Pitfalls in Forensic Odontology

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Abstract :

Forensic odontology or forensic dentistry has generated so much interest in the recent past that it has been suggested an important method in solving forensic cases in mass disaster, child abuse, bite mark analysis, crime/natural death, injuries and bio-terrorism. Commonly used methods in forensic odontology include Rugoscopy, Chieloscopy, Bite marks, Tooth prints (Ameloglyphics), Radiographs, Photographic study and Molecular method.

However there are certain pitfalls associated with the above methods in forensic odontology, which are to be weighed cautiously to make forensic odontology a more accurate, reliable and reproducible investigatory science.

In this paper we present our understanding of the limitations/ boundaries in various method employed in forensic odontology

Introduction

Forensic Odontology or forensic dentistry deals with proper handling, examination and proper evaluation of dental evidence, which will be then presented in the interest of justice. There have been many cases throughout history which have made forensic dentistry a important tool like, in mass disasters(terrorist attack ,earth quakes ,tsunami),child/elder/spouse abuse, bite mark analysis, criminal/natural death, injuries and bio-terrorism. It also helps in identification of decomposed and charred bodies like that of drowned persons, burns and victims of motor vehicle accidents. This is done using dental records including radiographs, ante-mortem and post-mortem photographs and DNA. Forensic odontology covers a wide variety of topics including bite mark analysis, tooth prints, rugoscopy, chieloscopy, dental DNA analysis, radiographs and photographic study. These various identification methods commonly fails or have certain pit falls and may not be efficient, the discrepancies associated with them must be scrutinized to make forensic Odontology more accurate, reliable and reproducible investigatory science. In this paper, the pit falls of various methods employed in forensic Odontology are highlighted.

2. Examination of Bite Marks

The science of identification of bite mark is relatively new in the field of forensic investigation and can be used to link a suspect to a crime. Bite can be defined as the mark made by human or animal teeth in the skin of alive people or cadavers with relatively softened consistence[1].Bite mark depending upon the crime or circumstances are impressions left on skin, food or other items left at a scene. Bite marks are circular or ovoid areas of abrasion or contusions; it may be composed of two U-shaped arches. The diameter of injury typically ranges from 25-40mm and often a bruise can be seen at the center. An analysis of bite mark can be done by pouring plaster casts of the teeth of the suspect after which it is matched by a life size photograph of the bite mark. The identification of perpetrator can also be done by the determination of ABO blood groups from the saliva on the bite mark, and linking bacteria and other micro-organism[2].

The pit falls encountered in recording bite marks are however many. According to Devore[3],Barbenel and Evans[4] skin is not a good medium for dental impressions which are liable for irregularities that could cause distortion. Also the bite marks can be altered through stretching, movements or a changing environment during and after the actual bite. Studies suggested that for the bite mark to be accurately analyzed, the body must be examined exactly in the same position it was in when the bite occurred which can be difficult to accomplish[5]. Incomplete bite marks are not conclusive and minimum of 4-5 teeth have to be present for reliable bite mark analysis[2]. Due to inherent alteration, the shape and clarity of bite marks found on the skin may change in short duration (10-20min). Bite marks are associated with hemorrhage and post injury edema, which can alter bite mark analysis.

` Bite mark analysis is also controversial because dental profile are subject to change, such as dental caries has shown to alter the arch and tooth configuration and must be taken into account when comparing a dental profile to the bite mark after significant amount of time has passed since the mark was made.

There have been several instances where bite marks evaluation had been proven incorrect through forensic sciences[6]. DNA analysis had shed some light on the limitations of bite mark analysis because the DNA from saliva, surrounding the area of the bite marks proves to be a more reliable form of identification like in the case where, the defendant was sentenced to death, which was found innocent after DNA analysis[7,8]

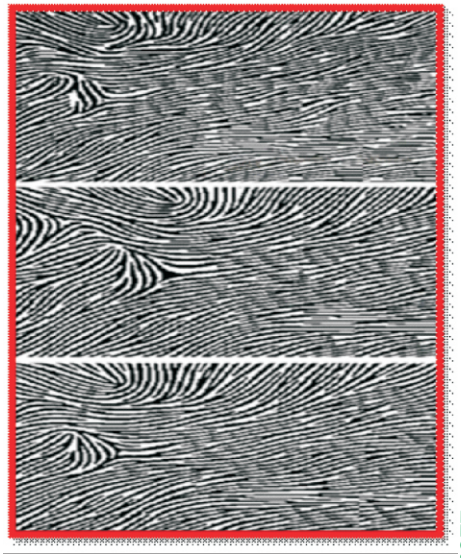
3. Examination of Lip Prints (Chieloscopy)

Lip prints are normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of human lip , between the inner labial mucosa, examination of which is known as chieloscopy[9]. Lip prints can be obtained at the crime scene from clothing, cups glasses, cigarettes, windows and doors. The various pattern identified include vertical, intersected, branched, reticular and undetermined. The anatomical landmark of the lip include chielion, stomion, labrale superius and labrale inferius. Various factors can alter lip prints recording. The lip prints which have to be study were only those which had no inflammatory disease or trauma. Lip prints have to be obtained within 24 hrs of the time of death to prevent the lip marks[9,10] Any pathology of lip such as mucocoel or any post surgical alteration of the lip can change the lip print pattern. Any debris or fluid on the lip surface, application of a thick layer of lipstick or over stretching of cellophane tape can alter lip print recording[11]. when the lines are not clear, individual identification based on these trace is extremely difficult unless the trace contains some individual characteristic like scars, cleft. The main feature for dental identification is the existence of ante mortem data which cannot be expected in chieloscopy. Therefore, the only use of chieloscopy will be, to relate lip prints to the lips that produce them.

4. Examination of Tooth Prints (Amelo-glyphics)

'Ameloglyphics', meaning the study of patterns of enamel rods (amelo meaning enamel; glyphics meaning carvings)[12]. Formation of enamel is a highly organized process in which the ameloblasts lay down the enamel rods in an undulating and inter-twining path. This is reflected on the outer surface of the enamel as patterns of the ends of a series of adjacent enamel rods..

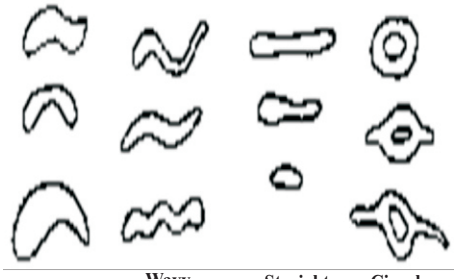
This study needs antemortem records. Enamel is the hardest substance in the body, the enamel surface is subject to both micro and macro-wearing. Teeth with decay, attrition, abrasion, erosion, hypoplasia, fracture and/ or restorations are not selected for tooth prints. The enamel rods do not traverse the whole length of enamel in a straight path instead, they traverse in undulating and inter-twining path which has been attributed to high tensile strength of enamel and appearance of gnarled enamel and Hunter-Schreger bands. So, the course of enamel rods is not the same throughout the thickness of enamel[13]. Ameloglyphics is still in its infancy and whether the tooth prints are the same at different depths of enamel has to be further evaluated.



5. Study of Palatal Rugae (Rugoscopy)

The study of the patterns of the grooves and ridges (rugae) of the palate to identify individual patterns is called as Rugoscopy. Palatal rugae comprises of 3 to 7 ridges on the anterior part of the palatal mucosa, each side of the median palatal raphae and behind the incisive papilla. The shapes of individual rugae were classified into 4 major types-curved, wavy, straight & circular.

The pit falls in applying rugoscopy in forensic Odontology are many. Postmortem identification is not possible without the antemortem records. Hauser et al. [14] have suggested that mean rugae count changes moderately in adolescence, then increases markedly from the age of 35 to 40 years. In contrast, Lysell[15] considered that the number of rugae decreased from 23 years of age onwards. Kapali et al. [16] have observed that denture wear, tooth malposition, and palatal pathology can cause alterations in rugae pattern. However, some events can contribute to changes in rugae pattern, including trauma, extreme finger sucking in infancy, and persistent pressure with orthodontic treatment and dentures[14].Palatal rugae are often destroyed in fire accident cases and in those cases of decomposition and thus rugoscopy does not have application after this stipulated period.



6. Radiographs

Various morphological and pathological alterations can be studied from the radiographs. Apart from routine findings, like decayed, missed, filled and fractured teeth, various stages of wound healing in extraction socket, degree of root formation, and bone trabecular pattern in the jaws aid in identification.

The utilizatiom of radiographs in identification is valuable if sufficient antemortem records are available, but in our country antemortem records are scant and incomplete .The transformation of dentition from deciduous to permanent set can always mislead. Inherent poor image quality is one of the most anticipated drawbacks. There are difficulties in matching the viewing angles (identical projection, angulation), exposure and similar magnification in postmortem radiographs to those taken antemortem.[17]

7. Photographs

Forensic photography, sometimes referred to as forensic imaging or crime scene photography, is the art of producing an accurate reproduction of a crime scene or an accident scene using photography for the benefit of a court or to aid in an investigation. It is part of the process of evidence collecting. It provides investigators with photos of victims, places and items involved in the crime.

However, photographs have considerable inherent limitations. The utilizatiom of radiographs in identification is valuable if sufficient antemortem records are available. The basic problem arises when three dimensional objects are replicated as two dimensional photographs, which can create distortion an d color change. French photographer, Alphonse Bertillon was the first to realize that photographs were futile for identification if they were not standardized by using the same lighting, scale and angles[17]. Camera orientation, close-up capability and stability are extremely critical factors while taking photographs. Sometimes photographs are associated with parallax error.A camera support such as a tripod should positioned the camera perpendicularly to the long axis of the region[2]. Photographs should be produced without a scale may be inherently inaccurate. small plastic rulers are subject to certain extent of inaccuracy and ABFO scale no.2 is designated as a standard scale[18].

8. Molecular Methods

Molecular methods in forensic dentistry offers a new tool when traditional identification methods fails due to the effect of heat, trauma, as well as in distortions and difficulties in analysis[19]. Molecular method utilize DNA for easy identification. Polymerase Chain Reaction is an enzymatic amplification of a specific DNA sequence, aiming millions of copies production from this sequence in a test tube. The method using PCR enables the distinction of a subject among the other ones with a high level of reliability, starting by 1ng (nanogram), equivalent to a single part in a billion grams, of the DNA target[20]

However this new technique has its own limitations. Errors may develop in sample collection, processing and interpretation. While processing too little amount of DNA can produce less intense bands which can cause misinterpretation of results[18]. Unfortunately, severely degraded DNA samples could contain only very short DNA template molecules making conventional STR typing unsuccessful[21].

9. Conclusion

Though forensic odontology has achieved giant strides in recent times, various techniques utilized in forensic odontology are bound by certain limitations which should be kept in mind when answering queries in the court of law, because an improper conclusion can alter and shatter the dreams and lives of alleged accused".

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