

Anatomical Variations of the Styloid Process and Eagle's Syndrome: an Integrative Review

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ABSTRACT

Introduction: the styloid process (PE) is a bony, cylindrical that originates in the posterior region of the temporal bone. The elongation of PE is known to cause a series of symptoms, but the cause is still unknown. The Eagle's syndrome (ES), or stylalgia, is a rare abnormality caused by an elongated styloid process (EP). This study aims to establish the relationship between anatomical variations of the EP with ES, highlighting its importance and relevance in the diagnosis of the disease.

Review: for this, a search was performed in the Pubmed and Science Direct databases, using the descriptors "Eagle syndrome", "Eagle's syndrome", "Anatomic Variation", "Elongated styloid process syndrome", "styloid stylohyoid syndrome", "elongated styloid process". A total of 117 articles were obtained, and after critical reading 22 portrayed case reports and research articles relevant to the study. The variation of the EP, both in length and angulation, favors the development of SE. Its modification will not necessarily lead to symptoms and surgical needs, but professionals must be aware of the symptoms that may arise, such as headache, pharyngeal pain, and otalgia. In the diagnosis, computed tomography and magnetic resonance imaging are often used to verify their involvement with nearby noble structures, such as the internal jugular vein and the internal carotid artery. Also, temporomandibular dysfunction (TMD) is one of the differential diagnoses, and it may present symptoms characteristic of PE stretching.

Conclusion: the development of further studies on ES is important to understand and direct a better treatment, using imaging studies and formulating a new standard of normality of the EP.

Keywords: Anatomy; Styloid process; Eagle syndrome.

Introduction

The styloid process (PE) is a bony, cylindrical cartilaginous anatomical accident that originates in the posterior region of the temporal bone¹. The PE is located in front of the styloid foramen. Together with the styloid ligament and the hyoid horn, they form PE and are usually 16 to 30 mm long and vary from person to person, depending on how each skull develops², however, the average length of an adult EP is 2.5 to 3 cm¹.

Therefore, when it exceeds 3 cm for congenital or acquired reasons, it stimulates multiple cranial nerves (V, VII, IX, X) and sympathetic nerves, thus alleviating several clinical symptoms¹. Although the cause of PE elongation is unknown, factors such as acquired trauma or genetics, such as hormones and excessive calcification, may be important causal factors to highlight¹⁻³.

Thus, Eagle syndrome, or stylalgia, is a rare abnormality caused by an elongated styloid process⁴⁻⁶. In many cases, the symptoms are a lump in the throat, frequent sore throat, otalgia, headache, carotid artery pain, decreased mobility of the cervical spine, and pain when opening the mouth⁵⁻⁷. However, these symptoms can worsen when swallowing, chewing, moving the tongue, rotating the head, or palpating the tonsillar fossa^{5,8}. As they are not specific, they can be confused with other diseases, such as facial muscle pain, temporomandibular joint pain, etc.⁵.

Then, in 1652, Marchetti realized the first case of ossified elongated PE⁹. In 1872, Weinlechner reported on the first operative case of painful PE elongation¹⁰. In 1937, Watt Eagle discovered two types of pharyngeal discomfort associated with elongated PE¹¹. Eagle described that there are two different descriptions: typical, presenting if there is atypical pain and foreign

body sensation, followed by carotid styloid syndrome⁶.

There are several ways to treat Eagle syndrome, including medications, surgery, or a combination of the two^{5,10,12}. Treatment is usually non-surgical and includes corticosteroids and anesthetics⁵. But in some patients who do not respond to treatment, surgery is needed to improve their condition¹³.

Therefore, this integrative review aims to establish the relationship between anatomical variations of the styloid process with Eagle syndrome, highlighting its importance and relevance in the diagnosis of the disease.

Methodology

An integrative review was conducted on the relationship between the anatomical variation of the styloid process and Eagle syndrome^{14,15}. For this study, the following databases were consulted: Pubmed (National Library of Medicine and National Institute of Health) and ScienceDirect. Articles were selected with a time restriction of the last 10 years in Portuguese, English, and Spanish.

For the search, the descriptors were used in combination with Boolean operators (AND and OR). In Pubmed, the Mesh descriptors were: "Eagle syndrome" OR "Elongated styloid process syndrome" OR "styloid stylohyoid syndrome" OR "Eagle's syndrome" OR "elongated styloid process" AND "Anatomic Variation";

and in Sciencedirect the Mesh descriptors were: "elongated styloid process" OR "Eagle syndrome" OR "Eagle's syndrome" AND "Anatomic Variation".

In the total tabulation of studies, it was identified that there were three repetitions in more than one base, and each article was considered only once. Inclusion criteria were research articles and case reports that addressed the anatomical variation of the styloid process and its relationship with Eagle's syndrome, prioritizing those that involved numerical data; as exclusion criteria, book chapters, and review articles. After being identified, those that belonged to the study objective were selected; those that did not fit were excluded.

Results

The overview of the electronic database search and the inclusion directions are shown in Figure 1.

Initially, 770 articles were identified. After being submitted to the inclusion and exclusion criteria, this number was reduced to 120, of which 3 were excluded for being duplicates, totaling 117 articles for analysis of the titles and abstracts. Of these, 36 articles were read in full, and only 22 had data relevant to the study objective.

Table 1 reveals the main findings of the studies used for the discussion. They are organized by sample, research approach, and main results.

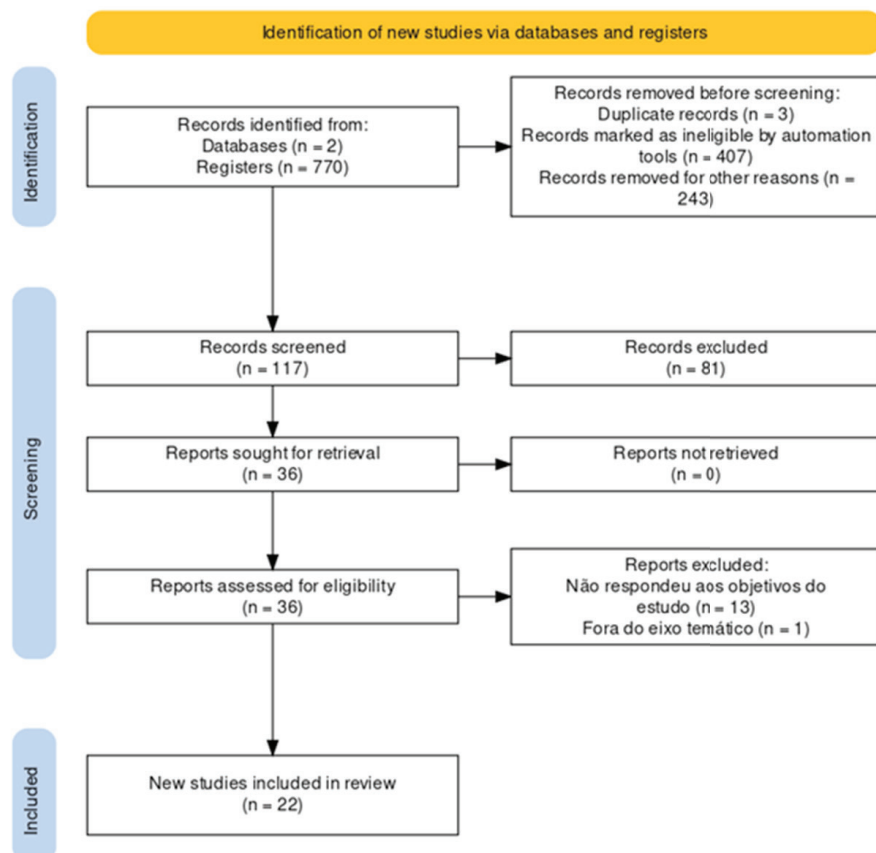


Figure 1. Search and selection of studies for the integrative review according to PRISMA recommendations. Source: Prepared by the authors.

Table 1. Characteristics of the studies that evaluated the relationship between anatomical variations of the styloid process and Eagle's syndrome.

Sample	Research Approach	Main results	Author
285 CT scans	CT scans	The clinical symptoms of Eagle syndrome were related more to the medial angulation of the styloid process than its length.	Al-Amad, Bayatti and Alshamsi
Single case report	Incidental finding of an elongated styloid process at autopsy	7 cm styloid process with absence of eagle's syndrome symptoms.	JADAV <i>et al.</i>
539 digital panoramic radiographs of patients with clinical symptoms	Evaluation of the average length of the right and left styloid process	The mean length of the styloid process in the Taiwanese population was 30 ± 0.7 mm (right side) and 29 ± 0.7 mm (left side)	CHEN, YEH, and HUANG.
100 digital panoramic images	Evaluation regarding the radiological characteristics of the styloid process.	The mean radiological length of the Sri Lankan population was 25.8 ± 7.5 mm and 23.2 ± 9.0 mm (right and left side) .	HETTIARACHCHI <i>et al.</i>
Computed tomography angiography (CTA)	CTA evaluation of the average length of the styloid process and the styloid-carotid process distance	The average length of the styloid process was 27.5 mm, and the distance between the styloid process and the internal carotid artery was 5.14 mm.	CRUDDAS, JOFFE, and BAKER.
99 computed tomography images	Evaluation of styloid process morphology and angulation	The mean lengths of the styloid process showed great morphological variability. In asymptomatic patients, the mean is above 30 mm. The author suggests a new normal range of length and angulation of the styloid process.	MUÑOZ-LEIJA <i>et al.</i>
Case report and CT scan pictorial review	Evaluation of the styloid process by review of computed tomography	The examination revealed a bilateral elongation of the styloid process measuring 51 mm on the right and 37 mm on the left and presenting a	SCAVONE <i>et al.</i>
Single case report	Evaluation of the styloid process using computed tomography	The CT scan revealed an elongation of the styloid process beyond the mandibular plane, close to the hyoid bone. In addition, an elongation of the upper horn of the thyroid cartilage was located.	SEKIDO <i>et al.</i>
Blunt dissection	Evaluation of osteogenic alterations in the lengthening of the styloid process in patients with Eagle syndrome	In 4 cases, the styloid process was very long, bone deposition was active in the upper part, and bone deposition was rare in the outer part	KIM <i>et al.</i>
MR angiography and three-dimensional computed tomography angiography	Evaluation of the styloid process in a patient with a juvenile stroke	Diffusion imaging revealed acute right frontal infarction, and angio-MRI showed occlusion of the distal cervical segment of the right internal carotid artery (ICA) and occlusion of the M3 branch of the ipsilateral middle cerebral artery. Additional 3D CT angiography images demonstrated a dissection of the cervical ICA adjacent to an elongated ipsilateral styloid process up to 3.1 cm long.	SHINDO <i>et al.</i>
Application report and a double-layer nitinol micro mesh stent	Evaluation of the styloid process using the CASPER carotid stent	Postoperative CT scan and angiography revealed an aneurysm formation by a 33 mm long styloid process compressing the internal carotid artery.	MATSUKAWA <i>et al.</i>

Case Report	Evaluation of carotid artery compression of the styloid process by surgical resection treatment	Styloid carotid syndrome can cause a stroke and severe neck pain that radiates into the ear. Not all elongated styloids are symptomatic; therefore, elongated styloids are more common than the clinical syndrome.	JELODAR <i>et al.</i>
Single case report	Evaluation of Eagle syndrome by computed tomography angiography	On examining the bone structure, the styloid process was longer than normal: 46 mm (right side) and 50 mm (left side). In addition, the right styloid process was adjacent to the internal carotid artery, causing slight compression on the artery.	MICHIELS <i>et al.</i>
192 x-ray images	Evaluation of the styloid process in TMD patients using X-ray imaging	In patients with temporomandibular joint dysfunction, the mean length of the styloid process was 40.8 mm in both genders. The mean length and angle of the styloid process were 40.4 mm and 54.9° in women, and 42.1 mm and 63.4° in men, respectively.	KROHN <i>et al.</i>
171 panoramic radiographs	Evaluation of the stylohyoid complex in TMD using panoramic radiographs	No associations were found between temporomandibular dysfunction (TMD) and ossification of the stylohyoid complex (SCO). But it was noticed that some symptoms of SCO are also present in TMD patients.	SANCIO-GONÇALVES <i>et al.</i>
5 computed tomography (CT) scans	CT evaluation of the styloid process in patients with clinical symptoms	CT demonstrated enlargement of the styloid process in 3 patients, 4 patients had a better outcome with neuromodulator therapy, and 1 patient required surgical resection of the styloid process.	GONZÁLEZ-GARCÍA, GARCÍA-AZORÍN and PORTA-ETESSA.
Single case report	Axial computed tomography with 3D reconstruction	A patient with a 37 mm long styloid process presented with painful symptoms when moving the mandible laterally to the right.	JASSO, MUNGUIA, and AMADOR.
2 Case reports	CBCT scans	The length of the styloid process of the woman was 28.13 mm, and its apex is located below the level of the mandibular foramen, 7.55 mm from the superior border of the ossified ligament. While the length of the styloid process of the man was 33.01 mm, the left side is 35.11 mm.	KABAK <i>et al.</i>
121 cone beam computed tomography scans	Evaluation of styloid process characteristics in the Taiwanese population using CBCT	12 patients had unilateral styloid process and 109 patients had bilateral styloid process, its mean length was 26.34 ± 7.44 mm. Forty-two patients had ESP.	CHU <i>et al.</i>
Case Report	Evaluation of Eagle Jugular Syndrome by means of magnetic resonance imaging and angiography	Hypertension induced by internal jugular vein (IJV) compression can trigger the development of dural arteriovenous fistula (DIVF).	SUZUKI <i>et al.</i>
Dissection of the styloid process	Evaluation of Eagle syndrome by extraoral dissection of the styloid process	The specific cause of this chronic pain that limits quality of life can be revealed using cheaper diagnostic techniques. Thus, differentiation of the symptom complex from temporomandibular joint disorders is easier.	THOENISSEN <i>et al.</i>
200 human skulls	Macroscopic analysis of the bilateral styloid process of the skull measured with a digital caliper	Of 200 skulls analyzed only 14 showed the elongated styloid process, with a mean length of 25.8±4.68 mm and 24.2±4.54 mm for the right and left sides, respectively.	KAPUR <i>et al.</i>

Main Outcome/Outcomes

In a study on the effect of the medial angulation of the styloid process by the University Dental Hospital Sharjah, the relationship between the angulation of the styloid process, the styloid process, and the symptoms of Eagle syndrome revealed, in a sample of 88 patients, in which the mean age of women was 42.8 years and men were 41.8 years, the predominance of the cervicgia symptom, with 31.8%. In addition, the medial angulation of the right styloid process, tied to its length and the patient's age, was predominantly associated with Eagle syndrome compared to the left styloid process¹⁶.

In an analysis of the prevalence of the elongated styloid process in the Taiwanese population, 539 digital panoramic radiographs were analyzed, and a significant difference was found in the length of the styloid process of the portion of the population reporting symptoms of Eagle syndrome compared to the length of the styloid process in the general Taiwanese population. Meanwhile, the length of the styloid process increased with the patient's age. Moreover, 41.5% had an elongated styloid process on the right side and 32.6% on the left side, and females were predominant. Considering the Taiwanese general population, the difference in length was obtained on the right side (56.17%) and left side (42.39%). However, it is notable that in the groups, patients aged between 41 and 60 years showed a longer styloid process compared to patients aged between 21 and 40 years. Therefore, the length was shown to be more elongated in patients with greater age and in those who presented symptoms related to Eagle Syndrome².

In the study on the proposal for the definition of the elongated styloid process, 99 CT images were obtained from patients with a mean age of 42 years of which 61% were male and 39% female. However, their gender was not a statistically important factor since there was considerable similarity between both genders regarding the length of the styloid process. Thus, 27.6% of the patients had an elongated styloid process, and the mean age of those with elongated PE was 51.73 years. Moreover, the "pseudo-articulated" and "segmented" types showed a significant difference in the type of anatomical variation ($P = 0.009$ and $P = 0.003$). With regard to angle, the sagittal angle was negligible compared to the right transverse angle in men compared to women (Altmamn *et al.*, 2022).

In the report on elongated styloid process syndrome with prolongation of the upper horn of the thyroid cartilage, one can observe cervical discomfort and pain on swallowing as common and important symptoms in the patients analyzed, are related to the styloid process syndrome. In this perspective, abnormalities in the thyroid cartilage, such as prolongation and deviation of the upper horn, are related to this pain and discomfort in the cervical region. The styloid process syndrome is more frequent in females and in patients

around 30 years of age or older. Regarding the length of the right styloid process, 60 mm was detected, and the upper horn of the thyroid cartilage was 23.2 mm. A long length of the hyoid bone was observed, and it is even suspected that calcification of the hyoid styloid ligament was the cause of its lengthening¹⁷.

By performing CT in one patient, bilateral elongation of the styloid process and medial deviation in shock with maxillary arteries were evidenced. Such findings are linked to the symptoms reported as cervicofacial pain. The patient in this case had no history of tonsillectomy or trauma. Thus, the 3D CT enabled the diagnosis of this syndrome and even a possible surgical procedure for the studied individual⁶.

In autopsies, many times, when analyzing cases of sudden death, it is possible to find cases in which the elongated styloid process compromised some cervical structure such as neurovascular compression, thus being an important clue to the cause of death. In addition, causes of fractures of the elongated styloid process can aid in the analysis of causes of death by hanging or strangulation. Headache and neck pain are commonly reported in sufferers of this condition; however, this diagnosis is most often considered after other possible causes for these symptoms have been ruled out¹⁸.

Regarding carotid artery anatomy, 355 patients were analyzed; among them, 50 had cervical carotid artery dissection (CCAD); of these, 4 had bilateral dissection. The relationship between styloid process length or styloid process-internal carotid distance and CACD revealed other symptoms. Thus, taking into consideration the demographic analysis and clinical presentation, studies demonstrate the average age and gender of patients with CACD, as well as traumatic mechanisms in 8% of patients and focal neurological evidence in 76% of patients. Such data were obtained from the study in relation to the control groups. When considering the controls, an aberrant artery was observed in 12 cases when compared to 94 of those who did not. In addition, the results of the surgery analyses show no dissection growth associated with styloid process length¹⁹.

The study on the styloid process in a Sri Lankan population indicated, regarding gender, the following percentages: 34.9% in males and 24.6% in females. The mean length was greater in men; however, the mean angulation values of the styloid process were greater in women. By observing the analysis of the tables, it can be seen that 29% of the individuals had an elongated styloid process, 24.6% of the women had this characteristic, and most of them had unilateral elongation. In men, 34.9% presented an elongated styloid process, and the occurrence of this anatomical variation in female and male people was not statistically significant²⁰.

In the cases analyzed about osteogenic alterations in elongated styloid processes of patients with Eagle

syndrome, active bone deposition is evident at the tip of the bone and a rare deposition in the lateral one. With this, the histochemical localization of osteogenic proteins as characteristic of the periosteal membrane, osteoid matrix, ligament fibers, and muscle bundles of each apex of the styloid process is perceived. In addition, the studies show immune reaction for osteogenic protein BMP-2, revealing its presence in the apex of the peritoneal membrane and in the ligament fibers of the styloid process. Staining for the protective proteins HSP-70 and HO-1 was clearly positive in the apical areas of the styloid process. Finally, the presence of multiple calluses in the medullary space occurred in the proximal area of the styloid process²¹.

Maxillofacial surgery for a patient at the Adolfo López Mateos Hospital in Mexico City has proven to be an effective and efficient procedure, as it performs the excision of the hyoid-style ligament with few anatomical and post-surgical risks. The patient in question was 53 years old and reported cervical and lateral neck pain. The analysis of this case is important to alert about the benefits of this procedure and the post-surgical treatment¹².

The reported case of a patient who suffered a bilateral ischemic stroke due to compression of the carotid artery by an elongated styloid process concerns a 40-year-old man, who had already suffered a stroke. This is the first case of a bilateral ischemic stroke due to an elongated styloid process caused by compression of the carotid artery. The removal of the styloid process was successful surgically²².

When assessing the relationship of the presence between elongated styloid process in patients with temporomandibular dysfunctions, mandibular ramus length, and sagittal angulation were obtained from x-ray images of the temporomandibular joint (TMJ) of 192 patients diagnosed with DRC/TMD. Regarding the ramus height, it was observed that it was more pronounced in women²³.

The study on ossification of the stylohyoid complex in temporomandibular dysfunction (TMD) indicated that TMD is associated with pain when swallowing ($P=0.023$) and pain when turning the head ($P < 0.001$). Regarding the gender of these patients: with TMD, 93.6% women; without TMD, 86.0% women in the group. In the analyses, no relationships were obtained between the elongated styloid process and ossification. In addition, there was no relationship between the side of pain and the side of elongation of the styloid process²⁴.

Regarding the clinical delimitation of the styloid process in both tonsillar fossae, in some patients, there was a predominance of pain on the left side of the ear or cervical region. In three patients, the images obtained by tomography revealed elongation of the style apophysis and/or calcification of the stylohyoid ligament. In addition, the most recurrent symptom in these patients was chronic and continuous pain in the

temporal region, with exacerbations by swallowing⁷.

In a case in which the carotid bleeding was caused by compression and perforation of the internal carotid artery, its relationship with Eagle syndrome was analyzed. The patient's cough was an important factor, since neck rotation was a possible cause of the contact between the styloid process and the internal carotid artery, thus occurring the laceration of the artery. Thus, the lack of apparent cause for bleeding in the carotid artery is a relevant factor in determining Eagle syndrome⁸.

Elongation of the styloid process and calcification of the styloid ligament are associated with Eagle syndrome. It is important to note that such abnormalities compress the carotid artery. Thus, this syndrome includes carotid artery dissection, focal stenosis, and pseudoaneurysm. Regarding gender, male patients, aged about 40 years, presenting with pain in the neck region and weakness in the right arm, presented as carriers of the syndrome²⁵.

It is important to note that nonspecific neck pain, the presence of stroke, and cervical artery dissection are important indicators of Eagle syndrome. Thus, patients with a mean age of 45 years who present with cervical carotid artery dissection are considered common cases of juvenile stroke. It is also noteworthy that the elongated styloid process is an important cause of cervical carotid artery dissection. In addition, it is worth noting that patient education is an important factor, as flexion or extension of the cervical region impacts their condition²⁶.

In the images obtained from CT scans of a Taiwanese population, different ossification patterns of the styloid process were obtained. Thus, the highest frequency belonged to the group aged 21 to 30 years, representing 45.24%; while the lowest frequency belonged to people aged 41 years, with a percentage of 9.52%. Regarding the group of patients with the unilateral styloid process, the number of women exceeded the number of men; as for the group of patients with a styloid process on both sides, the number of women without the syndrome was higher than the number of men. Regarding patients with an abnormality on only one side, there was no difference in the occurrence of gender. However, with regard to the bilateral presence, the number of men was higher than the number of women²⁷.

Ossification of the stylohyoid ligament and elongation of the styloid process was analyzed as the cause of lateral pain in the neck and face region in two literature review cases. However, such symptoms are not usually associated with Eagle syndrome. Therefore, radiological data is the main way to diagnose this condition. In this sense, to the symptoms of pain on the anterolateral surface of the face and cervical region, only on the right side, where the styloid process has been shown to be elongated, the ossification of the hyoid styloid ligament may be indicated by the mineral

density and the presence of high levels of calcium in the region²⁸.

Regarding temporomandibular dysfunction, in cases with the presence of Eagle syndrome, echoes of ultrasound were obtained due to ossification of the elongated styloid process. Eagle syndrome has similar symptoms to temporomandibular dysfunction, such as headaches and neck pain. This makes it difficult to diagnose the two anatomical disorders. However, through the studies, Eagle's syndrome should actually be considered as a contributor to this dysfunction. Thus, the elongated styloid process is a differential diagnosis for temporomandibular dysfunction. Magnetic resonance imaging and magnetic resonance angiography were important to avoid damage to surrounding structures and were used to analyze soft tissues, including the carotid arteries⁴.

In an osteological study that aimed to obtain data regarding variations in the length of the styloid process from 200 specimens, 7% of them showed the presence of an elongated styloid process with predominance on the right side, with 25.8±4.68 mm. However, the difference was not significant for the two sides ($P=0.724$). Moreover, the mean styloid process was 24.05±3.54 mm in females and 25.95±5.68 mm in males²⁹.

A case report about a 77-year-old patient with pulsatile, right-sided tinnitus indicates that the development of dural arteriovenous fistula (ARVD) may be induced by compression of the internal jugular vein since the pathological mechanism of ARVD is unclear. Thus, in cases of styloid process syndrome, the dural arteriovenous fistula should be considered, as this diagnosis may contribute to the treatment of ARVD³⁰.

Discussion

This article is an integrative review that attempts to establish a relationship between anatomical variations of the styloid process and Eagle syndrome, by comparing articles with imaging studies and autopsies. Most studies show that an enlarged styloid process, depending on the literature of each region, is a defining criterion for Eagle syndrome, and it may be symptomatic or asymptomatic.

The symptoms of Eagle syndrome are related more to the medial angulation of the styloid process than its length¹⁶. Besides the characteristic symptoms of Eagle syndrome, another symptom, such as hypertension, can also arise due to a compression of the internal jugular vein³⁰. In another study, it was observed that the average length of the styloid process has great morphological variation, and the average length of this process, in asymptomatic patients, is about 30mm; thus, suggesting a new normal range of length and angulation to consider the Eagle syndrome^{1,13}. Through a histological and immunohistochemical study, there was a proposition that Eagle's syndrome arises as

a result of the strong tension on the ligament in the styloid process²¹.

CT scans can be used as a standard method to diagnose the syndrome or even make differential diagnoses⁴. About three articles have evaluated the styloid process of patients using Computed Tomography (CT). One of the studies showed a bilateral elongation, measuring 51 mm on the right and 37 mm on the left⁶. Another study, on the other hand, which also analyzed 5 CTs with Eagle syndrome, found that 4 patients had clinical improvement from treatment with neuromodulators, and only 1 patient required surgical resection⁷.

Finally, a large study analyzed the characteristics of styloid process size in the Taiwanese population, of which 109 people were found to have bilaterally enlarged styloid process, while 12 had a unilaterally enlarged styloid process²⁷. In addition, in another analysis of the Taiwanese population, the mean length of the styloid process was 29.5 mm, while among those symptomatic of Eagle syndrome it was 32.5 mm, and the elongation was more frequent among older people².

There are six case report articles using CT that both evaluate the styloid process with Eagle syndrome and its relationship with the vascular part of the neck. In evaluating the styloid process, CT showed a widening of the styloid process beyond the mandibular plane⁷. However, in another study, when analyzing the bone structure, the styloid process was longer than normal, being 46 mm on the right side, and 50 mm on the left side, besides the right process being next to the internal carotid artery, causing it a slight compression⁸.

Another case report states that Eagle syndrome can cause a stroke and severe neck pain, which can radiate to the ear²². Such a statement is corroborated by two other case reports, in which one of them displays a patient with juvenile stroke whose imaging exams showed an elongated styloid process (length of 3.1); while the other demonstrates that the postoperative CT and angiotomography of another patient showed the formation of an aneurysm due to an enlarged styloid process (33 mm)^{25,26}. Finally, another possible symptomatology of an enlarged styloid process in length (37 mm) is pain moving the mandible¹².

The use of panoramic radiographs is also indicated but under guidelines aimed at ensuring an efficient image since it is millimeter data to be analyzed²⁰. Increased size of the styloid process is not a significant guarantee of the presence of symptoms, as noted in a case of a 7cm PE¹⁸. A study of two cases revealed that one patient with a short styloid process where the pain could be associated with arthritis rather than nerve compression, while the other had pain at the site where there was, in fact, PE elongation²⁸.

Although surgical procedures are important for the relief of Eagle syndrome symptoms, the styloid process elongation alone is not a reason for this indication¹⁹. In the study with 200 skulls, in 14, there was an elongated

styloid process²⁹, in which the average length of the right side was longer than the left side.

In another study, it was noted that the presence of elongation or ossification of the styloid process is common, but its relationship with symptomatology is rare²⁴. In an analysis of patients with temporomandibular dysfunction, the mean length of the styloid process was defined as long; however, it does not seem to be related to TMD²³. It is worth noting that other studies show different results than the above articles, i.e., they show an association between Eagle Syndrome and TMD.

Conclusion

It was found that the styloid process, when it undergoes anatomical variations, enables its carrier to develop Eagle syndrome. This abnormal bony protuberance is usually asymptomatic, being occasionally discovered in imaging exams. However, there are cases in which the elongation of the EP and/or calcification of the hyoid-style ligament are aggravated to the point of compressing nerves and blood vessels in the cervicofacial region, causing pain on the anterolateral surface of the face and cervical region, pharyngeal pain, headache, odontalgia, and otalgia, mainly. Such symptomatology is characteristic of Eagle syndrome, which in most cases is treated pharmacologically, except in rare cases in which the patient does not respond adequately to drugs, and

then a styloidectomy is performed.

This clinical complication should be further studied and known in the academic and scientific field since the wrong or delayed diagnosis of Eagle syndrome can further complicate the patient's condition, causing hypertension, carotid bleeding without apparent cause, presence of stroke, focal stenosis, pseudoaneurysm and even sudden death due to compression or dissection of the carotid artery by the PE. Moreover, in this study, a divergence in literature was seen regarding the contribution of this anomaly in the development of temporomandibular dysfunction, highlighting the importance of this subject receiving greater attention from the scientific community and the population having a greater incentive to perform routine dental consultations, which can facilitate early diagnosis and avoid complications.

During the course of this literature review, some limitations were encountered; among them is the difficulty in finding diversified descriptors for the problem at hand, which limited the use of the databases. Furthermore, time constraints were another obstacle that the authors had to overcome in order to finalize this study, but despite the fact that the deadlines were short to capture the entirety of this subject, these individuals managed to make good use of their time and hope to further elucidate the scientific community with the results presented in this paper.

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