Innovations

Morphometric Study of Styloid Process of Adult Dry Skulls and Elongated Styloid Process

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Abstract

Background: *The styloid process is a cylindrical, slender, needle-like projection of varying lengths averaging 2 to 3 cm. The styloid process projects from the inferior part of the petrous temporal bone and offers attachment to the stylohyoid ligament and the stylohyoid, stylopharyngeus, and styloglossus muscles. Through these structures, the styloid process facilitates the movement of the tongue, pharynx, larynx, hyoid bone, and mandible. It is considered elongated when it's longer than 3 cm. The exact cause of an elongated styloid process is unknown, but possible causes include, local chronic irritation, surgical trauma, endocrine disorders, and ectopic calcification. The definitive treatment for an elongated styloid process is surgical shortening of the styloid process. The present study was conducted to morphometric analysis of styloid process and to find incidence of elongated styloid process.* ***Materials and Methods:*** *The present study was conducted with 50 adult dry skulls. The skulls which had intact full styloid process were included in study. The styloid processes were measured for their length with vernier callipers. The skulls were grossly observed on both the sides for the elongation of the temporal bone, styloid process. The styloid process more than 30mm considered as elongated. The measurements were taken from the base to the tip. The data was expressed in mean±SD.* ***Results:*** *The average length of styloid process was 25.12+6.12mm and in males it was 25.92+5.36mm and in females it was 23.12+4.34mm. The length of right styloid process in males was 26.54±5.16mm and left was 25.06±3.82mm. The length of right styloid process in females was 25.68±5.04mm and left was 24.64±4.54mm. The longest styloid process was 4.72cm and shortest was 1.2cm. In Incidence of elongated styloid process was 1%.* ***Conclusion:*** *The morphological knowledge of elongated styloid process is clinically important since the course of the vertebral*

artery may be distorted and the study results may be helpful in practice of otolaryngology.

Keywords: *Eagle Syndrome, Temporal bone, Otolaryngology, Pharynx.*

Introduction

The styloid process is a cylindrical bony projection that originates from the inferior part of the petrous temporal bone just anteriorly to the stylomastoid foramen. Embryologically, this apophysis develops from the Reichert's cartilage of the second pharyngeal arch . It is subjected to ossification from the third trimester of pregnancy through the first ten years of life. Regarding its location, it is positioned laterally in the neck between the internal and external carotid arteries and the internal jugular vein. Several nerves including the glossopharyngeal, facial, accessory, hypoglossal, and vagus are located near the styloid process. Regarding anatomic structure, the distal part of the styloid process is considered the origin of various muscles including the stylohyoid, stylopharyngeus, and styloglossus. In addition, the stylomandibular ligament and the stylohyoid ligaments emerge from part of the styloid process and are inserted into the ramus of the mandible and the lesser horn of the hyoid bone respectively. The muscles attached to the styloid process are known as Riolan's bouquet. Riolan has described the muscle of the styloglossus, stylopharyngeus, and stylohyoid as red flowers whereas the stylomandibular and stylohyoid ligaments as white flowers. These structures contribute to the movement of the oropharyngeal complex[1,2,3,4,5].

Styloid process is the cylindrical and needle-like structure has a thickness that gradually tapers, forming the apex of the styloid process[6]. The process length varies between individuals, with an average length of 2 to 3 cm[7]. The styloid process projects from the inferior portion of the petrous temporal bone, lying inferior and anterior to the external auditory meatus, anteromedial to the mastoid process, and anterior to the stylomastoid foramen. It comprises 2 segments: a proximal component and a distal component. The proximal portion consists of the base of the process, which is contained within the vaginal process of the tympanic portion of the temporal bone. The distal component consists of the shaft and is the origin of 3 muscles: the stylohyoid, stylopharyngeus, and styloglossus[8]. The styloid process apex is also the origin of 2 ligaments: the stylohyoid ligament, which attaches to the lesser cornu of the hyoid, and the stylomandibular ligament, which attaches to the ramus of the mandible. Both ligaments facilitate the movement of the tongue, pharynx, larynx, hyoid bone, and mandible[9,10].

The styloid process originates as a part of Reichert's cartilage, which forms from the second pharyngeal arch during embryological development[6,11]. Reichert's cartilage is divided into 4 parts: the tympanohyal part, the stylohyal part, the ceratohyal part, and the hypohyal part. The tympanohyal part develops antenatally, attaches to the petrous portion of the temporal bone, and gives rise to

the base of the styloid process, which is ensheathed by the vaginal process of the tympanic part. The stylohyal part appears post-natally, giving rise to the shaft of the styloid process and the proximal portion of the stylohyoid ligament.The ceratohyal and its fibrous sheath regress, giving rise to the stylohyoid ligament. The hypohyal part gives rise to the lesser cornu of the hyoid bone. The styloid process undergoes endochondral ossification that begins at the final stages of pregnancy and is carried on over the first 8 years of life[6,12].

The elongated styloid process and structural changes in stylohyoid ligament with its clinical symptoms were first described by Eagle[13,14]. Elongated styloid process is known as Eagle's syndrome when it causes clinical symptoms as neck and cervicofacial pain. It may cause stroke due to the compression of carotid arteries. The compression depends on the size, shape, and orientation of the ossified styloid process. Eagle's syndrome is diagnosed by both radiographical and physical examination. The styloid process palpation in the tonsillar fossa is indicative of styloid process elongation which are not normally palpable. Palpation of the tip of the styloid process should exacerbate existing symptoms[15]. The present study was conducted to morphometric analysis of styloid process andto observe elongated styloid process.

Materials and Methods

The present study was carried out in the department of Anatomy of Konaseema Institute of Medical Sciences and Research Foundation , Amalapuram and GMC, Vizianagaram This study was conducted with 50 adult dry skulls.Out of 50, male were 35(70%) and 15(30%) were female. The dried skulls which had damaged styloid process were excluded from the present study. The skulls which had intact full styloid process were included in study.The styloid processes were measured for their length with vernier callipers. The skulls were grossly observed on both the sides for the elongation of the temporal bone, styloid process. The measurements were taken from the base to the tip. The data wasexpressed inMean±SD. If any skull having the ossified stylohyoid ligament was also considered as the continuation of the styloid process. The styloid process more than 30mm considered as elongated.

Results

The present study was conducted with 50 adult dry skulls were used for study. Out of 50, male were 35(70%) and 15(30%) were female. The average length of styloid process was 25.12+6.12mm and in males it was 25.92+5.36mm and in females it was 23.12+4.34mm. The length of right styloid process in males was 26.54±5.16mm and left was 25.06±3.82mm. The length of right styloid process in females was 25.68±5.04mm and left was 24.64±4.54mm. The longest styloid process was 4.72cm and shortest was 1.2cm. The prevalence of elongated styloid process was 1%.

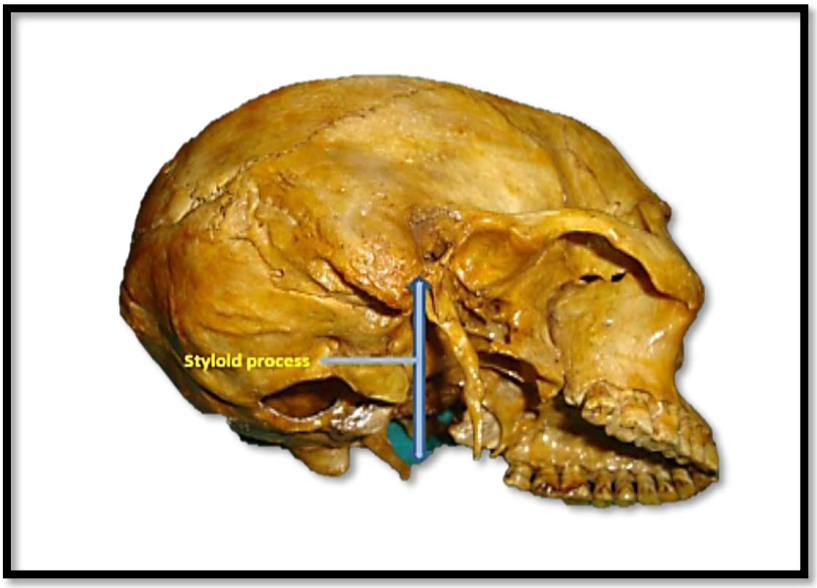

Figure 1. Skull showing Elongated styloid process

Table 1.Showing various parameters of styloid process.

Length styloid process	Mean+SD
Average Length	25.12+6.12mm
Male	25.92+5.36mm
Female	23.12+4.34mm
Male - Right Length	26.54±5.16mm
Male – Left Length	25.06±3.82mm
Female - Right Length	25.68±5.04mm
Female – Left Length	24.64±4.54mm
The longest styloid process length	4.72cm
The shortest styloid process length	1.2cm
Incidence of elongated styloid process	1%

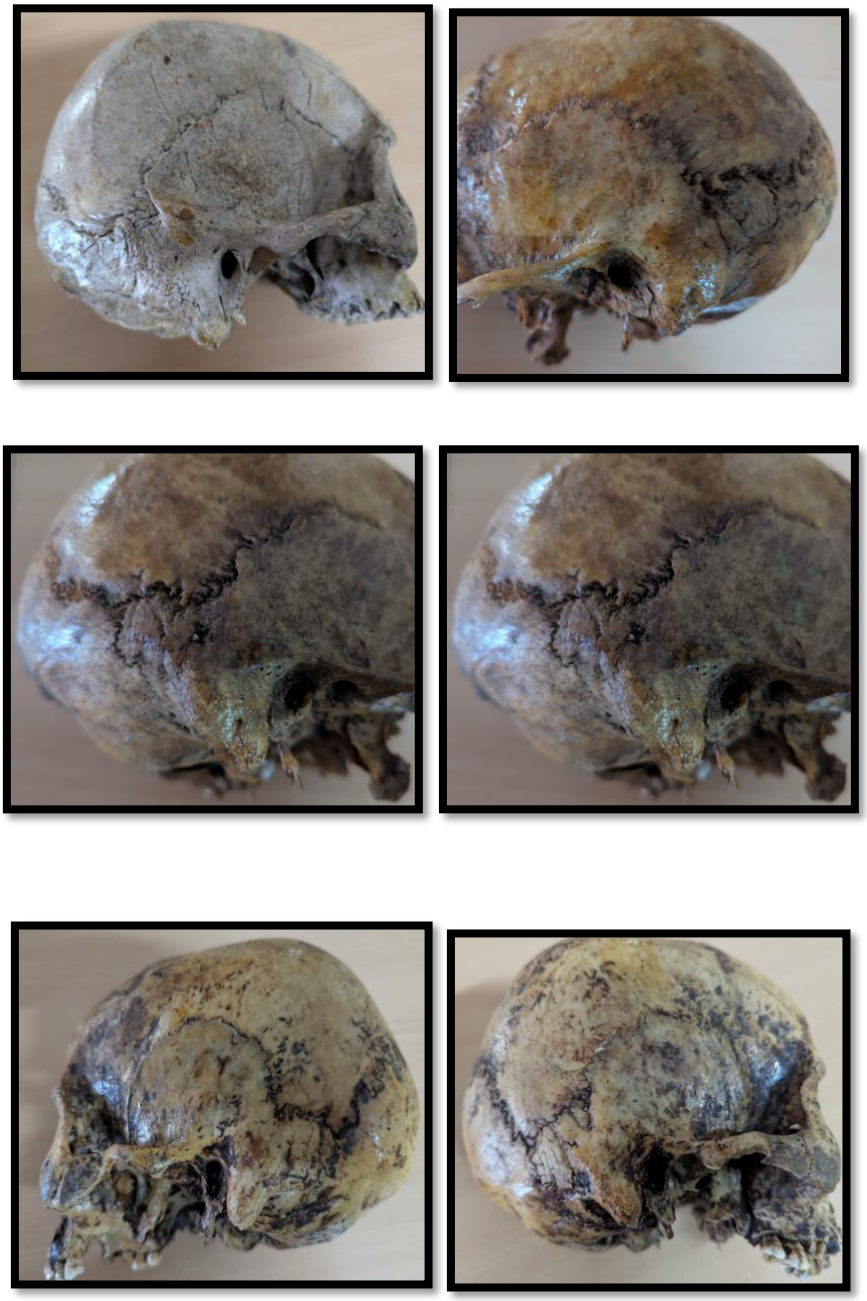

Figure 2.Showing Skulls with different lengths of styloid process

Discussion

In the adult the styloid ligament, normally composed of dense fibrous connective tissues may retain some of its embryonic cartilage and this have the potential to become partially or completely ossified in later life. Such as the ossification can get triggered by a pharyngeal trauma in form of hyperplasia or metaplastic alteration in cells of stylohyoid ligament. Another possibility is the mineralization of the ligament as a result of ageing and degenerative processes along with the spondylosis of cervical vertebra[16].The elongated styloid process is

characterized by recurrent pain in the oropharynx and face due to an elongated styloid process or calcified stylohyoid ligament. The styloid process is a slender outgrowth at the base of the temporal bone, immediately posterior to the mastoid apex. It lies caudally, medially and anteriorly toward the maxillovertebro-pharyngeal recess. Eagle considered tonsillectomy responsible for the formation of scar tissue around the styloid apex, with consequent compression or stretching of the vascular and nervous structures contained in the retrostyloidcompartment[17,18].

The present study was conducted with 50 adult dry skulls. Out of 50, male were 35(70%) and 15(30%) were female. The average length of styloid process was 25.12+6.12mm and in males it was 25.92+5.36mm and in females it was 23.12+4.34mm. The length of right styloid process in males was 26.54±5.16mm and left was 25.06±3.82mm. The length of right styloid process in females was 25.68±5.04mm and left was 24.64±4.54mm. The longest styloid process was 4.72cm and shortest was 1.2cm. Prevalence of elongated styloid process was 1%.

In study byPatilS[12] the means of length of styloid process, distance between bases and tips of styloid process were 2.58 cm, 6.80 cm and 4.65 cm respectively, while means of anterior and medial angles were 62.45° and 74.15°, respectively. Significant statistical difference was seen in anterior angles between groups with normal and elongated styloid processes ($p>0.001$).In study byCustodio[19] reported, from the lateral view of the left and right styloid, the length of the styloid process ranged, respectively, from 10.22 mm to 69.73 mm and from 8.30 mm to 63.77 mm. From a posterior view of the left and right sides of the skulls, the values range, respectively, from 15.57 mm to 69.51 mm and from 15.64 mm to 69.44 mm. In study byAhmetDursun[20] conducted with 259 cases (132 males, 127 females). The mean anterior styloid process lengths were detected to be 23.65 mm on the right side and 23.35 mm on the left side, and the mean lateral styloid process lengths were detected to be 21.77 mm and 21.64 mm on the right and left sides, respectively. The mean medial angulation of the styloid process was measured to be 64.37° on the right side and 64.42° on the left side, and the mean anterior angulation was measured to be 30.16° and 33.69° on the right and left sides, respectively.

In present study, elongated styloid process was found in 2(1%) skulls. Many previous studies have been done on length of styloid process and its relation to Eagle's syndrome. Generally, no correlation has been found between the severity of complaints and the length of stylohyoid chain ossification in symptomatic patients. It has been reported that abnormal angulations rather than elongation of the process is responsible for some concentrated symptoms. There have been studies investigating the angulation and length of the styloid process of the patients without symptoms of elongated styloid process with radiological studies. According to few studies, the anterior angulation and the length of the styloid process are responsible for the symptoms of Eagle's syndrome[21,22,23].

Conclusion

The study and knowledge of the anatomical variations of the styloid process may help clinicians from various specialties to diagnose Eagle syndrome. Knowledge of this disorder can prevent the worsening of the painful symptoms related to the elongated styloid process.

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