

MORPHOMETRIC ANALYSIS OF STYLOID PROCESS IN DRY HUMAN SKULLS AND ITS CLINICAL IMPLICATIONS ON EAGLE'S SYNDROME

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ABSTRACT

Background: The word styloid is the resultant of the greek word which states 'pillar'. There is a slender pointed structure in the temporal bone of the skull present at the front of the mastoid process. Styloid process rests amongst the internal carotid artery (ICA) and external carotid artery (ECA) of the head and neck. The styloid process has 3 muscles (styloglossus, stylopharyngeus and stylohyoid) and 2 ligaments (stylomandibular and stylohyoid ligaments) attached to it. The regular extent of styloid process is 20 – 30 mm, if greater than 30mm this will be regarded as the "elongated styloid process" and when symptoms like chronic cervical pain, neck pain, pain in opening and closing of mouth, pain in rotation of head occurs; that is called Eagle's syndrome. Eagle's syndrome can remain undiagnosed for a very long time as it can be correlated with many other disorders like third molar impaction and other teeth and mouth related disorders.

Aim: To analyse and scale the dimension of styloid process in various dry human skulls, and find out its clinical implications on Eagle's Syndrome.

Materials and Methods: Measurement of the styloid process was done in 51 dry human skulls taken from Saveetha Dental College, Chennai using digital vernier calliper. Both

length and breadth were calculated on both the sides of skulls and data was analysed using SPSS v23.0 software.

Results: Mean, Standard Deviation (SD) was calculated using this software. Out of 11 skulls 1 side of a skull was elongated with measurement of 42.87mm and others were in normal range.

Conclusion: From the analysis it was depicted that there was no obvious significant difference between the extents of styloid process on both the sides. Nevertheless, the presence of the this process may not cause any problem unless there is abnormal elongation or calcification of the process which was found in one skull in this study.

Key Words: Styloid Process, Temporal bone, Eagle's syndrome, Skulls, Clinical implication.

INTRODUCTION

Styloid process is a slender stick-like bony extension of temporal bone of skull, situated in front of stylomastoid foramen. The normal length of styloid process is 20-30mm and when longer than 30mm it will be called as elongated styloid process in humans and if any symptoms like chronic cervical pain, neck pain, pain in opening and closing of mouth, pain in rotation of head occurs it is referred as the Eagle's syndrome (1). The diagnosis of elongated styloid processes is very difficult as it can be misunderstood with teeth and mouth related disorders (2).

Digital radiographs, human dry skull, and computed tomography are used to evaluate the extent of the styloid process. The length can differ from person to person and side to side of a single skull. The term styloid is derived from Greek meaning 'pillar' (3). Styloid process is located between the 2 major arteries of head and neck the internal carotid artery and external carotid artery and attached to 3 muscles and 2 ligaments (4). The 3 muscles are styloglossus, stylohyoid, stylopharyngeus muscle and the 2 ligaments are stylohyoid and stylomandibular ligament (5-7). Extended styloid process can cause Eagle's syndrome if it includes dysphagia, dysphonia, otalgia, headache, dizziness (8,9).

The lengthened styloid process was first discovered by Eagle in 1937 (10). Elongated styloid process is usually asymptomatic but if symptoms appear it is termed as Eagle's syndrome. The cranial nerves present near the styloid process are glossopharyngeal, facial, accessory, hypoglossal, vagus (11). The elongation can cause various irritations in the structures nearby (12). Diagnosis is done if it is palpable in the ipsilateral tonsillar fossa. Treatment is through intraoral surgery. Our scientist experts with their encompassing information, research experience, data has transformed to several publications globally in well reputed indexed Journals (13-20),(21),(22),(23),(24,25),(26),(27),(28-32). The rationale for this work is to analyse the length and breadth of styloid process in dry human skulls.

MATERIALS AND METHODS

Total of 51 dry human skulls from the Department of Anatomy, Basic Medical Science at Saveetha Dental College were taken to carry out the study. Skulls with broken styloid processes were disqualified from analysis. Length and Breadth was scaled on both the sides of skull using a digital sliding vernier caliper (Figure 1). A styloid process with an average length is shown in Figure 2. The obtained data was analysed and viewed using SPSS v23.0 software. Mean, Median, Standard deviation (SD) was calculated. The measurement was done with the help of a digital vernier calliper. Pros of the study is that there was no sampling bias used. Cons are that only few dry human skulls were available with intact styloid processes.

RESULTS

The total dimension and breadth of the styloid process was measured and the data was noted for statistical analysis. The minimum left and right length was found to be 14.95 mm and 16.21 mm respectively. The minimum left and right breadth respectively was found 3.31 mm and 3.98 mm. The maximum left and right length was found 42.87 mm and 24.21 mm respectively. The maximum left and right breadth was calculated as 5.78 mm and 5.29 mm respectively. The mean of left and right length was calculated as 21.48 ± 7.64 mm and 20.27 ± 2.84 mm respectively. The mean of left and right breadth was measured 4.36 ± 0.85 mm and 4.63 ± 0.57 mm respectively. The dimensions on the right aspect and left aspect of the of the styloid structure of skull are shown in Table 1. The p value for the dimension of the styloid process between the left and right side was found to be 0.789 ($p > 0.05$) indicating statistically not significant. The p value for the breadth of the styloid process between the left and right side was found to be 0.285 ($p > 0.05$) indicating statistically not significant. One elongated process was found on the left side of the skull measuring 42.87 mm (Figure-3).



Figure 1: Shows the measurement of styloid process using digital vernier calliper



Figure 2: Shows the Styloid process (right) of a dry human skull



Figure 3: Shows the elongated styloid process.

Table 1: Shows the measurement of the Styloid process on the right and left side. All the values are expressed as Mean ± Standard Deviation.

	Minimum	Maximum	Mean	Standard Deviation	Significance
Left Length	14.95	42.87	21.4882	7.64604	0.789
Right Length	16.21	24.21	20.2791	2.84821	
Left Breadth	3.31	5.78	4.3645	0.85477	0.285
Right Breadth	3.98	5.29	4.6309	0.57053	

DISCUSSION

The dimension of the elongated styloid process was measured 42.87 mm and the breadth was measured 3.67 mm on the left side of the dry human skull. In a previous study (33), 500 radiographs were studied and a total 1000 styloid processes were recorded. Only 16.3% were elongated; 8.4% were on the right side and 7.9% were on the left side.

The mean and standard deviation found on the left and right side of the study were 21.48 mm \pm 7.64 mm and 20.27 mm \pm 2.84 mm respectively. In a previous study (33,34), the mean and standard deviation was found to be 34 mm \pm 8 mm and 33 mm \pm 8 mm for the left and right side respectively. It shows that most of the styloid processes were elongated. The p value was found to be 0.0002 i.e. there's a significant difference.

In another study (35), the mean length of the styloid process on the left and right side was 29.16 mm \pm 6.44 mm and 29.18 mm \pm 6.86 mm respectively. In this study, the length was found a little less than that of the previous study.

In another study (36), the size of the styloid process on right side was 9.3 mm and on left side was 8.9 mm which was performed on 60 dry human skulls. Subjects having lengthened styloid process show different symptoms. The most usual one is headache and radiating cervical pain. These pain symptoms may be assident or predictive. However, in this study the mean of left and right length was calculated as 21.48 \pm 7.64 mm and 20.27 \pm 2.84 mm respectively.

In another study (37), 100 OPGs were collected and size of the styloid process was analysed and the mean dimension of right aspect and left aspect of styloid process was 3.34 cm \pm 0.69 and 2.95 cm \pm 0.62 respectively in males. The mean size of right lateral side and left lateral side styloid process was 3.35 cm \pm 0.77 and 3.05cm \pm 0.76 respectively in females. The study revealed that the dimension of styloid process was higher than the average on right aspect and the left lateral side was normal within limits. This study however had the length of the styloid process higher on the left lateral side, which means there is no association with the size of styloid process with sides and further, no association with Eagle's syndrome.

Elongated styloid processes can cause chronic cervical pain, severe neck pain, facial pain, and the diagnosis can be undefined for long as it can block the path of external and internal carotid arteries (5). Very less dry human skulls were available for the measurement of the styloid process as it is broken very easily during handling. The result might get changed when there will be a high number of skulls for measurements.

CONCLUSION

The styloid process of various dry human skulls was measured and an elongated styloid process was found on one side. There might be a possibility of Eagle's Syndrome in the extended styloid process. The possibility of occurrence of styloid process which is long leading to Eagle's Syndrome is more when compared to other bony deformities of the base of the skull. This abnormal bony variation may cause several clinical problems of the neck. Hence a thorough knowledge of such anatomical bony variations can be very useful for the surgeons, neurosurgeons, orthopedic clinicians.

LIMITATIONS OF THE STUDY

The number of Dry Human Skulls for the measurement of the styloid process were very less as it can be broken very easily, and is to be handled very carefully. The research was limited

to a small sample size and dry skulls of various ethnicities and different geographical parts were not included.

FUTURE SCOPE

The elongated styloid process with complications of Eagle's Syndrome can be further analysed and studied with the help of X-rays and other types of radiographs of the humans.

AUTHOR CONTRIBUTIONS

Author 1: Dev Arora, carried out the study by collecting data and drafted the manuscript after performing the necessary statistical analysis and in the preparation of the manuscript.

Author 2: Karthik Ganesh Mohanraj, aided in conception of the topic, designing the study and supervision of the study, correction and final approval of the manuscript.

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CONFLICT OF INTEREST

All the authors declare that there was no conflict of interest in the present study.

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