

Measurement of Length of Styloid Process by Orthopantomography

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ABSTRACT

Background: Styloid process (SP) is an anatomical structure whose elongation is not well understood. Proper clinical and radiological assessment is needed to detect an elongated SP. Anatomical variation is also common. SP is said to be elongated if longer than 30 mm. Orthopantomogram (OPG) is also an imaging modality by which we can view SP.

Objective: The objective of this study was to assess the SP on OPG and identify eagle syndrome.

Materials and Methods: The study was conducted on archived OPG radiographs available in the Department of Oral Radiology, Gandaki Medical College Teaching hospital and Research Centre. These radiographs were from patients who were subjected to radiographic examination for other dental problems. The length of SP was measured on both sides using the measurement tool bars on the accompanying analysis software.

Results: Average length of SP on males was 26.5 mm \pm 14.4 mm in right and 25.5 mm \pm 6.19 mm in left; and on females was 23.78 mm \pm 5.93 mm on right and 24.7 mm \pm 10.44 mm in left. Elongated SP was more on males compared to females. Elongated styloid process (ESP) was more prevalent in 21 - 30 years of age group, similarly unilateral and bilateral elongation was also predominant on males compared to females.

Conclusion: OPG is also useful for detection of an ESP in patients with or without symptoms and helps to avoid misdiagnosis of tonsillar pain or pain of dental, pharyngeal or muscular origin as well as Eagle syndrome (ES).

Keywords

Eagle syndrome, Elongated styloid process, Orthopantomogram, Styloid ligament, Styloid process.

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INTRODUCTION

Styloid process (SP) is a cylindrical bone that arises from the temporal bone in front of the styloid mastoid foramen, which is derived from the Reichert's cartilage of the second brachial arch¹. It normally measures about 2 to 3 cm in length, although it varies in length from person to person and even from side to side in same individual^{2,3}.

The SP is a long, slender and pointed bony process projecting downwards, forwards and slightly medially from the temporal bone. It is interposed between the

parotid gland laterally and internal jugular vein medially. External carotid artery crosses tip of SP superficially. Facial nerve crosses the base of styloid process laterally after it emerge from stylomastoid foramen.

It descends between the external and internal carotid arteries to reach the side of the pharynx. When symptoms are associated with elongation of the SP, the condition is termed as Eagle syndrome³.

The ESP, when it causes pain on rotating head, dysphagia and referred otalgia is known as Eagle's syndrome. Eagle

syndrome was first described by Otorhinolaryngologist, named Eagle WW in 1937 on a case report of elongated SP, since then it is called Eagle's syndrome³. Eagle considered tonsillectomy is responsible for the formation of scar tissue around the styloid apex, with consequent compression or stretching of the vascular and nervous structure contained in the retro styloid compartment.

Eagle's syndrome is associated with disorders causing heterotopic calcification such as abnormal calcium-phosphorus metabolism and chronic renal failure. The syndrome is divided into two main sub types based on cranial nerve impingement and carotid arterial impingement. In cranial nerve impingement patient develops symptoms related to compression and irritation of cranial nerves V, VII, IX and X such as facial pain while turning the head, dysphagia, foreign body sensation, pain on extending tongue, change in voice, sensation of hyper salivation and tinnitus or otalgia. Compression of carotid artery produces vascular and ischemic symptoms, eye pain, visual symptoms, parietal pain and syncope.

MATERIALS AND METHODS

With this background we had proceeded to perform a retrospective study on archived OPGs to ascertain the length of the SP. Though there have been few studies done in the past this study was repeated for the fact that were no studies based on Nepalese population.

The study was conducted on archived OPG radiographs available in the Department of Oral Radiology, Gandaki Medical College Teaching hospital and Research Centre from August 2017 to April 2018. These radiographs were from patients who were subjected to radiographic examination for other dental problems.

A total of 1062 digital OPG, of patients aged between eight to 78 years were taken. From this group about 62 were excluded due to poor diagnostic quality. Out of radiographs 518 obtained from males and 482 from females. Only those radiographs were included in which both sides of SP were visible.

The radiographs were exposed with Vatechpa X-I (PCh-2500) machine, Korea. The exposures were taken at 70-73 kvp with 10-12 mA depending on the built of the patient.

SP measuring more than 30 mm were considered elongated⁵ if the styloid or stylomandibular ligaments were ossified, they were measured along with SP, as a part of ESP. Figures shows normal SP and ESP (Fig 1, 2).

The collected data was entered in a spreadsheet (Excel 2013, Microsoft, and Richmond, USA) and was analyzed using statistical analysis software (SPSS version 17, Chicago, USA). The chi-square test, unpaired t test, and one-way ANOVA were used for analysis.

Fig 1: Orthopantomogram with SP



Fig 2: Orthopantomogram with ESP



Statistics

The data obtained was tabulated using Microsoft Excel, Redmond, USA. The results were analyzed with Statistical Package for Social Sciences, (SPSS) ver 25.0. The expected statistical analysis was to compare the mean lengths of the right and left sides, and between genders. When the comparison was done between the right and left side in the same the gender paired t test was used and between genders comparison for the right and left side was done with unpaired t test. The level of significance was fixed at $p < 0.05$.

RESULTS

The study evaluated 1061 orthopantomographs. Out of these 61 were discarded for poor diagnostic quality, patient with artificial denture, and old age. A final set

of 1000 OPGs were taken for evaluation. Among the 1000 OPGs, 481 (48%) were males and 519 (52%) were females. The SP length was measured on both sides. The results obtained in the study are tabulated below (Table 1).

Table 1: The mean length of styloid process in males and females

	Numbers	Right	Left
Males	481	26.5 mm \pm 14.4	25.5 mm \pm 6.19
Females	519	23.78 mm \pm 5.93	24.7 mm \pm 10.44

The mean length of the SP on the right side for males was 26.5 \pm 14.4 mm and on left side was 25.5 \pm 6.19. The null hypothesis assumed was there is difference in length between the males and females. For the given scenario the statistical analysis performed was paired sample t test. The results were statistically insignificant ($p > 0.05$) with the difference between the right and left being different (Table 2).

Table 2: Comparison of the mean length of the styloid process in the right and left side for males

	Mean	SD	p-value
Right	26.55	14.41	0.35
Left	25.89	6.19	

The mean length of SP infor the right side was 26.5 mm \pm 14.4 and for left side was 25.8 mm \pm 6.19. The paired sample t test analysis was performed which had yielded statistically insignificant ($p > 0.05$) between the right and left sides (Table 3).

Table 3: Comparison of the mean length of the styloid process in the right and left sides for females

	Mean	SD	p-value
Right	23.78	5.93	0.079
Left	24.71	10.44	

Since the above tests showed that there is significant difference in the lengths between the right and left sides, we proceeded for the next analysis to compare the mean length of each side between genders.

The mean length of males, right SP 26.5 mm \pm 14.4 in 481 males and the mean length of females, right styloid process was 23.78 mm \pm 5.93 in 519 females. For the given scenario the unpaired sample t test was used. The test yielded statistically significant ($p > 0.05$) accepting the null hypothesis that there is difference between right side of males and right side of females (Table 4).

Table 4: Comparison of the mean length of the styloid process in the right side length between males and females

	Mean	SD	p-value
Males	26.55	5.93	$p < 0.05$
Females	23.78	14.41	

The mean length of males right SP was 26.55 \pm 5.93 mm and the mean length in females are 23.78 \pm 14.41 mm. The results showed statistically significant difference ($p < 0.05$) between males and females based on unpaired sample t test (Table 5).

Table 5: Comparison of the mean length of the styloid process in the left side between males and females

	Mean	SD	p-value
Males	25.89	6.19	$p < 0.05$
Females	24.71	10.44	

The mean length of males left SP was 25.8 mm \pm 6.19 and mean length in females was 24.7 mm \pm 10.44. The result showed statistically significant difference ($P < 0.05$) between males and females based on unpaired sample t test.

Out of 1000 OPGs, approximately 2000 SP were evaluated. The percentage of SP elongation was 57.56% in males and 42.43% in females.

ESP were seen in all age groups as shown in Table 1, and more prevalent in the age group of 21 - 30 years. Unilateral elongated in 116 patients out of which males were 49 and females were 69 and bilateral elongated SP in 122 out of which males were 68 and females were 54.

Table 6: Mean and number of enlarged SP according to age group

Age group (Years)	No.	Right	Left
≤ 20	14	33.1 \pm 5.07	32.0 \pm 5.48
21 - 30	68	32.8 \pm 5.24	32.1 \pm 5.46
31 - 40	56	34.2 \pm 5.60	33.4 \pm 6.11
41 - 50	36	32.5 \pm 5.75	33.3 \pm 5.99
51 - 60	36	32.4 \pm 5.45	32.0 \pm 5.23
60 - 70	16	34.5 \pm 7.29	32.1 \pm 7.17
≥ 70	12	32.6 \pm 8.51	32.5 \pm 8.26

DISCUSSION

“SP” is derived from the Greek word ‘Stylos’ meaning a pillar. The styloid process is a long, slender cylindrical bone arising from the temporal bone in front of the stylo mastoid foramen. Embryologically, the styloid

process and its ligaments are derived from the first and second branchial arches which also give rise to Reichert's cartilage. ESP was first reported by Eagle concerning findings indentomaxillofacial and ear-nose-throat patient³.

There are several imaging modalities used for diagnosis of the Eagle syndrome, panoramic radiography, lateral skull radiography, Towne's view radiograph, anteroposterior skull radiograph, and CT scan are some of them. The complete details of length, angulation and relation to adjacent structures can be obtained from a CT scan by formulating a 3D-CT^{5,6}.

Radiological normal length of SP measures between 2.5 to 3 cms as reported by Eagle⁷ but Kaufman *et al* has reported 30 mm as upper limit of normal SP⁴.

The exact cause for SP elongation is poorly understood and several theories had been proposed for the elongation of SP. It could be due to growth of osseous tissue at the insertion of stylohyoid ligament or it could be due to calcification of stylohyoid ligament due to unknown process or due to persistence of cartilaginous analog of stylohyal^{7,8}.

Various investigators have reported the incidence of elongated styloid as 1.4, 4, 7 and 18.2%, respectively^{4,9-11}.

The mean length of males, right and left styloid process was 26.55 mm \pm 14.41 and 25.89 mm \pm 6.19 respectively. The mean length of female right and left styloid process was 23.78 mm \pm 5.93 and 24.71 mm \pm 10.44 respectively, concluding that males have longer styloids as compared to females.

In several studies conducted by various authors reveals that the styloid processes were elongated more in males when compared to females and more on the left side when compared to the right side¹²⁻¹⁴. However, this finding differed from those of some other researchers, who found an increased incidence in females¹⁵.

The percentage of SP elongation was 57.56% in males and 42.43% in females. Unilateral elongation in left side (23.1%), right side (25.63%) and bilateral elongation was 28.5% in males and 22.26% in females. Bozkir *et al* had noted unilateral elongation in 25% and bilateral elongation in 75% of the panoramic radiographs¹⁷. In our study the length was greater on the right side than the left side.

In Balcioglu HA *et al* study, the length of the SP of males is statistically greater than the females in all age groups

and on both sides¹³.

In another anthropological study of 110 skulls, only five skulls had elongation of styloid process of which three had bilateral elongation and only two had unilateral elongation¹⁸.

CONCLUSION

Our study yielded the average length of the SP which was consistent with the studies earlier reported in the literature. Panoramic radiography (OPG) is useful for detection of ESP in patient with or without symptoms. It can also help us to avoid misinterpretation of the symptoms as tonsillar pain or pain of dental, pharyngeal or muscular origin.

Conflict of Interest

Conflict of interest declared none

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