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Periodontium and Periodontal tissues – An important aid in Human Identification

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Abstract

Periodontics is a clinical science which deals with diseases of periodontium and periodontal tissues are the supporting apparatus of the tooth which has many hidden genetic components that could be useful in the field of Forensic science. Though Periodontium has rich source of evidence as that of tooth but it is usually unfocused. Utilizing periodontal evidences and records Periodontist could serve in featuring the ante mortem and post mortem changes in gingival tissues. It is essential to bring the important hidden aspect of tooth supporting apparatus in the field of Forensic deontology to light that could aid during various crucial periods. This article highlights the importance of periodontal tissues in various aspects of forensic research and justifies the role of periodontist in forensic odontology.

Keywords: Periodontist, Forensic, Periodontium & Periodontal tissues, Ante mortem and Post mortem

Introduction

Forensic odontology is a field of dentistry which is involved in analyzing dental evidence in the interest of justice [1]. It is used in medico-legal cases for identifying the victim and deceased. The dental human identification is an essential procedure in the routine of medico-legal investigations. It is often performed through the comparison between the available ante mortem (AM) dental data of the missing person and the post mortem (PM) data collected from dead person [2]. An ante mortem record contains written case sheets, past dental and medical histories, radiographs, photographs, study models, drug list and other vital information about periodontal tissues. Periodontal tissue remains even when the deceased is buried, decomposed or cremated that are used in identifying the victim or a suspected person [3]. In those cases where ante mortem records are not available, and no clues to the possible identity exist, a post mortem dental profile is completed by the forensic dentist suggesting characteristics of the individual likely to narrow the search for the ante mortem materials [4]. Periodontist can aid in post mortem identification of a person in the following ways:

Individual identification

The central dogma of dental identification is that post mortem dental remains can be compared with ante mortem dental records, including written notes, study casts, radiographs etc. to confirm identity. Persons with numerous and complex dental treatments are often easier to identify than those individuals with little or no restorative treatment [5]. The periodontal structure of each patient is unique that could help in identifying the individual, particularly in those instances in which restorative treatment is absent or minimal. Clinical parameter that needs to be considered are changes in gingival color, contour, consistency, surface texture, position, and interproximal craters could be matched with ante mortem records to establish the identification of an individual [6]. Also, periodontal ligament morphology and pathology such as thickness, widening, and lateral periodontal cysts are much helpful in identification. Comparison of the ante and post mortem radiographic records forth alveolar bone height, contour and density of crustal bone, thickness of inter radicular bone, pattern of lamina dura, bone loss (horizontal or vertical), trabecular bone pattern and bone islands has helped in establishing the identity of the individuals. Records of the periodontal esthetic procedures have been used in identifying a person [7].

Sex determination

The determination of sex and ancestry can be accessed from skull shape and form. Apart from using skull shape, microscopic examination of teeth can be used to confirm sex by the presence or absence of Ychromatin. DNA analysis can also reveal sex. Currently, DNA comparisons may very well prove to be the most reliable and useful method of identification [4]. The use of oral epithelium cells harvested by pressure application of a toothbrush has been used to assess the minute qualities of DNA of individuals followed by gender identification by sex determining region-Y (SRY) gene amplification using real time polymerase chain reaction [8]. This is a valuable and sensitive tool and functional amounts of DNA could suffice from SRY gene amplification for human gender identification [9].

Quantitative cytomorphometric analysis of exfoliated healthy gingival cells which were obtained by scraping attached gingiva to assess the age- and gender-related alterations in the nuclear area, cytoplasmic area, and nuclear: Cytoplasmic ratio values of pathologic smears of oral premalignant and malignant lesions has revealed that attached gingival can be studied for human identification[10].

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[11].

Age Estimation

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[12].

Cementum in age estimation: Cementum apposes continuously; if contributing conditions could be avoided for a reasonable period of time, this property of cementum apposition aids as an adjunct to biological age estimation, which may serve to be significant tool in forensic investigations. Tooth cementum annulations can be used for age estimation of the deceased. These are counted on a pictomicrograph under light microscopy, polarized microscopy, or phase-contrast microscopy[13].

Number of incremental lines (n) = X/Y where, X = Total width of cementum from dentino-cementum junction to cementum surface and Y = Width of cementum between two adjacent incremental lines. Addition of the eruption age of the tooth with the number of lines can give us the age of the individual[14].

Changes in alveolar bone: Skull is the most commonly found bone in human remains and sometimes the only bone available. The changes in alveolar bone help in estimating the age of a person that begins at approximately 30 years and is consequential at approximately 50 years. The association of alveolar bone loss with age does not inevitably reflect the process of aging but also depicts behavioral changes (hygiene, hormonal impregnation, and tobacco) on the periodontal tissues. Alveolar bone loss is greater in Periodontitis, which forbids the application of the alveolar bone as a factor in forensic analysis[15].

Neurovascular supply: The neurovascular elements transit to supply teeth and supporting structures through vascular/ nutrient canals in bone. These are present in mandibular anterior region followed by premolar and maxillary sinus. Studies have suggested that nutrient canals ratio altered with respect to gender. With respect to age and gender, female showed maximum nutrient canals at 31- 40 years of age while males had maximum nutrient canals at 21-30 years of age[16].

Amino Acid Racemization: Organisms utilize proteins which are the building block of their biologic composition. All amino acids (except glycine) have two asymmetrical geometric forms that are mirror images of one another and are known as stereoisomer designated as “L” and “D” forms of the molecule. At birth, only the L form of the amino acid exists systemically. Racemization is the gradual and spontaneous process of converting to a mixture of equal amounts of the L and D stereoisomers. Racemization will begin immediately at birth. Age can be estimated by measuring the degree of racemization that has occurred in a metabolically inactive tissue[1]. Tooth dentin is rich in aspartic acid and assaying the degree of aspartic acid racemization within the tooth dentin has resulted in chronologic age assessment with error rates as low as ±3 years[17].

Determining Time of Death

Estimation of time elapsed since death is an important requisite in many forensic cases. The histological changes in the postmortem gingival tissues can be studied to determine the changes after death. Periodontal tissues are highly vascular in nature with enormous mitotic cellular activity[6]. After death there are several changes in the tissues which start within minutes and lasts upto many hours. The decomposition initiates within 15 min and progresses with time. The autolytic changes appear only in the superficial layers but the basal layer did not show any autolytic change and as the time increases the changes involves the basal layer which is evident in the sections studied at 4 h of time interval. Basal cell layer has an increased nuclear content compared with the other superficial layers of the epithelium. It has high mitotic potential and is considered to be composed of stem cells and progenitor cells[18].

Implants in forensics

Use of implants in the field of forensics is one of the leading edge that needs further pursuit. Though implants are identical and not customized, they have batch and serial number engraved [6]. Dental implants are made of titanium, which has high melting temperature of around 1650°C and are corrosion resistant [1]. Implants are embedded into bone by the process of osseointegration. In case of missing or deceased, the implants remains even after cremation which could be helpful in identification of the victim [19].

Conclusion

It is important to know the knowledge about forensic science and dental role in it and scope of periodontics and implantology should be understood in detail. Though Periodontium has rich source of evidence as that of tooth but it is usually unfocused. Utilizing periodontal evidences and records could serve as ante mortem evidence. Periodontist can actively part-take in probable and possible identification of a known and unknown individual before and after death. It is essential to bring the important hidden aspect of tooth supporting apparatus in the field of Forensic odontology to light that could aid during various crucial periods.

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Conflict of interest

There are no conflicts of interest.

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