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IS THE PALATAL RUGAE PATTERN AS UNIQUE AS A FINGERPRINT?

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Abstract

The palatal rugae patterns are widely considered to remain unchanged during an individual's lifetime. Given the invariance and stability of the rugae pattern, the palatal rugae themselves are equivalent to fingerprints and thus considered relevant for the identification of victims. The aim of the study is to establish, individual identity using palatal rugae patterns. The research consisted of 80 study models, 51% were females and 49% were men, separated into three age groups: 10 to 20 years (42%), 21 to 40 years (33%) and over 41 years old (25%). This study treats the shape, length and width of the rugaes as well as their distance from both palatine raphe and incisive papilla. Each individual had different rugae patterns including fraternal twins and the rugae patterns were not symmetrical, both in number and in their distribution regardless of the gender and age. This preliminary study has shown that there are no two identical palates in terms of their rugae pattern. The palatal rugae possess unique characteristics as they are absolutely individualistic and therefore, can be used as a personal oral print for identification in forensic cases.

Keywords: palatal rugae, personal identity, rugae pattern

INTRODUCTION

Determining an individual's identity can be a difficult task in cases of traffic accidents, mass disasters, wars, natural disasters, etc. The information collected from victims for accurate identification must be precise and include all objective findings (1). If the accident results in a full or partial loss of the jaw and teeth, identity establishing becomes considerably more complex, thus it is necessary to look for alternative identification options (2).
The palatal rugae patterns are widely considered to remain unchanged during an individual's lifetime (3). Given the invariance and stability of the rugae pattern, the palatal rugae themselves are equivalent to fingerprints and thus considered relevant for the identification of victims (4). Uniqueness, postmortal resistance and stability of the palatal rugaes represent an ideal parameter for forensic identification (5). The rugae pattern has the potential to remain intact by virtue of their internal position in the head when most other anatomical structures are destroyed or burned (6).
The aim of the study is to establish, individual identity using palatal rugae patterns.

MATERIALS AND METHODS

The research consisted of 80 study models, 51% were females and 49% were men, separated into three age groups: 10 to 20 years (42%), 21 to 40 years (33%) and over 41 years old (25%). All the patients were citizens of Bosnia and Herzegovina. Patients included in the study had various detentions, patients with a permanent detention, toothless patients, patients that have a mobile prosthesis, children (with parental approval). The exclusion criteria included patients with severe congenital anomalies and patients with severe systemic diseases. All patients completed the informed consent forms and anamnesis information was gathered.

Anatomic imprint using a metal wire was taken in the appropriate size from which a cast mould was created. Impression material used was alginate “Hydrogum”, manufactured by Zhermack Clinica while the cast used to mould the working model was „Elite Model“ by Zhermack Technical. All instructions by the manufacturer were followed such as water/powder ratio, vacuum mixing and the use of a vibrator. All casts were free of air bubbles or voids. Markings in the working model specified prominent palatal rugae and the medial palatal suture as well as the papillae incisiva (Fig. 1). All work models were photographed using a digital camera (Olympus FE-130) using the exact same settings and the photographs were transferred to a computer.
Using the VistaMetrix computer program the measurements included length of palatal rugae, width of palatal rugae, distance of palatal rugae to the median palatal suture and distance of palatal rugae to the papillae incisiva (Fig 2).

Variables describing size and position of the palatal rugae are continuous, within the reference proportions. In case that their empirical distribution values (Kolmogorov-Smirnov test of equality), the description was related to the estimate of their parameters (arithmetic median, range, standard deviation etc.). Differences among types of palatal rugae (defined by Lysell or Lima classification) were tested using a t-test for independent samples (in the event of two groups), or variance analysis in the event of multiple groups. In the event where variables describing palatal rugae were not conforming to normal distribution for testing the research hypothesis a nonparametric tests were used.

Fig. 1.a. Palatal rugae tracing and marking

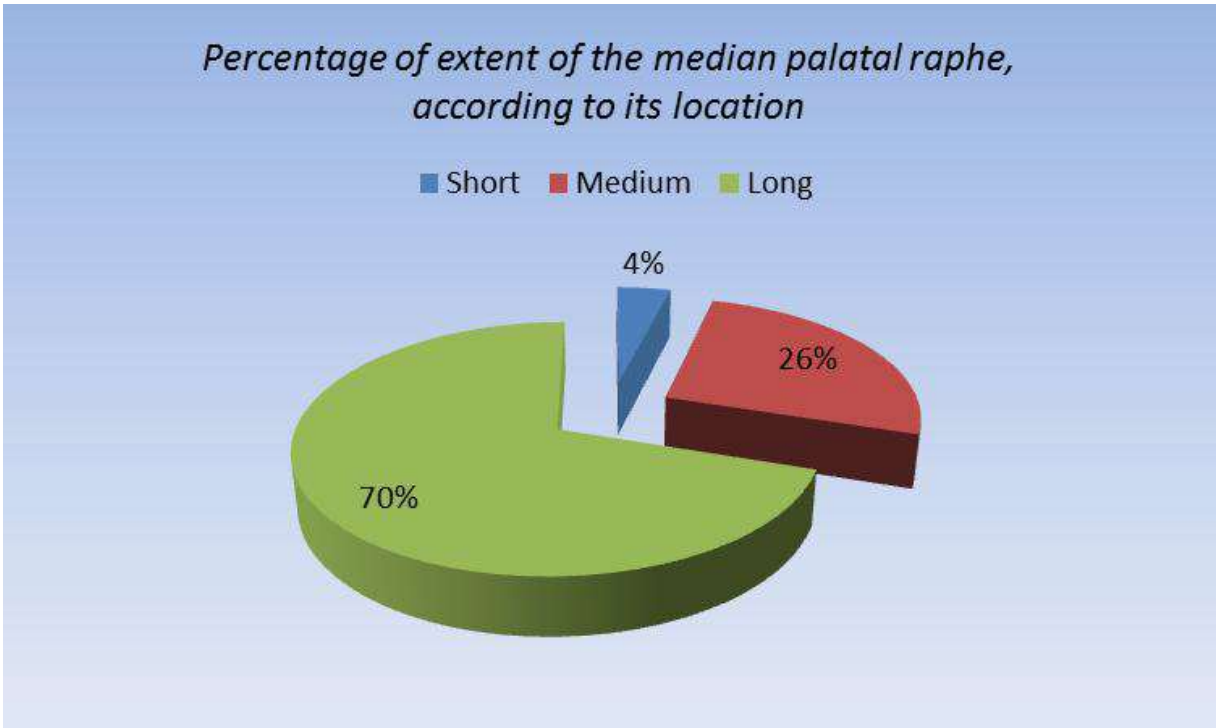
Fig. 2. Palatal rugae measuring

RESULTS

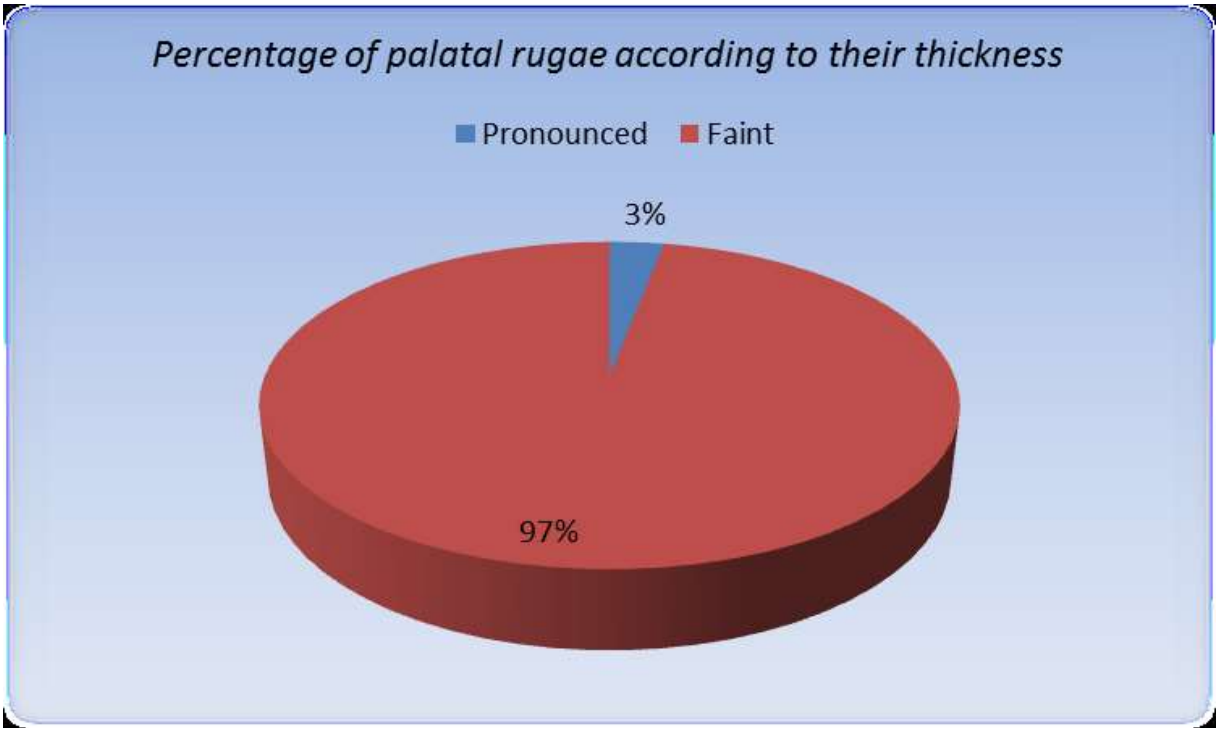
This study treats the shape, length and width of the rugaes as well as their distance from both palatine raphe and incisive papilla (Graph 1, 2 and 3).

Each individual had different ($p<0.05$) rugae patterns including fraternal twins and the rugae patterns were not symmetrical, both in number and in their distribution regardless of the gender and age ($p<0.001$). The average number of rugae in males was slightly more when compared to females, but it was statistically insignificant ($p=0.77$). Diverging pattern was found more commonly in females compared with males, who predominantly showed converging patterns ($p<0.05$) (Table 1).

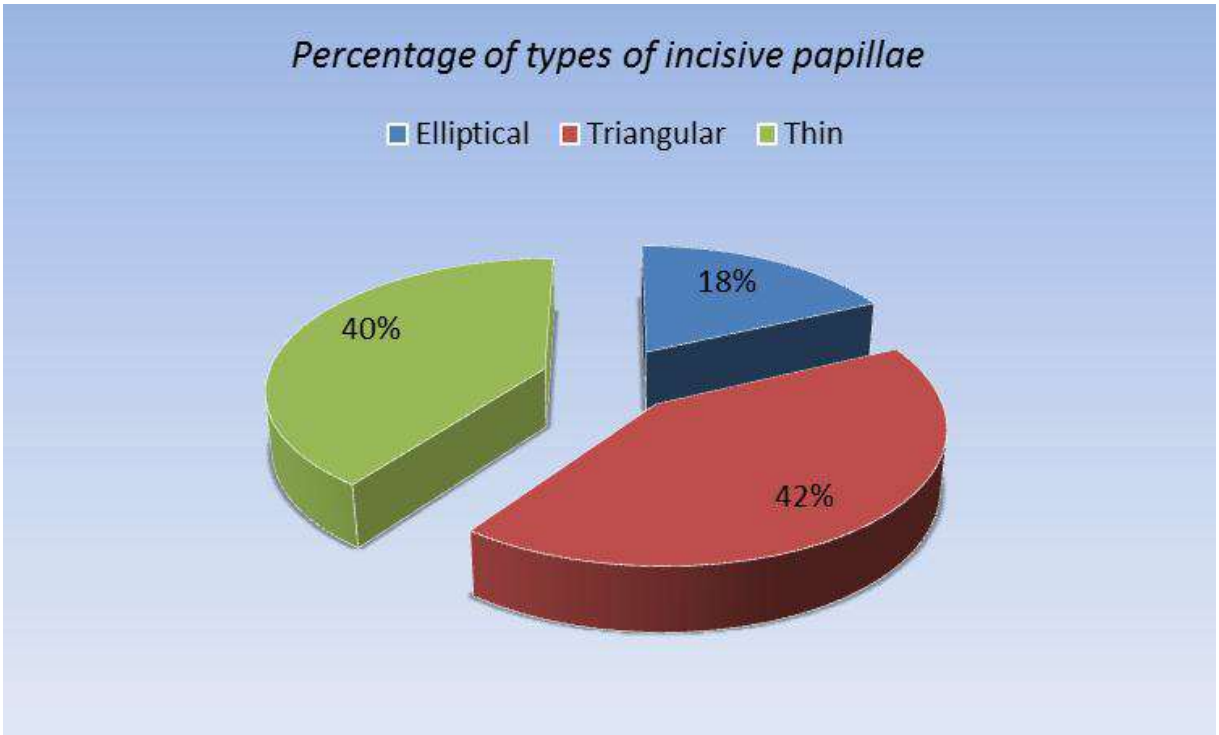
The use of pre- and post-orthodontic cases also demonstrates that the changes occurring with extractions and tooth movement or any other orthodontic treatment do not significantly alter the pattern of the palatal rugae ($p>0.05$).



Graph 1. Percentage of extent of the median palatal raphe, according to its location



Graph 2. Percentage of palatal rugae according to their thickness



Graph 3. Percentage of types of incisive papillae

Sex	Total number of subjects	Total number of rugae	Mean	SD
Male	41	299	7.3	0.94
Female	39	283	7.25	0.93
z-test	0.29			
p-value	0.77			

Table 1. Number of rugae per sex

DISCUSSION

Palatal rugae have been considered relevant for human identification due to its stability, which is equivalent to the fingerprint, in that it is unique for each ruga pattern. Palatal rugae appear to possess the features of an ideal forensic identification parameter, that is, uniqueness, postmortem resistance, and stability (7).

Palatal rugae patterns can differentiate the features among populations, because palatal rugae pattern and distribution are unique in each person.

In a study done by Saraf, rugae pattern can help to discriminate between Indian male and female. This study did not show any major difference in length of rugae, whereas rugae shape had implication on sex differentiation (3).

The results shows that variables of length and shape of the palatal rugae are statistically significant and on further discriminant analysis these variables can classify the sex of an individual. This study found that palatal rugae are sufficiently characteristic to indicate identity through discrimination.

This gave the evidence that palatal rugae may be used for identification purposes and was proved to be stable in the population under study.

CONCLUSION

This preliminary study has shown that there are no two identical palates in terms of their rugae pattern. The palatal rugae possess unique characteristics as they are absolutely individualistic and therefore, can be used as a personal oral print for identification in forensic cases.

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