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Periodontist's Role In Forensic Odontology

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Abstract:
Periodontist's Role In Forensic Odontology :
Society is faced with various challenges in every step. Despite leaps in modern technology, medical breakthroughs and the geographical changes that the last century has brought, there has not been substantial literature dedicated towards the upcoming branch in medical sciences viz., forensic medicine. This article highlights the importance of Forensic Odontology and reviews the role of the periodontist in the same. Through the specialty of Forensic Odontology, dentistry plays a small but significant role in this process. By identifying the victims of crime and disaster through dental records, dentists assist those involved in criminal investigations. The most common role of the forensic dentist is the identification of deceased individuals. They can aid in identifying the person by using previous dental records and present dental findings. Even if the individual's previous records are not available, dentists can identify the sex and age by using the current postmortem findings. Recently, periodontists have identified the features of ante mortem and postmortem changes in gingival tissues. Thus, in future, periodontists could also play an important role in forensic odontology.

Keywords: *Forensic odontology, Post mortem, Ante mortem, Gingiva, Periodontist.*

I. Introduction

Forensic odontology is an important and expanding field of dentistry. The application of these forensic techniques in identification, criminal justice and dental liability is being practiced worldwide. In mass disaster events, notably large commercial aircraft crashes, the traumatic forces are such that fragmentation and conflagration results in only the most durable of human tissues-dentition survive and become a potential source of identification.[1] It is suggested that, through the FDI World Dental Federation, each member country should appoint dentists, responsible for providing advice and assistance, to forensic odontologists in other countries, when nationals of the country are victims of an international disaster.[2] The most common role of the forensic dentist is the identification of deceased individuals.[3] Dental identification takes two main forms. Firstly, the most frequently performed examination is a comparative identification that is used to establish (to a high degree of certainty) that the remains of a decedent and a person represented by antemortem dental records is the same individual. Information from the body or circumstances usually contains clues as to who has died. Secondly, in those cases where antemortem records are not available, and no clues to the possible identity exist, a postmortem dental profile is completed by the forensic dentist suggesting characteristics of the individual likely to narrow the search for the antemortem materials.[4] The identification of the victims has to be done in three phases, each of them with its own specific work and problems. As the process of identification of bodies is an exacting science, and forensic odontology is known to be among the most reliable scientific methods in mass disasters, it is easily understood that forensic odontology takes an active part in all three phases of the identification process.[5] Dental identifications have always played a key role in natural and manmade disaster situations and in particular the mass casualties. Periodontist can aid in postmortem identification of a person in the following ways:

Comparative dental identification:

The central dogma of dental identification is that postmortem dental remains can be compared with antemortem dental records, including written notes, study casts, radiographs etc, to confirm identity. Clearly, individuals with numerous and complex dental treatments are often easier to identify than those individuals with little or no restorative treatment.[4] The forensic dentist produces the postmortem record by careful charting and written descriptions of the dental structures and radiographs. If the antemortem records are available at this time; postmortem radiographs should be taken to replicate the type and angle of these.[6] Structures which are examined during the comparative dental identification, particularly in those instances in which restorative treatment is absent or minimal.

Periodontal tissues [7] :

Gingival morphology and pathology:

a. Contour, recession, focal/diffuse, enlargements, interproximal craters
b. Colour:– inflammatory changes, physiological (racial) or pathological pigmentations
c. Calculus deposits

Periodontal ligament morphology and pathology
a. Thickness
b. Widening
c. Lateral periodontal cysts and

Alveolar process and lamina dura
a. Height, contour, density of crestal bone
b. Thickness of interradicular bone
c. Exostoses, tori
d. Pattern of lamina dura
e. Bone loss (horizontal/vertical)
f. Trabecular bone pattern of bone
g. Residual root fragments

Sex determination:

The determination of sex and ancestry can be assessed from skull shape and form.[8] Apart from using skull shape, microscopic examination of teeth can be used to confirm sex by the presence or absence of Y-chromatin. DNA analysis can also reveal sex.[9] Currently, DNA comparisons may very well prove to be the most reliable and useful method of identification. DNA is a stable molecule and can survive decomposition when contained within bones and teeth. Murakami et al[10] used pulp DNA of extracted teeth for determining the sex by means of polymerase chain reaction (PCR).

The size and shape of teeth are minimally dissimilar between males and females to allow reliable gender determination. The tooth showing the greatest sexual dimorphism is the mandibular cuspid. Anderson[11] noted the mesio-distal diameter of cuspid is less than 6.7 mm in females, whereas a measurement is greater than 7 mm in male. The maxillary cuspids also show sexual differences with root lengths being on the average 3 mm longer in males.[12] A famous study by Rao et al[13] used mandibular canine index to determine sex.

Dental calculus is used for determination of sex by the PCR method using primers, which recognize DYZ3 region of Y-chromosome and DXZ1 of X-chromosome. The minimum amount of DNA for sex determination was 3 pg. Sex determination using DNA in dental calculus will be quite useful for forensic application because it can be done without destruction of morphological characteristics of the teeth.[14]

Age determination:

Dental radiographs:

Dental radiographs have rarely been used as a dental age estimation methods. These are the nondestructive tools used in the forensic odontology. Age-related changes were studied in 452 extracted, unsectioned incisors, canines and premolars. The length of the apical translucent zone and extent of the periodontal retraction were measured on the teeth, while the pulp length and width as well as root length and width were measured on the radiographs and the ratios between the root and pulp measurements calculated. The periodontal retraction was significantly correlated with age in maxillary premolars alone.[15]

To correlate dental age with an individual's chronological age based on the calculated volume ratio of pulp versus tooth volume measured, an X-ray microfocus computed tomography unit (micro CT) with 25μ spatial resolution was used to non-destructively scan 43 extracted single root teeth of 25 individuals with well-known chronological age. Custom-made analysis software was used by two examiners to obtain numerical values for pulpal and tooth volume. This technique showed promising results for dental age estimation in a non-destructive manner using X-ray microfocus computed tomography.[16]

Dental pulp: Previous studies have shown that with advancing age the size of the dental pulp cavity is reduced as a result of secondary dentine deposition, so that measurements of this reduction can be used as an indicator of age. The following ratios were calculated: Pulp/root length, pulp/tooth length, tooth/root length and pulp/root width at three different levels and are used for age determination.[17]

Gingival Marginal : The marginal tissue recession of the periodontium has been used as one of the several indicators of age in methods for age estimation. Periodontal recession tended to be more rapid in males than in females. However periodontal recession is not sufficiently accurate to be used as a sole indicator of age determination.[18]

Teeth: Determination of age between 15 and 22 years depends on the development of third molars, which are the most variable teeth in the dentition. The margin of error falls to ±2 years during this time.[19] After age 22, post eruptive and degenerative changes are used for aging.[20] These changes are influenced by slowly acting pathologic processes and are too variable for most forensic applications. The only post eruptive method that holds promise of precise aging (±1 year) is the quantification of D-aspartic acid.[21]

This technique relies on a linear and stable time-related conversion of L-aspartic acid into its D-isomer, which accumulates in metabolically inactive dentin.[22]

Morphological age-related changes of teeth are used for estimation of age between freshly extracted teeth and teeth from human skeletal remains in order to develop appropriate dental age estimation after death. These changes were investigated by measuring variables on intact and half-sectioned teeth. A new computer assisted image analysis procedure was developed to measure variables in sectioned specimens. Dental color, translucency, length, attrition, cementum apposition, and secondary dentin showed higher values in teeth from human skeletal remains than in fresh extracted teeth. The postmortem interval affects age-related morphological changes in these teeth.[23]

The age of the individual can also be determined by means of a new scoring system Surface Roughness Scores (SRS) for surface roughness. However, the SRS could not be assessed with sufficient reproducibility, and the estimates were therefore too subjective to be used as the sole criterion for age estimation. This scoring system could, however contribute positively to a multiple regression method.[24]

Cementum in age determination:

Determination of age from cemental incremental lines was evaluated in intact teeth. [25, 26] Cemental annulations are not always easy to count. Mineralized 100µ thick cross-sections were subjected to one of the three treatments: unstained, stained with Villanueva's blood stain and stained with acridine orange.[26,27] Cresyl fast violet, Toluidine blue, hematoxylin or periodic acid Schiff (PAS) can also be used for staining. Ideal areas were selected by light microscopy and photographed. Countability of incremental lines from photographic enlargements were evaluated. The average number of years required for the eruption of a particular tooth was added to the incremental lines count to determine the estimated age for that individual. Results obtained from unstained mineralized 100µ thick cros-sections using differential interference microscopy (Nomarsky) provided the most countable lines. The accuracy and repeatability of the method is not dependent on tooth type or location, but on the average obtained from making as many counts as possible. Incremental lines in human dental cementum could be observed best using decalcified sections stained with cresyl violet excited by green light. Since incremental lines are not destroyed by acids and stains.[28] In another study demineralized stained sections of canines and single-rooted premolars were viewed in a fluorescence microscope. Non-fluorescent lines, seen against a fluorescent background were counted directly and computed this on the total width of the cementum. The correlation coefficient between tooth age and the number of lines for the whole material was 0.84 when counted and 0.73 when calculated. The coefficient was only significant in teeth from individuals below the age of 50 year.[29]

Langerhans cells:

Modified adenosine triphosphatase (ATPase) histochemistry was used to identify and count Langerhans cells (LC) in autopsy tissue from 8 oral mucosal sites, 8-20 h postmortem. Nonkeratinized mucosae of the soft palate, ventral tongue, lip, and floor of the mouth had the highest counts (508 ±110 LC/mm^2, n = 24), and keratinized mucosae of the hard palate and gingiva had the lowest counts (201± 97 LC/mm2; n = 8). The frequency of oral mucosal LC varies inversely with the degree of keratinization. There are regions of the oral mucosa that have no LC.[30]

Gingival tissue changes:

Gururaj and Sivapathasundharam[31] studied the postmortem changes in gingival tissues. Gingival sections from dead individuals showed vacuolation of nuclei in the spinous layers of epithelium suggestive of autolysis. Gingival sections from living individuals showed no changes, where as sections that were fixed after 24 and 48 hours showed changes throughout the epithelium similar to those in the dead individuals.

II. Conclusion

Forensic odontology is an important upcoming and expanding field of dentistry, which is practiced worldwide. The identification of a person in various situations is very important, by which the culprit in criminal cases could be identified and assist judicial proceedings and obtaining justice. Forensic odontologist identifies a person by determining sex and age, using various tissues & techniques, including that of gingiva, and from dental records. Like wise periodontist can also actively part-take in probable and possible identification of a known and unknown individual before and after death.

Refferences

[1]. Gould GA.: Forensic odontology: a global activity. J Calif Dent Assoc 2004 May; 32: 410-415.
[2]. Clark DH. An analysis of the value of forensic odontology in ten mass disasters. Int Dent J 1994; 44: 241-50.
[3]. Jones D G. Odontology often is final piece to grim puzzle. J Calif Dent Assoc 1998; 26:650-651.
[4]. Sweet D, DiZinno J A. Personal identification through dental evidence-tooth fragments to DNA. J Calif Dent Assoc 1996; 24:35-42.
[5]. De Valck E. The dentist as an expert in disasters: dental identification in the disasters with the Zeebrugge ferry. Rev Belge Med Dent 1990; 45:11-20.
[6]. Goldstein M, Sweet D J, Wood R E. A specimen-positioning device for dental radiographic identification. Image geometry considerations. J Forensic Sci 1998; 43:185-189.
[7]. IA Pretty, D Sweet. A look at forensic dentistry -Part 1: The role of teeth in the determination of human identity. Br Dent J 2001; 190:359-366.
[8]. www.nifs.com.au/FactFiles/teeth/how.asp?page=how&title=Forensic%20Dentistry#Identification, accessed on 22nd April, 2006.
[9]. Adachi H. Studies on sex determination using human dental pulp. II. Sex determination of teeth left in a room. Nippon Hoigaku Zasshi 1989; 43:27-39.
[10]. Murakami H, Yamamoto Y, Yoshitome K. Forensic study of sex determination using PCR on teeth samples. Acta Med Okayama 2000; 54:21-32.
[11]. Anderson J L, Thompson G W. Interrelationships and sex differences of dental and skeletal measurements. J Dent Res 1973; 52:431-438.
[12]. Verhoeven J W, van Aken J, van der Weerdt, G P. The length of teeth: A statistical analysis of the differences in length of human teeth for radiologic purposes. Oral Surg 1979; 47:193-199.
[13]. Rao NG, Rao NN, Pai ML, Kotian MS. Mandibular canine index- a clue for establishing sex identity. Forensic Sci Int 1989; 42:249-254.
[14]. Kawano S, Tsukamoto T, Ohtaguro H, Tsutsumi H. Sex determination from dental calculus by polymerase chain reaction. Nippon Hoigaku Zasshi 1995; 49:193-8.
[15]. Kvaal S, Solheim TA. non-destructive dental method for age estimation. J Forensic Odontostomato 1994; 12:6-11.
[16]. Vandevoort FM, Bergmans L, Van Cleynenbreugel J. Age calculation using X-ray microfocus computed tomographical scanning of teeth: A pilot study. J Forensic Sci 2004 ; 49:787-790.
[17]. Kvaal SI, Kolltveit KM, Thomsen IO, Solheim T. Age estimation of adults from dental radiograph. Forensic Sci Int 1995;74:175-85.
[18]. Solheim T. Recession of periodontal ligament as an indicator of age. J Forensic Odontostomatol 1992;10:32-42.
[19]. Mincer H H., Harris E F, Berryman H E. The ABFO study of third molar development and its use as an estimation of chronological age. J Forensic Sci 1993;38:379-390.
[20]. William G Eckert, Introduction to forensic sciences. In Mark Bernstein (ed) Forensic Odontology. 2nd ed. New York: CRC press, 1992; 304-351
[21]. Ogino T, Ogino H. Application to forensic odontology of aspartic acid racemization in unerupted and supernumerary teeth J Dent Res 1988; 67:1319.
[22]. Ohtani S, Yamamoto K. Age estimation using the racemization of amino acid in human dentin. J Forensic Sci 1991;36:792-800.
[23]. Mandojana JM, Martin-de las Heras S, Valenzuela A, Valenzuela M, Luna JD. Differences in morphological age-related dental changes depending on postmortem interval. Forensic Sci 2001; 46:889-892.
[24]. Solheim T, Kvaal S. Dental root surface structure as an indicator of age. J Forensic Odontostomatol1993; 11:9-21.
[25]. Stott GG, Sis RF, Levy BM. Cemental annulation as an age criterion in forensic dentistry. J Dent Res 1982; 6:814 -817.
[26]. Naylor JW, Miller WG, Stokes GN, Stott GG. Cemental annulation enhancement: a technique for age determination in man. Am J Phys Anthropol 198; 68:197-200.
[27]. Sousa EM, Stott GG, Alves JB. Determination of age from Cemental incremental lines for forensic dentistry. Biotech Histochem 1999l; 74:85-93.
[28]. Kvaal SI, Solheim T, Bjerketvedt D. Evaluation of preparation, staining and microscopic techniques for counting incremental lines in cementum of human teeth. Biotech Histochem 1996; 71:165-172.
[29]. Kvaal SI, Solheim T. Incremental lines in human dental cementum in relation to age. Eur J Oral Sci 1995;103:225-230.
[30]. Daniels TE. Human mucosal Langerhans cells: postmortem identification of regional variations in oral mucosa. J Invest Dermatol 1984; 82:21-24.
[31]. Gururaj N, Shivapathasundaram B. Post mortem finding in the gingiva assessed by histology and exfoliative cytology. J Oral Maxillo Surg 2004;8(1):18-21.