Uningá Journal, v. 58, eUJ3940, 2021
doi.org/10.46311/2318-0579.58.eUJ3940
ISSN 2318-0579
Biological I, II, III and Health Sciences

ELONGATED STYLOID PROCESS IN PANORAMIC RADIOGRAPHIES IN A SUBPOPULATION

PROCESSO ESTILOIDE ALONGADO NAS RADIOGRAFIAS PANORÂMICAS EM UMA SUBPOPULAÇÃO

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ABSTRACT

Styloid process elongation associated with symptoms such as cervicofacial pain, tinnitus and otalgia is called Eagle Syndrome. The objective of this study is to assess the presence of elongated styloid process through panoramic radiographs, in a subpopulation of the State of Para, Brazil, as to age and sex. Panoramic radiographs were selected and the apparent size of the styloid process was measured from the point where the styloid leaves the tympanic plate to the lower tip of the process. Data were analyzed by means of chi-square tests and the "t" test with a significance level of 5%. Forty-three percent of all elongated styloid processes were observed in patients aged between 18 and 35 years old. Of these styloid processes measuring more than 30 mm, there were 815 that showed a Type I elongation pattern, being 98 that showed a Type II calcification pattern and 92 showed a Type III calcification pattern. It is concluded that the Type I elongated styloid process was the most frequent, but no statistically significant correlation was found between the presence of the elongated styloid process and the studied variables.

Keywords: Bone lengthening. Osteogenesis. Panoramic radiography.

RESUMO

O alongamento do processo estiloide associado a sintomas como dor cervicofacial, zumbido e otalgia é denominado Síndrome de Eagle. O objetivo deste estudo é avaliar a presença do processo estiloide alongado em radiografias panorâmicas, em uma subpopulação do Estado do Pará, Brasil, em relação à idade e ao sexo. Radiografias panorâmicas foram selecionadas e o tamanho aparente do processo estiloide foi medido a partir do ponto em que o estiloide deixa a placa timpânica até a ponta inferior do processo. Os dados foram analisados por meio de testes qui-quadrado e teste "t" com nível de significância de 5%. Quarenta e três por cento dos processos estiloides alongados foram observados em pacientes entre 18 e 35 anos. Desses processos estiloides que mediram mais de 30 mm, foram 815 que mostraram padrão de alongamento do Tipo I, sendo 98 que apresentaram padrão de calcificação do Tipo II e 92 manifestaram padrão de calcificação do Tipo III. Conclui-se que o processo estiloide alongado do Tipo I foi o mais frequente, porém não foi encontrada correlação estatisticamente significante entre a presença do processo estiloide alongado e as variáveis estudadas.

Palavras-chave: Alongamento ósseo. Osteogênese. Radiografia panorâmica.

Received: February, 11th, 2021. Accepted: November, 12th, 2021.

INTRODUCTION

Styloid process is a bony projection of the petrous part of the temporal bone, projecting downward, forward, and slightly medially. Several of the symptoms attributed to an elongated styloid process are common clinical manifestations of temporomandibular joint disorders and, because of this overlap, there is always a potential for misdiagnosis (ZAKI *et al*., 1996). Vague facial pain, especially when swallowing, turning the head or opening the mouth, dysphagia, otalgia, headache and dizziness have been associated with elongated styloid processes or mineralized stylohyoid ligaments (CORRELL *et al*., 1979).

The length of the styloid process has been studied in several modalities of imaging exams, such as: panoramic radiography, lateral cephalometric (ANDRADE *et al*., 2012), anteroposterior cranial teleradiography, and computed tomography, for instance (NATSIS *et al*., 2015). In the Brazilian population, most studies carried out to assess the length of the styloid process used panoramic radiographs. Among the studies already conducted with the employment of panoramic radiographs, the Southeastern region of Brazil (SCAF *et al*., 2003; RIZZATTI-BARBOSA *et al*., 2005; GUIMARÃES *et al*., 2010; VIEIRA *et al*., 2018) is the one that has more studies on the subject, followed by the South (ROVANI *et al*., 2004; TAVARES *et al*., 2007), the Northeast (LINS *et al*., 2015) and the Mid-West (VIEIRA *et al*., 2015).

In light of the foregoing, the purpose of the study was to assess the presence of elongated styloid process through panoramic radiographs, in a subpopulation of northern Brazil, as to age and sex.

MATERIAL AND METHODS

This study was approved by the Research Ethics Committee of the Federal University of Para's Institute of Health Sciences, Brazil, under the Certificate of Presentation for Ethical Consideration: CAAE 30646920.0.0000.0018, Opinion number: 4.003553.

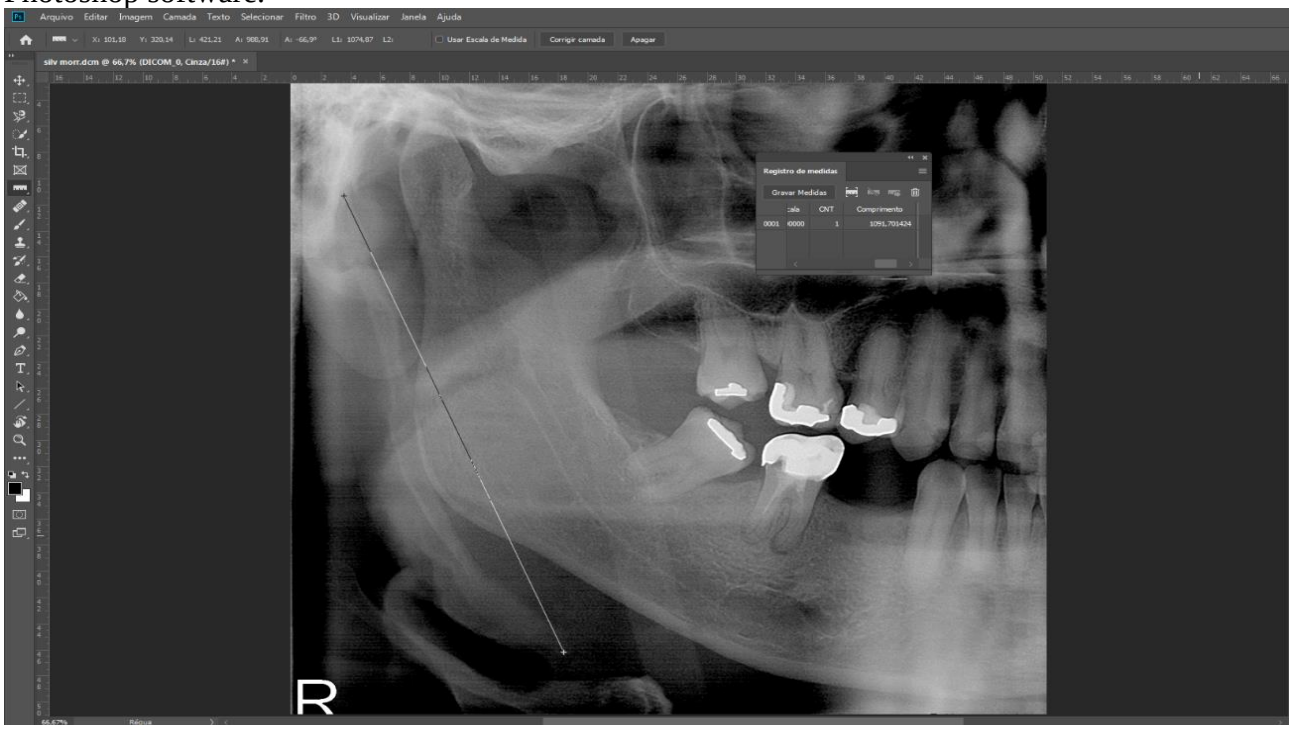
It is characterized as a descriptive-retrospective study of panoramic radiographs of 537 patients (332 women and 205 men), aged between 4 and 80 years old.

The panoramic radiographs used belong to the image database of the Dental Radiology Teaching Laboratory of a Dentistry course in the northern region of Brazil, and were performed between 2018 and 2019. The radiographs were obtained using the Eagle device (Dabi Atlante, Ribeirão Preto – SP, Brazil). Energy parameters were selected in accordance with the patient's physical characteristics. The average magnification factor reported by the manufacturer is 1:1.2.

Panoramic radiographs with barely visible styloid process, with errors in positioning and magnification, absence of age without the possibility of estimation, were excluded from the study, so 1000 radiographs were analyzed. It was decided to divide the sample into an interval of about 17 years, which generated four different age groups: patients under 18 years old, patients between 18 and 35 years old, between 36 and 53 and, finally, patients over 53 years old.

The radiographs were interpreted in a low-light environment for better visualization. The radiographs were analyzed by a dental-surgeon radiologist with 30 years of experience using a computer with a 32-inch screen and Windows 10 operating system. The styloid process on both sides was measured from the point at which the styloid left the tympanic plate at the tip of the process, regardless of whether the styloid process was segmented or not (Figure 1). Styloid processes measuring more than 30 mm were considered elongated. Measurements were taken with the ruler of the Adobe Photoshop CS image manipulation software, version 2019, (California, United States), in millimeters. Thirty days after the initial assessment, 30% of the sample was reassessed for measurement and classification agreement analysis.

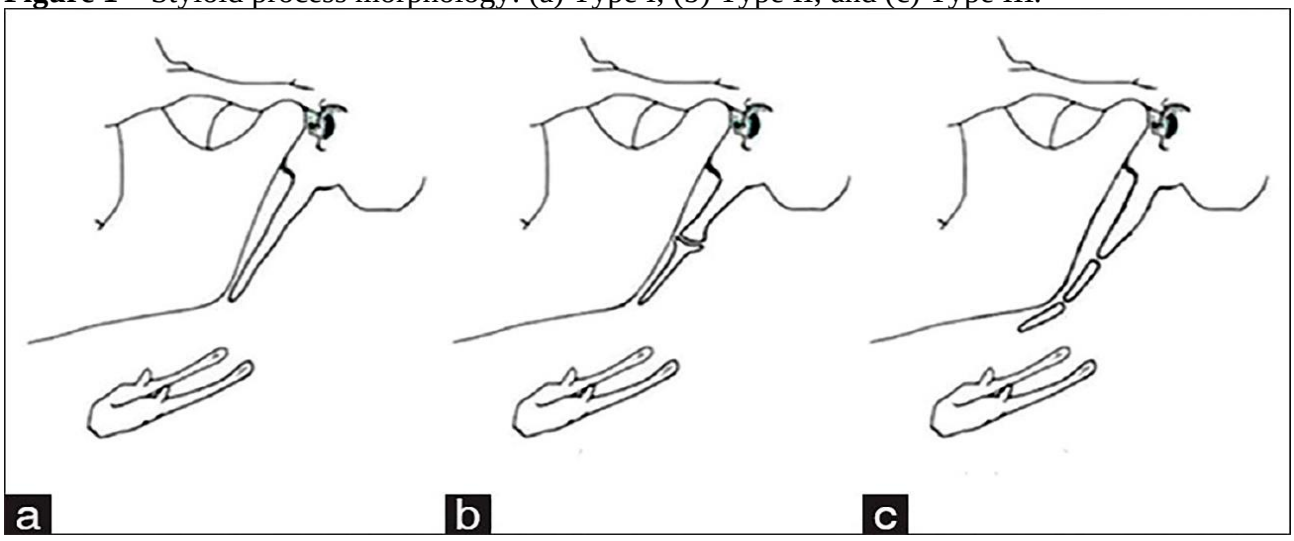
Figure 1 – Digital measurement of the length of the elongated styloid process using the Adobe Photoshop software.



Source: The authors.

For the styloid ligaments that were considered elongated (537 radiographs), the types of elongation were classified from the classification proposed by Langlais *et al*. (1977). (Figures 2).

Figure 1 – Styloid process morphology: (a) Type I; (b) Type II; and (c) Type III.



Source: Anbiaee and Javadzadeh (2011), adapted.

The data were tabulated, and statistical analyses were run with the Jamovi statistical software, version 1.1.9.0 (Oxford, United Kingdom), which included frequency distribution and cross-tabulation. The data were analyzed using the chi-square test and the t test, with a significance level set at 5%. The agreement test was conducted for measurement (Intraclass Correlation Index) and for classification (Kappa Index).

RESULTS AND DISCUSSION

The reproducibility study was carried out to verify the intraobserver agreement in relation to the measurements, and the intraclass correlation coefficient was 0.9175, which is considered excellent (FLEISS, 1986). As for the classification of the styloid process, the Kappa value was k = 0.8034 (substantial agreement), showing good intraobserver agreement (LANDIS; KOCH, 1977).

The use of panoramic radiographs is deemed an important diagnostic tool for styloid process elongation (MORE; ASRANI, 2010), as it is a simple procedure in obtainment, routinely used in Dentistry, and provides an overview of the maxillomandibular complex (GUIMARÃES *et al*., 2010). However, precautions must be taken when making and analyzing the images, as one must be careful with the degree of distortion and magnification inherent to the technical procedure and X-ray equipment.

The styloid process was measured through 1000 panoramic radiographs. The images that showed elongation (537 radiographs), on one or both sides, were classified as to the type of elongation. Thus, in 60 radiographs, the patients presented unilateral elongation, and in 477 radiographs, bilateral elongation, totaling 1,014 elongated ligaments. Of these, 537 (53.7%) showed styloid process elongation, and 463 radiographs did not show styloid process elongation. The sample data do not indicate statistical evidence that elongated styloid process is related to sex and age, $p > 0.05$, that is, females and males respond in the same way (Table 1). More and Asrani (2010), Shaik *et al.* (2013) and Sudhakara *et al.* (2013), in their turn, identified a higher prevalence of elongated styloid process in males.

Table 1 – Distribution of patients with elongated styloid process, by sex and age.

	Elongated styloid process				
	Unilateral		**Bilateral**		***p***
Sex (n = 537)					
Female	33	(55%)	299	(62.7%)	0.248
Male	27	(45%)	178	(37.3%)	
Age (n = 537)					
<18	7	(11.7%)	45	(9.4%)	0.949
18 – 35	26	(43.3%)	209	(43.8%)	
36 – 53	16	(26.7%)	127	(26.6%)	
>53	11	(18.3%)	96	(20.1%)	

Source: The authors.

There was no statistical difference between the age groups as to the prevalence of styloid process elongation, but there was a greater concentration in the group aged between 18 and 35 years old. The studies by More and Asrani (2010), Anbiaee and Javadzadeh (2011) and Ekici *et al*., (2013) reported that the length of this structure was associated with age. For the authors, this phenomenon can be caused by age-related factors and can be considered a physiological phenomenon of age.

With regard to bilateral incidence, there were no statistically significant differences for both sexes; in the present study, it was bilaterally traceable in 37.3% of men and 62.7% of women. In the present study, although there was no statistically significant difference in calcification, it was observed that Type I presented a greater bilateral occurrence, similarly to other studies (CORRELL *et al*., 1979; TAVARES; FREITAS, 2007; GUIMARÃES *et al*., 2010; SHAIK *et al*., 2013; LINS; TAVARES; SILVA, 2015). Of these the styloid processes measuring more than 30 mm (elongated), there were 824 that showed a Type I elongation pattern, being 98 that appeared with a Type II calcification pattern and 92 showed a Type III calcification pattern (Table 2).

Table 2 – Prevalence of elongated styloid processes by sex and age.

	Elongated styloid process		
	Type I	**Type II**	**Type III**
Sex (n=1014)			
Female	496 (60.2%)	70 (71.4%)	65 (70.7%)
Male	328 (39.8%)	28 (28.6%)	27 (29.3%)
Age (n=1014)			
<18	79 (9.6%)	10 (10.2%)	10 (10.9%)
18 – 35	355 (43.1%)	42 (42.9%)	42 (45.6%)
36 – 53	227 (27.5%)	24 (24.5%)	19 (20.7%)
>53	163 (19.8%)	22 (22.4%)	21 (22.8%)

Source: The authors.

In the studies by Ilgüy *et al.* (2005), Tavares and Freitas (2007), several methods for measuring the styloid process were used; some employed analogue radiographic equipment, as well as tweezers and manual rulers for direct measurement in imaging exams. In the present study, the method used was a digital tool for image measurements, similarly to the studies by Lins *et al*. (2015), More and Asrani (2010) and Gracco *et al*. (2017).

Table 3 – Means of the measurements of the styloid processes in millimeters.

	Right	**Left**	**95% Confidence Interval**		***p***
Female	40.8 mm	39.2 mm	-0.236	2.63	0.101
Male	42.5 mm	42.0 mm			

Source: The authors.

Table 3 shows that the mean length of the styloid process was not statistically significant as to the side (p = 0.101) in the studied population. Styloid process elongation is a frequent condition, and its prevalence has been studied in different populations around the world (REDDY *et al*., 2013; SHAIK *et al*., 2013) most cases are not associated with clinical symptoms. Some studies have shown that its occurrence in panoramic imaging exams varies largely, between 4% and 84.4% (LEITE *et al*., 1988; TAVARES; FREITAS, 2007; LINS; TAVARES; SILVA, 2015).

The standardization of participants concerning medical and dental history, racial characteristics, facial biotype, environmental influences, eating habits and socioeconomic factors could not be established in the present study. Thus, caution is needed when comparing the prevalence between different methodologies used, due to the absence of a standard to define age groups, as well as the analysis of the studied images.

The study showed that it is possible to diagnose styloid process elongation by means of panoramic radiography, but investigations using other imaging methods, such as computed tomography, and/or with a larger number of participants, can be carried out. It is considered the first study on the patterns of elongation and calcification of the styloid process in the population of the northern region of Brazil. Further research is needed to assess the presence of the styloid process and investigate the relationship between the type of styloid process and symptomatic presentation (Eagle syndrome) in patients.

CONCLUSION

Type I elongated styloid process was the most frequent, but no statistically significant correlation was found between the presence of elongated styloid process and the studied variables.

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