

Ossification of styloid ligament and its clinical implication: a report of human cases

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Abstract

A case of ossification of the right styloid ligament in an adult human caucasian skull was verified during routine activities of the Laboratory of Human Anatomy at the University of Santa Cruz do Sul - Brazil. This study presents its clinical considerations and applications. The presence of other anatomical variations was not verified.

Keywords: eagle syndrome, human skull, ossification, styloid ligament.

1 Introduction

The styloid process is a bone at the base of the skull. A lateral view provides better visualization of the styloid process. It is anterior and medial to the mastoid tip, and its base is practically sheathed in the tympanic portion. It descends anterolaterally, and its tip usually reaches the midpoint of the posterior margin of the mandibular branch. The styloid process is capable of a length change of a few centimeters; it is mostly straight, but occasionally can be curved with a concave ventromedial surface; a dorsal concavity is less frequent. From its extremity, the styloid ligament passes downwards to the lesser horn of the hyoid bone, which is therefore suspended from the skull (WILLIAMS, WARWICK, DYSON et al., 1995).

According to Moore and Dalley (2007), the styloid process gives origin to the styloid, stylopharyngeus, and Styloglossus. The normal length of the styloid process is usually from 2.5 to 3 cm (KAWAI, SHIMOZATO and OCHIAI, 1990). According to Niccoli Filho, Madeira, Peake et al. (1986), when the length exceeds 3cm, it can be considered to be elongated.

The first studies on the styloid process date from 1937 when Eagle detailed the mineralization symptoms of the styloid-stylo mandibular ligament complex, which later would characterize a syndrome named after him (PRASAD, KAMATH, REDDY et al., 2002).

According to Madeira (1997), the styloid process, which usually measures 2-3 cm, can be elongated (up to 8 cm), and the styloid muscle can be partially or totally ossified.

Eagle's Syndrome has been associated to a variety of symptoms such as pain, usually unilateral referred to the throat, tongue, eyes, midface, temporomandibular joint, and ear. The pain can be continuous or intermittent, and it is frequently described as deaf and more rarely, neuralgic. The parapharyngeal symptoms include discomfort sensation, dysphagia, difficulty in mouth opening, disturbed phonation,

burning mouth sensation, tongue swallowing, paresthesia, sialorrhea or hypersalivation, and limited neck movement. Auditory symptoms such as deafness and buzzing sounds in the ear can be present in addition to visual symptoms (MONTALBETTI, FERRANDI, PERGAMI et al., 1995).

Embriologically, it is believed that the styloid process as well as the hyoid bone and its ligaments is derived from a second branchial cord, in which a cartilage zone would remain and present a late growth and maturation potential (FROMMER, 1974).

The morphological aspects of ossification of the styloid ligament in humans as well as their implication in the characterization of the Eagle's Syndrome are described in this study.

2 Case report

In this study, a morphometric analysis was conducted in a cadaver skull, with approximately 30 years old, from the collection of the Laboratory of Human Anatomy of the University of Santa Cruz do Sul University. The ossification of the styloid ligament into the styloid process was observed (Figure 1).

A caliper (digital Digimess) was used to measure the styloid process. The ossification of the right ligament presented the following measures: length of 44.6 mm (base to the apex), apex width of 2.4 mm (see Figure 1, A₁), and base length of 5.6 mm (see Figure 1, A₂). The presence of ossification of the left styloid process was not verified and there was no sign of deformation of the skull bones either.

3 Discussion

Approximately 50% of the cases of ossification of the styloid ligament tend to be bilateral and the symptoms are related to the proximity of the styloid process to

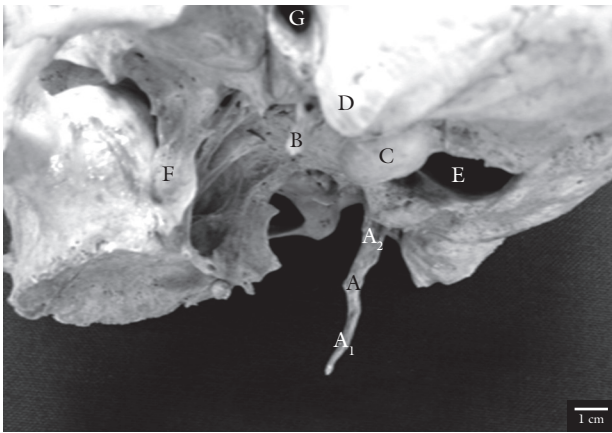


Figure 1. Inferior view of the skull. A) right process styloideus; A₁) ossification of the ligament stylohyoideum, apex; A₂) base; B) left process styloideus; C) condylus occipitalis; D) mastoid process; E) foramen magnum; F) processus pterygoideus; and G) external acoustic pore. Scale in centimeters.

the internal and external carotid arteries, trigeminal nerve, facial nerve, glossopharyngeal nerve, vagus nerve, pharyngeal muscles, and pharyngeal mucosa (BALBUENA, HAYES, RAMIREZ et al, 1997; GUO, JAOVISIDHA, SARTORIS et al, 1997).

Correll, Jesen, Taylor et al. (1979) investigated 1771 radiographies and estimated the incidence to be 18.2, 93% of which exhibited bilateral elongation. The ossification of the styloid-stylo mandibular ligament in the styloid process was found in 30% of a total of 1135 patients investigated by Keur, Campbell, McCarthy et al. (1986) corroborating the general consensus in the literature that this is a common radiographic finding. Nevertheless, Rossi, Freire, Prado et al. (2009) found that the ossification of the styloid ligament is not uncommon.

According to Leite, Niccoli Filho, Liberti et al. (1988), the mechanism of ossification of the styloid complex has not been fully understood yet. It has been suggested that due to its embryological cartilaginous origin the styloid ligament retains some cartilage with osteogenic potential (GRÄBER-DUVERNAY, PATET and BELOT, 1957; STAFNE and HOLLINSHEAD, 1962; GOSSMAN JUNIOR and TARSITANO, 1977; SIVERS and JOHNSON, 1985). According to Gross and Fister (1978), the junction of the styloid process with the temporal bone remains cartilaginous into adult age contributing to the elongation of the styloid process. Thus, there would not be ossification of the ligament per se, but of the persistent cartilage (ETTINGER and HANSON, 1975).

According to Liu, Wang, Zhang et al. (2005), the styloid process elongation seems to be more common among women; Rizzatti-Barbosa, Ribeiro, Silva-Concilio et al. (2005) add that this is due to menopause.

The etiology has been described by several authors, including Eagle (1937), suggesting that it is a result from a previous trauma. According to Gokce, Sisman and Sipahioglu (2008), liver disorders can lead to a change in the metabolism of calcium, phosphorus, and vitamin D predisposing to calcium deposition and ossification of the ligaments. On the other hand, Piagkou, Anagnostopoulou,

Kouladouros et al. (2009) reported that the etiology can be explained by a genetic alteration or according to three different theories. The first theory, the hyperplastic reaction, suggests that the styloid process had been stimulated by a pharyngeal trauma leading to the ossification of the styloid ligament. The second theory, metaplastic reaction, also includes a traumatic stimulus causing multiples metaplastic alterations in the cells of the styloid ligament, which results in its total or partial ossification. The third theory, anatomic variation, suggests that the styloid process and the styloid ligament are not usually ossified, but rather, an anatomic variation.

According to Murtagh, Caracciolo and Fernandez (2001), the Eagle Syndrome corresponds to a set of symptoms including recurring facial pain, discomfort sensation, and dysphagia, and it is directly related to the elongation of the styloid process or to the calcification of the styloid ligament. Neville, Damm, Carl et al. (2004) add that most cases are asymptomatic. Nevertheless, a significant number of patients can exhibit the set of symptoms caused by the pressure of anatomic structures, such as blood vessels and nerves which are topographically related to the elongated styloid process that characterize the syndrome.

Correll and Wesco (1982) explain that unnecessary teeth extractions have been used to relieve symptoms of neuralgia, temporomandibular joint disorder, and impacted third molar. In order to diagnose the elongation of the styloid process, methods such as the touching tonsillar fossa and panoramic and latero-lateral radiographies have been used (BLYTHE, MATTHEWS and CONNOR, 2009).

The objective of this study was to present a more detailed and accurate account of the ossification of the skull ligaments due to their relationships with pathologies in adjacent structures. In sum, this study can be useful to physicians, surgeons, and researchers who are interested in this anatomic region.

References

- BALBUENA, L., HAYES, D., RAMIREZ, S. and JONHOSON, R. Eagle's Syndrome: elongated styloid process. *Southern Medical Journal*, 1997, vol. 91, p. 331-334. PMID:9076308. <http://dx.doi.org/10.1097/00007611-199703000-00014>
- BLYTHE, J., MATTHEWS, N. and CONNOR, S. Eagle's syndrome after fracture of the elongated styloid process. *British Journal of Oral and Maxillofacial Surgery*, 2009, vol. 47, p. 233-235. PMID:18823683. <http://dx.doi.org/10.1016/j.bjoms.2008.08.009>
- CORRELL, R., JENSEN, J., TAYLOR, J. and RHYNE, R. Mineralization of the stylohyoid-stylomandibular ligament complex: A radiographic incidence study. *Oral Surgery, Oral Medicine, Oral Pathology*, 1979, vol. 48, p. 286-291. [http://dx.doi.org/10.1016/0030-4220\(79\)90025-2](http://dx.doi.org/10.1016/0030-4220(79)90025-2)
- CORRELL, RW. and WESCON, WE. Eagle's syndrome diagnosed after history of headache, dysphagia, otalgia, and limited neck movement *Journal of the American Dental Association*, 1982, vol. 104, p. 491-492. PMID:6950978.
- EAGLE, W. Elongated styloid process: report of two cases. *Archives of Otolaryngology*, 1937, vol. 25, p. 584-587.
- ETTINGER, RL. and HANSON, JG. The styloid or "Eagle" syndrome: An unexpected consequence. *Southern Medical Journal*, 1975, vol. 40, p. 336-340.

- FROMMER, J. Anatomic variations in the stylohyoide chain and their possible clinical significance. *Oral Surgery, Oral Medicine, Oral Pathology*, 1974, vol. 38, p. 659-667. [http://dx.doi.org/10.1016/0030-4220\(74\)90382-X](http://dx.doi.org/10.1016/0030-4220(74)90382-X)
- GOKCE, C., SISMAN, Y. and SIPAHIOGLU, M. Styloid process elongation or eagle's syndrome: Is there any role for ectopic calcification? *European Journal of Dentistry*, 2008, vol. 2, p 224.
- GOSSMAN JUNIOR, JR. and TARSITANO, JJ. The styloid-stylohyoidsyndrome. *Southern Medical Journal*, 1977, vol. 35, p. 555-560.
- GRABER-DUVERNAY, J., PATET, R. and BELOT, R. A propos de l'ossification complète de l'appareil hyoïdien de l'homme. *Revue lyonnaise de médecine*, 1957, vol. 6/8, p. 523-528.
- GROSS, B. and FISTER, J. Rapid development of stylohyoid syndrome after mandibular bone grafting. *Southern Medical Journal*, 1978, vol. 46, p. 18-21.
- GUO, B., JAOVISIDHA, S., SARTORIS, D., RYU, K., BERTHIAUME, M., CLOPTON, P., BROSSMAN, J. and RESNICK, D. Correlation between ossification of the stylohyoid ligament and osteophytes of the cervical spine. *The Journal of Rheumatology*, 1997, vol. 24, p. 1575-1581. PMID:9263154.
- KAWAI, T., SHIMOZATO, K. and OCHIAI, S. Elongated styloid process as a cause of difficult intubation. *Journal of Oral and Maxillofacial Surgery*, 1990, vol. 48, p. 1225-1228. [http://dx.doi.org/10.1016/0278-2391\(90\)90544-C](http://dx.doi.org/10.1016/0278-2391(90)90544-C)
- KEUR, JJ., CAMPBELL, JPS., McCARTHY, JF. and RALPH, WJ. The clinical significance of the elongated styloid process. *Oral Surgery, Oral Medicine, Oral Pathology*, 1986, vol. 61, p. 399-404. [http://dx.doi.org/10.1016/0030-4220\(86\)90426-3](http://dx.doi.org/10.1016/0030-4220(86)90426-3)
- LEITE, HF., NICCOLI FILHO, WD., LIBERTI, E., MADEIRA, MC. and SIMÕES, S. Prevalência do processo estilóide alongado em Crânios humanos. *Revista de Odontologia da UNESP*, 1988, vol. 17, n. 1/2, p. 145-151. PMID:3151022.
- LIU, S., WANG, Y., ZHANG, R., LIU, S. and PENG, H. *Diagnosis and treatment of 23 cases with stylohyoid syndrome. Shanghai Kou Qiang Yi Xue*, 2005, vol. 14, p. 223-226. PMID:15995763
- MADEIRA, MC. *Anatomia da face: bases anátomo-funcionais para a prática odontológica*. 2nd ed. São Paulo: Sarvier, 1997.
- MONTALBETTI, L., FERRANDI, D., PERGAMI, P. and SAVOLDI, F. Elongated styloid process and Eagle's syndrome. *Cephalalgia*, 1995, vol. 15, p. 80-93. PMID:7641256. <http://dx.doi.org/10.1046/j.1468-2982.1995.015002080.x>
- MOORE, KL. and DALLEY, AL. *Anatomia orientada para a clínica*. 5nd ed. Rio de Janeiro: Guanabara Koogan, 2007.
- MURTAGH, R., CARACCILOLO, J. and FERNANDEZ, G. CT findings associated with Eagle syndrome. *American Journal of Neuroradiology*, 2001, vol. 22, p. 1401-1402.
- NEVILLE, B., DAMM, D., CARL, M. and JERRY, E. *Patologia oral & maxilofacial*. 2nd ed. Rio de Janeiro: Guanabara Koogan, 2004.
- NICCOLI FILHO, WD., MADEIRA, MC., PEAKE, FL., FAIG LEITE, H. and SIMÕES, S. Prevalence of elongated styloid process and ossified stylohyoid ligament in adults: a roentgenographic study. *Quintessence International*, 1986, vol. 17, p. 581-585.
- PIAGKOU, M., ANAGNOSTOPOULOU, S., KOULADOUROUS, K. and PIAGKOS, G. Eagle's syndrome: a review of the literature. *Clinical Anatomy*, 2009, vol. 22, p. 545-558.
- PRASAD, KC., KAMATH, M. P., REDDY, KJM., RAJU, K. and AGARWAL, S. Elongated styloid process (Eagle's Syndrome): a clinical study. *Journal of Oral and Maxillofacial Surgery*, 2002, vol. 60, p. 171-175. PMID:11815916. <http://dx.doi.org/10.1053/joms.2002.29814>
- RIZZATTI-BARBOSA, C., RIBEIRO, M., SILVA-CONCILIO, L., DI HIPOLITO, O. and AMBROSANO, G. Is an elongated stylohyoid process prevalent in the elderly? A radiographic study in a brazilian population. *Gerodontology*, 2005, vol. 22, p. 112-115. PMID:19418452. <http://dx.doi.org/10.1002/ca.20804>
- ROSSI, AC., FREIRE, AR., PRADO, FB., BOTACIN, PR. and CARIA, PHF. Morphometric characteristics of the elongated styloid process in human skull: Case report and association with the Syndrome of Eagle. *Revista Odontológica de Araçatuba*, 2009, vol. 30, n.1, p. 20-23. PMID:15934355. <http://dx.doi.org/10.1111/j.1741-2358.2005.00046.x>
- SIVERS, JE. and JOHNSON, GK. Diagnosis of Eagle's syndrome. *Journal Oral Surgery*, 1985, vol. 59, p. 575-577.
- STAFNE, EC. and HOLLINSHEAD, WH. Roentgenographic observations on the stylohyoid chain. *Journal Oral Surgery*, 1962, vol.15, p. 1195-200.
- WILLIAMS, P., WARWICK, R., DYSON, M. and BANNISTER, L. *Gray Anatomia*. Edinburgh: Churchill Livingstone, 1995.

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