Morphometric Study of the Styloid Process of Temporal Bone

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ABSTRACT

Objective: Styloid process of temporal bone is clinically important, because variations in length, as well as the angulations of styloid process are associated with the symptoms of stylalgia (Eagle's syndrome) and the surgical excision of the process could alleviate neck and cervicofacial pain in patients. This study was aimed to evaluate the length, angulation and distance between bases and tips of the styloid process.

Materials and Methods: We studied 114 dry skull bones with intact styloid processes. The length of styloid process and distance between bases and tips of the styloid process were measured with the help of vernier calipers. The angulation (anterior and medial angles) of the styloid process was measured directly from the digital images by the image analysis using

Adobe Photoshop 7.0 and Image Tool 3.0 Program. A styloid process longer than 3 cm was identified as an elongated styloid process.

Results: 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).

Conclusion: Anterior angulation and distance between bases and tips decreased in elongated styloid processes while medial angulation showed no significant change. Our findings highlight the importance of the examination of styloid process in patients with symptoms of stylalgia.

Keywords: Eagle's syndrome, Styloid process, Temporal bone, Tonsillectomy

INTRODUCTION

The styloid process of temporal bone is a slender, pointed, bony projection from the inferior aspect petrous temporal bone. Its length varies, ranging from a few millimetres to an average of 2.5 cm. Its proximal part is ensheathed by the tympanic plate, while muscles and ligaments are attached to its distal part [1].

Styloid process is an apophysis which provides an anchorage for the stylopharyngeus, stylohyoid, styloglossus muscles, stylohyoid ligament and stylomandibular ligament [2]. It lies behind the pharyngeal wall between the internal and external carotid arteries. In close proximity is the glossopharyngeal nerve lying in the posterolateral wall of the tonsillar fossa. The facial nerve emerges from the stylomastoid foramen that is slightly posterolateral to the base of the styloid process. Medially the styloid process is related to the internal carotid artery with the sympathetic chain, internal jugular vein, accessory, hypoglossal, vagus and glossopharyngeal nerves [3,4].

Eagle's syndrome or Stylalgia presents with pharyngeal pain, otalgia and irritative sensation in the throat. It is thought to be caused by an elongated styloid process or calcified stylohyoid ligament. The presence of an elongated styloid process is not usually a pathognomonic finding for Eagle's syndrome. There are previous reports showing that the abnormal angulation rather than the elongation of the styloid process might be responsible for irritating numerous structures surrounding the styloid process leading to Eagles syndrome [5,6].

The aim of this study was to investigate and compare the angulation and the length of the styloid processes and the correlation between them.

MATERIALS AND METHODS

The present study was conducted on 114 dry skull bones with intact styloid processes in Department of Anatomy Maulana Medical College, New Delhi, India. The length of styloid process and distance between bases and tips of the styloid process were measured with the help of digital vernier calipers [Table/Fig-1,2]. The anterior and medial angulation of the styloid process was measured directly from the digital images by the image analysis using Image Tool 3.0 Program [Table/Fig-3-6]. Anterior angulation was measured between Frankfurt line and long axis of styloid process passing through tip of styloid process. Medial angulation was measured between line passing through bases of styloid process. A styloid process longer than 3 cm was identified as an elongated styloid process. The data was analysed statistically with SPSS version 17 using chi-square test.



[Table/Fig-1]: Measurement of length of styloid process and distance between bases and tips of the styloid process with the help of digital vernier calipers [Table/Fig-2]: Measurement of angulation directly from the digital images by the image analysis using Image Tool 3.0 Program [Table/Fig-3]: Distance between bases of the styloid process

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[Table/Fig-5]: Measurement of medial angulation-line passing through bases of styloid process and long axis of styloid process passing through tip of styloid process [Table/Fig-6]: Measurement of medial angulation-line passing through bases of styloid process and long axis of styloid process passing through tip of styloid process passing through the st

Parameter	Normal (<3cm) (n -98) 86%		Elongate (n-16)	Total (Mean) (n-114)	
	R	L	R	L	
Length (cm)	1.39 <u>+</u> 0.81	1.29 <u>+</u> 0.87	3.8 <u>+</u> 0.64	3.5 <u>+</u> 0.68	2.58 <u>+</u> 0.78
[Table/Fig-7]: Showing length of styloid process					

Parameters	Normal (<3cm) (n -98)	Elongated (>3cm) (n-16)	Total (n-114) (Mean)
Distance B/W Bases (cm)	6.9 <u>+</u> 0.52	6.7 <u>+</u> 0.58	6.8 ± 0.56
Distance B/W Tips (cm)	6.4 <u>±</u> 0.61	2.9 ± 0.69	4.65 <u>±</u> 0.74

[Table/Fig-8]: Showing length of styloid process

Parameter	Normal(<3cm) (n -98)		Elongated(>3cm) (n-16)		Total (n-114)	
	R	L	R	L	(Mean)	
Anterior Angle (deg)	67.4 <u>+</u> 8.13	66.1 <u>+</u> 8.24	58.07 <u>+</u> 9.23	58.3 <u>+</u> 9.27	62.46 ± 8.54	
[Table/Fig-9]: Showing length of styloid process						

Parameter	Normal(<3cm) (n -98)		Elongated(>	Total (n-114)	
	R	L	R	L	(Mean)
Medial Angle (deg)	75.7 <u>+</u> 6.11	75.4 <u>+</u> 6.32	72.9 <u>+</u> 6.52	72.6 ± 6.51	74.15 ± 6.45
[Table/Fig-10]: Showing medial angulation					

OBSERVATION AND RESULTS

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 62.46° and 74.15°, respectively. The styloid processes were divided into two groups - Group A Normal (< 3 cm) observed in 98 (86%) specimens and Group B elongated styloid process (>3 cm) seen in 16 (14%) specimens. The length of the styloid process showed variations and ranged from 0.7-2.9 cm for group A while it ranged from 3.1-3.9 cm in group B [Table/Fig-7]. The mean of distance between the bases of two styloid process was 6.9 ± 0.52 for group A while it was 6.7 \pm 0.58 in group B. The mean of distance between the tips of two styloid processes was 6.4 ± 0.61 for group A while it was 2.9 ± 0.69 in group B [Table/Fig-8]. In this study, the anterior angle of group A ranged from 61.3° - 69.7° while it ranged from 52.4° - 60 .1° in group B [Table/Fig-9]. The medial angle of group A ranged from 73.5-78.5 degrees while it ranged from 70.6-75.3 degrees in group B [Table/Fig-10]. Our study showed that anterior angulation and distance between bases and tips decreased in elongated styloid processes, which were stastically significant (p>0.001). But medial angulation showed no statistically significant change with increase in length of styloid process [Table/Fig-11].

DISCUSSION

Styloid process is part of stylohyoid complex along with lesser cornua of hyoid bone and stylohyoid ligament. The stylohyoid complex very variably develops from Reichert's cartilage of 2nd pharyngeal arch. It has four developmental components - Tympanohyal base of styloid process, Stylohyal \rightarrow shaft of styloid process, Ceratohyal

Parameter	Normal(<3cm) (n -98)		Elongated(>3cm) (n-16)		Total (Mean)
	R	L	R	L	
Length (cm)	1.39	1.29	3.8	3.5	2.58
Anterior Angle (deg)	67.4	66.1	58.07 *	58.3 *	62.46
Medial Angle (deg)	75.7	75.4	72.9	72.6	74.15
DISTANCE B/W BASES (cm)	6.9		6.7 *		6.8
DISTANCE B/W TIPS (cm)	6.4		2.9 *		4.65

[Table/Fig-11]: Showing relation between different morphometric values of styloid process

→ stylohyoid ligament and Hypohyal → lesser cornu of hyoid bone [7]. Several theories for variations in length and angulation of styloid process have been proposed. Excessive or abnormal ossification of stylohyoid complex components during development may result in abnormally elongated or angulated styloid process. Traumatic stimulus can also lead to multiples metaplastic alterations in the cells of the styloid ligament, which results in its total or partial ossification [8,9].

Two types of syndrome were described by Eagle. 'Classic styloid syndrome' occuring mainly after tonsillectomy and is characterized by dysphagia, odynophagia, a sensation of increased salivation, and a sensation of a foreign body in the pharynx, sometimes accompanied by vocal changes. Second type is 'stylocarotid syndrome' caused by the stylohyoid complex exerting pressure on the internal and external carotid arteries, regardless of tonsillectomy. The symptoms are caused by the stimulation of the sympathetic nerve plexus around the blood vessel. Orbital pain, parietal headache can occur and can be confused with cluster headache and migraine. In severe cases, vision disturbance and syncopal attacks can occur [10].

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 study the anterior angulation and the length of the styloid process are responsible for the symptoms of Eagle's syndrome [11-13].

Our study showed that anterior angulation and distance between bases and tips of styloid process decreased in elongated styloid processes. Medial angulation showed no significant change with increase in length of styloid process. Any pressure at the surrounding area of tonsilar fossa or manipulations around the neck area may lead to fracture of elongated and deviated styloid process leading to many clinical signs. Our findings highlight the importance of the examination of both angulation and length of styloid process in patients with symptoms of eagle's syndrome because with increase in length the angulation of styloid process is also affected.

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