Importance of Forensic Odontology

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Abstract

Forensic dentistry is the connection between the dental professions and forensic professions. In fact, the teeth and jaws are highly resistant to degradation and decomposition by postmortem. For a number of different reasons and situations such as mass disasters, in criminal investigations and in the case of disfigured bodies due to fire and vehicle accidents, dental identification of humans happens. The different methods include x-rays, antemortem & post-mortem photographs, tooth prints, palatal rugae, lip printing, bite marking and molecular methods such as polymerase chain reaction for pulp DNA analysis.

Keywords*: forensic, bite mark, lip print, tongue print, polymerase chain reaction*

Introduction

Forensic Odontology is the branch of forensic sciences that aims to establish identity of dead bodies: as offenders or innocent, based on available dental records and is also called Forensic Dentistry.[1, 2]. Teeth, lips, tongue, facial bones and associated dental items like fillings, dentures etc. can be source for identification of dead human bodies, it helps in identification of destroyed body age, sex accordingly[34]. Even in major accidents, violence, burial, or other serious exposure to the elements, they still avoid decomposition. For every individual the dental patterns are unique. This peculiarity is also due to the dentist's variety of treatments. A person's dentition is therefore useful for individual identification and comparison, if there are records for that purpose.[5] Teeth can survived after mortem so it is the most reliable to use for identification.[6.]

Forensic odontology in the recent scenario has following applications.

· Maxillo - mandibular investigation of hard and soft tissues.

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· Situations of major casualties where criminal investigation is crucial.

· Situations where there are incidences of bite marks. Example - Physical maltreatment with child, inflicting sexual trauma, in situations of unarmed personal safety measures.[7.]

Classification according to type of examination [8]:

· Examination of living individuals - Bite Injury, determination of sex and age.

· Examination of dead individuals - occlusal pattern variations of human dentition, dental restorative materials, prosthetic rehabilitations.

· Examination of physical materials: Identification of isolated human teeth

· Examination at the scene of crime or disaster-human skeletal remains with teeth intact tooth imprints

· Examination of dental records: By specific research team and dental experts

Recovery team:

The team members are supposed to collect the dead bodies and protect their identities by means of a numbering system, store the dental evidence safely in a proper transport media without interfering with them .9

Forensic odontologist should be part of this team and should search for onsite dental evidence to prevent contamination of the dental substances during transport to the mortuary.10

Ante Mortem Team:

The task of deciphering data of the missing person is assigned to the team. Family members of the missing person and health care providers play a crucial role in the purpose. Dental records including computed tomography scans, xrays, dental models and facial photographs are collected and stored in the appropriate tabular format.It serves as proof.11

Post Mortem Team

This is a team that tracks their cumulative research from dead bodies. In natural and manmade disaster situations the teeth material is a tough organic material that remains intact. Dental pulp tissue is important for DNA sampling. Vital teeth are extracted and sent for proper matching to forensic DNA laboratories.6

Figure 1 - Intact pulp tissue extract

Identification Team

As a conclusive step antimortem and postmortem teams accumulated reports are cross matched by a dedicated team of individuals.

According to the American Board of forensic odontology there are different grades of identification

· Positive identification – records with nil incidence of discrepancies

· Possible identification – the situation where there is doubt in the quality of AM/PM evidence

· Insufficient evidence – situation where the records vary significantly.

Dental Record Maintenance.

Maintaining dental records is a dentist's responsibility and an essential component that acts as a source of information for dentists and patients, both for medical, administrative and forensic purposes.12The dental graph should be accurately registered. This provides information on descriptions of all the teeth found in the mouth, such as teeth present or missing, restorations, pathologies such as caries, involvement in furcations, root sections and periodontal health.13

Sex determination

Forensic odontologist can determined age from dental and skelatal remains14.Woman has less cusp than male (distobuccal or distal cusp) in the mandibular first molar.15The scale of the crown and the tuber of Carabelli to be bigger in males.16.Using Polymerase Chain Reaction (PCR) DNA from pulp tissue is used for sex determination.17Sivagami et al. achieved 100% success in determining the individual's sex . 18

Age estimation

Dentition is used to estimate the age of children and adolescents and adults in three categories, namely prenatal, natal and postnatal time.19For children and young adults, age assessments are made using clinical methods such as the sequence of eruptions, radiographic methods such as the Schoulr and Masslers process, the Moorer, Fanning and Hunt method, the Demirijian, Goldstein and Taners method and the Nolla technique.20The eruption of third molars is important in separating juveniles and adults .21For adults, regressive alteration of the teeth, periodontal status such as loss of attachment, dentin translucency histologic changes such as gradual cement lines, radiographic assessment such as root resorption, cement apposition at the apex helps for age estimation.22 Gustafson developed a single tooth age estimation method that uses different stages of regressive teeth changes.23 several studies show pulp of tooth ratio with volumes calculates the age.24

Race determination

Carabelli cusp variation, fissure system, morphological incisor patterns are measures to distinguish between Caucasian, Asian and black races.[25]

Characteristic	Mongoloid (Eskimos, American Indians, Chinese)	Negroid	Caucasoid
Shovel-shaped incisor	Common	Uncommon	Uncommon
Carabelli's cusp on 1st molar	Uncommon	Uncommon	Quite common
Enamel pearls	Common	Uncommon	Uncommon
Mandibular 3rd molars	Commonly missing	Rarely missing	Can be missing
Mandibular 2nd molar with 5 cusps	Common	Common	Uncommon
Supernumerary teeth	-	Common	-

Figure 2 - Tooth morphology and race[26]

Socio economic status

Socioeconomic person can easily identify by seeing their teeth. Those who have number of caries and cheap material fillings, prosthetic, indicate low income status, protruded malocclusion in children indicate thumb sucking habit. Orthodontics applience , expensive tooth fillings indicate high income.[27]

Palatal rugae.

The ridge present on either side of the midpalatine raphe in the anterior part of the palate is reffered as palatal rugae. Palatal rugae is well covered by fat pad buccal teeth. This prevents decomposition. Palatal rugae pattern is special for every single person. Because of their anatomical position inside the mouth, the palatal rugae are well-preserved even after third degree burns. That keeps them well protected against trauma and isolated from high temperatures, more resistant to decomposition and thermal effect.[282930] Thomas et al [31]has classified rugae pattern as Diverge, Converge, Curve, Wavy, straight , Circular. Palatal rugae can also aid in gender and race differentiation

Lip print

Tsuchitsashi et al have suggested 6 different types of groove pattern in the lip that might be useful in investigating crime. Every individual has a different lip print.[32] Similar to the prints on the finger, thumb, foot and lip prints, these are also distinctive and do not alter during a person's life.[33] Recent studies have proven that lip prints are a superior method in gender determination compared to fingerprints and mandibular canine index[34]

Tongue print

The tongue's dorsal surface is special for each person. Even among identical twins, the characteristic features of the tongue display remarkable difference. For forensic odontology, lingual contact on the dorsal surface along with the lateral border has been proved useful. The tongue is a unique organ that exchanges many static and dynamic characteristics.[35]

Bite mark

In violent incidents such as sex-related crimes, cases of child abuse, and offenses involving physical altercations such as homicide, bite marks on human tissues can be observed. It can occur in situations where the attacker bites the victim or the victim bites the attacker as a defensive act, but it should be noted that in the cases, the bite victim may be the perpetrator. Male victims are most often bitten on their arms and shoulders, while female victims are most often bitten on their breasts, arms and legs.[36]In bite mark analysis, dental findings should include all the teeth present and missing, interrelation between both jaws, both arches form, dimension of mesiodistals and any unusual features if any like fractured, supernumerary, rotated etc.[37]

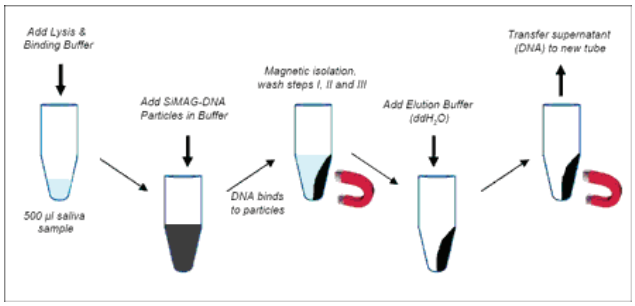
DNA analysis

DNA can be extracted from dentin and pulp with success. DNA remains intact for a very long time in the teeth and bones, and is therefore a valuable source of information. The method of DNA extraction consists of the following stages.[38]cell rupture or lysis, protein denaturation and inactivation by chelating agents and

proteinase final step involves DNA isolation

SALIVA

It has been shown that human saliva is an excellent source of high molecular weight DNA. Crime scene clothing, cigarette buds etc., can collect saliva samples. The isolated samples are analyzed and linked to suspicious reference sources.[39]



Figur 3 - Extraction of DNA samples from saliva[40]

Conclusion

Forensic dentistry plays a major role in identifying those individuals who can't be visually or otherwise identified. Teeth and dental structures ' durability ensures there is a lot of information that can be used for human identification purposes. This branch of medical science is focused on the idea that physiological variations, anatomy and effects of dental hard and soft tissue therapy are special to each individual. That is also very useful in situations with medico-legal background. As the scope of forensic science is very wide and challenging, Forensic odontology-trained dental surgeons can make unique contributions in the administration.

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References

1. Khalil MA., et al. "Human's dentition use in criminal investigations". Pakistan Oral and Dental Journal 34.4 (2014): 743-747.
2. Katpar S., et al. "National road map to promote dental education via ten commandments recommendations for Pakistan our perspective". Pakistan Armed Forces Medical Journal 66.1 (2016): 775.
3. Zeeshan M., et al. "Awareness and compliance about forensic dentistry among dental professionals of twin cities of Rawalpindi-Islamabad: A questionnaire based study". Pakistan Oral and Dental Journal 34.2 (2014): 277-280.
4. Avon SL. "Forensic odontology: the roles and responsibilities of the dentist". Journal-Canadian Dental Association 70.7 (2004): 453-458.
5. Auerkari E. Recent trends in dental forensics. Indones J Leg Forensic Sci 2008;1:5-12.
6. Pittayapat P, Jacobs R, De Valck E, Vandermeulen D, Willems G. Forensic odontology in the disaster victim identification process. J Forensic Odontostomatol 2012;30:1-2.
7. Zakirulla M, Meer A. Modern tools in forensic dentistry. J Contemp Dent 2011;2:28-32.
8. Stamm, A.D.B. and Carson, M.C.P., 2017. Forensic odontology. In Manual of Forensic Science (pp. 135-158). CRC Press.
9. DVIGuide:Interpol;2009.Availablefrom:http://www.interpol.int/INTERPOL-expertise/Forensics/DVI-Pages/DVI-guide.
10. Pittayapat P, Jacobs R, De Valck E, Vandermeulen D, Willems G. Forensic odontology in the disaster victim identification process. J Forensic Odontostomatol 2012;30:1-2.
11. Andersen Torpet L. DVI system international: Software assisting in the Thai tsunami victim identification process. J Forensic Odontostomatol 2005;23:19-25.
12. Balla SB. Forensic dental identification: Practice in Indian context compared to western countries. J Forensic Sci Med 2016;2:44-7.
13. Madi HA, Swaid S, Al-Amad S. Assessment of the uniqueness of human dentition. J Forensic Odontostomatol 2013;31:30-9.
14. Monali C, Pritam P, Tapan M, Kajal D. Gender determination: A view of forensic odontologist. Indian J Forensic Med Pathol 2011;4:147-51.
15. Jain N. Textbook of Forensic Odontology. 1st ed. New Delhi: Jaypee Brothers Medical Publishers; 2013.
16. Kaur M, Mago J, Kaur A, Kaur J, Sahota MK, et al. Sex determination in forensic odontology. WJPMR 2016;2:102-4.
17. Krishan K, Kanchan T, Garg AK. Dental evidence in forensic identification – An overview, methodology and present status. Open Dent J 2015;9:250-6.

18. Singh SK, Gupta A, Padmavathi BN, Kumar S, Roy S, Kumar A. Mandibular canine index: A reliable predictor for gender identification using study cast in Indian population. Indian J Dent Res 2015;26:396-9
19. Saranya V, Malathi N. Forensic odontology – A brief review. Sri Ramachandra J Med 2014;7:22-8.
20. Shamim T, Ipe Varghese V, Shameena PM, Sudha S. Age estimation: A dental approach. J Punjab Acad Forensic Med Toxicol 2006;6:14-6.
21. Schmeling A, Olze A, Pynn BR, Kraul V, Schulz R, Heinecke A, et al. Dental age estimation based on third molar eruption in first nation people of Canada. J Forensic Odontostomatol 2010;28:32-8.
22. Willems G. A review of the most commonly used dental age estimation techniques. J Forensic Odontostomatol 2001;19:9-17.
23. Kvaal SI, Kolltveit KM, Thomsen IO, Solheim T. Age estimation of adults from dental radiographs. Forensic Sci Int 1995;74:175-85
24. Scott GR, Turner CG. The Anthropology of Modern Human Teeth:Dental Morphology and its Variation in Recent Human Populations.Cambridge: Cambridge University Press; 1997.
25. Rawlani SM, Rawlani SS, Bhowate RR, Chandak RM, Khubchandani M. Racial characteristics of human teeth. International Journal of Forensic Odontology. 2017 Jan 1;2(1):38.
26. BAND PE, BAND V, LAMINA D. morphology and physiology. Endodontics E-Book. 2014 Jan 26:1.
27. Vodanovic M, Brkic H. Dental profiling in forensic sciences. Rad 514 Med Sci 2012;38:153-62
28. Hemanth M, Vidya M, Prasad N, Bhavana KV. Identification of individuals using palatal rugae: Computerized method. J Forensic Dent Sci. 2010;2:86–90.[PMC free article] [PubMed] [Google Scholar]
29. Kavita B, Einstein A, Sivapathasundaram B, Saraswati TR. Limitations in forensic odontology. J Forensic Dent Sci. 2009;1:8–10. [Google Scholar]
30. Bansode S, Kulkarni M. Importance of palatal rugae in individual identification. J Forensic Dent Sci. 2009;1:7–10. [Google Scholar]
31. Thomas CJ, Kotze TJ. The palatal rugae pattern: A new classification. J Dent Assoc South Afr 1983;38:153- 7.
32. Thabitha, R.S., Reddy, R.E., Manjula, M., Sreelakshmi, N., Rajesh, A. and Kumar, V.L., 2015. Evaluation of palatal rugae pattern in establishing identification and sex determination in Nalgonda children. Journal of forensic dental sciences, 7(3), p.232.
33. Tsuchihashi, Y., 1974. Studies on personal identification by means of lip prints. Forensic Science, 3, pp.233-248.
34. Reddy LV. Lip prints: An overview in forensic dentistry. J Adv Dent Res 2011;2:17-20.
35. Musa OA, Elsheikh TE, Hassona ME. Tongues: Could they also be another fingerprint? Indian J Forensic Med Toxicol. 2014;8:171–5. [Google Scholar]
36. Giannelli PC. Bite Mark Analysis. Paper 153. Faculty Publications; 2007. Available from: http://scholarlycommons.law.case.edu/ faculty publications/153. [Last accessed on 2016 Oct 02].
37. Masthan KMK. Textbook of Forensic Odontology, New Delhi: Jitendar P Vij, 2009
38. Higgins D, Austin JJ. Teeth as a source of DNA for forensic identification of human remains: a review. Science & Justice. 2013 Dec 1;53(4):433-41.
39. chemicell GmbH • geneMAG-DNA / Saliva • Version 1.0
40. K Ranganathan etal. J Forensic Odontol Vol L, Issue 1, 2008