Improve Awareness of the Forensic Odontology among Medical Graduates: Need of the Hour?

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Abstract

Introduction: Forensic odontology is a fastly growing field in both dental and forensic sciences. It involves the application of principles and expertise of dental sciences for criminal investigations. With increasing demand and use of dental evidence in forensic examinations, proper knowledge and awareness of the subject is more necessary than ever before.

Materials and Method: A survey was conducted in Medical and Dental colleges in and around Mangalore, Dakshina Kannada after approval from institutional ethics committee. It included MBBS and BDS students (III year to internship)

Result: The analysis of the data showed two fold results. Knowledge of tooth as a source of DNA, evidence for natural disasters in personalle identification was equal among the graduates. Medical graduates had higher awarenes of certain aspects like barr bodies and anthropometry whereas; Dental graduates were aware of the odontology aspects in identification of cases of rapes, child abuse, techniques like forensic radiology, bite mark analysis and sexual dimorphism in teeth.

Conclusion: The study highlighted the difference in knowledge of forensic odontology between medical and dental students. It emphasized on the need of increasing awareness of the subject among medical graduates and to help them understand the role of their peers from the dental fraternity in forensic sciences. The study also stressed on the need of a forensic odontologist in the State Forensic Team.

Keywords: *Forensic odontology, teeth, dental records, questionnaire, graduates*

Introduction

Forensic odontology has evolved as one of the most important tools of forensic sciences. It uses dental records, ante-mortem and post-mortem records, analysis of bite marks, oral photographs and radiographs in solving criminal cases and in identification of persons. It involves proper handling, examination and evaluation of dental-evidence, which could be presented in the court of justice.

Teeth tend to survive extreme conditions and is often resistant to decomposition, thus are sometimes the only source of information, the pulp contains DNA and enamel, dentin and cementum change with age. Every dentition is different, the rationale of forensic odontology depends on this uniqueness and recognizable marks of the teeth.[1]

Dentistry faction of forensic science plays important role in many scenarios like, solving cases of assaults, murders, rapes and domestic violences, identification of victims in natural disasters like fires, earthquakes, etc., and to examine and interpret archaelogical findings.[2] As time is passing, the number of criminal activities are also

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increasing, the murder and rapes cases we hear about in the NEWS are getting horrific by the day. In most of these cases the body of the victims ar eleft badly mutilited. Forensic Odontology plays a major role in getting to the root of these cases and finding the criminal.

It is important for Indian doctors and dentists to be educated and trained in the subject. More importantly, doctors must understand the role of a dentist in forensic related cases. Students should be exposed to forensic sciences during their undergraduate course to an extent where they truly understand the subject.

The objective of this study was to draw a comparison between the knowledge and awareness of forensic odontology between Medical and Dental graduates. It also aimed to recognise the need of a forensic odontologist in the state forensic team.

Aims and Objectives

The aim of this study is to compare the knowledge and awareness of forensic odontology among medical and dnetal graduates.

Materials and Method

A questionnaire study was conducted in medical and dental colleges of Mangalore, Dakshina Kannada after approval from Institutional ethical committee. It included students from IIIrd year to internship in both the groups.

A questionnaire validated by experts in forensics was prepared. It consisted of 23 questions with 6 divisions (TABLE B & C). First question has 18 subdivisions with Yes/No answers assessing the knowledge and need of forensic evidence.The next 5 questions have multiple choice answers, to evaluate subject specific knowledge of the participant have. Each consenting individual was given 10-15 minutes to answer the questionnaire. The collected data of both the groups was then entered in an excel sheet (Microsoft Inc.). Chi square test was done on the collected data and P Value was found calculated.

Result

Both medical and dental graduates (third year to internship) were given a survey on Forensic Odontology consisting of 23 questions, the questionnaire aimed to assess their knowledge and awareness on the subject. On analysis of the statistics many significant differences in the knowledge of the two groups were seen. (Table 1, 2 and 3)

It was observed that almost equal number of participants from both the groups knew that teeth can be used to recognize the dead and that the teeth contain DNA, they are aware that dental records can help during a forensic examination, most of them think that forensic examination requires a complete dental examination to be done when a case is brought to an expert. All the participants of both the groups are aware of bite marks being of importance in certain criminal offenses.

Chi square tests identified significant differences between the medical and dental graduates. Higher awareness and knowledge were observed among dental graduates in most of the questions about the subject. About 88.20% dental graduates knew that a tooth can be used to identify the gender of the dead compared to 64.90% medical graduates. Only 73.70% medical graduates know that enamel and dentin act as an aid for age identification, while this fact is known by 94.10% of dental graduates. 45.10% dental graduates know of institutions offering training in forensic odontology in contrast to only 6.10% medical graduates. The awareness among dental graduates was also high regarding the information of the cases being solved with the help of forensic odontology, accounting for 80.40% as compared to the medical graduates (42.10%). Approximately fifty seven percent (57.80%) dental graduates knew a forensic odontologist in the country compared to 4.40% of medical graduates. Although both medical and dental graduates agreed regarding the need for a forensic odontologist in the team of forensic expert, the need was emphasized more by the dental graduates (95.10%) compared to 79.80% by medical graduates.

While majority of participants agreed to the fact that dental forensic evidence can be presented as an expert witness in the court of law, the numbers were very high among dental graduates (89.20%) compared to the medical graduates group (69.30%). Around eighty eight percent (88.20%) dental graduates want their college to set up a forensic odontology department in contrast to 55.30% medical graduates agreeing for the same. Approximately, sixty two percent (61.80%) dental graduates feel forensic medicine is a good career option in comparison to only 43% medical students, also, 66.70% dental students have interest in forensic sciences, compared to 34.20% medical students.

Some of the attributes showed more positive response from the medical graduates. It was seen that more medical graduates (86.80%) knew that barr-bodies can be used to identify gender in comparison to 62.70% dental graduates. Though the number of participants who are confident in handling a forensic case is low in both the groups, the number is still higher in medical graduates (24.60%) than dental graduates (12.70%).

The participants were asked if forensic odontology was a recognized specialization in India, to our surprise, 47.10% dental graduates and 24.21% medical graduates agreed.

The participants were then asked, in what cases they believed dental evidence was of importance. Though not a significant difference was seen, but some options were considered more important by dental graduates than medical graduates. Dental graduates were more aware of the significance of dental evidence in solving cases of child assaults, rapes and domestic violence and murders. Around seventy three percent (73.5%) dental graduates and 61.4% medical graduates agreed on the importance of dental evidence in solving cases of child assaults, while 73.5% dental graduates knew about the role of dental records in solving rapes and domestic violence crimes comapred to 61.4% medical graduates.76.5% dental graduates said murder cases could also be solved with dental evidence whereas only 58.8% medical graduates agreed on the same.

The importance of archeological evidence was better understood by the medical graduates, with the percentages of medical graduates being 65.8% in comparison to 57.8% dental graduates.

When asked, what would they do if they recognized signs and symptoms of child abuse in a patient, more dental graduates (65.7%) thought that parents should be informed while more medical graduates thought (55.3%) NGO's should be notified. Almost 80% people of both the groups agreed on involving the police.

Most dental graduates(72.5%) know that visual identification is the first step of identification in unclaimed bodies in comparison to 64% medical graduates. Around 35.1% and 14% medical graduates thought that analysis of physical features and dental examination are the first steps respectively. The number of dental graduates who believed the same were much lesser.

Various techniques are used in forensic odontology examination to identify the deceased. Almost equal number of participants from both the groups thought comparative dental identification, forensic anthropology, DNA methods like PCR, rugoscopy, cheiloscopy, occupational dental considerations and abnormalities of tooth formation and eruption. More medical graduates (52.6%) believed forensic anthropometry is used in many cases compared to only 39.2% dental graduates agreeing to the same.

Bite mark analysis was considered important by 71.6% dental graduates compared to 56.1% medical graduates answering the same. (p value=0.019) Forensic radiology was another method more popular among dental graduates compared to medical graduates. Also, dental students felt that the study of habits and dental variations can also be more helpful compared to medical students.

The participants were then asked about how did they gain the knowledge about forensic sciences. Teachers played the most important role in education participants of both the groups. Almost equal number of participants gained knowledge from the internet and television sitcoms, crime scene investigation shows. While seminars held in colleges and institutions was a source of information for many dental graduates (51%), only 21.9% medical students gained knowledge from seminars. More medical graduates (33.3%) gained awareness from NEWS than dental graduates (24.5%). Family was the last source of knowledge on the subject.

TABLE 1: General awareness of forensic odontology and age and gender changes of teeth which can be used in forensic examination

QUESTION	N=216	DENTAL GRADUATES	MEDICAL GRADUATES	CHI SQUARE VALUE	P VALUE
1) Answer the following with yes, no or maybe					
Do you think that teeth can be used to recognise the dead?	213	101(99.00%)	112 (98.20%)	0.904	0.636
Can a tooth help identify the gender of an unclaimed dead body?	164	90 (88.20%)*	74 (64.90%)	23.737	<0.001
Can barr bodies be used to identify gender of a deceased?	163	64 (62.70%)	99 (86.80%)*	21.303	<0.001
Can enamel or dentin act as aid for age identification?	180	96 (94.10%)*	84 (73.70%)	17.727	<0.001
Do you think that teeth contain DNA?	151	79(77.50%)	72(63.20%)	5.292	0.071
Do you think that dental records can help during a forensic examination?	214	102(100%)	112(98.20)	1.806	0.405
Can bite marks be of importance in certain criminal offenses?	216	102(100%)	114(100%)		
Does forensic examination require a complete dental examination to be done when a case is brought to an expert?	176	88(86.30%)	88(77.20%)	5.254	0.072
Is forensic odontology a recognised specialisation in India?	72	48(47.10%)	24(21.10%)*	24.754	<0.001
Are you aware of any forensic odontology training centers in India?	53	46(45.10%)*	7(6.10%)	46.278	<0.001
Do you know about any forensic cases solved with the help of forensic odontology?	130	82(80.40%)*	48(42.10%)	33.279	<0.001
Do you know of any forensic odontologist in India?	64	59(57.80%)*	5(4.40%)	83.49	<0.001
Are you confident in handling any forensic related case?	41	13(12.70%)	28(24.60%)*	8.095	0.017
Can dental forensic evidence be presented as an expert witness in the court of law?	170	91(89.20%)*	79(69.30%)	12.744	0.002
Do you think your college should set up a forensic odontology department?	153	90(88.20%)*	63(55.30%)	28.347	<0.001
Do you think it is important to include a forensic odontology expert in a team of forensic medicine experts?	188	97(95.10%)*	91(79.80%)	11.454	0.003
Does forensic medicine as a specialty interest you?	107	68(66.70%)*	39(34.20%)	46.383	<0.001
Is forensic medicine a good career option?	112	63(61.80%)*	49(43.00%)	8.281	0.016

TABLE 2: awareness of tooth as an evidence in various cases among medical and dental graduates

QUESTION	N=216	DENTAL GRADUATES	MEDICAL GRADUATES	CHI SQUARE VALUE	P VALUE
2) In your opinion, is dental evidence of utmost importance is cases of?					
i) Fires	112	56(54.9%)	56(49.1%)	0.72	0.396
ii) Earthquakes	84	36(35.3%)	48(42.1%)	1.051	0.305
iii) Rapes and Domestic Violence	173	89(87.3%)*	84(73.7%)	6.218	0.013
iv) Child Assaults	145	75(73.5%	70(61.4%)	3.587	0.058
v) Archaeological Importance	134	59 (57.8%)	75(65.8%)*	1.443	0.23
iv) Murders	145	78(76.5%)*	67(58.8%)	7.642	0.006
v) Identification	184	94(92.2%)*	90(78.9%)	7.443	0.006
3) What would you do if you identify signs and symptoms of child abuse in a patient?					
i) Inform Parents	115	67(65.7%)*	48(42.1%)	12.024	0.001
ii) Inform Police	176	82(80.4%)	94(82.5%)	0.152	0.697
Iii) Inform NGO	108	45 (44.1%)	63(55.3%)	2.675	0.102
4) What is the first step for the means of identification for unclaimed bodies?					
i) Visual Identification	147	74 (72.5%)	73(64%)	1.795	0.18
ii)Analyzing Physical Features of the Body	63	23(22.5%)	40 (35.1%)*	4.097	0.043
Iii) Dental Examination	21	5(4.9%)	16 (14%)*	5.116	0.024
5) Can the following techniques be useful in identifying a deceased?					
i) Comparative Dental Identification	158	73(71.6%)	85(74.6%)	0.245	0.62
ii) Forensic Anthropology	108	50(49%)	58(50.9%)	0.074	0.785
iii) Rugoscopy	110	46(45.1%)	64(56.1%)	2.627	0.105
iv) Cheiloscopy	126	56(54.9%)	70(61.4%)	0.936	0.333
v) Bitemark Analysis	137	73(71.6%)*	64(56.1%)	5.524	0.019
vi) Forensic Radiology	111	62(60.8%)*	49(43%)	6.829	0.009
vii) DNA Methods	182	84(82.4%)	98(86%)	0.53	0.467
viii) Forensic Anthropometry	100	40(39.2%)	60(52.6%)*	3.897	0.048
ix) Occupational and Dental Considerations	70	36(35.3%)	34(29.8%)	0.735	0.391
x) Habits and Dental Variation	76	44(43.1%)*	32(28.1%)	5.359	0.021
xi) Abnormalities of Tooth Formation and Eruption	97	49(48%)	48(42.1%)	0.766	0.381
6) What is your source of initial knowledge about forensic sciences?					

Cont... **TABLE 2: awareness of tooth as an evidence in various cases among medical and dental graduates**

i) NEWS	63	25(24.5%)	38(33.3%)	2.029	0.154
ii) Teachers	137	68(66.7%)	69(60.5%)	0.875	0.35
iii) TV Shows	99	44(43.1%)	55(48.2%)	0.566	0.452
iv) Internet	87	41(40.2%)	46(40.4%)	0.001	0.982
v) Seminars	77	52(51%)*	25(21.9%)	19.804	<0.001
vi) Family	8	5(4.9%)	3(2.6%)	0.778	0.378

TABLE 3: Fields where increase in knowledge and understanding should be increased in the two groups

What medical graduate should understand	**What dental graduate should understand**
Importance in Fires, Rapes, Domestic Violence, Child Assaults, Murders, Identification	Barr Body
Importance of Bite Mark Analysis, Forensic Radiology	Importance of Forensic anthrompometry
Role of habits and dental variation in identification	
Sexual dimorphism characters in teeth	

Discussion

Forensic odntology is one of the most progressing fields of forensics. Newer morphometric, histological metrics are employed to not only identify the deceased but also to solve civil and criminal cases.

Size, shape and color of teeth vary with age, gender and ethnicity, hence they can be very helpful in classifying the dead. In addition the pulp is potential a source of DNA even in adverse conditions. In the present study both the groups were equally aware of teeth as a source of DNA and they were aware of teeth being able to to be used to identify the deceased. Previous dental records of a person ease the process of identification of a victim and even an offender (in cases of rapes, domestic violence, abuse, murder etc.,), dentition, number of teeth, restorations, crowns etc., all count as valuable information in cases of identification. Dental post-mortem and ante-mortem records can also help in certain cases, this was known by participants of both the groups, hence, doing a complete dental examination during a forensic evaluation is also considered of importance. Importance of bite marks was known by all the participants from th etwo groups. Bite marks are of grave importance in cases of rapes, domestic violence and abuse, they are very helpful in identifying the culprit.

In our cohort the awareness of use of teeth as an identification of sex was more in dental graduates than in medical graduates. Sexual dimorphism is an inherent trait of the tooth[3]. The sex chromosomes (X and Y chromosome) both code for the enamel formation and are responsible for the larger size of the teeth in males. Studies have shown minimal influence of hormones in regulating the tooth size. [4]

Dental graduates have better knowledge about using enamel and dentin in age estimation. Age changes in tooth can be in all structures of teeth. The enamel shows attrition, dentin formation is present throughout life leading to pulp recession, dentinal sclerosis is a part of the tooth aging process, cementum deposition occurs in increments. All these features can be grossly as well as radiological or histopathologically be estimated to assess age.[5,6,7] Enamel, dentin and cementum change with age, while the amount of enamel decreases, dentin increases with age correlating with formation of reparative and

sclerotic dentin and cementum increases with age. Thus, as seen with various methods of age estimation (like Gustafson's methods, Dermijian's method etc.,) enamel and dentin play an important role in identifying the age.

Use of teeth or the jaw to solve criminal cases since time immemorial. Awareness about cases solved with the help forensic sciencesis more in dental graduates. From the identification of Lollia Paulina to the identification of Abraham Lincoln's assassin to the very recent Nirbhaya case, all were solved with the help of forensic odontology. A forensic odontologist's presence, as agreed by most participants, is of importance in a state forensic team, as he/she is the most capable of doing a complete forensic dental examination as and when required. Dental forensic evidence, bite marks, oral radiographs, patient records, ante-mortem and post-mortem reports etc., can be used as evidence in a court of law.

Medical gradutes are more aware of use of barr bodies in identification of gender in the dead. Barr bodies are gender markers, presence of Barr bodies marks genetic femaleness. It is an inactivated X Chromosome.

However, forensic odontology is not a recognized specialization yet in India.This showed more awareness among medical graduates. Some institutions provide a diploma fellowship and certificate courses and training for the same in the country.

The number of people agreeing to importance of forensic odontology in Fires and earthquakes is still low, as it is of utmost importance in mass disasters. Teeth tend to survive high temperatures and extreme conditions, hence, can be the only source of information in these cases. Differences in jaw and teeth morphology, number of crowns and restorations can help in unmasking the criminals.

There is no correct response for who should be informed first in cases of child abuse, while some might consider that informing parents, agreed response by dental gradutes is must, a certain group of people, some dental graduates and most medical gradutes, might think that informing the police can be more helpful as parents can also be the reason of abuse in certain cases.

Most of the participant s agreed on visual identification being the first step of forensic examination. When an oral forensic examination is required to be done, firstly visual examination is done after a complete clean up of the deceased. Oral autopsy is done before any other body part is incisioned. Oral photographs must be taken before and after the autopsy procedure. Radiographs are taken by keeping the mouth open with clamps, impressions are made, and the dentition and oral conditions studied. These records are used to formulate a forensic report and find the criminal.

The awarness about the use of bitemarks in identifcation was more among the dental graduates. Bite mark analysis sure is on one of the most important tools of forensic dental sciences, however, rugoscopy and cheiloscopy can also be very helpful. Occupation considerations, habits and dental variation studies can also give fruitful results, like, notched incisors in tailors, attrited teeth in bruxers, etc.. Even though DNA methods came out to be the most popular response, it is not usually done in most cases, as it is very expensive in comparison to the other methods and time consuming as well. Similarly, comparative dental identification, though answered by many participants, is not always done.

The evaluation of the results of the present study reflected on the gap of knowledge between the two groups of participants. It is evident that dental graduates are more aware and educated on the subject of forensic odontology, yet the subject is not given much importance. However, dental gradutes also lack awareness in certain aspects , like the importance of barr bodies and the techniwue of forensic anthropomtry in identification, needed to updated by more intensive lectures on the subject. Medical graduates need to be taught various parts of the subject like sexual dimorphidm of teeth, use of teeth in cases of identification, natural disasters and rapes and murders, importnace of bite mark analysis and forensic radiology and role of dental variation and habits in identification. (Table 1, 2 and 3).

Forensic invetigations area team effort, where the forensic experts law makes and the police work together to solve mysteries around the death of a person.

Conclusion

Forensic odontology should be included on the curriculum of the both dental and medical degrees. More seminar should be held for medical students to understand the importance of the role of their peers in forensic sciences. A forensic odontologist should be made an integral part of the state forensic teams. The law makers, the police officers and the forensic medicine experts should come together to accept the role of

this new key member who can help solve many more unsolved cases.

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Ethical Clearance: A copy of ethical clearance from Institutional Ethics Committee is attached.

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