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Elongation pattern of styloid process in Saudi population: a factor to remember in the prevention of eagle syndrome

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Abstract

Background: The aim of this study is to determine the prevalence of styloid process (SP) patterns in Saudi population.

Materials and methods: This retrospective, cross-sectional study included 2010 digital panoramic radiographs (PRs) selected randomly for adult patients who visited five major hospitals in the Qassim region, Saudi Arabia, PRs were examined to detect any SP elongation. Data were collected and analyzed using SPSS v22.

Results: In this study, positive SP elongation was seen in 25.4% of the total cases, 14.2% and 11.2% male and female respectively. The mean age was 34.3 ± 13.9 years. Type I showed in 19.1%. Type II was seen in 1.7%. While type III came with 4.6% of the cases. Normal SP was seen in 74.7%. Patients between 30-50 years significantly more affected with type I pattern. Normal SP was reported mostly in the youngest age group 18-24 years with 31% of total cases.

Conclusions: SP has many patterns and variations that could be detected on digital PRs taken daily in most of dental clinics. Dentists should be trained to detect patients with such variation so that signs associated with Eagle syndrome are not misinterpreted.

Key words: elongated styloid process, eagle syndrome, panoramic radiograph

INTRODUCTION

X-ray consider the window that view all activities of the human body, either normal anatomy the body or abnormal, physiological or pathological activities. One of the of x-ray divisions is Orthopantomogram (OPG) or Panorama radiography which is a radiologic technique that provides an overview of the jaws and surrounding structures. [23] PRs enables the dentist to see a wide area of the maxilla and mandible. [24,25] It considered one of the best imaging modalities to view the styloid process (SP) bilaterally. [26] The SP is a cylindrical bone that emerges from the temporal bone in front of the stylomstoid foramen. It usually around 25 mm in length, but it can vary from person to person, and even within the same person, from side to side. [27] Elongated SP has been examined in several populations by distinctive methods and techniques, either advanced or traditional. Wide variation prevalence of SP elongation was noted, extending from 4 to 30%. [33] Elongated SP comes usually with no symptoms. Eagle et al [8] reported only 4 to 10.3% symptomatic cases characterizing Eagle syndrome or as it's also known styloid syndrome. Eagle syndrome symptoms may include throat pain or foreign body sensation, dysphagia, or facial pain. It may also cause neck or throat pain that radiate to the ipsilateral ear. [9] The cause is unknown, but several hypotheses have been proposed, including congenital elongation due to the persistence of an embryonic cartilaginous outgrowth, calcification of the stylohyoid ligament, and development of bone tissue at the ligament's insertion. [28,10] SP can be assessed using an anatomical structure. An elongated SP and calcification of the stylohyoid ligament can be detected with proper clinical and radiographic examination. [25] This aim of this study is to determine the prevalence of SP patterns in Saudi population.

MATERIALS AND METHODS

This retrospective, cross-sectional study included 2010 digital PRs selected randomly for adult patients who visited five major hospitals in the Qassim region (Qassim University Dental Hospital, King Fahd Specialist Hospital, Buraydah Central Hospital, King Saud Hospital, and Alrass General Hospital) for dental treatment between January 2017 and December 2017. From a diagnostic standpoint, the included digital radiographs had to be adequate, with optimum contrast and density and no distortion or obscuring structure. Poor-quality radiographs with insufficient exposure times or incorrect angulations were removed from this study. All digital radiographs for adult patients that met the study's criteria were examined extensively, and the patients' demographic details, such as gender and age, was registered. Patient information was kept private.

The radiographs were collected from the hospitals' digital archives and imported into the College of Dentistry at Qassim University, Radiology department's computer system, where they were then displayed. Advanced digital radiograph imaging software (DIGORA® for Windows 2.7; SOREDEX) was used to examine them.

A single professional oral and maxillofacial radiologist reviewed and interpreted all of the radiographs. In a darkened room, all of the radiographs were investigated on the same 21-inch LCD monitor resolution (1920 1200 at 60 Hz); the same environmental conditions prevailed during the examination of all of the radiographs (Figure 1,2,3,4). Each original digital image was magnified using the software's magnification feature, then manipulated by the examiner to improve the image's contrast and brightness to provide the clearest image in the examined areas.

Sample divided into 1209 and 801 male and female respectively. They were aged between 20-75 years. Data were collected regarding age, gender and SP morphology based on Langlais' classification [19] who classify the pattern of SP to 3 types. (Table 1).

Statistical analysis

Data was analyzed using the statistical package SPSS 22.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p < 0.05$. Inferential statistics was done using Chi square test. The analysis using Chi square test for proportion was done for two variables (age and gender) against the proportion of participants in various patterns of SP elongation.

RESULTS

Evaluating the SP for 2010 PRs divided into 1209 and 801 male and female respectively. Sample age ranged between 20 and 75 years old with a mean of 34.3 ± 13.9 years. The prevalence of type I elongation pattern (uninterrupted integrity of SP) was 382 cases (19.1%), of them, 207 and 176 male and female respectively [Figure 2]. The mean age of positive type I is 38 ± 13.9 years.

Type II (Pseudoarticulation pattern) showed in only 34 cases (1.7%), of them 18 and 16 male and female respectively with mean age 35 ± 13.9 years [Figure 3]. Type III was present by 92 cases (4.6%) divided into 60 and 32 male and female respectively with mean age 37 ± 13.9 years [Figure 4]. Normal SP (Non elongated SP; the tip of the process does not cross the mid portion of mandible body) was showed in 1502 (74.8%), of them 924 male and 578 female [figure 1]. Although statistical analysis reported that there was no statistical significance in gender categories against the proportion of various patterns of SP elongation ($p=0.82$, $X^2=0.915$).

Statistical analysis between categories of age against the proportion of various patterns of SP elongation was found to be statistically significant ($p=0.026^*$, $X^2=18.80$).

The analysis within all age/gender category against the proportion of various patterns of SP elongation reported to be statistically significant ($p=0.001^*$).

Patients between 26-40 years were more affected with type I pattern ($p=0.001^*$). The least pattern prevalence was type II pattern, it was only seen in 3.6%. Type III was most commonly seen in 26-40 age group with total percentage 7.4%. Normal SP was reported mostly in the youngest age group 18-24 years with 626 cases ($p=0.001^*$). (Table 2)

DISCUSSION

SP term is derived from the Greek word "Stylos" which mean a pillar. It's a cylindrical bone originated from the temporal bone frontal to the stylomastoid foramen. [27] The anatomy of styloid complex includes SP of the temporal bone, stylohyoid ligament and lesser horn of the hyoid bone. SP can be described as slender, pointed, bony projection from the inferior aspect petrous temporal bone. Usually, its length starting from a few millimeters to an average of 2.5 cm. Its proximal part is unsheathed by the tympanic plate, while muscles and ligaments are

attached to its distal part [22,29]. SP had been classified by Langlais according to the type of elongation. Langali classified the SP elongation to three types of complexes. Type I, elongated; Type II, pseudoarticulated; and type III, segmented. [19]

The diagnosis of elongation of SP were done depending on PRs by many studies including Asutay et al. [1] on East Eagean, Gracco et al. [11] on Italian, Vieira et al. [34] on Brazilian and Sakhdari et al. [30] on Iranian. Other studies had evaluated the SP elongation based on dry skulls, including Vadgaonkar et al. [33] on indian, Sakaew el. [32] on Thai, Custodio et al. [5] on brazilian, Natsis et al. [20] on Greek. In Poland, Iwańczyk et al. [13] published a study of two cases were having glomerulonephritis and diagnosed with eagle syndrome by PA.

Cone beam computed tomography can be used as an advanced diagnostic tool to assess the SP pattern, Buyuk et al. [4], Donmez et al. [7], and Öztunç et al, [21] used it on Turkish population, Kailasam et al [14], and Ramadoss et al. [27], on Indian population, Khairallah A [15], used it on Lebanese population, Andrei et al. [2] used it on Romanian population, Czajka et al. [6] used it in polish cases.

The normal length of SP ranges between 20 to 30 mm, below 20 mm considered as short SP. [16] While many studies suggest that SP considered elongated when it is longer than 30 mm. [32,30,17,18]. Although, there is limited number of studies consider the SP elongated when it exceeds 45 mm. [35]

This study found the prevalence of elongated SP in 36.8% of total samples, all 36.8% have SPs lengthening more than 30 mm and crossing the mid portion of mandibular body. While 56.6% of the samples have normal length SPs ranging between 20-30 mm and the tip of the process did not crossed the mid portion of mandible body.

In the present study, men were slightly more affected with different pattern of SPs, although no significant difference were proven considering male to female sample number ($p=0.82$, $X^2=0.915$).

Investigation showed 293 out of 879 cases with unilateral elongated SPs while bilateral was reported in 586 cases. This is consisted with other studies including Sakhdari et al [30], and Vieira et al. [34].

Further researches using CT or CBCT for a three-dimensional evaluation of the SP is required, to investigate in specific the prevalence of different pattern SP in Qassim population, Saudi Arabia.

CONCLUSIONS

SP has many patterns and variations that could be detected on digital PRs taken daily in most of dental clinics. Elongated SP may often be asymptomatic, they can only be diagnosed coincidentally by routine PRs. Dentists should be trained to detect patients with such variation so that signs associated with Eagle syndrome are not misinterpreted.

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Type	Characteristics
Type 0 (Normal)	Non elongated SP; the tip of the process does not cross the mid portion of mandible body
Type 1 (Elongated)	Uninterrupted SP; the tip of the process crosses the mid portion of mandibular body.
Type 2 (Pseudo-segmented)	The SP is apparently joined to the mineralized stylomandibular or stylohyoid ligament by a single pseudoarticulation, which is usually located superior to a level tangential to the inferior border of the mandible.
Type 3 (Segmented)	Two or more segments are seen, with interruptions either above or below the level of the inferior border of the mandible.

Table 1 Types of elongated SP according to combined Langlais and modified MacDonald-Jankowski classifications. [19]

Variables	Category	Number and percentage	Styloid Process Pattern				Chi square value	P value	Chi square value	P value
			Type I	Type II	Type III	Type 0				
Gender	Male	60.1% (1209)	17.2% (207)	1.6% (18)	5% (60)	76.2% (924)	0.915	0.82	60.56	0.001*
	Female	39.8% (801)	22% (176)	2% (16)	4% (32)	72% (578)			57.76	0.001*
Age group	18–25	35.4% (712)	10.3% (73)	0.6% (4)	1.3% (9)	88% (626)	18.80	0.026*	83.26	0.001*
	26–40	31.0% (624)	29.1% (181)	2.4% (15)	7.4% (46)	61% (382)			42.11	0.001*
	41–54	23.5% (473)	18.7% (88)	2% (10)	6.2% (29)	73% (346)			54.04	0.001*
	≥55	10.1 (204)	20% (41)	2.3% (5)	4% (8)	74% (150)			59.60	0.001*

Table 2 Descriptive analysis of variables. *P<0.05 is statistically significant.

Figure 1. Radiograph show Type 0 elongated SP.

Figure 2. Radiograph show Type 1 elongated SP.

Figure 3. Radiograph show Type 2 elongated SP.

Figure 4. Radiograph show Type 3 elongated SP.

HANEX D







