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Original Research Article

Modified classification for styloid process – An original research

Joseph Johny[1]*, Akhila S Prakash[1], Keerthi K[1], Reshma PN[1], Tiny S Alex[1], Aiswariya S[1]

[1]*Dept. of Oral Medicine and Radiology, Sree Anjaneya Institute of Dental Sciences, Calicut, Kerala, India*

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ABSTRACT

Context: Orthopantomograms of different individuals were studied to understand the prevalence of morphological variants in styloid process. New types of styloid processes were identified other than that found in the existing classification while proceeding with the study. Thus, a deeper examination of this topic felt interesting.

Aims: To identify the anatomical variations of styloid process and its distribution according to age and gender on digital panoramic radiographs.

Materials and Methods: A total of 1000 panoramic radiographs from the database were analyzed for the types and distribution. Langlais classification with modification is used for the study.

Result and Conclusion: The tapered and wavy forms were identified apart from Langlais classification of styloid process, in elongated category. Among total population under study elongated category were predominant compared to other types and gender wise distribution manifested the predilection of elongated category among male. Moreover, the elongated variant dominated among the older individuals than adult and younger age groups. Considering age as the parameter Type IV category prevails in younger age group.

Key Messages: 1): The two new morphological variants among the elongated variant of styloid process categorized as tapered and wavy were identified, which is to be included in existing classification. 2): Elongated variant is most predominantly seen, of which tapered variety is common among elongated variety, 86.6% was seen in females and 83.8% was seen in males; 3): Wavy variant was dominant in males with 16.1%, whereas in females it was 13.3%. 4): Contemplation of gender as parameter, manifested male predilection to elongated category. 5): Relatively high prevalence of type IV category was analyzed next to elongated variant among age group upto 20 years.

1. Introduction

The styloid process is a slender, needle like structure that projects from petrous part of temporal bone. It arises from endochondral ossification of the cartilage from the second pharyngeal arch and offers attachment to stylohyoid ligament, stylohyoid, stylopharyngeus and styloglossus muscle. The styloid process and ligament derives from the first and second branchial arches called Reichert's cartilage. During Fetal development, Reichert's cartilage fuses with the styloid bone to the hyoid bone.[1]

It is located between internal and external carotid arteries and internal jugular vein being typically straight and occasionally curved.[2] The muscle attachments include styloglossus, stylopharyngeus and stylohyoid.[3] The origin of stylohyoid and stylomandibular ligament is from the tip of styloid process and is attached to the lesser cornua of hyoid bone and to the angle and posterior border of angle of the mandible between masseter and medial pterygoid respectively.[4–6]

* *Corresponding author*.
E-mail address: joseph_kjr@rediffmail.com (J. Johny).

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The important anatomic structures closely located to styloid process are facial nerve that runs anteriorly and medially,[1] vagus, hypoglossal nerve, spinal accessory nerve, internal jugular vein, internal carotid artery on its medial side, occipital artery, and posterior belly of digastric muscle.[5–10] The elongation of styloid process can be attributed by calcification of stylohyoid and stylomandibular ligaments which triggers a series of symptoms such as foreign body sensation in throat, pain on rotating the head, vertigo, dysphagia, odynophagia, facial pain, ear ache, head ache, tinnitus and trismus resulting in Eagle's syndrome.[7] It may also result in stroke because of compression of carotid artery.[5,11] However, it seldom produces symptoms.[12] Therefore, accurate knowledge about both normal and abnormal styloid processes are inevitable for clinicians, surgeons and radiologists.

The ossification of stylohyoid ligament can be explained by various theories, namely, theory of reactive hyperplasia, reactive metaplasia, anatomic variants and aging and developmental anomaly resulting from loss of elasticity in the ligament simulating tendinosis.[13]

The study focused on the distribution of the morphological variants according to age and gender distribution of the population under study based on classification put forth by Robert P Langlais. Langlais classification describes the calcification patterns manifested as morphological variants such as Elongated, Pseudo articulated, Segmented which is modified to include Type IV category. [Table 1]

2. Materials and Methods

A total of 1000 digital panoramic radiographs available in computer as soft copies were selected for the study. The radiographs having positional and magnification errors were excluded during selection process. The panoramic radiographs were taken with KODAK 8000 care stream machine with exposure parameters 73 kV, 12mA, 13.9 sec. The selected radiographs included age group ranging from 8 to 82 years. The collected data was entered in a spread sheet and was analyzed statistically. Since we have referred orthopantomograms of patients which were already taken, informed consent was not required.

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3. Results

Thousand radiographs were analysed using Langlais classification to find out the prevalence of the morphological variants among the selected radiographs, as well as according to age and gender as parameters. During the study new variants were discovered incidentally which has not been included in Langlais classification, namely, tapered and wavy variants. [Table 2] Out of the orthopantomograms examined 61% comes under elongated variant, 8% showed pseudoarticulation, 10% were segmented and 21% were Type IV. [Figure 1] Apart from Langlais classification, among elongated, 85.2% was found to be tapered while 14.7% were wavy. Thus elongated type prevailed and tapered were commonly detected among it.

Considering gender as criterion 30% of females and 31% of males shows elongation of styloid process, 4% of males and females shows pseudoarticulation, 9% of females and 1% of males shows segmented pattern and 13% of females and 8% of males shows Type IV pattern.[Figure 2].

Contemplating age as the parameter, among 0 to 20 years old group, 47% displayed elongation, 8% shows pseudo articulation, 6% manifests segmented pattern while 37% shows Type IV pattern. Among 21-40 years old group, 83% appeared to be elongated, 11% shows segmentation, 5% showed Type IV pattern with no pseudo articulation. Among 41 to 90 years old group, 67% shows elongation, 11% shows pseudo articulation, 14% shows segmented pattern, 5.8% shows Type IV pattern. [Figure 3]

Thus elongated category dominated among male while considering gender and adults contemplating age. Segmented variant dominated among older individuals than adults and younger age group and also it prevailed among females. Pseudoarticulation was perceived in greater number among younger individuals than the older ones in the study. Type IV variant dominated among females as well as among younger age group individuals.

Table 1: Langlai's Modified Classificationof Styloid Process-2013 (R Sudhakaran et al)

Type 1- Elongated
Type 2- Pseudoarticulated
Type 3- Segmented
Type 4 –Type IV (Distant ossification)

Table 2: Suggested new classification of styloid process

Type 1- Elongated Tapered Wavy	A. Tapered
	B. Wavy
Type 2- Pseudoarticulated	
Type 3- Segmented	
Type 4 –Type IV	

4. Discussion

The variations of styloid process is manifested in thickness of segments, angle and direction of deviation, length of process and degree of calcification. While we were tracing different Orthopantomograms, we came across different types of styloid process that led us to take a deep study on it. Styloid process varies among individuals manifesting different shapes and sizes.

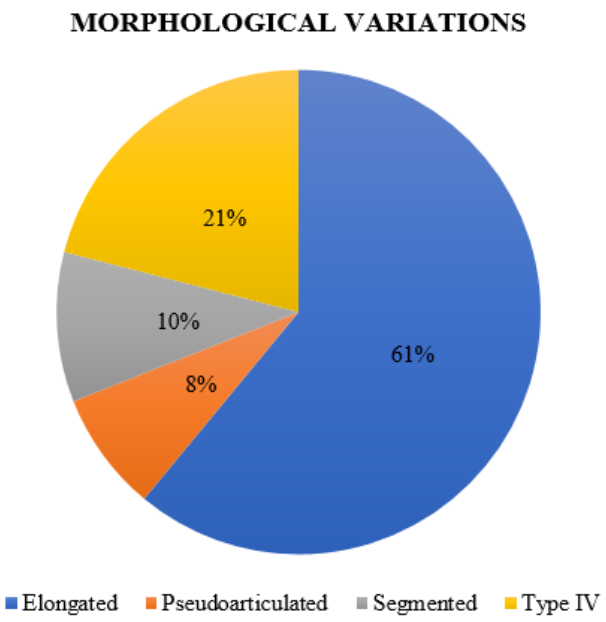

Figure 1: Pie diagram showing distribution of morphological variations of styloid process

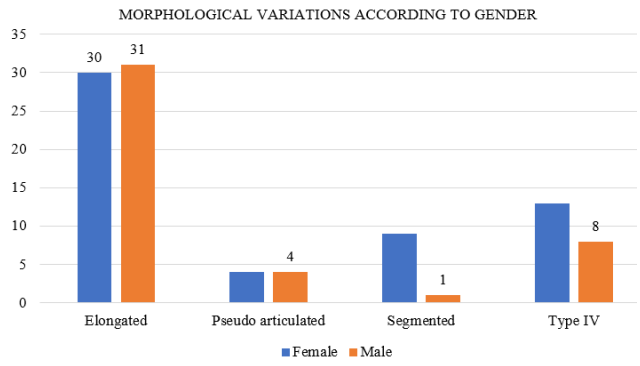

Figure 2: Bar Diagram showing distribution of morphological variations according to gender

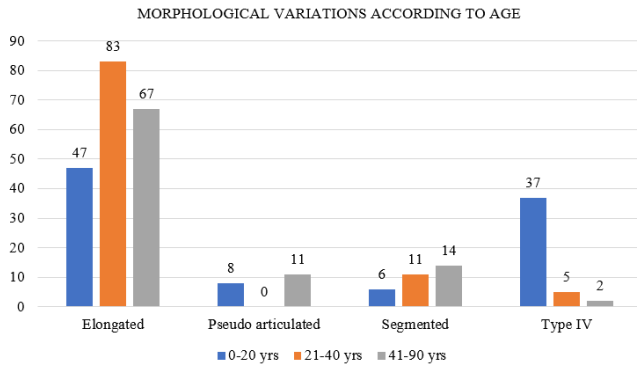

Figure 3: Bar Diagram showing distribution of morphological variations according to age

The development of stylohyoid apparatus is from 4 segments:

1. The base of styloid process developed from tympanohyal portion.
2. The shaft of styloid from Stylohyal portion.
3. The stylohyoid ligament from Ceratohyal portion.
4. The lesser cornua of hyoid bone from Hypophyal portion.[14]

The ligament has the potential to mineralize as it is of cartilaginous origin.[15] The mechanism of ossification is not fully understood but the varying degrees of ossification and elongation of stylohyoid chain suggested to be the result of retention of cartilage within stylohyoid ligament during ossification.[14] The styloid chain can vary according to the length, thickness, angle and direction of deviation and degree of ossification.[16]The palpation of Styloid Process in the tonsillar fossa, which is unusual suggests styloid process lengthening.[5]

There are diverse methods in imaging elongated styloid process such as lateral head and neck, posterior-anterior skull, exaggerated Towne's, Panoramic, Transoral, Lateral oblique of mandible and anterior- posterior skull radiography and computed tomography.[17,18] In our study, as in Erol,[19] we used panoramic radiographs of patients as it is the preferred method. According to Erol the elongation of styloid process is related to ectopic calcification which occurs due to calcification of non-osseous soft tissues resulting from abnormal calcium and phosphorous levels. When the elongated styloid process causes clinical symptoms such as neck and cervicofacial pain it is known as Eagle's syndrome.[7,20–26] These signs and symptoms are considered to be due to the compression of Styloid process on neural and vascular structures located adjacent to it. Uncommon symptoms including dysphagia, tinnitus and otalgia may occur in such patients.[27] The size, shape, and orientation of the ossified styloid process is attributed to its compression of vital structures.[28]

The existing classification of styloid process was proposed by Langlais, which includes elongated, pseudoarticulated, segmented,[29] which is modified to include Type IV.

In addition, we discovered tapered and wavy forms of elongated type with the proportion of each types in different individuals, in the study conducted. Hence we modified Langalais classification to include Tapered and Wavy variants in Elongated category. Among tapered variety, 86.6% was seen in females and 83.8% was seen in males and wavy variant was dominant in males with 16.1%, whereas in females it was 13.3%.

Our study centered mainly on variation of morphological patterns in accordance with age and gender, unlike R Sudhakaran et al study,[14] Type 1 pattern is more frequent type in females and Type IV pattern is predominant among

age group upto 20 years (37%) next to elongated variant (47%). In comparison with the study conducted by Mun Bhawni Bagga et al, it shows male predilection for the elongated variant.[5]

In comparison to the study put forward by K C Prasad et al the elongated variant is more common among the age group ranging from 30-40 years.[17] Whereas in the study by R W Correll et al the findings contrasts as elongated variant according to age were considered to be more among older individuals.[30]

Likewise, in contrast to the study by R Sudhakaran et al, the Type IV pattern displayed prevalence next to Type I pattern. The appearance of Type IV variant predicted to be due to the following reasons:

1. The loss of structural appearance in panoramic radiograph occurring due to hypomineralisation of styloid process in the region of base of skull.
2. Masking a portion of radiopaque styloid resulting from increased intensity of soft tissue structure in radiograph.
3. The presence of carotid artery calcification in region of styloid process simulating presence of Type IV styloid process.[31]
4. The presence of styloid process being masked by artefactual radiopaque structures.

According to the article published by Mehmet Ilguy et al,[26] elongated category was predominant in age group 40- 49 while our study showed its predominance in age groups up to 20 years and beyond 41 years (37%). In conflict to the study conducted by Galal Omami,[32] considering gender as the parameter, elongated category was more common in males compared to females.

5. Conclusion

In conclusion, our study discovered two new morphological variants, tapered and wavy apart from Langlais Classification. The study displayed predilection to elongated pattern among the sample analyzed, of which the tapered variant was found to be common in elongated category. On centering the distribution of existing classification among age and gender, the Type IV category was found to be the predominant one next to Type 1 in younger age groups (0-20 years) and elongated variant dominated in the adults followed by which comes segmented variant. Considering older individuals the same pattern as of the adult follows. Moreover the Type 1 pattern dominates among adult than the older individuals but while contemplating gender it is dominated among male. Segmented variant predominated among older individuals than adults and younger age group and also it prevailed among females. Pseudo articulation was found in greater number among younger individuals than the older ones in the study. Type IV variant prevailed among females as well as among younger age group individuals.

6. Source of Funding

None.

7. Conflicts of Interest

None.

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Author biography

Joseph Johny, Associate Professor and HOD https://orcid.org/0000-0001-7561-0186

Akhila S Prakash, Intern https://orcid.org/0000-0003-2705-5741

Keerthi K, Intern https://orcid.org/0000-0002-2550-6564

Reshma PN, Intern https://orcid.org/0000-0002-6740-7732

Tiny S Alex, Intern https://orcid.org/0000-0003-3254-8188

Aiswariya S, Intern https://orcid.org/0000-0002-6777-8189

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