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Exploring The Role of Forensic Dentistry in Private Practice: A Study of Modinagar District Dentists

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Abstract

Introduction: Forensic odontology is a specialized branch of dentistry that plays a vital role in criminal investigations, disaster victim identification, and legal proceedings by utilizing dental records and expertise. In India, forensic odontology is still underdeveloped and underutilized, especially among private dental practitioners. This study aimed to assess the awareness, knowledge, and practices of forensic odontology among private dental practitioners in Modinagar (Uttar Pradesh).

Methods: A cross-sectional, questionnaire-based survey was conducted among 200 private dental practitioners (100 BDS and 100 MDS degree holders) in Modinagar City. A validated questionnaire was used to assess their awareness, knowledge, and practices related to forensic odontology, including dental record-keeping, familiarity with forensic techniques, and experience in handling forensic cases. Data were analyzed using descriptive and

inferential statistics, including Chi-square tests and independent t-tests.

Results: Postgraduate practitioners demonstrated significantly higher knowledge of forensic odontology compared to undergraduates. A greater percentage of postgraduates (67%) were aware of the importance of using dental data for identifying deceased individuals, and more postgraduates (62%) understood the uniqueness of rugae patterns. However, both groups reported limited experience in handling forensic cases, with only 30.5% having such experience. Record-keeping practices were also lacking, with only 53% of postgraduates and 29% of undergraduates maintaining dental records.

Conclusion: The study reveals significant gaps in the knowledge and practices of forensic odontology among private dental practitioners in Modinagar. The findings highlight the need for structured training programs and awareness campaigns to improve forensic dental practices, thereby enhancing their role in legal and criminal investigations in India.

Clinical Significance: Improving forensic knowledge and practices among dental practitioners is crucial for accurate dental identification in criminal cases and disaster victim identification, supporting the justice system.

Keyword: Antemortem, Cheiloscopy, Odontology, Pandemics, Dental evidence

Introduction

Forensics, a field integral to the justice system, has a long history, with its name derived from the Latin word "forum," meaning "court of law." Over time, forensics has evolved into a multidisciplinary domain encompassing specialized fields, including forensic odontology. This subspecialty of dentistry, as defined by the Federation Dentaire International (FDI), focuses on the management, examination, evaluation, and preservation of dental findings. Forensic odontology plays a pivotal role in legal investigations by providing essential dental evidence to support justice.[1]

Forensic dentistry, a branch of forensic science, applies dental knowledge primarily for identifying deceased individuals. This process involves comparing antemortem (before death) dental records with postmortem (after death) findings. The success of forensic dental identification relies on well-maintained dental records, which become especially valuable when other identification methods are unavailable or ineffective.[1] Dental identification has a rich historical background, dating back to 66 CE. In India, the earliest recorded case occurred in 1191, when King Kannauj, Jayachandra Rathore, was identified by his artificial anterior teeth. Despite this early example, forensic odontology in India is still underdeveloped. While it has demonstrated potential in aiding forensic medicine, it remains underutilized and not widely recognized across the country.[2]

Forensic odontology contributes to human identification, crime scene investigations, bite mark analysis in abuse cases, age and gender determination, and providing expert testimony in court. Dental records are particularly reliable in cases where other physical identifiers are compromised.[3] Key areas of forensic dentistry include dental identification, bite mark analysis, cheiloscopy (lip print analysis), and rugoscopy (study of palatal rugae patterns). The field is also expanding into sialo-chemistry, the chemical detection in saliva, as a forensic tool.[3] Given the importance of dental identification, a pressing question arises: Should private dental practitioners receive adequate training in forensic odontology? This question has significant implications for both the field and the justice system.[3]

In India, maintaining dental records is both a professional and legal requirement. The Indian Dental Association (IDA) advises keeping relevant documents, images, models, and communications for at least five years, which is essential for protecting patient rights and shielding practitioners from legal risks, such as malpractice cases. However, law enforcement tends to rely on government-employed dental surgeons for forensic expertise, often overlooking private dentists trained in forensic odontology. This reflects a broader issue: India has a shortage of skilled forensic odontologists, a critical gap that demands attention. The need for forensic odontologists is growing in India due to increasing crime, violence, pandemics, mass disasters, and child abuse. Disfigured victims in events such as road accidents require identification, and oral surgeons often play a key role using forensic dentistry. However, this task is hindered by the lack of training and resources available to many dental practitioners, especially those in private practice.

Private dental practitioners in India are expected to maintain accurate dental records, but many struggle with subpar record-keeping. This not only affects patient care but also forensic investigations where dental records are crucial for identification. This underscores the urgent need to assess the awareness, knowledge, and practices of forensic dentistry among private dental practitioners in India. In light of this, a study was conducted in Modinagar to assess forensic dentistry awareness among private dental practitioners. The aim is to address gaps in knowledge and practice to strengthen forensic dentistry in the region. By evaluating current practices, the study seeks to provide insights that can guide future training programs and policy initiatives in forensic odontology across India.

Methodology

Study Design & Setting: This study was a cross-sectional, questionnaire-based survey aimed at assessing the awareness and knowledge of forensic dentistry among private dental practitioners in Modinagar City, Uttar Pradesh, India. The study was conducted among private dental practitioners operating in Modinagar City, including both Bachelor of Dental Surgery (BDS) and Master of Dental Surgery (MDS) degree holders. Data collection took place during the summers of 2022 and 2023.

Sample Size Determination: The sample size was calculated using the Fisher formula for estimating proportions, with a 95% confidence interval, a 20% prevalence rate, and a 5% margin of error. The required minimum sample size was 198, and to ensure robustness, 200 participants were included in the study.

Sampling Technique: Participants were selected using a simple random sampling method from a list of private dental practitioners obtained from business contact directories. Dentists were contacted by phone and provided with information about the study objectives. Consent to participate was obtained before inclusion in the study.

Inclusion Criteria& Exclusion Criteria: The study included private dental practitioners with BDS or MDS degrees who were actively practicing in Modinagar City and willing to participate. Dental practitioners operating outside Modinagar City, as well as undergraduate and postgraduate dental students, were excluded from the study.

Data Collection Instrument: A validated, pretested, and structured questionnaire served as the data collection instrument. The questionnaire, designed in English, included 20 items that focused on key variables such as: awareness of forensic dentistry concepts, knowledge

about the importance of dental records in forensic identification, familiarity with forensic techniques like bite marks, lip prints, and rugae patterns, practices related to maintaining dental records, training and experience in forensic dentistry, and willingness to improve knowledge in forensic odontology.

Procedure: Participants were provided with a self-administered questionnaire, which they completed within 10–12 minutes. The questionnaire included both dichotomous (Yes/No) and multiple-choice questions.

Ethical Considerations: Ethical approval for the study was obtained from the Institution's Ethical Committee.

Statistical Analysis: Data were analyzed using IBM SPSS Statistics version 23.0. Descriptive statistics were used to summarize the data, including frequency distributions, percentages, means, and standard deviations. For inferential statistics: **Chi-square Test:** Used to evaluate the association between categorical variables, such as differences in forensic dentistry knowledge between BDS and MDS practitioners. **Independent t-test:** Applied to compare the mean knowledge scores between two independent groups (e.g., BDS vs. MDS practitioners).A p-value of less than 0.05 was considered statistically significant, with a significance level set at 5% and a 95% confidence interval.

Results

Participant Demographics: A total of 120 private dentists in Modinagar participated in this cross-sectional survey, comprising 103 (51.5%) males and 97 (48.5%) females. The participants were evenly split between undergraduate (BDS) and postgraduate (MDS) levels, with 100 (50%) from each group. The age range of male participants was 24 to 59 years, with a mean age of 35.6 ± 3.68 years. Female participants ranged from 25 to 56 years, with a mean age of 33.7 ± 2.42 years. Overall, the age of participants varied from 24 to 59 years, with a mean age of 34.8 ± 3.26 years.

Knowledge of Forensic Odontology: Table 1 compares the knowledge of forensic odontology between undergraduate and postgraduate dentists. Knowledge about presenting forensic dental evidence in court (Q1) was high in both groups, with 59% of undergraduates and 61% of postgraduates, showing no significant difference (p = 0.973). Awareness of using dental data to identify deceased individuals or suspects (Q2) was significantly higher among postgraduates (67%) than undergraduates (59%) (p = 0.049). Familiarity with bite mark patterns (Q3) was reported by 31% of undergraduates and 43% of postgraduates, showing a significant difference (p = 0.032). Awareness that lip prints can assist in gender determination (Q4) was noted by 47% of undergraduates and 52% of postgraduates (p = 0.048). Knowledge that rugae patterns are unique to individuals (Q5) was higher among postgraduates (62%) compared to undergraduates (44%), with a significant difference (p = 0.001). Confidence in understanding forensic dentistry (Q6) was also significantly higher among postgraduates (61%) than undergraduates (43%) (p = 0.001).

Attitude Toward Forensic Odontology: Table 2 outlines attitudes toward forensic odontology. In terms of identifying deceased individuals in mass deaths (Q7), 32% of undergraduates and 45% of postgraduates considered it part of their job, with a significant difference (p = 0.001). Confidence in handling forensic cases (Q8) was reported by 25% of undergraduates and 36% of postgraduates, also showing a significant difference (p = 0.040). The feasibility of determining dental age from teeth alone (Q9) was recognized by 27% of undergraduates and 37% of postgraduates (p = 0.045). Both groups (58%) affirmed the ability of x-rays to

reveal gender and age (Q10), with no significant difference (p = 0.768). Awareness of gender determination from skull and teeth (Q11) was higher among postgraduates (40%) than undergraduates (32%), with a significant difference (p = 0.049). Knowledge of signs of child abuse and domestic violence (Q12) was noted by 35% of undergraduates and 48% of postgraduates (p = 0.001). Willingness to upgrade forensic odontology knowledge (Q13) was expressed by 61% of undergraduates and 59% of postgraduates, with no significant difference (p = 0.885).

Practice in Forensic Odontology: Table 3 summarizes practices related to forensic odontology among undergraduate and postgraduate dentists. Educational instruction in forensic dentistry (Q14) was provided to 24% of undergraduates and 34% of postgraduates, with a significant difference (p = 0.016). Experience with forensic cases (Q15) was reported by 29% of undergraduates and 32% of postgraduates, with no significant difference (p = 0.759). Collaboration with local forensic teams (Q16) was done by 33% of both groups, showing no significant difference (p = 0.889). Maintenance of dental records (Q17) was observed in 29% of undergraduates and 53% of postgraduates, with a significant difference (p = 0.001). Contact with authorities or courts regarding forensic evidence (Q18) was reported by 25% of undergraduates and 47% of postgraduates, also showing a significant difference (p = 0.001).Record-keeping duration (Q19) revealed 48% of undergraduates and 24% of postgraduates kept records for 0-6 months, with significant differences (p = 0.001). Methods for upgrading knowledge (Q20) included books, the internet, journals, and CDE programs, with no significant differences (p = 0.763).

Discussion

The integration of science and technology in forensic science is crucial for crime investigation and justice, relying on scientific evidence in legal proceedings. Forensic odontology, a key subfield, helps identify deceased individuals by comparing ante-mortem and post-mortem dental records, utilizing the durability of dental tissues.[,] Historical cases, such as Raja Jayachandra Rathore's identification in 1191 through prosthetic teeth[1] and the 2004 tsunami, which emphasized the need for forensic odontologists,[11] highlight its importance.

In India, law enforcement typically relies on government dental surgeons, not private practitioners with specialized forensic degrees.[12] The limited application of forensic odontology is due to a lack of trained professionals, as seen in high-profile cases like the death of Prime Minister Rajiv Gandhi.[13] Studies from cities like Pune, Bhubaneswar, and Chennai reveal significant gaps in knowledge and practice among dentists. Preethi et al.[1] and Navya N et al.[2] found low enthusiasm and knowledge in Chennai, while Sarode et al.[1] identified poor attitudes in Pune. Nagarajappa R et al. reported positive attitudes but poor record-keeping.

Despite its growth in developed countries, forensic odontology in India is hindered by a shortage of trained professionals, insufficient facilities, and inadequate undergraduate exposure.[21] Introduced in the BDS curriculum in 2007 with limited content, forensic odontology is only minimally integrated into MDS programs in subspecialties like Oral Pathology.

Comparison of Knowledge Regarding Forensic Odontology: The knowledge of forensic odontology among undergraduate and postgraduate dentists was assessed using six questions from a questionnaire based on studies by Preethi S et al. (2011)[1] and Dinesh Kumar

T et al. (2022)[22]. Regarding expert witness evidence, 60% of subjects were aware they could present forensic dental evidence in court, with 59% of undergraduates and 61% of postgraduates recognizing this role. These findings are consistent with Rahman et al. (2017)[23], which reported 62.5% of undergraduates and 65.2% of postgraduates, and Roy et al. (2019)[2], where 71.6% of undergraduates and 73.2% of postgraduates were aware. However, our results differ from Ugbodaga PI et al. (2023)[2], where only 28.3% of dentists, and Al-Qahtami S et al. (2017)[2], where 32.7% of undergraduates and 34% of postgraduates, were aware of this role.

1. **Relevance of Dental Records:** A total of 63% of subjects understood the importance of dental records in identifying deceased individuals or accused criminals, with 59% of undergraduates and 67% of postgraduates recognizing this. These results align with those of Abdul N et al. (2022)[2] and Bhat PR et al. (2023)[2], but differ from Hannah et al. (2017)[2], where 86.3% of participants acknowledged this importance.
2. **Knowledge about Bite Marks:** Only 37% of subjects had knowledge about bite mark patterns, with 31% of undergraduates and 43% of postgraduates aware of bite mark analysis. These results are similar to Abdul N et al. (2022)[2] and Preethi S et al. (2011)[1] but differ from Juber R et al. (2017)[1], which found that 62% of undergraduates had a better understanding compared to 51.5% of postgraduates..
3. **Lip Prints:** Approximately 49.5% of subjects were aware that lip prints could aid in gender determination. This included 47% of undergraduates and 52% of postgraduates. These findings are similar to those of Govindraj S et al. (2018)[16], where 46% of subjects knew that lip prints could help determine gender.
4. **Palatal Rugoscopy:** A total of 53% of subjects understood that rugae patterns are unique to individuals. Among these, 44% of undergraduates and 62% of postgraduates recognized this uniqueness. These findings are comparable to Sweetha et al. (2018)[30] and Chandran et al. (2021)[31].
5. **Overall Knowledge Adequacy:** About 48% of subjects felt their current knowledge level of forensic odontology was adequate. This included 57% of undergraduates and 39% of postgraduates. These results align with Sweetha et al. (2018)[30] and Ram AJ et al. (2022)[32].

Postgraduate dentists demonstrate significantly higher knowledge of forensic odontology compared to undergraduates. This difference may be due to undergraduates relying primarily on books and the internet, while postgraduates have access to additional resources such as journals, workshops, andconferences.[33]

Comparison of Attitude Towards Forensic Odontology: Attitudes towards forensic odontology among undergraduate and postgraduate dentists were assessed through seven questions from the questionnaire based on Preethi S et al. (2011) and Dinesh Kumar T et al. (2022)[22]

Role in Mass Fatality: Overall, 61.5% of subjects did not believe they had a crucial role in identifying deceased individuals in mass fatality incidents. This included 68% of undergraduates and 55% of postgraduates. Similar findings were reported by Rahman et al. (2017)[23] and Roy et al. (2019)[24].

1. **Confidence in Handling Forensic Cases:** A total of 69.5% of subjects lacked confidence in handling forensic dentistry cases. This included 75% of undergraduates and 64% of postgraduates. These

results align with Prajapati G et al. (2018)[34] Isher DK et al. (2019)[33].

2. **Estimating Dental Age:** Only 32% of subjects could estimate an individual's dental age by examining their teeth. This included 27% of undergraduates and 37% of postgraduates. Our findings are consistent with studies by Sujeet S et al. (2020)[31]and Govindraj S et al. (2018)[16].
3. **Identifying Abuse:** Approximately 41.5% of subjects could identify indicators of domestic violence and child abuse through dental examinations. This included 35% of undergraduates and 48% of postgraduates. These results are similar to those of Sweetha et al. (2018)[30] and Patel A et al. (2020)[35].
4. **Willingness to Upgrade Knowledge:** About 60% of subjects expressed a willingness to enhance their knowledge of forensic odontology. This included 61% of undergraduates and 59% of postgraduates. This finding is consistent with Juber R et al. (2017)[15] and Preethi S et al. (2011)[19].

Comparison of Practice Regarding Forensic Odontology: The practice of forensic odontology among undergraduate and postgraduate dentists was evaluated through six questions from the questionnaire based on studies by Preethi S et al. (2011)[19] and Dinesh Kumar T et al. (2022)[12].

1. **Formal Training in Forensic Odontology:** Only 29% of subjects had received formal training in forensic odontology. This included 24% of undergraduates and 34% of postgraduates. These findings are consistent with studies by Sarode et al. (2017)[14], where only 30% of subjects had received formal training, and Abdul N et al. (2022)[27].
2. **Handling Forensic Cases:** A total of 30.5% of subjects reported having handled forensic cases. This included 28% of undergraduates and 34% of postgraduates. These findings align with Isher DK et al. (2019)[33] and Rahman et al. (2017)[23].
3. **Participation in Forensic Teams:** About 34% of subjects were part of a forensic team. This included 33% of undergraduates and 35% of postgraduates. This is consistent with Juber R et al. (2017)[15].
4. **Maintenance of Dental Records:** Only 41% of subjects maintained dental records in their clinics. This included 29% of undergraduates and 53% of postgraduates. These findings align with Sarode et al. (2017)[14], where 39% of subjects maintained dental records and Preethi S et al. (2011)[19].
5. **Court Appearances for Forensic Evidence:** Approximately 36% of subjects had been called to present forensic evidence in court. This included 25% of undergraduates and 47% of postgraduates. These findings are in line with Prajapati G et al. (2018)[34], where 34% of subjects had court experience, and Govindraj S et al. (2018)[16].

Conclusion

This study provides valuable insights into the understanding, attitudes, and practices of forensic odontology among dental practitioners in Modinagar City, revealing significant gaps between undergraduate and postgraduate practitioners. While postgraduates generally demonstrate greater knowledge and a more positive attitude towards forensic odontology, both groups face challenges in practical application. Many dentists, regardless of education level, reported a lack of confidence and limited experience in managing forensic cases, raising concerns given the importance of forensic odontology in criminal investigations and legal proceedings. The findings highlight the need for more structured and thorough training in forensic odontology within dental education. Despite postgraduates' better

knowledge, the absence of formal training and hands-on experience shows that the current curriculum is insufficient. Integrating forensic odontology more comprehensively into both undergraduate and postgraduate programs, alongside offering specialized workshops, could improve preparedness and confidence in forensic cases.

Clinical Significance: This study holds clinical significance by highlighting the need to strengthen the role of forensic odontology in criminal investigations and legal processes in Modinagar. It identifies gaps in the knowledge, attitudes, and practices of private dental practitioners, underscoring the importance of improved training and awareness in this field. Enhancing education and integrating forensic odontology into routine clinical practices will lead to more accurate dental record-keeping and better preparedness for handling forensic cases. This is crucial for effective identification in mass disasters, abuse cases, and criminal investigations, ultimately supporting the justice system through dentistry.

Limitations: The sample size and regional focus on private dental practitioners in Modinagar may limit the generalizability of the findings to other areas or types of practitioners. Additionally, self-reported data could introduce response bias.

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Legend Tables

Table 1: Comparison of Knowledge regarding Forensic Odontology

Q. No.	Question	Response	Under-graduate	Post-graduate	Overall	P value
1	Do you know that you can present forensic dental evidence in the court as an expert witness?	No	41 (41%)	39 (39%)	80 (40%)	0.973
		Yes	59 (59%)	61 (61%)	120 (60%)	
2	Have you ever considered the use of dental data in identifying the deceased or a suspect in a criminal case?	No	41 (41%)	33 (33%)	74 (37%)	0.049 (Sig)
		Yes	59 (59%)	67 (67%)	126 (63%)	
3	Are you familiar with the patterns that teeth leave behind when they bite?	No	69 (69%)	57 (57%)	126 (63%)	0.032 (Sig)
		Yes	31 (31%)	43 (43%)	74 (37%)	
4	Do you know lip prints	No	53 (53%)	48 (48%)	101 (50.5%)	0.048

	can help in gender determination?	Yes	47 (47%)	52 (52%)	99 (49.5%)	(Sig)
5	Do you know rugae pattern are unique for an individual?	No	56 (56%)	38 (38%)	94 (47%)	0.001 (Sig)
		Yes	44 (44%)	62 (62%)	106 (53%)	
6	How well-versed are you in the field of forensic dentistry at the moment?	No	57 (57%)	39 (39%)	96 (48%)	0.001 (Sig)
		Yes	43 (43%)	61 (61%)	104 (52%)	

Table 2: Comparison of Attitude towards Forensic Odontology

Q. No.	Question		BDS	MDS	Overall	P value
7	Is the identification of the dead an important part of your job in the event of a mass death?	No	68 (68%)	55 (55%)	123 (61.5%)	0.001 (Sig)
		Yes	32 (32%)	45 (45%)	77 (38.5%)	
8	Are you confident in handling forensic dentistry-related cases?	No	75 (75%)	64 (64%)	139 (69.5%)	0.040 (Sig)
		Yes	25 (25%)	36 (36%)	61 (30.5%)	
9	Is it feasible to determine an individual's dental age only by looking at their teeth?	No	73 (73%)	63 (63%)	136 (68%)	0.045 (Sig)
		Yes	27 (27%)	37 (37%)	64 (32%)	
10	Are x-rays of the teeth and cranium able to reveal a person's gender and age?	No	42 (42%)	41 (41%)	83 (41.5%)	0.768 Non-Sig)
		Yes	58 (58%)	59 (59%)	117 (58.5%)	
11	Can you determine the gender of an individual by examining the skull and teeth?	No	68 (68%)	60 60%)	128 (64%)	0.049 (Sig)
		Yes	32 (32%)	40 (40%)	72 (36%)	
12	Do you know what to look for to see signs of child abuse and domestic violence?	No	65 (65%)	52 (52%)	117 (58.5%)	0.001 (Sig)
		Yes	35 (35%)	48 (48%)	83 (41.5%)	
13	Are you willing to upgrade your knowledge regarding forensic odontology?	No	39 (39%)	41 (41%)	80 (40%)	0.885
		Yes	61 (61%)	59 (59%)	120 (60%)	

Table 3: Comparison of Practice Regarding Forensic Odontology

Q. No.	Question		Under-graduate	Post-graduate	Overall	P value
14	Has your educational experience included any instruction in	No	76 (76%)	66 (66%)	142 (71%)	0.016 (Sig)
		Yes	24 (24%)	34 (34%)	58 (29%)	

	forensic dentistry?					
15	Have you experience in situations involving forensic dentistry?	No	71 (71%)	68 (68%)	139 (69.5%)	0.759
		Yes	29 (29%)	32 (32%)	61 (30.5%)	
16	Do you work with the local forensics team?	No	67 (67%)	65 (65%)	132 (66%)	0.889
		Yes	33 (33%)	35 (35%)	68 (34%)	
17	In your dental practice, do you keep records of dental procedures?	No	71 (71%)	47 (47%)	118 (59%)	0.001 (Sig)
		Yes	29 (29%)	53 (53%)	82 (41%)	
18	Have you been contacted by the authorities or the court for inquiries about forensic evidence?	No	75 (75%)	53 (53%)	128 (64%)	0.001 (Sig)
		Yes	25 (25%)	47 (47%)	72 (36%)	
19	For how long do you maintain dental records? (in Months)	0-6 Month	48 (48%)	24 (24%)	72 (36%)	0.001 (Sig)
		6-12 Month	17 (17%)	19 (19%)	36 (18%)	
		12-24 Month	21 (21%)	23 (23%)	44 (22%)	
		>24 Month	14 (14%)	34 (34%)	48 (24%)	
20	In the field of forensic dentistry, how may one increase their level of expertise?	Books	43 (43%)	41 (41%)	84 (42%)	0.763
		Internet	38 (38%)	40 (40%)	78 (39%)	
		Journal	18 (18%)	16 (16%)	34 (17%)	
		CDE	1 (1%)	3 (3%)	4 (2%)	