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ORIGINAL RESEARCH

Bridging the Knowledge Gap in Forensic Odontology: A Cross-sectional Study Among Dental Professionals in India

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Abstract

Background: Forensic odontology plays a critical role in human identification in mass disasters yet remains underrepresented in dental curricula.

Aim: To assess the awareness and knowledge of forensic odontology among dental professionals in India.

Methods: A cross-sectional survey was conducted among 619 participants (UGs, interns, PGs, faculty, practitioners). A validated 14-item questionnaire was disseminated digitally. Awareness levels were categorised based on a composite score. Chi-square and Bonferroni tests were used for analysis.

Results: Bitemark analysis (73.8%) and DNA analysis (51.9%) were among the most recognised methods. Awareness of dental features such as palatal rugae (65.4%) and cusp of Carabelli (42.8%) was moderate. PGs and practitioners showed significantly higher awareness levels ($p < 0.001$) compared to UGs.

Conclusion: Awareness is uneven, with gaps evident particularly among undergraduate students.

Clinical Significance: The findings underscore the urgent need to integrate forensic odontology into the mainstream dental curriculum to improve readiness in medico-legal scenarios.

Keywords: Forensic Odontology, Dental Identification, Awareness Survey, Forensic Education, Dental Students.

Introduction

Forensic odontology, a vital subdiscipline of forensic science, plays a crucial role in human identification, particularly in mass disasters or when bodies are disfigured beyond recognition. Globally, it has been instrumental in high-profile events such as the 9/11 World Trade Centre attack and the 2004 Indian Ocean tsunami, where dental evidence was among the few viable tools for victim identification. These experiences underscored the indispensability of dental records in disaster victim identification (DVI), leading to formalized protocols by international bodies such as INTERPOL and the International Organisation for Forensic Odonto-Stomatology (IOFOS) (IOFOS | INTERNATIONAL ORGANIZATION for FORENSIC ODONTO-STOMATOLOGY) [1,2].

Teeth and oral structures provide durable and unique identifiers, including palatal rugae, tongue prints, and dental morphological traits such as Carabelli's cusp and shovel-shaped incisors. They also serve as reliable DNA reservoirs, with pulp often resistant to environmental degradation. These features allow for age and gender estimation and support medico-legal investigations even in challenging circumstances [3–7]. The Ahmedabad plane crash further highlighted the value of dental evidence in India, where DNA extracted from teeth provided closure for families when other methods failed [8].

In India, forensic odontology has been recognized within the Bachelor of Dental Surgery (BDS) curriculum, and standard textbooks such as *Shafer's Textbook of Oral Pathology* now dedicate a chapter to the subject [4,5]. However, structured exposure remains inconsistent across institutions, with many offering only limited or optional coverage. As a result, awareness among graduates is often inadequate, despite regulatory emphasis on its inclusion.

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This study aims to assess the level of knowledge and awareness of forensic odontology among dental students, interns, postgraduates, faculty, and general practitioners in India.

Materials And Method

Study Design and Setting

A descriptive, cross-sectional study was conducted among dental students, interns, postgraduates, faculty, and general dental practitioners across India to assess their awareness and knowledge of forensic odontology. This study has been reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for cross-sectional studies.

Participants

Participants included undergraduate (UG) and postgraduate (PG) dental students, interns, faculty, and general dental practitioners. Convenience sampling was used. Inclusion criteria included individuals affiliated with dental education or clinical practice. Non-dental students and individuals without clinical exposure were excluded. A total of 619 participants submitted valid responses, comprising 505 UGs, 40 interns, 47 PGs, 4 faculty, and 23 general practitioners.

While a convenience sampling technique was employed, a post hoc power analysis was conducted. With a sample size of 619, the study achieved over 80% power to detect medium effect sizes (Cohen's w = 0.3) at an alpha level of 0.05 using Chi-square tests for group comparisons. This suggests adequate statistical power for the primary objectives of the study.

Questionnaire Development and Validation

A structured self-administered questionnaire was developed in Google Forms after an extensive literature review and expert validation. The questionnaire comprised 14 questions divided into binary (Q1, Q2, Q3, Q14), categorical (Q5, Q6, Q9–Q12), and Likert-scale (Q4, Q7, Q8, Q13) formats. The internal consistency of the questionnaire was assessed using Cronbach's alpha, which yielded a value of 0.82, indicating good reliability. Content validity was ensured through expert review by five academic faculty members with specialisation in forensic odontology, and necessary revisions were made following a pilot test among 15 participants.

Scoring and Awareness Classification

Scoring was carried out according to a predetermined rubric:

- Binary scoring (1 for correct, 0 for incorrect or blank).
- Categorical scoring based on the number of correct concepts mentioned (1–6 scale).
- Likert-scale scoring on a 4-point scale (1 = Poor to 4 = Excellent).
- The cumulative awareness score ranged from 0 to 46. Based on the final score, awareness levels were categorised as:
- 0–15: Low Awareness
- 16–30: Moderate Awareness
- 31–40: High Awareness
- 41–46: Excellent Awareness

Data Collection and Management

The questionnaire was open for responses for two weeks (1–14 March 2025) and was disseminated digitally through academic WhatsApp groups, institutional mailing lists, and professional forums to ensure broad outreach. Participation was voluntary and anonymous.

To illustrate, questions included

"Rugoscopy refers to the study of… (palatal rugae / lip prints / other)."

"Which of the following are reliable DNA sources in burnt remains? (tooth pulp / mandibular bone / other)."

All responses were collected automatically via Google Forms, checked for duplicates using email IDs and timestamps, and exported to Microsoft Excel for coding and analysis.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NY). Descriptive statistics were reported as frequencies and percentages. Chi-square tests were used to evaluate associations between awareness levels and participant groups. A post hoc Bonferroni correction was applied for multiple comparisons. A p-value < 0.05 was considered statistically significant.

Results

A total of 619 participants responded to the questionnaire, including 505 undergraduate (UG) students, 40 interns, 47 postgraduate (PG) students, 4 faculty members, and 23 general dental practitioners.

Conceptual Awareness

Table 1 shows that 87.0% of participants correctly defined forensic odontology, indicating a high level of basic conceptual understanding. As seen in Table 2 and Table 3, 79.0% correctly identified rugoscopy as the study of palatal rugae and 72.0% identified cheiloscopy as the study of lip prints. However, only 41.7% of respondents were aware that dentists could present evidence in court, while 58.3% either denied this or were unsure (Table 4).

Knowledge of Forensic Techniques and Traits

Participants showed good awareness of certain forensic odontology techniques, with bitemark analysis (73.8%), palatal rugae (65.4%), and teeth as identifiers (56.9%) being the most commonly recognised (Table 5). However, key forensic traits like restorations (20.7%) and prostheses (24.1%) were poorly acknowledged. Traits such as the cusp of

Carabelli (42.8%) and shovel-shaped incisors (27%) received limited recognition, indicating insufficient coverage of dental morphological markers in the curriculum.

DNA Retrieval Knowledge

Table 6 illustrates awareness regarding sources of DNA in forensic cases. For cadavers, the pulp of the tooth (64.6%) and bone of the mandible (54.0%) were the most cited sources. However, awareness of viable DNA sources in burnt bodies was comparatively lower. The misconception that mandible bone is a reliable DNA source in burnt remains persists, despite its vulnerability to degradation under extreme heat.

Identification Methods

As seen in Table 7, DNA analysis was the most frequently identified method for personal identification (78.0%), followed by bitemark analysis (48.9%) and lip prints (43.1%). Shape of the mandible (48.6%) and cranial measurements (46.2%) were most commonly recognized for gender estimation, while eruption of the third molar (64.8%) was the top choice for age estimation.

Roles and Tools in Forensic Odontology

According to Table 8, participants demonstrated high recognition of roles such as bite mark analysis (72.7%) and postmortem identification (71.9%). Tools like dental records (68.5%), dental radiographs (66.4%), and photographs (55.4%) were commonly acknowledged. However, awareness of intraoral scans (52.3%) and casts/models (39.6%) was comparatively lower.

Awareness Score Distribution and Group-Wise Comparison

Table 9A presents the awareness distribution across different participant groups. The majority of UG students fell under the moderate category (49.1%), whereas PGs and general practitioners had a higher proportion in the high and excellent awareness categories. Statistical analysis (Table 9B) revealed significant differences between UG students and interns, PGs, and general practitioners ($p < 0.05$), suggesting that clinical exposure and practical experience positively influence awareness of forensic odontology.

Discussion

This study identified moderate levels of awareness of forensic odontology among dental students and professionals, with significant variation across educational levels. Similar findings were reported by Kumaraswamy et al. [9], who found that only 47.5% of medical students were aware of forensic odontology. In our study, 73.8% of respondents recognised bite mark analysis, which is lower than the 94% awareness found among medical students in Kumaraswamy's study, possibly due to the latter's exposure to autopsy procedures. Our finding that 65.4% of participants identified palatal rugae aligns with Preethi et al. [10], who emphasised the rising recognition of non-invasive forensic identifiers. However, global studies such as Avon (2004) and Acharya (2010) have consistently highlighted that structured curricular inclusion is lacking, contributing to persistent knowledge gaps [2,11].

A distinctive contribution of this study lies in identifying specific curricular blind spots**.** First, awareness of prostheses (24.1%) and restorations (20.7%) as forensic identifiers was strikingly low, despite their central role in international forensic protocols. Second, nearly half of the participants incorrectly considered the mandibular bone a reliable source of DNA in burnt remains, a misconception not widely highlighted in previous Indian surveys. Finally, the statistically significant differences in awareness levels between undergraduates and both postgraduates and general practitioners underscore the importance of clinical exposure and practical experience in shaping forensic competence. These findings provide novel, context-specific evidence that can inform curricular reforms targeting lesser-known but highly relevant aspects of forensic odontology.

The statistically significant differences observed between undergraduate students and postgraduates/general practitioners suggest that clinical exposure strongly influences forensic knowledge. General practitioners, who demonstrated higher awareness scores, likely benefit from continued clinical practice and on-the-job experience. Moreover, the ability to identify tools like dental records (68.5%) and radiographs (66.4%) points to familiarity gained through practical application, whereas traits like dental restorations (20.7%) and prostheses (24.1%), despite being critical forensic identifiers were poorly recognized, possibly due to their minimal coverage in standard dental curricula.

One surprising finding was the relatively low awareness regarding shovelling traits (27%) and restorations (20.7%), which are well-documented identifiers in forensic literature [5]. The highest awareness was observed for bite marks and palatal rugae, indicating a selective emphasis within the educational system. Interestingly, nearly half the participants (49.1%) considered the mandible bone a viable source of DNA in burnt bodies. However, evidence suggests that DNA degradation is more pronounced in bones under extreme heat compared to protected dental pulp [12]. This misconception highlights the need for clearer instruction on tissue resilience in forensic scenarios.

The results of this study emphasize the urgent need for forensic odontology to be integrated as a standalone subject within dental education. Curricular reform should include exposure to forensic case studies, hands-on workshops, and interdepartmental collaboration with forensic medicine units. As suggested by other authors [13,14], introducing elective rotations, simulated disaster drills, and mock courtroom testimony sessions may enhance student engagement and professional preparedness. Moreover, public and private

institutions should partner with forensic experts to create continuing dental education (CDE) modules for practicing dentists.

This study, while comprehensive, has several limitations. The use of convenience sampling may have introduced selection bias, as participants with a pre-existing interest in forensic odontology might have been more inclined to respond. The respondent pool was also heavily skewed towards undergraduate students, which may limit the generalizability of the findings across all strata of dental professionals. Furthermore, the study relied on self-reported data collected through an online questionnaire, which is subject to recall bias, misunderstanding of terminologies, and social desirability bias. Lastly, while the study included a wide geographical base, regional representation was not uniform and may not fully capture disparities across institutions or states.

Conclusion

- Participants showed good baseline conceptual awareness of forensic odontology, but recognition of its medico-legal role was limited.
- Awareness of common techniques such as bite marks, rugoscopy, and cheiloscopy was satisfactory, while knowledge of restorations, prostheses, and dental morphology as identifiers was poor.
- DNA analysis was the most frequently recognized method of personal identification; however, misconceptions persisted regarding reliable DNA sources in burnt remains.
- Traditional tools like dental records, radiographs, and photographs were well acknowledged, but awareness of newer tools such as intraoral scans remained limited.
- Postgraduates and general practitioners demonstrated significantly higher awareness compared to undergraduates, highlighting the importance of clinical exposure and practical experience.

Recommendations

- Governing bodies (e.g., DCI, IAFO) should ensure structured inclusion of forensic odontology across all dental curricula.
- Undergraduate teaching should be strengthened with practical modules, case simulations, and exposure to real or mock forensic investigations.
- Continued dental education (CDE) programs and workshops should be encouraged to enhance awareness among interns, practitioners, and faculty.
- Interdisciplinary collaborations with legal and forensic sciences should be promoted to improve preparedness for medico-legal and disaster victim identification roles.

References

1. Sweet D, Hildebrand D. Forensic odontological response to the September 11 attacks on the World Trade Center in New York City. Dent Clin North Am. 2003;47(1):197-208.
2. Avon SL. Forensic odontology: the roles and responsibilities of the dentist. J Can Dent Assoc. 2004;70(7):453-8.
3. Indian Association of Forensic Odontology. Membership data [Internet]. Ghaziabad: IAFO; [cited 2025 Jul 24]. Available from: https://www.iafo.in
4. Radhika T, Jeddy N, Nithya S. Tongue prints: a novel biometric and potential forensic tool. J Forensic Dent Sci. 2016;8(3):117-9.
5. Schwartz TR, Schwartz EA, Mieszerski L, McNally L, Kobilinsky L. Characterization of deoxyribonucleic acid obtained from teeth subjected to various environmental conditions. J Forensic Sci. 1991;36(4):979-90.
6. Rawlani SM, Rawlani SS, Bhowate RR, Chandak RM, Khubchandani M. Racial characteristics of human teeth. J Forensic Odontostomatol. 2017;35(1):2-6.
7. Shah P, Velani PR, Lakade L, Dukle S. Teeth in forensics: a review. Indian J Dent Res. 2019;30(2):291-7.
8. Moneycontrol. Tooth by tooth, gene by gene: How India is identifying the victims of Ahmedabad air crash [Internet]. Mumbai: Moneycontrol; 2025 [cited 2025 Jul 24]. Available from: https://www.moneycontrol.com/
9. Kumaraswamy J, Patil K, Mahima VG. Scope of forensic odontology in India. Int J Forensic Odontol. 2018;3(1):17-20.
10. Preethi S, Einstein A, Sivapathasundharam B. Awareness of forensic odontology among dental practitioners in Chennai: a knowledge, attitude, practice study. J Forensic Dent Sci. 2011;3(2):63-6.
11. Acharya AB. A decade of forensic odontology in India. Indian J Dent Res. 2008;19(2):100-2.
12. Fredericks JD, Latta GH, Adkins KF. Effect of environmental conditions on human dental DNA. Sci Justice. 2015;55(2):124-30.
13. Harchandani N, Marathe S, Warhekar S, Lodha R. Awareness of forensic odontology among dentists in India: a systematic review. J Adv Med Dent Sci Res. 2014;2(3):10-6.
14. Khalifa FN, Al-Zahrani A, El-Dibany MM, Al-Banawi FS. Reliability of pulp/tooth volume ratio for age estimation using CBCT among a Saudi subpopulation. J Forensic Odontostomatol. 2024;42(2):28-38.