

## Amelogyphics: A feasible forensic tool in dentistry

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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 of new and dependable methods for recognition and confirmation of victims in mass disasters such as military conflicts and wars as well as in natural disasters that involves multiple fatalities. Forensic Odontology recently employed various methods like rugoscopy, dental labelling, DNA analysis from dental pulp, bite marks analysis, etc. Currently it embraces the study of enamel rod end patterns. The study of these enamel rod end patterns is known as Amelogyphics.

**Keywords:** Forensic odontology, Amelogyphics, Enamel rod patterns.

### Introduction<sup>1,2</sup>

DNA analysis, finger prints and dental patterns are currently used for individual recognition in mass disasters. Whereas there are disaster in which only small fragments of calcified tissues are available for recognition of victims that includes dental hard tissues. Teeth can resist decomposition and destruction due to postmodern and extreme temperatures. Hence, teeth can be used to identify personal identification of the victim. Components of a tooth are enamel, dentin, pulp and cementum out of which enamel and dentin are highly calcified structures that can resist decomposition. The study of the enamel rod end pattern is known as Amelogyphics. The enamel rod end pattern for every individual is unique therefore, it is used as valuable tool in Forensic Odontology. Enamel rod end patterns are termed as tooth prints.

### Enamel rods<sup>3,4</sup>

Enamel rods are the fundamental units of tooth enamel of size approximately 4µm in width and 8µm in length. Enamel rods are made up of hydroxyapatite crystals which are tightly packed and organized. Hydroxyapatite crystals are hexagonal in shape and they provide rigidity to the enamel rods as well as strengthen them. Enamel rods are also known as Enamel prisms. They are arranged in rows along the tooth, long axis of enamel rod and is usually perpendicular to underlying enamel- dentine junction.

As enamel rods reach on the outer surface the size and diameter of enamel rods increases. While passing from dentin enamel junction to outer surface, ratio of enamel rods diameter increases.

There are three main patterns of enamel rods shape. These are-

Pattern 1: Circular

Pattern 2: Aligned in parallel rows

Pattern 3: Arranged in staggered rows such that the tail lies between two heads in the new row, giving a keyhole appearance.

### Methods to study enamel rod patterns<sup>5</sup>

Acid etching, recording patterns, peel technique and automated biometrics are employs for the study of enamel rod-end patterns in amelogyphics. They are used as sequential steps for individual identification.

### Acid Etching<sup>5</sup>

Acid etching removes the mineral component on the surface enamel. It also removes smear layer from enamel surface as well as results in uneven dissolution of surface of enamel.

Etchants used for acid etching are 10% citric acid, 10% phosphoric acid, 10% maleic acid, 2.5% oxalic acid, 2.5% nitric acid, 10% orthophosphoric acid. Most regularly used acid to etch enamel for studies is gel form of 10% orthophosphoric acid. The morphological nature changes in the angulation of the prism crystals because the demineralization is selective at certain microregions. Demineralization varies as it depends on the angulation of rods, it can be greater at the prism head or at the periphery.

Patterns can be classified into two types:

1. Type 1- Honeycomb patterns because of principal dissolution of prism cores
2. Type 2- Cobble stone appearance because of principal dissolution of prism peripheries

Other patterns which are less familiar and are noted to a lesser extent are:

- a. Mix of type 1 and 2
- b. Pitted enamel surface as well as structures that look like unfinished puzzle
- c. Flat, smooth surface

Effect of etching of enamel depends on different factors such as type of acid used, acid concentration, etching time, etchant form, rinse time, whether enamel is instrumented prior to etching, chemical composition and conditions of enamel. Fine differences in features of enamel and effect on ability of acid conditioner to correctly demineralize are caused by surface instrumentation, age of patient and external pattern.

### Recording of enamel rod-end patterns<sup>5</sup>

Copying of enamel rod endings on tooth surface using proper material for reproducing complete and accurate enamel rod-end patterns is one of the chief steps for obtaining a tooth print for individual identification in amelogyphics. Cellulose acetate film, cellophane tape, light body impression compound or metal shadowed colloid ion film core used for recording and duplication of enamel rod patterns of enamel surface.

### Peel technique<sup>5</sup>

Peel technique includes use of cellulose acetate film. Cellulose acetate film records complete patterns and subpatterns of the enamel rods more accurately as compared to cellophane tape and light body rubber-base impression compound. Therefore, cellulose acetate film is considered as a conclusive material for recording enamel rod ending on the superficial tooth surface for individual identification. There are no empty spaces or incomplete patterns seen in the records. There is no difference in minute points and scores in subsequent imprints taken from the same area of the same tooth. This method reproduces the same pattern and subpatterns in consequent marks taken from the same area of the same tooth.

Duplication of an acid-etched mineral surface, taken on acetate film is known as *peel*. Peeling is easier to do and is of low cost way of making duplications of hard tissue surfaces.

Cellulose acetate film is unable to adapt properly on the irregular tooth surface this makes peel technique more complicated for recording enamel rod-end patterns on the surface of complete teeth, this is a drawback of the peel technique.

### Automated biometric analysis<sup>5,6</sup>

Biometrics is the individual's behavioral or physiological features and they are the key and important methods used for identification and verification. Fingerprints identification is the most popular biometric technique used. Automated systems and software tools have the capacity to distinguish individuals reliably and they refine fingerprints recognition, facial recognition and iris scanning.

For peculiarly verifying an individual by depending on biometric data it should be-

1. Highly peculiar to each individual
2. Easily achievable
3. Should not undergo any significant change over a period of time
4. Easily transmittable
5. Easily distinguishable by untrained person

Each tooth of an individual has unique enamel rod-end patterns, this makes the biometric analysis of tooth a reliable supplement for identification of a individual. It is a simple method and cheap as well as speedy.

### Conclusion

Bodies of victimized individuals are decomposed in mass disasters and only small particles of calcified tissues are obtained. Finger prints, DNA analysis, dental patterns and other methods of forensics are not functional for individual recognition in these circumstances. Teeth are indestructible in extreme temperatures and in decomposition, this makes them most dependable evidence for verification of individual. The peculiarity of teeth makes them popular and reliable in forensic Odontology. But as other identification methods Amelogyphics also have some limitations as the value of enamel rod-end patterns as a forensic tool depends on reproduction and permanency. Therefore, further studies are required for making forensic Odontology much more better.

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### Conflict of interest

None.

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