



Original Research Article

Forensic odontology: A dental detective's perspective from central India

Mayank Chandrakar^{1*}¹Dept. of Dentistry, Government Medical College, Mahasamund, Chhattisgarh, India

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ABSTRACT

Introduction : Forensic dentistry is application of dental knowledge in criminal and civil.**Materials and Methods :** A questionnaire study was conducted among 133 Policemen of Mahasamund to assess their knowledge of Forensic Dentistry. Data was analyzed using SPSS software version 18.0.**Results :** 83.50% knew that Forensic Science was useful in solving legal cases. 36.10% participants had knowledge that Forensic Odontology is useful for Age determination, D.N.A. analysis and Bite Marks. Police Personnel who had greater than 10 years' experience had more knowledge of Forensic Dentistry. (P value < 0.001). Police Personnel who had rank above Constables had more knowledge about Forensic Dentistry. (P value = 0.01).**Conclusion :** This study revealed that most of the Police Personnel had inadequate knowledge about Forensic Dentistry. A sound knowledge on Forensic Dentistry and their practical applications in crime scenes are essential for Police Personnel to provide timely justice to one and all.This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial 4.0 International](https://creativecommons.org/licenses/by-nc/4.0/), which allows others to remix, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.For reprints contact: reprint@ipinnovative.com

1. Introduction

Forensic science is scientific method of collection and examining information about the past which is then used in a court of law. Forensic science can play vital role in a judicial setting and accepted by the court and general scientific community to separate truth from untruth.^{1,2} Forensic identifications are multidisciplinary team efforts that essentially involve the coordination and cooperation of Policeman, Lawyers, forensic pathologists, forensic odontologists, forensic anthropologists, serologists, criminalists and other specialists.³

Forensic sciences generally is used for solving Medicolegal Case. Judiciary in India is facing complex problems right now leading to abnormal delays in doing justice; nearly 4.7 Crore cases are undecided in the Indian courts.⁴ So a common man feels halting to approach the

Police Stations or Law Courts and when they become sufferer of crime or injustice.

Forensic Odontology is application of dental knowledge in criminal and civil cases that are imposed by Policeman in legal system.⁵⁻⁷ Forensic is derived from the Latin word forum, which means "court of law". Odontology refers to study of teeth. Forensic Odontology has been described by the Federation Dentaire International as that branch of dentistry which, in the interest of justice, deals with the proper handling and examination of dental evidence and with the proper evaluation and preservation of dental findings.^{8,9}

Forensic odontology is an important and intrinsic part of forensic science. This is chiefly used for identification of living and deceased persons. Today, forensic odontology has developed as a new ray of hope in assisting forensic medicine. Though this is in infancy state in India as comparison to developed countries of the world like U.S.A. and U.K. There Forensic Odontology has considered a

* Corresponding author.

E-mail address: mchandrakargc@gmail.com (M. Chandrakar).

recognized branch of dental surgery in Forensic Medicine.³

Forensic Odontology comprises identification of human remnants through dental records at the scene of crime, child or adult abuses¹⁰ and determines age and sex of the living or deceased for presenting forensic dental testimony as a witness in a court.¹¹ In forensic odontology, tooth prints, radiographs, dental photographs and investigations like rugoscopy and cheiloscropy are used.^{12,13} DNA fingerprinting is an excellent method for accurate forensic diagnosis.^{14,15}

Dental identification has a decisive role in the identification of remains when post-mortem changes, traumatic tissue injury or lack of fingerprint record negates use of visual or fingerprint methods. The tooth has been used as weapons in identification of biter. Teeth are the most stable parts in the body and can be heated to temperature of 1600°C without appreciable loss of microstructure.^{16,17}

Dental identification has played a significant in natural as well as manmade disasters. Natural (Earthquake, Drought and Tsunami) or man-made disasters (Terrorism, Homicides and Suicide Bombing) can lead to loss of lives of millions of people internationally.^{18–20}

Crimes oftenly associated with biting are homicide, rape, sexual assault, robbery and child abuse. The crime type, age and sex of the subject impact on the likely anatomical location of a bite injury. Bite marks will assist to solve the crime. Bite marks give not only information about the dental characteristics of the criminal but also their psychological background.²¹

India has a fantastic history of forensic science. Application of science and technology for detection and investigation of crime and administration of justice is well known to us. Its detailed allusion is found in 'Kautilya's Arthashastra' 2300 years ago. Papillary lines ('Rugoscopy') were studied thousands of years ago by Indians. First case of identification from India was of Raja Jayachandra Rathore of Canouj, who died on the battlefield in 1191 and his body was identified by his false anterior teeth. Forensic Odontology had been applied successfully in the case of the assassination of the former Prime Minister of India, Mr. Rajiv Gandhi.²² A forensic odontologist from Dharwad, Dr. Asith B Acharya helped Police in solving NewDelhi Gang Rape Case 2012.²³ Forensic odontology has play remarkable role in Sheena Bora murder case (2012). In this case Sheena was murdered and her body was buried three years ago but forensic experts identified her from skull and tooth.²⁴

At present, natural and man-made disasters are occurring more oftenly in India with increasing crime like sexual assault and child abuse. There can be difficulty of recognition of mangled body, So Dental Surgeon's role is crucial in identification of body. Dental expert can help Police Personnel in solving criminal cases. There is need of formal training of Police Personnel in forensic

science. Before undertaking the dental expert opinion Police Personnel have to investigate principally regarding dental involvement in crime and preserve dental testimony. Hence Forensic Odontology is of preeminent importance to all Police Personnel.^{5–7} In India under sections 174 and 176 Cr.P.C., only police and magistrate inquests are done and they are public servants with very less exposure to law and forensic science throughout their professional training. Policemen and Judges are scientifically lay individuals. There are difference in agencies in India who do crime scene investigation and autopsy and other scientific investigations. One remarkable feature is these agencies are working alone, with less coordination.²⁵ Considering above facts in mind a questionnaire study had done to evaluate the knowledge of Forensic Odontology among Policemen of Mahasamund.

2. Materials and Methods

This questionnaire survey was conducted from 5 February 2022 to 7 February 2022 in Policemen of District Police Headquarter of Mahasamund for assessment of knowledge of Forensic Dentistry. Survey schedule for data collection had made. On an average 45 Police Personnel were interviewed face to face per day.

This study's ethical clearance was obtained from Ethical Committee of Rungta Dental College, Bhilai. Incharge of District Police Headquarter, Mahasamund gave permission for doing study among Policemen. A written informed consent was taken from every participant before the study.

A self administered questionnaire was given to every participants. Both male and female Policemen took active participation. The validity of the questionnaires were assessed by both Dental Surgeon and Policemen.

A total of 133 Police Personnel, available at the time of study and agreed to participate formed the final sample.

2.1. Inclusion criteria

Policemen who were available at the time of study and who gave consent for participation were included.

2.2. Exclusion criteria

1. Police Personnel who were absent on the day of study because of their duty.
2. Police Personnel who did not give consent and who were not willing to participate.

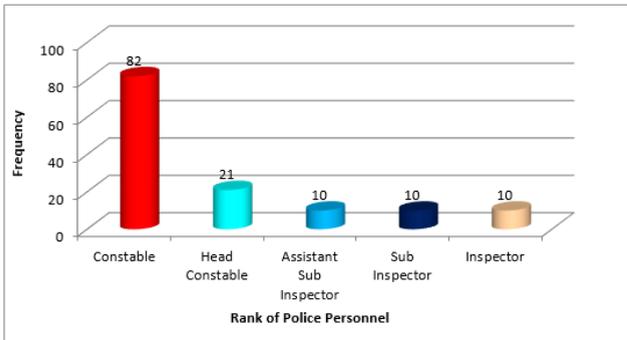
2.3. Proforma

A self-administered questionnaire consisted of 19 questions in which 3 questions were open ended questions. The questionnaire comprised information about Demographics, Basic knowledge of Forensic Science, Basic knowledge of Forensic Dentistry, Dental Identifications, Abuse, Bite Mark Evidence and Criminal Litigations. The questionnaire and

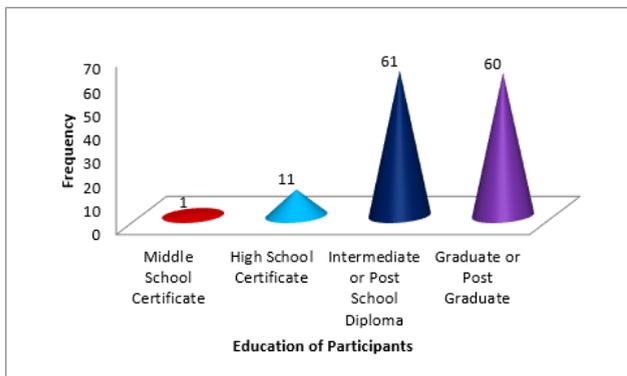
consent forms are made in Hindi language and used in survey.

2.4. Statistical analysis

SPSS software package version 18.0 was used for analysis of collected data and Descriptive statistics was recorded. Associations between overall knowledge of forensic odontology and experience, sex, rank and education of Police Personnel were tested using Chi-square test. p-value less than 0.05 was considered statistically significant in our study.



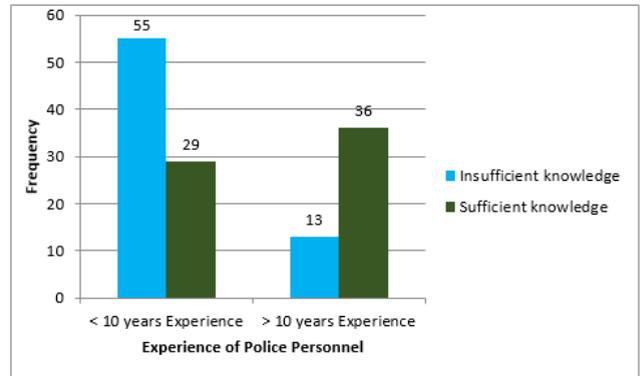
Graph 1: Distribution of police personnel according to rank



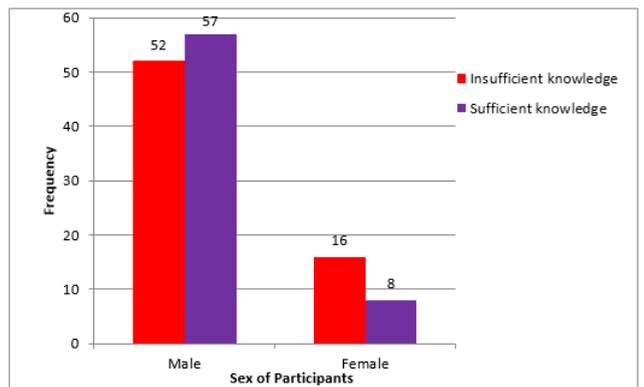
Graph 2: Distribution of participants according to education

3. Results

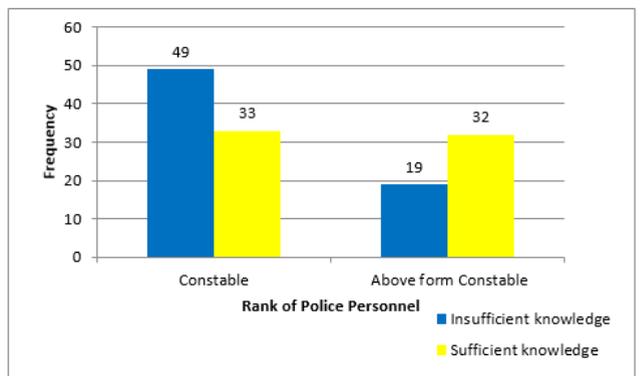
A total of 133 Police Personnel of District Police Headquarters of Mahasamund available at the time of study were included in our study. 12 Police Personnel refused to participate in study. 92% participants gave responses. The mean age of participants was 34.81 years (SD-10.93). The mean experience of Police Personnel was 11.10 years (SD-10.00). Most of the participants were Male (82.00%) in our study. Out of 133 Policemen 61.70% Constables, 15.80% Head Constables, 7.50% Assistant Sub Inspectors, 7.50% Sub Inspectors and 7.50% Inspectors were agreed



Graph 3: Overall knowledge of forensic dentistry among police personnel according to experience



Graph 4: Overall knowledge of forensic dentistry among police personnel according to sex



Graph 5: Overall knowledge of police personnel according to rank

Table 1: Distribution of police personnel according to rank

	Frequency	Percentage
Constable	82	61.70%
Head Constable	21	15.80%
Assistant Sub Inspector	10	7.50%
Sub Inspector	10	7.50%
Inspector	10	7.50%
Total	133	100.00%

Table 2: Distribution of participants according to education

	Frequency	Percentage
Middle School Certificate	1	0.80%
High School Certificate	11	8.30%
Intermediate or Post School Diploma	61	45.90%
Graduate or Post Graduate	60	45.10%
Total	133	100.00%

Table 3: Frequency distribution of participants regarding basic knowledge of forensic science

Question Number	Question	Options	Frequency	Percentage
1	Do you know what is Forensic Science?	Yes	133	100%
		No	0	0%
2	Do you know Forensic Science help is sought by Police in solving cases for investigations?	Yes	111	83.50%
		No	22	16.50%
3	Do you know Forensic Dentistry is a part of Forensic Science?	Yes	110	82.70%
		No	23	17.30%

Table 4: Frequency distribution of participants regarding basic knowledge of forensic dentistry

Question Number	Question	Options	Frequency	Percentage
4	Have you had any formal training in evaluating dental evidence?	Yes	0	0%
		No	133	100%
5	Do you know that Forensic Odontology can be used for identification of victims?	Yes	77	57.90%
		No	56	42.10%
6	Do you know that Forensic Odontology can be used for determination of age and sex of victims?	Yes	84	63.20%
		No	49	36.80%
7	In what situations Forensic Odontology is useful in criminology?	Age determination	19	14.30%
		D.N.A.	29	21.80%
		Bite Marks	37	27.80%
		All of the above	48	36.10%

to take part in survey. (Table 1 and Graph 1) In present study 45.90% participants were intermediate or post school diploma. (Table 2 and Graph 2)

3.1. Basic knowledge of forensic science (Table 3)

All participants had knowledge about Forensic Science. Majority of them (83.50%) answered that Forensic Science help is sought by Police in solving cases for investigations.

In present study (82.70%) Police Personnel had awareness that Forensic Dentistry is part of Forensic Science.

3.2. Basic knowledge of forensic dentistry (Table 4)

No participants had any formal training for evaluating dental testimony. Only (57.90%) were aware of that Forensic Odontology can be used for identification of victims. In present study (63.20%) were a view of that Forensic

Table 5: Frequency distribution of participants regarding dental identifications

Question Number	Question	Options	Frequency	Percentage
8	Do you know about dental identification marks which can be used for identification of victims?	Yes	70	52.60%
		No	63	47.40%
9	Do you know importance of saliva in victim's identification?	Yes	47	35.30%
		No	86	64.70%
10	Do you know that D.N.A. analysis can be done using person's teeth?	Yes	62	46.60%
		No	71	53.40%
11	Do you know role of dental prosthesis in identification of dead persons in Mass Disaster?	Yes	54	40.60%
		No	79	59.40%

Table 6: Frequency distribution of participants regarding abuse

Question Number	Question	Options	Frequency	Percentage
12	Do you know importance of Dental Photography in Abuse and Domestic Violence cases?	Yes	52	39.10%
		No	81	60.90%

Table 7: Frequency distribution of participants regarding bite mark evidence

Question Number	Question	Options	Frequency	Percentage
13	Do you know about Bite Marks?	Yes	30	22.60%
		No	103	77.40%
14	What is Bite Marks?	Correct Answer	14	46.67%
		Wrong Answer	16	53.33%
		Total	30	100%
15	In what way Bite Marks help?	Correct Answer	8	26.67%
		Wrong Answer	22	73.33%
		Total	30	100%
16	How do you record and preserve Bite Marks?	Correct Answer	5	16.67%
		Wrong Answer	25	83.33%
		Total	30	100%
17	You can see Bite Marks from crime scenes. Who do analysis of this Bite Marks?	Medical Practitioner	39	29.30%
		Criminal Lawyer	8	6.00%
		Pathologist	8	6.00%
		Forensic Dental Expert	78	58.60%

Table 8: Frequency distribution of participants regarding criminal litigations

Question Number	Question	Options	Frequency	Percentage
18	Do you know importance of teeth preservation in Medicolegal cases?	Yes	75	56.40%
		No	58	43.60%
19	In violence incidents if you found some missing teeth in person, Do you take consultation of Dental Surgeon?	Yes	85	63.90%
		No	48	36.10%

Table 9: Overall knowledge of forensic dentistry among police personnel according to experience

Knowledge level of Forensic Dentistry	Experience		Total	P-value
	< 10 years	>10 years		
Insufficient knowledge	55 (65.48%)	13 (26.53%)	68 (51.13%)	< 0.001 (HS)
Sufficient knowledge	29 (34.52%)	36 (73.47%)	65 (48.87%)	
Total	84(100.00%)	49 (100.00%)	133(100.00%)	

Chi-square test, P value < 0.001 at 95%Confidence Interval,(HS) Highly Significant

Table 10: Overall knowledge of forensic dentistry among police personnel according to sex

Knowledge level of Forensic Dentistry	Sex		Total	P-value
	Male	Female		
Insufficient knowledge	52 (47.71%)	16 (66.67%)	68 (51.13%)	0.09 (NS)
Sufficient knowledge Total	57 (52.29%)	8 (33.33%)	65 (48.87%)	
	109 (100.00%)	24 (100.00%)	133 (100.00%)	

Chi-square test, P value > 0.05 at 95% Confidence Interval, (NS) Not Significant

Table 11: Overall knowledge of forensic dentistry among police personnel according to rank

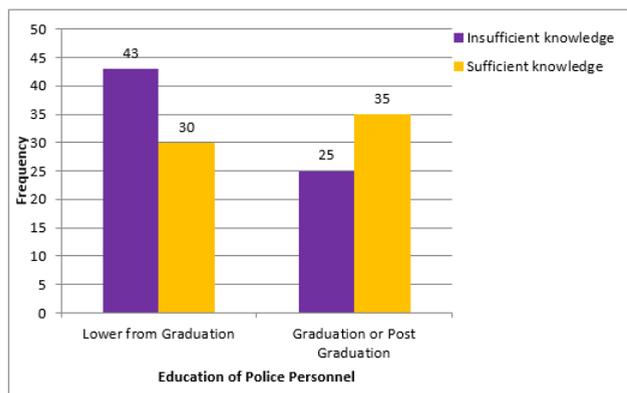
Knowledge level of Forensic Dentistry	Rank		Total	P-value
	Constable	Above from Constable		
Insufficient knowledge	49 (59.76%)	19 (37.25%)	68 (51.13%)	0.01 (S)
Sufficient knowledge Total	33 (40.24%)	32 (62.75%)	65 (48.87%)	
	82 (100.00%)	51 (100.00%)	133 (100.00%)	

Chi-square test, P value < 0.05 at 95% Confidence Interval, (S) Significant

Table 12: Overall knowledge of forensic dentistry among police personnel according to education

Knowledge level of Forensic Dentistry	Education		Total	P-value
	Lower from Graduation	Graduation or Post Graduation		
Insufficient knowledge	43 (58.90%)	25 (41.67%)	68 (51.13%)	0.04 (S)
Sufficient knowledge Total	30 (41.10%)	35 (58.33%)	65 (48.87%)	
	73 (100.00%)	60 (100.00%)	133 (100.00%)	

Chi-square test, P value < 0.05 at 95% Confidence Interval, (S) Significant



Graph 6: Overall knowledge of police personnel according to education

Odontology can be used for recognition of age and sex of victims. Only (36.10%) participants had knowledge that Forensic Odontology is useful for Age determination, D.N.A. analysis and Bite Marks.

3.3. Dental identifications (Table 5)

In present study 52.60% participants had enough knowledge that dental identification marks can be used for identification of victims. According to 35.20% participants saliva can be helpful for victim's identification. Among participants, 46.60% were aware of the fact that D.N.A. analysis can

be done using person's teeth. About 41% participants gave positive nod on importance of Dental prosthesis in recognition of deceased person in Mass Disaster.

3.4. Abuse (Table 6)

Only (39.10%) had knowledge about importance of Dental Photography in Abuse and Domestic Violence cases.

3.5. Bite mark evidence (Table 7)

Only 22.60% knew about Bite Marks. Out of that 46.67% reported correctly about Bite Marks. Most of them (73.33%) did not know about how Bite Marks can be helpful for solving cases. Eighty three percent participants did not aware of record and preservation of Bite Marks correctly. When multiple options were provided to them for the question, who do analysis of Bite Marks, 58.60% Police Personnel were a view of that Forensic Dental Expert do analysis of Bite Marks.

3.6. Criminal litigations (Table 8)

Fifty six percent participants had knowledge of importance of teeth preservation in Medicolegal Cases. If violence occurs, 63.20% participants took consultation of Dental Surgeon.

3.7. Overall knowledge of forensic dentistry among policemen according to experience (Table 9 and Graph 3)

Police Personnel who had more than 10 years experience had better knowledge of Forensic Dentistry. (P value < 0.001) Correct number of responses < 8 which are given by participants are considered as insufficient knowledge about Forensic Dentistry according to Experience.

3.8. Overall knowledge of forensic dentistry among policemen according to sex (Table 10 and Graph 4)

There is no significant difference in knowledge of Forensic Dentistry according to sex. (P value = 0.09) Correct number of responses < 8 which are given by participants are considered as insufficient knowledge about Forensic Dentistry according to sex.

3.9. Overall knowledge of forensic dentistry among policemen according to rank (Table 11 and Graph 5)

Police Personnel who had rank above from Constables had more knowledge about Forensic Dentistry. (P value = 0.01) Correct number of responses < 8 which are given by participants are considered as insufficient knowledge about Forensic Dentistry according to rank.

3.10. Overall knowledge of forensic dentistry among policemen according to education (Table 12 and Graph 6)

Graduated or Post Graduated Police Personnel had more knowledge about Forensic Dentistry. (P value = 0.04) Correct number of responses < 8 which are given by participants are considered as insufficient knowledge about Forensic Dentistry according to Education.

4. Discussion

Forensic Odontology is an integral part of Forensic Science which related with proper handling and examination of dental testimony with appropriate evaluation and presentation of dental findings. Dental records can be used for identification of crime victims or accidents that are necessary for medicolegal cases. It also includes detection and assessment of severity of injuries of teeth and its Bite Marks. D.N.A. analysis of teeth pulp is useful in identification of corpses also. Bite Marks which are left by criminal on victim's body or any innate objects like glasses on the crime scene can give clue for identification of criminal. D.N.A. analysis of saliva left on Bite Marks has a lot of importance.

Teeth had been used for identification of individual from 66 A.D., it has been said that Nero's mistress Sabina got his wife killed by her soldiers. She recognized his wife by

black anterior teeth. Dental Testimony was first accepted in court of United States of America of Webster-Parkman case in 1849. Dr. Oscar Amoeda, who is father of Forensic Odontology identified 126 victims of a fire accident of Le Bazaar de la Charite in Paris in 1897. Antemortem dental records were compared with Postmortem dental records for identification of victims. Baggi described in 1977 that dead bodies of Hitler and his mistress Eva Brauma were identified by his dental surgeon using dental testimony.

Forensic odontology had decisive role in the investigation of criminal acts like World Trade Centre New York tragedy on 11 September 2001 and terrorist incident in Bali which happened in October 2002. It has significant role in transport accidents such as Yogyakarta air crash of 2007 and the "Black Saturday" bushfires of February 2009.²⁶

At present there have been localized natural disasters and terrorist acts which have highlighted Forensic Odontology within forensic science, police departments and wider community. Forensic Dentistry helps a lot to Police Personnel in identification of Disaster victims, when Tsunami came in the Indian Ocean on 26 December 2004 in Thailand. Disaster Victims Identification Teams of 30 countries involved in identification of dead body. They did remarkable job for identification of deceased person and assisted Policemen.²⁶ Policemen reach first crime scene and do their investigation. The Policemen should have enough knowledge in identification individual's age and sex by teeth, Bite Marks, Dental Photography and DNA analysis using teeth.

The Belgium disaster victim identification team also assists with the identification of victims of mass disasters (natural, accidental, and mass murders). They consider the contributions of different teams (forensic pathology, anthropology, odontology, federal police, and crime scene investigation) both on the scene of the attack at the Brussels National Airport (Zaventem) in 2016.

This study shows finding that Police Personnel with more than 10 years experience had better knowledge of Forensic Dentistry. (P value < 0.001) They got more number of handling general cases and encountering a variety of cases.

There had no significant difference in knowledge of Forensic Dentistry according to sex. (P value > 0.09) This can be explained that Male Police Personnel and Female Police Personnel had same training experience, similar qualification and same intelligent quotient. .

Our study has striking finding that Head Constables, Assistant Sub Inspectors, Sub Inspectors and Inspectors had more knowledge about Forensic Dentistry than Constables. (P value = 0.01) This indicated that they were more involved in solving cases. One study done by Sharma et al. showed that About 68.7% of high-rank officers had essential information that dental evidence could be used as extraordinary biological testimony in the context of law.⁵

Graduated or Postgraduated Police Personnel had better knowledge of Forensic Dentistry. (P value = 0.04) This suggested that Education influences knowledge of Forensic Dentistry among Police Personnel.

In our study, 82% Policemen were males. This shows Police Profession is mainly dominated by Males. Woman Police Personnel continues to be negligible in Police Department in India.

Our study included only those Police Personnel who were present on day of study and willing to participate. Many Police Personnel who went outside from District Police Headquarter for doing their duty could not able to participate in study. This is limitation of our study.

Policemen who have less knowledge of Forensic Odontology will be unable to skillfully assess and handle scientific testimony which leads to factual errors. Majority of criminal cases, conflicts, natural and man-made disasters dealt by the Policemen. Usually they do not involve active participation of forensic dental experts.²⁸ Pandit et al. also displayed that there should be requirement for better communication between the Policemen and Forensic Odontologists.⁶ Mansour Al-Sarhani-endorsed use of Forensic Odontology in criminal probes to identify the suspects and victims.²⁹ Rahmat et al. also implied that Policemen could be educated through structured continuing education programs.³⁰ The traditional Police Training does not include basic concepts in Forensic Odontology right now. Essential scientific concepts about Forensic Odontology can be incorporated and that practical internship can also be included for Policemen so that they can able to independently solving cases in Forensic Odontology.

Recommendations

1. There is urgency of training of Policemen regarding Forensic Odontology in India.
2. Continuing Dental Education Program might be done by Dental Colleges in India for Policeman.
3. For Mass Disaster Manpower strength available should be established. These should include local personnel, Policemen, transportation companies as well as specialists such as forensic odontologists, forensic pathologists, forensic anthropologists and fingerprints specialists etc.
4. Referral centers should be established with well-equipped dental labs at least at the district levels, standardization of techniques and improvements in record keeping is very important.

5. Conclusion

This study revealed that most of the Policemen had inadequate knowledge about Forensic Dentistry. This study shows current status of our country in the field of Forensic Odontology. Forensic Dentistry helps Policemen and judges in the law court to reconstruct truth from tooth. A

good knowledge on Forensic Odontology in crime scenes are requisite for Policemen to provide timely justice to everyone.

Forensic Odontology can help very much to Policemen. Although Policemen are given knowledge about medicolegal cases, but further reorientation about Forensic Dentistry is very much required. If they have sufficient knowledge regarding Forensic Odontology, they can efficiently work in solving criminal cases and in mass disasters.

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7. Conflict of Interest

None.

8. Ethics Approval

Ethical Approval was taken from Institutional Review Board Rungta Dental College, Bhilai

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Author biography

Mayank Chandrakar, Senior Resident

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