

Elongation Pattern of Styloid Process in Saudi Population: A Factor to Remember in the Prevention of Eagle Syndrome

Research Article

Ali Alswed^{1*}, Bassam Alhumaiani²

¹Department of Dentistry, Ministry of Health, Riyadh, Kingdom of Saudi Arabia.

²Maxillofacial Surgery and Diagnostic Sciences Department, Qassim University, Qassim, Saudi Arabia.

Abstract

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

Methods: This retrospective, cross-sectional study included 2010 digital panoramic radiographs selected randomly for adult patients who visited five major hospitals in the Qassim region, Saudi Arabia, PRs were examined to detect any styloid process elongation. Data were collected and analyzed using SPSS v20.

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.

Conclusion: Styloid process has many patterns and variations that could be detected on digital panoramic radiographs 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.

Keywords: 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 divisions of x-ray is Orthopantomogram (OPG) or Panorama radiography which is a radiologic technique that provides an overview of the jaws and surrounding structures [1].

The panoramic radiograph enables the dentist to see a wide area of the maxilla and mandible. [2, 3] It considered one of the best imaging modalities to view the styloid process bilaterally [4].

The styloid process is a cylindrical bone that emerges from the temporal bone in front of the stylomastoid 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 [5].

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% [6].

Elongated SP comes usually with no symptoms. Eagle et al., [7] 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 [8].

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 [9, 10].

*Corresponding Author:

Ali Alswed,
Department of Dentistry, Ministry of Health, Riyadh, Kingdom of Saudi Arabia.
E-mail: A.alswed@gmail.com

Received: June 8, 2021

Accepted: August 29, 2021

Published: September 03, 2021

Citation: Ali Alswed, Bassam Alhumaiani. Elongation Pattern of Styloid Process in Saudi Population: A Factor to Remember in the Prevention of Eagle Syndrome. *Int J Dentistry Oral Sci.* 2021;8(9):4233-4236. doi: <http://dx.doi.org/10.19070/2377-8075-21000863>

Copyright: Ali Alswed©2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

The styloid process can be assessed using an anatomical structure. An elongated styloid process and calcification of the stylohyoid ligament can be detected with proper clinical and radiographic examination [11].

This aim of this study is to determine the prevalence of styloid process patterns in Saudi population.

Materials and Methods

This 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. This research was carried out in strict compliance with the World Medical Association's Declaration of Helsinki, and it was approved by the Ethics Committee at the College of Dentistry, Qassim University (EA/501/2017).

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 styloid process morphology based on Langlais' classification [12] who classify the pattern of SP to 3 types. (Table 1). SPSS software version 20.0 was used to analyze the collected data with a confidence interval of 95%.

Results

Evaluating the styloid processes for 2010 panoramic radiographs 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 styloid process) was 382 cases (19.1%), of them, 207 and 176 male and female respectively. 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. 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. 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. Although there were no significant association between gender and SP elongation.

Figure 1. Radiograph show Type 0 elongated SP.



Figure 3. Radiograph show Type 2 elongated SP.

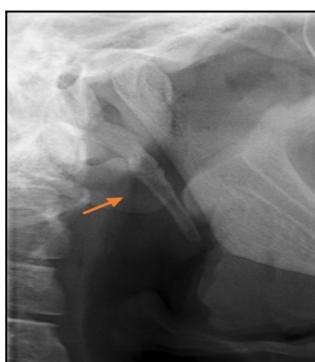


Figure 2. Radiograph show Type 1 elongated SP.

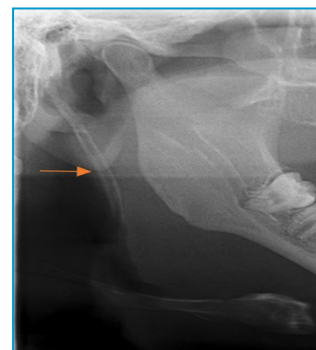


Figure 4. Radiograph show Type 3 elongated SP.

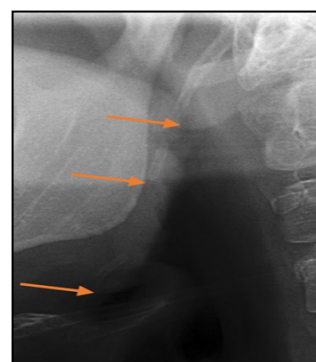


Table 1. Type of elongated SP according to combined Langlais and modified MacDonal - Jankowski classifications.

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 2. Descriptive analysis of study variables.

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

Considering the age variable, study find patients between 30-50 years significantly more affected with type I pattern. The least pattern prevalence was type II pattern, it was seen mostly in age group 26-40 with 2.4%. Type III 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. (Table 2).

Discussion

Styloid process 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 stylo mastoid foramen [5].

The anatomy of styloid complex includes styloid process 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 [13, 14].

Styloid process had been classified by Langlais according to the type of elongation. Langali classified the styloid process elongation to three types of complexes. Type I, elongated; Type II, pseudoarticulated; and type III, segmented [12].

The diagnosis of elongation of SP were done depending on panoramic radiographs by many studies including Asutay et al. [15] on East Eagean, Gracco et al. [16] on Italian, Vieira et al. [17] on Brazilian and Sakhdari et al. [18] on Iranian. Other studies had evaluated the SP elongation based on dry skulls, including Vadgaonkar et al. [19] on indian, Sakaew et al. [20] on Thai, Custodio

et al. [21] on brazilian, Natsis et al. [22] on greek.

Cone beam computed tomography can be used as an advanced diagnostic tool to assess the SP pattern, Buyuk et al. [23], Donmez et al. [24], and Öztunç et al. [25] used it on Turkish population, Kailasam et al [26], and Ramadoss et al. [27], on Indian population, Khairallah A [28], used it on Lebanese population, Andrei et al. [29] used it on Romanian population.

The normal length of SP ranges between 20 to 30 mm, below 20 mm considered as short SP. [30] While many studies suggest that SP considered elongated when it is longer than 30 mm. [20, 30-32]. Although, there is limited number of studies consider the SP elongated when it exceeds 45 mm [33].

Our 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.

Our 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. [18], and Vieira et al. [17].

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

Saudi Arabia.

Conclusion

Styloid process has many patterns and variations that could be detected on digital panoramic radiographs 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.

Ethical Approval

This research was carried out in strict compliance with the World Medical Association's Declaration of Helsinki, and it was approved by the Ethics Committee at the College of Dentistry, Qassim University (EA/501/2017).

Data Availability

The collected data used to support the findings of this study were supplied by [Ministry of Health, Saudi Arabia,] under license and so cannot be made freely available. Requests for access to these data should be made to [Ministry of Health, Department of Dentistry, 00966937].

References

- Rodríguez-Vázquez JF, Mérida-Velasco JR, Verdugo-López S, Sánchez-Montesinos I, Mérida-Velasco JA. Morphogenesis of the second pharyngeal arch cartilage (Reichert's cartilage) in human embryos. *J Anat*. 2006 Feb;208(2):179-89. Pubmed PMID: 16441562.
- Gokce C, Sisman Y, Ertas ET, Akgunlu E, Ozturk A. Prevalence of styloid process elongation on panoramic radiography in the Turkey population from cappadocia region. *Eur J Dent*. 2008 Jan;2(1):18-22. Pubmed PMID: 19212504.
- Shah N, Bansal N, Logani A. Recent advances in imaging technologies in dentistry. *World J Radiol*. 2014 Oct 28;6(10):794-807. Pubmed PMID: 25349663.
- Sridevi K, Mahesh N, Krishnaveni B, Deepika ADN, Thejasri V, Leninson BHD. Evaluation of Styloid Process and Its Anatomical Variations: A Digital Panoramic Study with Systematic Review. *J Int Soc Prev Community Dent*. 2019 May-Jun;9(3):256-262. Epub 2019 Jun 7. Pubmed PMID: 31198698.
- Sudhakar Reddy R, Sai Kiran Ch, Sai Madhavi N, Raghavendra MN, Satish A. Prevalence of elongation and calcification patterns of elongated styloid process in south India. *J Clin Exp Dent*. 2013 Feb 1;5(1):e30-5. Pubmed PMID: 24455048.
- Hettiarachchi PVKS, Jayasinghe RM, Fonseka MC, Jayasinghe RD, Nayakkara CD. Evaluation of the styloid process in a Sri Lankan population using digital panoramic radiographs. *J Oral Biol Craniofac Res*. 2019 Jan-Mar;9(1):73-76. Epub 2018 Oct 4. Pubmed PMID: 30302305.
- Eagle WW. Elongated styloid processes: report of two cases. *Archives of otolaryngology*. 1937 May 1;25(5):584-7.
- Ferreira PC, Mendanha M, Frada T, Carvalho J, Silva A, Amarante J. Eagle syndrome. *J Craniofac Surg*. 2014;25(1):e84-e86.
- Saccomanno S, Greco F, DE Corso E, Lucidi D, Deli R, D'Addona A, Paludetti G. Eagle's Syndrome, from clinical presentation to diagnosis and surgical treatment: a case report. *Acta Otorhinolaryngol Ital*. 2018 Apr;38(2):166-169. PMID: 29967562.
- Radak D, Tanaskovic S, Kecmanovic V, Babic S, Popov P, Gajin P. Bilateral Eagle Syndrome with Associated Internal Carotid Artery Kinking and Significant Stenosis. *Ann Vasc Surg*. 2016 Jul;34:271.e15-8. Epub 2016 May 10. Pubmed PMID: 27174357.
- Bagga MB, Kumar CA, Yeluri G. Clinicoradiologic evaluation of styloid process calcification. *Imaging Sci Dent*. 2012 Sep;42(3):155-61. 155. Epub 2012 Sep 21. Pubmed PMID: 23071965.
- Langlais RP, Miles DA, Van Dis ML. Elongated and mineralized stylohyoid ligament complex: a proposed classification and report of a case of Eagle's syndrome. *Oral Surg Oral Med Oral Pathol*. 1986 May;61(5):527-32. Pubmed PMID: 3459129.
- Patil S, Ghosh S, Vasudeva N. Morphometric study of the styloid process of temporal bone. *J Clin Diagn Res*. 2014 Sep;8(9):AC04-6. Epub 2014 Sep 20. Pubmed PMID: 25386413.
- Stranding S. *Gray's Anatomy: The Anatomical Basis of Clinical Practice*. 40th ed. New York: Churchill Livingstone; 2008. p. 1806.
- Asutay F, ERDEM NF, Atalay Y, ACAR AH, Asutay H. Prevalence of Elongated Styloid Process and Eagle Syndrome in East Egean Population. *Bezmialem Science*. 2019 Jan 1;7(1):28-33.
- Gracco A, De Stefani A, Bruno G, Balasso P, Alessandri-Bonetti G, Stellini E. Elongated styloid process evaluation on digital panoramic radiograph in a North Italian population. *J Clin Exp Dent*. 2017 Mar 1;9(3):e400-e404. Pubmed PMID: 28298982.
- Vieira EM, Guedes OA, Morais SD, Musis CR, Albuquerque PA, Borges AH. Prevalence of Elongated Styloid Process in a Central Brazilian Population. *J Clin Diagn Res*. 2015 Sep;9(9):ZC90-2. Epub 2015 Sep 1. Pubmed PMID: 26501021.
- Sakhdari S, Saberi S, Shamshiri AR. Prevalence and Pattern of Styloid Process Elongation and Calcification on Digital Panoramic Radiographs in an Iranian Population. *Journal of Islamic Dental Association of Iran*. 2018 Apr 10;30(2):44-51.
- Vadgaonkar R, Murlimanju BV, Prabhu LV, Rai R, Pai MM, Tonse M, Jiji PJ. Morphological study of styloid process of the temporal bone and its clinical implications. *Anat Cell Biol*. 2015 Sep;48(3):195-200. Epub 2015 Sep 22. Pubmed PMID: 26417479.
- Sakaew W, Arnanteerakul T, Somintara S, Ratanasuwon S, Uabundit N, Iamsaard S, Chaisiwamongkol K, Chaichun A, Hipkaso W. Sexual Dimorphism Using the Interstyloid Distances and Clinical Implication for Elongated Styloid Process in Northeastern Thailand. *International Journal of Morphology*. 2016 Dec 1;34(4).
- Custodio AL, Silva MR, Abreu MH, Araújo LR, de Oliveira LJ. Styloid Process of the Temporal Bone: Morphometric Analysis and Clinical Implications. *Biomed Res Int*. 2016;2016:8792725. Epub 2016 Sep 15. Pubmed PMID: 27703982.
- Natsis K, Repousi E, Noussios G, Papathanasiou E, Apostolidis S, Piagkou M. The styloid process in a Greek population: an anatomical study with clinical implications. *Anat Sci Int*. 2015 Mar;90(2):67-74. Pubmed PMID: 24664363.
- Buyuk C, Gunduz K, Avsever H. Morphological assessment of the stylohyoid complex variations with cone beam computed tomography in a Turkish population. *Folia Morphol (Warsz)*. 2018;77(1):79-89. Pubmed PMID: 28653301.
- Donmez M, Okumus O, Pekiner FN. Cone beam computed tomographic evaluation of styloid process: A retrospective study of 1000 patients. *Eur J Dent*. 2017 Apr-Jun;11(2):210-215. Pubmed PMID: 28729795.
- Oztunç E, Evlice B, Tatli U, Evlice A. Cone-beam computed tomographic evaluation of styloid process: a retrospective study of 208 patients with orofacial pain. *Head Face Med*. 2014 Feb 15;10:5. Pubmed PMID: 24528515.
- Kailasam S, Massillamani F, Potluri VL, Prabakaran A, Guntuku NL, Priya CV. Morphometric Evaluation of Styloid Process Using Cone Beam Computed Tomography-A Retrospective Study of Chennai Population. *Journal of Advances in Medicine and Medical Research*. 2018 Mar 12:1-2.
- Ramadoss T, Sha K. Assessment of the styloid process by cone beam computed tomography. *Int J Radiol Radiat Ther*. 2017;2(5):123-127.
- Khairallah A. CBCT Findings of Complete Calcification of the Stylohyoid Ligament: Case Reports. *J Dent Health Oral Disord Ther*. 2015;2(2):00040.
- Andrei F, Motoc AG, Didilescu AC, Rusu MC. A 3D cone beam computed tomography study of the styloid process of the temporal bone. *Folia Morphol (Warsz)*. 2013 Feb;72(1):29-35. Pubmed PMID: 23749708.
- Koshy JM, Narayan M, Narayanan S, Priya BS, Sumathy G. Elongated styloid process: A study. *J Pharm Bioallied Sci*. 2015 Apr;7(Suppl 1):S131-3. Pubmed PMID: 26015690; PMCID: PMC4439650.
- Kaufman SM, Elzay RP, Irish EF. Styloid process variation. Radiologic and clinical study. *Arch Otolaryngol*. 1970 May;91(5):460-3. Pubmed PMID: 5442737.
- Keur JJ, Campbell JP, McCarthy JF, Ralph WJ. The clinical significance of the elongated styloid process. *Oral Surg Oral Med Oral Pathol*. 1986 Apr;61(4):399-404. Pubmed PMID: 3458151.
- Jung T, Tschernitschek H, Hippen H, Schneider B, Borchers L. Elongated styloid process: when is it really elongated? *Dentomaxillofac Radiol*. 2004 Mar;33(2):119-24. Pubmed PMID: 15314005.