Awareness and Utilisation of Forensic Odontology Among Police Personnel of Uttarakhand: A Knowledge, Attitude and Practice Study

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ABSTRACT-

Introduction: Forensic odontology (FO) is a critical branch of dentistry that contributes significantly to criminal investigations by examining and preserving dental evidence. Police personnel, often the first responders at crime scenes, play a pivotal role in evidence collection and handling. However, the effectiveness of FO is contingent upon their knowledge and training.

Aim: To assess the knowledge, attitude, and practices (KAP) of police officials regarding forensic odontology, with a focus on identifying, collecting, utilizing, and interpreting dental evidence.

Materials and Methods: A cross-sectional study was conducted among 236 police personnel using a pre-validated questionnaire comprising 22 questions. The questionnaire aimed to assess the participants' awareness, attitude, and practical application of forensic odontology.

Results: 207 Police personnel participated in our study out of which 187 were male. Higher-ranking officers and those with graduate or postgraduate education demonstrated commendable knowledge and positive attitudes toward forensic odontology with a response rate of 85%. However, significant knowledge and practice gaps were identified, particularly among constables and head constables. A majority expressed a willingness to attend training or seminars to enhance their understanding.

Conclusion: Improving the knowledge and practical application of forensic odontology among police personnel through structured training programs and interdepartmental collaboration can enhance the preservation and use of dental evidence in investigations.

Keywords: Forensic odontology, Dental evidence, Police, Awareness, Evidence collection

Introduction

Forensic odontology (FO) is a vital branch of forensic science, uniquely positioned at the intersection of dentistry and law enforcement. Its primary applications lie in human identification, crime scene analysis, and post-mortem examinations.[1] The use of dental evidence has proven critical in diverse scenarios, from bite mark analysis in violent crimes such as assault and rape, to identifying victims in mass disasters like plane crashes and natural catastrophes.[2] The durability of teeth, which resist decomposition and environmental damage, makes them invaluable for forensic investigations, often serving as the only remaining evidence in severely degraded remains.

One of FO's landmark applications was in the conviction of serial killer Ted Bundy, where bite mark evidence played a pivotal role. Additionally, in mass disasters such as the 2004 Indian Ocean tsunami, FO was instrumental in identifying victims through dental records, further underscoring its importance in humanitarian efforts. FO played a crucial role in the Nirbhaya case by analysing bite marks found on the victim's body, which were compared with the dental impressions of the accused to confirm their involvement. This evidence, along with medical reports, helped establish the violent nature of the assault and corroborated other forensic findings, including DNA evidence. The bite mark

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analysis also aided in reconstructing the sequence of events, strengthening the prosecution's case. Presented in court as scientific proof, FO significantly contributed to the conviction of the perpetrators, highlighting its importance in criminal investigations. Despite these advancements, awareness and utilisation of FO among law enforcement remain limited, particularly in regions where access to forensic expertise is scarce.

Police personnel, as first responders, have a critical role in preserving and collecting evidence. Proper handling of dental evidence at crime scenes is paramount to maintain its integrity.[3] Errors, such as contamination or mishandling of evidence, can compromise investigations, resulting in missed opportunities for justice. A 2016 study revealed that only a small fraction of law enforcement professionals in India had received formal training in forensic odontology, highlighting significant gaps in knowledge and practice.[2]

Training and education are crucial for empowering police personnel to utilize forensic odontology effectively. Structured programs, workshops, and collaborations with forensic experts can help first responders recognize the value of dental evidence and adhere to standardized collection protocols.[4] For instance, bite marks, dental records, and DNA extracted from dental tissues provide reliable data for identifying individuals and linking suspects to crime scenes.

The ultimate goal is to integrate FO seamlessly into law enforcement practices, making it a routine component of investigations. Such efforts would not only enhance investigative outcomes but also ensure justice is served efficiently and accurately.[5] By bridging the knowledge gap through education and partnerships, forensic odontology can reach its full potential as a cornerstone of modern forensic science.[6]

This study aimed to assess the knowledge, attitude, and practices (KAP) of police officials in Uttarakhand regarding forensic odontology, with a focus on identifying, collecting, utilizing, and interpreting dental evidence.

Materials and Methods

This study was conducted after obtaining ethical clearance from Ethical Committee and Institutional Review Board of college.

Study Design and Participants

Sample size formula used is,

$$N = \frac{Z^2 P (1-P)}{d^2}$$

Wherein, Z = 1.96 (Constant)
P = 19% (Prevalence)
d = 0.05 (significance level)

So, $$N = \frac{(1.96)^2 \times 0.19 (1-0.81)}{(0.05)^2}$$
= 236.3 rounded off to 236

Hence, the sample size obtained was 236

Wherein,

n = the sample size,

Z = the statistic corresponding to level of confidence,

P = expected prevalence (obtained from the article of Sharma, et al), and

d = is precision (set at 5%)

This descriptive cross-sectional study targeted police personnel of varying ranks, from constables to high-ranking officers. A structured, pre-validated questionnaire consisting of 22 items was administered to 236 participants to evaluate their knowledge, attitudes, and practices (KAP) regarding forensic odontology.

Questionnaire Details

The questionnaire was divided into four sections:

1. **Demographic Information**: Gender, educational qualifications, and rank were recorded to assess correlations between these factors and the level of FO awareness.
2. **Knowledge Assessment:** Questions gauged participants' understanding of the role of dental evidence in crime scene investigations, human identification, and other forensic applications.
3. **Attitude Evaluation:** Statements explored participants' willingness to learn about FO, their perceptions of its importance, and openness to attending related training programs.
4. **Practice-Related Questions:** These examined how frequently police personnel encountered scenarios involving dental evidence and their ability to respond effectively.

Statistical Analysis

The responses were analysed using the chi-square test, with a significance threshold set at $p<0.05$. The findings were further categorized based on rank and educational background to identify patterns and gaps in awareness.

Results

Characteristics of the Study Population

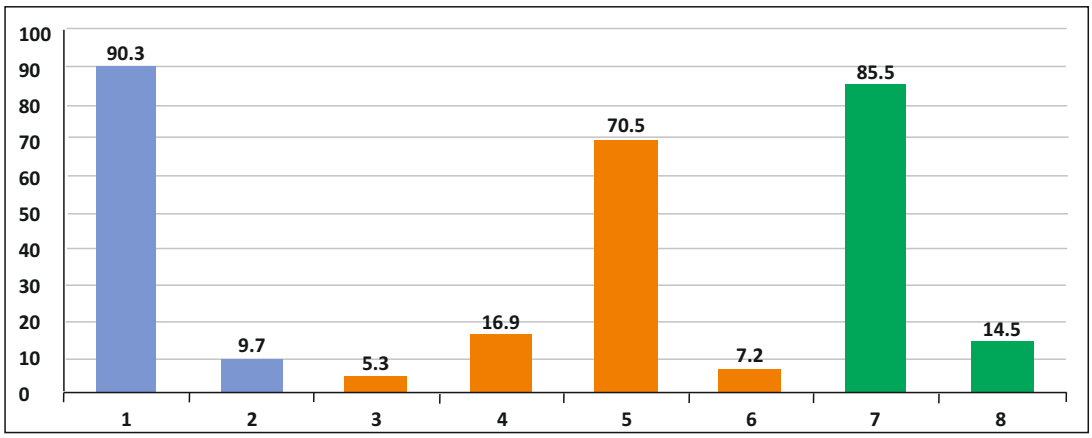
After removing the incomplete questionnaires, the study sample comprised 207 participants, predominantly male (90.3%, n=187), while females accounted for 9.7% (n=20). Educational levels ranged from high school to postgraduate degrees, with a majority being graduates (70.5%, n=146). Participants were predominantly constables or head constables (85.5%, n=177), while higher-ranking officers constituted 14.5% (n=30). ***Table 1 and Graph 1***

Awareness Levels by Rank

Rank played a significant role in determining the awareness and application of forensic odontology. High-ranking officials demonstrated superior knowledge and positive attitudes in all evaluated areas.

		N (%)
Gender	Male	187 (90.3)
	Female	20 (9.7)
Education	High School	11 (5.3)
	Higher Secondary	35 (16.9)
	Graduate	146 (70.5)
	Post-graduate	15 (7.2)
Rank	Constable & Head Constable	177 (85.5)
	High Rank Officials	30 (14.5)

Table 1: Characteristics of Study Population



Graph 1: Characteristic of study population

Significant Findings by Rank:

- Post-mortem dental examination: 82.6% (n=171) of participants acknowledged its importance. Among them, constables constituted 84.1%, while high-ranking officers accounted for 73.3%.
- Evidence collection from blood-stained cigarette butts: Awareness was higher among high-ranking officers (50%) than constables (31.6%).
- Dental evidence at crime scenes: This was recognized by 53.3% of high-ranking officers compared to 27.7% of constables. (Table 2, Table 3 and Graph 2). Further insights into frequency-based responses across different ranks are illustrated in Graph 4.

Education and Awareness

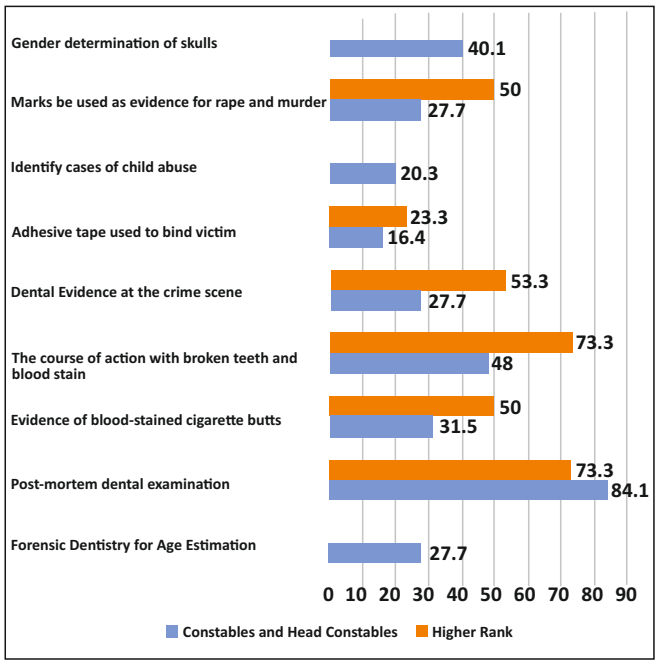
Education level emerged as a critical determinant of awareness. Postgraduates exhibited the highest awareness

Table 2: Significant findings according to rank related to forensic dentistry

According to Rank	Total Positive Response	Percentage Response	P value
Forensic Dentistry for Age Estimation	49	23.7	P = 0.001
Post-mortem dental examination	171	82.6	P = 0.001
Evidence from blood-stained cigarette butts	71	34.3	P = 0.001
The course of action with broken teeth and blood stain	107	51.7	P = 0.001
Dental Evidence at the crime scene	65	31.4	P = 0.02
Adhesive tape used to bind the victim	36	17.4	P = 0.001
Identify cases of child abuse	36	17.4	P = 0.001
Bike marks be used as evidence for rape and murder	72	34.7	P = 0.001
Age/gender determination of skulls	71	34.3	P = 0.001

Table 3: Observations based on ranks

	N	Constables and Head Constables	Higher Rank officials
Forensic Dentistry for Age Estimation	49	49 (27.7)	0
Post-mortem dental examination	171	149 (84.1)	22 (73.3)
Evidence of blood-stained cigarette butts	71	56 (31.6)	15 (50)
The course of action with broken teeth and blood stain	107	85 (48)	22 (73.3)
Dental Evidence at the crime scene	65	49 (27.7)	16 (53.3)
Adhesive tape used to bind the victim	36	29 (16.4)	7 (23.3)
Identify cases of child abuse	36	36 (20.3)	0
Bike marks be used as evidence for rape and murder	72	49 (27.7)	15 (50)
Age/Gender determination of skulls	71	71 (40.1)	0



Graph 2: Observations based on ranks

in key areas of forensic odontology, followed by graduates. High school and higher secondary participants showed comparatively lower knowledge levels.

Significant Findings by Education:

- Human identification methods: Postgraduates (40%) and graduates (12.3%) had the highest positive response rates, highlighting the impact of higher education on FO awareness.
- Dental evidence at crime scenes: Postgraduates significantly outperformed others, with 66.7% recognizing its importance compared to 30.1% of graduates. (Table 4,5 and Graph 3). Graph 5 highlights the frequency distribution of significant responses across different educational levels.

Challenges and Barriers

Key challenges identified include:

1. **Lack of Training:** A significant proportion of participants admitted to not receiving formal training in handling dental evidence.
2. **Absence of Protocols:** Graph 6 illustrates that standardized guidelines for collecting and preserving dental evidence are either unavailable or poorly implemented. Perception of FO as a Niche Field: Many participants viewed forensic odontology as a specialized domain not directly applicable to their routine duties.

Discussion

At the site of crime investigation, all the involved in crime

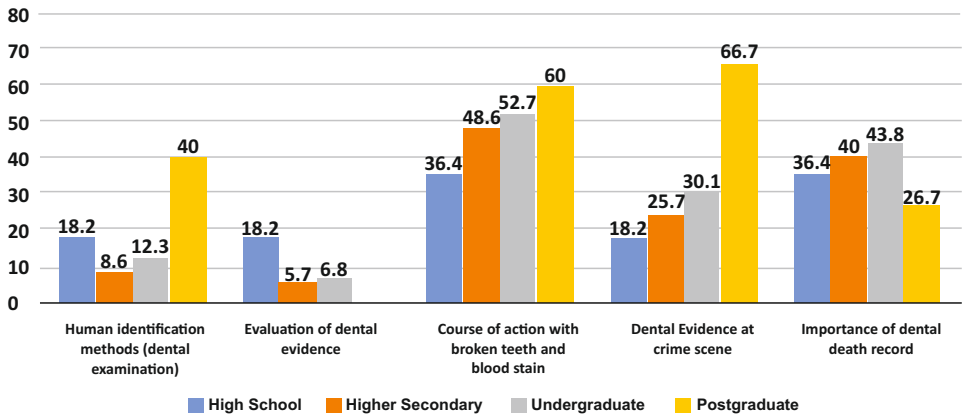
Table 4: Significant findings according to the education related to forensic dentistry

According to Education	Total Positive Response	Percentage Response	P value
Human identification methods (dental examination)	29	14	P = 0.001
Evaluation of dental evidence	14	6.76	P = 0.001
The course of action with broken teeth and blood stain	107	51.7	P = 0.001
Dental Evidence at the crime scene	65	31.4	P = 0.045
Importance of dental death record	86	41.5	P = 0.001

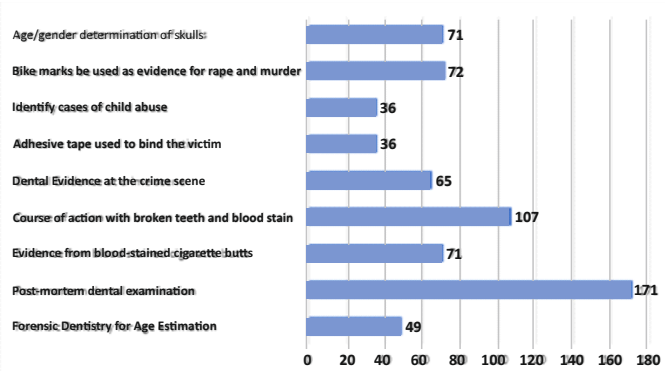
P < 0.05 using Chi square test

Table 5: Observation Based on Education

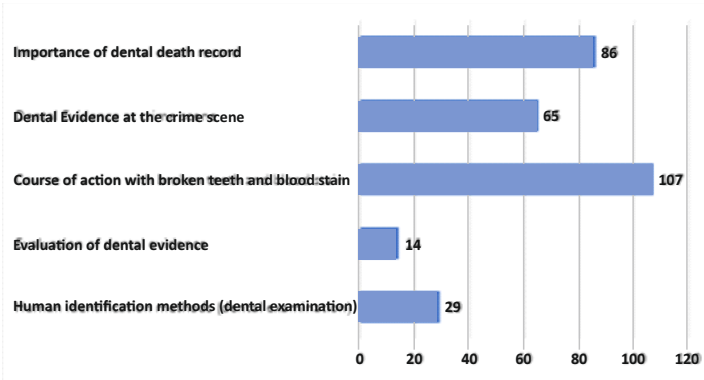
	N	HS	HrSec	UG	PG
Human identification methods (dental examination)	29	2 (18.2)	3 (8.6)	18 (12.3)	6 (40)
Evaluation of dental evidence	14	2 (18.2)	2 (5.7)	10 (6.8)	0
The course of action with broken teeth and blood stain	107	4 (36.4)	17 (48.6)	77 (52.7)	9 (60)
Dental Evidence at the crime scene	65	2 (18.2)	9 (25.7)	44 (30.1)	10 (66.7)
Importance of dental death record	86	4 (36.4)	14 (40)	64 (43.8)	4 (26.7)



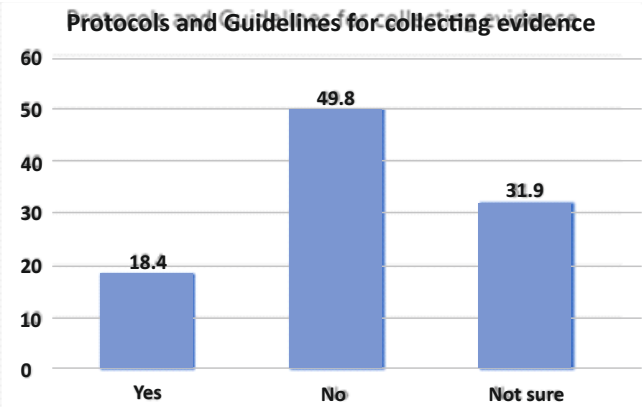
Graph 3: Observation Based on Education



Graph 4: Significant findings according to Rank of Police Personnel and Forensic Dentistry (in frequency)



Graph 5: Significant findings according to the education of Police Personnel and Forensic Dentistry (in frequency)



Graph 6: Are there any protocols and guidelines for collecting evidence

investigating and especially the first responders should have an adequate understanding about the forensic process and the protocols. The priority should be to maintain the integrity of crime scene and importantly the evidence [6,9]. FO has also played a central role in bringing unsolved investigations to a satisfactory conclusion at many occasions. The study attempted, to evaluate the knowledge, awareness and understanding of police personnel when it comes to dental evidences. Results of our study were in accordance with study by Pandit et al.(2016)[2] in terms of role of police personnel at the crime site and level of understanding of forensic data. In another study conducted by Choudhary E, et al.[1] The Participants irrespective of their ranks have enough knowledge about the role of forensic in age estimation (P = 0.009) with 100%

response rate among gazetted officers as in our study. Proper guidelines and protocols to be followed for collection, identification and assessing evidence by officials must be laid down that are to be followed throughout the nation as adopted and implemented by American Board of FO. For the sake of mutual benefits, it is important to have positive rapport among forensic dental services and police personnel. The change has to be initiated from the basic level. For Proper collection, preservation, documentation and analysis of the evidence and also to ensure proper scientific protocols, it is necessary to have integrated approach and teamwork.

Need for Training and Standardized Guidelines

The lack of standardized protocols for handling dental evidence remains a significant barrier.[7] Training programs tailored to different ranks can bridge these gaps. First responders, particularly constables and head constables, should be equipped with practical skills for preserving dental evidence.[8]

Policy Recommendations[9]

1. Integrate FO in Police Training Curricula: Modules on forensic odontology should be included in police academies to ensure foundational knowledge among recruits.
2. Workshops and Seminars: Periodic seminars, as suggested by the participants, can enhance ongoing awareness.[7]
3. Collaborations with Forensic Experts: Partnerships between law enforcement and forensic odontologists can streamline evidence collection processes.

Conclusion

Forensic odontology offers immense potential in solving criminal cases by providing crucial evidence related to human identification, crime scene analysis, and post-mortem examinations.[10],[11] This study reveals disparities in awareness levels based on rank and education, emphasizing the need for targeted training initiatives. Enhancing the knowledge and skills of police personnel in forensic odontology is essential for preserving the integrity of dental evidence and ensuring justice.[12]

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Nil.

Conflicts of interest

There are no conflicts of interest.

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