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ABSTRACT

Objective: the present study aimed to investigate the prevalence of the elongated styloid process by panoramic radiography and characterize them by sex, age, side of elongation, and morphologic. **Materials and Methods:** the approach was a retrospective, descriptive study. It analyzed digital medical records and panoramic radiography from

240 subjects over 18 years old. All data were registered with the Odontology Clinic between 2021 and 2022. The exams were performed using panoramic radiography (model Eagle, DABI, Atlante) and the images were analyzed by the software from the equipment. It adopted the morphological classification proposed by Langlais. Finally, it was performed the statistical analyzes. **Results:** the prevalence of the elongated styloid process was 20,8%, mostly in women, between 18 to 39 years old, bilateral and morphological classification type I. **Conclusion:** the present study showed that the elongated styloid process was a common finding, and it should be considered in clinical cases of pain or orofacial discomfort. Therefore, it must disseminate the characteristics and symptoms from the elongated styloid process, mostly for health professionals.

Keywords: Prevalence, bone lengthening, panoramic radiography, speech, language, hearing sciences, dentistry

1 INTRODUCTION

The styloid process is a thin bone projection that measures approximately 25 mm in length, originating in the temporal bone, anterior and medially to the stylomastoid foramen, from where the facial nerve arises (BRUNO *et al.*, 2022; CAVALCANTE *et al.*, 2017; GUIMARÃES *et al.*, 2010; HANDEM *et al.*, 2016; LINDENBLATT *et al.*, 2018; Martello *et al.*, 2019; Millán *et al.*, 2019; NUNES *et al.*, 2021; ÖZTAS; ORHAN; 2012; PEREIRA *et al.*, 2022; PIGACHE *et al.*, 2018; RAFARE; CHAGAS; 2019; SAMPAIO *et al.*, 2021). Amid this process are still located important structures such as the internal jugular vein, external and internal carotid artery, and the vagus, glossopharyngeal, accessory, and hypoglossal nerves (BALDINO *et al.*, 2020; MUÑOZ-LEIJA *et al.*, 2020; NUNES *et al.*, 2021; PEREIRA *et al.*, 2022; SAMPAIO *et al.*, 2021; SOUZA *et al.*, 2020).

Several studies state that when the styloid process has a length above 25 mm, it can be considered elongated (BORGES *et al.*, 2021; CAVALCANTE *et al.*, 2017; JALISI; JAMAL; GRILLONE; 2017; Millán *et al.*, 2019; PEREIRA *et al.*, 2022; SAMPAIO *et al.*, 2021).

The cause of its elongation is not yet clearly described in the literature (BADHEY *et al.*, 2017; BEDI *et al.*, 2019; MAHMOUD; ASHOUR; 2020; Martello *et al.*, 2019; NUNES *et al.*, 2021;

SAMPAIO *et al.*, 2021; WATERS *et al.*, 2019), but studies state that its incidence has been observed between 1.4% and 30% of the population, being more frequent in individuals over 30 years of age and occurring more frequently in women than in men, presenting a ratio of 3:1 (BADHEY *et al.*, 2017; BEDI *et al.*, 2019; JALISI; JAMAL; GRILLONE; 2017; MAHMOUD; ASHOUR; 2020; Martello *et al.*, 2019; SAMPAIO *et al.*, 2021; WATERS *et al.*, 2019).

The elongation of the styloid process can occur asymptotically, but when there are symptoms, these present in the most varied ways such as orofacial pain, headache, dysphagia, odynophagia, dysphonia, otalgia, limitation of the mouth opening, limitation of cervical movements and foreign body sensation in the throat (BARDHOSHI *et al.*, 2022; HANDEM *et al.*, 2016; JALISI; JAMAL; GRILLONE; 2017; LINDENBLATT *et al.*, 2018; MAHMOUD; ASHOUR; 2020; Martello *et al.*, 2019; SACCOMANNO *et al.*, 2018; SAMPAIO *et al.*, 2021; WESTBROOK; KABBAZ; SHOWALTER; 2020).

There are also reports in the literature of the occurrence of reversible transient ischemic attacks, with the presence of ophthalmic symptoms and episodes of presyncope due to compression of the carotid artery, as well as decreased blood flow in the middle cerebral artery caused by the elongation of the styloid process (JALISI; JAMAL; GRILLONE; 2017; MAHMOUD; ASHOUR; 2020; SAMPAIO *et al.*, 2021; YOKOYA *et al.*, 2021).

Borges *et al.* (2021) state that even in the absence of symptomatology reported by the patient, it is also important to diagnose cases in which stretching of the styloid process is observed, since in the future these individuals have greater chances of presenting them.

The diagnosis can be made through clinical examination, where the symptomatology referred by the patient will be relevant, as well as the examination of digital palpation in the tonsillar fossa followed by the analysis of complementary examinations such as panoramic radiography and/or computed tomography, considered as the gold standard (BORGES *et al.*, 2021; HANDEM *et al.*, 2016; JALISI; JAMAL; GRILLONE; 2017; MAHMOUD; ASHOUR; 2020; SAMPAIO *et al.*, 2021).

Studies have described that due to the symptoms resembling several pathologies, the elongation of the styloid process can be easily misdiagnosed (such as temporomandibular joint disorder, temporal arteritis, glossopharyngeal or trigeminal neuralgia, and migraine, among others), negatively impacting its treatment, since the diagnosis will not occur in the proper way (GRACCO *et al.*, 2017; Aguiar *et al.*, 2020; NUNES *et al.*, 2021; SAMPAIO *et al.*, 2021).

Fernandes *et al.* (2016) reported that countless times these patients are misdiagnosed, leading to the underdiagnosis of this condition and consequently causing its incidence to be underestimated. Such alteration when not properly diagnosed impacts the quality of life of the patient since its symptomatology causes physical and psychological exhaustion. The authors also emphasize that the

uncertainty of the diagnosis may also burden the health system, considering that this individual may be referred to various specialties in the health area, as well as perform a greater number of complementary tests to reach a correct diagnosis.

Martello *et al.* (2019) emphasize the importance of health professionals being aware of the changes that can be caused by the lengthening of the styloid process since many of these professionals end up treating only symptoms such as cervicofacial pain and in cricopharyngeal regions without success for not including this condition in their diagnoses due to lack of knowledge.

Among the health professionals whose work is inserted in the context of the symptomatology presented, there is the speech therapist, a professional legally qualified for the evaluation and rehabilitation of functions related to vocal, orofacial, auditory, and swallowing alterations (AMERICAN SPEECH-LANGUAGE-HEARING ASSOCIATION, 2015; BRAZIL, 1981; FEDERAL COUNCIL OF SPEECH-LANGUAGE PATHOLOGY AND AUDIOLOGY, 2016; FEDERAL COUNCIL OF SPEECH-LANGUAGE PATHOLOGY AND AUDIOLOGY, 2021). Because of the above, it is worth mentioning that this patient has a high chance of being referred to the speech therapist for evaluation and rehabilitation of such functions. However, no studies were identified in the literature that associated speech therapy with Eagle Syndrome, which may indicate a possible lack of knowledge of these professionals about this alteration. The observed data becomes worrisome since this professional receives patients frequently with the symptoms that are commonly reported in this Syndrome and, based on the assumption that the appropriate diagnosis becomes essential for the success of the rehabilitation process of the functions related to swallowing, voice, hearing and orofacial motricity since it guides the elaboration of the appropriate therapeutic strategies for each patient, The following question remains: could the cases of failure in the process of speech therapy rehabilitation be related to the presence of stretching of the undiagnosed and/or incorrectly diagnosed styloid process?

Due to the possibility of lengthening the styloid process being underdiagnosed due to the lack of knowledge of the health professionals involved in the care of the patient, and also, considering that the symptomatology presented harms the quality of life of these individuals, this study aims to investigate the prevalence of stretching of the styloid process in a population in the South of Brazil and characterize them, as well as contributing to the dissemination of information about the existence of this alteration and its symptomatology to these professionals, thus enabling these patients to be diagnosed and treated appropriately.

2 THEORETICAL FOUNDATIONS

2.1 THE STYLOID PROCESS AND ASSOCIATED STRUCTURES

The styloid process has embryological origin in the second branchial arch of Reichert's cartilage (BALDINO *et al.*, 2020; BRUNO *et al.*, 2022; GRACCO *et al.*, 2017; MUÑOZ-LEIJA *et al.*, 2020; PEREIRA *et al.*, 2022; QURESHI; FAROOQ; GORELICK; 2019). It is formed from an ossification that begins still in the intrauterine life and continues until the eighth year of life (CAVALCANTE *et al.*, 2017).

It is a bone structure that can present in a conical shape, rounded, thin, or enlarged (CAVALCANTE *et al.*, 2017), measuring approximately 25 mm and being located at the base of the skull, laterally to the jugular fossa, anteromedial to the mastoid process and medially to the temporal bone (BORGES *et al.*, 2021; Millán *et al.*, 2019; PEREIRA *et al.*, 2022).

Figure 1 – styloid process.



The arrows in red indicate the location of the styloid process.

Source: the author.

At the medial view are the vagus, accessory, and glossopharyngeal cranial nerves, being still emerged from the stylomastoid foramen, the facial nerve (MILLÁN *et al.*, 2019; PEREIRA *et al.*, 2022). According to Cavalcante *et al.* (2017), the region where the styloid process is situated is innervated by the cranial pairs: V (Trigeminal Nerve), VII (Facial Nerve), IX (Glossopharyngeal Nerve) and X (Vagus Nerve).

The apex of the styloid process reaches the posterior edge of the mandible ramus serving as support to the stylohyoid, stylopharyngeal, and styloglossal muscles (ALZAREA, 2017; PEREIRA *et al.*, 2022; SAMPAIO *et al.*, 2021; SOUZA *et al.*, 2020). In it are still inserted the stylohyoid ligaments (which connect the styloid process to the hyoid bone, and the stylo-mandibular ligament) that extends to the angle of the mandible (BORGES *et al.*, 2021; FERNANDES *et al.*, 2016; GUIMARÃES *et al.*, 2010; GRACCO *et al.*, 2017; LINDENBLATT *et al.*, 2018; MUÑOZ-LEIJA *et al.*, 2020).

The styloid process is situated posterior to the pharynx and between the internal and external carotid artery, these being divisions of the common carotid artery which is responsible, along with the external carotid artery, for the vascularization of the anterior trine of the neck (MILLÁN *et al.*, 2019; PEREIRA *et al.*, 2022). In turn, the internal carotid artery is the main source of irrigation for the brain and orbital structures (CAVALCANTE *et al.*, 2017).

Although the length of the styloid process varies between 25 mm and 30 mm (ALZAREA, 2017; BRUNO *et al.*, 2022; BORGES *et al.*, 2021; DUARTE-CELADA *et al.*, 2021; MUÑOZ-LEIJA *et al.*, 2020; SOUZA *et al.*, 2020; WOLINSKA *et al.*, 2021), several authors state that it can be considered elongated when it is larger than 25 mm (OKADA *et al.*, 2022; SAMPAIO *et al.*, 2021; SANCHEZ-LEGAZA; REPETTO-LOPEZ; GALLEGO-GALLEGOS; 2017), which can occur unilaterally or bilaterally (BRUNO *et al.*, 2022; SHAYGANFAR *et al.*, 2018). According to Guimarães *et al.* (2010), this prolongation may also be accompanied by calcification of the stylohyoid and stylo-mandibular ligament, which may cause symptoms such as craniofacial and cervical pain.

Figure 2 – Elongated styloid process.



The arrows in red indicate the location of the elongated styloid process.

Source: the author.

The etiology is still unknown, but studies indicate that affected patients usually have a history of previous trauma, which could indicate a possible etiological factor (ALZAREA, 2017; BALDINO *et al.*, 2020; NUNES *et al.*, 2021; OZTAS; Orhan, 2012; PEREIRA *et al.*, 2022; SANCHEZ-LEGAZA; REPETTO-LOPEZ; GALLEGO-GALLEGO, 2017; WOLINSKA *et al.*, 2021).

It is hypothesized that the growth of the styloid process causes pressure on nearby structures such as nerves, arteries, and tonsils, which could justify neural, vascular, and autonomic symptoms such as orofacial pain, headache, dysphagia, dysphonia, limitation of cervical movements and foreign body sensation in the throat (JALISI; JAMAL; GRILLONE, 2017; MAHMOUD; ASHOUR, 2020;

SACCOMANNO *et al.*, 2018; SAMPAIO *et al.*, 2021; WESTBROOK; KABBAZ; SHOWALTER, 2020).

Guimarães *et al.* (2010) point out that regardless of the cause of the elongation of the styloid process, it is relevant to remember that it acts as a foreign body reaching the soft tissues, culminating in a series of symptoms involving the regions of the throat, tongue, eyes, middle third of the face, temporomandibular joint and ear. Soares *et al.* (2017) highlight that it often causes pain that can be continuous or intermittent.

Studies indicate that when there is symptomatology associated with the elongation of the styloid process, it is characterized as a syndrome called Eagle Syndrome (AL-AMAD; AL BAYATTI; Alshamsi, 2021; GRACCO *et al.*, 2017; HANDEM *et al.*, 2016).

2.2 STRETCHING OF THE STYLOID PROCESS AND EAGLE SYNDROME

Eagle (1937) conducted a study where he described in detail the symptoms caused by the lengthening of the styloid process, as well as its treatment, which later received the name Eagle Syndrome. In this study, the author stated that this alteration is present in 4% of the population, and of these, about 4% to 10% have varied symptoms. Studies reiterate that there is a higher incidence in females older than 30 years (CAVALCANTE *et al.*, 2017; EAGLE, 1937).

Eagle (1937) described two distinct syndromes, classifying them as Classical Syndrome and Carotid Artery Syndrome. The author stated that Classic Syndrome is the most common and is usually observed after performing tonsillectomy. While Carotid Artery Syndrome is not related to previous surgery in the pharyngeal region, which is associated with mechanical causes due to compression of the internal and external carotid arteries.

In Classic Syndrome, the referred symptomatology is characterized by pharyngeal and auditory symptoms (CAVALCANTE *et al.*, 2017; EAGLE, 1937; HANDEM *et al.*, 2016). In Carotid Artery Syndrome, when the involvement of the external carotid artery occurs, the symptoms usually present are pain in the infraorbital, temporal, auricular, and occipital regions. The point that when the involvement occurs in the internal carotid artery the patient can report a headache that extends from the ophthalmic region to the occipital, and can often be confused with a headache, which ends up inducing underdiagnosis (CAVALCANTE *et al.*, 2017). Still, other studies report that Carotid Artery Syndrome may be associated with the occurrence of transient cerebral ischemic events (MILLÁN *et al.*, 2019; RAFARE; CHAGAS, 2019; SHAYGANFAR *et al.*, 2018; YOKOYA *et al.*, 2021).

The diagnosis should be made taking into account the clinical symptomatology, followed by a physical examination where palpation should be performed on the tonsillar fossa and confirmed through the performance of imaging examination, which can be panoramic radiography, computed

tomography, and even angiography (used to check if there is the involvement of the carotid artery) (LINDENBLATT *et al.*, 2018; SANCHEZ-LEGAZA; REPETTO-LOPEZ; GALLEGO-GALLEGOS, 2017; SHAYGANFAR *et al.*, 2018). According to Cavalcante *et al.* (2017), some symptoms may be considered relevant to aid in the diagnosis, such as pain during head rotation, recurrent headaches, and vertigo.

The appropriate treatment is given through the surgical excision of the styloid process or even in a conservative way, aiming at the relief of the symptoms presented (CAVALCANTE *et al.*, 2017). Studies report that the definition of the type of treatment to be adopted should be taken into account the intensity of the symptoms presented, so that when they present in mild to moderate intensity, one can adopt the conservative form of treatment and, when these present in a severe form, with the presence of intense and refractory pain, it is suggested to opt for surgical treatment (SANCHEZ-LEGAZA; REPETTO-LOPEZ; GALLEGO-GALLEGOS, 2017).

Bruno *et al.* (2022) state that conservative treatment is performed by prescribing drugs to treat neuropathic pain through the use of NSAIDs, carbamazepine, valproate, gabapentin, or amitriptyline, but they also state that in cases where there is persistence of symptoms, the possibility of surgical treatment should be analyzed.

When there is a need for surgical treatment, it can be performed through an intra or extraoral approach, and both techniques have advantages and disadvantages in their applications (EAGLE, 1937; Millán *et al.*, 2019).

In intraoral access, the advantages are the shorter duration of the procedure, the absence of visible scars, less dissection of nearby tissues, and greater brevity in the recovery time. It is considered disadvantages of the use of this technique are the risk of infection of the deep cervical spaces, limited operative field, difficulty in visualization, and deficient exposure to nearby structures increasing the risk of neurovascular injury (EAGLE, 1937; Millán *et al.*, 2019).

Considering the extraoral approach by submandibular route, it is obtained advantages the better visualization of the operative field, as well as of the neighboring structures minimizing the risks of injury of neurovascular structures, but this technique brings disadvantages the presence of scar, the longer time for the surgical procedure and also, the risk of injury of the facial nerve (EAGLE, 1937; Millán *et al.*, 2019).

Bruno *et al.* (2022) emphasizes that for the correct definition of the type of treatment to be adopted, each case should be evaluated individually.

2.3 INTERDISCIPLINARY ACTION IN EAGLE SYNDROME

Considering that the symptomatology presented in Eagle Syndrome is similar to those of numerous other pathologies, health professionals must be aware of the existence of this alteration, especially those whose performance is involved in the diagnosis and treatment of chronic head and neck pain (LINDENBLATT *et al.*, 2018; RAFARE; CHAGAS, 2019).

In a study carried out, the authors emphasized that the diagnosis of nonspecific orofacial pain becomes difficult, with the need for an interdisciplinary approach (SANCHEZ-LEGAZA; REPETTO-LOPEZ; GALLEGO-GALLEGOS, 2017). Millán *et al.* (2019) emphasize that the existence of Eagle Syndrome should be taken into account and investigated in cases of orocervicofacial pain.

Fernandes *et al.* (2016) described in their study a case of Eagle Syndrome in which the patient presented varied and nonspecific symptoms, being referred to several medical specialties for investigation, and even analyzed the possibility of treating psychosomatic symptomatology. The authors emphasize the difficulty and slowness in the process to reach the appropriate diagnosis, which ends up causing great physical and emotional exhaustion of the patient. In the case reported by the authors, the appropriate diagnosis was made about eight months after the first medical consultation.

According to Martello *et al.* (2019), several medical professionals and dental surgeons may be treating only the symptoms of cervicofacial pain and cricopharyngeal regions without success because they do not raise the possibility of Eagle Syndrome.

Most of the symptoms present in Eagle Syndrome fall within the level of primary health care, making it important that professionals working in Family Health Units are aware of this change to avoid incorrect and/or late diagnosis, as well as its possible complications and impacts on the patient's quality of life (FERNANDES *et al.*, 2016).

Yavuz and Keskinruzgar (2019) stated that dental surgeons need to be aware of the differential diagnosis of Eagle Syndrome, given that the symptoms presented can be easily confused with a toothache and Temporomandibular Disorder, which can induce incorrect diagnoses and unnecessary procedures.

Soares *et al.* (2017) state that for an adequate diagnosis of Eagle Syndrome, a careful evaluation is necessary, also taking into account the physical and anatomical variations and characteristic changes that can be proven through imaging examination.

Because most of the symptoms presented are directly related to the areas of activity of the speech therapist (swallowing, voice, hearing, and orofacial motricity), it is essential that this professional also has knowledge related to the possibility of the presence of stretching of the styloid process and its symptomatology to make their contribution to the interdisciplinary team, aiming at the adequate diagnosis of these individuals.

Martello *et al.* (2019) stated that interdisciplinary action, as well as knowledge and understanding about the performance of health professionals from other areas, becomes essential since in this way the patient is seen as a whole, increasing the chances of reaching a correct diagnosis, in a reduced time and still, avoiding unnecessary treatments.

3 GOALS

This study aims to investigate the prevalence of styloid process elongation in digital panoramic radiography exams performed at the Dental Imaging Laboratory of the State University of Ponta Grossa – UEPG, in the period from 2021 to 2022 and to describe its characteristics regarding sex, age, affected side, and morphological type.

4 MATERIALS AND METHOD

4.1 SAMPLE

This study was approved by the Research Ethics Committee of the Universidade Estadual de Ponta Grossa – UEPG with opinion number 1,473,168. This is research characterized as descriptive, cross-sectional, and retrospective.

We analyzed the medical records and panoramic radiography exams of 240 individuals over 18 years of age who were treated at the Dental Clinic of the State University of Ponta Grossa – UEPG and underwent digital panoramic radiography in 2 years (2021 and 2022). Demographic data of sex and age were also recorded.

During the analysis of the images, the inclusion criterion was to be at least 18 years old. The present study dispenses with the use of the Free and Informed Consent Form (ICF), considering that the data used come from the image bank of the Dental Laboratory of UEPG.

4.2 IMAGE ACQUISITION AND ANALYSIS

The exams analyzed in the present study were performed in their entirety at the Dental Clinic of the State University of Ponta Grossa – UEPG, using the Tomographic/Panoramic equipment model Eagle® (DABI Atlante). The images were analyzed by a single previously trained examiner. They had JPG format and were analyzed through the native *software* of the equipment for analysis.

To perform the analysis of the styloid process, the morphological classification proposed by Langlais *et al.* was adopted. (1986), which is performed according to the aspect of the radiographic image presented, and can be classified into three types: type I - elongated, type II - pseudo articulated, and type III - segmented.

In the classification of type I – elongated the styloid process occurs continuously and uninterrupted, while in type II – pseudoarticulated the styloid process is joined to the stylomandibular ligament or stylohyoid forming a pseudo articulation and in type III – segmented there are several mineralized segments (Fig. 1) (PIEDMONT; OF MELLO; BSPREADOK, 2014; LANGLAIS; MILES; VAN DIS, 1986; MAHMOUD; ASHOUR, 2020).

Figure 1 – Morphological classification.



On the left in the figure, the classification of type I: is elongated. In the center of the figure, is the classification of type II: pseudoarticulate. To the right of the figure, the classification of type III: segmented. Adapted from Mahmoud and Ashour (2020).

4.3 DATA ANALYSIS

The data obtained were tabulated using a Microsoft Excel spreadsheet and later analyzed using descriptive statistics. For statistical analysis, the individuals were divided into groups according to age group, namely: individuals aged between 18 and 39 years, between 40 and 59 years, and over 60 years.

The Kolmogorov-Smirnov test was used to verify the normality of the data. For comparison analysis of the prevalences in the different subgroups (sex, age, and morphological type), the chi-square test was used. The test was performed using the SPSS v.24 software for Windows. For all analyses, the significance value adopted was $p < 0.05$.

5 FINDINGS

Of the total sample, 101 (42%) individuals were male and 139 (58%) were female, being subdivided into groups according to age group, as described in Table 1.

Table 1 – Characterization of the sample.

| | |
|--------------------------|------------|
| Gender | |
| Male (n, %) | 101 (42,0) |
| Female (n, %) | 139 (58,0) |
| Age group | |
| 18-39 years (n, %) | 159 (66,2) |
| 40-59 years (n, %) | 53 (22,1) |
| 60 years or older (n, %) | 28 (11,7) |

Source: the author.

Considering the prevalence of styloid process elongation in the sample analyzed, 50 cases (20.8%) were obtained, 16 cases (15.8%) in male patients, and 34 cases (24.5%) in female patients. The data related to gender are described in Table 2.

Table 2 – Comparison of the prevalence of stretching between men and women (n = 240).

| | Total (n = 240) | Men (n = 101) | Women (n = 139) | p |
|------------------------|-----------------|---------------|-----------------|------|
| Stretching present (%) | 50 (20,8) | 16 (15,8) | 34 (24,5) | 0,11 |

Source: the author.

When comparing the prevalence of stretching between different groups classified by age group, a total of 29 cases (20.9) were obtained in patients aged 18 to 39 years, 18 cases (13%) in patients aged 40 to 59 years, and 3 cases (2.2%) in patients over 60 years. These data are described in Table 3.

Table 3 – Comparison of the prevalence of stretching between different age groups (n = 240).

| | 18-39 years (n = 159) | 40-59 years (n = 53) | 60 years or older (n = 28) | P |
|------------------------|--------------------------|-------------------------|-------------------------------|-------|
| Stretching present (%) | 29 (20,9) | 18 (13,0) | 3 (2,2) | 0,02* |

* = p < 0.05.

Source: the author.

Considering the affected side (unilateral or bilateral), it was observed that 23 cases (46%) were unilateral and 27 cases (54%) were bilateral. Data on the prevalence per affected side are described in Table 4.

Table 4 – Comparison of the prevalence of unilateral and bilateral stretching (n = 50).

| | Unilateral | Bilateral | p |
|------------------------|------------|-----------|------|
| Stretching present (%) | 23 (46,0) | 27 (54,0) | 0,42 |

Source: the author.

About the individuals who presented unilaterally elongated styloid process, when comparing the prevalence between the right and left sides, it was observed that in 15 cases (65.2%) the alterations were present on the right side, and in 8 cases (34.8%) they were on the left side. The data cited are described in Table 5.

Table 5 – Comparison of the prevalence of stretching between the right and left sides (n = 23).

| | Right Side | Left Side | p |
|------------------------|------------|-----------|-------|
| Stretching present (%) | 15 (65,2) | 8 (34,8) | 0,04* |

* = p < 0.05.

Source: the author.

Analyzing the most prevalent morphological type, we obtained 41 cases (82%) of type I - elongated and continuous and 9 cases (18%) of type III - segmented, as described in Table 6.

Table 6 – Comparison of prevalence according to morphological classification (n = 50).

| | Type I - Continuous | Type III - Segmented | p |
|------------------------|---------------------|----------------------|----------|
| Stretching present (%) | 41 (82,0) | 9 (18,0) | < 0.001* |

* = p < 0.05.

Source: the author.

6 DISCUSSIONS

The elongation of the styloid process has been the target of study in the most diverse populations around the world, with high variability in its prevalence being observed (BRUNO *et al.*, 2017). Some cases may be associated with very varied and nonspecific symptomatology, which may end up inducing incorrect diagnoses and inadequate treatments (SACCOMANNO *et al.*, 2021; CAVALCANTE *et al.*, 2017; SOARES *et al.*, 2017; SAMPAIO *et al.*, 2021).

Eagle (1958) stated that the styloid process can be considered elongated when it presents a length greater than 25mm and, being associated with the presence of symptoms, can be classified as Eagle Syndrome or Styloid Syndrome. However, other authors report that this structure should be considered elongated only when it has a length above 30mm (BALDINO *et al.*, 2020; NUNES *et al.*, 2021; DUARTE-CELADA *et al.*, 2021; WOLINSKA *et al.*, 2021). However, it is worth mentioning that in the literature there is a study report, where the Computed Tomography scans of 133 individuals diagnosed with Eagle Syndrome were evaluated, where the authors observed that about 15.4% of the cases had a styloid process with a length of less than 30 mm (CHEN *et al.*, 2017; LISAN *et al.*, 2019).

In a systematic review study, the authors stated that the highest mean about the length of the styloid process was observed in a group whose individuals were aged > 54 years, that is, apparently there is an association between the length of this structure and the increase in age, which suggests that the length of this structure can be considered a continuous variable, considering that this tends to increase with the age of the individual (BRUNO *et al.*, 2022; BRUNO *et al.*, 2017). However, Kapur *et al.* (2022) stated that the length of the styloid process may present variations due to differences related to different populations and ethnic groups.

Given the wide variability found in the literature, it can be concluded that there is still no consensus regarding the length that can be considered normal or elongated (BALDINO *et al.*, 2020;

MUÑOZ-LEIJA *et al.*, 2020). Therefore, in the present study, we considered the styloid process that presented a length above 25 mm to be elongated.

Regarding prevalence, in this study, we observed that the elongated styloid process was present in 20.8% of the sample analyzed, which is similar to some data found in the literature, such as in a study conducted in Saudi Arabia, where 2,010 panoramic radiography examinations of patients seen in the dental services of five large hospitals were analyzed, where the authors observed that 25.4% of the analyzed sample had an elongated styloid process (ALSWEED; ALMUTAIRI, 2022). Souza *et al.* (2020) conducted a study through the analysis of dry skulls, obtained through donation, from the cemetery of a municipality in Paraná, with a prevalence of 15% of elongation of the styloid process. And yet, in the study conducted by Shayganfar *et al.* (2018) where 393 CT scans of patients with a history of previous trauma in a hospital in Iran were analyzed, the authors observed a prevalence of styloid process elongation in 22.4% of the sample and, although the study was conducted using another type of imaging test, the result found corroborates what was observed in our study.

Although there are reports in the literature of prevalence similar to that found in the present study, it is worth mentioning that there are also several studies pointing out a great variability of observed prevalences, as in the study conducted by Nunes *et al.* (2021) with a Brazilian population, where 503 panoramic radiography exams were analyzed, and it was observed that 46.2% of the sample had elongation in the styloid process. Bruno *et al.* (2022) conducted a systematic review study where they analyzed the scientific publications related to the use of panoramic radiography as a diagnostic method for the elongated styloid process and observed that the prevalence of stretching ranged from 3.7% to 51.2%.

In our study, when considering the most affected sex, there was a higher prevalence in females (24.5%) than in males (15.8%), but this difference was not statistically significant. This finding is in agreement with other studies conducted (CAVALCANTE *et al.*, 2017; GUIMARÃES *et al.*, 2010; WATERS *et al.*, 2019), but diverges from others where the authors observed higher prevalence in the male population (NUNES *et al.*, 2021; MUÑOZ-LEIJA *et al.*, 2020; GRACCO *et al.*, 2017). Some authors state that although in their studies no predilection was observed with sex when compared to the presence of associated symptomatology, a statistically significant difference was observed, where symptoms were more prevalent in women than in men (CAVALCANTE *et al.*, 2017; SWAPNA *et al.*, 2021), which may explain the fact that some studies report a higher prevalence of Eagle Syndrome in the female population since there are symptoms, the patient tends to seek medical attention, favoring the diagnosis.

When comparing the prevalence of the elongated styloid process among different groups classified by age group, we observed that the most affected individuals (20.9%) were aged between 18

and 39 years, followed by individuals aged between 40 and 59 years (13%). About this data, we observed a statistically significant difference, where patients over 60 years of age had the lowest prevalence (2.2%). The observed result corroborates the study conducted by Swapna *et al.* (2021), where panoramic radiography exams were analyzed, and the authors observed that the prevalence of the elongated styloid process was higher in individuals aged between 20 and 39 years, occurring in smaller numbers in individuals aged over 50 years. Chu *et al.* (2022) conducted a study through the analysis of Computed Tomography scans in a Taiwanese population, where they observed a higher prevalence in individuals aged between 21 and 30 years (45.24%), followed by individuals aged between 31 and 40 years (30.95%), being less prevalent in the population whose group was formed by individuals over 41 years (9.52%).

The cases in which the elongated styloid process was presented bilaterally were more prevalent in our study (54%) and, although no statistically significant difference was observed, this finding is in agreement with several other studies found in the literature, where the authors state that when comparing the affected side, taking into account the form of unilateral or bilateral involvement, the highest prevalence observed occurs in the bilateral form (SOUZA *et al.*, 2020; ALZAREA, 2017; MUÑOZ-LEIJA *et al.*, 2020; BUYUK; GUNDUZ; AVSEVER, 2018; CHU *et al.*, 2022; CAVALCANTE *et al.*, 2017; GRACCO *et al.*, 2017; GUIMARÃES *et al.*, 2010; CARVALHO *et al.*, 2021). However, although in smaller numbers, there is also a report in the literature of a study conducted where the form of unilateral involvement was more prevalent (GOVINDARAJALU; SHARMA; PARSANA, 2020), as well as a study where no predilection for the uni or bilateral form was observed (SOUZA *et al.*, 2020).

In cases where the elongated styloid process was present unilaterally, when compared to which side was most affected (right or left), we observed a statistically significant difference, where changes on the right side (65.2%) were more prevalent than on the left side (34.8%), which is consistent with another study conducted through the retrospective analysis of medical records of patients with Eagle Syndrome, underwent excision of the styloid process, where it was observed that 65% of the patients had the right side affected, while 35% had the styloid process elongated on the left side (GOVINDARAJALU; SHARMA; PARSANA, 2020). However, some authors report having observed a higher prevalence on the left side than on the right side (KAPUR *et al.*, 2022; GUIMARÃES *et al.*, 2010).

In our study, considering the morphological classification proposed by Langlais *et al.* (1986), a statistically significant difference was observed, where the most prevalent type of styloid process was type I (continuous or uninterrupted elongated), being observed in 82% of the sample, followed by type III (segmented), observed in 18% of the cases. The data presented are in agreement with the results

obtained in several studies, where the authors report a higher prevalence of type I stretching (MUÑOZ-LEIJA *et al.*, 2020; ALZAREA, 2017; BUYUK; GUNDUZ; AVSEVER, 2018; CHU *et al.*, 2022), followed by type III (ALSWEED; ALMUTAIRI, 2022).

Several authors report that the panoramic radiography exam is effective in the diagnosis of the elongation of the styloid process and also point to the benefits of using this exam, considering that they are tests commonly requested in cases of orofacial pain, easy to perform and interpret, in addition to avoiding the exposure of the individual to higher doses of radiation (compared to computed tomography) and also, being more economical. Such benefits favor its use for the investigation and diagnosis of this alteration, as well as for the performance of epidemiological studies (BRUNO *et al.*, 2019; SACCOMANNO *et al.*, 2021; SWAPNA *et al.*, 2021).

Although this alteration has been widely studied in the most diverse populations worldwide, it is observed that in the literature there is no consensus on several aspects, considering that the studies differ both concerning the length of the styloid process that should be considered elongated and with the prevalence of this alteration, being reported in the studies a high variability.

However, it is worth mentioning that most of the authors emphasize the extreme importance of health professionals being aware of this alteration, considering that interdisciplinary action in these cases is fundamental to reaching the diagnosis and appropriate treatment, minimizing the negative impacts on quality of life, as well as the physical and emotional exhaustion of these patients, and also, reducing the costs of the health system, since these individuals will not be erroneously referred to various specialties, nor will they perform unnecessary procedures/treatments.

It is important to note that the vast majority of scientific publications found on the subject come from medical and dental professionals, and no study by speech therapists is located in the databases. Considering that this is the professional legally qualified for evaluation and rehabilitation of various functions related to the head and neck, acting directly on most of the symptoms that are commonly reported by these patients, it is necessary to disseminate knowledge also to this category of professionals so that, knowing of the existence of this alteration, they can contribute to the interdisciplinary team in the diagnosis and appropriate treatment.

Although our study fulfilled the objective of evaluating the prevalence of the elongated styloid process, as well as describing its characteristics, it is important to emphasize that it presented some limitations, such as the absence of information related to the presence of symptoms in these patients, which would make the study even more complete. However, it can be considered as a starting point for further studies, where the presence of symptoms associated with the elongation of the styloid process can be identified and clinical examination (in addition to imaging) can be performed to identify the prevalence of Eagle Syndrome in our population and thus, through more robust data, to be able to

disseminate even more information, drawing the attention of health professionals to the existence and importance of the correct diagnosis of this syndrome.

6 CONCLUSIONS

The elongation of the styloid process presented a relevant prevalence in the population studied (20.8%), occurring more frequently in women, in individuals aged 18 to 39 years, in the bilateral form and more commonly in morphological type I (continuous or uninterrupted elongation).

Given the above, it is worth emphasizing the importance of considering the possibility of the presence of this alteration in cases of pain or discomfort in the orofacial region. Therefore, it is essential to disseminate information related to the existence of the elongated styloid process and its symptomatology to health professionals.

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