

Connecting forensic odontology among medical practitioners in central Kerala – An original study

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ABSTRACT

Introduction and Background: The word forensic, defined by Clark, is derived from the Latin word “*forensis*,” which means “*before the forum*.” Odontology refers to the study of teeth. Even though the scope of forensic odontology is well established among dental professionals, its practical application lies largely in the hands of medicolegal professionals. The interaction between the above mentioned two communities is highly crucial for the proper application of forensic odontology in medicolegal issues. **Aim:** The main aim of this study is to analyze the knowledge, attitude, and practice of forensic odontology among medical practitioners in central Kerala since they are the connecting link between victims and the forensic odontologists. **Results:** A total of 200 medical practitioners had participated in the study, and the response rate was 100%. The study indicated that medical practitioners who are having an experience of above 15 years had more knowledge regarding forensic odontology when compared with those below 15 years of experience. However, the awareness of modern technologies in forensic odontology and latest techniques to register dental markings were found to be more prevalent among doctors with less than 15 years of experience.

Keywords: Age estimation, bite marks, dental evidence, DNA analysis, forensic medicine, forensic odontology, gender determination, medical practitioners

Introduction

Keiser-Neilson in 1970 defined forensic odontology “as the branch of dentistry that addresses the proper handling and examination of dental evidence and the evaluation and presentation of dental findings in the interests of justice.”^[1] From AD 66 till date, dental identification has proved vital in identifying deceased individuals and the court of law accepted the first case in the year 1849.^[2]

Various methods can be used to resolve issues related to criminal cases with the help of forensics. Even though the scope of forensic odontology is well established among the dentists, its

practical application lies largely in the hands of legal and medical professionals. The timely interaction between the above two fraternities is crucial for its proper application in medicolegal cases. Injuries to teeth, oral tissues, and jaws as a result of various causes like abuse, assault, and crime-related injuries, which initially reaches the primary health-care center, need to be properly evaluated and examined. Timely recording and documentation of forensic evidence is possible only with the help of medical professionals as they are usually the first ones to arrive at the scene of crime or to interact with the victims.

The forensic discipline of law involves the application of science and technology in investigation and detection of crime and administration of justice, through the coordinated efforts of a multidisciplinary team comprising specialists in the medical and forensic fraternity as well as the law enforcement authorities.^[3] The aim of this study was to analyze the knowledge, attitude, and

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practice of forensic odontology among medical practitioners in central Kerala as they are the connecting link between victims and the forensic odontologists. Extensive and thorough research in scientific literature did not reveal any articles, related to awareness of forensic odontology among medical professionals in Kerala.

Materials and Methods for the Research

Informed consent

The medical practitioners working in public health centers, causalities, and private practitioners of central Kerala were requested to voluntarily participate in this study and their confidentiality was respected throughout during the research process.

Study design and participants

A prevalidated questionnaire was distributed among 200 medical practitioners in central Kerala [Table 1]. Random sampling method was used to draw the sample. Both male and female medical practitioners were included in the study. The content validity and face validity of the questionnaire were assessed by professionals in the medical and dental field. The questions were framed to assess the knowledge and application of forensic odontological techniques in a day-to-day practice among medical practitioners.

Questionnaire design

The questionnaire had a set of 15 questions. The first part of the questionnaire consisted of questions related to demographic

details like their age, gender, and duration of work experience and the specialty in which the participants are practicing. The second part of questions was set to access the knowledge aspects of the participants in forensic odontology, such as whether they knew that forensic odontology is a part of forensic medicine; susceptibility of dental hard tissues to degradation; the role of teeth and its associated structures in estimation of age; identification of gender of the victim/deceased; and application of forensic odontological technique such as deoxyribonucleic acid (DNA) analysis with the help of teeth and saliva, bite mark analysis, lip print analysis, and different methods for collecting the bite marks. Binary method of responses such as Yes and No was used to collect responses.

Statistical analysis

The data collected were analyzed using the software Statistical Package for the Social Sciences (SPSS version 18.0). Descriptive statistics for the collected data was recorded. The associations between different variables were tested using the Chi-square test. P value of less than 0.05 was considered statistically significant.

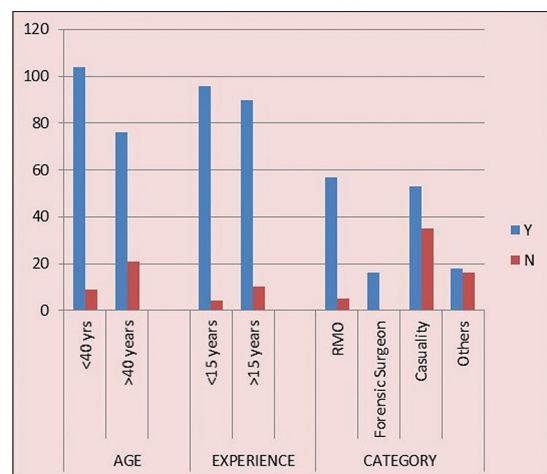
Results

A total of 200 individuals participated in the study, and the response rate was 100%. Medical practitioners of less than 40 years of age composed of 56% and more than 40 years accounted for 44%. The study group composed of doctors in the age group between 23 and 87 years. Depending on the experience, 66% of the medical professionals had an experience of less than 15 years, and 34% had experience more than 15 years. The forensic surgeons included in the study were 8%, 31% residential medical officers (RMO), 44% causality doctors, and others were 17%.

To access the knowledge of forensic odontology among medical practitioners, questionnaire survey was conducted, in which the following questions were asked regarding general awareness of forensic odontology [Graphs 1 and 2], cases handled using

Table 1: Questionnaire format

Age:
Years of experience in medical field
Specialty: Causality/RMO/Forensic surgeon/others
1. Is forensic dentistry a part of forensic medicine?
2. Have you handled any forensic dentistry-related cases before?
3. Whether gender determination is possible with the help of teeth and facial bones?
4. Whether forensic dentistry can play a role in victim/deceased and criminal identification?
5. Is dental hard tissue easily susceptible to degradation?
6. Are you aware of bite mark registration?
7. Do you know how long a bite mark remains in human body?
8. Are you aware of the materials and methods for bite mark registration?
9. Do you know to analyze lip prints?
10. Did you know the court of law accepts the statement of dentist as an expert witness involving civil and criminal cases?
11. Whether DNA from tooth and saliva serve as an excellent source for investigation in mass disasters?
12. Whether the age and gender of a deceased person can be identified in a mass disaster using forensic odontology?
13. Did you know about any case solved with the help of forensic odontology?
14. Would you recommend the unique coding system for the dental appliances for the ease of victim identification?
15. Are you willing to attend a general awareness program related to forensic odontology?



Graph 1: Response rate for question 1: is forensic dentistry a part of forensic medicine?

forensic odontology, lip print and bite mark analysis [Graph 3], DNA from tooth and saliva which serves as a source for victim identification [Graph 4], and awareness of gender and age estimation with the help of teeth and associated structures [Graph 5].

From the study, medical practitioners above 40 years had more knowledge regarding forensic odontology, when compared with those below 40 years; however the doctors below 40 years of age were more aware about the modern technologies in forensic odontology and various latest techniques to register dental markings.

Medical practitioners, who had greater than 15 years of experience, had more knowledge regarding forensic odontology, handled such cases, and are aware of gender and age determination with the help of teeth and its associated structures when compared to medical professionals with less than 15 years of experience.

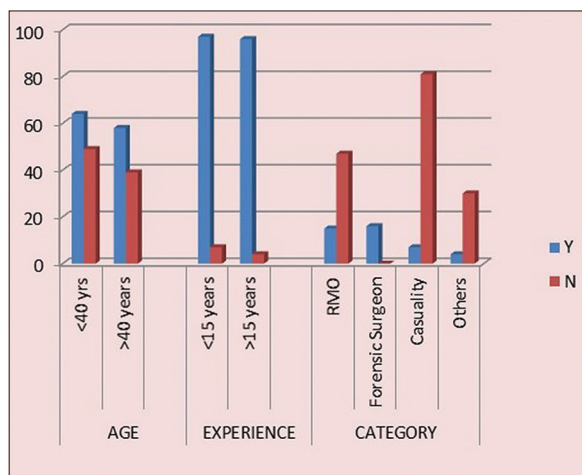
About 99% of medical professionals were willing to attend the forensic odontology-related awareness programs and every

participant agreed with the opinion of a unique coding system in dental appliances, which could be helpful in person identification.

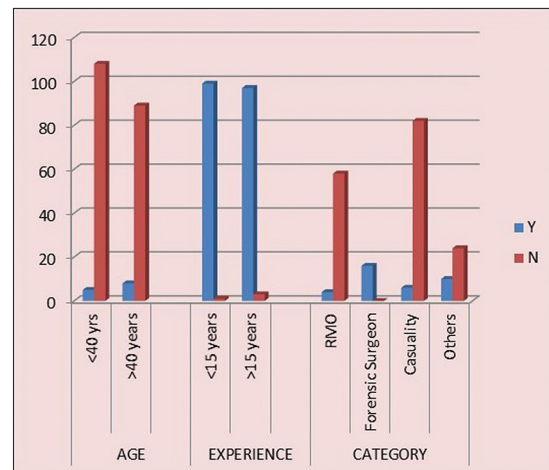
Forensic surgeons were found to have more knowledge regarding DNA analysis with the help of teeth and also knew that dentist can be an expert witness in a court of law, and awareness of bite mark/lip print analysis, the materials used to register, age and gender determination using tooth and associated structures when compared to causality doctors, RMO, and others. Statistical analysis revealed *P* value less than 0.05 in most of the responses when doctors were divided by specialty [Table 2].

Discussion

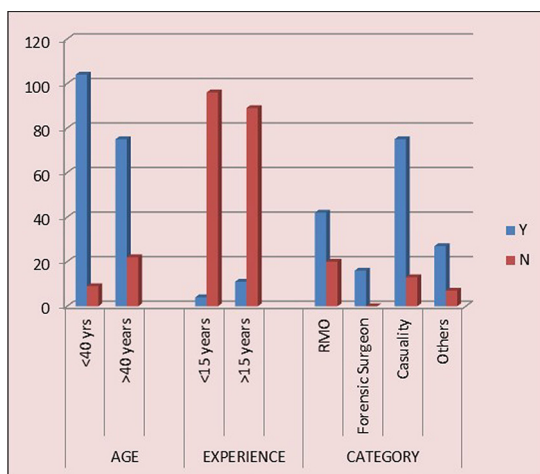
Forensic odontology is one of the promising tools for person identification in mass disasters like earthquakes, flood, aviation disasters, tsunamis, crime investigations and identification of decomposed and disfigured bodies, victims due to burn, and motor vehicle accidents.^[3] The history dates back to 66 AD



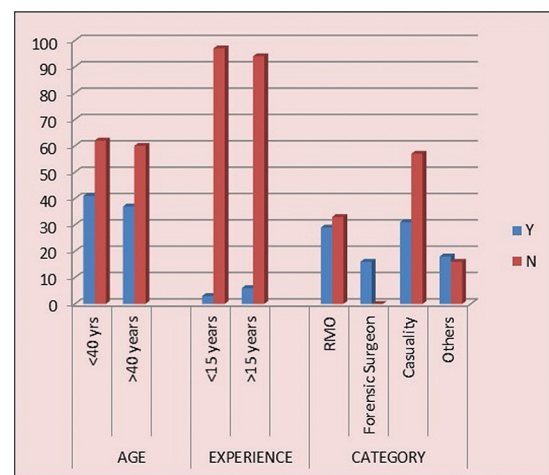
Graph 2: Response rate for question 4: whether forensic dentistry can play a role in victim/deceased and criminal identification?



Graph 3: Response rate for question 6: are you aware of bite mark registration?



Graph 4: Response rate for question 11: whether DNA from tooth serves as an excellent source for investigation in mass disaster?



Graph 5: Response rate for question 12: whether the age and gender of a deceased person can be identified in mass disaster using forensic odontology?

Table 2: Statistical analysis

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Experience	0.94	0.92	0.77	0.01	0.71	0.70	0.79	0.58	0.39	0.79	0.39	0.62	0.21	-	0.68
Age	0.67	0.70	0.17	0.06	0.74	2.0	0.12	0	2.52	0.10	0.98	0.46	0.14	-	0.53
Category	0.64	0	0	0	0.05	0	0	0	0	0	0	0	0	-	0

when the first victim Lollia Paulina, a rich Roman Empress, was identified using unique arrangement of her teeth.^[4] Later, Adolf Hitler was identified which was a turning point in history, where forensic odontology had the potential to serve as corroborative evidence which supplements fingerprints and DNA. The practice of forensic odontology has gained importance in a number of countries across the world. Any injuries to teeth and teeth-related structures result of various causes like abuse, assault, crime-related injuries, and trauma, which initially reaches the primary health-care professionals, need to be properly evaluated and examined. The present study showed the knowledge, awareness, and attitude among the medical practitioners toward forensic odontology. A questionnaire was framed to assess the knowledge about lip prints, bite marks, and DNA from tooth and saliva, as they are the integral components of forensic odontology.

In our study, 87% of the medical professionals knew that the gender determination was possible with tooth and facial bones, but only 72% of them were aware of age and gender determination of deceased individual, which was possible using forensic odontology.

Medical practitioners, who participated in this study, above 40 years had more knowledge regarding forensic odontology, when compared with those less than 40 years; this may be due to increased exposure to forensic odontology-related crimes, traumas, and accidents, but the awareness of modern technologies in forensic odontology and various latest techniques to register dental markings were more among doctors less than 40 years of age.

Knowledge about bite mark analysis, retention of bite marks in human body, and the materials used for bite mark registration was more among doctors who are below 40 years of age. This may be because of their updated knowledge in the field of forensics through their exposure to social media or by forensic odontology-related awareness programs.

During crime investigations, many types of assaults are encountered of which biting is the primary type. The bite mark is “a mark made by teeth either alone or in combination with other mouth part.” Bite mark analysis is a piece of evidence that the dentition of the biter (human or animal) is unique and can be compared scientifically and can be related to the resultant pattern mark on the surface of victim or object.^[5]

In the recently reported cases, the bite marks on the person's body were identified through bite mark analysis, showing that the marks were left by the accused which served as an adjunct

in getting the right judgment.^[6] The clarity and shape of bite marks found on the skin of the victims will change in very short duration (10–20 min) both in living and dead; therefore, this necessitates their recording at the earliest possible time.^[7] Medical practitioners may be the one who can come across such findings within this interval of time. Proper management of such marks by placing a scale beside the bite mark and making a note of distance at which photograph was taken within this time can serve as an excellent clue for the final proper judgment in the court of law.^[8] Sheets of acetate are used to draw the bite marks in the body of victim, which can then be placed over one another for comparison. A dental cast can be made of the bite mark for later comparison to a suspect sample, if possible.^[9]

Awareness about the lip print and its analysis is more in medical practitioners who are below 40 years, when compared to those above 40 years. Lip prints are normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of human lip, between the inner labial mucosa and outer skin.^[7] In closed mouth position, the lip exhibits well-defined grooves, while in open mouth position, the grooves are relatively ill defined and difficult to interpret.^[10]

Medical practitioners, who had greater than 15 years of experience, had more knowledge regarding forensic odontology, handled such cases, and are aware of gender and age determination with the help of tooth and its associated structures when compared to professionals less than 15 years of experience. This may be because the former groups are frequently encountering forensic-related cases during their daily practice.

Awareness of person identification using DNA from tooth and saliva was more in practitioners who are less than 15 years of experience. This may be due to DNA-based studies using tooth and saliva, which is getting popularity in recent years, and this age group is more exposed to such studies from social media.

Saliva is often detected in scenes of crime along with bite marks or lip prints where the oral cavity may have been involved.^[11] For saliva collection, the classical technique is by using a single wet cotton swab or section of a wet filter paper laid passively on the skin.^[12] Another technique, suggested by Sweet *et al.*, is by using a wet cotton swab (similar to the classical method) followed by a dry cotton swab, known as the double swab technique, and found to provide a better yield of saliva recovered from the skin surface.

DNA from skin-deposited saliva samples can be extracted by the phenol–chloroform method. Salivary exfoliated cellular examination and DNA profiling in sex determination and individualization of

accused in scenes of crime is proving to be of immense help in forensic investigations.^[13] Comparison of DNA from teeth, jaws, and other parts of unidentified individuals is possible with a known antemortem sample from clothing, hairbrush, stored blood, biopsy specimen or cervical smear of the same individual.^[14]

Inadequate awareness, knowledge, and attitude about forensic odontology among the medical students were noticed in a study conducted by Kumaraswamy *et al.* and the reason they suggested for this could be lack of handling of forensic dentistry cases in emergency medicine department.^[15]

In our study, about 99% of medical practitioners were willing to attend the forensic odontology-related awareness programs and almost every participant agreed with the opinion of unique coding system in dental appliances, which could be helpful for person identification if the investigating team discover some dental appliances from the crime scene.

A study conducted in Australia showed the empirical role of forensic odontologists in disaster management and victim identification and is fulfilled by maintaining comprehensive, well-structured, and accurate dental records for both research teaching purposes, as well as for medicolegal matters.^[16] Al Azri *et al.* conducted a study which suggested the need of record keeping guidelines and practices to increase the level of details, extent, and period of retention of records so that the information needs of forensic odontology activities are met.^[17]

Comparison of results from the present study with other available published literature is not possible since no similar studies are available in medical literature till date. Contents of the article were compared using STROBE checklist for the cross-sectional study.

A basic forensic odontology training program should be given to medical professionals for assisting a dentist and legal professionals in presenting the proper evidence to detect and to solve a crime. Reporting of any instance of human abuse is mandatory for making a proper judgment by judiciaries. Medical professionals should be encouraged to attend regular conferences and seminars related to forensic odontology, which in turn could improve their knowledge and practical skills to handle forensic odontology-related cases.

Conclusion

The medical professionals should be well equipped with the knowledge of identifying an individual's age and gender by teeth, associated structures, facial bones, and DNA analysis using teeth and saliva. Medical professionals who are willing to attend forensic odontology-related awareness programs will be capable to identify and record the right data at the right time, which will in turn help in the criminal investigation.

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Conflicts of interest

There are no conflicts of interest.

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