

Prevalence and Pattern of the Elongated Styloid Process among a Saudi Population

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Abstract

Introduction: The objectives of this study were to assess the elongation of the styloid process (SP) on digital panoramic radiographs (DPRs) and to evaluate the prevalence of the elongation according to age, sex, and type. **Materials and Methods:** DPRs of 198 geriatric edentulous patients were analyzed. The radiographic length of the SP was measured on both sides using the measurement toolbars on the accompanying analysis software. The student's t-test, Chi-square test, and analysis of variance test were used for statistical analysis. **Results and Discussion:** The elongated SP was seen in 87 of the 198 patients. It was observed that as age increased, elongation of the SP increased with a male predominance. Type I elongation was more common than other types of elongation. Bilateral elongation was more commonly found than unilateral elongation, and both types of elongation were frequently seen in males compared to females. **Conclusions:** The prevalence of the elongated SP in the present study was higher than the other reports from edentulous patients.

Key words: Digital panoramic radiographs, elongation, styloid process

INTRODUCTION

The styloid process (SP) is a long, slender, pointed bony process, and occasionally curved^[1] projecting downward, forward, and slightly medially from the temporal bone bilaterally in an anterior–inferior course.^[2] The SP develops from the Reichert's cartilage of the second pharyngeal pouch. The stylopharyngeus, stylohyoid, and styloglossal muscles, and stylohyoid and stylomandibular ligaments, are attached to the SP.^[2-4] The SP, in addition to the styloid ligament, stylomandibular ligament, and the hyoid bone lesser cornu form the styloid complex.^[5]

The SP immediately arises from the temporal bone concerning the anteromedial aspect of the stylomastoid foramen. Anatomically, the apex of the SP is clinically important as it is placed between external and internal carotid arteries.^[6] It closely interacts with the upper portion of the carotid space between the external and internal carotid arteries and the internal jugular vein, together with the cranial nerves V and IX; also, the facial nerve runs anteriorly and medially to the SP.^[3]

The exact etiology of the SP elongation is unknown. However, several propositions have

been suggested since initially described by Dr. Eagle. One theory has described a congenital etiology; other studies have suggested calcification/ossification of the stylohyoid ligament of uncertain cause.^[7-9] In contrast, others believe that local chronic irritations, hormonal disorders, trauma from surgery, the persistence of mesenchymal elements, osseous tissue growth, and mechanical stress or trauma during the development of SP may lead to calcification and elongation of the SP.^[10,11]

The normal length of the SP reaches between 20 and 30 mm; nevertheless, it varies from person to person and even from side to side in the same person.^[2,12,13] When an SP develops beyond 30–33 mm, it is deemed elongated, which may be seen unilaterally or bilaterally.^[8] An elongated SP can cause unusual pressure on the vital neurovascular structures in an intimate relationship to the SP.^[7] Eagle's syndrome is a condition associated with the elongation of the SP or the calcification of the stylohyoid ligament. Approximately

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4% of the population exhibits SP elongation, which is consistently observed as an incidental radiographic finding.^[2] Among this population, 4–10% are presented with symptoms characterized clinically by throat and neck pain that radiates into the ear.^[13,14] The commonly associated symptoms are neck or throat pain, dysphagia, foreign body sensation, facial pain, tinnitus, otalgia, and occasionally limitation of mandibular movement.^[3,15]

The present study was conducted on digital panoramic radiographs (DPRs) of a Saudi population with the following aims and objectives:

- To measure and assess the length of the SP on DPRs
- To determine the variation in age, sex, and sides of the elongated SP
- To compare the length of the SP between the right and left sides.

MATERIALS AND METHODS

A retrospective study was conducted on 208 DPRs from the radiology archives at the Department of Radiology at Al Jedaani Hospital, Jeddah, Kingdom of Saudi Arabia. The DPRs were of patients aged 20 years and above.

The radiographic apparatus was used. The apparent lengths of the SP were measured with the aid of a measurement tool on the accompanying application software.

The DPR with the SPs of both sides were included in the study, and DPR with artifacts or errors in magnification or patient positioning resulting in the SP not showing or the absence of patients' age and gender were excluded from the study. The SP length was measured on the frontal side of the SP, from its point of origin at the tympanic plate to the tip of the process, regardless.

Data were evaluated on the same monitor over by the senior radiologist and the principal investigator. To reduce the chances of errors, 50 images were randomly chosen and rechecked after a fortnight.

The SP measuring >30 mm was deemed elongated, and those <30 mm were considered normal. The elongated SPs were classified according to Langlais *et al.*^[5] radiologic features classification as type I as elongated, type II as pseudoarticulated, and type III as segmented.

The radiographic presentation of type I, mineralized complex, is seen as uninterrupted integrity of the stylohyoid complex regardless of its length. In type II, the SP is joined to the mineralized stylomandibular or stylohyoid ligament by a single pseudoarticulation. Type III comprises either short or long non-continuous portions of the styloid complex or interrupted segments of the mineralized styloid ligament.

The collected data were classified according to age groups, gender, and the length of the SP on both the right and left sides. In addition, the radiographs were classified into two age groups, the DPR of individuals into either the 20–40 years or 41–60 years.

The data were analyzed with the IBM-Statistical Package for the Social Sciences (IBM-SPSS). Descriptive and inferential statistical analyses were conducted during the present study. Results on continuous variables are presented as mean \pm standard deviation (SD) (range), and results of categorical variables are presented in number and percentage. The level of significance is set at $P < 0.05$. Analysis of variance was used to determine the significance of study parameters between the two groups of patients. The student's t-test was used to find the significance of study parameters on a continuous scale between two groups (intergroup analysis) on metric parameters. The Chi-square test was used to find the significance of study parameters on a categorical scale between two or more groups.

- Ethical approval was obtained before starting the study from the Ibn Sina National College for Medical Sciences, Jeddah, Kingdom of Saudi Arabia.
- Data collected were coded and locked in a password-protected computer on the candidates' laptops to ensure confidentiality and privacy of patient data.

RESULTS

Two hundred and eight DPR were analyzed, of whom 147 were males and 61 were females. The radiographs were divided into groups according to age and gender: Group Age 1, age 20–40 years old, 147 subjects; Group Age 2, age 41–60 years old, 61 subjects; Group Gender A, 147 males; and Group Gender B, 61 females.

The mean age distribution of the participants and the mean SP lengths to gender [Table 1]. The mean age of the male participants was 37.7 ± 8 (range: 21–58) years. The mean age of the female participants was 34.4 ± 5.6 (range: 20–45) years.

For the male participants, the mean length of the SP on the right side was 24.2 ± 6.6 (range: 5.4–36.1) mm and the mean length of the SP on the left side was 28.0 ± 7 (range: 13.4–46.3) mm. For the female participants, the mean length of the SP on the right side was 26.4 ± 6.7 (range: 15.4–41.9) mm and the mean length of the SP on the left side was 30.6 ± 7.7 (range: 18.4–46.7) mm. There was no statistically significant difference between the mean SP lengths regarding gender ($P > 0.05$).

The comparison of the mean SP lengths to age groups [Table 2]. The mean SP length right side was 25.7 ± 6.4 mm in the 20–40 age group and 22.8 ± 7.1 mm in the 40–60 age group. The mean SP length left side was 29.8 ± 7.6 mm in the

Table 1: The mean age distribution of the participants and the mean styloid process lengths according to gender

Criteria	Male (N=147)			Female (N=61)		
	Mean	SD	Range	Mean	SD	Range
Age (years)	37.7	8.0	21–58	34.4	5.6	20–45
Length of right styloid process (mm)	24.2	6.6	5.4–36.1	26.4	6.7	15.4–41.9
Length of left styloid process (mm)	28.0	7.0	13.4–46.3	30.6	7.5	18.4–46.7

N: Number of participants, mean \pm standard deviation of the SP length, no statistically significant difference between the mean SP lengths

Table 2: The comparison of the mean styloid process lengths according to age groups

Criteria	20-40 (N=146)			40-60 (N=62)		
	Mean	SD	Range	Mean	SD	Range
Length of right styloid process (mm)	25.7*	6.4	13.9–41.9	22.8*	7.1	5.4–36.1
Length of left styloid process (mm)	29.8*	7.6	18.4–46.7	26.4*	5.7	13.4–44.4

N: Number of participants, mean \pm standard deviation of the SP length. *A statistically significant difference between the mean SP lengths in terms of gender ($P < 0.03$) (student t-test)

20–40 age group and 26.4 ± 5.7 mm in the 40–60 age group. There was a statistically significant difference between the mean SP lengths in age ($P < 0.03$).

misreading of the symptoms as pain stemming from tonsillar tissues, or from any other causes. Furthermore, the present study showed a higher prevalence of the elongated SP among females than males.

DISCUSSION

There are assortments of approaches to decide the measurements of the SP and analyze Eagle syndrome: Panoramic radiographs, lateral views of the neck, and processed computed tomography.^[16] Scaf *et al.* reported that the mineralization of the SP is considered present if its length is 30 mm or surpassing from the temporal bone on the panoramic radiographs.^[17]

In the present study, it was seen that there was a significant statistical difference in the length of the SP on the left side when compared with the different age groups. Which was consistent with the studies by various researchers.^[5,17,18] However, these findings contrast with other studies who advocated that elongation may not have an association with age.^[19,20]

The present study also demonstrated that while the females had more elongated SPs than males, this finding was not statistically significant. This finding is also mirrored by numerous studies.^[21,22]

CONCLUSION

It is vital practitioner to be aware of the possible structural deviations of the SP whose clinical significance is not well established. Elongation of the SP may be a casual asymptomatic radiographic reflection. Panoramic radiographs are efficient and can determine the accurate status of the elongated SP that can ascertain the diagnosis, thus obviating

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ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee, ISNC, Jeddah, KSA (Protocol identification: 039MP08052019).

DATA AND MATERIALS AVAILABILITY

All data associated with this study are present in the paper.

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