ORIGINAL ARTICLE

Ameloglyphics and predilection of dental caries

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ABSTRACT

Background: Dental caries is an infectious disease of microbiologic origin resulting in destruction and loss of tooth structure and is related to every speciality of dentistry. Many studies have been carried out to identify the causative factors, methods of prevention, and treatment of dental caries. Ameloglyphics is the study of enamel rod end patterns. These patterns have been found to be unique to individual teeth of the same individual and also to different individuals. A possible correlation between the type of enamel rod end pattern and the occurrence of dental caries might help in predicting caries susceptibility of an individual and implementation of preventive measures. This is a simple and easy method cutting short elaborate methods currently in use and can be invaluable in caries prevention. **Objective:** This study is aimed at ascertaining the possibility of a correlation between enamel rod end patterns and occurrence of dental caries, which might help in identifying predisposition to dental caries. **Materials and Methods:** Thirty carious and 30 noncarious teeth were used to obtain enamel rod end patterns. Occurrence of any particular pattern in either of the study groups, which might affect the predisposition of teeth to dental caries was analyzed. **Results:** No particular rod end pattern was found in teeth affected by dental caries. Also, no particular pattern was found to be unique to teeth not affected by dental caries.
Key words: Ameloglyphics, caries susceptibility, dental caries, tooth prints

INTRODUCTION

Individual identification is gaining importance like never before in the present world. Numerous methods have been used for personal identification in forensic odontology, which include rugoscopy, cheiloscopy, bite marks, tooth prints (ameloglyphics), radiographs, photographic study, and molecular methods.[1,2] Of these various methods, ameloglyphics or the study of tooth prints is of particular interest as the enamel of teeth is a highly calcified structure in the body that resists decomposition and, therefore serves as an invaluable tool in identification of individuals.[3,4] The use of these different patterns can also be extended to identification and possible correlation between the occurrence of several congenital defects and acquired diseases. For example, the spectrum of dermatoglyphics, rugoscopy, and cheiloscopy has extended from individual identification, gender determination, to predilection of occurrence of cleft lip and palate. It has also been possible to understand the familial occurrence of such congenital defects using these relatively inexpensive modalities. Likewise, the use of enamel rod end patterns can be made to identify the susceptibility of an individual to common dental ailments, which are acquired during one's lifetime.

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Enamel is a product of ectoderm-derived cells. The process of enamel formation is a complex and organized one, carried out by specialized cells called ameloblasts. These cells lay down enamel rods that are the basic structural unit, in an undulating and inter-twining path. This is reflected on the outer surface of enamel as patterns of ends of a series of adjacent enamel rods. These enamel rod end patterns are termed tooth prints and the study of these prints is known as "ameloglyphics" (*amelo*: Enamel, *glyphics*: Carvings). Enamel does not remodel once it has been formed. It also does not remain in contact with the secretory cells or ameloblasts. Once they form, ameloblasts move or retract away from the enamel surface. They leave behind the prism morphology, which is evident on the surface enamel and is species-specific.[5]

Dental caries is a microbial disease affecting the dental hard tissues, the manifestations of which persist throughout life. It causes permanent damage and changes in the tooth structure. It is perhaps the only disease distressing mankind so commonly across all geographical barriers, age groups, gender, socioeconomic status, and so on.[6] It is also the most common dental complaint across the world. Therefore, it is imperative on the part of clinicians to have a thorough knowledge of the etiological factors, pathogenesis, treatment modalities, and most importantly prevention of dental caries. Numerous theories on the etiology of dental caries have been proposed and discussed. These include the external factors or environmental factors, which play a central role in the etiopathogenesis of dental caries. Studies such as dermatoglyphic dependence of dental caries and its relation with salivary bacterial levels have been done in the past. A positive correlation with loops and *Streptococcus mutans* growth was found in a particular study.[7] The role of the host factor, that is, the tooth and its structure in particular has been limited to deep pits, fissures, and areas of the tooth where food retention occurs. The inherent predisposition of tooth structure, that is, the structure of enamel surface and its susceptibility to dental caries is a less-explored area of interest. Enamel rod end patterns provide for better understanding of the surface structure of enamel. Since, dental caries affecting smooth surfaces of teeth might go unnoticed until a large defect forms, this structural analysis might prove useful in identification and prevention of dental caries to a large extent. The objective of this study was to understand the complex rod end patterns and to explore the possibility of a particular rod end pattern predisposing teeth to dental caries. This is a simple and easy method cutting short elaborate methods currently in use and can be invaluable in caries prevention.

Aims and Objectives

- To study and analyze the rod end patterns of carious and noncarious teeth
- To determine if there is any difference in the rod end patterns in carious teeth as compared to that of noncarious teeth
- To explore if a particular rod end pattern predisposes teeth to dental caries.

MATERIALS AND METHODS

In the present study, 30 carious and 30 noncarious extracted molar teeth were taken. All the teeth selected were from permanent dentition. The armamentarium used included 37% orthophosphoric acid, distilled water, ethyl alcohol, cellophane tape, tweezers, cotton, scissors, permanent marker, and glass slides [Figure 1]. The method followed is as follows. The teeth were first thoroughly cleaned. The central region of the middle third of the buccal/lingual surface of the chosen tooth was selected as the representative area [Figure 2]. This area was selected because the enamel rods are oriented almost perpendicular to the external tooth surface here, and would therefore be most representative. The chosen area was etched using 37% orthophosphoric acid for 30 s [Figure 3]. The acid was then rinsed with a gentle spray of distilled water [Figure 4]. This was followed by the application of ethyl alcohol on the same area to ensure complete desiccation in the area [Figure 5]. The ethyl alcohol absorbs the moisture as it evaporates, thereby ensuring a dry area. After the tooth

Figure 1: Armamentarium: Ethyl alcohol, distilled water, 37% orthophosphoric acid, tooth specimen, glass slide, permanent marker, cellophane tape, cotton, and scissors

Figure 2: Central region of the buccal/lingual surface chosen as the representative area

Figure 3: Chosen area etched with 37% orthophosphoric acid for 30 s

is completely dried, transparent cellophane tape was applied onto the etched area without using finger pressure [Figure 6]. A small cotton roll was then used to adapt the tape onto the tooth surface [Figure 7]. The tape was then pulled away gently and transferred onto a clean glass slide for microscopy [Figure 8]. The slides were then observed under light microscope attached with a digital camera. The area of interest was viewed under different magnifications. A digital image of a suitable area was obtained at 40× [Figure 9]. The digital image was then subjected to biometric conversion using fingerprint analysis software [Figure 10a and b]. The software used recognizes and compares prints for similarities and dissimilarities, if any. All the images of the rod end patterns of the carious and noncarious teeth were analyzed and compared within the two groups.

RESULTS

In the present study, a total of 60 teeth consisting of 30 noncarious and 30 carious teeth rod end patterns were

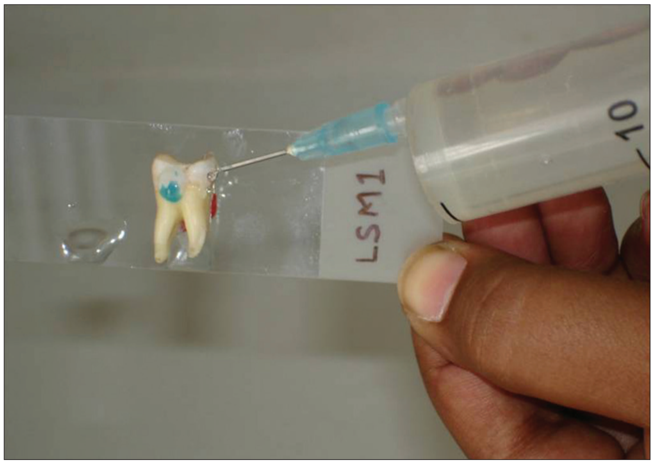

Figure 4: Etchant washed with a gentle spray of distilled water

Figure 6: Application of cellophane tape to obtain tooth-print

Figure 8: Print transferred onto a clean glass slide

analyzed. The cellophane tape technique of obtaining tooth prints was followed. All the 60 tooth prints were distinct from one another. Each tooth print consisted of series of lines displaying a variety of patterns. These variations included patterns such as straight, branched, looped, whorled and wavy ones. In some cases, a single tooth print displayed more than one such pattern.

Biometric analysis of tooth rod end patterns showed nothing in common within the carious and the non-carious group. In addition no particular or common pattern could be discerned between the carious and the non-carious group.

DISCUSSION

Human identification has been largely possible with skeletal remains, especially teeth, when soft tissue cannot provide reliable information or has been lost.[4] Modern life is characterized by the concentration of large populations in a given area. With this comes an increased need for new and reliable methods of forensic identification to identify victims

Figure 5: Application of ethyl alcohol to ensure complete desiccation

Figure 7: Application of a cotton roll over cellophane tape for better adaptation

Figure 9: Example of a digital image of the rod end patterns (40×)

of mass disasters. Tooth prints or ameloglyphics can provide one such identification procedure. Enamel being the hardest tissue of the body, provides an excellent source of information related to individuals. The enamel surface has a variable appearance such as the perikymata, aprismatic enamel, prism end or rod end patterns. These patterns are formed by the basic structural units of enamel, the enamel rods or prisms. Each prism consists of several million hydroxyapatite crystals packed into it. Each rod approximately measures 5 to 6 μm in diameter and 2.5 mm in length. They follow an undulating course from the dentinoenamel junction to the external tooth surface. Many rods span the entire thickness

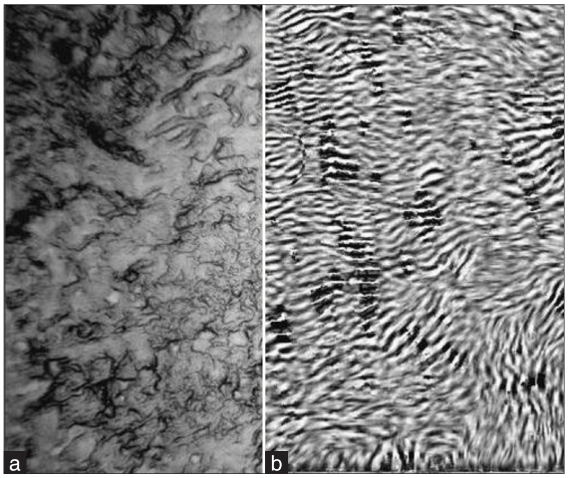

Figure 10 (a and b): Biometric conversion

of enamel in a straight course, whereas most have a wavy pattern. The acid etching on the surface 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 mineral density, the etching results in an uneven dissolution of the surface enamel along with the removal of the smear layer. About 10 µm of surface enamel is removed by acid etching, revealing etching patterns or rod end patterns or tooth prints. The present study concluded that there was no common enamel rod end pattern among the study groups, that is, no two rod end patterns of the carious and noncarious groups were found to be similar. Also, no particular pattern was found to be unique to either of the study groups. Each tooth of the study groups showed a different pattern. The pattern varied in different areas of the print from the same tooth also. This could probably be due to the differential movement of the ameloblasts during amelogenesis in relation to the same tooth. The environmental factors during the different periods of the tooth development may also have had an effect on the course of the ameloblasts resulting in different arrangement. These are manifested as different print patterns. The role of genetics in the determination of rod end patterns is yet to be understood.

CONCLUSION

The occurrence of divergent enamel rod end patterns suggests that structurally there is no difference in enamel surface of carious and noncarious teeth. Enamel does not show any predisposing structural variations in the occurrence of caries, other than the factors known thus far. Caries process initiates and progresses whatever be the type of surface enamel, based on the interplay between the environmental, host, substrate, and time factors. However, since the rod end patterns may be different at different depths of enamel, the importance of age-related changes such as abrasion, attrition, and so on, which result in wearing out of surface enamel in relation to different rod end patterns should be analyzed. This study did not include teeth showing wear. Also, caries being a very dynamic process involving a diverse range of factors, should be further studied in relation to rod end patterns of different areas of the same tooth, particularly those from the tooth surface affected by caries and those relatively unaffected. The exploration of enamel rod end patterns in the areas of developmental defects, which affect enamel might help in a better understanding of these defects.

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