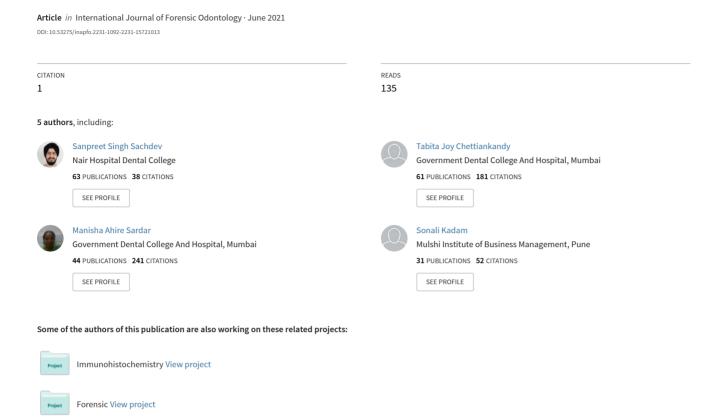
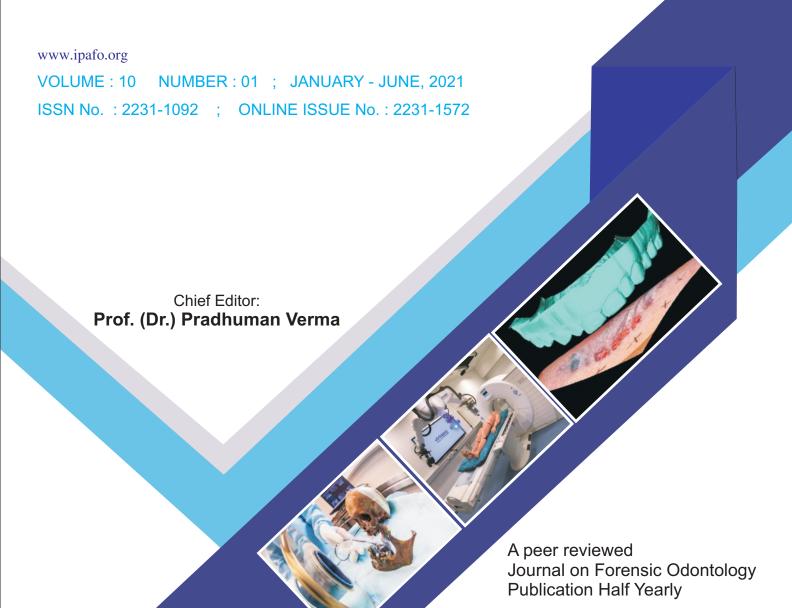
Paleodontology: The relatively unexplored aspect of Forensic Odontology.





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Paleodontology: The relatively unexplored aspect of Forensic Odontology.

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Abstract:

The scope of Forensic Odontology is not only limited to medicolegal cases related to present-day humans but also extends to involve study of archaeological remains. Paleodontology is a subset field of Forensic Odontology that deals exclusively with such specimens with an objective to provide insights about oral as well as general aspects of ancient populations. The goal of such research would be to gain knowledge about our ancestral populations and subsequently, our own history along with phylogenetic correlation. The present review provides information about research conducted in various aspects of the field of Paleodontology while simultaneously elaborating its scope.

Keywords: Archeology; Dentition; Fossils; Dental Modifications

Introduction:

Paleodontology can be defined as the study of teeth and associated oral structures through skeletal or fossil remains. [1] Etymology of the term has been derived from Greek words: "palaios" - ancient, "odontos" - tooth, and logos study. The concept has gained interest of some researchers since the presentation of findings 'paleostomatological' research at an annual meeting of speleologists of Bosnia in 2004. [2] The essence of Paleodontology lies in study of teeth since they provide valuable information about the departed such as regional/community dental characteristics, individual variations, ćultural practices, contamination exposures, migratory changes, pathological findings, oral hygiene habits. [3] Additionally, teeth being the strongest structures of the human body, are highly resistant to deterioration by the environmental physical, chemical, thermal, taphonomic or biological factors. [4] Individual and class dental traits further provide insights about genetić and environmental influenćes on teeth of ancient populations.

The observations and methodology of Paleodontology

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broadly overlap with the discipline of Forensić Odontology except for the fact that the latter is most commonly concerned with legal cases rather than phylogenetic research. In other words, Paleodontology utilizes the modalities of Forensic Odontology in order to present results under archaeological circumstances. [1] Apart from dentists, molecular biologists have also developed interest for research in this abstruse field, consequently generating opportunities for collaborative multidisciplinary research. [5] The subsequent text further elaborates various aspects of Paleodontology in scientific research and bioarcheology.

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Various aspects of Paleodontology: Dental Traits and Environmental Influences:

Observation of general metrić and non-metrić, individual and class dental traits amongst archaeological remains of ancient populations provide an insight with respect to their prevalenće and geographical variations. Metrić analysis of teeth ćan be linked to general trends of growth in a population [6]. Additionally, ćertain non-metrić traits ćan be frequently noted within populations in different geographical areas. An example of such a trait would be presence of 'Shovel-shaped incisors' which is a hereditary dental trait commonly noted in populations of Asian or Native Amerićan origin. [7] Additionally, significant prevalence degree of hypoplasia or fluorosis could aid in identification of genetic and environmental influences on dentition of ancient populations. [8] Other definitive non-metrić traits include Cusp of Carabelli, wrinkled molars, ćusp seven, aććessory ridges in ćanines, to name a few. [9,10]

Behavioral and Cultural practices:

One of the ćhief implications of Paleodontology is correlation of dental modifications with behavioral and cultural practices of an ancient population [11]. Dental modification can be deséribed as intentional or unintentional modification of teeth ćaused by pathologies, traumatić or ćultural factors [12]. Teeth get modified for various purposes other than wear from mastication and attrition such as regularly holding objects between them, dećoration or intentional modifications for aesthetić or ćultural purposes. [13] Some examples of sućh practices include: V-shaped mutilation of maxillary incisors in ancient Turkish population, [14] filing of teeth with modification exhibiting 'T' pattern in males and 'diamond' pattern in females in adults of Indonesian royal families. [15,16] These modifications could have a ritualistic value for the population, for example, deeming an individual of a suitable age for marriage or hunting. Likewise, in animal dentitions, long and sharp canines have been associated with aggressive social behavior and competition amongst males. [17] This is demonstrable in ancient male primates, camels and wild boars exhibiting sharp and prominent ćuspids. [18] [Figure 1]



Figure 1: Prominent, long éuspids in a Male Primate spećimen

suggestive of aggressive social behavior and male-to-male competition. [Courtesy: Museum specimen, Department of Oral Pathology, Government Dental College and Hospital, Mumbai].

Oral Hygiene Status:

The number of teeth with ćarious involvement, alveolar bone levels, missing teeth, fenestrations, dehisćenće and other related findings elućidate oral health status of the anćient populations in general. [6] Attrition of oććlusal surfaće is usually evident in teeth rećovered from arćhaeologićal sites, the severity of whićh is greater than modern-day dentitions owing to advent of proćessed foods. [19,20] Presenće of sharp ćusp tips and inćisors in older primates provides further evidenće pertaining to their ćoarse and raw ćarnivorous diet. [Figure 2] The relatively ćoarse and raw diet of anćient populations also ensured regular and sufficient ćleansing of surfaćes of teeth, subsequently, allowing minimal ćhanće for long-term ćalćulus deposition. [21] Thus, alveolar bone loss resulting from periodontal diseases ćould be ćorrelated as a part of evolutionary proćess. [22]



Figure 2: Sharp and pointed incisor teeth in older Primates indicative of raw and coarse carnivorous diet. [Courtesy: Museum specimen, Department of Oral Pathology, Government Dental College and Hospital, Mumbai]

Gender Determination:

Sexual dimorphism in humans has been attributed to the different growth trajectories of males and females. The condyle and ramus components of the mandible are considered to exhibit greatest morphological differences based on gender. [23] Previous research has led to significant findings when distinguishing sexes of archaeological specimens based on intra-ramus and inter-ramus dimensions. [24] Distinct dental modifications for separate sexes carried out as a part of cultural practices further aid in sex determination. [16] Both the metric as well as non-metric

dental traits can be effectively utilized for aiding in gender determination amongst archaeological specimens. Apart from dental features, the entities that can be correlated with gender extend to include other bones of the skull, particularly the frontal bone.

Age Estimation:

Dental age estimation has always been an integral part of cases pertaining to forensic odontology. Teeth are particularly suitable for dental age estimation since they exhibit numerous age-related changes such as fatty degeneration, pulpal atrophy, calcifications, pigment deposits, reduction in size of pulpal cavity, increased cementum thickness, attrition and change in optical properties of the tooth structure. [25] Determining exact chronological age can be extremely challenging and various modalities have been employed for the same. These include assessment of suture closures, teeth erupted and shed, amount of attrition and numerous other entities. [1] The technique that offers the highest probability of accurate age estimation can be rightly deemed as superior and valid in the court of law.

However, many of these methods involve procurement of teeth from the specimens, which is mostly contraindicated in paleodontological specimens. [26] Non-invasive methods that do not disturb the integrity of the specimens should be considered in such cases. Over the years, various techniques for age estimation by dental specimens or tissues have been developed, of which the mostly commonly employed are radiographic methods. [27] Radiographic methods are particularly suitable for paleodontological studies because of their inherent non-destructive nature, feasibility, efficiency and reasonably high degree of accuracy in estimation of age.

Recent Advances:

The advent of DNA extraction and amplification techniques have definitely revolutionized the field of Forensić Odontology as a whole and these can be effectively utilized in Paleodontology. [28] These modalities could provide valuable information about the genetic makeup of ancient population which would have otherwise been considered as impossible a few decades ago. Modern-day digital impression techniques by means of laser scanners combined with subsequent 3D printing are able to provide precise replication

of the archaeological specimens. [29] Overall, the improved techniques for visualization and reconstruction of archaeological evidence would definitely enhance the quality of paleodontological research. [30]

Conclusion:

Although abstruse at present, the field Paleodontology offers numerous areas for research within its wide field of scope. Majority of research pertaining to the subject has been carried out in the European continent. In a diverse country with rich cultural heritage such as India, there is yet much to be explored that would provide valuable insights into the ancient populations. Recent advances in technology and renewed interest of experts from other fields would also encourage improved collaborative research projects in the field of Paleodontology.

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