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Palatal Rugae in Forensic Odontology –---A Review

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Abstract: *Establish a person's identity can be a very complex process, one of the main objectives of the forensic sciences. It is widely acknowledged that in some forensic situations there are limitations to identification of the deceased by fingerprints, DNA and dental records. Palatoscopy or palatal rugoscopy is the study of palatal rugae in order to establish a person's identity. Palatal rugae pattern of an individual may be considered as a useful adjunct for sex determination for identification purposes. This paper will provide a review on palatal rugae and its applications in forensic dentistry.*

Keywords: *Palatal rugae, Rugoscopy, Human identification*

I. Introduction

Forensic Odontology is a specialty in dentistry which occupies a primary niche within the total spectrum of methods applied to medico-legal identification. Forensic odontology can be defined as a branch of dentistry which deals with the appropriate handling and examination of dental evidence and with the proper evaluation and presentation of dental findings in the interest of justice[1].

Identification of an individual is a prerequisite for certification of death and for personal, social and legal reasons. Human identification is a mainstay of civilization, whether in living or dead, and the identification of unknown individual has always been of paramount importance to our society. Human identification is based on scientific principles mainly involving fingerprints, dental records and DNA analysis. Limitations to the use of fingerprints occur in situations where the hands are charred or mutilated.

Sometimes, it becomes necessary to apply a lesser known and unusual technique like palatoscopy. Palatoscopy or palatal rugoscopy is the name given to the study of palatal rugae in order to establish a person's identity. Palatal rugae are irregular, asymmetric ridges of mucous membrane extending lateral from the incisive papilla and the anterior part of the median palatal raphe, which is just behind the maxillary central incisor teeth[2]. In the literature there is consensus opinion that palatal rugae remains fairly stable in number and do not undergo any change due to growth, ageing, tooth extraction and disease[3].

II. Historical background

Winslow (1732) described palatal rugae as a permanent feature on the hard palate.

Santorini (1775) in Tabula VII of his septemdecimtabulae, depicted a drawing of three continuous wavy lines, which crosses the palate. In 1889 Harrison Allen first suggested the use of palatal rugae as an alternative method of identification. Gloria (1911) defined rugae as a ridge extending to atleast one half the distances from the median palatal raphe to the dental arch. Ritter.R(1943) even between twins, the studies indicated that the patterns are similar but not identical.

III. Embryology

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, where specific extracellular matrix molecules are spatiotemporally expressed during development (Amasakiet al.,2003).

The first rugae is distinguished in human embryos of 32 mm CRL (Butchtováet al., 2003) next to the incisive papilla. Then, in the prenatal stage are relatively prominent (Gegenbaur, 1878, Waterman &Meller, 1974), the PR at birth are well trained with a typical orientation pattern (Gegenbauer) and adolescence acquire the final feature shape of each individual (Yamazaki, 1962). Once they are formed may experience changes in their size due to growth of the palate, but its shape is maintained (Jordanov, 1971, Lang &Baumeister, 1984).

IV. Definition

According to the Glossary of Prosthodontic Terms-8, Rugae are anatomical folds or wrinkles (usually used in the plural sense); the irregular fibrous connective tissue located on the anterior third of the palate[4]. They are also called "plicapalatinae" or "rugae palatine."

V. Classification

The firstsystem of classification was developed by Gloria in 1911 and the rugae pattern is categorized in to 2 ways. Specifying the number of rugae and extend of rugae relative to teeth. He further distinguished two types of rugae namely simple or primitive and more developed[5].

I. Lysell classification:

Depend on length palatal rugae[6] classified into

- Primary rugae - length of more than 5 mm
- Secondary rugae - length between 3-5 mm,
- Fragmentary rugae -length between2-3 mm.

Smaller than 2mm in length are discarded

II. Lima classification[7] (1968)

He classified rugae into 4 main types

- Punctuate
- Straight
- Curved
- Composite

III. Carrea(1955) [8]classification:

Depending on direction, he classified palatal rugae into 4 main types.

- Type I - Posterior –anterior directed rugae
- Type II - Rugae perpendicular to raphe
- Type III - Anterior –posterior directed rugae
- Type-IV - Rugae directed in several direction

IV. Trobo classification:

Palatal rugae classified into 2 types[9]

- Simple - Rugae shapes are well defined, and further subdivided into A,B,C,D,E,F
- Compound-Rugae were formed by union of two or more simple rugae and classified as type X

Classification	Rugae type	Shape
TYPE A	Point	
TYPE B	Line	
TYPE C	Curve	
TYPE D	Angle	
TYPE E	Sinuous	
TYPE F	Circle	

V. Kapali et al classification:

The rugae were divided into 4 types based on their shape[10] as:

- Curved - They had a crescent shape and curved gently.
- Wavy -If there was a slight curve at the origin or termination of curved rugae.
- Straight -They run directly from their origin to termination.

Circular- Rugae that form a definite continuous ring were classified as circular.

VI. Basuri classification[8]:

It distinguishes between all primary rugae , which is more anterior one(labelled as letters) and accessory rugae(labeled as numbers) (figure 1)

Primary rugae Classification	Accessory rugae classification	Rugae anatomy
Type A	1	Point
Type B	2	Line
Type C	3	Curve
Type D	4	Angle
Type E	5	Sinuous
Type F	6	Circle
Type X	7	Polymorphic

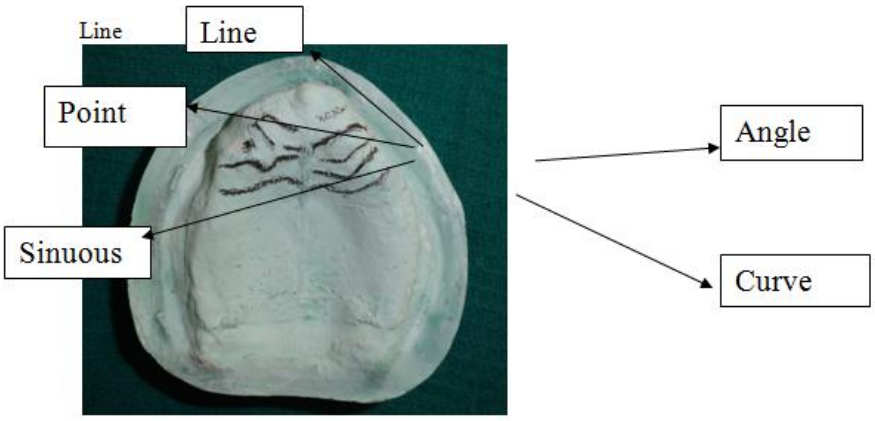

Figure 1 Rugae anatomy

VII. Thomas and kotze classification[5]:

1. Rugae dimension and prevalence:

- Length - determined according to latest rugae dimension and is classified as primary, secondary or fragmentary rugae
- Prevalence- rugae is determined by counting and recording the number in each category(primary, secondary and fragmentary) and not the total number on each side.
- Area – determination of the surface area of the primary rugae.

2. Primary rugae details:

Can be described as annular, papillary,crosslink, branches, unification, breaks, unification with non primaryrugae.

3. Rugae pattern dimensions:

- Distance between most anterior point on incisive papilla and most anterior point on rugae pattern regardless of the side.
- Distance between incisive papilla to posterior border of last primary or secondary rugae
- Distance between incisive papilla to the posterior border of last rugae

4. Angle of divergence:

- Measured in degree between the line formed by the medial palatal raphe and line joining incisive papilla with the origin of most primary or secondary rugae on one side of palate.

5. Dental arch and palate dimensions:

- Width- line joining the mesio-palatal cusp of permanent maxillary first molar or deciduous second molar is used to project a point below and perpendicular to it on the gingival margin to determine the width.
- Depth – point below and perpendicular to line joining the tips of mesiopalatal cusp of permanent maxillary first molar or deciduous second molar on the midpalatal raphe is used to determine the depth.
- Center – perpendicular distance between the line joining the tips of mesiopalatal cusp of permanent maxillary first molar or deciduous second molar and the point on midpalatal raphe determines the center.

Palatal rugae have been shown to be highly individual and consistent in shape throughout life[11, 12]. The anatomical position of the rugae inside the oral cavity (surrounded by cheek, lips, tongue and the buccal pad of fat) also give some protection in cases of trauma or incineration. When identification of an individual by other methods is difficult, palatal rugae may thus be considered as an alternative source of information (usually if comparative material is available) enabling the search field to be narrowed.

It is assumed that the rugae facilitate food transport through the oral cavity, prevent loss of food from the mouth, and participate in food crushing. Because of the presence of tactile and gustatory receptors, rugae contribute to perception of taste, mechanical food qualities, and tongue position[13]and also participated in speech and in the suction in children (Thomas et al., 1987).

Despite being protected by their internal position within the head, some events can contribute to changes in rugae pattern, including trauma, extreme finger sucking in infancy and persistent pressure with orthodontic treatment and dentures. In one study, it has been reported that no two palates are alike in their configuration (figure 2a & 2b) and that the palatal print did not change with time or age. Even between twins, the studies indicated that the patterns are similar but not identical[14].

Figure 2a palatal rugae not identical with figure 2b

There are different ways to analyze the palatal rugae. Intraoral inspection is probably the most used and most easy, economic method. However, this can create difficulties if a future comparative review is required. A more detailed and accurate and the need to preserve evidence may justify the use of photographs or impressions (Utsunoet al.2005). While observing the shape of the rugae is a subjective process, it is relatively easy to record and does not require complex instrumentation.

Lorton (1988) describes in detail about CAPMI (computer assisted post-mortem identification system) software. It has the advandages of simplification of data management, easy of learning the program, online help and physical characteristics and free availability of the program. Currently, the principal computer programs are CAPMI4 and WinID2.Limsons and Julian[15], who compared some points of the rugae patternsusing computer software, reported that the percentage of correct matches ranged from 92 to 97% based on four computer operators.

Only one study on palatal rugae pattern in two different populations of India has been performed by Nayaket al[16] who reported lack of sex dimorphism in their sample. Maki Ohtaniet al[17] explored the accuracy of using the palatal rugae pattern in forensic practice for personal identification in edentulous cases, and suggested 94% correct matches. Kapaliet al[10] in their study did not reveal any significant differences in the number of primary rugae between Australian Aboriginal males and females. However, Dohke and Osato[18] indicated that among the Japanese, the females had fewer rugae than males. According to muthusubramaniamet al[19], palatal rugae are stable anatomic landmarks that resist changes in burnt victims and in cadavers normally up to a period of 7 days. Palatal rugae can be used as an effective forensic aid in identification process. Identification process beyond 7 days requires proper storage of cadavers in the mortuary.

VI. Conclusion:

The palatal rugae are very important in dental and forensic practice. Also it can be used to evaluate the dental movements, as they remain stable over a person's life. In addition, show a significant association between shapes and ethnicity. Finally, the palatal rugae can be used as reliable guide to the forensic identification.

References:

[1]. Dayal PK. Textbook of Forensic Odontology. 1st edn.Paras Medical Publishers, 1998.
[2]. Paliwal A.,Wanjari S. and Parwani R., Palatal rugoscopy,Establishing identity, J Forensic Dent Sci.,2(1), 27-31 (2010)
[3]. Buchner A., The identification of human remains, Int Dent J, 35, 307- 11 (1985)
[4]. Caldas IM., Magalhães T. and Afonso A., Establishing identity using cheiloscopy and palatoscopy, Forensic Sci.Int., 165(1), 1-9 (2007)
[5]. The Academy of Prosthodontics. The Glossary of Prosthodontic Terms.8th edn. CV Mosby, 2005
[6]. patil MS, patil SB, Acharya AB. Palatal rugae and their significance in clinical dentistry: a review of literature J Am Dent Assoc 2008; 139: 1471-78
[7]. Bullar A, Kaur RP, Kamat MS palatal rugae; an aid in clinical dentistry. J Forensic Res 2011; 2(3): doi :10 . 4172/2157-7145. 1000124
[8]. Lima OC, RugoscopiaRevistaBrailiera de Medicine 25: 806-7, 1968
[9]. Caldas IM, Magalhaes T, Afonso A. establishing identity using cheiloscopy and palatalscopy. Forensic SciInt 2007; 165:1-9
[10]. Hermosilla VV, San pedro VJ, Cantin IM, Suazo GIC, Palatal rugae: systematic analysis of its shape and dimensions for use in human identification. Int J Morphol 2009; 27: 819-25
[11]. Kapali S, Townsend G, Richards L, Parish T. palatal rugae patterns in Australian aborigines and Caucasians. Australian dent J: 1997:42:129-33
[12]. Lysell L. Plicapalatinaetransversae and papilla incisive in man: a morphological and genetic study.ActaOdontolScand1955; 13:5-137.
[13]. Thomas CJ, Kotze T. The palatal ruga pattern: a new classification. J Dent Assoc S Afr1983; 38:153-7.
[14]. Buchtova M, Tichy F, Putnova I, Misek I. The development of palatal rugae in the European pine vole, Microtussubterraneus(Arvicolidae, Rodentia).Folia Zool2003;52:127-36.
[15]. Ritter R. Z MorpholAnthropol 1943;40:367-72. Cited in Hauser A, Daponte A, Roberts TS. Palatal rugae.J Anat1989;165:237-49.
[16]. Limson KS, Julian R. Computerized recording of the palatal rugae pattern and an evaluation of its application in forensic identification. J Forensic Odontostomatol 2004; **22**: 1-4.
[17]. Nayak P, Acharya A, Padmini A, Kaveri H. Differences in the palatal rugae shape in two populations of India. Arch Oral Biol2007;52: 977–82.
[18]. Ohtani M, Nishida N, Chiba T, Fukuda M, Miyamoto Y, Yoshioka N. Indication and limitations of using palatal rugae for personal identification in edentulous cases. Forensic SciInt2008; **176**: 178-82.
[19]. Dohke M, Osato S. Morphological study of the palatal rugae in Japanese 1. Bilateral differences in the regressive evaluation of the palatal rugae.Jap JOral Biol1994; 36:125-40.
[20]. Muthusubramanian, M.; Limson, K. S. & Julian, R. Analysis of rugae in burn victims and cadavers to simulate rugae identification in cases of incineration and decomposition. J. Forensic Odontostomatol., 23(1):26-9, 2005