

A Study of Styloid Process: Distance between Base of Styloid Process and Carotid Canal and Two Styloid Process**Kiran Kumar S.¹, G. S. Malipatil²**¹Assistant Professor, Department of Anatomy, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, India²Professor and HOD, Department of Anatomy, Pacific Institute of Medical Sciences, Umarda Udaipur, Rajasthan, India

Received: 20-03-2023 / Revised: 21-04-2023 / Accepted: 25-05-2023

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Conflict of interest: Nil

Abstract:**Background:** The styloid process is normally a thin cylindrical sharp bony projection which arises from the lower surface of the petrous part of the temporal bone, derivative of a second branchial arch. Styloid process is usually extends downwards, due to anatomical and congenital variations in length or number and angulations may compress adjacent neurovascular structures.**Aim and Objectives:** To evaluate distance between base of styloid process and Carotid canal and two styloid process.**Material and Method:** This was an observational descriptive study conducted in department of Anatomy KIMS, Bangalore and other Medical Colleges in and around Bangalore. Study Includes 121 Adult Human skulls with intact styloid Process. The styloid process length and the interstyloid distance of the skull between the right and left sides were measured using a digital Vernier calliper.**Results:** 121 fulfilled the study criteria of at least one styloid process intact. distance between styloid process and mastoid base in the range of 0.2 -0.5cm and 0.6-1.1 cm respectively, there was no significance difference between these two groups. There was no significance difference between the two groups with distance between styloid process and carotid canal, in the range of 0.2-0.5 and 0.6-1.1 cm. 63(52.07%) were in the range of 6.6-7.5cm and 7.6-8.5cm were in the range of 53(43.80%) and 5(4.13%) were in the range of 5.6-6.5cm.**Conclusion:** Our study may be helpful for maxillofacial surgeons, dentists, radiologists, and anaesthetists to reach the proper diagnosis by doing pre-operative evaluation.**Keywords:** Styloid process, Interstyloid distance, Branchial Arch, maxillofacial surgeons etcThis is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Variation is the law of nature. Every human is unique anatomically to such an extent that even identical twins are not alike. Styloid process is derived from the Greek word 'Stylos' meaning a pillar. The styloid process is normally a thin cylindrical sharp bony projection which arises from the lower surface of the petrous part of the temporal bone, derivative of a second branchial arch. It lies in front of the stylomastoid foramen and its tip projects anteriorly and inferiorly between internal and external carotid arteries and also laterally to the pharyngeal wall and tonsillar fossa [1]. The styloid process has attachments to three muscles and two ligaments. The stylopharyngeus, stylohyoid and styloglossus muscles originate here [2].

Styloid process laterally covered by parotid gland, facial nerve crosses its base, external carotid artery crosses its tip and medially, it is separated from

beginning of internal jugular vein by stylopharyngeus. Lateral to the stylomastoid foramen, tympanomastoid suture lies which accommodates auricular branch of vagus nerve. Internal carotid artery, internal jugular vein and, vagus, spinal accessory and hypoglossal cranial nerves lie on its medial side. In close proximity is the glossopharyngeal nerve lying in the posterolateral wall of tonsillar fossa [3].

Styloid process is usually extends downwards, due to anatomical and congenital variations in length or number and angulations may compress adjacent neurovascular structures. Stylomastoid foramen intervenes between styloid and mastoid processes; the foramen transmits facial nerve and stylomastoid artery. Any abnormal or congenital variations of styloid process or ossified ligamentous structures around area of stylomastoid foramen may partially or completely compress the facial nerve and leads

to Bell’s palsy is a condition that causes weakness or paralysis of the muscles in the face. Considering the various relations of styloid process with important neurovascular structures and its morphological variations, this study was aimed to evaluate distance between base of styloid process and Carotid canal and two styloid process.

Materials and Method

This was an observational descriptive study conducted in Department of Anatomy KIMS, Bangalore and other Medical Colleges in and around Bangalore. Study Includes 121 Adult Human skulls with intact styloid Process.

The styloid process length and the inter styloid distance of the skull between the right and left sides were measured using a digital Vernier calliper. For the length of the styloid process, the measurement was taken from the base of the skull to the tip of the styloid process. For the inter styloid distance at the base of the skull, the measurement were taken between the bases of right and left styloid process

(Fig-2). While the interstyloid distance at the tip was measured as the distance between the tips of right and left styloid process. The parameters were measured by two observers independently with predetermined procedures to prevent inter-observer and intra- observer error.

With the help of digital Vernier callipers measurements were taken. Qualitative data were presented with frequency and proportion while quantitative data were presented by mean and standard deviation. Proportion difference between styloid process were assessed by using chi-square test. P-value less than 0.05 were considered as statistically significant.

Observation and Results

121 fulfilled the study criteria of at least one styloid process intact. This study was conducted on these 121 skulls. They were examined for variations that exist in morphology and morphometric parameters of Styloid process.

Table 1: Distance between Styloid process and mastoid base

Distance between Styloid process and mastoid base(in cm)	Side of the styloid process			Chi-Square	P-value
	Right	Left	Total		
0.2-0.5	59(48.76%)	56(46.28%)	151 (47.52)	0.07	0.699
0.6-0.9	61(50.41%)	62(51.24%)	123 (50.83)		
1.0-1.3	1(0.83%)	3(2.48%)	4 (1.65)		
Total	121(100%)	121(100%)	242 (100)		
Mean ± SD	0.55± 0.13	0.57±0.13	0.56 ± 0.13		

When the Styloid Processes were divided in to two groups with distance between styloid process and mastoid base in the range of 0.2 -0.5cm and 0.6-1.1 cm respectively, there was no significance difference between these two groups.

Table 2: Distance between Styloid process and carotid canal

Distance between Styloid process and carotid canal (in cm)	Side of the styloid process			Chi-Square	P-value
	Right	Left	Total		
0.2-0.5	60(49.59%)	56(46.28%)	116 (47.93)	0.15	0.699
0.6-0.9	60(49.59%)	62(51.24%)	121 (50.41)		
1.0-1.3	1(0.83%)	3(2.48%)	4 (1.65)		
Total	121(100%)	121(100%)	242 (100)		
Mean ± SD	0.56± 0.11	0.57±0.13	0.57 ± 0.12		

The mean distance between Styloid process and carotid canal of the combined left and right side is 0.57cm with standard deviation of +/- 0.12 cm. The right side has mean distance of 0.56 cm with standard deviation of +/- 0.11cm and the mean distance on the left side is 0.57cm with standard deviation of +/-0.13 cm. There was no significance difference between the two groups with distance between styloid process and carotid canal, in the range of 0.2-0.5 and 0.6-1.1 cm.

Table 3: Distance between right and left Styloid process

Distance between two Styloid processes (in cm)	Total	Percentage
5.6 – 6.5	5	4.13
6.6 – 7.5	63	52.07
7.6 – 8.5	53	43.8
Total	121	100
Mean +/- sd	7.58± 0.458	

Out of 121 skulls, the distance between the right and left styloid process, 63(52.07%) were in the range of 6.6-7.5cm and 7.6-8.5cm were in the range of 53(43.80%) and 5(4.13%) were in the range of 5.6-6.5cm.

Table 4: Correlation between the distance between Styloid process and carotid canal and other variables

Particulars	Mean \pm SD	Correlation coefficient	p- value
Length of the styloid process	1.469 \pm 0.717	0.21	<0.001
Diameter of the styloid process at the base	0.34 \pm 0.097	0.121	0.061
Distance between styloid process and mastoid base	0.56 \pm 0.13	0.609	<0.001
Medial angulation	72.83 \pm 6.65	-0.055	0.396
Anterior angulation	68.16 \pm 8.42	-0.46	0.474

There was statistically significant Correlation between the distance between styloid process and carotid canal and the length of styloid process, styloid process and mastoid base with correlation coefficient of 0.609 with the correlation coefficient of 0.210 and p value of <0.001.

Discussion

Embryologically the styloid process, stylohyoid ligament and the lesser cornu of the hyoid bone are developed from the second brachial arch called as the Reichert's cartilage because it is of cartilaginous origin [4] It has been suspected that an elongated styloid process could be caused by: congenital elongation of the styloid process due to persistence of the cartilaginous analogue of the Styloid, calcification of the stylohyoid ligament by unknown mechanism and growth of osseous tissue at the insertion of the stylohyoid ligament [5]. Ossification can take place during childhood and adolescence when the rate of bone growth is increased. After the age of 20 there is a rapid decrease in ossification formation [6]. However, other authors support that an inconsistent trend exists toward greater ossification of the stylohyoid ligament with advanced age [7]. A normal range of the length of the styloid process differs among the studies in the literature. Eagle *et al* reported the normal length of the styloid process as 2.5 cm. other authors measured the length as 3 cm. It has been reported that it is probably symptomatic when the length exceeds 4cm [8].

In our study 121 skulls were included who were satisfied inclusion and exclusion criteria. They were examined for variations that exist in morphology and morphometric parameters of Styloid process. We have observed that there were no statistically significant difference was observed between styloid process and mastoid base also we have not observed significant difference of styloid process and carotid canal. But among 52.07 % of the skulls it was observed that distance between two styloid process was 6.6 – 7.5 cm followed by 7.6 – 8.5 cm. In the study of Massey, there were only 11 cases of styloid process having length of more than 4 cm out of 2000 cases studied[9]. Harma gives incidence of 4-7% for elongated styloid process[10]. Elongation was seen four times more in males than females and in 75% of cases the elongation was bilateral. The elongation and thickening of styloid process to an extent reported here is very rare. The possible clinical course causes for thickening and surgical approaches needs to be evaluated. According to the the study

by Ajay Ravatha et al[11] The interstyloid distance shows that a very limited space was available for accommodating the structures of neck, consisting of the larynx, commencement of the oesophagus, cranial nerves and great vessels which supports our study.

Previous study done by [12] on styloid process for sex determination showed statistically significant differences of the interstyloid distance at both the base and the tip of the processes.(p < 0.05).The present study findings coincides with the our study.

Conclusion

Many important anatomical structures are in close proximity with the SP. These structures may be compressed or irritated because of variations in the morphology of SP. Our study may be helpful for maxillofacial surgeons, dentists, radiologists, and anesthetists to reach the proper diagnosis by doing pre-operative evaluation.

Acknowledgement: None

Funding: None

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