International Journal of Scientific Study

Original Article

Styloid Process Elongation – A Cross Sectional Study in North Western Part of India

Smita R Priyadarshini[1], Vela D Desai[2], Rajeev Sharma[3], Isha Gaurav[4]

1 Department of Oral Medicine and Radiology, Jaipur Dental College, Jaipur, Rajasthan, India **2** Professor and Head of Department Oral Medicine and Radiology, Jaipur Dental College, Jaipur, Rajasthan, India. **3** Department Oral medicine and Radiology, Jaipur Dental College, Jaipur, Rajasthan, India. **4** Department Oral medicine and Radiology, Jaipur Dental College, Jaipur, Rajasthan, India.

Abstract

Introduction: Elongated styloid process (ESP) is being more often seen in panoramic radiographs which are commonly used in dental practice. The panoramic radiograph shows less limitation when used to make measurements of ESP, such as the superimposition of other skeletal structures as a clear image of the basal part of the stylohyoid complex is obscured in other extra oral structures.

Aims and Objectives: To evaluate the magnitude of occurrence of elongated styloid process of the patients who were attending the dental OPD of Oral Medicine and Radiology Department of Jaipur Dental College.

Materials & methods: It is a cross sectional study based on the panoramic radiographs of patients who reported to the department during the months of January to November 2012. Type and Pattern of Calcification of both the left and right side were analyzed independently and the length was measured using the Kodak imaging soft ware. Styloid process measuring more than 30mm were considered as elongated. All data collected 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 with significance level < .05

Results: 52.43% subjects had elongation in the styloid process with an increase in the length of the styloid process as age increased and was most commonly seen in the age group between 61-70 yrs.

Conclusion: Since the prevalence of an elongated styloid process was found to be higher in this study, awareness could be spread among people, who are prone to styloid process elongation, especially rural populations where individuals have a fibrous diet & chewing habits which leads to clenching of the jaw muscles and increases the weight loading of the styloid bilaterally and promotes ossification.

Keywords: Elongated styloid process, Panoramic radiographs, Prevalence

Introduction:

The styloid process is derived from Greek word stylos that means "pillar" which usually serves as point of attachment for muscles and refers to the slender, pointed process (protrusion) of temporal bone of the skull. The length of the styloid process has been reported to vary according to different authors with variation in the size on either side.[1] The length varies from approximately 25 mm long with its tip located between the external and internal carotid arteries, lateral to the pharyngeal wall and the tonsillar fossa. The close proximity of the styloid process to many of the vital neurovascular structures in the neck makes it clinically significant.[2]

The styloid process is asymptomatic; there could be increase in the length of the styloid process due to ossification of the stylohyoid and stylomandibular ligament causing clinical symptoms. These clinical

symptoms could be manifested as pain in the parapharyngeal, retromandibular or cervical region. Apart from unilateral sore throat, dysphagia, tinnitus, unilateral facial and neck pain, and otalgia, foreign object lodged in the throat and difficulty in swallowing, pain remains the dominant symptom.

Elongated styloid process (ESP) is being more often seen in panoramic radiographs which are commonly used in dental practice. The panoramic radiograph shows less limitation when used to make measurements of ESP, such as the superimposition of other skeletal structures as a clear image of the basal part of the stylohyoid complex is obscured in other extra oral structures. When the literature was reviewed very few studies have been conducted to estimate the prevalence of ESP in India with no such study in this part of the country. So the present study was designed to determine radiographically the presence of ESP.[2]

Aims and Objectives:

1. To evaluate the magnitude of occurrence of elongated styloid process of the patients who were attending the dental OPD of Oral Medicine and Radiology Department of Jaipur Dental College.
2. To assess the gender and age predilection of elongated styloid process.
3. To identify the radiographic types and patterns of calcifications
4. To assess the variation in the length of styloid process according to age.

Materials and Methods:

This study was undertaken in the Department of oral medicine and radiology, Jaipur dental college to evaluate the prevalence of elongated styloid process. It is a cross sectional study based on the panoramic radiographs of patients who reported to the department for regular dental problems and as these radiographs being a part of the regular investigatory procedure. All the panoramic radiographs were screened during the months of January to November 2012

Inclusion criteria: Patients who were advised panoramic radiographs as a part of their dental investigatory procedure.

Exclusion Criteria: Pregnant patients & Infants, Subjects who were uncooperative or not willing to be a part of the study**,** undiagnostic radiographs.

Panoramic radiograph is the most commonly used investigatory procedure in dentistry which is used as a part of regular radiographic procedure to visualize the styloid process. The Kodak 8000 Digital Panoramic system was used which complies with the directive 93/42/CEE relating to medical equipment**.** The magnification factor used for the machine was 1.5 Radiographs with adequate contrast and with minimum faults were included. The integrity of all the structures was checked. The styloid process on the panoramic radiograph is the anatomical basis of the styloid process.

The real origin of the styloid process is from the lower part of the temporal bone which is hidden by the shadows of the base of the skull. In this study the basis of the styloid process is defined on the basis of the anatomic landmarks. Here the measurements are on the frontal side of the styloid process where it leaves the tympanic plate of the temporal bone. In this area on panoramic radiograph a thin transparent line is generally visualized between the shadows of the styloid process and the tympanic plate of the temporal bone.

The tip of the styloid process is the bony end, which includes the mineralized part of the ligaments. If the styloid hyoid or stylomandibular ligaments were ossified they were measured along the styloid process as a part of styloid process, which was classified as calcified stylohyoid segment.

Type and Pattern of Calcification of both the left and right side were analyzed independently and the length was measured using the Kodak imaging soft ware. Styloid process measuring more than 30mm were considered as elongated.

Langlias et al 1986 have classified the radiographic appearance of elongated and mineralized stylohyoid ligaments based on the types of styloid process and pattern of calcifications as mentioned.[3]

Type of calcifications[Figure 1 A, B,C, D]

Pattern of calcification[Figure-2 A,B,C, D]

In order to minimize bias all the panoramic radiographs were made and evaluated in the same fashion and read twice by the same observer in two different occasions independently.. In case of any doubt other extra oral views like the anterior posterior and the lateral skull views were advised.

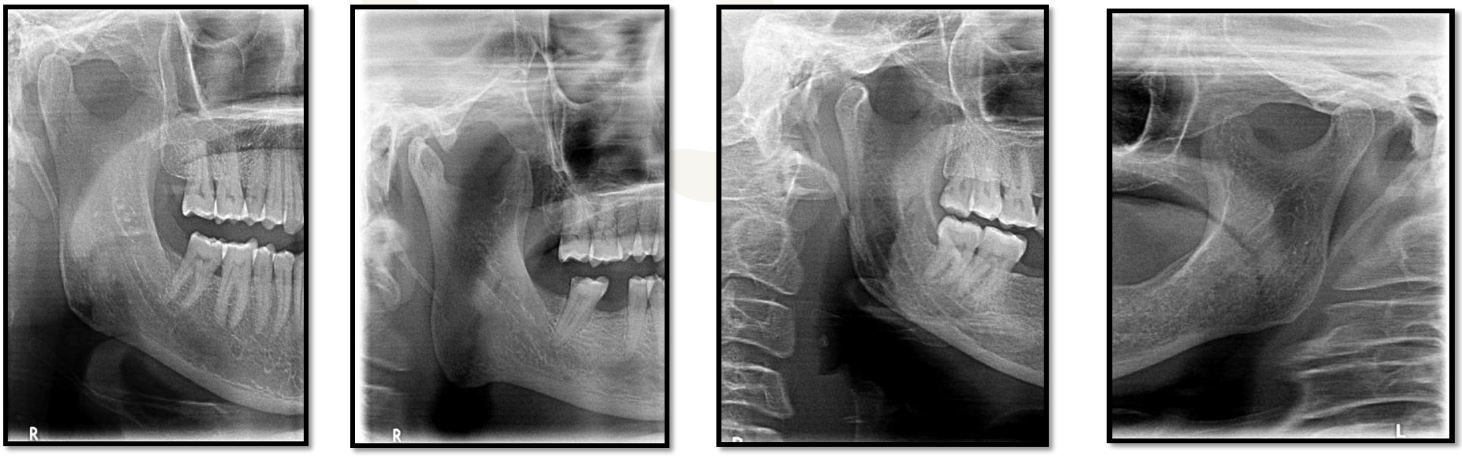
There after the patient were referred for their complaints for the necessary treatment. All the data collected data was entered in a spreadsheet (Excel 2007, Microsoft, Richmond, USA) and was analyzed using statistical analysis software (SPSS version 17, Chicago, USA). The chi-square test, unpaired *t* test, and one-way ANOVA were used for analysis with significance level <.05.all

Figure 1: –Types of Calcification of Styloid Process

A: Elongated, B Psedo articulated C. Segmented

Figure 2:- The Pattern of Calcification of the Styloid Process

A - Calcified outline B - Partially Calcified C- Nodular D - Completely Calcified



Statistical analysis were performed using a statistical software –statistical package for the social sciences version 14.0(Spss Inc, Chicago,III)

Results:

A total of 941 panoramic radiographs were evaluated. Of which 421 radiographs showed elongation in the styloid process i.e 52.43 % . 21.3% subjects had bilateral elongation of the styloid process, 17.56% right side elongation & 13.57% had left side elongation in styloid process. [Table – 1]

When the length of the styloid process was compared on the right and left side the mean length on the right side was 28.11 for males and 26.98 for females similarly 27.18 in males and 26.25 for females on the left side. [Table – 2]

Type 1 calcification is most commonly seen in 20.64% of subjects where as Type 3 was least commonly seen in 11.62 % subjects. On the right side type of calcification in the left styloid process was type 1 and least being type 3 seen in 22.51 % & 8.71% respectively. [Table- 3]

When the right and left sided were compared there wasn't any significant difference in the Type of Calcification with a $p > 0.05$

The pattern of calcification most commonly seen on right side was Type A seen in 19.40 % and the least common being Type D found in 1.14% subjects. Similarly on Left side Type A pattern was seen in 20.02% subjects where at least common pattern was Type D seen in 1.56% subjects. With significant difference in the patterns of calcifications in left side with a $p < 0.05$ [Table – 4]

Discussion:

Anatomical variation in the length of the styloid process and its stylohyoid chain is said to have profound anatomical, anthropological as well as of clinical importance. Knowledge of the clinical appearance and radiographic characteristics of styloid process would enable differential diagnosis of different pathological changes in the orofacial and perioral area.

The elongation of styloid process is considered an anomaly which can be accompanied by calcification of the stylohyoid and stylomandibular ligaments, which can trigger a series of symptoms such as dysphagia, odynophagia, facial pain, ear pain, headache, tinnitus and trismus. [4]

Therefore this study was conducted to evaluate the occurrence and variation in the styloid process in Jaipur region of Northern western India.

The occurrence of elongated styloid process was 52.43% amongst the total subjects who were evaluated. This was similar to the study carried out in Mathura where the prevalence found was to be 52.1%. But studies done in other regions showed lesser incidence as in Davangere in Southern India where mineralization of the styloid process was found in 24.8%. Also in another study conducted by More C et al found that elongation in the styloid process in 19.4% of its subjects. Such higher prevalence rate of elongated styloid in this region could be attributed to the combination of factors such as race, lifestyle, and dietary habits. The subjects reporting to the department mostly comprised of a rural population where most people perform strenuous work like carrying heavy weight on their heads, which in turn could promote ossification in the ligament. They also chew hard fibrous foods which in turn could increase the masticatory load on the ligament leading to ossification of the ligament.[5, 6, 7]

In this study, we observed that there was an increase in the length of the styloid process as age increased which was in consistent with the studies done by various researchers. Okabe et al found a significant correlation between serum calcium concentration and the length of styloid process

Table 1: Occurrence of Elongated Styloid Process

	Male		Female		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
Styloid Process Not Elongated	239	45.79	143	50.89	382	47.57
Styloid Process Elongated	283	54.21	138	49.11	421	52.43
Right Styloid Process Elongated	93	17.82	48	17.08	141	17.56
Left Styloid Process Elongated	73	13.98	36	12.81	109	13.57
Styloid Process Bilaterally Elongated	117	22.41	54	19.22	171	21.30
Total	522	100.00	281	100.00	803	100.00

Table 2: Comparison of Styloid Process Length w.r.t. Sex

	Sex	N	Mean	Std. Deviation	'P' Value*
Right	**Male**	545	28.1128	9.04019	.099
	Female	237	26.9819	8.19764	
Left	**Male**	520	27.1895	8.73271	.171
	Female	232	26.2565	8.34888	

Table 3: Distribution Type of Calcification of Right Elongated Styloid Process

Type Of Calcification	Male		Female		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
Type 1	134	20.87	65	20.19	199	20.64
Type 2	77	11.99	44	13.66	121	12.55
Type 3	78	12.15	34	10.56	112	11.62
Total	642	100.00	322	100.00	964	100.00

Chi-Square = 0.980 With 2 Degrees Of Freedom; P =0.613

Table 4: Distribution of Pattern of Calcification if Left Styloid Process

Pattern Of Calcification	Male		Female		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**
A	144	22.43	49	15.22	193	20.02
B	106	16.51	70	21.74	176	18.26
C	33	5.14	22	6.83	55	5.71
D	10	1.56	6	1.86	15	1.56
Total	642	100.00	322	100.00	964	100.00

Chi-Square = 9.979 with 3 Degrees of Freedom; P = 0.02

among 80 years old subjects. They noticed that longer the styloid process, higher was the serum calcium concentration. This could be a possible reason for increase in the length of styloid process with age. However, these findings differed from Correlly RW et al who suggested that age may not have a role in elongation. There could be difference in these results as the serum calcium level of the subjects was not measured so a possible co relation could be made. [8,9]

Studies conducted by Bagga M B et al found 79.5% of cases had bilateral elongation in the styloid process and 20.5% of cases had unilateral whereas More C et al found bilateral elongation in 75% and a unilateral elongation in 25% of cases. In the present study bilateral elongation was found in 21.30 % subjects but unilateral elongation was found in 31.13% subjects (Table II & Graph II). Unlike those studies where bilateral elongation was a common finding we had subjects where unilateral elongation was prevalent, this could be due to improper chewing habits or racial variation amongst subjects included in our study.[5,7]

The prevalence of Type I type of calcification was most commonly seen in 20.64% on right side and 19.40% on left. This was in agreement with the studies done in Mathura & Ahmadabad where type I calcification followed type II & III .This similarity could be attributed to the fact that all these places were in the Northern part of the nation unlike those carried in Bangalore where Type II is the most common pattern followed by I & II. [10]

Pattern A (Completely calcified) type was the most common pattern of calcification which was seen in 19.4% on right side & 20.02% on left side in subjects considered in the present study. There was a significant difference in the patterns of calcifications in the age wise distribution in the left side with a $P < 0.05$ Unlike studies done by Bagga M et al and More C et al pattern B (partially calcified) was the most common pattern. This variation in the result could be due to the wide variation in the sample size. The elongated styloid process on the right side was significantly more when compared to the left side which was in accordance with the study conducted by More B et al. Unlike the study done by G Roopashri et al revealed that left side elongation was more when compared to right. This difference in the result could be due to regional variation in Jaipur & Ahmadabad situated in western part of India when compared to Bangalore being in southern part of the country.

In the present study no statistically significant difference was observed between genders in the unilateral or bilateral elongation of the styloid process. This was in agreement with the reports of previous studies done by Ferrario VF et al, Ilgüy M et al and Omnell KA et al. But studies done by G Roopashri et al found that elongated styloid was more common in females than males. Although these findings were not stastically significant, these findings were similar to studies conducted by Ferrario et al. This variation could be due to difference in the sample size and life style among people.[11,12,13,14]

Conclusion:

Since the prevalence of an elongated styloid process was found to be higher in this study, awareness could be spread among people who are prone to styloid process elongation, especially rural populations where individuals have a fibrous diet & chewing habits which leads to clenching of the jaw muscles and increases the weight loading of the styloid bilaterally and promotes ossification.

Panoramic radiography is useful for detection of an elongated styloid process and/or ossification of stylohyoid ligaments in patients with or without symptoms and can thus help avoid misinterpretation of the symptoms and hence panoramic radiography is an economical and best imaging modality to view the elongation of styloid process. It also helps to avoid misinterpretation of the symptoms as tonsillar pain or pain of dental, pharyngeal, or muscular origin. Due to the medial angulations of the styloid process and superimposition of other skeletal structures, some errors may occur when measuring the length of the styloid so proper care should be taken while measuring the styloid process. Dentists should keep a proper knowledge of these symptoms

and other diseases associated with such symptom, to include styloid process elongation in the differential diagnosis associated with atypical pain in the face or oral cavity in order to facilitate best treatment for these cases.

Therefore long term follow up study could be carried out to check if masticatory habits and change in the serum calcium levels could be directly correlated to the elongation of the styloid process in this region.

Acknowledgments:

The authors wish to thank Dr. Shruti Sharma, Dr. Rajdeep kaur for the help during the study & Dr. Rajeev Yadav for his help in the statistical analysis.

References:

1. Kim E, Hansen K, Frizzi J. Eagle syndrome: case report and review of literature. Ear Nose Throat J. 2008; 87: 631–633.
2. Moffat DA, Ramsden RT, and Shaw HT. The styloid process syndrome. Journal of Laryngology & Otology 1977; 91: 279-294
3. Lengele B, Dhem A. Microradiographic and histological study of the styloid process of the temporal bone. Acta Anat. 1989;135:193–199.
4. Kelly Machado de ANDRADE, Carolina Almeida RODRIGUES, Plauto C. Aranha WATANABE Marcelo Oliveira MAZZETTO . Styloid Process Elongation and Calcification in Subjects with TMD: Clinical and Radiographic Aspects. Braz Dent J (2012) 23(4): 443-450
5. Mun Bhawni Bagga, C. Anand Kumar and Garima Yeluri, Clinicoradiologic evaluation of styloid process calcification,Imaging Sci Dent. 2012 September; 42(3): 155–161
6. G Roopashri, MR Vaishali, Maria Priscilla David, Muqeet Baig, Uma Shankar ,Evaluation of Elongated Styloid Process on Digital Panoramic Radiographs ;The Journal of Contemporary Dental Practice, September-October 2012;13(5):618-622
7. More CB, Asrani MK. Evaluation of the styloid process on digital panoramic radiographs. Indian J Radio Imaging. 2010;20:261–265.
8. Tushar Phulambrikar, Rajeshwari A, B Balaji Rao, Ashish M Warhekar, Prashanthi Reddy . Incidence of Elongated Styloid Process: A Radiographic Study,Journal of Indian Academy of Oral Medicine and Radiology, July-September 2011;23(3):S344-346
9. Okabe S, Morimoto Y, Ansai T, Yamada K, Tanaka T, Awano S, et al. Clinical significance and variation of the advanced calcified stylohyoid complex detected by panoramic radiographs among 80-year-old subjects. Dentomaxillofac Radiol. 2006;35:191-9.
10. Correlly RW, Jensen JL, Taylor JB, Rhyne RR. Mineralization of the stylohyoid-stylomandibular ligament complex. Oral Surg Oral Med Oral Pathol 1979;48:286-91.
11. Ferrario VF, Sigurta D, Daddona A, Dalloca L, Miani A, Tafuro F, et al. Calcification of the stylohyoid ligament: Incidence and morphoquantative evaluation. Oral Surg Oral Med Oral Pathol 1990;69:524-29.
12. Ilguy M, Ilguy D, Guler N, Bayirli G. Incidence of the type and calcification patterns in patients with elongated styloid process. J Int Med Res. 2005 Jan-Feb;33(1):96-102.
13. Omnell KA, Gandhi C, Omnell ML. Ossification of the human stylohyoid ligament: a longitudinal study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998;85:226–232
14. Ferrario VF, Sigurta D, Daddona A, Dalloca L, Miani A, Tafuro F, et al. Calcification of the stylohyoid ligament: incidence and morphoquantitative evaluations. Oral Surg Oral Med Oral Pathol.1990;69:524–529

Corresponding Author

Dr. Smita R. Priyadarshini

Department of Oral Medicine and Radiology, Jaipur Dental College, Jaipur, Rajasthan,India

Email id- *drsmitapriyadarshini@gmail.com*