FH, Neri Benevides AML, Aguiar Melo MC. Borderline Personality Disorder and Sexual Abuse: A Systematic Review. Psychiatry Res.2018;262:70–7.
7. Bennett B. Mental Illness: A Guide to Recovery. Trafford publishing; 2004.
8. Alexander KA, Miller E. Sexual violence—Another public health emergency. JAMA network open. 2022;5(10): e2236285.
9. Basile KC, Smith SG, Chen J, Zwald M. Chronic diseases, health conditions, and other impacts associated with rape victimization of US women. J Interpers Violence. 2021;36(23-24):NP12504-20.
10. Jina R, Thomas LS. Health Consequences of Sexual Violence Against Women. Best Pract Res Clin Obstet Gynaecol. 2013 ;27(1):15–26.
11. Patil SS, Deokar RB, Pathak HM. Overview of rape related laws in India and necessary recommendations. J Forensic Med Sci Law. 2019;28(1):17–21.
12. Ghosh I, Chowdhury S, Biswas S. Prevalence of Major Depressive Disorder in Survivors of Sexual assault examined in a Medical College of West Bengal. J Indian Acad Forensic Med. 2024; 46(2-Suppl):340-4.
13. Patil SS, Deokar RB, Mankar DD. Study of Feedback of Survivors of Sexual Offences Subjected for medicolegal Examination in Tertiary Care Municipal Hospital. J Forensic Med Sci Law. 2022;31(1):16-23.
14. Mukhotib MD. Sexual Violence Against Women with Disabilities [Internet]. Rumah Kitab. 2024 [cited 2025 Sept 7]. Available from: https://rumahkitab.com/kekerasan-seksual-terhadap-perempuan-dengan-disabilitas/
15. Mazinan RG, Dudek C, Warkentin H, Finkenstaedt M, Schröder J, Musil R, et al. Borderline Personality Disorder and Sexuality: Causes and Consequences of Dissociative Symptoms. Borderline Personal Disord Emot Dysregul. 2024;11(1):8.
16. Collazzoni A, Ciocca G, Limoncin E, Marucci C, Mollaioli D, Di Sante S, et al. Mating strategies and sexual functioning in personality disorders: a comprehensive review of literature. Sex Med Rev. 2017;5(4):414-28.
17. Siregar WZB, Prihatini ES. Passing the Sexual Violence Crime Law in Indonesia: Reflection of a Gender-Sensitive Parliament? Politics Govern. 2024;12:8245.
18. Susilowati CMI, Frans MP. Legal Reform in Addressing Sexual Violence in Indonesia: An Analysis of the Implementation of Law No. 12 of 2022 on Sexual Violence Crimes. Rev Direito Sex. 2024;5(2):183–202.
19. Garland-Thomson R. Integrating Disability, Transforming Feminist Theory. The Disability Studies Reader, 5th ed. 2016;14(3):360–80.
20. Garland-Thomson R. Feminist disability studies. Signs: Journal of women in Culture and Society. 2005;30(2):1557-87.
21. Vantrees A. Inaccessible Justice: The Violation of Article 13 of the CRPD and the ICC's Role in Filling the Accountability Gap. Int Rev Red Cross. 2023;105(922):542–65.
22. Di'faeni A, Asyia N, Nulhaqim SA. Social Services for Children Victims of Domestic Violence: A Feminist Perspective Analysis in Social Work. Jurnal Anifa: Studi Gender dan Anak. 2024;5(2):1–11.
23. Amrita A, Deokar RB. Clinical Forensic Psychology: It's Emergence, Significance and Application in India. J Forensic Med Sci Law 2022;31(2):80-83.
24. Kumar DA, Ghormade P, Akhade S, Sarma B. Analysis of Injury Characteristics in Victims of Interpersonal Violence: Clinical Forensic Medicine Unit Perspective in a Tertiary Care Centre. J Forensic Med Sci Law 2023;32(2):4-8.
25. Pande PVS et al. Survivors of Child Sexual Violence in India and Their Search for Justice: A Case Series and Review of Literature. J Forensic Med Sci Law 2023;32(2):63-69.
26. Varma NM, Pawar MN, Deokar RB. Executive Summary of the Forensicon 2022 - 25th Annual State Conference of Medicolegal Association of Maharashtra (MLAM). J Forensic Med Sci Law 2023;32(2):80-84.
27. Bale PG, Dere RC, Kukde HG, Kumar NB. Study of Victims of Child Sexual Assault at a Tertiary Health Care Center in Western Maharashtra. J Forensic Med Sci Law 2023;32(1):15-19.
28. Rautji R, Dingre N, Karmarkar M, Deshpande K. Legally Safe Medical Documentation: Ensuring Compliance and Patient Protection. J Forensic Med Sci Law. 2024;33(2):79-81. doi: 10.59988/jfmsl.vol.33issue2.14

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Review Article

Ethical Reflections on IVF- Ownership Issues of Gametes and Embryos, an Indian Perspective

Anjankar A J[a*], Ajay N Keoliya[a], Sudhir V Ninave[a], Pawan Wankhade[a]
[a]Department of Forensic Medicine, J N Medical College, DMIHER, Wardha, Maharashtra, India.

Article Info

Received on: 14.06.2024
Accepted on: 16.10.2025

Key words
IVF,
ART,
Gametes and embryos,
Ownership issues,
Ethical concerns.

Abstract

Background- The initial attempts at achieving pregnancy through IVF procedures began more than half century ago and were limited to animals and the first successful IVF in mammals occurred in 1959. The world's first baby, Louse Brown, conceived by IVF was born in UK in the year 1978. Subsequently, these pioneering efforts of the scientists were successfully taken forward in India and the first IVF baby was born in 1986 giving hope to infertile couples, not being able to conceive naturally. With increased awareness, acceptance & accessibility, IVF became popular in spite of its restricted affordability in the society. As a result, number of social, ethical issues and dilemmas started surfacing in absence of specific regulatory framework in India. **Objectives:** The ICMR guidelines on Assisted Reproductive Technology, 2005 tried to address certain concerns. However, major milestone was reached when 'The Assisted Reproductive Technology (regulation) Act, 2021' came into existence, which addressed many delicate ethical concerns. The present work intends to identify such concerns and the extent to which they are addressed and tries to provide rationale explanations for those which are partly addressed or which still lack clarity in absence of specific guidelines. **Discussion:** Assisted Reproduction involves myriads of social, moral and ethical issues and challenges but the present discussion is restricted to ownership issues with respect to gametes and embryos in the light of ART (regulations) Act, 2021. The Act, vide section 28(2) addresses this issue and provides guidelines in this regard.

1. Introduction

Sexual Infertility has been defined as inability to conceive after one year of unprotected coitus or other proven medical condition preventing a couple from conception. About one in six couples of reproductive age group encounter this type of problems with fertility. According to WHO estimate, overall prevalence of primary infertility in India is between 3.9 to 16.8%.[1]

Infertility has immense demographic, social, psychological, emotional and cultural implications. In addition, inability to procreate is considered as a personal tragedy, at times stigma and has a wrecking impact on life of the person for not fulfilling the biological role of parenthood.[2]

Accordingly, even in India, with increased awareness more and more infertile couples are

How to cite this article: Anjankar AJ, Keoliya AN, Ninave SV, Wankhade P. Ethical Reflections on IVF- Ownership Issues of Gametes and Embryos, an Indian Perspective. J Forensic Med Sci Law. 2025;34(2):52-56. doi: 10.59988/jfmsl.vol.34issue2.10

***Corresponding author:** Dr. A J Anjankar, Dept. of Forensic Medicine, Jawaharlal Nehru Medical College, Sawangi Meghe, Wardha (MS). Phone: 9765404004 Email: ajanjankar@gmail.com

seeking remedies and approaching the fertility clinics. The Center for disease Control and Prevention (CDC) defines ART to include "all fertility treatments in which both eggs and sperms are handled to help achieve a pregnancy". In general ART procedures are all about surgical removal of eggs from woman's ovaries and then combining them with sperms in laboratory and implanting them or storing for subsequent use.

2. Historical & legal background

Assisted reproductive technology (ART) came to limelight when the first report of successful use of AI in human beings was published in 1943, [2] which subsequently revolutionized IVF. With increased knowledge and understanding of reproductive physiology and advent of technology the major historical milestone of successful IVF in human was reached leading to birth of Louise Joy Brown, the first test tube baby on July 25, 1978.[2] This was immediately followed by the announcement of Dr Subhas mukherjee from Kolkata of birth of World's second and India's first test tube baby Kanupriya alias Durga in October 1978, the work which remained unpublished in absence of authentic scientific evidence.[2] Since then, couples deprived of progeny increasingly started to approach IVF centers and ART could fulfill reproductive aspirations of infertile couples across the globe. With the birth of first scientifically authenticated and well documented test tube baby, Harsha, in 1986 in India, IVF clinics 'mushroomed' across the country without any accreditating, supervisory and regulatory framework and/or control of the government.[3]

Indian Council of Medical Research (ICMR) took the initiative and developed draft 'National Guidelines for ART clinics in India' in the year 2002, the document was then subjected to extensive public debate in the country and suggestions from the stakeholders including National Commission for Women and National Human Rights Commission were also sought.[4] Incorporating the comments and suggestions received, the draft guidelines were submitted to Government of India. The Ministry of Health and Family Welfare, Government of India published them as 'National Guidelines for Accreditation, Supervision and Regulation of ART clinics in India' in 2000 [2,5] which was, subsequently, translated into 'Assisted Reproductive Technology (Regulation) Bill, 2017'. [6]

The Assisted reproductive Technology (Regulation) Act 2021 which is presently in vogue provides legal framework for regulation, supervision and accreditation of ART practices and clinics and addresses other related issues including ethical practice of assisted reproductive technology services in India.[7] The Act provides for establishment of National board, state Boards and National Registry and for accreditation and supervision of ART clinics and banks so as to ensure that the medical and socio-legal rights of the stakeholders are protected and the services provided are within the laid down ethical framework.[3]

3. Ethical Perspectives

Assisted Reproduction involves myriads of social, moral and ethical issues and challenges including broader concerns like access to ART clinics due to their inequitable geographical distribution and preferential availability to privileged couples based on their financial soundness and spending capacity.[8] The present discussion is restricted to ownership issues with respect to gametes and embryos in the light of ART (regulations) Act, 2021.

a. One of the common issues encountered in typical IVF procedure is the creation of supernumerary embryos which are in excess of those replaced in the first cycle and are frozen to be used later, either if the first trial is not successful or when the couple wants to have another child .[9] Lately, efforts are being made to reduce the number of embryos transferred so as to reduce the inherent risk of multiple pregnancies. Such restrictive policies in embryo transfer along with improved cryopreservation techniques has resulted in increasing the number of cryopreserved embryos [10] and gametes. Once the couple completes the family or discontinue the treatment, the fate of unused embryos becomes uncertain. They create ethical dilemmas about their fate as to what is to be done with them and how long they should be preserved.
b. The issue of ownership of gametes also arises when the gametes are preserved before vasectomy or cancer treatment where the fertility is threatened by chemotherapy or radiotherapy and the person dies. Should such gametes be used for IVF especially when the remaining partner is a woman? In other words, does the person who stores gametes/embryos can use them for procreation after death?[9]
c. The next important issue is what is the precise role & extent to which informed consent can address to some of the above issues and whether clear

prior directives (advanced directives) can be incorporated in the consent to deal with the issues likely to arise subsequently. Clarity on the validity of advanced directives also needs to be established. Such issues could include duration of cryopreservation & its discontinuation in appropriate situations, scope for possible future use and permission to use/donating the genetic material to laboratories for continued research. Validity of such directives in cases of death or incapacity of either party. Peculiar situation may arise in case of stored embryos when there is divorce or separation of spouses as the decision taken by two persons in wedlock as a 'single unit' no longer holds true.

d. The question of legitimacy of a child born through ART along with its rights and privileges needs attention. Whether such child can be considered as biological child and shall have the same rights and privileges similar to naturally born child needs to be established.
e. Privacy and confidentiality issue may arise when registration of birth under the Act is required to be done and the name of the father might be required.[11]

4. International scenario

Internationally, the guidelines address such issues but they are either insufficient to address vital issues or lack clarity and uniformity to be made applicable in Indian situation. In some countries the couple do have ownership rights over the gametes and embryos only up to the maximum age limit specified for IVF. In Canada, Spain and United States maximum period of cryopreservation has not been prescribed, where as Australia and UK have laid down relevant guidelines. [12] The Laws of France, Germany, Sweden and other countries prohibits use of gametes from deceased individuals even when there is written consent is available, whereas, in UK sperms from the deceased person can be used for IVF if informed consent is available. Human Fertilization & Embryology Authority (HFEA) is UK's independent regulatory authority for fertility treatment and research using human embryos. Article 5.9 of Human Fertilization and Embryology authority (HFEA) code of practice lays down that anyone who consents to storage must state what is to be done with the gametes or embryos in the event of his or her death or incapacity to give or revoke consent.[9]

The European Society of Human Reproduction and Embryology acknowledge that the donors relinquish all rights of ownership from the moment embryos are created, whereas American Society for Reproductive Medicine advocate dual consent and requires that donors should also have a role in decision making about use of the embryo created using their gametes.[12]

5. The Indian Act, strengths and gap.

Role of consent: The ART Act, 2021 mandates that no treatment should be offered without written informed consent from the couple.[13] Any couple or any partner in the couple has right to withdraw the consent at any time before the gametes or embryo is transferred to the uterus. The ART clinics/banks are obliged to maintain/ preserve the consent form and other related documents for the period of ten years from the date of completion of ART procedure. The various forms of consent signed by couple / woman to be used in appropriate situations have been prescribed (Form number 12 to 18 and 21). However, legal battles are on for the rights of the wife even without consent of the husband. A groundbreaking judgment of Delhi High Court has come in 2018 in favor of woman who sought IVF using donor's sperm without consent of the husband on the ground that requirement of husband's consent was 'discriminatory and violated the woman's fundamental right to reproductive autonomy'. In a parallel case Bombay High Court also delivered similar verdict in 2022 but currently the issue is sub judice and similar case is being considered by Supreme Court of India.

Supernumerary embryos: It is an established fact that with increase in success of in vitro fertilization outcomes, the issue of unused or supernumerary embryos has been increasingly surfaced. Notably in Europe, approximately one third of couples did not use their surplus embryos posing challenge for patients and clinics.[14] Section 22(2) of ART (regulation) Act, 2021 mandates that cryopreservation should be done only with specific instructions and consent as to what is to be done in case of death or incapacity of either party. Advanced directives are also mandatory for duration of cryopreservation. As per the Act, gametes from the donors or embryos should be preserved for ten years and afterwards may be allowed to perish or may be donated to research organizations for purposes of research, with the consent of commissioning couple or individual (The Assisted Reproductive Technology regulation Act, 2021). The ethical decision on the issue of use of human gamete and embryo for

research purposes depends upon conscientious application of principles of informed consent.[15-17] This endorses the fact that the right to decide the fate of genetic material by the gamete providers or commissioning couple is considered a 'fundamental right' and therefore the use of genetic material, especially for procreation, without valid informed consent is considered to be a serious violation of that person's autonomy.[9, 15] Patient has liberty to change his earlier decision or directives. He is at liberty to revoke earlier directives and re-decide the issue on the basis of new situation or new value structure. The Act provides for donation of embryo for research purposes to an approved laboratory with the consent of commissioning couple, in cases where embryo is found suffering from pre-existing, heritable, genetic or life threatening diseases. It further provides that the unused oocytes can be given for research to registered research organization only after seeking written informed consent from the commissioning couple (s. 27(5) of ART Act 2021).[18] In India, as per section 24(f) of the Act, collection of gametes posthumously shall be done only with prior consent of the commissioning couple.

With advanced directives, there is always a possibility that a person may not be able to make a correct decision about the event where there is a considerable temporal distance, highlighting the possibility to change his earlier decision at a later date. There are two possible solutions to the issue. Firstly, the consent taken earlier should include the couple's decision as to what should be done in case of divorce or separation. Secondly, advance directive can be given by the couple when they are together.[9]

Anonymity and confidentiality: There is an issue of anonymity in relation to gametes and embryo donation which needs to be addressed. The section 21, clause (e) of the ART Act specifies that the anonymity about the donor or the commissioning couple should be maintained. This anonymity protects the privacy of the donor and also prevents any possible future claims of parentage. Section 21(e) of the Act mandates that, 'clinics and the banks shall ensure confidentiality of the couple, woman and donor shall be disclosed only for the database maintained by National Registry or in a medical emergency, that too at the request of commissioning couple or by Court order.

Legitimacy: The question of legitimacy of a child needs attention. The ART Act, 2021 s 31(1) deals with the rights of the child born through ART.[20] The child born through ART shall be biological child of the 'commissioning couple' and such child shall have all the rights and privileges available to natural child from commissioning couple. Sub-section 2 clarifies that the donor shall relinquish all the rights over the child born from his gametes.

6. Summary & Conclusion

Rapid revolution in the treatment of infertility in form of ART is considered as one of the extraordinary accomplishments of medical science. It was rightly considered as a boon to the infertile couple as it could fulfill their innate desire of parenthood. However several moral, ethical and legal issues in relation to ART procedure and clinics required to be addressed as there was no regulatory legal framework in India before 'The Assisted Reproductive Technology (Regulation) Act, 2021' came into existence. Issues pertaining to informed consent, need and relevance of advanced directives use of gametes and embryos for research, issues of autonomy and anonymity, fate of embryo in the event of death, separation or divorce etc. have been addressed in the Act and certain other ethical issues still needs clarity and authentic elaboration. Efforts have been made to provide rational and ethical solutions to the issues partly addressed by the ART (Regulation) Act, 2021.

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.
Source of funding: None to declare.

References:

1. Infertility- National Health Portal of India. [Cited on 28th May 2024].Available at https://www.india.gov.in/national-health-portal?page=1
2. Sharma RS, Saxena R, Singh R. Infertility & assisted reproduction: A historical & modern scientific perspective. Indian J Med Res. 2018; 148(Suppl 1):S10-4.
3. M Gouri Devi. 'IVF in India- swinging in legal and ethical aspects'. ET Healthworld, 17th august 2016, pp 1-9.
4. National Guidelines for Accreditation, Supervision and Regulation of ART Clinics in India 2005, ministry of Health and Family Welfare, Govt. of India, 2005, pp 1-133.
5. Yadav M. Medico-Legal & Ethical Aspects of Artificial Insemination. J Indian Acad Forensic Med. 2006; 28 (4):131-4.
6. Patil SS, Deokar RB, Pathak HM. Assisted Reproductive Technology: A Literature Review. J Forensic Med Sci Law. 2020; 29(2):61-4.

7. The Assisted Reproductive Technology (Regulation) Act, 2021 (Act No. 42 of 2021), part II, Section I. [Cited on 28th May 2024].Available at http://egazette.nic.in
8. Brezina PR, Zhao Y. The ethical, legal, and social issues impacted by modern assisted reproductive technologies. Obstet Gynecol Int J. 2012; 2012(1):686253.
9. Pennings G. What are the ownership rights for gametes and embryos? Advance directives and the disposition of cryopreserved gametes and embryos. Hum Reprod. 2000; 15(5):979-86.
10. Chandy A, Waanbah B, Yadav B, Kunjummen AT, Riley DJ, Kamath MS. Knowledge and attitudes of subfertile couples towards disposition of supernumerary cryopreserved embryos: an Indian perspective. Reprod Biomed Soc Online. 2019; 9:11-6.
11. Rinehart LA. Storage, transport, and disposition of gametes and embryos: legal issues and practical considerations. Fertil Steril. 2021; 115(2):274-81.
12. Baía I, de Freitas C, Samorinha C, Provoost V, Silva S. Dual consent? Donors' and recipients' views about involvement in decision-making on the use of embryos created by gamete donation in research. BMC Medical Ethics. 2019; 20(1):90.
13. Rautji R, Dingre N, Karmarkar M, Deshpande K. Legally Safe Medical Documentation: Ensuring Compliance and Patient Protection. J Forensic Med Sci Law. 2024;33(2):79-81. doi: 10.59988/jfmsl.vol.33issue2.14
14. Bartolacci A, Dolci C, Pagliardini L, Papaleo E. Too many embryos: a critical perspective on a global challenge. J Assist Reprod Genet. 2024; 41(7):1821-4.
15. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research - Ethical aspects. J Forensic Med Sci Law. 2024;33(1):1-4. doi: 10.59988/jfmsl.vol.33issue1.1
16. Dere RC, Kukde HG, Deokar RB, Patil SS, Kumar NB. Executive summary of the XXIV State Annual conference of Medicolegal Association of Maharashtra (MLAM): Forensicon 2021. J Forensic Med Sci Law 2022;31(1):84-88.
17. Deokar RB, Patil SS. Avenues in Forensic Medicine. J For Med Sci Law 2023;32(2):1-3.
18. Mohite S, Sukhdeve R, Sonawane S, Deokar R, Kolle S, Hinnawi S. Executive Summary of the XXVI Annual State Conference of Medicolegal Association of Maharashtra (MLAM) - Forensicon 2023. J Forensic Med Sci Law. 2024;33(2):73-78. doi: 10.59988/jfmsl.vol.33issue2.13
19. Asplund K. Use of *in vitro* fertilization-ethical issues. Ups J Med Sci. 2020; 125(2):192-9.
20. Pande PVS et al. Survivors of Child Sexual Violence in India and Their Search for Justice: A Case Series and Review of Literature. J Forensic Med Sci Law 2023;32(2):63-69.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Review Article

From Hippocratic Oath to Digital Sovereignty: Legislating Patient Data Rights and Protection in Nigeria and India

Chinyere C Ogah[a], Chuks Molokwu[b], Princess Chinyere Ngene[c], Victor C Aneke[c], Hemen P Faga[d]*
[a]Senior Lecturer, [d]Professor, Faculty of Law, Ebonyi State University, Abakaliki, Nigeria. [b]Lecturer, Department of Forensic Science, Federal University of Technology, Owerri, Nigeria. [c]Lecturer, David Umahi Federal University of Health Sciences, Uburu, Nigeria.

Article Info

Received on: 06.09.2024
Accepted on: 25.10.2025

Key words
Data protection,
Patient rights,
Data sovereignty,
Medical records,
Digital privacy.

Abstract

Introduction: In the digital age, the data subject is increasingly empowered to control and determine the uses of information relating to his digital identity. Medical records have gradually transcended their physical form into sensitive digital data. **Objective:** This paper examines the current state of legal frameworks in Nigeria and India protecting this sensitive data and its governance vis-à-vis the patient's right of data sovereignty**. Methodology:** Using the doctrinal black-letter approach, which includes primary and secondary sources, the paper examines the governance of sensitive health data under the Nigeria Data Protection Act (NDPA) 2023 and India's Digital Personal Data Protection Act (DPDPA) 2023 to determine if patients in the two jurisdictions have attained digital sovereignty, and analyses how these jurisdictions balance the sanctity of medical confidentiality and patient data sovereignty. **Results and Discussion:** It argues that while India has developed a robust jurisprudence recognizing patient data rights through consumer protection law, Nigeria's approach was historically restrictive, finding that the enactment of the NDPA 2023 represents a seismic shift, potentially bringing Nigeria's statutory framework in line with modern data protection principles and, in some aspects, surpassing India's yet-to-be-fully-implemented DPDPA 2023. **Conclusion:** The paper concludes that both nations are on a convergent path towards empowering patients as data subjects, but success hinges on effective implementation, robust enforcement, and cultural change within healthcare institutions.

1. Introduction

A patient's journey through the healthcare system leaves a digital and paper trail—a narrative of vulnerability, hope, diagnosis, and treatment. This narrative encapsulated in the medical record,

How to cite this article: Ogah CC, Molokwu C, Ngene PC, Aneke VC, Faga HP. From Hippocratic Oath to Digital Sovereignty: Legislating Patient Data Rights and Protection in Nigeria and India. J Forensic Med Sci Law. 2025;34(2):57-62. doi: 10.59988/jfmsl.vol.34issue2.11

***Corresponding author:** Hemen P. Faga, Professor, Faculty of Law, Ebonyi State University, Abakaliki, Nigeria.
Email: hemenfaga@gmail.com

is more than a clinical tool; it is a profound repository of personal data, intimately detailing the patient's biological data and vulnerabilities.[1] Historically, this dossier was treated as the exclusive property of the healthcare institution, a secret ledger locked away from the very person it described.[2] The patient was a subject of the record, not its owner.

Today, a global revolution in data protection challenges this paternalistic model. The concept of 'information self-determination' posits that individuals have a fundamental right to control their personal data.[3] a category in which health information is arguably the most sensitive. This paper explores the tumultuous journey towards recognizing this right in two of the developing world's largest democracies: **Nigeria and India**. Both nations share interesting similarities: an expanding population; a rapidly digitalizing healthcare sector, and a history of relegating patient access to medical records to a privilege, rather than a right.[4]

This paper delves into the legal history, judicial activism, and regulatory challenges that define the battle for patient data sovereignty. It examines Nigeria's transformative Data Protection Act (NDPA) 2023 against India's revolutionary Digital Personal Data Protection Act (DPDPA) 2023 and the complex tapestry of medical ethics and consumer law, to answer the following questions: have patients in both countries attained digital sovereignty in the protection and governance of their personal health data? What are the gaps evident in Nigeria and India's data protection legal framework for the protection and governance of patients' personal health data? How can these gaps be remedied drawing from the provisions of each country's data protection regime?
In order to answer these questions, the paper is divided into eight sections. Section 2 explains the research methodology. Sections 3 and 4 establishes the special status of health data and the critical balance between confidentiality and the governance of health data in Nigeria and India. Section 5 examines Nigeria's transformative journey from a paternalistic model to the rights-based paradigm of the Nigeria Data Protection Act (NDPA) 2023, while section 6 traces India's development of patient rights through robust consumer jurisprudence underpinned by the Digital Personal Data Protection Act (DPDPA) 2023.

Section 7 offers a structured comparative analysis of both regimes in Nigeria and India, evaluating the rights and gaps for the protection and governance of personal health data. Section 8 contains the conclusion and recommendations for both countries to achieve genuine patient data sovereignty through effective enforcement, cultural change, and legal harmonization.

2. Method

The paper adopts a comparative legal research method utilizing the doctrinal black-letter approach to analyze the primary legislative frameworks of Nigeria's Data Protection Act (NDPA) 2023 and India's Digital Personal Data Protection Act (DPDPA) 2023. The research involves a critical analysis of these statutes and regulatory guidelines, supplemented by secondary sources including scholarly journal articles, books, online sources and case law. The objective is to systematically compare the provisions for patient data rights, identify regulatory gaps, and evaluate the efficacy of each legal regime in transitioning from traditional medical confidentiality to a modern framework of digital data sovereignty, thereby assessing their alignment with global data protection standards.

3. Medical Data: Why It Demands Special Protection

Medical data encompasses a wide spectrum of information, from genetic blueprints and biometric data to medical history, diagnosis, and treatment notes.[5] It can reveal not just current health status of a patient but also future vulnerabilities, family lineages, and deeply private aspects of one's life. The sensitivity of this data creates a dual imperative:

a. Protection: it must be shielded from unauthorized access, misuse, and discrimination. A data breach involving health information can have devastating consequences, from social stigma to insurance denial and employment discrimination.
b. Access: the data subject—the patient—must have the ability to access, understand, and utilise this information for their own care, continuity of treatment, and empowerment.

In both Nigeria and India, the transition from paper-based to electronic health records (EHRs) has amplified these imperatives.[6] Digitisation offers immense benefits for healthcare delivery but also magnifies the risks of data misuse and the critical need for robust legal safeguards.

4. Confidentiality, Trust, and the Governance of Health Data in Nigeria and India

There is a veiled connection between the time-honored principle of confidentiality and data self-determination of patients.[7] Historically, the ethical duty of confidentiality enshrined in professional codes like the Medical and Dental Council of Nigeria

(MDCN) Code of Medical Ethics[8] and the Medical Council of India (MCI) Regulations,[9] is the bedrock of therapeutic alliances. However, the digital revolution has fundamentally reshaped this matrix such that the patient's narrative is no longer confined to handwritten notes in a dusty file, but now transformed into structured digital data that can be copied, stored, analyzed, and shared across continents in milliseconds. Therefore, for the patient to retain control of health data, this transformation demands a parallel evolution of the traditional, albeit crucial, ethical duty of confidentiality, towards a more robust, comprehensive governance structure for the entire lifecycle of data processing. This encompasses not just the final act of disclosure, but every step including the initial collection, its storage security, the myriad uses, and the potential transfer to third parties.[10,11]

Such shift creates a critical tension, particularly in the realm of secondary data use—using health data for purposes beyond the immediate clinical care of the individual patient,[12] extending to vital endeavors like biomedical research, public health surveillance, epidemiological studies, and healthcare system planning. Indeed, in vast and diverse nations such as Nigeria and India, the potential benefits of aggregated health data could be staggering; it may help track the spread of infectious diseases, identify risk factors for non-communicable diseases like diabetes and hypertension, and ultimately develop more effective, personalized treatments tailored to their unique populations.[13]

The ethical and legal challenge of the digital revolution vis-à-vis confidentiality and data self-determination of patients is striking a balance between the public good and the individual's right to privacy and autonomy. This can be achieved through implementing principled safeguards, such as:

a. Anonymisation and Pseudonymisation*:* the former (Anonymisation) irreversibly strips data of all direct and indirect identifiers and effectively removes the data from the scope of privacy laws.[14] The latter (Pseudonymisation) on the other hand, replaces identifying fields with artificial identifiers, which offers a practical middle ground. Both principles protect patient identity while allowing researchers to link data points meaningfully.[15]
b. Purpose Limitation and Data Minimisation*:* purpose limitation mandates that data collected for one specific purpose (e.g., treating malaria) should not be arbitrarily repurposed for another (e.g., marketing insurance products) without further authorisation.[16] Data minimisation requires that only data that is strictly *necessary* for the stated purpose is collected. This prevents the hoarding of excessive, sensitive information, thereby reducing the risk and impact of potential data breaches.[17]

The legal landscape in both Nigeria and India increasingly reflects this sophisticated approach. The era of relying on broad implied consent—where a patient's mere presence in a hospital was sufficient consent to any future use of their data—has ended. Nigeria and India's new data protection laws, the NDPA (2023) and DPDPA (2023), pushes towards models where patients are informed about how their data would be used for secondary purposes, and their consent explicitly and specifically required for such activities.[18]

This seismic shift transforms the patient from a passive subject of data collection into an informed participant in the health data ecosystem, with the right to know how his digital double is being used to advance medicine, and the power to consent to that noble cause.[19]The balance between harnessing the incredible power of health data for the greater good and protecting individual privacy is the defining challenge of modern medical ethics in the digital age.

5. The Nigerian Landscape: From Paternalistic Custodianship to Data Subject Empowerment

5.1 The Pre-NDPA 2023 Era: A Regulatory Vacuum

Prior to 2023, Nigeria's legal framework for medical data protection was strikingly anachronistic.[20] The MDCN Code of Medical Ethics 2008 and sections 27-29 of the National Health Act (NHA) 2014 placed the ownership and control of medical records firmly with healthcare providers.[21] Paragraph 44 of the MDCN Code explicitly stated that records were "not for the consumption of any person who is not a member of the profession". Patients seeking their records for litigation or second opinions faced a wall of institutional resistance, often having to resort to costly court orders for disclosure.[22] This created a profound power imbalance, leaving patients unable to verify the accuracy of their records or hold providers accountable.

5.2 The Paradigm Shift: The Nigeria Data Protection Act 2023

The enactment of the Nigeria Data Protection Act (NDPA) 2023 was a watershed moment. Section 34 of the Act reclassifies the patient from a passive subject to an active data subject with enforceable

rights. By defining health data as "sensitive personal data" in section 65, the Act in section 30 imposes stricter processing conditions. Key rights granted to patients (data subjects) under the NDPA include:

a. Right of access *(section 34):* The right to obtain a copy of their personal data in a commonly used electronic format.
b. Right to data portability *(section 38):* A revolutionary right to receive their data in a structured, machine-readable format and transmit it to another provider. This right, inspired by the EU's General Data Protection Regulation (GDPR), has the potential to break down data silos and foster competition and continuity of care.
c. Rights to rectification, erasure, and restriction of processing *(*sections 35, 36, 37*):* Empowering patients to correct inaccuracies and control further processing of their data.

Crucially, section 63 of the NDPA gives it supremacy over any inconsistent provision in prior laws like the NHA 2014, effectively nullifying clauses that denied patient access.

6. The Indian Framework: A Tapestry of Consumer Jurisprudence and Evolving Statute

India's journey has been different, characterized not by a single legislative breakthrough but by a gradual, court-driven evolution towards recognizing patient rights, primarily through the lens of consumer protection.

6.1 Regulatory guidance and judicial activism

Regulation 1.3.2 of the MCI Regulations 2002 mandates that medical records be provided to patients or their authorized attendants within 72 hours of a request. This creates a clear, albeit ethically-based, obligation. Indian courts, particularly the National Consumer Disputes Redressal Commission (NCDRC) and various State Commissions, vigorously enforced this right.[23,24] In a series of landmark judgments, the courts ruled that:

a. Withholding medical records constitutes "deficiency in service" under the Consumer Protection Act.
b. Adverse inferences can be drawn against hospitals that fail to produce records in negligence cases.[25]
c. The defence of "routine destruction" of records is unacceptable when litigation is anticipated.[26,27]

This jurisprudence humanized the law, placing the patient's right to know and seek redress at the forefront.[28]

6.2 The Digital Personal Data Protection Act (DPDPA) 2023

India's new DPDPA 2023, seeks to consolidate this framework into a modern data protection regime. Like Nigeria's NDPA, sections 6, 7, 11 and 12 of the DPDPA requires explicit consent for processing health data, and grants rights of access and erasure. However, it contains some significant drawbacks compared to the NDPA. First, it fails to define health data or categories it as sensitive personal data, although section 7 includes health services as one of the 'legitimate uses' for which data can be processed. This reduces the effectiveness of the Act in protecting health data compared to the NDPA, which imposes a duty on the data controller or data processor to assess the risks involved in handling such sensitive health data. Second, its implementation is still in its infancy,[29] and its interaction with the existing sector-specific rules (MCI Regulations) and powerful consumer jurisprudence remains to be tested. A critical omission, compared to Nigeria's NDPA, is the lack of an explicit right to data portability, which could be a significant drawback for patients in a fragmented healthcare market.[30, 31] Social criticism strengthens legal system by ensuring laws dealing with societal needs for data privacy with enhancing transparency, fostering civic trust, and contributing to a more equitable and sustainable legal system.[32]

7. Comparative Analysis: Two Paths to a Common Goal

The comparison is given in Table 1.

Table 1: Comparative Analysis Nigeria & India.

Feature	Nigeria (Post-NDPA 2023)	India (Post-DPDPA 2023)
Core Legal Basis	Dedicated, comprehensive data protection law (NDPA)	New data protection law (DPDPA) layered over strong consumer protection law and medical ethics regulations.
Right of Access	Statutory right to access and copy.	Statutory right under DPDPA, plus a pre-existing regulatory (MCI) and judicial mandate for access within 72 hours.
Data Portability	Explicit statutory right to receive data in a machine-readable format and transmit it.	Not explicitly provided in the DPDPA (a significant gap).
Enforcement Mechanism	Nigeria Data Protection Commission (NDPC)	Data Protection Board of India (DPBI) – yet to be fully operationalised;[31] currently heavily

		reliant on judicial enforcement.
Historical Context	Radical shift from a restrictive, paternalistic model to a liberal, rights-based one.	Evolutionary development, with courts using consumer law to create a *de facto* rights regime ahead of formal statute.
Biggest Challenge	Implementation and cultural change. Overcoming deep-seated institutional resistance in the healthcare sector and building the capacity of the new NDPC	Integration and clarity. Harmonizing the new DPDPA with existing powerful laws (Consumer Protection Act, MCI rules) and ensuring the new DPBI is effective.

This comparison reveals that Nigeria has, on paper, leaped ahead with a more GDPR-aligned framework, particularly with its inclusion of data portability.[33] India, however, has the advantage of a well-established body of case law that has already normalized the concept of patient data rights for both the public and the judiciary.[34]

8. Conclusion and Recommendations: The Road Ahead for Data Sovereignty

The enactment of the NDPA 2023 signals a commitment to bring Nigeria's data protection standards in line with global norms. India's framework, while currently more complex and lacking in portability, is built on a solid foundation of judicial precedent that has actively protected patients for over two decades. However, for patients in both countries to truly enjoy data rights and protection under the new legal frameworks, Nigeria must implement the newly adopted General Application and Implementation Directive (GAID) 2025, which provides clarity on data portability right, including technical standards, timelines, and permissible fees under the NDPA regime.

The Nigeria Data Protection Commission must also embark on awareness campaigns to educate patients and healthcare providers about their new rights and obligations, and build enforcement capacity to ensure compliance and impose meaningful sanctions for violations. India on the other hand, must provide clear guidance on harmonizing the DPDPA with the Consumer Protection Act 2019 and MCI regulations to avoid legal confusion. It must consider a future amendment to the DPDPA to introduce a right to data portability similar to the position under the NDPA 2023, to further empower patients and promote interoperability in the healthcare sector. The Data Protection Board of India must be set up expeditiously to provide a dedicated and expert enforcement authority. More so, the courts in both countries must continue to play a proactive role in interpreting these new laws in favor of patient autonomy and privacy, and finally, the development of a secure, standardized, and interoperable Electronic Health Record system must be prioritized to make these rights technically feasible.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

Source of funding: None to declare.

References:

1. Basil NN, Ambe S, Ekhator C, Fonkem E. Health Records Database and Inherent Security Concerns: A Review of the Literature. Cureus.2022; 14(10): e30168.
2. Mair J. Who Owns the Information in the Medical Record? Copyright Issues. Health Inf Mgt J. 2011; 40(3):31-7.
3. Hooghiemstra T. Informational Self-Determination, Digital Health and New Features of Data Protection. EDPL.2019; 2: 160.
4. Oke GI, Sibomana O. Adoption of Digital Health Technology in Nigeria: A Scoping Review of Current Trends and Future Directions. Adv Public Health. 2025; 2025(1):4246285.
5. Dahdah MI, Mishra RK. Digital Health for All: The Turn to Digitized Healthcare in India. Soc Sci Med. 2023; 319: 114968.
6. Floyd PT, Oates JC, Acker JW, Warren RW. Defining the Medical Record: Relationships of the Legal Medical Record, The Designated Record Set, and the Electronic Health Record. Perspect Health Inf. Manag. 2021; 18(4): 4.
7. Olukorode SO, Adedeji OJ, Adetokun A, Abioye AI. Impact of Electronic Medical Records on Healthcare Delivery in Nigeria: A Review. PLOS Digit Health. 2024; 3(9): e0000420;
8. Onyegbule KG, Nnaemeka NE. Protecting Patient Confidentiality in Nigeria: Legal, Ethical, and Public Health Perspective. NAU J Comm Prop L.2025; 12(2): 11-2.
9. Medical Council of India (Professional Conduct, Etiquette and Ethics) Regulations, 2002.
10. Deokar RB, Patil SS, Chavan KD. Current Medical Ethical Issues. Int J Educ Res Health Sci 2019; 2(3):1-3.
11. Kerr G, Kulshreshtha N, Greenfield G, Li E, Beaney T, Hayhoe BW et al. Features and frequency of use of electronic health records in primary care across 20

countries: a cross-sectional study. Pub Health. 2024; 233:45-53.
12. Alhomidan ZS, Albaqami NM, Alshehri AA, Aldubaib AA, Alsuwailem AB, Ghadam KFA. Confidentiality in the era of electronic health records: ethical challenges and solutions. Int J Community Med Public Health. 2025; 12(4): 1904–10.
13. Vayena E, Blasimme A. Health research with big data: Time for systemic oversight. J Law Med Ethics. 2018; 46(1): 119–29.
14. Dornan L, Pinyopornpanish K, Jiraporncharoen W, Hashmi A, Dejkriengkraikul N, Angkurawaranon C. Utilisation of Electronic Health Records for Public Health in Asia: A Review of Success Factors and Potential Challenges. BioMed Res Int'l.2019; 8: 7341841.
15. Tahir H, Brezillon P. Data Anonymization Process Challenges and Context. Int'l J Database Mgt Sys.2023; 15(6): 1-10.
16. Adedipe AA, Oke C, Oke B. Enhancing Data Privacy: Pseudonymization and the Nigeria Data Protection Act (2023). Duale, Ovia & Alex – Adedipe Legal Associates, 2024, [cited on 16th Sept 2025]. Available from: https://www.doa-law.com/wp-content/uploads/2024/08/Pseudonymization-Article_v2.pdf
17. Winter JS, Davidson E. Big Data Governance of Personal Health Information and Challenges to Contextual Integrity. The Inf Soc. 2019; 35(1): 36-51.
18. Park HA. The Dt Min Protocol: Implementing Data Minimization Principles in Medical Information Sharing. Electronics. 2025; 14: 1501.
19. Sood A, Mishra D, Surya V, Singh H, Sundaresan R, Pal D et al. Challenges and Recommendations for Enhancing Digital Data Protection in Indian Medical Research and Healthcare Sector. NPJ Digit Med.2025; 8(1):48.
20. Akker van den OR, Stark S, Strech D. Ethics Practices Associated with Reusing Health Data: An Assessment of Patient Registries. BMC Med. 2024; 22: 577.
21. Idoko B, Alakwe JA, Ugwu O, Idoko JE, Idoko FO, Ayoola VB et al. Enhancing healthcare data privacy and security: A comparative study of regulations and best practices in the US and Nigeria. Magna Scientia Adv Res Reviews. 2024; 11(2): 151-67.
22. Aderibigbe TO, Sodipo B. Patient's Medical Records, Privacy and Copyright in Nigeria: On-going Research. Univ Western Austr L Rev.2017; 42(2): 89-90.
23. Athavale SU. Digi Doctor- Concise Review of Telemedicine Practice Guidelines, 2020. J Forensic Med Sci Law. 2021; 30(2):63-6.
24. Gupta M, Gupta, B. Consumer Protection Act in Medical Practice: A Narrative Review from an Indian Perspective. Int J Med Pub Health. 2025; 15(3): 1981-7.
25. Kanaiyalal Ramanlal Trivedi v Dr. Satyanarayan Vishwakarma (1996) 3 CPR 24 (Guj); (1997) 1 CPJ 332 (Guj); (1998) CCJ 690 (Guj). Ozair Husain v Union of India, AIR 2003 Delhi 103.
26. Patil SS, Deokar RB, Dere RC. Euthanasia and Living Will -Right to Die with Dignity: A Literature Review. J Forensic Med Sci Law. 2023; 32(2):75-9.
27. Dr. Shyam Kumar v Rameshbhai, Harmanbhai Kachiya (2002) 1 CPR 320; (2006) 1 CPJ 16 (NC).
28. Deokar RB, Patil SS. Cybercrime: Medicolegal Perspective. J Forensic Med Sci Law. 2025;34(1):1-3. doi: 10.59988/jfmsl.vol.34issue1.1
29. SA Quereshi v Padode Memorial Hospital and Research Centre II (2000) CPJ 463 (Bhopal).
30. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research - Ethical aspects. J Forensic Med Sci Law. 2024;33(1):1-4. doi: 10.59988/jfmsl.vol.33issue1.1
31. Bahl R, Bagai R, Ghoshal S, Iyer A. Data Protection Laws and Regulations India 2025. International Comparative Legal Guides, 2025, [cited on 24th Sept 2025]. Available from: https://iclg.com/practice-areas/data-protection-laws-and-regulations/india
32. Bich NN, Tuan VV. Social Criticism and its Impact on Law-Making Activities in Vietnam: A Critical Analysis. J Forensic Med Sci Law. 2025;34(1):44-49. doi: 10.59988/jfmsl.vol.34issue1.9
33. Centre for Health Equity, Law & Policy, Endangering Health Data: An Issue Brief on India's Data Protection Law, Indian Law Society 2024, [cited on 26th Sept 2025]. Available from: https://bfda9b73-bb63-4945-b64d-2477e3eb985d.usrfiles.com/ugd/bfda9b_2a1937feefe84d0b9b0847802d2493a1.pdf
34. N Viswanath, G Kedia. 'Operationalising the DPDPA: Implementing Consent Management Systems', Mondaq, 20 June 2025, [cited on 30th Sept 2025]. Available from: https://www.mondaq.com/india/privacy-protection/1639922/operationalising-the-dpdpa-implementing-consent-management-systems.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Review Article

Decoding Criminal Symbolism: Integrating Forensic Semiotics, Linguistics and Behavioural Profiling in Investigation

Rajneesh Kumar[a*], Gurminder Kaur[a], Ankit Anand[c], Hrishikesh Manu[d], M Shamima Parveen[e]
[a]Research Scholar, [b]Assistant Professor & Head, School of Law, Pondicherry University, R. V. Nagar, Kalapet, Puducherry, Pin-605014, India. [c]Assistant Professor, Crescent School of Law, B S Abdur Rahman Crescent Institute of Science and Technology, GST Road, Vandalur, Chennai, Tamil Nadu, Pin Code- 603 203. [d]Assistant Professor of Law, Chanakya National Law University, Nyaya Nagar, Mithapur, Patna- 800001, Bihar, India. [e]Associate Professor, Saveetha School of Law, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India. Pin - 600 056.

Article Info

Received on: 16.10.2025
Accepted on: 05.11.2025

Key words
Behavioural Profiling, Crime Scene Analysis, Criminal Symbolism, Forensic Linguistics, Forensic Semiotics.

Abstract

Introduction: Crime scenes are commonly contaminated with symbolic artefacts, graffiti, inscriptions or ritualistic arrangements that reveal offender intention and behaviour. Classic forensic approaches focus on physical evidence, while the potential of semiotic and linguistic interpretations has been to date overlooked. **Objectives:** This study integrates forensic linguistics and semiotics in crime scene analysis, focusing on how symbolic evidence can contribute to offender profiling, behaviour interpretation and investigative procedures. **Materials and Methods:** A systemic review of peer reviewed articles, cases report and forensic books published in last two decades were analysed. Research related to crime scene symbolism, forensic linguistics, and behavioural profiling was reviewed with respect to methodology, findings, and applied usefulness. **Results:** There are patterns suggesting an association between symbolic artefacts and offender's behaviour forms of communication and psychological characteristics. Incorporating semiotic and linguistic models facilitates contextualised comprehension of crime scenes and the making of investigative decisions while also pinpointing unmet needs in terms of standardisation, methodological robustness as well cross-jurisdictional bending. **Conclusions:** Forensic semiotic linguistic analysis is a promising interdisciplinary supplement to routine investigation. More attempts in the future should ideally concentrate on standardization, empirical validation and integration into forensic casework routine to enhance interpretation of evidence and judicial reliability.

1. Introduction

A crime scene is much more than a physical locale of violence or infraction; it is a communicative space inscribed with traces of human action, intention, and emotion. Crime scene

How to cite this article: Kumar R, Kaur G, Anand A, Manu H, Parveen MS. Decoding Criminal Symbolism: Integrating Forensic Semiotics, Linguistics and Behavioural Profiling in Investigation. J Forensic Med Sci Law. 2025;34(2):63-69. doi: 10.59988/jfmsl.vol.34issue2.12

***Corresponding author:** Rajneesh Kumar, Research Scholar, School of Law, Pondicherry University, R. V. Nagar, Kalapet, Puducherry, Pin Code- 605014, India. (M): +91-7277709863. Email: rkgupta2311@gmail.com

investigation in India has been transformed slowly but surely from a primitive, knocking-at-doors traditional inspection of crime scenes to a more scientific forensic visitation and examination. Prior investigative methods were primarily based on testimony of eyewitnesses, circumstantial re-enactment and intuitive reasoning by detectives. However, in the wake of forensic science laboratories as institutions, digital forensics and behavioural profiling units, it has turned from a one-off practice to standardised evidence usage.

2. Historical Development of Crime Scene Investigation in India

India has moved away from intuitive policing and eyewitness accounts to a system that is more evidence-based and organized. Confessions and conjectural reasoning were key to pre-independence investigations. Evidentiary standards were set by the Indian Evidence Act, 1872, and 1957 saw the establishment of the Central Forensic Science Laboratory (CFSL), which was the first sign that scientific crime-solving was on its way. The introduction of fingerprinting, toxicology, serology and subsequently DNA and digital forensics increased the reliability of investigations. But the Indian forensic approach remains predominantly materialist, fascinated by what occurred rather than why. This disparity between physical trace and psycho-social meaning is one indication of the necessity for a forensic semiotics/linguistics which decodes symbolic residues such as graffiti, ritual marking, and behavioural indicators. So the history of crime scene investigation in India must be seen in terms of a semiotic turn, where science approaches interpretation of criminal intent and significance.

Relevance of Symbolic and Semiotic Evidence

Contemporary forensic semiotics examines communication, psychology and criminology through the study of the signs by which context clues relay an offender's logic or motive. Such evidence whether in ritualistic patterns, verbal expressions or digital symbols offers a behavioural map that complements classical forensic results. Semiotic analyses of memes, emojis and digital discourse play a key role in bringing to light intent, ideology and emotional disposition of cyber and ideology-related crimes. Through the combination of semiotic, linguistic and behavioural analysis, it is possible not only to chart the order of acts but also gain insight into the meaning-system in which those acts were made. This movement from evidence conceived of as object to evidence understood as sign complexifies the scientific and psychological understanding of criminal behaviour.

The present review attempts to consolidate the recent literature and case study on the significance of forensic linguistics, semiotics and symbolic evidence in crime scene investigations in India. It considers the decoding of a symbolic communication that connects physical trace to psychological insight. The paper, in the end, highlights the importance of semiotic interpretation as an adjunct to traditional forensic processes and its role in developing more nuanced and evidentially credible knowledge of criminal behaviour and investigative truthfulness of Indian criminal justice system.

3. Signs, Symbols, and Speech: Forensic Semiotics and Linguistics in India

Crime scenes themselves are interpreted not only in terms of physical context, but also as a signifying process and language. Forensic semiotics, a relatively new cross-disciplinary field, uses the concepts of semiotic theory and especially the idea of the signifier and signified from Ferdinand de Saussure to decrypt crime as a mode of communication.[1] In the work of forensic investigation, each object, gesture or space is a sign that carries with it an intentional (or unconscious) message about the mentality of the criminal.[2] The semiotic method tries to discover the story behind the set, why certain objects are there as they are and how, for example, some symbols or markings could suggest dominance, revenge or even mental anguish or what culturally bound or subjective meanings might account for them. As a practical aid to investigation, semiotic analysis templates can be employed through which visual or spatial symbols (e.g., crosses; circles; religious motifs) may be logged under thematic indicators such as "control", "fear", "ritualism", or "ideology". Such templates assist in bridging the relationship between specific symbolic configurations and the offender's modus operandi or type.

As a counterpart to this, forensic linguistics considers language as evidence. It includes handwriting analysis, judicial screening of suicide notes and ransom demands, and vetting the authorship of digital messages. Language cues, including syntactic, lexical, and acoustic content as well as semantic anomalies would reflect deception, coercion or emotion. As much of the crimes committed in India include multilingual communication, forensic linguistics can thus be useful. Investigators often come across messages in

Hindi, English or regional scripts such as hybrid code-mixing commonly observed among texts exchanged in urban digital communication. While it makes analysis more difficult, there is also valuable information on where offenders are from based on the variety of language that has been recorded. The linguistic behaviour, such as the ratio of code mixing and script alternation to regional vocabulary and discourse style etc., is more frequently being deployed for establishing the socio-linguistic background, level of education or the region from where suspects belong. In this light, forensic linguistics serves to capture information about not only language authenticity but wearer behaviour as well.

Semiotics and linguistics in association with behaviour profiling that enhances the interpretational efficiency of forensic investigation. Behavioural science studies psychological motivations and personality traits, semiotic and linguistic cues can be context evidence concerning communication and symbolism.[3] For instance, there might be a connection between usage of particular words or colours or religious symbols/references and certain offender types (e.g., narcissistic ritual-based ideological offenders). For example, repeated references to certain symbols such as trident (trishul) or specific colour schemes may reflect ideological or ritualistic motivations and help the investigator bridge symbolic expression and psychological predisposition.

The Indian scenario is fraught with cultural and linguistic diversity, which makes forensic interpretation challenging. Symbols can have multiple interpretations for various groups; colours, gods or objects of worship can represent either religious expression or criminal activity according to circumstances. Officers are rarely correctly trained in semiotic and linguistic analyses, they may interpret the inscriptions being analysed incorrectly. However, despite these constraints increasing academic interest and interdisciplinary collaboration is placing India's forensic perspective in wider picture. The creation of structured semiotic and linguistic assessment methods, as well as their inclusion in forensic teaching and police investigation manual, would lead to positive impact on the reliability of practical symbolic and linguistic interpretation in India.

4. Understanding Symbolic Evidence through Rituals, Graffiti and Digital Whispers

Symbolic evidence in forensic research sometimes extends beyond traditional material traces, to the place where culture and communication intersects with criminal intention. With its heterogeneous socio-religious and linguistics makeup, India makes decoding such symbols both crucial and complicated. The language of symbols is often the criminal vernacular, from ritualistic artefacts to coded graffiti and digital icons. Traditional Ritualistic and cultural symbols rank amongst the oldest types of symbolic evidence in Indian crimes. Offences relating to human sacrifice, tantric practices and caste retaliation often include ritual objects like ashes, vermillion, blood stains or consecrated items set out in deliberate patterns. This kind of relic is usually a composite of unreason, identity and mental deviancy. In some rural homicide cases, yantras or religious drawings have been found near the victim's body to invoke protection or claim ownership. The police make a lot more money from these and similar "superstitious vestiges." They rather consider their outreach side as atavistic.[4] A significant lacuna remains between anthropological knowledge and forensic practice, highlighting the necessity for culturally attuned investigative models.[5]

Urban Graffiti and Coded Messages find a more recent technique for symbolic communication within the city based crime scene. Indian cities have seen the use of graffiti as territorial markers not just by street gangs and political agitators but also by cyber-vigilante groups. These inscriptions, which include numeric signs and symbolic emblems, function as nonverbal claims of power and membership. In some instances, graffiti has been deployed after-the-fact as performative acts, intended to mock police or bolster group solidarity. But in India, it is seldom that our policing and forensic agencies have databases to recall graffiti, unlike the western counterparts. This mirrors a more general institutional delay in the acceptance of urban semiotics as an appropriate forensic instrument.

Digital Symbolism has evolved to be our next generation's frontier of forensic reading. The signals are hidden in online discourse like hashtags, emojis, memes or symbols used on the dark web and have double significance: hate-connected hub at one end of a dialogue, mass violence plotting at the other. Such a semiotic landscape in India's cybercrime especially when found between encrypted transactions or social media exchanges demands interpreting. For instance, fanatical organisations

have been known to use seemingly benign emojis or modified memes to plant recruitment messages or send threats without any text. At the same time, Indian cyber-forensic infrastructure is overwhelmingly reactive and not interpretive when it comes to digital symbology but rather concerned with finding material evidence.

In traditional, urban and digital settings, recurring motifs in Indian crime demonstrate a timeless truth: symbols bridge intent with act, psyche with scene. It's not so much that they are missing but that the system does not see them as indications of something. Integrated institutionally, forensic semiotics can transpose those covert signs into narrative-reconstructive and behaviour-interpretative mechanisms thereby enhancing the epistemic ground of Indian criminal investigation.

5. Case Studies and Narratives from the Indian Crime Scene

The semiotic nature of forensic investigation is thus most vividly drawn in actual cases. Crime scenes of India steeped in cultural diversity and social conflict, exhibit patterns of symbolic communication which frequently evade traditional forensic analysis. In custodial deaths, ritualistic murders or serial killings too, what symbols do is that they are means of power and a mode of recording in the psychic planning.[6] A close reading of couple of Indian cases proves the vacuum in interpretation that exists between behavioural science hypotheses to legal evidence.

Custodial Death as a category poses one of the most disturbing facets of forensic deduction. Autopsy reports often show evidence of injuries that are not in line with official accounts marks from ropes indicating restraint, abrasions in areas of pressure or positional asphyxia, which is a form of torture.[7] Read semiotically, these physical indicators convey an institutional violence and an inequity of power reposing in state authority over subject. The aesthetic configuration of the scenes, e.g. victims in a kneeling or suspended position, can serve for both exercises of power as well as to silence witness. In the killing of P. Jeyaraj and J. Bennicks in Tamil Nadu (2020), forensic evidence, along with symbolic humiliations, was a reminder that violence doesn't work simply as act but as message.[8] However, the Indian investigative spectroscope features little such evidence-based crackling around spatial or corporeal symbolism; a reluctance at interpretation of crime-scenes as anything other than material.

Ritualistic Murders and Cult Crimes also reveal the conflicting tangle of belief, dread, and forensics. Several "tantric" murders, the bodies of victims bearing ritual signs or surrounded by sacrificial items or objects associated with religious ceremonies, have been reported from states such as Odisha, Jharkhand and Uttar Pradesh. In these instances, the crime scene serves as a performative text as a signifying act of purification, placation, or control. Yet forensic authorities tend to treat the latter as irrational practices rather than as interpretive systems that stem from local cosmologies. Failing to consult an ethnologist will generally prevent the exposure of embodied patterns, especially ones that offenders interpret as divinely inspired. The inability to offer these is a direct reflection of the lack of forensic training that is contextualized by culture including sociology and religion and not just evidence.

Serial Crimes in India have unique symbolic and behaviour signatures but there is little research on this style of offending. Both the Tamil Nadu's Auto Shankar killings [9] and Noida's Nithari child murders [10] had ritualistic undertones, sexual compulsions and object-related fetishes surfacing. Repeating methods such as burial positions, sorts of tools employed or post-death handling serves as a symbolic script through which perpetrators dominate the dead and landscapes. But Indian forensics frequently shatters these into isolated bits and pieces of evidence, while failing to see them as part of a broader communicative system of compulsion or ritual. A comparative look across metropolitan and rural contexts also indicates a contrast between the semiotic interpretations of forensics. Urban crimes, too, tend to do their talking in coded vocabularies like verbal flares, digital graffiti tags, the writings on city walls and meme-like murals that prove both mysterious and rife with subcultural identity. And in rural crimes we have a mafia of meaning created out of ritual objects, community imperatives and caste diktats that prescribe not just the motive but also the method. Institutional blinders of procedural rigidity may be the same, even as the symbolic vocabulary changes with geography. An understanding of crime, as liberated from both solved and pending cases for India's forensic landscape, suggests an impatient wait for its forensic framework to evolve beyond procedural empiricism to a more fertile ground of interpretive empiricism of symbols, space and speech approaching the discourse as communicative

extensions of criminal conduct rather than sheer co-incidence.

6. Methodological and Analytical Tools for Decoding Symbolic Evidence

Interpreting language on crime scenes necessitates an interdisciplinary tool to connect semiotics, linguistics and behaviourism. Global literature has succeeded to provide a theoretical framework but their application to the Indian perspective is not only scanty but also piecemeal and not uniform. Such methods are powerfully transformative but hampered by institutional inertia.[11]

The Semiotic Frameworks acts as the theoretical structure on which to interpret crime scene symbolism. The triadic model, including syntax (structural), semantics (sense) and pragmatics (context) enable scientists to engage with meaning rather than method. The syntactic level is concerned with spatial organization: how objects, places, or inscriptions are configured structurally in a given tableau. It is what it interprets these signs to mean whether a colour, a gesture, a symbol amounts to anger, ritual or ideology. It is the business of pragmatic interpretation to place these nuances in sociocultural and psychological context. The Indian forensic process, however, rarely uses such layered analysis; most crime-scene documentation does not extend beyond the recording of physical evidence and does not engage with its communicative aspect.[12] The lack of semiotic protocols with which to interpret the evidence lends itself to both over and under interpretation, which has in turn created evidentiary lacunae for crimes involving embedded cultural behaviours.[13]

Forensic Linguistics Techniques take this interpretive skill and apply it to language. Sophisticated linguistic profiling comprises of authorship attribution, discourse analysis, and psycholinguistic assessment of texts like ransom notes, suicide messages, or digital messages. Some of the most common forensic linguistic tools currently used in Western contexts include computer-assisted authorship analysis tools like JGAAP, Signature Stylometric and corpus linguistic software. These facilitate pattern recognition, n-gram analysis and the comparison of lexical, syntactic and stylistic features in handwritten as well as digital texts thus enabling a more systematic examination of linguistic evidence.

But India's multilingual texture complicates such analyses. Regional scripts, code-mixed language (a blend of Hindi and English), dialect diversity require an understanding of these linguistic nuances that most forensic laboratories may not have. Even digital texts, WhatsApp chats or social media postings fall under their home, and even create new semiotic codes with tones, emoji use and meme culture. While the Western forensic systems are moving towards the AI-based linguistic patterning, there have been regular inclusions of such technological moves in India only a few places like cybercrime units and are not an everyday affair to be used for mainstream forensic detections. Linguistic profiling features like code-mixing ratios, script variation, regional vocabulary and discourse style have potential to be tied to the offender's identity and its tendency.

This integration of Behavioural Profiling provides the psychological connection that links symbols and offender characteristics. Part of the foundation in behavioural forensics is connecting symbolic expression to personality structure such as control, narcissism, and ritual compulsion.[14] But in India, profiling is often anecdotal or police-led, without empirical basis. Structured instruments like the HCR-20 (Historical, Clinical, Risk Management), the Psychopathy Checklist-Revised (PCL-R) and standardized behavioural coding systems can provide measurable and interpretable offender personality traits that are related to signs of crime scene symbolism. Unified semiotic, linguistic and behaviour integration platforms thus enable cross-disciplinary teams to integrate symbolic acts, linguistic signals and personality perceptions within a single framework which tightens up interpretative consistency while reducing subjective bias.

A semiotic approach to criminal behaviour would better complement traditional psychological profiling, but psychologists are unlikely to speak the same language as linguists or investigators. The deficiency of the existing methods in India is at system rather than ideational level. There is a critical limitation of interdisciplinary training, access to linguistic databases, and research on culturally specific signs. On the other hand, a large number of Indian FSLs (Forensic Science Laboratories) are functionally constrained with highly stringent procedural guidelines and over-reliance on hard science based quantifiable evidence that precludes subjective interpretations. As a result, symbolic and linguistic evidences although abundant in narrative potential but figuratively disappear under law.

7. The Indian Challenge and Future Horizons: Bridging Gaps through Innovation and Integration

The incorporation of semiotic and linguistic analysis into India's forensic and legal systems is obstructed by a tangle of structural, legal, and cultural impediments. Symbolic and linguistic proof may shed light on the intents and patterns of behaviour of offenders, India's investigative model remains grounded in a form of stultifying empiricism: it prefers hard, clanging pieces of evidence like DNA and skin or finger prints over interpretive insights. This constructionist perspective ignores the fields that focus on meaning, communication and cultural context elements central to contemporary crime interpretation.

One limitation is the lack of standardized methods to define and maintain symbolic or lexical evidentiary data. They are not equipped to record matters of object placement, graffiti, inscriptions, or ritual configuration. Such hints therefore, go unnoticed or are dismissed as mere chance. There are no standard procedures or manuals in Indian FSLs that guide in symbolic documentation resulting in non-uniformity and loss of information case-wise. Judicial admissibility poses another challenge. Despite admitting expert evidence the Bharatiya Sakshya Adhiniyam, 2023 does not provide for semiotic and linguistic interpretation per se. Courts that they appealed to and other courts generally seem to like numbers better, because anything interpretive or involving science seems subjective or secondary to them. Sparse case law adds to the distrust in symbolic evidence, and illustrates an institutional reluctance to embrace qualitative approaches. Cultural diversity also adds complexity. Symbols and nuances of language differ across India's regions and religions, to the effect that what indicates respect in one place may mark protest or criminal affiliation in another. Without cultural literacy, detectives are in danger of misunderstanding. This problem is compounded by training lacunae: few law enforcement and forensic professionals encounter semiotics, forensic linguistics or profiling behaviour, meaning that there are procedural blanks in their understanding.[15] But regardless of those obstacles, innovation is a way forward. Various trace evidences may be collected from crime scene. Polycyclic aromatic hydrocarbons are helpful in the different fields of forensic science such as forensic toxicology, environmental forensics, petroleum forensic and food forensic.[16] The integration of artificial intelligence, machine learning, and digital forensics has the potential to change how symbolic and linguistic patterns are evaluated. They can detect patterns, spotting similar language, or a pattern of behaviour across large data sets linking crimes that may otherwise have appeared unrelated. Comparatively, in other western nations such as the US, UK and Australia there are formal semiotic and linguistic analysis procedures that have been implemented in forensic practice. As an example, structured symbolic documentation and computational linguistics for analysing threat is in use by the UK's National Crime Agency, and AI-supported authorship and semantic analysis during profiling are used by the FBI. In Australia, it is the combination of behavioural profiling and semiotic interpretation in organised crime investigations. These comparative practices illustrate that there may be ways in which India can institutionalize the treatment of symbolic evidence.

However, AI-driven symbolic analysis along with several other technologies is conspicuously missing from India's forensic ecosystem. For progress to be institutionalized, India needs nationally standardized protocols for symbol evidence.[17,18] A "Symbolic Evidence Documentation Manual" in the Bureau of Police Research and Development (BPR&D) or the Directorate of Forensic Science Services could frame categories, procedures, scissoring techniques for analysis , bringing legal legitimacy to them in court.[19,20] Capacity building is equally vital. Training of investigators, forensic scientists and judges should include forensics semiotics, linguistic analysis and behavioural profiling. These courses in law, psychology, and anthropology and data science could be included in the curricula at the National Forensic Sciences University; police training academies and judicial academies to encourage inter-disciplinary competency. Judicial recognition requires empirical support. Partnership between universities and forensic laboratories should look at how robust and useful symbolic analysis is. Slow introduction to evidence through expert testimony can assist courts in developing towards acceptance of interpretive evidence under the Bharatiya Sakshya Adhiniyam.

8. Conclusion

This paper has illustrated the interpretability of semiotic, linguistic and behavioural profiling in decoding the untold crime stories from Indian crime scenes. From the reviewed literature and case files,

we become aware of that symbol (as ritual objects, graffiti, digital imprint) serve as not only periphery interview clues but also communicative tools„ into which offender intent, cultural backdrop or even psychological state are embedded. However, India's forensic and legal practices become restricted due to procedural empiricism not taking into account the value of evidentiary and investigative signification measures. The combination of forensic semiotics, linguistics analysis and behavioural science has a potential to contribute substantially to increasing the accuracy of investigation and justice. As taking into account symbolic evidence as part of a larger communicative context, it then permits to the investigators to have a more detailed reconstruction of motive and thinking. But the level of achievements can only be considerable through standardization, advanced trainings and empirical research at Indian forensic establishments. The future of Indian forensics is what lies beyond what's seen in learning to read the language of crime not only through what's seen, but through the meant.

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.
Source of funding: None to declare.

References:

1. Danesi M. Forensic semiotics: a note on applying semiotics to the study of crime. Lang Semiotic Stud. 2019;5(1):1–20. Available from: https://doi.org/10.1515/lass-2019-050101
2. Leone M. From fingers to faces: visual semiotics and digital forensics. Int J Semiotics Law. 2021; 34(2):579–99. Available from: https://doi.org/10.1007/s11196-020-09766-x
3. Marono A, Clarke DD, Navarro J, Keatley DA. A behaviour sequence analysis of nonverbal communication and deceit in different personality clusters. Psychiatry Psychol Law. 2017; 24(5):730–44. Available from: https://doi.org/10.1080/13218719.2017.1308783
4. Shaffer R. Ritual killings: how crimes of superstition thrive in the new India. Pulitzer Center. 2021 Oct 20. Available from: https://pulitzercenter.org/stories/ritual-killings-how-crimes-superstition-thrive-new-india
5. Baryah N, Krishan K, Kanchan T. The development and status of forensic anthropology in India: a review of the literature and future directions. Med Sci Law. 2019; 59(1):61-9. Available from: https://doi.org/10.1177/0025802418824834
6. Loader I. A question of sacrifice: the deep structure of deaths in police custody. Soc Leg Stud. 2020 ;29(3):401-20. Available from: https://doi.org/10.1177/0964663919874111
7. Herath JC, Pollanen MS. Clinical examination and reporting of a victim of torture. Acad Forensic Pathol. 2017; 7(3):330-9. Available from: https://doi.org/10.23907/2017.030
8. The News Minute. 'Bennix-Jayaraj beaten till blood splashed walls, floors': CBI forensic report to HC [Internet]. 2020. Available from: https://www.thenewsminute.com/article/bennix-jayaraj-beaten-till-blood-splashed-walls-floors-cbi-forensic-report-hc-136206
9. R. Rajagopal & Ors. vs. State of Tamil Nadu & Ors. (1994 SCC (6) 632).
10. Surendra Koli v. State of Uttar Pradesh and Others, (2011) 16 SCC 494.
11. Toppo R, Sinha S. Evaluating and accessing the scope of forensic linguistics in a multilingual context in India. Language in India [Internet]. 2023; 23(8). Available from: https://languageinindia.com/aug2023/ravinaforensiclinguisticsmultilingualcontext.pdf
12. Radosteva A. Cultural consultations in criminal forensic psychology: a thematic analysis of the literature [Internet]. Los Angeles (CA): Antioch University; 2023. Available from: https://aura.antioch.edu/cgi/viewcontent.cgi?article=1453&context=etds
13. Amirbayeva D. Understanding the significance of forensic linguistics among law students [Internet]. 2024 Oct 13. Available from: https://dx.doi.org/10.2139/ssrn.5046127
14. Yang S, Liu Z. On the construction of the system for forensic psycholinguistics. Forensic Phonet Linguist Educ Dev. 2019;7(2): 109–27. Available from: https://doi.org/10.14746/fped.2018.7.2.2019.8.1.7
15. Singhania L, Thakur VS. Grammatically guilty: a critical appraisal of the salience of forensic linguistics in the criminal justice apparatus in India. Int J Semiot Law. 2025; 2:1-5. DOI:10.1007/s11196-025-10355-z
16. Satpute A, Pandey A. Importance of Polycyclic Aromatic Hydrocarbons as a Chemical Marker in Forensic Studies.J Forensic Med Sci Law 2023;32(1):80-84.
17. Aneja P, Choudhary SK, Mathur S. Speaker identification of the Electronically Disguised Voices. J Forensic Med Sci Law 2022; 31(2):56-60.
18. Deokar RB, Patil SS. Cybercrime: Medicolegal Perspective. J Forensic Med Sci Law. 2025;34(1):1-3. doi: 10.59988/jfmsl.vol.34issue1.1
19. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law 2023;32(2):1-3.
20. Dinkar VR. Forensic scientific evidence: problems and pitfalls in India. Int J Forensic Sci Pathol. 2015;3(2):79–84. Available from: https://doi.org/10.6084/m9.figshare.5666086.v1

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Review Article

The Borrowed Servant Doctrine: A Scientific Legal Review with special Reference to Indian Medical Case Law

Sachin S Patil[a*], Ravindra B Deokar[b], Rajesh C Dere[c]
[a]Professor (Additional), FMT, Seth G S Medical College & KEM Hospital, Mumbai, Maharashtra, India. [b]Professor (Additional), Department of Forensic Medicine & Toxicology, LTMMC & LTMG Hospital, Sion, Mumbai, Maharashtra, India-400022. Orcid id: 0000-0003-1539-1035. [c]Professor & Head, FMT, TNMC, Mumbai, Maharashtra, India.

Article Info

Received on: 03.02.2025
Accepted on: 25.12.2025

Key words
Vicarious Liability, Hospital Liability, Medical Negligence, Indian High Courts, Duty of Care.

Abstract

The Borrowed Servant Doctrine is a nuanced principle of agency and vicarious liability law that assigns responsibility when an employee temporarily performs duties under a third party's control. While well-developed in common law jurisdictions, the doctrine's contours in India especially in medical negligence jurisprudence remain intertwined with broader principles of hospital liability and duty of care. This review provides a comprehensive analysis of the doctrine's historical origins, legal tests, and its medico legal applicability in Indian courts. Indian High Courts and the Supreme Court have navigated overlapping supervisory relationships in healthcare settings, emphasizing control, delegation, and foreseeability in liability attribution. Incorporating recent judgments and medico-legal literature, this article argues that Indian jurisprudence implicitly incorporates borrowed servant reasoning within established vicarious liability doctrines rather than treating it as an independent principle. The review further highlights the doctrine's forensic significance in analysing complex medical negligence cases involving outsourced services, visiting consultants, and multi-institution care teams. Clear understanding of these legal mechanisms is essential for forensic practitioners, legal professionals, and institutional policymakers to ensure accountability while safeguarding professional autonomy.

1. Introduction

'Medical negligence litigation often raises complex questions of responsibility where multiple parties are involved in patient care, including hospitals, visiting specialists, trainees, and ancillary staff. Traditional vicarious liability principles encapsulated in respondent superior hold employers liable for their employees' negligent acts performed within the course of employment.[1] However, when a medical professional works under the supervision of an entity other than their nominal employer, as often happens in multi-disciplinary healthcare settings, courts must determine which institution exercised actual control at the material time.

How to cite this article: Patil SS, Deokar RB, Dere RC. The Borrowed Servant Doctrine: A Scientific Legal Review with Special Reference to Indian Medical Case Law. J Forensic Med Sci Law. 2025;34(2):70-75. doi:10.59988/jfmsl.vol.34issue2.13

***Corresponding author:** Dr Sachin S Patil, Professor (Additional), FMT, Seth G S Medical College & KEM Hospital, Mumbai, Maharashtra, India. Email: sspfmt7@gmail.com (M): +91- 9136667077.

The Borrowed Servant Doctrine, which originated in 19th and 20th-century common law, allocates liability based on supervision and control rather than contractual status. Its forensic relevance in Indian medical jurisprudence arises where hospital accountability intersects with delegated clinical practice. Medical negligence litigation in India frequently involves questions of vicarious liability, as healthcare delivery often requires teamwork among employees with varying degrees of employment affiliation. Situations such as visiting surgeons using hospital facilities, anaesthetists employed separately, outsourced laboratories, and private specialists working in government hospitals create ambiguity in identifying the legally liable party.The borrowed servant doctrine addresses this ambiguity by focusing on effective control over the medical professional at the time of the alleged negligent act.

This doctrine becomes a decisive tool in determining whether liability attaches to:

- the hospital (borrowing employer),
- the original employer (general employer), or
- both (shared control scenarios).

It is extremely important to clarify this ambiguity as there are incidence of violence against doctors, nurses and other staff as well as destruction of hospital property by the relatives of patient citing the medical negligence.[2,3,4,5]

2. Origin and Conceptual Analysis

The borrowed servant doctrine holds that an employee lent by one employer to another becomes the servant of the latter if the latter has the right to control the manner and method of work. Consequently, liability shifts to the temporary employer. The essential inquiry focuses on who had the right of control over the employee's detailed work at the time of the tortious act, a principle remarkably applicable in healthcare where institutional hierarchies and delegation are commonplace. While traditional tests for borrowed servant status include the control test, the scope of employment, and whose business was being advanced, courts prefer a fact-intensive approach to establish the party exercising functional oversight.

This control-centric analysis aligns with the underlying social policy: liability should rest with the entity that directs and benefits from the acts performed, especially in contexts like medical care where patient reliance is paramount.

In healthcare:

- Medical teams often include externally hired anaesthetists, technicians, or specialist consultants.
- Hospital staff may work under the direct supervision of a specialist surgeon or department head.
- Certain services (e.g., diagnostic labs, blood banks, physiotherapy) may be outsourced.

In these situations, the doctrine clarifies who had operational control of the professional conduct that allegedly constituted negligence.

3. Key Indian Medical Case Laws Involving Borrowed Servant Principles

While Indian courts rarely label cases explicitly as "borrowed servant doctrine," the reasoning is unmistakably aligned with it. These cases revolve around the control test, supervision test, and integration test.

3.1 Achutrao Haribhau Khodwa v. State of Maharashtra (1996)

Facts: A surgical mop was left inside the patient's abdomen.

Held: The State was held liable for negligence by hospital staff even though the negligent O.T. personnel were not directly hired by the government. The Supreme Court emphasized that the hospital had complete control of the operation theatre environment.

Relevance: This case supports the idea that when a hospital has operational control over staff regardless of employment origin, it becomes vicariously liable.[6]

3.2 Savita Garg v. National Heart Institute (2004)

Facts: A patient died due to negligent post-operative care by nursing and ICU staff.

Held: The hospital was liable because the staff, whether full-time employees or contract workers, functioned under the hospital's direct control.[7]

Relevance: The Court noted that hospitals cannot escape liability by claiming that negligent employees were not on permanent employees which is perfectly consistent with the borrowed servant principle.[7]

3.3 Dr. Lakshman Balkrishna Joshi v. Trimbak Bapu Godbole (1969)

Though focused on doctor's individual duty, the Court recognized that during surgical procedures, control is temporarily transferred from the hospital administration to the surgeon.

Relevance: This case recognizes the reality that control during surgery may shift to the operating surgeon, potentially making the surgeon the

temporary employer of nurses, anaesthetists, or technicians.[8]

3.4 Samira Kohli v. Dr. Prabha Manchanda (2008)

This landmark case on consent indirectly reflects borrowed servant reasoning: during surgery, the consulting surgeon controlled the entire medical team.

Relevance: The Court highlighted that surgical team members act under the direction of the surgeon, a conceptual pillar of borrowed servant liability.[9]

3.5 Spring Meadows Hospital v. Harjot Ahluwalia (1998)

Facts: Negligence by a nurse and trainee doctor caused severe harm.

Held: The hospital was held liable even though the negligent trainee doctor was not a permanent hire.

Relevance: Operational control by the hospital was the decisive factor, another application of borrowed servant principles.[10]

4. Outsourced Laboratory Cases

When a hospital outsources a test to a third-party lab, **the hospital and/or lab can be held responsible** if the error causes harm then the courts have held that outsourcing does *not* absolve liability. The hospital remains vicariously liable under the legal *doctrines qui facit per alium facit per se ("he who acts through another does so himself") and respondent superior*.

Indian Cases and Legal Precedents Involving Outsourced Lab Negligence

4.1 Lifeline Laboratory vs Anjana Agrawal

- A consumer complaint was filed because a **wrong blood group report** was issued by Lifeline Laboratory, leading to the cancellation of a planned kidney transplant.
- This case was fought under **the Consumer Protection Act, 2019**; it involved an outsourced laboratory whose erroneous results impacted treatment decisions.[11]

4.2 Consumer Court Decisions on Diagnostic Errors

- In another case, a **state consumer commission found Dr Lal Pathlabs liable** for issuing significantly incorrect urea and creatinine results, which triggered unnecessary hospitalization and trauma for the complainant. The laboratory was ordered to pay ₹3.5 lakhs in compensation.[12]

4.3 **Outsourced lab errors are treated just like other medical negligence** if:

- The report is **incorrect or delayed**, leading to misdiagnosis or wrong treatment.
- There is **failure to adhere to standard practices** (ICMR guidelines, SOPs).
- The error leads to **financial loss, mental trauma, or actual physical harm**

5. Vicarious Liability in Medical Negligence: Indian Legal Doctrine

Under Indian law, hospitals owe a non-delegable duty of care to patients and can be held vicariously liable for negligent acts of their staff and associated professionals. The Supreme Court in cases such as Indian Medical Association v. V.P. Shantha underscores that medical services fall within consumer protection jurisdiction, reinforcing institutional accountability.[13] Likewise, in Managing Director, Kamineni Hospitals v. Peddi Narayana Swamy & Anr. (2025), the Supreme Court upheld a finding of vicarious liability for a hospital alongside the attending doctor, ordering compensation for medical negligence, and reaffirming that a hospital's liability may not be negated based on contractual structures alone.[14]

Indian High Courts have also developed jurisprudence relevant to control and supervision in negligence contexts. For example, the Delhi High Court recently quashed an FIR in a medical negligence case where a surgical counting error occurred, emphasizing that unintentional errors although serious may not always amount to criminal liability, particularly where compensation has been paid and professional accountability assessed in civil remedies. Such cases underscore the courts' analytical balance between professional error and negligence tied to institutional responsibility.[15]

The Allahabad High Court in 2025 criticized private healthcare practices prioritizing profit, terming them detrimental to patients' interests, and reaffirmed that negligent practice cannot be shielded by financial motivations.[16]

Other High Court observations, such as the Kerala High Court ruling that doctors should not be blamed for every adverse outcome absent gross negligence, further illuminate judicial sensitivity to professional autonomy within the duty of care framework, a factor often assessed alongside control when assigning institutional liability.[17]

6. Tests and Forensic Application in Healthcare Control as Primary Determinant

In medico-legal disputes involving borrowed servant questions, courts typically examine:

- Who directed the detailed performance of medical services;

- Who benefitted from the services rendered at the time of the tortious act;
- Whether the professional acted under the institutional protocols, policies, and supervision of the healthcare provider.

These factors overlap with forensic determinations about *standard of care* and *foreseeability of harm*, where expert testimony and institutional records play key roles in judicial assessment.

7. Indian High Courts and Borrowed Servant Reasoning in Practice

While Indian judgments seldom label decisions as applying the Borrowed Servant Doctrine explicitly, their reasoning often reflects its core logic:

- Courts assess whether a hospital's infrastructure and supervisory staff guided the healthcare professional's actions.
- Institutional policies and standard operating procedures (SOPs) become evidence of control.
- Patient reliance on hospitals for comprehensive care influences liability irrespective of the employment contract.

For instance, when a visiting surgeon uses hospital facilities and nursing staff, the hospital may be held jointly liable where procedures and supervision fall within its functional domain, even if formal employment is absent, a practical application of borrowed servant logic in liability attribution.[18,19]

7. Comparative Jurisprudence and International Perspectives

The Centrality of "Control" in Liability Allocation

Across jurisdictions, control over the manner and means of work has consistently emerged as the dominant criterion for determining liability in healthcare negligence cases. This reflects a broader evolution of vicarious liability from a narrow master, servant conception to a more functional and policy-oriented analysis.

Healthcare delivery is inherently complex, involving layered hierarchies, professional autonomy, and institutional protocols. Courts internationally have adapted traditional tort principles to ensure that organizational responsibility keeps pace with modern healthcare realities.

United Kingdom: Institutional Integration and Vicarious Liability

Cassidy v Ministry of Health (1951)

Cassidy remains a foundational authority in English medical negligence law. The court held the Ministry of Health liable for the negligent acts of hospital-employed doctors, emphasizing:

- The organizational integration of doctors into the hospital system
- The hospital's responsibility for patient care as a composite service
- The patient's lack of choice or control over individual practitioners

The court rejected the argument that a doctor's professional independence negates vicarious liability. Instead, it recognized that hospitals hold themselves out as providers of comprehensive medical services and must bear responsibility for failures within that system.[20]

Evolution beyond Strict Employment

Subsequent UK jurisprudence expanded liability even where traditional employment relationships were absent. The courts increasingly apply the "enterprise risk" and "close connection" tests, holding institutions liable where:

- The tort is closely connected to the institutional role assigned to the professional
- The institution created or significantly enhanced the risk of harm

This approach reflects public policy considerations—particularly patient protection and loss distribution.[21,22]

United States: Borrowed Servant and Apparent Agency Doctrines

The U.S. has developed a more fragmented but conceptually rich framework.

Under this doctrine, liability turns on who had the right to control the specific negligent act at the time it occurred. Courts examine:

- Who directed the work
- Who controlled the manner of performance.
- Whether the general employer relinquished control

However, rigid application has proven inadequate in hospital settings, where control is often diffused.[23,24]

Apparent or Ostensible Agency

To overcome these limitations, U.S. courts widely apply apparent agency, especially in hospital negligence cases. Liability arises when:

- The hospital represents the doctor as its agent
- The patient reasonably relies on that representation
- The patient does not meaningfully select the physician independently.

This doctrine explicitly centers patient perception and reliance, reflecting consumer-protection logic.[25]

Convergence of International Principles

Despite doctrinal differences, UK and U.S. approaches converge on key principles:

- Control need not be micromanagement; systemic and structural control suffices
- Professional autonomy does not immunize institutions
- Patient reliance and institutional representation are decisive
- Liability is shaped by policy considerations, not merely formal contracts.[26]

Critical Discussion

Indian medico-legal practice reflects a pragmatic adaptation of borrowed servant reasoning within the broader cause of patient protection. Instead of rigidly applying borrowed servant rules, courts emphasize whether institutions exercised sufficient control over medical acts and whether patients justifiably relied on those institutions for competent care. This approach aligns with international medico-legal standards and ensures victims have effective recourse against negligent healthcare providers.[6,7,10,13]

8. Conclusion

The Borrowed Servant Doctrine's conceptual emphasis on control and supervision remains highly relevant in medical negligence litigation. While Indian case law does not frequently invoke the doctrine by name, its principles are implicitly applied in vicarious liability and duty of care analyses. Recent High Court interventions, reflecting both accountability and equitable justice, demonstrate evolving judicial engagement with complex liability questions in healthcare. For forensic medicine and legal practice, a nuanced understanding of these doctrines enhances analysis of multi-agency cases where institutional responsibility must be traced amid overlapping supervisory roles.

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.
Source of funding: None to declare.

References:

1. Reddy KSN. Essentials of Forensic Medicine and Toxicology. 35th ed. New Delhi, India: Jaypee publishers; 2022. P. 45.
2. Deokar RB, Patil SS. Violence Against Doctors: Prevention, Administrative and Legal Recourse. J Forensic Med Sci Law. 2023;32(1):1-3.
3. Bardale RV, Haridas SV, Dixit PG. Analysis of Alleged Medical Negligence Cases Referred for Opinion: A Retrospective Study. J Forensic Med Sci Law. 2021;30(2):27-30.
4. Deokar RB, Patil SS, Bhise SS. Medicolegal cases in hospitals. J Forensic Med Sci Law. 2018; 27(2):1-2.
5. Patil SS, Deokar RB, Pathak HM. Overview of Clinical Establishment Act. J Forensic Med Sci Law. 2018;27(1):11-5.
6. Achutrao Haribhau Khodwa v. State of Maharashtra. (1996) 2 SCC 634.
7. Savita Garg v. National Heart Institute. (2004) 8 SCC 56.
8. Dr. Lakshman Balkrishna Joshi v. Trimbak Bapu Godbole. AIR 1969 SC 128.
9. Samira Kohli v. Dr. Prabha Manchanda. (2008) 2 SCC 1.
10. Spring Meadows Hospital v. Harjot Ahluwalia. (1998) 4 SCC 39.
11. Lifeline Laboratory v. Anjana Agrawal. CC/13/114. DOD:21/12/2021. National Consumer Disputes Redressal Commission (NCDRC). [cited on 23rd Dec 2026] Available from: https://www.casemine.com/judgement/in/61f6af72b50db99177197898
12. Dr. Lal Pathlabs pvt. Ltd. Vs. Mr. Inder Prakash Wadhwa. FA/984/2014. DOD:26/05/2025. Delhi State Consumer Disputes Redressal Commission. [cited on 23rd Dec 2026] Available from: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://legalmaestros.com/wp-content/uploads/2025/06/dr-lal-path-labs-605634.pdf
13. Indian Medical Association v. V.P. Shantha. (1995) 6 SCC 651.
14. Managing Director, Kamineni Hospitals v. Peddi Narayana Swamy & Anr., 2025 INSC 527 (Supreme Court of India).
15. Venkateshwar Hospital & Anr v. State of NCT of Delhi. W.P.(Crl.) 3976/2025. Delhi High Court. Dec 2, 2025.
16. Private hospitals, nursing homes treat patients as ATMs, says HC. Times of India [Internet]. 2025 Jul 25 [cited on 23rd Dec 2026]. Available from: https://timesofindia.indiatimes.com/city/lucknow/pvt-hosps-treat-patients-like-atms-hc/articleshow/122927499.cms
17. Can't blame doctors for every death during treatment, rules Kerala High Court. Times of India [Internet], Kochi/City News. 2025 May 20 [cited on 23rd Dec 2026] Available from: https://timesofindia.indiatimes.com/city/kochi/cant-blame-doctors-for-every-death-during-treatment-rules-kerala-high-court/articleshow/121297845.cms
18. Prosser WL, Keeton WP. Prosser and Keeton on the Law of Torts. 5th ed. St. Paul (MN): West Publishing Co.; 1984. p. 500–503.

19. Winfield P, Jolowicz J. Tort. 18th ed. London: Sweet & Maxwell; 2010.
20. Cassidy v Ministry of Health [1951] 2 KB 343.
21. Deokar RB, Patil SS. Violence Against Doctors: Prevention, Administrative and Legal Recourse. J Forensic Med Sci Law 2023;32(1):1-3.
22. Athavale SU. Digi Doctor- Concise Review of Telemedicine Practice Guidelines, 2020. J Forensic Med Sci Law 2021;30(2):63-66.
23. Giliker P. Vicarious Liability in Tort: A Comparative Perspective. Cambridge: Cambridge University Press; 2010. p. 90–115.
24. Larson A, Larson L. Larson's Workers' Compensation Law. New York: Matthew Bender; 2000. P. 67.01–67.04.
25. Furrow BR, Greaney TL, Johnson SH, Jost TS, Schwartz RL. Health Law. 7th ed. St. Paul (MN): West Academic; 2018. p. 381–95.
26. Fleming JG. The Law of Torts. 9th ed. Sydney: Law Book Co; 1998. p. 409–20.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Short Communication

Executive Summary of the XXVII Annual State Conference of Medicolegal Association of Maharashtra (MLAM)- FORENSICON 2025

Amol Shinde[a], Manoj Patekar[b*], Ashish Pathak[b]
[a]Professor & Head, [b]Assistant Professor, Department of Forensic Medicine and Toxicology, Punyashlok Ahilyadevi Holkar Government Medical College (PAH GMC), Baramati, Maharashtra, India.

Article Info

Received on: 28.10.2025
Accepted on: 05.12.2025

Key words
Innovative Forensic Medicine,
Artificial Intelligence,
Research,
Justice,
Medicolegal Expertise.

Abstract

FORENSICON 2024, the XXVII Annual State Conference of Medicolegal Association of Maharashtra (MLAM) was successfully hosted on the 7th and 8th of December, 2024 by the Department of Forensic Medicine and Toxicology at the Punyashlok Ahilyadevi Holkar Government Medical College (PAH GMC), Baramati, serving as a vital platform for practitioners, academics, and researchers in the forensic and medicolegal field. The conference focused on emerging trends, ethical dilemmas and technological advancements crucial to modern forensic practice, encompassing themes likely centered around clinical forensics, toxicology updates, and medico-legal jurisprudence. FORENSICON 2024 brought together experts from across the state and beyond, featuring keynote addresses, interactive workshops, and robust scientific sessions including numerous paper and poster presentations, fostering interdisciplinary collaboration between medical professionals, law enforcement, and the judiciary. More than 350 delegates attended the conference, which included faculty and postgraduates from the forensic medicine field as well as medical officers, lawyers, police officers with MBBS undergraduates and interns. The successful organization of the conference was steered by the dedicated organizing committee, led by Dr. Amol Shinde, Organizing Secretary, Dr. Manoj Patekar, Joint Secretary and Dr. Ashish Pathak, Treasurer. FORENSICON 2024 reinforced MLAM's commitment to advancing forensic science and education in Maharashtra, leaving participants equipped with enhanced knowledge and a strengthened network to address the complex challenges in medicolegal practice.

1. Introduction

A The "XXVII Annual State conference of Medicolegal Association of Maharashtra (MLAM) - 'FORENSICON 2024'" was organized by Department of Forensic Medicine & Toxicology, Punyashlok Ahilyadevi Holkar Government Medical College, Baramati on the 7th and 8th December

How to cite this article: Shinde A, Patekar M, Pathak A. Executive Summary of the XXVII Annual State Conference of Medicolegal Association of Maharashtra (MLAM) - FORENSICON 2025. J Forensic Med Sci Law. 2025;34(2):76-82. doi:10.59988/jfmsl.vol.34issue2.14

***Corresponding author:** Dr Manoj Patekar, Assistant Professor, Department of Forensic Medicine and Toxicology, Punyashlok Ahilyadevi Holkar Government Medical College (PAH GMC), Baramati, Maharashtra, India. Email:drmanojpatekar@gmail.com, (M): +91-8888808164.

Photograph 1: FORENSICON 2024 Organizing team.



2024. The previous conference "26th Annual State Conference of Medicolegal Association of Maharashtra (MLAM) 'FORENSICON 2022', was held on 28th & 29th October 2023 hosted by the Department of Forensic Medicine & Toxicology, H.B.T Medical College & Dr. R.N. Cooper Municipal General Hospital, Mumbai (Maharashtra) India.[1]

Photograph2: The inauguration with lamp lightening ceremony



Photograph 3: Organizing Secretary Address.



2. Executive summary

The objective of the conference was to underscore the vital role of innovations in forensic medicine plays in enhancing the justice system. The conference was held at the newly inaugurated central auditorium of Punyashlok Ahilyadevi Holkar Government Medical College, Baramati under the eminent leadership of Dr Amol Shinde. The conference was attended by almost 350 registered delegates and above, from various states. The Delegates were the Faculty, Medical Officers, Postgraduate students, interns, undergraduates and researchers as well as lawyers and police officers deputed from various parts of the Maharashtra.

The Organizing team was presided by Patron, Dr. C. B. Mhaske (Dean), PAHGMC, Baramati, Organising secretory Dr. Amol Shinde, Joint secretory Dr. Manoj Patekar, and Treasurer Dr. Ashish Pathak (**Photograph 1**).

Photograph 4: MLAM Secretary Address.



The theme of the conference was ***"Innovative Forensic Medicine: Pioneering Research for Justice through Medico-Legal Expertise"*** as the name suggests it aims at the intersection of medical science and law. The inauguration ceremony held at the central auditorium of the college building.

The inauguration was started with lamp lightening (**Photograph 2**) by the dignitaries followed by Sarswati vandan performed by undergraduate students and then Organising secretary's address (**Photograph 3**) and MLAM Secretary's address(**Photograph 4**). This was followed by release of souvenir of FORENSICON 2024 (**Photograph 5**) along with the **Journal of Forensic Medicine, Science and Law**-the official publication of MLAM (Editor-in-chief-Dr Ravindra Deokar, associate editors- Dr S.S. Bhise, Dr. S.S.Patil)(**Photograph 6**).

Day 1 Proceedings (7th December 2024)

The first scientific session of the FORENSICON 2024 conference commenced by **Dr. Amit Patil**, Professor and Head of Forensic Medicine and Toxicology at AIIMS Patna, focused on the

Examination of Human Skeletal Remains, Utilizing both Standard Forensic Approaches and Advanced Techniques. This presentation explored the sophisticated methodologies employed in forensic examination of skeletal remains, integrating traditional morphological assessment with cutting-edge forensic technologies to enhance identification accuracy and establish critical parameters such as cause and time of death. The importance of this topic cannot be overstated, as forensic analysis of skeletal remains serves as a cornerstone when only bones are retrievable at crime scenes, disaster sites, or in cases of decomposed remains, providing crucial evidence for medico-legal identification and case resolution.[2]

Photograph 5: Release of Souvenir of Forensicon 2024.



Photograph 6: Release of Journal of Forensic Medicine Science and Law (Scopus indexed journal).



The second session transitioned to the **Digitalization of Medical and Medico-Legal Records**, addressing the critical transformation from traditional paper-based documentation to electronic health and legal records. This comprehensive exploration examined the multifaceted implications of digital record keeping, including enhanced accuracy, improved security protocols, increased accessibility for authorized personnel, and compliance with medico-legal requirements. The session was presented by **Dr. Kailash Zine**, Dean of GMC Buldhana, a renowned academician with vast experience in medical education administration.[3]

The prestigious **Dr. C. A. Franklin Oration: "Honesty and Integrity in Medical Profession"** by **Dr. Rajesh Dere**, Professor and Head-FMT TNMC &

BYL Nair Charitable Hospital, Mumbai occupied a prominent position in the day's program, delivering a keynote address that emphasized the foundational role of ethics, honesty, and integrity in both medical and forensic professions. This distinguished lecture addressed the moral imperatives that underpin professional conduct, highlighting how these fundamental values ensure trustworthiness, maintain professional standards, and guarantee quality patient care—all essential elements for establishing and maintaining forensic credibility in legal proceedings.

The next topic, **Competency-Based Medical Education (CBME) Curriculum Reforms**, emphasizing enhanced forensic knowledge and skills development within the modern medical education framework. **Dr. Sandeep S. Kadu**, Controller of Examinations at MUHS Nashik and an expert in medical education assessment and curriculum development, provided comprehensive insights into how these reforms align forensic medical education with contemporary competency standards for improved clinical and investigative effectiveness. The session explored how CBME transforms traditional teaching methodologies by focusing on measurable competencies that directly relate to real-world forensic practice, ensuring graduates possess both theoretical knowledge and practical skills essential for modern forensic medicine.[4, 5]

Photograph 7: Panel discussion at conference.



The afternoon session addressed the contemporary issue of **Professional Misconduct** by **Dr. Shailesh Mohite**, Dean, TNMC & BYL Nair Charitable Hospital, Mumbai, offering a critical overview of various types of misconduct, recent high-profile examples, and existing regulatory frameworks that govern medical practice. This discussion promoted awareness of misconduct patterns and advocated for preventive strategies designed to uphold medical and forensic standards while protecting both patient and practitioner rights within the healthcare system.

Ethical complexities took centre stage during the session on **Rights of the Unborn Child and Ethical Dilemmas Surrounding Late-Term Pregnancy Termination** by **Dr. Shailendra Dhawane**, Professor and Head-Forensic Medicine &Toxicology, GMC, Chandrapur. These discussions centred on the intricate medico-legal rights of the unborn child and the complex ethical decisions that healthcare providers must navigate when considering late-term pregnancy termination, addressing issues vital for both forensic and obstetric practitioners who must balance legal mandates with ethical imperatives in their professional practice.[6]

The next session by **Dr. Jayesh Lele**, Hon. Secretary General, IMA HQ, New Delhi, on **An Examination of the Prosecution of Medical Professionals and Litigation Challenges**, exploring common causes of litigation against healthcare providers while recommending comprehensive strategies for legal protection and risk mitigation. This session addressed the growing concern of defensive medicine and its impact on healthcare delivery quality.[7]

The day concluded with the session of the panel discussion on **The Medicolegal Issues in Day to Day Practice** brought together a range of experts who discussed key initiatives and challenges in improving the quality and efficiency of medicolegal services in Maharashtra. The esteemed panellist included **Dr. S.C. Mohite, Dr. B.G Chikhalkar, Dr. Mandar Karmarkar, Dr Rajesh Dere, Dr Jayesh Lele, Shri Rajendra Mavle, Forensic Scientist and Mr Kale, Police Official (Photograph 7).** This session explored how diverse stakeholders, including police, healthcare professionals, legal experts, and activists, are working together to enhance medicolegal services in Maharashtra, aiming for a more integrated and effective system.[8]

General body meeting of MLAM was held around 5:45 pm in the central auditorium of PAH GMC Baramati. Various issues pertaining to members were discussed and possible solutions were advised. It was followed by the election for next MLAM executive committee. The returning officers for the election were Dr R.V. Kachare and Dr. H.V. Godbole, and the election was conducted uneventfully.

Day 2 Proceedings (8th December 2024)

The second day commenced with **Medical and Medicolegal Documentation: Current Practices and Need for Change** was delivered by **Dr. Rajendra Bangal**, Registrar, MUHS, Nashik, providing a thorough analysis of current documentation standards while identifying significant gaps and advocating for comprehensive reforms. This session emphasized the urgent need to improve accuracy, enhance legal robustness, and increase reliability in medico-legal case handling, recognizing that proper documentation serves as vital evidence in legal proceedings and supports continuity of patient care.[9, 10]

The next topic on **Research Publications from a Forensic Perspective** formed the focus of the subsequent session, where encouragement and guidance on forensic research publication processes were provided, emphasizing scientific rigor and measurable impact on the discipline. **Dr. Ravindra B. Deokar**, Additional Professor of Forensic Medicine and Toxicology at Seth GSMC & KEM Hospital Mumbai, shared his experience as an active forensic researcher and educator, highlighting the importance of quality research in advancing forensic medicine and contributing to the global body of forensic knowledge.[11]

The next topic by **Designer Drugs in Forensic Toxicology** occupied a critical position in the day's scientific program. **Dr. Naresh Zanjad**, Professor and Head of Forensic Medicine and Toxicology at Dr. VMGMC Solapur, addressed the complex challenges presented by new psychoactive substances, including forensic detection complexities and their far-reaching legal ramifications. This topic holds crucial importance for accurate forensic toxicology in drug abuse cases and legal proceedings, as designer drugs continue to evolve rapidly, outpacing traditional detection methods and creating significant challenges for forensic laboratories worldwide.

Followed by interesting topic of **Impact of Artificial Intelligence in Forensic Medicine and Toxicology** by **Dr. Nilesh K. Tumram**, Professor and Head of Forensic Medicine and Toxicology at GMC Nandurbar and a researcher in AI applications, presented comprehensive insights into how AI technologies are revolutionizing forensic diagnostics, data analysis, and predictive modelling. The adoption of these technologies promises to enhance forensic case efficiency, improve accuracy rates, and drive innovation across multiple forensic disciplines, representing a paradigm shift in how forensic investigations are conducted.[12]

Legal challenges in the justice system were examined through an analysis of conviction rates in relation to **Common Mistakes Made by Doctors, Police and Lawyers** by **Dr. Indrajeet Khandekar**, Professor at MGIMS Sewagram and a legal-forensic expert, provided systematic analysis of errors that contribute to low conviction rates in medico-legal cases, emphasizing the need for collaborative corrections among all stakeholders in the criminal justice system to improve outcomes and ensure justice for victims.

The pressing issue of **Violence against Healthcare Professionals** was addressed through a discussion of legal provisions for handling assault on doctors at the ground level. **Dr. Rajeev Joshi**, Founder-Proposer of the Medicolegal Society of India and a medico-legal policy advocate, examined existing laws designed to address violence against medical professionals while highlighting significant challenges in enforcement and implementation of protective measures.[13]

Technical and legal aspects of forensic practice were explored through a session on the **Adversity of Viscera Collection and its Legal Implications**.by **Dr. Rajesh V. Bardale** Professor and Head Forensic Medicine &Toxicology, GMC, Miraj, addressed the complex challenges associated with proper viscera collection, preservation, and analysis, along with the legal frameworks that govern these critical forensic procedures.

The conference concluded with the topic on **The Legal Landscape of Cybercrime** by **Mr. Sandeep Gadiya**, Cybercrime Investigator& Cyber Forensic Expert, Pune. This session provided a comprehensive overview of current cyber laws, advanced forensic investigation tools and techniques, and the significant challenges facing law enforcement in cybercrime prosecution, reflecting the growing importance of digital forensics in modern criminal investigations.[14-16]

Parallel scientific activities in the form of Podium and poster presentations separately held for the faculty and postgraduate students, and also poster presentations for undergraduate on the theme of future of forensic medicine enriched the conference experience. These presentations were coordinated and judged by senior faculty members, encouraging scientific communication and

knowledge sharing among participants while fostering academic exchange and student engagement in forensic research and practice.[17-19]

Photograph 8: Prize distribution at Valedictory ceremony.



These comprehensive sessions collectively provided delegates with deep understanding of forensic medicine's evolving scientific, ethical, legal, and educational frontiers, effectively shaping best practices and establishing future directions for the discipline while addressing contemporary challenges facing forensic practitioners in India and globally.[20]

The two day conference concluded with valedictory session presided by the Dr A K Batra and Dr A G Pathak. Awards for faculty, postgraduate podium and poster presentation along with undergraduate poster presentations were distributed (**Photograph 8**). Delegates expressed their gratitude and views about successful conduction of the conference and congratulated the organizing team (**Photograph 9**).

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.
Source of funding: None to declare.

Photograph 9: Delegates at Valedictory Ceremony.



References:

1. Mohite S, Sukhdeve R, Sonawane S, Deokar R, Kolle S, Hinnawi S. Executive Summary of the XXVI Annual State Conference of Medicolegal Association of Maharashtra (MLAM) - Forensicon 2023. J Forensic Med Sci Law. 2024; 33(2):73-8.
2. Ambade H, Kaore A, Thakre B, Ambade V, Kamdi N. Study of Disparity of Opinion Between Anatomical Examination of Bones and Police History in Medicolegal Cases. J Forensic Med Sci Law. 2022; 31(2):11-4.

3. Kattamreddy AR, Ganja CD, Khan MT. A Strong Need for Digitalization in Medico-Legal Practice in India. J Forensic Med Sci Law. 2021; 30(1):69-71.
4. Deokar RB, Patil SS. Competency based Medical Education curriculum for Undergraduates Forensic Medicine Perspectives. J Forensic Med Sci Law. 2019; 28(2):1-2.
5. Kadu SS, Deokar RB, Waghmode AH, Bangal RS, Kanekar RA, Kanitkar M. Designing Blueprints for Theoretical Assessments of the undergraduate Medical Students in Forensic Medicine and Toxicology. J Forensic Med Sci Law. 2024; 33(1):39-44.
6. Patil SS, Deokar RB. Advances of Medical termination of pregnancy Amendments act in India. J Forensic Med Sci Law. 2022; 31(2):65-70.
7. Bardale RV, Haridas SV, Dixit PG. Analysis of Alleged Medical Negligence Cases Referred for Opinion: A Retrospective Study. J Forensic Med Sci Law. 2021; 30(2):27-30.
8. Chhetri TB, Chhetri TR, Ahmed SM. Knowledge, Attitude and Practice of Medical Ethics and Medico-Legal Issues by Clinicians: A Cross-Sectional Study at a Tertiary Healthcare Centre in Maharashtra. J Forensic Med Sci Law. 2023; 32(2):56-62.
9. Rautji R, Dingre N, Karmarkar M, Deshpande K. Legally Safe Medical Documentation: Ensuring Compliance and Patient Protection. J Forensic Med Sci Law. 2024; 33(2):79-81.
10. Pawar HJ, Pawar MN. A Study of Impact of Medical Records on Healthcare Management at Tertiary Care Teaching Hospital. J Forensic Med Sci Law 2020;29(2):7-13
11. Deokar RB, Patil SS. Research Publication: Forensic Perspective. J Forensic Med Sci Law. 2024;33(2):1-4
12. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research - Ethical aspects. J Forensic Med Sci Law. 2024; 33(1):1-4.
13. Deokar RB, Patil SS. Violence against Doctors: Prevention, Administrative and Legal Recourse. J Forensic Med Sci Law. 2023; 32(1):1-3.
14. Singh SN, Singh D, Dev K, Mittal AK, Srivastava A. Anti-Forensics: Tool against Cyber Forensic. J Forensic Med Sci Law. 2023; 32(1):68-73.
15. Deokar RB, Patil SS. Cybercrime: Medicolegal Perspective. J Forensic Med Sci Law. 2025; 34(1):1-3.
16. Varma NM, Pawar MN, Deokar RB. Executive Summary of the Forensicon 2022 - 25th Annual State Conference of Medicolegal Association of Maharashtra (MLAM). J Forensic Med Sci Law 2023;32(2):80-84.
17. Oanh TC, Tuan VV. Insoluble Challenges of Prosecuting Transnational Cybercrime: A Case in a Developing Country. J Forensic Med Sci Law. 2025; 34(1):60-3.
18. Deokar RB, Dere RC, Patil SS. Looking at Recent Evolution in Toxicology Through Legal Lens. J of Indian Acad of Forensic Med 2025;47(1):7-11. doi:10.1177/09710973251371356
19. Deokar RB, Dere RC, Patil SS. Genomics and Precision Medicine in Forensic Medicine. J of Indian Acad of Forensic Med 2025;47(2): 123-125. doi:10.1177/09710973251381715
20. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law 2023;32(2):1-3.

JOURNAL OF FORENSIC MEDICINE SCIENCE AND LAW
(Official Publication of Medicolegal Association of Maharashtra)
Email.id: mlameditor@gmail.com

PRINT ISSN: 2277-1867
ONLINE ISSN: 2277-8853

Short Communication

Speaking for the Dead: The Evolution of Verbal Autopsy

Rahul M Band[a], Madhusudan R Petkar[b*], Sadhana V Lakhute[c]
[a]Associate Professor, [b]Professor, FMT; [c]Associate Professor, Community Medicine, Dr. D.Y. Patil Medical College, Hospital & Research Centre, Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India.

Article Info

Received on: 18.10.2025
Accepted on: 25.12.2025

Key words
Cause of Death, Prevalent Diseases, Statistics, Structured questionnaire.

Abstract

Deciding prevalent diseases in society, mortality data is useful. Cause of death (COD) is crucial to provide information about diseases in community and to take preventive measures for them. There is scarcity of qualified and registered medical practitioners, particularly in rural areas, to certify it at the time of death. It leads to a lack of information and data for statistics. Physician's role is important and irreplaceable by computer coding methods.

1. Introduction

Mortality data are important in deciding prevalent diseases in society. Cause of death (COD) is crucial to provide information about diseases in community and to take preventive measures for them. However, the non-availability of qualified and registered medical practitioners, particularly in rural areas, to certify it at the time of death leads to a lack of information and data.[1-5] As a result, COD data based on the "Medical Certification of Cause of Death" is insufficient to represent the whole country accurately. To address this problem, epidemiologists developed a novel approach called "Verbal Autopsy (VA)" to identify the most likely COD, based on an inquiry of relatives of the deceased. In 2001, VA was implemented as a component of India's Sample Registration System, which is overseen by the Registrar General of India for Births and Deaths Office.

2. Evolution of Verbal Autopsy:

World Health Organization (WHO) in want of mortality data from low and middle income countries published WHO Verbal Autopsy Instrument and Manual (latest version in 2022). According to this manual, trained interviewers are required to get information from relatives of the deceased using a structured questionnaire. The collected information is about the deceased's symptoms, medical history, and circumstances leading to death.[6] This data is then analyzed by physicians or computer-based diagnostic programs to assign the most likely cause of death.

In African and Asian countries where medical certification of death is low, the most effective technique for determining causes of death (COD) is physician-coded verbal autopsy (PCVA). India also faced similar problems with mortality statistics, so All-India Institute of Medical Sciences (AIIMS), New Delhi, developed the "Mortality in India Established through Verbal Autopsy" (MINErVA) platform with state-level partners across India in November 2017.[7] In MINErVA network, VA questionnaire form is reviewed independently by

How to cite this article: Band RM, Petkar MR, Lakhute AV. Speaking for the Dead: The Evolution of Verbal Autopsy. J Forensic Med Sci Law. 2025;34(2):83-84. doi:10.59988/jfmsl.vol.34issue2.15

***Corresponding author:** Dr Madhusudan R. Petkar, Professor, FMT, Dr. D.Y. Patil Medical College, Hospital & Research Centre, Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India. Email: drmadhupetkar@gmail.com Mobile: 9527404224. ORCID: 0000-0002-4488-7438.

two trained community physicians to separately assign COD. Wherever both assign the same cause of death, it is reported as the final COD, and if it differs, then it is finalized by reconciliation between two physicians. If the difference persists, then a third senior community physician (as adjudicator) independently reviews the VA form to assign the final COD. The final underlying cause is then assigned specific three-character codes from the International Classification of Diseases- Tenth Revision (ICD -10).

An alternate technique to PCVA for determining the COD is computer-coded verbal autopsy (CCVA), which is thought to be effective and economical. Computer methods can be algorithm-based like tariff and random forest method or probabilistic like InterVA (Expert based) and King – Lu, simplified symptom pattern etc (Data-driven).[8] A study by Benara SK et al[9] found that the PCVA method performed better than CCVA methods. CCVA methods are still evolving and must be rigorously validated in extensive studies. Software tools like OpenVA, are also being used to automatically process VA data. A study by Gupta M[10] suggests that PCVA is the optimal option available in the current scenario, until CCVA methods evolve in scope, design and performance.

2. Conclusion

Medical professionals should have knowledge of these VA methods and tools and wherever possible, should participate in these projects. Physician's role is irreplaceable by computer coding methods. Data generated through VA is used for formulating health policies by governments and health organisation; hence it must be as accurate as possible.

Contributor ship of Author: All authors equally contributed. **Conflict of interest:** None to declare.
Source of funding: None to declare.

References:

1. Ray S, Das DK. Verbal autopsy - concept and role in Indian scenario. J Compr Health. 2019; 7(2):12–5.
2. Deokar RB, Patil SS. Artificial Intelligence in Healthcare and Biomedical Research – Ethical aspects. J Forensic Med Sci Law. 2024; 33(1):1-4.
3. Yadav J, Yadav M. Virtual Autopsy – Way forward in Forensic Medicine. J Indian Acad Forensic Med. 2021; 43(4): 374-8.
4. Ravat PS, Deokar RB, Ravat SH. Future and Scope of Forensic Neurosciences in Criminal Investigation System towards Justice. J Forensic Med Sci Law. 2022; 31(1):77-82.
5. Deokar RB, Patil SS. Avenues in Forensic Medicine. J Forensic Med Sci Law. 2023; 32(2):1-3.
6. World Health Organization. Verbal autopsy standards: The 2022 WHO verbal autopsy instrument. Geneva: WHO. 2022:1–40.
7. Krishnan A, Gupta V, Nongkynrih B, Kumar R, Kaur R, Malhotra S et al. MINErVA Network†. Mortality in India established through verbal autopsies (MINErVA): Strengthening national mortality surveillance system in India. J Glob Health. 2020 ; 10(2):020431.
8. Leitao J, Desai N, Aleksandrowicz L, Byass P, Miasnikof P, Tollman S et al. Comparison of physician-certified verbal autopsy with computer-coded verbal autopsy for cause of death assignment in hospitalized patients in low- and middle-income countries : systematic review. BMC Med. 2014 ; 12 :22.
9. Benara SK, Sharma S, Juneja A, Nair S, Gulati BK, Singh KJ et al. Evaluation of methods for assigning causes of death from verbal autopsies in India. Front Big Data. 2023; 6:1197471.
10. Gupta M, M Lakshmi PV, Prinja S, Singh T, Sirari T, Rao C et al. Comparative performance of verbal autopsy methods in identifying causes of adult mortality: A case study in India. Indian J Med Res. 2021 ; 154(4) :631-40.