© 2016 IJSRST | Volume 2 | Issue 6 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

The Role of Ante-Mortem Records of Palatal Rugae in Disaster Victim Identification (DVI)

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ABSTRACT

The aim of this paper is to highlight the significance of palatal rugae in forensic identification, especially in DVI and need for generating awareness drive among the dental practitioners and people, to adopt the norm of creating and maintaining ante-mortem record of palatal rugae to be effectively used in the process of Forensic personal Identification.

Background: Establishing the unknown person's identity is one of the major objectives of forensic sciences. Especially in case of decomposed, mutilated, severely burnt bodies, which are now routinely encountered in ever increasing mass disaster episodes; multi-pronged strategy is required to overcome this challenge. Various anthropologic techniques, comparisons of fingerprints and of DNA are most used. In certain cases, however, when these techniques cannot be applied, it is necessary to apply alternate, less known but reliable techniques. It is well established fact that Palatal Rugae possess the features of an ideal forensic identification parameter, that is, uniqueness, post-mortem resistance, and stability. They are considered equivalent to the fingerprint, for their uniqueness of pattern.

Conclusion : Palatal rugae are very significant in forensic personal identification and can be very effectively used if Ante- Mortem records are available for comparison. Generating its keen awareness among the dental practitioners and people is 'need of an hour'.

Keywords : Palatal Rugae, Forensic Personal Identification, Ante- Mortem Records, Awareness Drive

I. INTRODUCTION

Over the past few decades as the technology has progressed by leaps and bounds and has revolutionized almost each aspect of our life- where we live, what and how we eat, drink, exercise, sleep, recreate, travel, suffer, and die; so have the crimes and disasters- natural or manmade. Technology has kept its promise of supersonic speed and pan global span- be it life or death. Airplane crashes- accidental or deliberate, high rise buildings collapses, conventional or suicide bombings, stampedes, flash floods, cyclones, tsunamis, and so on ensure that 'fast and furious' death reaches larger population.

As the death of human being is the matter of vital concern to civilized society, identity of each dead person must be recorded[11] and cause of death must be certified by a licensed physician. Each obscure, un- natural death calls for further investigation. Establishing the unknown person's identity is one of the major objectives of forensic sciences. Especially in case of decomposed, mutilated, severely burnt bodies, which are now routinely encountered in ever increasing mass disaster episodes; multi-pronged strategy is required to overcome this challenge.

Forensic sciences leave no stone unturned to get clinching evidence that can establish positive identification of the deceased. Quest continues to discover new parameters and to develop new techniques for this purpose.

II. METHODS AND MATERIAL

A. Need for Identification of Deceased Individual

In civilised society, establishing and recording of the identity of the deceased, cause of death are of paramount importance for the following reasons[11]:

i) Criminal- Typically an investigation to a criminal death cannot begin until the victim has been positively identified.

ii) Marriage- Individuals from many religious backgrounds cannot remarry unless their partners are confirmed deceased.
iii) Monetary- The payment of pensions, life assurance and other benefits relies upon positive confirmation of death.
iv) Burial/ Cremation- Many religions require that a positive identification be made prior to burial/ cremation in geographical sites.
v) Social- Society's duty to preserve human rights and dignity beyond life begins with the basic premise of an identity.
vi) Closure- The identification of individuals missing for prolonged periods can bring sorrowful relief to family members.

B. Challenges Posed To DVI (Disaster Victim Identification)

Establishing the identity of unknown human dead body has always been a challenge faced by the investigative agencies, more so in DVI (Disaster Victim Identification) cases, due to :

i) Large number of dead bodies.
ii) Mutilated, burnt, decomposed bodies beyond recognition.
iii) Destruction of infrastructure and basic support system.
iv) Disruption of law and order.
v) Requirement of intensive, collaborative efforts by multi-professional experts.
vi) Alarming increase in mass disasters over last few decades.
vii) Ill equipped insufficient preparedness for disaster management.
viii) Very poor awareness among people regarding maintaining ante- mortem records.

The Indian Ocean tsunami of 26 December 2004 created unprecedented challenges for forensic identification of dead bodies. Epicentre in the Indian ocean of 9.0 Richter magnitude quake was at North West of the Indonesia's Sumatra Island with a series of after shock waves. The tidal waves reached 6 provinces in the west coast of southern Thailand, leaving 5395 dead, 8457 injured and 2991 missing, 1.895 bodies were waiting for identification for 6 months (Thailand National Police Office Report, June 9, 2005, Personal Identification Center Report, June 29, 2005). The complete examination was conducted by a team of trained and experienced forensic experts.[4]

Dr. Siribang-on Pibooniyom, from the Department of Hospital Dentistry, Thailand, described the power of tsunami- in his own words[27]

"In the simple puncture wounds we found, a small hole was visible on the outside, but when opened up, sand and debris had gone throughout the entire length of that part of the body. Such was the nature of the contamination due to the tremendous force generated by that giant destructive wave."

He also highlighted the challenges in DVI - "Many of the victims of the devastating tsunami had no dental records or recorded fingerprints and DNA samples didn't work in many of these instances due to the contamination by seawater."

C. India, Disasters Timeline[28]

Following is the list representing few of the disasters that struck various parts of India from year 2010 to 2013. Increase in frequency can easily be noted.

2013	10/29- Andhra Pradesh- India bus fire kills 45
	10/14- India relieved at low cyclone death toll-21 killed
	10/13 -Many dead in India temple stampede- 89 killed
	10/12 -Huge cyclone batters eastern India
	09/26- Dozens feared trapped in Mumbai building collapse
	08/18 -India express train kills people crossing track- 12 killed
	08/13 -Indian submarine hit by explosion- 18 killed
	07/16 -Bihar- School meal kills 22 in India
	06/21- Death toll in Uttarakhand 'flooding – 500killed
	04/05 -Mumbai building collapse toll rises- 60 killed
2012	11/01 -Cyclone tears into south Indian coast
	07/29- Deadly fire strikes Indian train- 47 killed
2011	12/08 -At least 89 died in fire in Calcutta

	hospital fire
	09/18 -16 dead in India, Nepal after 6.9 quake
	01/14 -Stampede kills 100
2010	07/18- At least 45 dead in train collision
	05/27 -100 dead after 'sabotage' derails train
	05/21 Plane crash leaves about 160 dead

D. Forensic Identification Parameters

The ideal forensic identification parameter should have following features:

a. Individuality/ Uniqueness- the parameter should provide unique feature for each individual. No two individual should possess identical features.
b. Stability- the parameter should maintain its pattern stability throughout the life span of the individual.
c. Post- mortem resistance to change- it should remain unchanged over significant period of time even after death of the individual.
d. Duplication- it should be impossible to duplicate it by any means in other individual.
e. Alteration- it should be impossible to alter it to take on any other form by any means.
f. Recordable- it should be convenient, economical and socially acceptable to create and maintain its record.

Various anthropologic techniques, comparisons of ante-mortem and post mortem records of fingerprints, dental profile, and DNA are most used parameters to establish the identity of the deceased. In certain cases, however, when these techniques cannot be applied, it is necessary to apply alternate, less known but reliable techniques, such as palatal rugoscopy (study of palatal rugae pattern).

III. RESULT AND DISCUSSION

A. Comparison of Various Forensic Identification Parameters

CRITERIA	FINGERPRINTS	DNA	DENTITION	PALATAL RUGAE
Uniqueness/ Individuality	Unique	Unique	Unique	Unique
Stability (Permanency of the pattern throughout the life and after death)	Excellent	Excellent	Changes with age, and other factors (diseases, trauma)	Excellent
Post-Mortem resistance	Good	Excellent	Excellent	Good
Duplication in other individual	Not Possible	Not Possible, except in monozygotic twins	Not Possible	Not Possible
Alteration	Not Possible	Not Possible	Possible by various treatments	Not Possible
Ease of recording	Easy	Complex	Easy	Easy
Cost of recording	Low	High	Moderate, (cumulative cost is high due to need for updating after each change)	Moderate
Advantages	Highly reliable,	Highly	Highly reliable when upgraded	Reliable,

	well established and validated over a century	reliable, and validated	ante-mortem records are available, well established and validated	Significant in limbless, burnt bodies
Limitations	Limbless bodies, highly decomposed, or severely burnt bodies	Contamination in decomposed, putrefied bodies Expensive and time consuming	Frequent changes due to eruption, attrition, caries, periodontal diseases, extractions and cosmetic modifications Need for updating of records	Not well established. Very low level of awareness among dentists and other people about its significance.

B. Significance Of Palatal Rugae in Forensic Identification

Transverse palatine folds or palatal rugae are asymmetrical and irregular elevations of the mucosa located in the anterior third of the palate, made from the lateral membrane of the incisive papilla, arranged in more or less transverse direction from palatine raphe located in the mid-sagittal plane. The palatal rugae appear towards the third month of intrauterine life, from the covering connective tissue in the palatine process of maxillary bone, and its development and growth is mutually controlled by epithelial-mesenchymal interactions[12].

Palatal rugae, due to their internal position, are protected from trauma and high temperatures by lips, cheek, tongue and buccal pad of fat teeth and bone and do not demonstrate age related changes. Rugae are not markedly affected in fire survivors by the intensity of the fire and has the ability to resist decomposition changes for up to seven days after death under ideal conditions of storage in mortuary[19].

Palatal rugae pattern is proved to remain stable even after different orthodontic treatments[9], involving extraction and non-extraction methods[4,] and use of headgear[3] that change teeth alignment.

Rugoscopy has proven to be a reliable identification method for patients who were submitted to rapid palatal expansion, because even in the presence of intra-oral changes owing to the use of palatal expanders, the palatine rugae retained the biological and technical requirements for the human identification process[7].

It is well established fact that Palatal Rugae possess the features of an ideal forensic identification parameter, that is, uniqueness[6,14], post-mortem resistance[19], and stability[6]. They are considered equivalent to the fingerprint, for their uniqueness of pattern. In spite of these merits, rugae have not often been used as a widespread forensic tool due to lack of awareness among dental practitioners and general public, regarding its significance in forensic identification.

C. Awareness Drive

Disaster management is not the sole responsibility of the Governments. It is responsibility of each individual. Disasters have become part of life. Insurance companies and Government agencies have created awareness among people to get their life, belongings insured, against any eventuality. Legal experts have created awareness among people regarding making their wills. Medical faculty and Government agencies have created awareness among people regarding immunization (e.g. polio), screening tests for various diseases (e.g. cancer), or preservation of stem cells, consumer forums have created awareness drive regarding rights of consumers.

Similarly, it is need of the hour that the forensic experts launch the awareness drive among people regarding the significance of creating and maintaining their various individual ante- mortem records, such as fingerprints, palatal rugae, and DNA profile.

Availability of good quality Anti- Mortem record will certainly play crucial role in Disaster management as follows

i) It will save great amount of efforts, time and money of the investigating agencies by speeding up identification process.
ii) Thus, it will enable quick disposal of the dead bodies.
iii) That will drastically reduce burden of huge resources required to preserve the unclaimed/ unidentified bodies.
iv) That will help control post disaster epidemics.
v) It will increase overall efficiency of the disaster management team.
vi) It will have far reaching positive social impact.

Ante- mortem record of palatal rugae in the form of dental stone cast has many advantages

i) It is easy to make, non-invasive technique.
ii) It is economical- costs well below Rs. 50/- per dental stone cast which is one time cost unlike dentition records which need to be updated with every alteration in dental status after restorations, extractions or orthodontic treatment; or unlike DNA profile which is expensive.
iii) It is tangible, permanent record. The stone cast is dimensionally very stable, considerably moisture, heat/ fire resistant, and wear and tear resistant.
iv) It requires small storage space and ordinary storage conditions, thus very convenient to store.
v) It can be easily use for digitalization of data for the future use.

IV. CONCLUSION

Establishing identity of unknown dead body is a challenging task in itself. When such body is highly decomposed, burnt, or mutilated beyond recognition, intensive collaborative efforts from multi profession experts are required to attain the goal. The situation is worsened when the experts are confronted with the load of mutilated bodies or only remnants, as in cases of mass disasters. As the magnitude and frequency of the disasters is observed to be increasing over past few decades, every effort must be made to be better equipped to manage the fallout of such disasters. Although better methods and sophisticated techniques are being developed to tackle the issue of Disaster Victim Identification, they suffer the handicap if one of the most fundamental principles of forensic sciences- 'Law of Comparison-Only likes can be compared' is not diligently followed. Thus, reliable Ante-Mortem record is indispensible. Fingerprints have been and still continue to be real 'stalwart' for forensic identification; however the Disaster Era demands more. DNA profile has great promise, but also has its own limitations such as contamination and high cost. Palatal rugae pattern offers great promise of being ideal forensic identification parameter owing to its uniqueness, stability, post-mortem resistance to change, ease and cost effectiveness of making ante-mortem and post-mortem records and convenience of storing and comparison.

Forensic experts/ odontologists must consider it as their professional duty to create awareness drive among dental practitioners and general public regarding the significance of the palatal rugae in forensic identification and creating and maintaining ante-mortem records.

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