

PALATAL RUGAE PATTERNS IN THE SERBIAN POPULATION

GORDANA FILIPOVIĆ, MIRJANA JANOŠEVIĆ, PREDRAG JANOŠEVIĆ, JULIJA RADOJIČIĆ,
ZORICA AJDUKOVIĆ and OLIVERA TRIČKOVIĆ JANJIĆ

Faculty of Medicine, Clinic of Stomatology, 18000 Niš, Serbia

Abstract – Establishing the gender of a dead person is one of the main aspects in forensic medicine, especially in cases of massive disasters. Palatal rugae have been related with specific racial groups and are said to be useful in sex determination. One hundred pre-orthodontic plaster casts, equally distributed between males and females with an age range of 15-30 years, were examined for different rugae patterns by the Thomas classification. The total number of rugae was not significantly gender linked. According to size, the primary type of rugae was dominant in both males and females. Wavy and curved patterns of rugae were the most common, both in males and females. There was a significant sex difference in the circular and converging types which was higher in males and females, respectively.

Key words: rugae palatal; Serbian

INTRODUCTION

The characteristics of the rugae pattern have been the subject of numerous investigations by anthropologists, biologists, orthodontists and forensic experts (Thomas and Kotze, 1983; English et al., 1988; Almeida et al., 1995; Kapali et al., 1997). Palatal rugae refer to the ridges on the anterior part of the palatal mucosa, each side of the median palatine raphe and behind the incisive papilla (Thomas and Kotze, 1983). Palatal rugae develop in the third month of intrauterine life as localized regions of epithelial proliferation and thickening even before the elevation of the palatal shelves (Amasaki et al., 2003). Later, fibroblasts and collagen fibers accumulate in the connective tissue beneath the thickened epithelium and attain a distinctive orientation (Hauser et al., 1989).

Palatal rugae are stable topographical structures in the oral cavity (Thomas and Kotze, 1983; English et

al., 1988; Abou et al., 1998; Limson and Julian, 2004; Caldas et al., 2007), and neither diseases, chemical agents or trauma change the form of palatal rugae which are protected from inside the oral cavity (English et al., 1988). Rugae are unique to each individual, and Thomas and Kotze (1983) stated that palatal rugae are similar to finger prints. Henceforth it was suggested that rugae could be used to establish an individual's identity (English et al. et al., 1988; Muthusubramanian et al., 2005; Bansode and Kulkarni, 2009; Jain and Chowdhary, 2013; Bhullar et al., 2011; Indira et al. 2012), however, researchers have disagreed as to whether or not legal identification could be based solely on palatal rugae (Robison et al., 1998; Caldas et al., 2007). Given that there are differences in the appearance of certain rugae patterns in a population (Shetty et al., 2005; Paliwal et al., 2010; Gondivkar et al., 2011), it is necessary to establish certain rugae parameters so that identification would be more reliable. At present no such standards have

been determined for the Serbian population. Therefore, this study was an attempt to determine the number and predominant pattern of rugae in the Serbian population.

MATERIALS AND METHODS

The sample for the present study consisted of 100 dental casts (50 males and 50 females). All the subjects were Serbs, healthy individuals free of congenital abnormalities, inflammation, trauma or orthodontic treatment. The classification used to describe the rugae patterns was based on those described by Thomas and Kotze (1983). This classification takes into consideration the number, length, shape and unification of rugae. The shapes are classified into curved, wavy, straight and circular; curved are crescent shaped and curved gently; wavy describes rugae with a slight curve at the origin or termination of a curved rugae; straight rugae run directly from their origin to termination; circular rugae form a definite continuous ring. The rugae were classified based on their length as follows: primary >5mm, secondary 3-5mm, fragmentary <3mm. Unification considers rugae that (i) converge where two rugae originate away from the center and unite towards it, while (ii) diverging rugae originate from the center and diverge away from it. Rugae were plotted in black pen on the model, and identification was performed using a magnifying glass. The measurement was performed with a digital nonius (Mitutoyo, Tokyo) by one examiner.

RESULTS AND DISCUSSION

Investigators have implied that palatal rugae are unique to each individual and can be used successfully in human identification. The determination of sex is important in cases of major disasters where bodies are often mutilated beyond recognition, and identification of the sex of victims builds the biological profile of unidentified human remains (Bharath et al., 2011). Thomas and Kotze (1983) studied the rugae patterns of six South African populations to analyze the interracial differences. They found that rugae were unique to each ethnic group and that they

can be used in genetic research. Hauser et al., (1989) compared the rugae pattern of Swazi and Greek populations and found definite differences between the two populations. Considering that there are differences in specific populations, it is necessary to determine specific population palatal rugae patterns.

The present study did not show any significant differences in the number of rugae between the sexes in the Serbian population (Table 1). No significant difference in the length of rugae was found between the sexes. (Table 2). Table 3 gives the descriptive statistics of different types of rugae categorized by gender. The wavy and curved patterns of rugae were found to be the most common both in males and in females. There was also a significant gender difference in the circular type, which was more frequently present in males, whereas the frequency of the converging type was higher in females.

The results of our study are similar with the results of previous investigators (Kapali et al., 1997; Patil et al., 2008; Fahmi et al., 2001; Jibi and Chowdhary, 2011; Saraf et al., 2011) that there are no significant differences between the sexes in the number of rugae. However, Gondivkar et al., (2011), Dohke and Osato (1994), Hermosilla et al., (2009) and Preethi et al., (2007) found that females had fewer rugae than males. A statistically significant association between rugae forms and ethnicity has been noted (Kapali et al., 1997; Hermosilla et al., 2009).

In the present study the commonest palatal rugae shapes were wavy and curved compared with sinuous and curved observed in Caucasian and aboriginal Australians (Kapali et al., 1997), and in two Indian populations (Preethi et al., 2007) and Chileans (Hermosilla et al., 2009). In addition, circular rugae were present, although they constituted less than 5% of the total shapes of rugae. The circular and converging patterns of rugae were found to be statistically different in the sexes. This means that sex prediction based on rugae is more reliable when the converging and circular types of rugae are used (Saraf et al., 2011). In the study of Preethi et al., (2007) on Western and South Indian populations, the circular group

Table1. Descriptive statistics of % of different types of rugae categorized by gender

| | M(N=50) | F(N=50) |
|------------|-------------|--------------|
| Wavy | 45.7 ± 12.4 | 44.7 ± 16.1 |
| Curved | 27.7 ± 14.1 | 27.8 ± 14.5 |
| Straight | 13.2 ± 9.6 | 11.8 ± 12.2 |
| Circular | 3.2 ± 4.1* | 1.8 ± 2.7 |
| Converging | 8.2 ± 9.8 | 12.2 ± 10.1* |
| Diverging | 2.0 ± 6.5 | 1.7 ± 4.2 |

* – p<0.05 (Mann-Whitney U Test)

Table2. Descriptive statistics of % of different length – types of rugae categorized by gender

| | M(N=50) | F(N=50) |
|------------|-------------|-------------|
| Fragmented | 7.7 ± 13.8 | 10.1 ± 18.5 |
| Secondary | 19.9 ± 11.0 | 20.2 ± 12.6 |
| Primary | 72.4 ± 21.6 | 69.7 ± 18.4 |

Table3. Number of rugae and the mean value for males and females

| | male | female |
|------------|------|--------|
| Japanese | 4.7 | 4.5 |
| Aborigines | 5 | 4.9 |
| Saudis | 7.3 | 7.2 |
| Indians | 4.9 | 4.6 |
| Serbs | 4.7 | 4.6 |

was found to be absent. Eboh (2012) reported that the dominant rugae form among the Urhobo ethnic group was followed by the sinuous type. Santos and Caldas (2011) reported that there are no differences in shape of palatal rugae between Portuguese males and females. Fahmi et al., (2001) found that females had more converging type than males and males had more circular rugae.

CONCLUSIONS

The palatal rugae pattern of the investigated Serbs was characterized by the presence of primary rugae in most individuals, that mainly assumed wavy and curved shapes. There was also a significant gender difference in the circular type which was higher

in males and in the converging type which was higher in females. When compared with the results from other studies, it is clear that the palatal rugae pattern can be set for different ethnic groups. This small sample justifies further work on a larger sample to confirm these findings.

Acknowledgments - The research presented in this paper was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, under Projects No. 41018, No. 45004.

REFERENCES

- Abou, E.F., Mona, M. and Z.H. Gamal (1998). A study of palatal rugae pattern (rugoscopy) in Egyptian population. *Egypt. Dent. J.* **44**, 3177-84.
- Amasaki, H., Ogawa, M., Nagasao, J., Mutoh, K., Ichihara, N., Asari, M. et al. (2003). Distributional changes of BrdU, PCNA, E2F1 and PAL31 molecules in developing murine palatal rugae. *Ann. Anat.* **185**, 517-23.
- Bansode, S.C. and M.M. Kulkarni (2009). Importance of palatal rugae in individual identification. *J. Forensic Dent. Sci* **2**, 77-81.
- Bharath, S.T., Kumar, G.R., Dhanapal, R. and T.R. Saraswathi (2011). Sex determination by discriminant function analysis of palatal rugae from a population of coastal Andhra. *J. Forensic Dent. Sci.* **3**, 58-62.
- Bhullar, A., Kaur, R.P. and M.S. Kamat (2011). Palatal rugae-an aid in clinical dentistry. *J. Forensic Res.* **2**, 124.
- Caldas, I.M., Magalhães, T. and A.Afonso (2007). Establishing identity using cheiloscopy and palatoscopy. *Forensic Sci Int.* **165**, 1-9.
- Dohke, M. and S. Osato (1994). Morphological study of the palatal rugae in Japanese. 1. Bilateral differences in the regressive evolution of the palatal rugae. *Jpn. J. Oral Biol.* **36**, 126-40.
- Eboh, D.E.O (2012). Palatal rugae patterns of Urhobos in Abraka, South-Southern Nigeria. *Int.J.Morphol.* **30**, 709-13.
- English, W.R., Robison, S.F., Summitt, J.B., Oesterle, L.J., Brannon, R.B. and W.M.Morlang (1988). Individuality of human palatal rugae. *J. Forensic Sci* **33**, 718-726.
- Fahmi, F.M., al-Shamrani, S.M. and Y.F.Talic (2001). Rugae pattern in Saudi population sample of males and females. *Saudi. Dental Journal* **13**, 92-95.
- Gondivkar, S.M., Patel, S., Gadgil, A.R., Gaikwad, R.N., Chole, R. and R.V. Parikh (2011). Morphological study of the

- palatal rugae in western Indian population. *J. Forensic Leg. Med.* **18**, 310-2.
- Hauser, G., Daponte, A. and M.J. Roberts (1989). Palatal rugae. *J Anat.* **165**, 237-49.
- Hermosilla, V. V., San Pedro, V. J., Cantin, M. and G.I.C. Suazo (2009). Palatal rugae: Systemic analysis of its shape and dimensions for use in human identification. *Int. J. Morphol.* **27**, 819-25.
- Indira, A., Gupta, M. and M.P. David (2012). Usefulness of palatal rugae patterns in establishing identity: Preliminary results from Bengaluru city, India. *J. Forensic Dent. Sci.* **4**, 2-5.
- Jain, A. and R. Chowdhary (2013). Palatal rugae and their role in forensic odontology. *J. Investig. Clin. Dent.* [Epub ahead of print]
- Kapali, S., Townsend, G., Richards, L. and T. Parish (1997). Palatal rugae patterns in Australian Aborigines and Caucasians. *Austral. Dent. Journal* **42**, 129-33.
- Limson, K.S. and R. Julian (2004). Computerised recording of the palatal rugae pattern and an evaluation on its application in forensic identification. *J. Forensic Odontostomatol.* **22**, 1-4.
- Muthusubramanian, M., Limson, K.S. and R. Julian (2005). Analysis of rugae in burn victims and cadavers to simulate rugae identification in cases of incineration and decomposition. *J. Forensic Odontostomatol.* **23**, 26-9.
- Paliwal, A., Wanjari, S. and R. Parwani (2010). Palatal rugoscopy: Establishing identity. *J. Forensic Dent. Sci.* **2**, 27-31.
- Preethi, N., Ashith, B., Padmini, A. T. and H. Kaveri (2007). Differences in the palatal rugae shape in two populations of India. *Arch. Oral Biol.* **52**, 977-82.
- Santos, C. and M. Caldas (2012). Palatal rugae pattern in a Portuguese population: a preliminary analysis. *J. Forensic Sci.* **57**, 786-788.
- Saraf, A., Bedia, S., Indurkar, A., Degwekar, S. and R. Bhowate (2011). Rugae patterns as an adjunct to sex differentiation in forensic identification. *J. Forensic Odontostomatol.* **29**, 14-19.
- Shetty, S.K., Kalia, S., Patil, K. and V.G. Mahima (2005). Palatal rugae pattern in Mysorean and Tibetan populations. *Indian. J. Dent. Res.* **16**, 51-55.
- Thomas, C.J. and T.J. Kotze (1983). The palatal rugae pattern: A new classification. *J. Dent. Assoc. S. Afr.* **38**, 153-7.
- Virdi, M.S., Singh, Y. and A. Kumar (2010). Role of Palatal Rugae in Forensic Identification of the Pediatric Population. *The Internet Journal of Forensic Science*. Volume 4 Number 2