■ **REVIEW ARTICLE**

Forensic Odontology: The Periodontal Perspective: A Review

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ABSTRACT

CONTEXT: Periodontics has significant potential for application in forensic odontology as a clinical dental specialty. Forensic odontology is used in medico-legal cases in order to identify the victims and deceased. Forensic odontology plays a pivotal role in age determination of the individual. Moreover, forensic odontology plays a crucial role to maintain the criminal records. The role of periodontology to identify the deceased by gingiva, periodontal ligaments, alveolar bone, perio-asthetics, etc. has their own evidentiary value in forensic investigation. However, periodontology also has its own significant value in determining the time since death. Moreover, periodontics is also used for the gender determination. The purpose of this paper is to summarize the application of periodontology in forensic odontology, to review the role of periodontists in this field, and to analyze the future implications in this field. It inspires further "perioscopical" research in the field of forensic odontology and in forensic investigation or in the court of justice.

KEYWORDS | forensic odontology, periodontics, post-mortem

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INTRODUCTION

FORENSIC ODONTOLOGY IS A BRANCH OF dentistry that assess evidences of dental origin in the aspect of justice. The identification of victims, suspects in mass disasters, such as abuses, crime scenes can be well examined thoroughly through proper evaluation and presentation of ongoing scenario's.[1]

Periodontology is a field that includes the supporting structures of teeth like gingiva, periodontal ligament, cementum and alveolar bone, its associated diseases conditions as well as treatment modalities for healthy periodontium.

Using this morphology and pathology in forensic odontology helps us to identify individual for age estimation studies, on the basis of root anatomy of tooth.[2] In medico-legal investigations the vital features of dental characteristics is considered as deciding factor, More commonly performed by comparing the antemortem (AM) dental data of the missing individual with the postmortem (PM) dental data of the deceased individual.[3]

The forensic odontologist primarily evaluate the deceased individuals in number of ways and mainly consists of 2 steps: 1) Comparative identification - it serves to establish that the decedent and person are the same at the time of inspection. 2) Non-existing identification - PM dental profile signifying the characteristics of the individual likely to limit the search for

the AM materials when AM records are not obtainable.[4]

This review summarize the use of periodontology in forensic odontology, to evaluate the role of periodontist within field and its application in perioscopic research.

Implementation of periodontal knowledge in forensic Dentistry

A postmortem examination of the periodontal structures can assist with identifying the deceased, determining the time and season of their death, deciding their gender, and estimating their age.

Identifying the Deceased

The periodontal structures along with perio-aesthetic, implant procedures & recognition helps in detection of the deceased individuals. The following categories are involved in forensic odontology in relation to periodontology.

Gingiva: Normal morphology and pathology of gingiva along with changes in the contour, color of gingiva and additional deposition of plaque and calculus will be taken as counterpart.

Periodontal ligament: The changes in the thickness & widening of periodontal ligament, subsequently the presence of any lateral periodontal cyst or periodontal abscess.[5]

Alveolar bone: bone height, contour, and density of crestal bone; thickness of interradicular bone; pattern of lamina dura; Bone loss (horizontal/vertical); trabecular bone pattern and bone ;presence of exostoses, tori & presence of any residual root fragments.

Perio Aesthetics: Aesthetic surgeries like root coverage in treatment of recession, Crown lengthening, gingival depigmentation perio-ortho procedures, periodontal microsurgery play a major role in the understanding the behaviour characterstics of person and help in relating person in the crime scene as friendly, trustworthy, intelligent, and self-confident.[6]

Implant recognition: G. Michelinakis in 2006 innovated a new implant recognition program to determine the various implant systems with aid in database.

Additionally, radiographic and clinical images of the implant systems are included in the software database. In the end, the manufacturer's details are revealed, and this aids in the case recognition and simplifies the work of a dental forensic expert.[7]

Determining the Time & Season of Death

At the time of death , the release of tissue fluids results in cell autolysis, and body continues to change hence PM changes and its examination are considered as vital part in medico - legal practice. The cellular changes are observed under microscope. It is precise and concise at the level of investigation of crime scene.

Henssge C, Madea B in 2004 identified the features of decomposition at the cellular level in PM gingival tissues at different times after death and observed cellular changes in unfixed AM gingival tissue at regular intervals and view at point of decomposition within 10 hours of death.[8]

Secondly, the histological and ultrastructural study by Pradeep *et al.,* in 2009 reviewed on the changes in the electrolytes and gingival tissue between the three groups that included normal, 2hrs, and 4hrs since apotosis. There was no notable difference between the 2 hour and 4 hours after death samples under light microscope An ultrastructurally significant difference in gingival tissue morphology was observed between the 2 hours and 4 hours postmortem samples.[9]

Determination of season of death – Cementum can be helpful in determining the season of death. Its growth is symbolized by opaque bands representing winter or dormancy season and translucent bands representing summer or growth season. [10]

As stated by Wedel in 2007, dental cementum increment analysis (DCIA) can provide the season of death by determining the timing of changeover from winter to summer bands.[11] He further demonstrated that the teeth extracted in early October showed a shift to opaque bands whereas the teeth extracted in early April switched to emerging translucent bands.

Moreover, he found that significant correlations were found between band

thickness and the number of days in each season, suggesting bandwidth increases with the length of each season. Thus, he provided a useful tool for forensic anthropologists to determine the season of death through DCIA.[11]

Determining the gender

Using the sex-determining region Y (SRY) gene by real-time polymerase chain reaction (PCR), cells in the oral epithelium can be harvested for the assessment of minute quantities of deoxyribonucleic acid (DNA) for gender identification. It has proven to be a valuable and sensitive tool for gene amplification since DNA found in bone and teeth has a long shelf life and is not decomposed.[12]

Dental Calculus in Gender Determination – Dental calculus is used with the PCR method for detecting sex using two different primers, one for the DYZ3 region of the Y chromosome and one for the DXZ1 region of the X chromosome. Due to the fact that it does not destroy the morphology of the teeth, the calculus method is preferred for classifying sexes.[13]

Age estimation of the deceased –
Cementum: a reliable marker for age estimation – A vital component of identifying a deceased person when information about the deceased is limited is estimating their age. In the periodontium, the cementum is a connective tissue that surrounds the tooth, forms in concentric, incremental lines throughout life, each line representing one year. [14]

Comparatively to other human morphological or histological traits, tooth cementum annulations (TCAs) have been shown to be a reliable source of age estimation.[15]

Studies have shown that the tooth cementum annulation (TCA) is an accurate method of estimating age from other histopathological or morphological features.[15] Microscopically examined, the apical and middle third of the root of a tooth are assessed and counted for the alternating bands of light and dark. A light microscope, polarized microscope, or phase contrast microscope can be used for this examination.[16] The number of incremental lines (n) = X/Y In this case, X = total width of cementum from dentino-cementum junction to cementum surface. Y = width of the cementum between two consecutive lines.

Based on the eruption age of the tooth and the number of lines, we can estimate an individual's age. Nonetheless, to be able to ensure a high level of accuracy, TCAs diagnosis must be based on more than one tooth of each individual and must be supported by different methods in forensic cases.[17]

Gingival Changes: Soleheim in 1992 stated that the recession of the marginal tissue provides an indication of aging when applied to age.[18]

The method may not be as precise as a single indicator of age, however it can contribute significantly to a number of regression methods for estimating age, particularly for premolars. Alveolar bone in age estimation: The alveolar bone level of anterior monoradicular teeth was measured on the labial aspect by Lamend in 1992. He concluded that the amount of alveolar bone loss increased with aging.[19] Age can be estimated by histological evaluation of osteons in bones.[20] Periodontal ligament in age estimation: The Periodontal ligament is considered as a marker for age estimation, its visibility was visualized in orthopantomograms of mandibular third molar in paitent age range from 17 to 31 years in Portuguese population. A four-stage classification was devised based on the appearance of completely mineralized third molars lacking the periodontal ligament. Each periodontal stage (0,1,2,3) was evaluated for its median, variance, minimal and maximal age & in both sexes, age and stage were statistically significantly correlated. Stage 3 can serve as a marker in this population to indicate that a male is older than 21. It is recommended to use a different marker for females. An advantage of this technique is its ability to determine the age of males over the age of 21.[21]

Future Implications

Periodontists may use gingival epithelial cells for optimum identification of human, based on the study of Barr bodies and sex-determination.

A judicial approach to the accomplished facts should also be implemented through the evaluation of them.[22]

CONCLUSION

Maintaining the proper dental record is very important in the critical situations. Dentists should be enhanced to maintain dental records, apply distinctive marks in prosthesis and also maintain a database, which can be made available when required. The success of forensic dentistry is highly dependent on the availability of data. Literature demonstrates that forensic dentistry can have crucial contributions made by periodontists as well as an active role in possibly identifying suspected or unknown individuals before and following their death. Throughout the compilation of review articles, we have attempted to provide inputs from periodontology that could stimulate forensic research with a methodical nature. **IJFMP**

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