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AMELOGLYPHICS - A REVIEW

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Abstract

Soft tissues are unable to provide reliable information of human identification in mass disasters, it is largely feasible with skeletal remains especially teeth. There is a crucial need for new and dependable methods for recognition and confirmation of victims in mass disasters. Forensic Odontology employs various methods like rugoscopy, dental labelling, DNA analysis from dental pulp, bite marks analysis, etc. Currently it embraces the study of enamel rods end patterns. Ameloglyphics is an analysis of the end patterns of the enamel rod. These patterns have been found to be unique to the individual teeth of the same individual, as well as to different individuals. A potential association between the type of enamel rod end pattern and the incidence of dental caries can help to predict the individual's susceptibility to caries and to implement preventive measures.Individual identification is becoming more important than ever in today's world. Numerous techniques have been used for victim recognition in forensic dentistry, including ruboscopy, cheiloscopy, bite marks, dental impressions (ameloglyphics), radiographs, photographic samples, and biochemical approaches.The use of enamel rod end patterns may be used to identify the susceptibility of an individual to common dental conditions that are acquired during one's lifetime.

Keywords*:* *Biometric analyses; Forensic science; Peel technique.*

Introduction

The general dentist apart from having a broad background knowledge of general dentistry, should possess knowledge of the role of the forensic pathologist, methods used in autopsy, the role of a dentist in the identification of a person, and the importance of maintaining dental records of all patients.[3] In India, qualified forensic odontologists are very few.[4]This is probably due to the lack of proper awareness [5]. In scenarios of The application of scientific methods and techniques under investigation by a court law. Forensic odontology:

The term ‘forensic’ means ‘court of law’. Forensic odontology has been defined as that branch of dentistry that is in the interest of justice, deals with the proper handling and examination of dental evidence and with proper evaluation, and presentation of dental findings.[1]Forensic odontology has played a key role in identification of

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people in mass disasters, in crime investigation, in ethnic studies, and also identification of decomposed and disfigured bodies like that of drowned persons, also fire victims, and victims of motor vehicle accidents.

ROLE OF TEETH IN FORENSIC ODONTOLOGY:

In such situations, dental hard tissues gain importance for identification based on the condition of the deceased. Teeth can withstand extreme temperatures and are resistant to postmortem decomposition. Therefore, the use of dental evidence is the method of choice in establishing an identity from badly burned, traumatised, decomposed and skeletonized remains[2]. The various methods employed in forensic odontology include rugoscopy, cheiloscopy, bite marks, tooth prints for teeth, radiographs, photographic study, and also molecular methods [3, 4].

ENAMEL:

Enamel is the hardest and essential substance in our body. Enamel is a product of ectoderm that is the derived cells called ameloblasts[5] The basic structural unit of enamel is the enamel rods which are also called enamel prisms. The development of enamel is a complex process, where the ameloblasts lay down in the enamel rods in an undulating and inter-twining pathway.

ENAMEL ROD:

Enamel is a product of ectoderm derived from the cells called ameloblasts [6] The basic structural unit of the essential part of the tooth enamel is the enamel rods (enamel prisms). Enamel do not remodel or don't remain in close contact with the cells which synthesise it, rather the ameloblasts retract away from the enamel surface once it has matured and the tooth has erupted. Enamel prisms morphology reflect the morphology of ameloblasts in a species that is in a very -specific manner.Alterations to the matrices are reflected as defects in the structure that is the organization of enamel [7]. Previously our team have conducted numerous original studies[8–14],and surveys [15–22] over the past 5 years.now we are focussing on epidemiological surveys. The idea for this review stemmed from the current interest in our community.

ULTRASTRUCTURE OF ENAMEL:

Studies with electron microscopes revealed that the enamel rods have a keyhole or paddle-shaped patterns with rounded heads and narrow tail region. The rounded head of each rod fits closely in the concavity between the heads, and Arrangement of enamel rods, tails of the rods on either side. The region between the two enamel rods in the one row thought to be the interred substances, actually represents the tail portion of the enamel rod in the previous row. The rods measure about 4-5 μm in breadth and 9 μm in length. Many patterns are observed regarding the arrangement of the rods, but usually, they are arranged with their head portion near to the occlusal and the incised surface and their tail portion pointing cervically [23]
Macroscopically, the incremental pattern of the enamel rods which is exhibited on the tooth surface as perikymata [24]but microscopically, groups of enamel rods run in a unique direction, which differs from an adjacent group of enamel rods and results in forming various and different patterns of enamel rod endings on the tooth surface [25].It has been estimated that each and unique tooth has millions of enamel rods and that the number varies in all the teeth.
The length of the rods in the enamel rod is greater than the thickness of the enamel as a result of the oblique direction and wavy arrangement of the rods. It varies in different portions of the crown of the tooth, being long in the thicker portions like in the cusps (cusp area) and short in the thinner portions in the cervical area.
The size and diameter of the enamel rods become more as they reach the outer surfaces.Although it is observed that the average diameter of the enamel rod is 4-5 μm, there is considerable variation with its course. It has been suggested that the diameter of the enamel rods is more in the ratio of 1:2 while passing from the dentin enamel junction to the outer surface.

TYPE OF ENAMEL RODS:

The shape of the enamel prisms approximates to one of three patterns :
Pattern I: Prisms are circular.
Pattern II: Prisms are aligned in parallel rows.
Pattern III: Prisms are arranged in staggered rows such that the tail of prism lies between two heads in the next row, giving a keyhole appearance. [25]

RECORDING OF ENAMEL RODS AND PATTERNS:

In ameloglyphics, recording of enamel rod endings on the tooth surfaces are proceeded using acid etchant, acetate peel technique, and automated biometrics as sequential steps for reproducing complete and accurate enamel rod end patterns for personal identifications [26]

ACID ETCHING:

The acid etching on the surfaces of enamel results in the removal of the surface mineral component in the rod and rod sheath. As the rods and rod sheaths have a different and various
mineral density, the etching results in an uneven dissolution of the surface enamel along with the removal of the smear layer.
The effect of acid etching on enamel depends on the following:

1. Kind of acid used.
2. Acid concentration.
3. Etching time.
4. Form of etchant.
5. Rinse time.
6. Whether enamel is instrumented before etching.
7. Chemical composition and condition of enamel [27]

About 10% of orthophosphoric acid in gel form is the most commonly used acid to condition the enamel in viva studies.
Three types of etching patterns can also be obtained:
1. Predominant dissolution of the prism cores.
2. Predominant dissolution of the prism peripheries.
3. No prism structure is evident

ACETATE PEEL TECHNIQUE:

A peel is a replica of an acid-etched mineral surface, made upon acetate film.Peeling is a simple, inexpensive, and rapid way of making replicas of dental hard tissue surfaces. The peel-making technique was first developed by the palaeobotanist to study Cellular structures of the fossil plants and later taken upon by the palaeobotanist, carbonate petrologists, and paleontologists to study both the texture and structures of carbonate rocks and fossils. Further modifications were done to study dental hard structures due to its unique mineralogical compositions [28] The peel can be examined under a microscope with the incident or transmitted light or with combinations of both and can be stored for posterity.

AUTOMATED BIOMETRIC TECHNIQUE:

The term “biometrics” refers to identification techniques that are based on specific physical characteristics. It is a technology of identification or authentication of a person that transforms a biological, morphological, or behavioral characteristic in digital value. When the patterns studied are consistently recognized and provide greater confidence, they are referred to as “positive identification”. Biometric-based identification and verification methodologies such as fingerprint verification, iris scanning, and facial recognition have also been steadily improved and refined in automated systems and software, which can distinguish individuals reliably.

USES OF AMELOGLYPHICS:

Enamel rod end patterns are unique for each tooth in an individual and may be used as an adjunct with other methods for personal identification. This technique is a simple, inexpensive, and rapid method which can be performed by even a dental auxiliary staff. Usually, this method of personal identification can be included as adjunct antemortem dental records of firefighters, soldiers, jet pilots, divers, and people who live or travel to politically unstable areas. [29] And this record can be used for the predilection of dental caries, gender predilection.

CONCLUSION:

Ameloglyphics can play a significant role in the personal identification of individuals particularly working in dangerous occupations such as soldiers, divers, jet pilots, and people who live and travel to potentially unstable environments. Ameloglyphics is a simple inexpensive technique that is used as an adjunct method in personal identification.

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AUTHOR CONTRIBUTION:
Amrithaashri S carried out literature search and drafted the manuscript. Archana Santhanam supervised in preparation of the manuscript. All the authors had equally contributed in developing the manuscript.

CONFLICT OF INTEREST:
There was no conflict of interest as declared by the authors.

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