



RESEARCH ARTICLE

RADIOGRAPHIC EVALUATION OF ELONGATED STYLOID PROCESS – A RETROSPECTIVE STUDY

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ABSTRACT

Aim: To retrospectively evaluate the prevalence, morphology, and calcification pattern of the elongated styloid process in a hospital based population in the region of Chennai.

Materials and Methods: 350 digital panoramic radiographs were retrieved randomly from the archival records and evaluated. The length of the styloid process was measured from the point where the styloid process left the tympanic plate to the tip of the process despite the styloid process being segmented or not. Based on the radiographic appearance, the elongated styloid process were classified according to their morphology and calcification pattern. The collected data was subjected to statistical analysis using student's t test and chi-square test.

Results: The mean age of elongated styloid process was 42.93±4 years. Elongated styloid process was more prevalent in males when compared to females ($p < 0.05$). Type I (elongated) was the most common morphology of elongated styloid process assessed (52.4%) and the most common pattern of calcification assessed was calcified outline (41.9%).

Conclusion: Styloid process elongation significantly increases with increasing age with an increased male predominance. Styloid process elongation may be coincidental asymptomatic radiographic finding. The panoramic radiographs are economical, easily accessible and useful diagnostic aid for early detection of elongated styloid process with or without symptoms.

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INTRODUCTION

The styloid process is derived from the greek word "stylos" meaning pillar. It develops from the Reichert cartilage of the second brachial arch. It is a slender bony structure that protrudes from the lower surface of the temporal bone and gradually tapers and lies in the tonsillar fossa. (Gozil *et al.*, 2001; Krennmair and Piehslinger, 2003; Camarda and Deschamps, 1989). The normal length of the styloid process is 20 mm to 30mm and it is considered to be elongated when its length is greater than 30mm (Gokce *et al.*, 2008 a). Langlais *et al.* (1986) classified elongated styloid process based on the morphology into 3 types. Type I - Elongated, Type II – Pseudoarticulated and Type III- segmented (Fig 1a). Based on the pattern of calcification the styloid process was classified into 4 types (Fig 1b) namely, Type A- Calcified outline, Type B- Partially calcified, Type C- Nodular, Type D- Completely calcified (Langlais *et al.*, 1986).

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The diagnosis of elongated styloid process is usually done by physical examination and radiologic evaluation. Physical examination includes digital palpation for the styloid process at the tonsillar fossa. Several radiographs can be utilized to evaluate the elongated styloid process which includes Lateral skull radiograph, townes radiograph, panoramic radiograph, Lateral oblique ramus view, Cone Beam Computed Tomography and Computed Tomography. Of these panoramic radiographs are routinely used due to the ready availability, ease of use and patient compatibility (Shah *et al.*, 2012). Eagle's syndrome is used to define the series of symptoms associated with elongated styloid process or calcified stylohyoid ligament (Eagle, 1949). The compression of styloid process on some neural and vascular structures results in characteristic signs and symptoms of Eagle syndrome. Symptomatic elongated styloid process is usually observed in 2% to 4% of general population (Ilgüyü M *et al.*, 2005). Hence, the present study was tailored to retrospectively evaluate the prevalence, morphology, and calcification pattern of the elongated styloid process in a hospital based population in the region of Chennai. The main objectives of the study was to assess the frequency of elongated styloid process according to

age, sex and also to assess the types and patterns of calcification of elongated styloid processes.

MATERIALS AND METHODS

The present study was conducted in the Department of Oral Medicine and Radiology, Faculty of Dental Sciences, Sri Ramachandra University, Chennai, India. The study was approved by the Ethics Committee for student's proposals, Sri Ramachandra University. 350 digital panoramic radiographs retrieved randomly from the archival records were evaluated in the study. The radiographs used in this study had originally been taken for orthodontic examination and full mouth rehabilitation and not for the study process. Inclusion criteria included 1) Age: 20 to 80 yrs, 2) Sex: both sexes, 3) X-rays that allow the complete visualization of the styloid process from start to end point bilaterally. The radiographs with questionable stylohyoid complex, positioning and magnification errors and superimposed normal anatomical structures were excluded from the study.

All the radiographs were taken using Planmeca Promax Dimax 3/3D X-ray unit under the exposure factors as recommended by the manufacturer. The length of the styloid process was measured with the tools on the accompanying software (Dimax Pro 4.1.5) with a magnification factor of 1.2. All the radiographs were evaluated by a single expert maxillofacial radiologist. The length of the styloid process was measured from the point where the styloid process left the tympanic plate to the tip of the process despite the styloid process being segmented or not. Followed by this the assessment of morphology and calcification pattern was done using the criteria based on Langlais *et al* (1986). The collected data was analysed with SPSS 16.0 version. To describe about the descriptive statistics, frequency was used. For categorical variables, percentage was used and for continuous variables, mean & S.D were used. To find the significant difference between the bivariate samples in paired groups the Paired sample t-test was used. To find the significance in categorical data Chi-Square test was used. In both the above statistical tools the probability value <0.05 is considered as significant level.

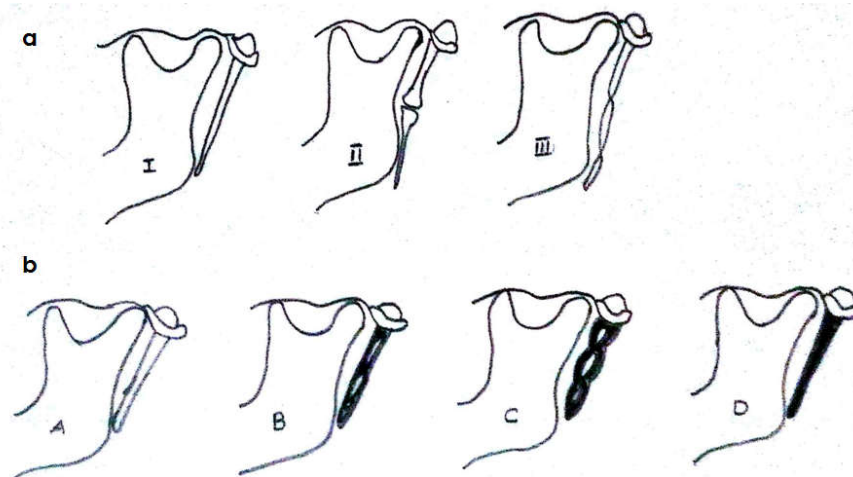


Figure 1. (a) Morphology of Elongated styloid process (Langlais et al., 1986). Type I - Elongated, Type II- Pseudoarticulated, Type III- Segmented. (b) Calcification pattern of Elongated styloid process (Langlais et al., 1986). Type A- Calcified outline, Type B- Partially calcified, Type C- Nodular, Type D- Completely calcified

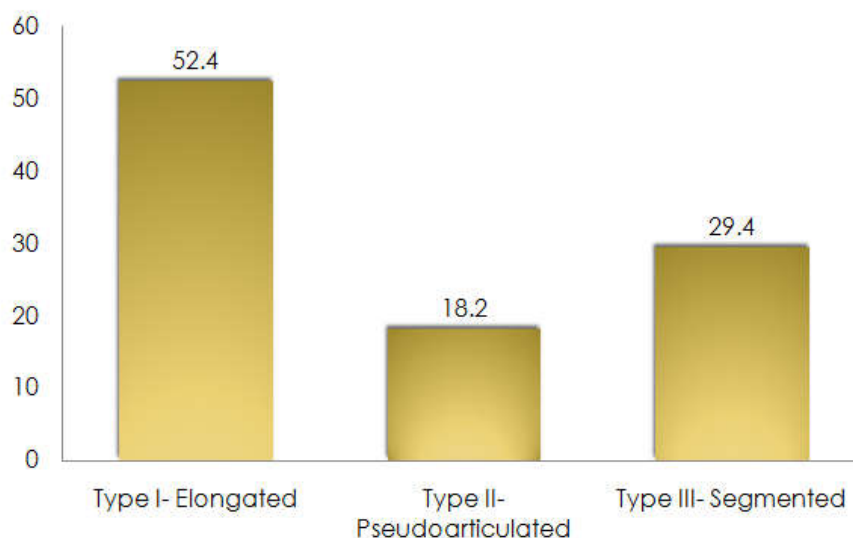


Figure 2. Graph showing the distribution of morphology of elongated styloid process in the study population

RESULTS

The average length of the styloid process in the study population was 25.97±6.88 mm. The mean length of the styloid process was increased in population greater than 60 years (Table 1).

Table 1. Mean length of styloid process in various age groups

Age	N	Mean (mm)	SD	P value
Upto 30 yrs	126	25.19	6.45	
31 - 60 yrs	188	26.03	6.93	<0.05
> 60 yrs	36	28.32	7.61	
Total	350	25.96	6.87	

P<0.05; Significant difference

The percentage of elongated styloid process in the present population was 27.2%. The mean age of elongated styloid process in the present study was 42.93±4 years. Bilateral elongated styloid process was seen in majority of the population (83.7%) followed by right side (13%) and left side (3.3%).

The prevalence of elongated styloid process was significantly increased in males (62%) when compared to females (38 %), P<0.05. When the morphology of elongated styloid process was assessed in the study population, it was noted that Type I- Elongated (52.4%) was the most common finding followed by Type III- Segmented (29.4%) and Type II- Pseudo articulated (18.2%) being the least common type, p<0.05 (Fig 2, Fig 4). Amongst the calcification pattern assessed, Calcified outline (41.9%) was the most common type followed by partially calcified (31.4%), completely calcified (22.1%) and nodular type (4.6%), p<0.05 (Fig 3, Fig 5).

DISCUSSION

In 1937, Eagle coined the term stylalgia to define the pain associated with elongation of styloid process or ossification of stylohyoid ligament which may occur due to compression of neural and vascular bundles (Eagle, 1949). The various presenting symptom in Eagle syndrome can be dysphagia, foreign body sensation in the throat, pain when turning the

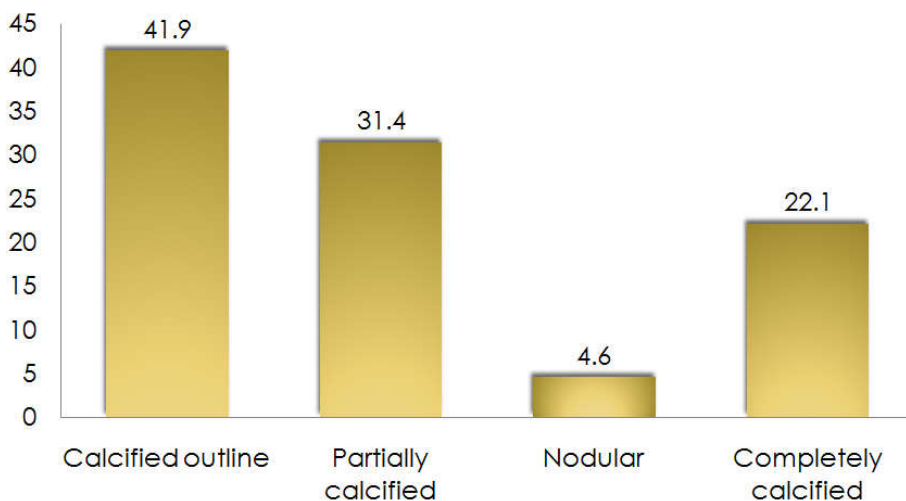


Figure 3. Graph showing the distribution of calcification pattern of elongated styloid process in the study population

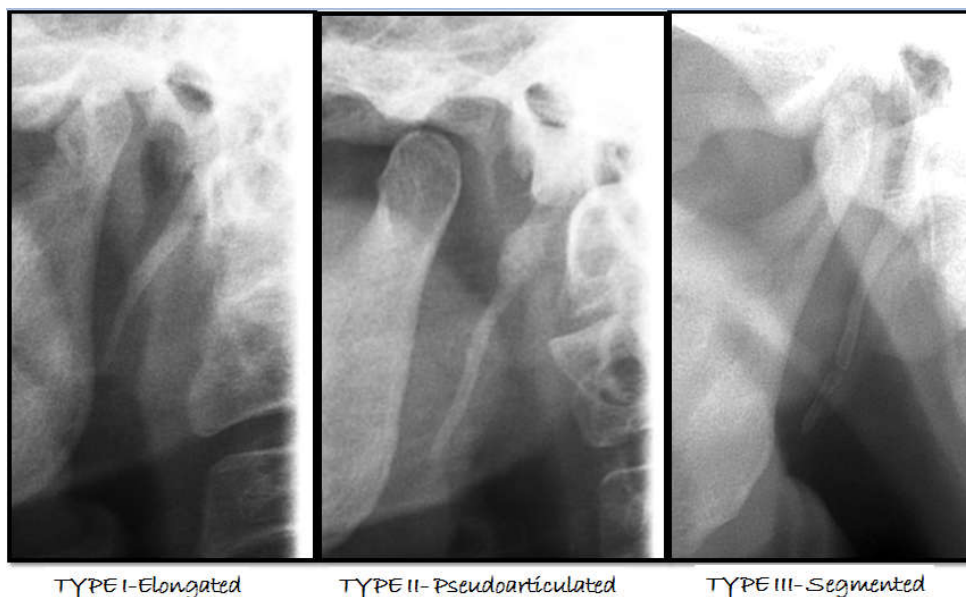


Figure 4. Patterns observed in study population – Morphology

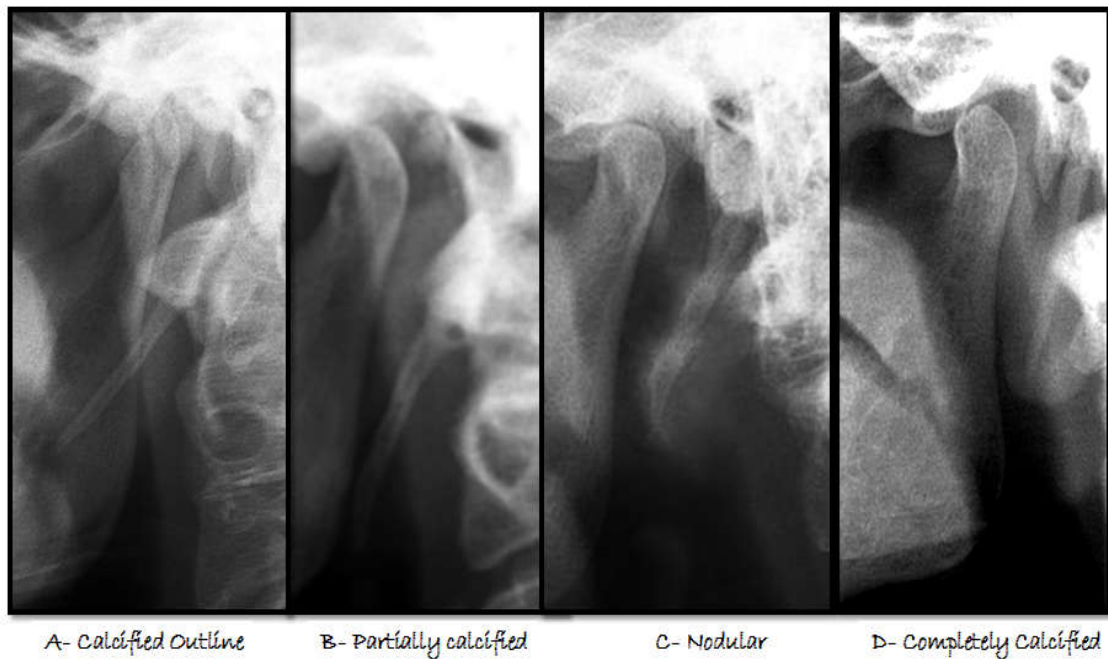


Figure 5. Patterns observed in study population – Calcification pattern

head, vertigo, odynophagia, ear ache, facial pain, trismus, tinnitus and in extreme cases, stroke due to compression of carotid arteries (Feldman, 2003; Tiago *et al.*, 2002). These symptoms can be confused with a wide range of other disorders like temporomandibular disorders, neuralgia (Bagga *et al.*, 2012). Glossopharyngeal neuralgia, pulsatile tinnitus, carotidynia, globus pharyngeus and dysphonia are a few other clinical manifestations which can present in patients other than the classic features of Eagle syndrome. This could be attributed to the fact that the elongated styloid process caused compression of several neural elements such as glossopharyngeal nerve, chorda tympani, lower branch of trigeminal nerve. Also, this compression will lead to granulation tissue proliferation which will continuously pressure the surrounding structures causing pain (Ceylan *et al.*, 2008). The ossification of stylohyoid ligament can be attributed to several theories which includes reactive hyperplasia, reactive metaplasia, variations in normal anatomy, process of ageing, developmental anomaly, trauma all of which resulting in loss of elasticity in the ligament provoking tendinosis (More and Asrani, 2010). Several other regional factors which may include dietary pattern could also be an important reason for different types and patterns of elongated styloid process (Gokce *et al.*, 2008 b). Recent hypothesis reveals that the calcification of styloid is an element of heterotopic bone formation or ossification, given that microstructurally the osteoid matrix is also at hand with the calcification (Bozkir *et al.*, 1999). The world wide prevalence of elongated styloid process is 4% to 28%, however only 4% are symptomatic (Ilgüy M *et al.*, 2005). The prevalence of elongated styloid process in the present study in the region of Chennai was 27.2%. Several studies conducted in Indian population revealed a prevalence of 15% to 52% (Bagga *et al.*, 2012; More and Asrani, 2010; Reddy *et al.*, 2013). A study conducted in Northern population of Mathura region showed the highest prevalence of 52.1% (Bagga *et al.*, 2012). The mean age of elongated styloid process in the present study was 42.93±4. This could be due to the fact that there is a progression in length of calcification with advancing age (Jaju *et al.*, 2007). This was again similar to the results of the above mentioned studies.

Males were most commonly affected than females in our population which was consistent with Indian literature (Bagga *et al.*, 2012; More and Asrani, 2010; Reddy *et al.*, 2013), however it was contradictory to study conducted in foreign population (Ferrario *et al.*, 1990; Lins *et al.*, 2015). Type I elongation with calcified outline was most commonly observed in the study population which was consistent with studies conducted in Mathura population (Bagga *et al.*, 2012). However several other studies in Indian population had Type I elongation with partially calcified (More and Asrani, 2010; Shah *et al.*, 2012) and completely calcified pattern (Reddy *et al.*, 2013). Bilateral elongated styloid process (83.7%) was commonly observed in the study population which was consistent with the results of previous studies (More and Asrani, 2010; Bagga *et al.*, 2012). The reason for this could be the clenching of jaw muscles during chewing which causes bilateral loading of the styloid process leading to its ossification (Bagga *et al.*, 2012). Panoramic radiography is a very useful and readily available tool for diagnosis of symptomatic and asymptomatic elongated styloid process. Some limitations in panoramic radiography could be image magnification, distortion, improper patient positioning, all of which could limit its diagnostic accuracy in evaluation of elongated styloid process (Shah *et al.*, 2012). Also, artefactual presence of certain radiopaque structures in the region of styloid process can mask its presence which again should be confirmed by higher imaging modalities like Cone Beam Computed Tomography or Computed Tomography if surgical removal is planned (Reddy *et al.*, 2013). Some limitations in the present study is that since it was a retrospective study the presence or absence of symptoms in the above studied patients could not be evaluated.

Conclusion

Within the limitations of the study it is concluded that

- Panoramic radiography is a valuable diagnostic tool for evaluation of elongated styloid process.

- The prevalence of elongated styloid process increases with increasing age.
- Styloid process elongation was mostly bilateral.
- Elongated styloid process was more prevalent in males when compared to females.
- Type I elongation with calcified outline was the common finding observed in the study population.

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