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ELONGATED STYLOID PROCESS: AN ANATOMICAL FINDING AND A LITERATURE REVIEW OF ITS CLINICAL IMPLICATIONS IN EAGLE'S SYNDROME

José Aderval Aragão[1]; Adler Oliveira Silva Jacó Carvalho[2]; Henrique Montalvão Routman da Cunha[2]; André Elias Rezende Santos[2]; Giovanna de Oliveira Sá Costa[2]; Lorena Pinto de Menezes[2]; Gilvan Paixão Santos Junior[2]; Wallance Geovane Alexandre Lima[2]; Ryan Kelvin Lima Passos[2]; Enzo Souza Santos[2]; Davi Andrade Cunha[2]; Iapunira Catarina Sant'Anna Aragão[3]; Felipe Matheus Sant'Anna Aragão[4]; Rudvan Cicotti[5]; Francisco Prado Reis[5]; Deise Maria Furtado de Mendonça[6].

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ARTIGO ORIGINAL

RESUMO

Introdução: O processo estilóide (PE) é uma projeção óssea delgada, localizada na face inferior da porção petrosa do osso temporal. Seu comprimento varia de 25-30 mm, sendo considerado alongado quando ultrapassa a 30 mm. As causas do alongamento do processo estilóide não são bem definidas e várias teorias têm sido propostas, como: o alongamento congênito decorrente da persistência de um folheto embrionário cartilaginoso, a calcificação do ligamento estilo-hióideo, resultando na aparência de um processo estilóide alongado, e a formação de tecido ósseo na inserção do ligamento estilo-hióideo. **Objetivo:** Relatar a ocorrência de um processo estilóide alongado. **Material e Métodos:** Foi um achado anatômico, observacional, em um crânio seco, pertencente ao Laboratório de Anatomia da Universidade federal de Sergipe (UFS). O achado foi documentado através fotografias obtidas por uma câmera digital (SONY DSLR-A100K) e a morfometria do processo estilóide foi realizada com um paquímetro digital Vonder. **Resultados:** Na base inferior de um crânio seco de humano foi encontrado um processo estilóide alongado, com uma linha de soldadura de sua projeção ântero-posterior sugerindo tratar-se da divisão estiloial e ceratoial do aparelho hióideo. O processo estilóide tinha um comprimento de 55,84 mm e espessura proximal, médio e distal de 6,59mm, 4,44mm e 2,12mm, respectivamente. **Conclusões:** A presença de um processo estiloide alongado, geralmente acima de 30 mm ou 40 mm em alguns critérios, é o achado radiológico chave para o diagnóstico, embora a apresentação clínica seja fundamental. A síndrome é caracterizada por sintomas como dor cervicofacial persistente e disfagia, que podem ser bastante debilitantes para os pacientes. A dificuldade no diagnóstico reside muitas vezes na inespecificidade dos sintomas, que podem mimetizar outras condições, tornando a diferenciação diagnóstica

essencial para um manejo adequado. Você está correto ao apontar que a etiologia exata do alongamento e da calcificação do ligamento estilohioide ainda não é completamente compreendida, o que sublinha a necessidade contínua de mais pesquisas para aprofundar nosso entendimento anatômico e clínico da condição. Isso, por sua vez, pode levar a melhores abordagens de diagnóstico e tratamento.

Palavras-chave: Anatomia humana; Processo estilóide; Ligamento estilo-hióide; Síndrome de Eagle; Morfometria.

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ABSTRACT

Introduction: The styloid process (SP) is a slender bony projection located on the inferior surface of the petrous part of the temporal bone. Its length varies from 25-30 mm, being considered elongated when it exceeds 30 mm. The causes of styloid process elongation are not well defined, and several theories have been proposed, such as congenital elongation due to the persistence of a cartilaginous embryonic sheet, calcification of the stylohyoid ligament resulting in the appearance of an elongated styloid process, and bone tissue formation at the stylohyoid ligament attachment. **Objective:** To report the occurrence of an elongated styloid process. **Materials and Methods:** It was an anatomical, observational finding in a dry skull belonging to the Anatomy Laboratory of the Federal University of Sergipe (UFS). The finding was documented through photographs taken with a digital camera (SONY DSLR-A100K) and morphometry of the styloid process was performed with a Vonder digital caliper. **Results:** An elongated styloid process was found at the inferior base of a dry human skull, with a solder line of its anteroposterior projection suggesting it is the stylohyal and ceratohyal division of the hyoid apparatus. The styloid process had a length of 55.84 mm and proximal, middle, and distal thickness of 6.59 mm, 4.44 mm, and 2.12 mm, respectively. **Conclusions:** The presence of an elongated styloid process greater than 40 mm in length is key to the diagnosis of Eagle syndrome, characterized by cervicofacial pain and dysphagia. Accurate diagnosis is vital for the differentiation and management of symptoms, despite the unknown etiology. Further research is crucial for anatomical and clinical understanding.

Keywords: Human Anatomy; Styloid process; Stylohyoid ligament; Eagle Syndrome; Morphometry.

Instituição afiliada
[1]Titular Professor of Clinical Anatomy, Department of Morphology, Federal University of Sergipe (UFS), Aracaju, Sergipe, Brazil.
[2] Medical Student, Department of Medicine, Federal University of Sergipe (UFS), Aracaju, Sergipe, Brazil.
[3] Medical Clinic of Municipal Hospital Munir Rafful (MHMR), Volta Redonda, Rio de Janeiro, Brazil.
[4]Cardiology Resident at the Heart Institute of the Hospital das Clínicas, Faculty of Medicine, University of São Paulo (INCOR), São Paulo, SP, Brazil.
[5]PhD student in the Postgraduate Program in Physiological Sciences at the Federal University of Sergipe, Aracaju, Sergipe, Brazil
[6]Titular Professor of the Medical School, Tiradentes University (UNIT), Aracaju, Sergipe, Brazil
[7]Associate Professor of Anatomy, Department of Morphology, Federal University of Sergipe (UFS), Aracaju, Sergipe, Brazil.
Autor correspondente: *José Aderval Aragão adervalufs@gmail.com*

Introduction

The styloid process (SP) is a slender bony projection located on the inferior face of the petrous part of the temporal bone, anteromedial to the stylomastoid foramen, connecting to the lesser horn of the hyoid bone by the stylohyoid ligament. It is situated between the internal and external carotid arteries, posterior to the pharynx, where the stylohyoid, styloglossus, and stylopharyngeus muscles are inserted, innervated respectively by the facial, hypoglossal, and glossopharyngeal nerves (Bozkir et al., 1997; Keur et al., 1986). This process also has two ligaments attached at the superior portion: the stylohyoid ligament, which connects to the apex of the lesser horn of the hyoid bone, and the stylomandibular ligament, which attaches to the angle of the mandible.

The normal length of the styloid process typically ranges between 25 and 30 mm (Pinto et al., 2008; Eagle, 1949; Eagle, 1962). It is considered elongated when its length exceeds 30 mm (Kaufman, Elzay, Irish, 1970; O Carroll, 1984; Keur et al., 1986; Sokler, Sandev, 2001; Scaf, Freitas, Loffredo, 2003; Jung et al., 2004; Sahoo et al., 2023). However, some researchers consider the styloid process elongated when its length exceeds 40 mm (Monsour, Young, 1986; Jung et al., 2004; Skrzat et al., 2007). The causes of ossification of the stylohyoid ligament and elongation of the styloid process are not well defined in the literature, with various theories proposed, such as congenital elongation due to the persistence of a cartilaginous embryonic sheet; calcification of the stylohyoid ligament, resulting in the appearance of an elongated styloid process; and bone tissue formation at the insertion of the stylohyoid ligament (Baddour, McAnear, Tilson, 1978; Glogoff, Baum, Cheifetz, 1981; Sá et al., 2004).

The term "elongation of the styloid process" has been used since Eagle's initial publications describing cases of patients with symptoms in the otorhinolaryngology (ear, nose, throat) and dentistry (dentomaxillofacial) areas (Eagle, 1949; Pinto et al., 2008). These symptoms include cervical pain, otalgia, throat pain and sensation of a "foreign body," pain upon changing head position, headache, cervicofacial pain, pain during swallowing, shoulder pain, among others (Luz, Rodrigues, Chilvarquer, 1994; Guimarães et al., 2006). Thus, the presence of an elongated styloid process associated with these symptoms became known as Eagle Syndrome. This condition is characterized by partial or total mineralization of the stylohyoid ligament, and when accompanied by

radiographic images of process elongation, it confirms the clinical diagnosis (Yamaguchi, 2005).

Recognizing the importance of understanding the anatomical variations of the styloid process and their respective clinical implications, the present study aims to report an anatomical finding of an elongated styloid process and, in conjunction, present a comprehensive literature review on Eagle's Syndrome, with a specific focus on its correlation with elongated styloid processes

Case Report

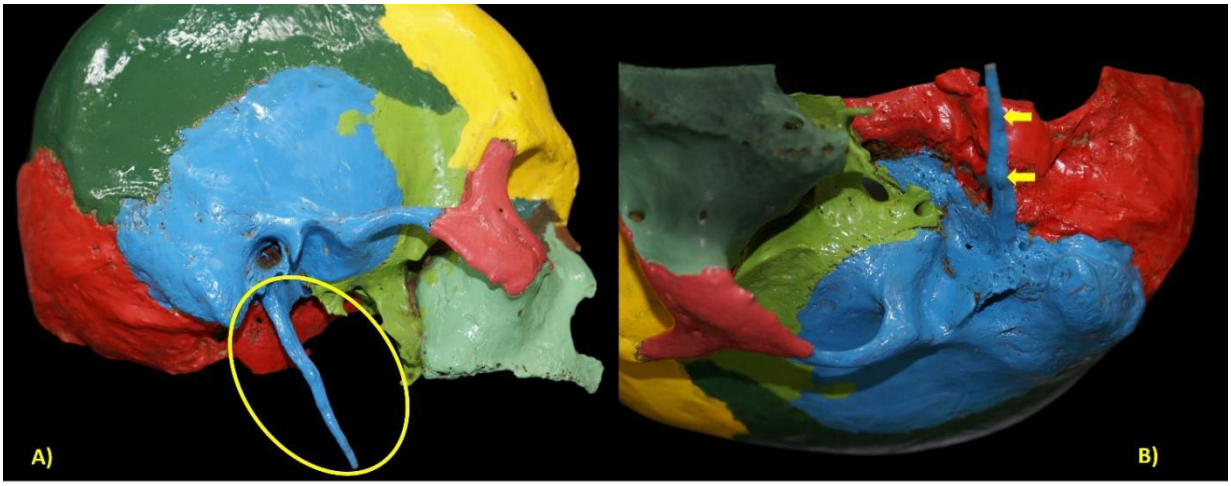
During a study of dry human skulls at the Anatomical Collection and Museum of the Federal University of Sergipe (UFS), a right hemicranium was observed with an unusually long styloid process (**Figure** 1A), with no information on the sex or age of the individual. The observational anatomical finding was documented with photographs taken by a digital camera (SONY DSLR-A100K), and the morphometry of the styloid process was performed with a digital caliper with 0.05 mm precision.

At the inferior base of the anatomical finding, an elongated SP was identified, with a solder line in its anteroposterior projection suggesting the stylohyal and ceratohyal division of the hyoid apparatus **(Figure** 1B).

In a cranio-caudal analysis, the studied styloid process is attached at its base, having a triangular shape, and a width that decreases along its trajectory. It is positioned obliquely—converging towards the median plane, directed anteriorly. It also presents bony protuberances in the median region.

The length of the right styloid process was measured at 55.84 mm, from base to apex. The measured widths along the process are: a) basal width: 6.59 mm; b) middle width: 4.44 mm; c) distal width: 2.12 mm.

Figure 1 - Elongated styloid process



Discussion

The styloid apparatus consists of the styloid process, the lesser horn of the hyoid bone, and its connection via the stylohyoid ligament. This system is derived from the second branchial arch, known as Reichert's cartilage (Tanwar et al., 2011).

Reichert's cartilage can be divided into four parts: tympanohyal, stylohyal, ceratohyal, and hypohyal. The first two form the styloid process, with stylohyal accounting for most of it. The ceratohyal portion forms the stylohyoid ligament, while the hypohyal gives rise to the lesser horn of the hyoid bone (Yamaguchi, 2005).

Anatomical anomalies of the styloid apparatus are not uncommon, often characterized by the elongation of the SP. This anatomical condition can be asymptomatic but may also lead to Eagle Syndrome or Stylo-Stylohyoid Syndrome (Leite et al., 1988).

The etiology of elongated Eagle Syndrome remains unknown, but three theories have been proposed to explain stylohyoid ligament calcification. The first is reactive hyperplasia, where the styloid process ossifies at its terminal zone, such as after pharyngeal trauma, leading to ossification of the stylohyoid ligament. The second is reactive metaplasia, where traumatic stimuli induce metaplastic changes, causing segmented calcifications of the ligament. Finally, there is the anatomical variation theory, arising from the persistence of a cartilaginous embryonic sheet, explaining calcification presence in children and youth without a history of cervical or pharyngeal

trauma (Guzzo et al., 2006).

Langlais, Miles, and Van Dis (1986) proposed a classification for SP elongation and stylohyoid ligament calcification. Based on calcification patterns, they are described radiographically as fully calcified, partially calcified, nodular, or calcified at their external limit. Morphologically, they are classified into three types: Type 1 - elongated; Type 2 - pseudo-articulated; and Type 3 - segmented (Yamaguchi, 2005; Tanwar et al., 2011, Chu et al., 2022). Due to the solder line of the stylohyal and ceratohyal division present in the anatomical finding studied, we classify it morphologically as Type 2 – pseudo-articulated.

The normal size of the styloid process is highly variable, with cadaver studies reporting lengths between 15.2 mm and 47.7 mm. Radiographically, the styloid process is defined as normal when under 25 mm and elongated when over 40 mm, making Eagle Syndrome likely (Sá et al., 2004).

The prevalence of elongated styloid processes varies in the literature from 2% to 30% (Gokce et al., 2008). Guimarães et al. (2010) state that the prevalence of elongation in the population ranges from 4% to 28%, with only 4% to 10.3% symptomatic. According to Pereira et al. (2008) and Nogueira-Reis et al. (2022), elongated styloid process syndrome is most commonly seen between the ages of 30 and 50, with a preference for females.

The SP in this study was 55.84 mm, suggesting an anatomical anomaly known as an "elongated styloid process" and potential Eagle Syndrome.

According to Leite et al., (1988), an elongated styloid process on one or both sides, associated with symptoms such as: pain in the head, pharynx, ear, neck, face, tongue, along the internal and external carotid arteries, dysphagia, dysphonia, restricted neck movements, and a foreign body sensation in the throat, suggests a diagnosis of Eagle Syndrome.

These symptoms, along with styloid process elongation, are more common than expected. However, most general practitioners are unaware of Eagle Syndrome, often excluding it during differential diagnosis with various temporomandibular joint diseases and facial and oral neuralgias (Guimarães et al., 2006; Lages et al., 2006).

Kolagi et al., (2010) note that the thickness of the styloid process is rarely

reported in the literature but is significant for Eagle Syndrome's clinical manifestation and should be evaluated in surgical approaches. In the two cases described, the styloid process base width was 10 mm, while in the present study, it was 6.59 mm.

Eagle Syndrome diagnosis involves clinical and radiographic examinations, requiring professionals to recognize clinical manifestations and identify styloid processes in regional radiographs (Reis et al., 2001).

Despite being considered relatively common by many authors, the elongated styloid process is poorly known and diagnosed in clinical practice. This highlights the necessity to understand and efficiently diagnose it in affected patients. Thus, the importance of studies describing anatomical changes associated with styloid process elongation and their clinical implications is underscored, broadening the knowledge on this topic.

Conclusion

Recognizing an elongated styloid process, especially when exceeding 55.84 mm, is crucial as a potential indicator of Eagle Syndrome. This condition, often associated with symptoms such as cervicofacial pain and difficulty swallowing, requires careful clinical attention. Although the etiology of elongation remains uncertain, accurate diagnosis is essential to avoid confusion with other conditions and improve symptom management. Further studies are essential to deepen the anatomical and clinical understanding of this anomaly.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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