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Radiographic Prevalence and Clinical Significance/ Etiology of Elongated Styloid Process in Females

Raood T. Al-Kaki[1], Sara M. El-Khateeb[2,3*] and Eman A. Arnout[2,3]

[1]College of Dentistry, Taibah University, Al- Madinah Al Monwarah, KSA.
[2]Department of Oral and Basic Clinical Sciences, College of Dentistry, Taibah University, Al-Madinah Al Monwarah, KSA.
[3]Department of Oral Medicine, Periodontology, Diagnosis and Oral Radiology, Faculty of Dentistry, Ain Shams University, Cairo, Egypt.

Authors' contributions

This work was carried out in collaboration between all authors. Author RTAK examined the panoramic radiographs for presence of styloid process elongation, distributed the questionnaire and statistically analyzed the data. Author SMEK prepared the manuscript for publication and interpreted the data. Author EAA designed the study and wrote the introduction, methodology and results with reference organization. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aims: The aim of the present study was to investigate the radiographic prevalence of elongation and calcification in styloid complex and its clinical significance and etiology in female patients attending Taibah University Dental Clinics (TUDC) in Al-Madinah, KSA.

Study Design: Retrospective observational study.

Place and Duration of Study: Oral Radiology Unit, Taibah University Dental clinics, Faculty of Dentistry, Al Madinah Al Monwarah, Saudi Arabia, between February 2015 and February 2016.
Methodology: A total of 2114 archived digital panoramic radiographs of female patients attending TUDC with a mean age of 33.3 that ranges from (18-80 years) were examined for the presence of

**Corresponding author: E-mail: saraelkhateeb77@gmail.com;*

elongated styloid process or calcification of stylohyoid ligament. We excluded cropped or blurred panoramic radiograph.

Results: The most frequent age for elongation was between 20-40 years. An overall prevalence of calcification and elongation in the styloid complex was 189 patients (11%) out of 1714. About 176 (10.3%) of them had elongated styloid process with complete calcification while 13 (0.7%) had fragmented calcification. Head or neck injury was the prevalent suspecting etiology in 31.3%, and pain with swallow was a clinical finding of participated patients in the questionnaire.

Conclusion: It is critical that the dentist should be attentive to normal variation in the styloid complex to be able to detect any elongation or calcification which could be discovered incidentally in radiographic examination particularly panoramic radiograph. Panorama is an economical, easily accessible and useful diagnostic screening tool for an early detection of elongated styloid process with or without symptoms.

Keywords: Elongation; calcification; panoramic radiography; stylohyoid complex.

1. INTRODUCTION

The stylohyoid complex (SHC) continues from the styloid process (SP) of the temporal bone to the hyoid bone and positioned in front of the stylomastoid foramen. The SHC consists of the SP, the stylohyoid ligament (SHL) and the lesser horn of the hyoid bone [1]. The SP as a component of SHC can be seen on radiography while the SHL only can be viewed if it is ossified. The SHL extended from the SP to a lesser horn of the hyoid bone [2,3].

SHL ossification or calcification and SP elongation are found accidently in different radiographic images, for instance, panoramic radiographs [4] The Panoramic technique is a simple tomographic examination that produces a panoramic image of the maxillofacial area [5].

SP elongation can cause compression on many vital nerves and vessels related. This compression accompanied by certain symptoms that may be confused with other causes of head and neck pain. That is why the diagnosis is usually difficult [4].

The SP is a cylindrical cartilaginous bone which immediately arises from the temporal bone posterior to the mastoid apex, with the styloid ligament and the small horn of the hyoid bone the styloid process forms the styloid apparatus. The SHL has a potential for calcification because of its cartilaginous origin. An elongated SP occurs in about 4% of the general population, although only a small percentage of these patients are symptomatic. The actual incidence is with a female-to-male predominance of 3:1 [6]. The typical length of the SP is 20 to 30 mm when it becomes longer than 30mm it is considered elongated [7].

The elongation occurs most commonly as a result of a post-traumatic proliferation of the styloid bone, calcification of the SHL or an abnormal elongation of the SP by 30 mm or more [7]. The possibility of its being a recessive genetic disorder could also be included. Cranial nerves which could be involved include the trigeminal, facial, glossopharyngeal, vagus, spinal accessory and hypoglossal nerves. The occasional carotid plexus and cervical plexus involvement can produce a wider symptomatology [8-9].

However, when recurrent pain occurs in the oropharynx and face due to elongated SP or calcified SHL, it is referred to as Eagle's syndrome [10]. Eagle Syndrome is a rare condition, first described by Wett Eagle in 1937, where an elongated SP (>30mm) is in conflict with adjacent anatomic structures [11-13].

This syndrome characterized by symptoms typically occurring after tonsillectomy or pharyngeal trauma. It manifests as long-term pain or as a nagging dull pain in the throat. Occasionally pain is radiating to the ipsilateral ear with the feeling of a throat foreign body, rarely, it manifests as dysphonia, odynophagia, headache, and increased salivation [14].

2. MATERIALS AND METHODS

This study was a retrospective observational study, which done at TUDC in female section, Al-Madinah, Saudi Arabia. All High quality digital panoramic radiographs included from the database of the Oral Radiology Unit of TUDC, which taken from the January 2014 to December 2015. These panoramic radiographs were taken for routine examination. All digital panoramic radiographs were acquired by Care Stream

CS9000, select 3D Extraoral Digital Imaging System (SM749, Rochester NY, USA), with a current of 4 mA, and a tube voltage of 90 kVp.

All panoramic radiographs were screened for the existence of calcification or elongation of the styloid complex by two skilled Oral and Maxillofacial Radiologists and one Dental internship. Only Radiographic images that showed the whole mandible, condylar head, and hyoid bone, without patient preparation, positioning or exposure errors, were included.

The apparent length of the SP was measured following Shaik et al. [15] 2013 study at the point where SP extends from the temporal bone with the help of the measuring tools of CS software. Any SP extending below an imaginary line connecting the anterior nasal spine and the mastoid process was considered elongated. Also, any calcification or fragmentation in the styloid complex was reported.

All cases that showed elongation or calcification phoned for their approval for an interview to fill in a questionnaire, and to assess clinical symptoms and etiological factors. The questionnaire consisted of nine close-ended questions (Fig. 1).

Questionnaire for the clinical symptoms and etiology of elongated styloid process		
1-Do you feel pain when you swallow?	Yes	No
2-Do you feel pain when you yawn or when you open your mouth widely?		
3- Do you feel foreign body sensation in your pharynx?		
4- Do you feel any kind of discomfort in your neck?		
5- Did you extract the lower wisdom teeth?		
(If yes, was it traumatic?)		
6- Did you undergo tonsillectomy?		
7- Do you have chronic sore throat?		
8- Do you feel pain when you turn your head to the right or left? If yes which side: Right left both		
9- Have you ever had any head injury? (If yes tell us about it).....		

Fig. 1. The study questionnaire

2.1 Ethical Consideration

Taibah University, College of Dentistry Research Ethics Committee "TUCD-REC" approved this study on February 2015; informed consent has been endorsed for the questionnaire part of the study and waiver of consent for the retrospective part. Confidentiality of data guaranteed by the commitment of the principal investigator to use codes for all study subjects included in this study (Appendix 1).

3. RESULTS AND DISCUSSION

A total of 2114 stored digital panoramic radiographs were assessed, 400 panoramic radiographs were excluded from the study due to patient positioning errors or image cropping and blurring, so only 1714 were included. All female patients were in the age range from (18-80 years) and a mean age of 33.3 years.

Chi-square test showed a significant correlation between age and styloid process elongation (*P* =.000) and between age and styloid process calcification (*P* =.036) (Figs. 2 and 3).

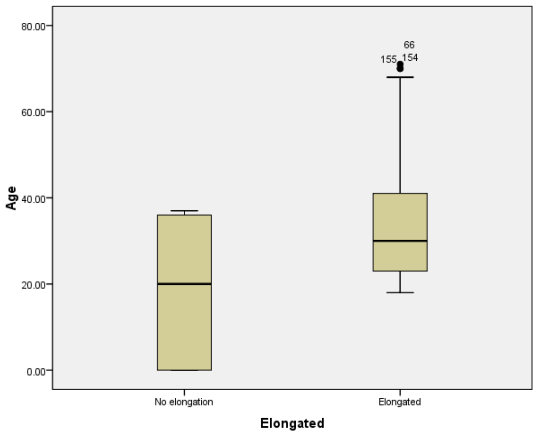

Fig. 2. Box plot diagram showing relationship between elongation of styloid process & patient's age

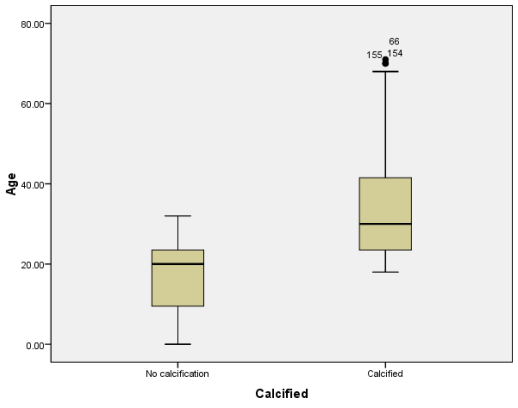

Fig. 3. Box plot diagram showing relationship between calcification of styloid process & patient's age

We found an overall prevalence of calcification and elongation in the styloid complex in 189 patients (11%), 176 (10.3%) of them had elongated SP with complete calcification while 13 (0.7%) had fragmented calcification (Table 1) (Figs. 4 and 5).

Spearman's rho test showed a high significant correlation between elongation and calcification in the styloid process in our sample (P=0.293**). In our study the most common age for styloid process elongation and calcification was between 20-40 years.

Only 32 patients out of 189 (with elongated and calcification of SHC) accepted participations in the survey, and the results were on (Table 2).

Table 1. Showing frequency and percentage of elongation and calcification of styloid complex

	Frequency	Percentage
Elongation & Calcification	176	10.3%
Fragmentation	13	0.7 %
No elongation or calcification	1525	89%
Total	1714	100%

Table 2. Showing number and percentage of patients suffering from different clinical manifestation and etiology

Question	Number of patients	Percent
Pain with swallow	4	12.5%
Pain with yawning	5	15.6%
Foreign body sensation	5	15.5%
Pain with turning the head	4	12.5%
History of 3rd molar extraction	7	21.9%
Difficult extraction	7	21.9%
Tonsillectomy	2	6.3%
Chronic throat pain	4	12.5%
Head or neck injury	10	31.3%

3.1 Discussion

The occurrence of elongation in the styloid process varies greatly among public [16]. Studies reported that its radiographic incidence particularly in panoramic views fluctuated between 4% and 28% [17,18]. An attentiveness of clinical significance and radiographic appearance of styloid process elongation is essential to all oral specialists convoluted in the identification and management of head and neck pain. Eagle syndrome, sometimes called styloid or stylohyoid syndrome, is defined as "the symptomatic elongation of the styloid process or mineralization (ossification or calcification) of the stylohyoid ligament complex" [19].

Fig. 4. Panoramic radiograph for a 37 years old female patient showing left styloid process elongation (white arrows)

Fig. 5. Panoramic radiograph for 48 years old female patient showing left styloid process elongation (white arrows)

In our study, we used digital panoramic radiograph to examine any elongation or calcification in the styloid complex because it is a simple and inexpensive screening imaging technique for the maxillofacial region. Also it is characterized by easy image manipulation and this was in agreement with some authors who stated that panoramic radiograph is an essential diagnostic tool for the styloid process elongation [17,18,20,21]. It is designated as the favorite and simple imaging mean when a general idea of the maxillofacial complex is required [22].

We measured the elongation in the styloid process similar to the method described by Shaik et al. 2013 [15] who used imaginary line connecting the anterior nasal spine and the mastoid process as a reference line and any SP extended below this line was considered elongated.

In our study, we found that 189 patients (11%) out of 1714 had calcification and elongation in the styloid complex, 176 (10.3%) of them had elongated styloid process with complete calcification while 13 (0.7%) had fragmented calcification. As well as, Guimaraes et al. [22] examined 2,600 panoramas, reported 146 images of elongation of the SP, most commonly found in females at the age of 11–40 years.

In contrary to our study, Goncales ES et al. 2003 [23] stated the incidence of the elongated styloid process was 22.79%. Also MacDonald DS, 2001 [9] informed that the prevalence of an elongated styloid process was low in Hong Kong (8.6%) and in London (7.8%), but when the calcified stylohyoid ligaments are included, it raised to 12.5% in Hong Kong and 23.6% in London While segmented calcification is considerably more numerous in London [24]. The value of calcification is broadly comparable with the 18 to 25% in other studies [25,26,27].

In disagreement with the current study Shaik et al. 2013 [15] reported that prevalence of styloid process elongation was (36.8%) in Saudi females in Aseer region.

In accordance with our study Gulnara S et al. 2003 study affirmed that the prevalence of elongated styloid process was 12.6% [28] While Shah SP et al. 2012 [29] found that the elongation prevalence was 15.7% and all included patients were asymptomatic.

We found that the most common age for elongation was between 20-40 years. This was in agreement with a similar study made in College of Dentistry, King Khalid University, Abha, Saudi Arabia [15].

However, there is no agreement among the authors regarding the common age range for SP elongation, because some described a higher incidence in the age group between 41 and 50 years [30]. While other between 30 and 40 years [31], and others have mentioned a greater increase after 50 years of age [26]. In Carla study, 2015 the most affected age groups were between 25 and 39 years old and 40 and 59 years old with equal frequencies of 43.1% [32].

Our study reported that only 13 cases showed fragmented, incomplete calcification, although Reddy et al. 2013 [33] and Bagga et al. 2012 [34] found partially calcified pattern most prevalent in south and north Indian population.

Our study reported various symptoms among our sample ranging from pain with swallowing to the feeling of foreign body but unfortunately this was in a small percentage of patient complained of elongation of SP, as only 17% of them accepted to participate in the questionnaire survey.

Most patients with elongated styloid processes are asymptomatic and are revealed accidently at radiograph or identified at post-mortem examination. It has appraised that about 4-10% of people with an elongated styloid process will have symptoms [35,36].

The anatomic correlation between the styloid process and its nearby structures initiated the signs and symptoms of Eagle's syndrome [37].

The symptoms can be mixed up with particular additional conditions including a widespread diversity of facial neuralgias, and oral and temporomandibular diseases [38]. So, a detailed differential diagnosis for styloid process elongation should be made.

Our study found that the most etiological factor for the elongated styloid process was head and neck injuries. The precise cause of styloid process elongation isn't completely stated; many theories have been assumed. It could be due to development of osseous tissue at the insertion of stylohyoid ligament or it could be due to calcification of stylohyoid ligament due to unknown process or due to perseverance of cartilaginous analog stylohyal [39,40].

Our study is considered the first study of prevalence of styloid process elongation to be done in Al Madinah Al Monwarah region, Saudi Arabia but further studies are recommended to conduct on larger population and both sexes.

4. CONCLUSION

It is critical that the dentist should be attentive to normal variation in the styloid complex to be able to detect any elongation or calcification which could be discovered incidentally in radiographic

examination particularly panoramic radiograph which is an economical, easily accessible and useful diagnostic screening tool for an early detection of elongated styloid process with or without symptoms.

CONSENT

All patients signed an informed consent before participating in the study to fill the questionnaire. The consent was at the beginning of the questionnaire (Appendix 1).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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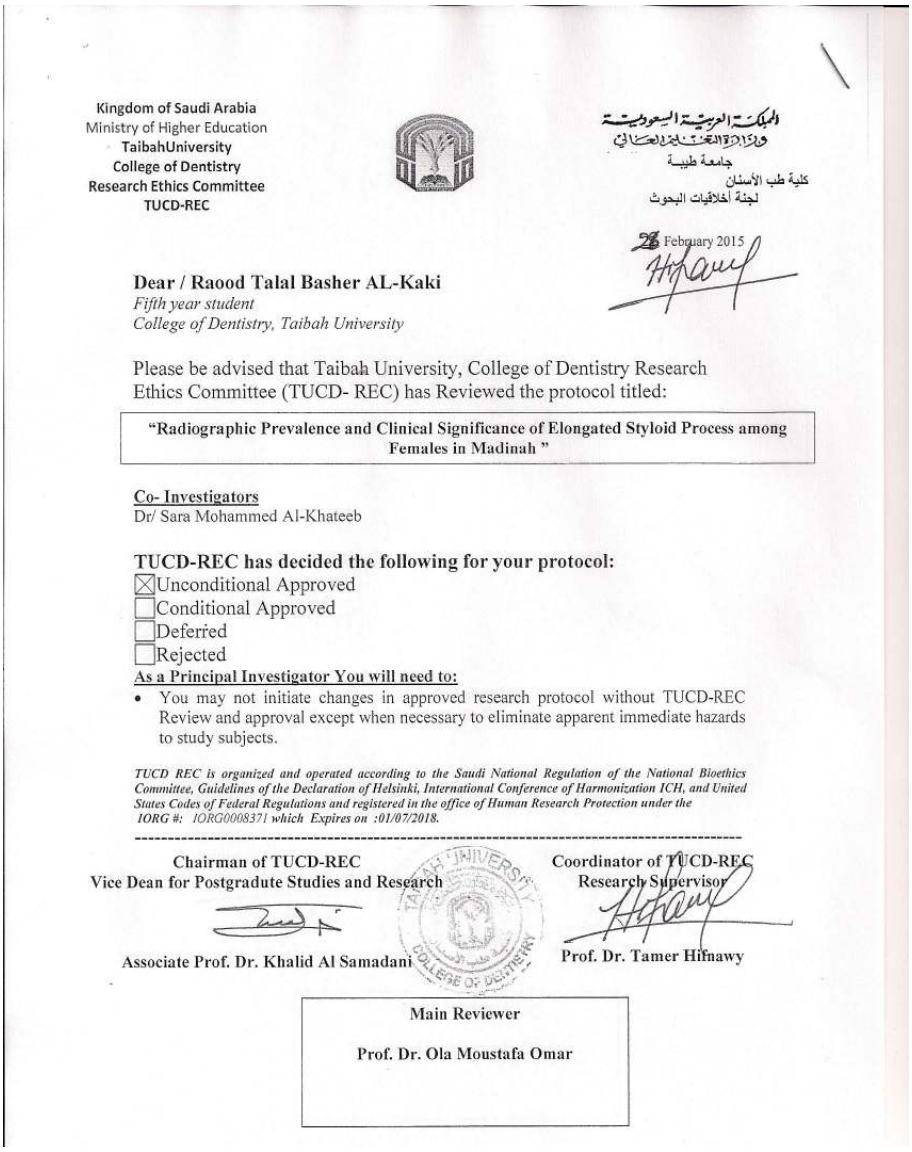
APPENDIX 1

Copy of ethical approval



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لجنة أخلاقيات البحوث

25 February 2015

Dear / Raood Talal Basher AL-Kaki
Fifth year student
College of Dentistry, Taibah University

Please be advised that Taibah University, College of Dentistry Research Ethics Committee (TUCD- REC) has Reviewed the protocol titled:

"Radiographic Prevalence and Clinical Significance of Elongated Styloid Process among Females in Madinah "

Co- Investigators
Dr/ Sara Mohammed Al-Khateeb

TUCD-REC has decided the following for your protocol:
☒ Unconditional Approved
☐ Conditional Approved
☐ Deferred
☐ Rejected

As a Principal Investigator You will need to:

- You may not initiate changes in approved research protocol without TUCD-REC Review and approval except when necessary to eliminate apparent immediate hazards to study subjects.

TUCD REC is organized and operated according to the Saudi National Regulation of the National Bioethics Committee, Guidelines of the Declaration of Helsinki, International Conference of Harmonization ICH, and United States Codes of Federal Regulations and registered in the office of Human Research Protection under the IORG #: IORG0008371 which Expires on :01/07/2018.

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