ORIGINAL RESEARCH

Prevalence of Elongation and Calcification Patterns of Styloid Process using Panoramic Radiographs – An Observational Retrospective Study.

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Abstract

Introduction: Elongation of styloid process can cause pain and discomfort for few people in the head and neck region. And radiographs are an important tool to diagnose it. Aimed to evaluate presence of elongated and calcified styloid process in both males and females.

Materials and Methods: The study group comprises of 302 panoramic radiographs of both males and females. Radiographs are examined for ideal viewing conditions by two observers. The entire data are compiled and then statistically analysed using chi square test.

Results and Conclusion: Mean length is 31.238mm. 57% population shows elongation of styloid process. 92.7% of the population shows external calcification. 79.5% population shows continuous form of styloid process and most of them are male.

Introduction

The Greek word "stylos" which means "a pillar" forms the word "styloid". It ranges in between 25 to 30 mm to be called normal in length. Anatomically it appears to be a thick cylindrical structure that tapers to form the apex.[1] It follows straight line of projection normally, but it varies sometimes and can be found curved in some cases.

The two ligaments originate from the apex are the stylohyoid ligament and the stylomandibular ligament. Both these ligaments help in the movement of the pharynx, larynx, tongue, hyoid bone and mandible.[2]

Embryologically, Reichert's cartilage helps in the formation of styloid process. It divides into four parts, the stylohyal part, the ceratohyal part, hypohyal part and the tympanohyal part.[3] At the final stages of pregnancy the styloid process undergoes endochondral ossification and the ossification completes when the child reaches 8 years.[4]

Compression on many vital nerves and vessels like the trigeminal, facial, hypoglossal nerves, spinal accessory glossopharyngeal and vagus, can be due to its elongation.[5] This compression makes the diagnosis a little difficult as it might get confused with other causes too.[6]

Trauma can cause periodic pain in the oropharynx due proliferation of the styloid bone or there could be an another cause for it being a recessive genetic disorder.[7] Long term dull pain in the throat can occur after tonsillectomy or pharyngeal trauma.[8] Other factors like bending of styloid process head in anteroposterior or mediolateral direction can also be taken in consideration for unknown pain.[9] Eagle's syndrome can be easily diagnosed through radiographic imaging but in case of any tumor or osteomyelitis bone scintigraphy is preferred.[10]

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Other factors include local chronic irritations, hormonal disorders or surgical trauma.[11] Evaluate the presence of elongation and calcification in both males and females so as to correlate it with gender predilection along with elongation and calcification patterns. Along with the frequency of the elongated and calcified styloid process in males and females.

Materials and Methods

This study was conducted at DY Patil School of dentistry, Nerul. All High quality digital panoramic radiographs included from the database from 2016 to 2020. 302 orthopantomographs (female/ male) aged 18 to 60 years are taken, and 302 stylohyoid complexes are radiographically evaluated. All the measurements are taken from the right side only. All digital panoramic radiographs are acquired by Care Stream CS9600, with a current of 10 mA, and a tube voltage of 70 kVp.)

All OPGs are from the database 2016-2020. Males and females between the age group of 18-60 years and OPGs taken for various dentomaxillofacial indications such as

orthodontic, temporomandibular joint evaluation, prosthetic and restorative purposes.

Patients below the age group of 18 yrs, patients with trauma of maxillofacial region, developmental anomalies/ pathologies and radiographs showing surgical plates and screws were not considered in this study.

Sample Size for Frequency in a Population

Population size (for finite population correction factor or fpc)(*N*): 1000000
Hypothesized % frequency of outcome factor in the population (*p*): 80.3%+/-5
Confidence limits as % of 100(absolute +/- %) (*d*): 5%
Design effect (for cluster surveys-*DEFF*): 1

Sample Size(n) for Various Confidence Levels

Confidence Level(%)	Sample Size
95%	244
80%	104
90%	172
97%	298
99%	420
99.9%	685
99.99%	958

Equation

Sample size n = [DEFF*Np(1-p)]/[(d2/Z21-α/2*(N-1)+p*(1-p)]

Fig. 1: Measurement of right styloid process done with the help of software.

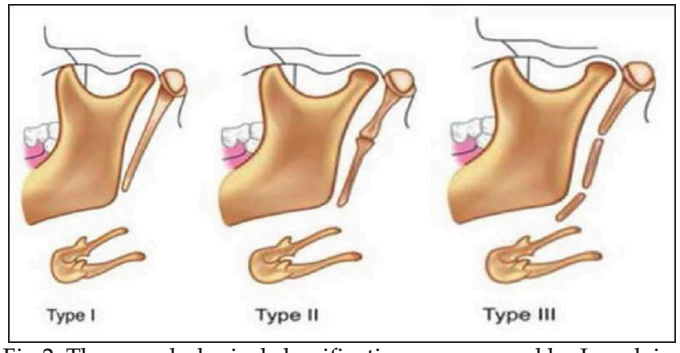

Fig.2: The morphological classification as proposed by Langlais in 1986.

Results from OpenEpi, Version 3

Considering the overall prevalence of asymptomatic patients as 80.3% as per the study conducted by Gupta N et al(Gupta N, Khan M, Doddamani LG, Kampasi N, Ohri N. A study on assessment of the length of styloid process in digital panoramic radiographs. J Indian Acad Oral Med Radiol2015;27:516-9.) the sample sized derived is 244.

All panoramic radiographs were screened for the actuality of calcification and extension of the styloid complex. Only Radiographic images that showed the whole condylar head, and hyoid were analysed.

The apparent length was measured following Shaiketal. 2013 (Figure 1). Also, any calcification or fragmentation in the styloid complex was noted.

Trained examiners performed the radiographic examinations in order to obtain reproducible results and higher reliability.

The analysis of radiographs was performed using linear measurements of the styloid process. After the images are properly calibrated, the program displays the image that is selected for analysis and allows adjusting brightness and contrast to increase the visualization of region and the accuracy of measurements. It was then traced directly on the radiographs from the caudal margin on the tympanic plate to the tip of the stylohyoid complex.

Classification of styloid process elongation was given by Langlais[12] into the three types (Figure 2):-

Type I – Continuous or Uninterrupted uniformity

Type II – Pseudoarticulated

Type III – Segmented. Long or short with no continuous portions of the stylohyoid complex

Type IV - Distant ossification.

Classification according to calcification pattern was also given by Langlais into four types (Figure 3): -

- Calcified outline
- Partially calcified
- Nodular
- Completely calcified

Other relevant studies confirm 30mm length as normal and above it is considered to be elongated.[13] Ethics Guidelines by the institution approved this study.

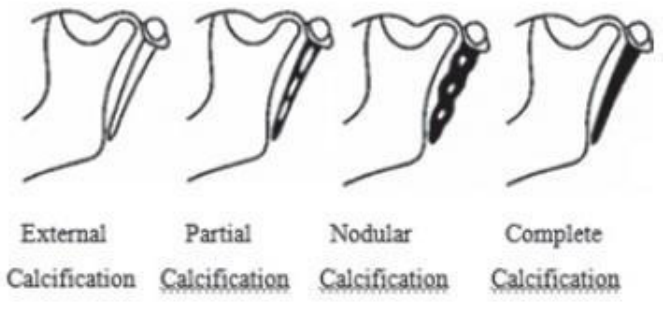

Fig.3: The classification according to calcification proposed by Langlais (1986)

Table 1: Distribution of study participants according to frequency of the length of the styloid process, calcification pattern, and elongation pattern as compared to Gender

		Gender		Total	Comparative Statistics	Significance
		Male	Female			
Length	Normal	78	52	130	0.00	0.98
	Elongated	103	69	172		
	Total	181	121	302		
Calcification pattern	External	170	110	280	2.31	0.51
	Partial	8	6	14		
	Complete	2	2	4		
	Nodular	1	3	4		
	Total	181	121	302		
Elongation pattern	Segmented	19	22	41	9.11	0.01*
	Continuous	154	86	240		
	Pseudo	8	13	21		
	Total	181	121	302		

* Statistically significant at p<0.05

Table 2: Distribution of study participants according to frequency of the length of the styloid process, calcification pattern, and elongation pattern as compared to Age Groups

		Age Groups		Total	Comparative Statistics	Significance
		18-40	41-60			
Length	Normal	82	48	130	5.13	0.024*
	Elongated	86	86	172		
	Total	168	134	302		
Calcification pattern	External	161	119	280	16.97	0.001*
	Partial	1	13	14		
	Complete	2	2	4		
	Nodular	4	0	4		
	Total	168	134	302		
Elongation pattern	Segmented	20	21	41	1.15	0.56
	Continuous	135	105	240		
	Pseudo	13	8	21		
	Total	168	134	302		

* Statistically significant at p<0.05

Results

A total of 302 stored digital panoramic radiographs are assessed to evaluate the elongation and calcification pattern.

We see distribution according to the frequency of the length, calcification pattern, and elongation pattern as compared to gender. According to length, 78 Males and 52 Females were having normal length of styloid process. 103 Males and 69 females were having elongated styloid process. Now according to the calcification pattern present, 170 Males and 110 Females were having External calcification, 8 Males and 6 Females were having Partial calcification, 2 Males and 2 Females were having complete calcification and 1 Male and 3 Females were having nodular calcification. Now according to the elongation pattern, 19 Males and 22 Females were having Segmented styloid process, 154 Males and 86 Females were having Continuous and 8 Males and 13 Females were having Pseudo Segmented styloid process. (ref. table 1)

In this study we see distribution according to frequency of the length, calcification pattern, and elongation pattern as compared to Age groups. (ref. table 2)

In this study we see distribution of participants according to frequency of the calcification pattern and elongation pattern as compared to the length. 125 normal length shows external calcification, 3 normal lengths styloid process shows Partial calcification and 2 normal lengths styloid process shows Complete calcification but there was no styloid process having nodular pattern which was normal in length. 155 elongated styloid process shows External calcification, 11 elongated styloid process shows Partial calcification, 2 elongated styloid process shows Complete calcification, 4 elongated styloid process shows Nodular calcification pattern. 19 normal lengths

Table 3: Distribution of study participants according to frequency of the calcification pattern and elongation pattern as compared to the Length of styloid process

		Length		Total	Comparative Statistics	Significance
		Normal	Elongated			
Calcification pattern	External	125	155	280	6.06	0.109
	Partial	3	11	14		
	Complete	2	2	4		
	Nodular	0	4	4		
	Total	130	172	302		
Elongation pattern	Segmented	19	22	41	1.11	0.57
	Continuous	100	140	240		
	Pseudo	11	10	21		
	Total	130	172	302		

* Statistically significant at p<0.05

styloid process shows Segmented pattern, 100 normal lengths styloid process shows Continuous pattern, 11 normal lengths styloid process shows Pseudo segmented Styloid process. 22 elongated styloid process shows Segmented pattern, 140 elongated styloid process shows Continuous pattern and 10 elongated styloid process shows Pseudo segmented Styloid process. (ref. table 3)

Discussion

The occurrence of elongation in the styloid process varies greatly among public. Studies reported that its radiographic incidence particularly in panoramic views fluctuated between 4% and 59%.[14]

Our sample size has more male than female which has been randomly selected. Overall mean length was 31.238mm. Mean normal length was 27.487mm and mean elongated length was 34.074mm.

57% had elongation of the styloid process in this study. In other studies, Gulnara Set al.15had 12.6%, More and Asrani[16] had 19.4%, Shah et al.[17] had 15.7%, Shaik et al.[18] had 36.8%, Carla19 had 43.1%, and Hettiarachchi et al.[20] had 59.5% elongated styloid process found in their studies. We could see the elongation varies from, as low as 7.8% to as high as 59.5%.

External calcification was found to be maximum in our study with 92.7% which is in accordance with the study by Shaik et al.[21] but is not in accordance with the study by Ilguy et al.22 in turkey.

Continuous pattern of elongation was found to be 79.5% in this study. Normal length of the styloid process is more in male than in female but male has more elongated styloid process than females. External calcification, more partial calcification and equal complete calcification of the styloid process are more in males than in females. But females having more nodular calcification in this study. Females showing more segmented and pseudo segmented styloid process but males showing more continuous pattern of elongation.

According to two groups, we see normal length of styloid process in group A more than in group B. And both groups having equal number of elongated styloid process. Group A showing more number of external calcification than group B. Group B showing more number of partial calcification than group A. Both groups A and B having equal number of complete calcification of styloid processes. Group A shows more nodular pattern than Group B.

Group B shows more segmented and pseudo segmented styloid process than group A. Group A shows more continuous styloid process than group B.

In case of elongated styloid process, we see external, partial and nodular calcification more than in the normal length styloid process. But complete calcification seen equally in both normal and elongated.

Elongation shows more segmented and continuous pattern than normal length. Pseudo segmented pattern seen more in case of the normal length.

Conclusion

Owing to the wide range of prevalence of anatomical variations, further studies with vastly larger sample among different populations of different ethnical origin with advanced evaluation, individual styles may explore the need to rethink the range.

Oral physicians should be apprehensive of the styloid process extension, which is frequently a coincidental asymptomatic radiographic finding.

Elongated styloid process or the calcified stylohyoid process also bear significance for ENT surgeons. As a rule of nature, variations and changes are normal and differences exist anatomically.

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