EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 6
Issue: 7
277-280
Year: 2019

PREVALENCE AND ANATOMICAL VARIATIONS OF STYOLOID PROCESS IN WESTERN MAHARASHTRA POPULATION- A DIGITAL RADIOGRAPHIC STUDY

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Article Received on 07/05/2019 **Article Revised on 28/05/2019** **Article Accepted on 19/06/2019**

ABSTRACT

Background: The styloid process (SP) is an anatomical structure whose clinical importance is not well understood. Elongated Styloid Process is of clinical and surgical importance to clinicians, dentist, radiologists and ENT surgeons because of its close relation to vital stuctures. This study is undertaken to assess the prevalence and patterns of elongation and calcification of SP on digital panoramic radiographs. **Mathedology:** A total of 1460 digital panoramic radiographs obtained of patients over 20 years of age, were obtained using Carestream Digital panoramic system. The apparent length of SP was measured on both sides with help of divider and transparent plastic scale. The evaluations of the type of elongation and calcification pattern were made by styloid process parameters used by Langlais et al. (1986)[11] as follows. **Results:** The average length of the right and left styloid process in males was 26.96 ± 8.748 and 27.76 ± 8.33, respectively, whereas in females right and left average length was 26.02 ± 5.86 and 26.59 ± 7.00, respectively. The length of the styloid process on both sides increased with age; males had longer styloid process than females. The prevalence of styloid process in the present study was 27.32% . Langlais type I elongated styloids and type A calcification pattern were more common than others. **Conclusion:** Panoramic radiography is useful for the detection of an elongated styloid process in patients with or without symptoms, and helps avoid misdiagnosis of tonsillar pain or pain of dental, pharyngeal, or muscular origin.

KEYWORDS: Styloid Process, Elongation, Anatomic Variation, Digital Panoramic Radiograph.

INTRODUCTION

Styloid process (SP) is a thin and long cylindrical bony prominence of the temporal bone lies caudally, medially and anteriorly toward the maxilla vertebropharyngeal recess, which involves the carotid arteries, internal jugular vein, facial, glossopharyngeal, vagal and hypoglossal nerves.[1] The term "styloid process" is derived from the Greek word "stylos" meaning a pillar which usually serves as a point of attachment.[2]

It is originated from the Reichert's cartilage of the second bronchial arch between SP and hyoid bone regresses.[3] The tip of the SP is of surgical importance because vital structures such as external carotid artery, internal jugular vein, Glossopharyngeal nerve, accessory nerve and Vagus nerve are in medial relation and facial nerve in lateral relation with the SP. The tip of the SP is continuous with the Stylohyoid ligament, which extend to the lesser cornu of the hyoid bone. Muscles and ligaments are attached at various parts of the Styloid process.[4]

The SP provides the origin attachments for several muscles such as the styloglossus, stylohyoid, and stylopharyngeus muscles and for ligaments such as the stylohyoid and stylomandibular ligaments.[5]

SP normally measures about 25 mm in length although it varies in length from person-to-person and even from side to side in the same person. The SP length which is longer than 30 mm was considered to be elongated SP.[6]

In 1937, Watt Eagle was the first that described the elongation of the SP could be associated with pain in the

head-neck region and pressure on the carotid artery and cranial nerves. He named it the Eagle's syndrome. This syndrome may cause symptoms such as pain in the neck and pharynx with/without a recurrent earache and pain in the mastoid region of the involved side.[1,2,5]

Some patients may complain of pain on swallowing (dysphasia) or an abnormal sensation of a foreign body in the pharynx or neck and cervicofacial pain. It may also cause stroke due to the compression of carotid arteries.[2] The mechanism of the ossification of stylohyoid apparatus is not fully understood. It is suggested that some part of the cartilage is retained within the stylohyoid ligament during ossification, which results in varying degrees or patterns of ossification and elongation of stylohyoid chain.[2,5]

Various theories have been proposed to explain the ossification of stylohyoid/stylomandibular ligaments, namely, theory of reactive hyperplasia, reactive metaplasia, anatomic variance, and aging and developmental anomaly, due to a loss of elasticity in the ligament simulating tendinosis.[7,8]

Studies have estimated that, in approximately 2–28% of general population, there is radiographic evidence of an elongated SP, however, most cases are asymptomatic.[9] There are various variations of the styloid chain ranging from the thickness of segments, angle and direction of deviation, degree of calcification, and length of the SP, which need to be described radiographically according to its appearance on it.[2]

The analysis of radiographs and clinical examination of the patient are considered important tools to confirm the diagnosis of elongated SP. Care must be taken to make the differential diagnosis with the dysfunctions of temporomandibular joint, tumors of tongue base, and trigeminal and glossopharyngeal neuralgia, as well as migraine states, unerupted third molars, myofascial pain, and cervical arthritis.[10]

The present study aimed to assess the prevalence and patterns of elongation and calcification of SP on digital panoramic radiographs of Maharashtra people.[1]

MATHEDOLOGY

The present study was conducted in the Department of Oral Medicine and Radiology. A total of 1460 digital panoramic radiographs obtained from December 2017 to May 2019, of patients over 20 years of age, which were available as soft copies in the archival records of our Radiology Department were selected for the study.

The Institutional Ethical Committee approval was obtained before commencement of the study. Digital Ortho-pantamographs (OPG) were obtained from Carestream Digital Health INC- France, Model- CS-8100SC using charged coupled device sensors under standard exposure factors (KVp of 90, duration of 13 s, and current of 9 mA). Digital OPG's free of any projection errors, which showed the SP clearly and accurately with optimal density and contrast were selected for the study. Radiographs with positioning and magnification errors were excluded during the evaluation process. All OPGs were made and evaluated in the same manner by a single oral radiologist with the help of measuring tools. The apparent length of SP was measured on both sides from caudal margin of tympanic plate to tip of SP with help of divider and transparent plastic scale. In case of segmentation each segment was measured and summed. The evaluations of the type of elongation and calcification pattern were made by SP parameters used by Langlais et al. (1986)[11] as follows,

Type I: Uninterrupted
Type II: Psudoarticulated
Type III: Segmented

Calcification patterns were also categorized as follows:
Type A: Styloid process with calcified external borders.
Type B: Incomplete calcification of styloid process along with central radiolucent areas.
Type C: Nodular pattern along with variable degrees of central radiolucency.

Data regarding age, sex, right and left sides, length, type and pattern of calcification, and apparatus used were transferred to a spreadsheet in Microsoft Excel 2007; and the statistical calculations were obtained by using Statistical Package for Social Science (SPSS) Version 20 (SPSS version 20, IBM, Armonk, NY, United states of America).

RESULTS

A total of 1460 panoramic radiographs were evaluated, out of which 894 belonged to males (61.23%) and 566 belonged to females (38.76%) [Table 1]. In the present study, the average length of the right and left SP in males was 26.96 ± 8.748 and 27.76 ± 8.33, respectively, whereas in females right and left average length was 26.02 ± 5.86 and 26.59 ± 7.00, respectively. Mean length of the SP was more in males than females in both the right and left side.

Table. 1. Gender wise distribution of cases

Gender	Number of Cases	Percentage (%)
Male	894	61.23
Female	566	38.76
Total	1460	100

Age group in the present study ranged from 20 years to 70 years, maximum number of patients were in the age range of 31 to 40 years (28.08%), followed by 41 to 50 years (25.97%), 21 to 30 years (25.61%) and least were in above 50 years (19.10%). Elongated SP was more prevalent in the age group of 51–70 years [Table 2].

Table. 2. Age wise distribution of cases.

Age groups (Years)	Number of Cases	Percentage (%)
21-30	374	25.61
31-40	410	28.08
41-50	397	25.95
>50	279	19.10
Total	1460	100

Out of 146 , only 399 (27.32%) showed elongation. Occurrence of bilateral elongation was more (15.47%) compared to unilateral elongation (11.84%) [Table 3].

Table. 3. Occurrence of elongated Styloid process on unilateral and bilateral.

ST Elongation	No (%)
Unilateral elongation	173 (11.84)
Bilateral elonagtion	226 (15.47)
Total out of 1460	399 (27.32)

According to Langlais classification 842 (57.76%) showed Type I, 436 (29.86%) Type II and 182 (12.46%) showed Type III elongation [Table 4].

Table. 4: Types of elongation according to Langlais et al.

Elongation Types	Number of Cases	Percentage
Type I: Uninterrupted	842	57.67
Type II: Pesudoarticulated	436	29.86
Type III: Segmented	182	12.46
Total	1460	100

Type A calcification pattern was most common 941(64.45%), followed by Type B 396 (27.12%) and Type C 123 (8.42%) [Table 5].

Table. 5. Types of Calcification according to Langlais et al.

Calcification Types	Number of Cases	Percentage
Type A	941	64.45
Type B	396	27.12
Type C	123	8.42
Total	1460	100

DISCUSSION

Variation is the law of nature. Every human is unique anatomically to such an extent that even identical twins are not alike. The SP is normally a cylindrical bone which arises from the temporal bone in front of the stylomastoid foramen.[5]

The normal SP, as reported by Eagle, measured 2.5–3 cm, whereas Kaufman et al[12] reported 30 mm as the upper limit for the normal SP anything above this will be considered as elongated.[1,2,5]

At present, reports concerning the SP and measurements of its length are mostly based on panoramic radiographs. The signs and symptoms with this syndrome are due to the anatomic relationship between SP and its surrounding structures. The symptoms can be confused with some disorders including a wide variety of facial neuralgias and oral, dental, and temporomandibular diseases.[13-16]

In the present study, the average length of the right and left SP in males was 26.96 ± 8.748 and 27.76 ± 8.33, respectively, whereas in females right and left average length was 26.02 ± 5.86 and 26.59 ± 7.00, respectively. Mean length of the SP was more in males than females in both the right and left side. These findings were similar to study done by Alok et al [2] 2016 and Gupta et al [5] 2015.

Majority of patients in the present study were in the age range of 31 to 40 years (28.08%) followed by 41 to 50 years (25.97%). Elongated SP was more prevalent in the age group of 51–70 years. Sakhdari et al. [1] 2018 reported the rate of the elongated SP was higher in the 40-60 years old age group compared to the other groups where as Gupta et al [5] reported maximum were found to be in age group of 26–33 years.

The prevalence of SP in the present study was 27.32% which was in consistent with study done by Alpoz et al.[3] 2014 who reported 27.1% of elongated SP. More and Asrani's [7] (2010) in their study reported 19.4% of elongated SP where as Sakhdari et al [1] (2018) reported the prevalence rate of 22% which was less compared to our study. Sudhakara Reddy et al. [17] (2013) reported Elongation of the SP 29% which was higher than the present study. Lins et al [10] (2015) and Bagga et al [16] (2012) reported prevalence of elongated SP 38.57% and 52.1% respectively which was higher than most studies which could be related to their method of measurement.

In the present study occurrence of bilateral elongation was more (15.47%) compared to unilateral elongation (11.84%). Bozkir et al.[18] (1999) studied 200 OPGs of edentulous patients aged above 50 years. They found elongated SP in 8 patients; among these 8 patients, 2 had unilateral and 6 had bilateral elongated SP. Bilateral elongation was also reported by many others authors i.e. Sakhdari et al [1] 2018, Gupta et al [5] 2015 and More and Asrani's [7] (2010) and the percentage of occurrence was much more higher than our study.

According to Langlais classification Type I (57.76%) elongation was more common in the present study than Type II (29.86%) and Type III (12.46%), and Type A calcification pattern was most common (64.45%), followed by Type B (27.12%) and Type C (8.42%). Similar results were reported by many authors i.e Gupta et al,[5] More and Asrani's,[7] Shaik et al [14] 2013 Roopashri et al [15] 2012, Bogga et al [16] 2012. Also, elongation patterns of Type I and calcification of Type A were more common in Shah et al [19] 2012. Lins et al [10] in their study reported that occurrence of Type I elongation and Type B calcification was more common.

Few studies have we modified the Langlais classification by adding a fourth variant of the elongation and

calcification patterns. Type IV: Elongation of the SP due to distant ossification. Type D: Completely calcified SP with no evidence of a radiolucent interior, and reported that Type- A elongation and type D calcification was common than other types.[2, 5]

However, similar to the present study, Alpoz et al [3] in their study found no correlation between the gender and elongation whereas the age had a significant effect on the elongated SP. The relationship between age and elongation of the SP seems to be logical, while, it cannot affect the pattern of elongation. Many studies have shown no significant relation between gender, age, and the pattern of elongation and calcification was found. Sudhakara Reddy et al [17] in their study, most patients were older compared to the present study, and this could be the reason for the lack of significant relationship between age and SP elongation in their study.

CONCLUSION

The knowledge of the elongated SP is of immense clinical and surgical importance to clinicians, dentist, radiologists and ENT surgeons because of its close relationship with vital structures. Digital OPG is useful for detection of an elongated SP or ossification of stylohyoid ligaments in patients with or without symptoms and can thus avoid misinterpretation of symptoms such as tonsillar pain or pain of dental, tonsillar, and pharyngeal region.

Despite the fact that there are several studies in the literature regarding this topic, a better understanding of the correlations between the types and patterns of calcification should be investigated in daily clinics, in order to associate the presence of SP elongation with the clinical symptoms.

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