

An insight into the awareness and utilization of “dental evidence” among the police force in Punjab

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Introduction

Forensic Odontology (FO)/Dentistry faction of Forensic Medical Science deals with the proper handling, examination, and evaluation of dental evidence, which could be then presented in the interest of justice.^[1] It utilizes the dentist's acquaintance and skills to serve the law enforcement agencies. The rationale of this field is

Abstract

Introduction: The prime objective of the subsequent investigation is to ascertain the identity of an individual by the evaluation of evidence and facts relevant to crime or disaster. The whole process revolves around the correct interpretation of the facts, reconstruction, and comprehension of the sequence of events and thus single evidence forms a very important piece of information. In most of the countries including India, forensic medical, and dental evaluation at the crime scene are performed by police officials as medical and dental experts are rarely involved as first responders. **Aims and Objectives:** This questionnaire-based study is aimed to emphasize the importance of dental evidence in human identification, age and gender determination, and expanding the role of dentistry in criminal investigations. **Material and Methods:** A questionnaire-based study was conducted among the 350 gazetted and nongazetted police officers posted in Ludhiana (Punjab) commissionerate. It was exploratory in nature. **Results:** We found that the gazetted officers, postgraduates, and personnel with <20 years of experience revealed that commendable knowledge, positive attitude, and approach for the practical applications of forensic odontology (FO) in routine investigations. **Conclusion:** Dental professionals and law enforcement agencies must go hand in hand so that FO can be utilized to its maximum potential.

Key words: Forensic, knowledge, law, odontology, police, records

based on the uniqueness of the individual's dentition and recognizable imprints of the teeth.^[2] When postmortem changes, traumatic injuries, tampered fingerprints, decomposed or burnt bodies and unavailable circumstantial evidence nullify the use of commonly accepted forensic medicine principles, dental identification assumes a primary role by revealing the truth from the tooth.^[3] In the

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last few decades, this branch has justified its utilization in different aspects of individual identification and criminal investigations.^[4]

From the past few years, there has been an alarming rise in incidences of brutal rapes, human trafficking, terrorist attacks, homicides, and natural disasters in India.^[5] Many such cases have been primarily solved with forensic dental evidence. It is difficult to forget the horrifying Nirbhaya rape and murder case (2015), where photographic and computer-aided analysis of the bitemarks found on the victim's body helped to identify the five prime suspects.^[6] In Sheena Bora murder case (2016), the facial superimposition technique was used to ensure the identity through skeletal remains particularly jaw and teeth, which were exhumed 3 years after the murder^[7] and also in Prime minister Rajiv Gandhi's assassination (1991), dentition helped in his identification.^[8] Apart from these cases, selected famous international cases have also been enlisted in literature which has involved dental forensic science.^[9] Moreover, Indian statistics reveals nearly 63,611 deaths in 2001–2010 due to various natural disasters. These incidents have emphasized on the necessity to adopt a multidisciplinary approach for identifying the victims and perpetrators.^[10] The information on the individual's age, race, and gender and also sometimes cause and time of death could be ascertained by recognizing dental sample as substantial evidence by police personnel as they are the first one to take custody of investigating sites/crime scenes.^[11] The knowledge about recognizing a dental sample as substantial evidence by police personnel is important to prevent the loss and tampering of evidence. However, the irony is that neither the police force nor the dentists are well aware of the significance of dental evidence and a dentist's opinion in the context of law.^[12] The criminal trials in India are governed by the Criminal Procedure Code and Indian Evidence Act 1872, which are the parent procedural laws. The sections 45, 46, and 47 of the act highlight that the court when required can trust the skills of persons with technical knowledge of the facts concerned.^[13] Thus, a dental professional's words could be used as an expert opinion in the context of law. It is high time to realize that this branch is no longer an abstraction but is closely woven into the fabrics of the law enforcement agencies.^[14]

In our country, where FO is still in its infancy, it becomes a necessity to educate and arm the crime investigating officers and their team with the protocols and tools of forensic dental science. This would help them to identify, recover, and interpret the dental evidence correctly, thus providing timely justice to all.^[15] This questionnaire-based study is pursued with the following objectives.

Objectives

- A. To evaluate the knowledge and attitude of police officials regarding the subject of FO and dental evidence
- B. To assess the awareness about identification, collection, utilization, and interpretation of dental evidence by investigators (disaster management/crime scene)
- C. To emphasize the importance of utilization of FO protocols and tools for evidence evaluation
- D. To develop an awareness/training program based on the feedback.

Material and Methods

This questionnaire-based survey was carried out by the Department of Oral Pathology and Public Health Dentistry of Christian Dental College and Hospital, Ludhiana (Punjab). It was exploratory in nature, cross-sectional in design. The study was conducted among the police officers posted in Ludhiana commissionerate including the gazetted and nongazetted police personnel as participants. The officials on special duty/short-term duty/leave, those who participated in the pilot study and officials who could not read or write Punjabi were excluded from the study.

The stratified sampling technique was used, and police stations/posts of five zones (North, South, East, West, and Central) in Ludhiana were covered. Statistically, the sample size for the study for a population of 4300 police officials in Ludhiana was calculated to be 350 (with a degree of accuracy = 5% and confidence interval = 95%). The information on the nature of the study was provided to all the participants and the consent implied by an individual's voluntary completion of the questionnaire was acknowledged. A pilot study was conducted among 30 police officers, which were later excluded from the main study.

A questionnaire containing 22 questions was designed to assess the awareness, approach, and status of utilization of dental evidence and FO science among the participants [Figure 1]. It was prepared initially in English and later translated into the official Punjabi language. Back translation was done for content reliability. The validity of the questionnaire was also assessed in both languages. The content validity was evaluated through the distribution of questionnaire among the subject experts and investigating officers. The content and face validity were observed to be 0.8 which was satisfactory. The questionnaire was comprised two parts. The first section was for demographic details and the second part catered to questions emphasizing on forensic dentistry and dental evidence. Sufficient time was given to the participants to fill the questionnaire (5–7 min). Descriptive statistics were used for statistical evaluation. Completed questionnaires were coded, and spreadsheets were created for data entry, and the data were analyzed using SPSS version 17 (SPSS Inc., Chicago, IL, USA). Chi-square test was used to find the association between demographics parameters and knowledge, attitude, and practice regarding FO.

Questionnaire

1) Accurate Human Identification methods involve. (Can tick more than one option)

- Circumstantial evidence e.g. wallets, jewelry, clothing etc.
- Photographic evidence e.g. victim, crime scene, inanimate objects.
- Medical evidence/Medical examination
- Dental evidence/Dental examination
- None of the above

Any other:

2) According to you, Forensic dentistry/Dental evidence can be used for. (Can tick more than one option)

- Can be used for human identification in natural/man-made disasters and criminal investigations
- Can provide time and cause of death
- Can be used for age estimation
- Can be used to present evidence in court
- None of the above

Any other:

3) Where did you learn about forensic dentistry? (Can tick more than one option)

- Newspapers/ internet
- Workshops
- Cases/training
- Other sources

4) Who visits the crime scene/ investigating site first? (Can tick more than one option)

- Inspectors, constables
- Medical officer
- Forensic team
- Forensic dental expert

Any other:

5) Do you think postmortem dental examination should be done?

- Strongly agree
- Moderately agree
- I don't know
- Strongly disagree
- Moderately disagree

6) If Dental Evidence is collected, who evaluates it?

- Medical officer
- Local government hospital
- Forensic lab
- Dental professionals at private institutes
- Forensic dental expert
- None of the above

7) Blood stained cigarette butts are obtained from a crime scene/ investigating site. What do you think can be the possible evidences? (Can tick more than one option)

- Fingerprints
- Lip prints
- Saliva
- Blood stains
- None of the above

Any other:

8) A decomposed and partially skeletonized dead body is found along with pieces of broken teeth and blood stains. Two right side front teeth were broken. What will be your course of action?

- Collection and evaluation of the broken teeth and blood stains
- Discard the teeth and only evaluate the blood stains.
- Collect and evaluate teeth only
- None of the above

Any other:

9) At a crime scene, if you recover a dental prosthesis (crown/cap or dentures) what will you do?

- Ignore it as an evidence
- Try to fit it in the suspect's/victim's mouth
- Collect and take it to a forensic lab for evaluation
- None of the above

Any other:

10) In a robbery case, assailants have used adhesive tape to bind victim's hand. Which possible evidences on the tape could help to nab the assailants? (Can tick more than one option)

- Fingerprints
- Lip prints
- Bite marks on the torn off end of the tape
- Saliva
- Tape cannot be used as evidence

Any other:

11) What could be the most reliable evidence to identify the case of child abuse? (Can tick more than one option)

- Bruises or fractures on the face or body
- Burn marks on the skin
- Bite marks on the body
- All of the above
- None of the above

Any other:

12) A 27-yr old woman was found raped and murdered. The evidence collected from the crime scene including blood samples, fingerprint smudges and sperm sample were proved inconclusive. Bite marks were found on her chest.

A) What can be used as evidence?

- Bite marks on the body
- Saliva around bite mark
- Both of the above
- None of the above

B) What according to you is the accurate method for collecting bite marks?

- Photography
- Impressions and models
- Tissue sample/ saliva around the bite-mark
- All of the above
- None of the above

13) 20 skulls have been recovered at a deserted construction site. Age/Gender determination could be done using

- Forensic medical science
- Forensic dental science
- Both
- None

Any other:

14) Have you ever utilized ante-mortem (before death) records? If yes, what were the records that you used?

- Medical records
- Dental records
- Both
- None

Any other:

15) Do you think maintaining before death Dental records could be as significant as Medical records?

- Yes
- No
- Not Sure

16) While identifying and collecting evidence you rely on. (Can tick more than one option)

- Training
- Experience
- Information through workshops
- Information on internet
- None of the above

Any other:

17) Do you have any Protocol/Guidelines for evidence collection?

- Yes
- No
- Not Sure

18) What do you think are the problems associated with dental evidence? (Can tick more than one option)

- Lack of awareness
- Difficulty in collection & complicated techniques of evaluation
- Difficult to justify in court as evidence
- Lack of records
- None of the above

Any other:

19) Which Indian penal codes are most relevant to Forensic dentistry/Dental evidence?

- IPC no 302(for murder)
- IPC no 307 (for attempt murder)
- IPC no 376 (for rape)
- All of the above
- None of the above

20) Do you know about high profile cases where Dental Evidences proved to be significant for conclusion?(Can tick more than one option)

- Sheena Bora murder case
- Nirbhaya rape and murder case
- Beant Singh(CM Punjab) assassination case
- Rajiv Gandhi (PM India) assassination case
- None of the above

Any other:

21) Do you feel you have sufficient knowledge about forensic dentistry?

- Yes
- No
- Not sure

22) Would you like to attend a seminar/workshop on forensic dentistry/dental evidence, if provided with an opportunity?

- Yes
- No
- Not sure

Thank you for your valuable Time & Co-operation.....

Figure 1: Questionnaire

Results

The first part of the questionnaire was designed to obtain the demographic details of the participants including the age, gender, rank, qualifications, and the experience. The males (89%) formed the dominant study participants as compared to females (11%). The mean age of the participants was 37.6 years. More than half of the participants had <20 years of experience (54.3%), and 64% of individuals

were undergraduates. The constables and head constables constituted 41.7% and 36.9% of the study population, respectively [Figure 2]. Most of the participants considered the study idea and design highly constructive, and the response rate was 100%.

The police officials irrespective of their ranks have sufficient knowledge about the role of FO in age estimation ($P = 0.004$) with 100% response rate for gazetted officers. About 68.7%

of high-rank officers were aware of the fact that dental evidence could be used as substantial biological evidence in the context of law. When questioned about high-profile cases which have been solved using dental evidence, 38% of the participants mentioned Nirbhaya case, but most of them were unaware of other cases. However, 19% considered dental prosthetic replacements as important evidence which should be taken to the forensic laboratory for evaluation ($P = 0.004$). Nearly, 51% of them were significantly aware of the fact that as such no center or state level guidelines are available for dental evidence collection [Figure 3 and Table 1].

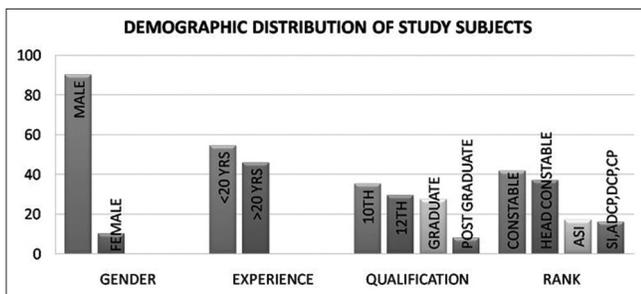


Figure 2: Demographic distribution of participants

Based on their education, we observed that 75% of matriculates considered circumstantial evidence such as wallets, jewelry, and clothing as more significant proofs for human identification. For evidence collection, undergraduate, graduates, and postgraduates depended mainly on their training ($P = 0.001$). About 64.3% of postgraduates considered bitemarks as reliable evidence from the crime scene; however, only 21% were equally aware of the significance of tissue sample and saliva around the bitemark as substantial evidence [Table 2]. Fingerprints and blood stains were considered as the most reliable evidence over the lip prints and saliva ($P = 0.006$) by the participants with more than 20 years of experience. The bitemarks, bruises, and saliva were considered as reliable evidence in cases of child abuse by the officers with <20 years of experience ($P = 0.004$). Nearly, 77% of participants on experience basis considered lack of proper record maintenance as major hindrance for the utilization of dental records for forensic investigations [Table 3].

Discussion

The enforcement of the principles of FO in routine criminal investigations and mass disasters involves the

| BASED ON RANK | TOTAL POSITIVE RESPONSE | % Significant Response | p-value |
|---|-------------------------|------------------------|---------|
| Forensic odontology for age estimation | 214 | 61.1 | .004 |
| Dental evidence in context of law | 91 | 26.0 | .001 |
| Use of dental prosthesis as evidence | 65 | 18.6 | .004 |
| No protocol for evidence collection | 179 | 51.0 | .001 |
| Knowledge about high profile cases (Nirbhaya case) solved using dental evidence | 132 | 37.7 | .009 |
| BASED ON QUALIFICATION | TOTAL POSITIVE RESPONSE | % Significant Response | p-value |
| Circumstantial evidence for human identification | 225 | 64.3 | .001 |
| Bite marks as evidence from crime scene | 106 | 30.3 | .002 |
| Tissue sample/ saliva around bite mark | 110 | 31.4 | .001 |
| For evidence collection rely on training | 207 | 59.1 | .001 |
| BASED ON EXPERIENCE | TOTAL POSITIVE RESPONSE | % Significant Response | p-value |
| Fingerprints as evidence over dental evidence | 231 | 66.0 | .005 |
| Evidence in child abuse cases | 103 | 29.4 | .009 |
| Bite mark and saliva as evidence | 184 | 52.6 | .002 |
| Methods for collection of bite mark | 79 | 22.6 | .009 |
| Lack of records | 60 | 77.1 | .006 |

Figure 3: Significant findings from the study

Table 1: Observations based on the Rank

| Criteria | Based on rank | | | | |
|--|---------------|------------|------------|------------|-----|
| | Constable | HC | ASI, SI | ADCP, DCP | *N |
| Forensic odontology for age estimation | 81 (55.5%) | 72 (55.8%) | 45 (76.3%) | 16 (100%) | 214 |
| Dental evidence as substantial evidence in court | 29 (19.9%) | 34 (26.4%) | 17 (28.8%) | 11 (68.7%) | 91 |
| Use of dental prosthesis as evidence | 33 (22.6%) | 28 (21.7%) | 4 (6.8%) | 16 (100%) | 65 |
| No protocol for evidence collection | 50 (34.2%) | 42 (32.6%) | 10 (16.9%) | 16 (100%) | 179 |
| High profile cases (Nirbhaya case) | 65 (44.5%) | 45 (34.9%) | 19 (32.2%) | 13 (81.2%) | 132 |

*N: Number of participants

Table 2: Observations based on the qualification

| Criteria | Based on qualification | | | | *N |
|--|------------------------|------------------|------------|------------|-----|
| | 10 th | 12 th | Graduate | PG | |
| Circumstantial evidence for human identification | 92 (74.8%) | 63 (61.2%) | 58 (60.4%) | 12 (42.9%) | 225 |
| Bite marks as evidence on adhesive tape | 32 (26.0%) | 28 (27.2%) | 28 (29.2%) | 18 (64.3%) | 106 |
| Tissue sample/saliva around bite mark | 51 (41.5%) | 32 (31.1%) | 21 (21.9%) | 6 (21.4%) | 110 |
| For evidence collection rely on training | 59 (48.0%) | 64 (62.1%) | 63 (65.6%) | 21 (75.0%) | 207 |

*N: Number of participants

expertise of forensic dentists, investigating officers, and judiciary.^[16] At the crime investigating site, all personals involved (especially the first responders) should have an adequate understanding of the forensic process and the scientific disciplines. Their prime priority should be to maintain the integrity of crime scene and evidence.^[17] We observed that 51% of police personnel were not aware of the protocols or guidelines for evidence collection, especially regarding dental evidence. Forensic medical science is essential and integral part of the training curriculum of the police force, but FO is only briefly discussed. Thus, explaining the hostile and indifferent attitude toward the forensic dentistry. This study highlighted the lack of knowledge and training for the identification and handling of dental evidence.^[18] We found that gazetted officers, postgraduates, and personnel with <20 years of experience revealed praiseworthy knowledge, positive attitude, and approach for the practical applications of FO in routine investigations. However, personnel with more than 20 years of experience were sticking to the old norms, and 75% of them still considered fingerprints as more substantial proofs over tooth prints. Although we could not find data, supporting these findings in the literature.^[6,18,19] This study emphasizes the role of education and mass media to develop a positive approach for a new field.

Our research comes with modest limitations that include small sample size, although sampling was based on stratification. Second unequal distribution of participants according to designation (more of constables and head constables in our study) was also observed. As this study was a questionnaire based in design, subjectivity could be a confounding factor. But all in all, it sheds light on the prevalence and status of FO in criminal investigations and disaster management.

Table 3: Observations based on the experience

| Criteria | Based on experience | | *N |
|---|---------------------|-------------|-----|
| | <20 years | >20 years | |
| Fingerprints as evidence over dental evidence | 113 (59.5%) | 118 (73.8%) | 231 |
| Evidence in child abuse cases | 67 (35.3%) | 36 (22.5%) | 103 |
| Bite mark and saliva as evidence | 115 (60.5%) | 69 (43.1%) | 184 |
| Methods for collection of bite mark | 53 (27.9%) | 26 (16.3%) | 79 |
| Lack of records | 42 (22.1%) | 18 (11.3%) | 60 |

*N: Number of participants

In this study, constables, head constables, and the assistant subinspectors formed the team of investigating officers reaching first at the crime scene site as described by 96% of the participants. A few said that nature of the crime or incidence decides who will be the first to take hold of the situation. The similar findings were observed in the studies conducted by Pandit *et al.*^[6] and Garg *et al.*^[20] In accordance with this findings, Senthil *et al.* in their study conducted in Puducherry observed that oral and dental findings were not reported in crime investigation files, and dental samples as substantial biological evidence were not valued and accepted by the police force due to ignorance or lack of awareness.^[19] Thus, the whole investigation could be compromised and misled if dental evidences are left unnoticed by the evidence collectors.^[21] Deebaei *et al.* in their study conducted in Tehran observed that out of 248 only in 4.8% cases, the tooth information (dental records and position of teeth) had been used for identification.^[18] In this study, police personnel had meager knowledge regarding the tools and equipment required for dental evidence collection and transportation, with only 23% respondents being aware of bitemarks collection methods. Shamim has discussed few dental evidence identification protocols, methods, and tools in their study.^[22]

Most of the criminal cases, conflicts, and natural and man-made disasters dealt by the police force do not involve the active participation of forensic dental experts.^[23] We strongly feel that in such circumstances knowledge and skill of forensic odontologist could be a blessing in disguise, as a tooth could be the missing lead for solving a crime by comparative dental identification.^[24] Pandit *et al.* also highlighted the need for better communication between the police personnel and forensic odontologists.^[6] Mansour Al-Sarhani-advocated the implementation and utilization of FO in criminal investigations to identify the suspects and victims.^[25] Rahmat *et al.* also suggested that police officers could be educated through structured continuing education programs.^[26]

Hence, we recommend the inclusion of FO as a separate subject in the training curriculum of the police officers as police professionals, who lack the knowledge of FO, would be unable to competently assess and handle scientific evidence and hence the pursuit of justice can be seriously hampered potentially, leading to factual errors.^[27] Dental institutes should conduct seminars, symposiums, workshops, and hands-on programs for the police and other security forces educating and instilling the practical aspects of FO. The educative programs should be conducted in different states, to ensure the utilization of this branch and police department should also embrace the knowledge and avail the services.^[28]

Proper official dental evidence identification, collection, and analysis guidelines should be laid down and followed throughout India equivalently as adopted and implemented by American Board of FO.^[29] A positive rapport with the police department is also required to begin the forensic dental services which could be mutually beneficial. The change has to be brought from the grass root levels. Teamwork is essential to ensure that evidence relating to the injury is documented, collected, preserved, analyzed, and interpreted following appropriate protocols and using scientifically accepted techniques.^[30]

Shanbhag emphasized that several dentists and legal professionals are quite ignorant of the importance of keeping well-maintained dental records for the identification of unknown persons in the field of forensics and thus undermine their role as forensic experts^[31] whereas dental records are more readily available than fingerprint database especially in American and European countries.^[32] Hence, dentists have the social and legal obligation to maintain accurate, legible dental records of their patients. This is not practiced in India as we do not have a law to govern this and antemortem record maintenance depends on personal preferences.^[32,33] Therefore, the central government should legalize the process of maintenance of antemortem dental records by government/private institutions, practitioners and should set the appropriate protocols while releasing

these records safeguarding the privacy of patients.^[34] The dental institutes should be identified at district/state levels, which could serve as referral centers with well-equipped dental laboratories, standardized techniques, and skilled forensic odontologists. The forensic dental experts should be recruited in state-level forensic laboratories.^[35]

This study is conducted with the aim of changing the perception of society and police department toward the forensic dental science. We intend to collect the baseline data from the police personnel through this questionnaire-based study, emphasizing the importance of dental evidence in human identification, age and gender determination, and expanding the role of dentistry in criminal investigations. In the future, we plan to develop an awareness/training program based on the feedback. As this study is one of the few to encompass police personnel at a district level, it can be considered as an ongoing process of learning and delivering best possible methods to practice FO.

Conclusion

This article attempts to make the concerned professionals aware of the expanding role of FO. Dental Professionals have the moral responsibility of introducing and educating the police personnel and legal professionals about the potential applications of this branch so that judiciary would not falter to base their judgment on the undisputed dental evidence provided by Forensic dentist in the Court of law. The need of the hour is that dental professionals and law enforcement agencies must go hand in hand so that FO can be utilized to its maximum potential. The paucity of trained and skilled forensic dental manpower in India should be catered, and endeavors to foster and develop this discipline within the overall forensic science framework in India should be encouraged.

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Conflicts of interest

There are no conflicts of interest.

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