

**Elongated styloid process in a dry human skull and its relation to the Eagle's Syndrome:  
case report and biometrical assessment**

**Processo estilóide alongado em um crânio humano seco e sua relação com a Síndrome de  
Eagle: relato de caso e avaliação biométrica**

**Proceso estiloides alargado en un cráneo humano seco y su relación con el Síndrome del  
Eagle: reporte de caso y evaluación biométrica**

Received: 09/11/2020 | Reviewed: 09/13/2020 | Accept: 09/14/2020 | Published: 09/14/2020

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### **Abstract**

The purpose of the present study was to report a case of an elongated styloid process in a dry human skull and present its biometrical values. The styloid processes of the skull from an 80-year-old Brazilian female individual were inspected and 10 measures were performed bilaterally. Despite small differences between the right and left styloid processes regarding the antero-posterior and lateral-medial widths on the three thirds measured, one must highlight the considerable differences showed on the total length of the styloid process (left side: 65.94; right side: 28.90) and on the length of the sheath of the styloid process, which was of 30.01mm on the left side and it was not acquired on the right side because of its small dimensions. The paper discusses its findings from an anatomical and clinical perspectives, providing anatomical basis for a better understanding of the Eagle's syndrome.

**Keywords:** Eagle's syndrome; Styloid process; Morphometry.

### **Resumo**

O objetivo deste trabalho é relatar um caso de processo estilóide alongado em crânio humano seco e apresentar seus valores biométricos. Os processos estilóides do crânio de uma mulher brasileira de 80 anos foram inspecionados e 10 medidas foram realizadas bilateralmente. Apesar das pequenas diferenças entre os processos estiloide direito e esquerdo em relação às larguras ântero-posterior e médio-lateral nos três terços medidos, destaca-se as diferenças consideráveis apresentadas no comprimento total do processo estiloide (lado esquerdo: 65,94; lado direito: 28,90) e no comprimento da bainha do processo estilóide, que era de 30,01mm no lado esquerdo e não foi adquirido no lado direito devido às suas dimensões pequenas. O artigo discute suas descobertas de uma perspectiva anatômica e clínica, embasado em um conhecimento anatômico para uma melhor compreensão da síndrome de Eagle.

**Palavras-chave:** Síndrome de eagle; Processo estilóide; Morfometria.

## Resumen

El propósito del presente estudio fue reportar un caso de proceso estiloides alargado en un cráneo humano seco y presentar sus valores biométricos. Se inspeccionaron las apófisis estiloides del cráneo de una mujer brasileña de 80 años y se realizaron 10 medidas de forma bilateral. A pesar de las pequeñas diferencias entre las apófisis estiloides derecha e izquierda con respecto a los anchos antero-posterior y lateral-medial en los tres tercios medidos, hay que destacar las considerables diferencias que se muestran en la longitud total de la apófisis estiloides (lado izquierdo: 65,94; lado derecho: 28,90) y en la longitud de la vaina de la apófisis estiloides, que fue de 30,01 mm en el lado izquierdo y no se adquirió en el lado derecho por sus pequeñas dimensiones. El documento analiza sus hallazgos desde una perspectiva anatómica y clínica, proporcionando una base anatómica para una mejor comprensión del síndrome de Eagle.

**Palabras clave:** Síndrome de eagle; Apófisis estiloides; Morfometría.

## 1. Introduction

The styloid process is a cylindrical bony projection of the temporal bone which length usually varies from 2 to 3 cm. It is considered elongated when it exceeds such measure (Rosa et al., 2008). The styloid process is located laterally to the jugular foramen, anteromedially to the mastoid process and medially to the tympanic portion of the temporal bone. Furthermore, it is located between the internal and external carotid arteries, close to the glossopharyngeal, vagus, accessory, and hypoglossal cranial nerves (Correll et al., 1979; Mortellaro et al., 2002; Guzzo et al., 2006; Rossi et al., 2009).

This structure provides fixation to the stylohyoid, styloglossus, and stylopharyngeus muscles and to the stylomandibular and stylohyoid ligaments (Goss, 1988). The relation between the stylohyoid process and the stylohyoid ligament constitutes an anatomical complex, which has been referred to as stylohyoid ligament complex, which is derived from the second branchial arch, also associated to the lesser horn of the hyoid bone (Oliveira & Massucato, 2009).

Studies had shown morphological alterations related to the styloid process (Balbuena et al., 1997; Tiago et al., 2002; Sá et al., 2004;). In this regard, one must highlight its elongation, which, according to a few theories, occurs due to the persistence of an embryonic cartilaginous leaflet, to the growth of the process, due to factors that trigger osteogenesis, such as trauma, or to the calcification of the stylohyoid ligament, usually associated with the

female sex or old age (Balbuena et al., 1997; Sá et al., 2004; Tiago et al., 2002; Cerqueira et al., 2014).

Morphological changes related to an elongated styloid process may cause important clinical implications, such as mild facial pain, difficulty in swallowing, limited head, neck and oral opening movements, dysphonia, dysphagia, pharyngeal pain, glossitis, otalgia, headache, pain in the temporomandibular joint and foreign body sensation in the throat, deafness, tinnitus and visual disturbances (Moraes et al., 1991; Tiago et al., 2002; Monte et al., 2005; Cerqueira et al., 2014). These symptoms are often associated to the compression of the carotid arteries and of the CN V, VII, IX, and X (Cerqueira et al., 2014), and are characteristic of the so-called “Eagle’s Syndrome”, described by W.W. Eagle’s in 1937, from clinical observations and cervicopharyngeal symptoms associated with the presence of the elongated styloid process (Eagle, 1937; Eagle, 1948).

Considering the anatomical basis of the Eagle’s Syndrome and its association to an elongated styloid process, the aim of this study was to report a case an elongated styloid process with an emphasis on describing its biometric aspects.

## 2. Case Report

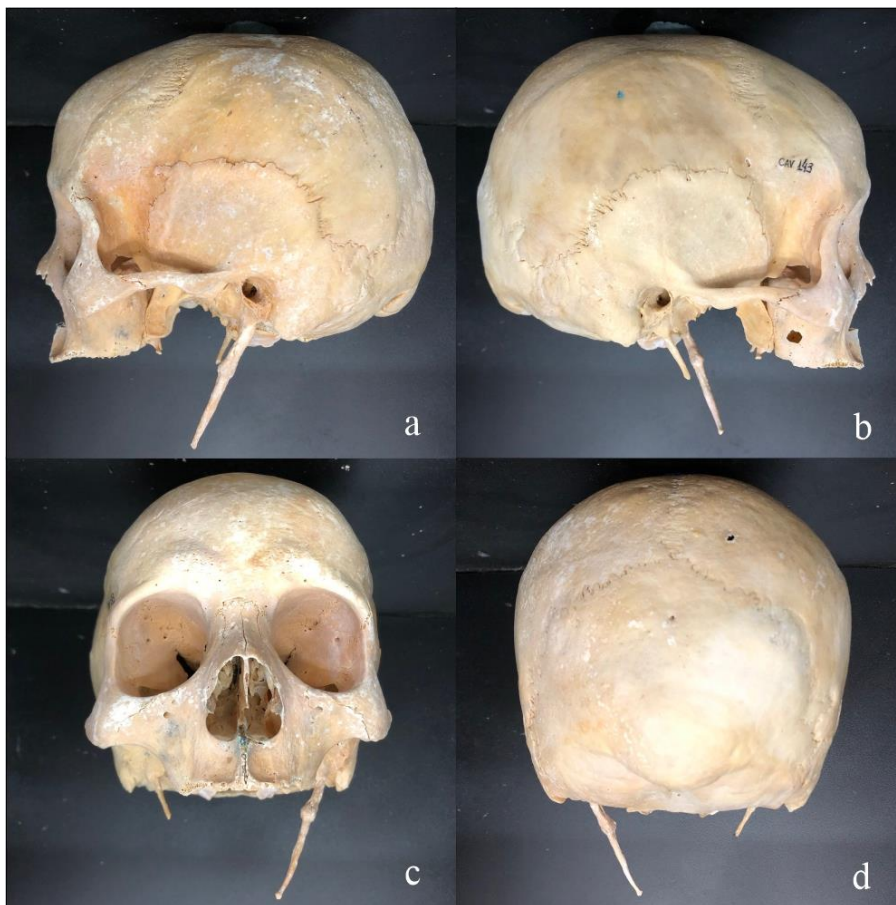
During the processes of screening and cataloging the bones of the bone collection of the Federal University of Pernambuco – Vitória Academic Center (UFPE-CAV), a biometrical analysis was performed in a dry skull from an 80-year-old Brazilian female individual. Using a steel caliper rule (0.05mm x 150m, Western, model 235), the following measures were obtained in both of the styloid processes:

- 1) Antero-posterior width of the sheath of the styloid process (vaginal process) = right: 3.63mm/ left: 5.77mm;
- 2) Latero-medial width of the sheath of the styloid process (vaginal process) = right: 3.09mm/ left: 4.77mm;
- 3) Length of sheath of the styloid process (vaginal process) = right: unable to measure/ left: 30.01mm;
- 4) Total length of the styloid process = right: 28.9mm/ left: 65.94mm;
- 5) Antero-posterior width – cranial third = right: 3.63mm/ left: 5.77mm;
- 6) Latero-medial width – cranial third = right: 3.09mm/ left: 4.77mm;
- 7) Antero-posterior width – middle third = right: 3.53mm/ left: 4.70mm;

- 8) Latero-medial width – middle third = right: 2.29mm/ left: 3.29mm;
- 9) Antero-posterior width – caudal third = right: 2.45mm/ left: 2.52mm;
- 10) Latero-medial width – caudal third = right: 1.86mm/ left: 1.91mm.

Despite small differences between the right and left styloid processes regarding the antero-posterior and lateral-medial widths on the three thirds measured, one must highlight the considerable differences showed on the total length of the styloid process (left side: 65.94; right side: 28.90) and on the length of the sheath of the styloid process, which was of 30.01mm on the left side and it was not acquired on the right side because of its small dimensions. Hence, the left styloid process was considered elongated, since its length exceeded the 3 cm established by the literature. Figure 1 shows the assessed skull in different views.

**Figure 1** – Dry skull from an 80-year-old Brazilian female. (a) lateral left view, (b) lateral right view, (c) frontal view, and (d) posterior view.



Source: Authors' research data (2020).

### 3. Discussion

The etiology and pathophysiology of Eagle's Syndrome is poorly understood, and its clinical diagnosis is difficult, requiring radiological confirmation (Uludag et al., 2013). Despite the little evidence regarding the pathophysiology of elongation of the styloid process, the following theories have emerged: the "reactive hyperplasia" theory, based on traumas that activate the remnants of the original connective and fibrocartilage cells; the "reactive metaplasia" theory, an abnormal healing after a trauma that initiates ossification of the stylohyoid ligament; the "anatomical variance" theory, without any recognizable trauma, and, in addition to these factors, one must highlight and consider other causes, such as the endocrine post-menopause and the dysfunction and genetic transmission. Systemic conditions that alter the metabolism of calcium and phosphorus, such as terminal kidney disease, have also been associated the Eagle's Syndrome (Costantinides et al., 2013).

The occurrence rate of elongated styloid process is controversial. Despite the reports of Eagle's, whom established an occurrence of 4%, it can be as high as 28%. Symptoms related to Eagle's Syndrome occur in about 4% to 10.3% of patients with an elongated styloid process (Soh, 1999; Uludag et al., 2013). Nevertheless, according to Beder et al. (2006), an elongated styloid process is found on 1,4% to 30% of the population. Moreover, Hernández et al. (2000), state that Eagle's Syndrome occurs similarly in male and female individuals, however, this condition is usually found in female individuals with over 50 years of age. According to Quereshy et al. (2001), there is no prevalence of elongation of the styloid process in children,

The diagnosis of Eagle's Syndrome is made through the patient's clinical symptoms and imaging tests. Radiographic exams are extremely important for the correct diagnosis of the Eagle's Syndrome as they are able to measure the length of the styloid process in vivo. The clinical suspicion of the syndrome can be confirmed using conventional radiography (lateral and antero-posterior views), pantomography, and computerized tomography of the head and neck (Rosa et al., 2008). However, despite the relevance of pantomography, it does not show the relationship between bony structures and adjacent soft tissues (Alcalde et al., 1994).

Regarding the treatment route, steroid, anesthetic, and cervicotomy can be used. However, it is worth mentioning that the most effective treatment is via surgical resection of the aforementioned process (Bafaqeeh, 2000; Eagle, 1937; Eagle, 1948; Tiago et al., 2002).



Furthermore, there is also an hypothesis that the individuals may not show the characteristic signs and symptoms of Eagle's Syndrome. This is supported by the fact that the present case report regards an elongated styloid process of an 80-year-old female individual that came to this age with no surgical intervention to treat it. This hypothesis is supported by the majority of asymptomatic cases that present an elongated styloid process (Moraes et al., 1991; Tiago et al., 2002; Monte et al., 2005; Cerqueira et al., 2014).

To the best of our knowledge, the dimensions of the elongated styloid process showed in the present case were never once reported on scientific literature and can be of use for anatomists, clinicians, and researchers to come to a better understanding regarding this anatomical variation and the anatomical basis for the Eagle's Syndrome.

#### **4. Final Considerations**

The styloid process of the right antimer presented 28.90 mm of length, which is considered within the parameters of normality, whilst the left antimer showed an styloid process of 65.94 mm, which is characterized as elongated and can aid in a better understanding regarding the anatomical basis for the Eagle's Syndrome.

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