

Prevalence of Stylohyoid Ligament Calcification on Panoramic Radiographs in an Iranian Population

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Abstract

Introduction: The aim of this study was to investigate the prevalence of stylohyoid ligament complex elongation in a group of Iranian patients using digital panoramic radiographs. **Methods:** Panoramic radiographs of 1211 patients (684 females and 527 males) referred to the dental school of Hamadan university of medical science were selected from 2011 to 2013. The stylohyoid ligament complexes were investigated. **Results:** This abnormality was seen in both sexes. A calcified complex was found in 632 (52.2 %) of the patients. Both-sided (right and left) type 1 calcified complex (according to O'Carroll classification) was observed in 207 patients, while types 2–4 were found in 204, 112, and 109 patients, respectively. **Conclusion:** The results suggest that stylohyoid ligament calcification complex is frequent in Iranian population and present in both sexes with equal distribution. In addition, calcifications were seen more often at age of 20-40 years, and the extent of calcification did not show a tendency to increase with age.

Key words: Elongated styloid process syndrome, stylohyoid ligament calcification, panoramic radiograph.

Introduction

In the area of stylohyoid complex, mineralization or calcification is relatively common and well-known anatomical abnormalities in the field of head and neck radiology. However, the etiology and pathogenesis are not well understood (1). Stylohyoid complex includes an styloid process, stylohyoid ligament, and small horn of hyoid bone and it has been drawing the attention of researchers at least for 400 years (2,3). Calcification of stylohyoid ligament starts, usually bilaterally, from the base of skull and extends downwards. Calcified ligament is palpable in the top of the tonsils as a hard and sharp structure. When the total length of the bone process and/or mineralized portion of the adjacent ligament (stylohyoid or stylomandibular) in radiography is more than 30 mm we consider it as elongated styloid process. The length of the process can be much elongated, and reportedly, it could reach 10cm or more (1).

Mineralization in the stylohyoid complex area has special importance due to its potential to create clinical symptoms. Elongated styloid process is one of the causes of head and neck pain that is known as “stylohyoid syndrome”. The symptoms include nagging or aching sensation in throat on swallowing or turning the head, spreading to the ear or mastoid region. When the patient has a recent history of neck trauma (e.g., tonsillectomy), the condition is called Eagle's syndrome. Accurate diagnosis is important because the symptoms are similar to other diseases in this region. Most patients are not diagnosed, because clinical features are intangible, and accurate diagnosis by clinical findings alone is difficult. Practitioners, especially dentists

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should be aware of the related radiological features in order to correct diagnosis and consider it in the differential diagnosis of other head, throat and neck complaints (4).

The most useful radiographs that show the stylohyoid process include panoramic radiograph, PA and lateral cephalometric radiograph, lateral view of mandible, Town view, CT and MRI (5,6). The panoramic radiography is a usual examination in oral medicine and diagnosis; it is also the best imaging modality to view the styloid process bilaterally (7).

With the widespread use of panoramic radiography in dentistry, dentists are more aware of different kinds of styloid process and stylohyoid ligament. Through this method, it is possible to identify and measure the stylohyoid process from the temporal bone with the external auditory meatus as a reference point (8).

Many researchers have compared the prevalence and severity of mineralized area in stylohyoid ligament with age and highly different results are obtained (9-14). O'Correlletal, did not express any relationship between length of the mineralization and age (1), whereas Ruprecht and colleagues found an opposing trend with increasing age and further ossification of stylohyoid ligament (15). On the other hand, Ferrario was found a relationship between the number and length of mineralized stylohyoid ligaments and patient age (16).

The reported incidence of calcification varies in different populations including our country, Iran, and has been reported a wide range from 4% in Eagle study (17) to 28% in the study by Kaufman (9). According to our reviews no study still has taken place on the prevalence of calcification in Hamadan. So, due to the variation in prevalence of this calcification in different populations; and also considering disagreement in previous studies about the relationship between this calcification and age, the aim of our study was to investigate the prevalence of elongated stylohyoid ligament by digital panoramic radiographs and analysis of the incidence in relation to age and sex subgroups in patients referred to dentomaxillofacial radiology department, faculty of dentistry, Hamadan university in Iran, between the years 2011 to 2013.

Materials and Methods

Totally 1322 digital panoramic radiographs, which were available as the software version in the PC's hard drive in our radiology department, selected for this study. Panoramic radiographs, taken from March 2011 to March 2013 with a similar x-ray machine (Planmeca Promax, Helsinki, Finland) and with technical conditions of maximum 84 kVp and 16 mA and 17 seconds, were evaluated. All The panoramic radiographs were taken in the standing position, and the

patients were asked to bite on the biting portion of the radiographic equipment using the anterior teeth to establish the location. The Frankfort horizontal plane was placed parallel to the horizontal plane to maintain a consistent head position (18). Stylohyoid ligament length from the base of the skull to the tip of each, were analyzed in the existing radiographs (19). A whole number of 1211 radiographs with a good view of stylohyoid ligaments and traceable process from the base of the skull were selected among which 111 radiographs that were difficult to interpret due to technical or anatomical reasons were excluded from the study. Small horn of hyoid bone position helps us to determine the incorrect position of the patient during the entire examination. All images without the opacity of right and left horns in the similar level were excluded. The radiographs were reviewed twice by the same observer with the interval of 2 weeks. All signs of mineralization in the area of stylohyoid and stylomandibular in this study were considered to be part of the stylohyoid ligament complex. We considered the coupler plane, from anterior nasal spine (ANS) to the mastoid processes, If the whole of the stylohyoid processes were depicted above this plane, it was normal (20).

In this study, digital panoramic radiographs of the patients referred for routine clinical evaluation were used; so the need of ethical approval was not sought. We used O'Carroll classification (10) for ranking the stylohyoid ligament calcification (Fig. 1).

Type 1- stylohyoid ligament calcification is above the mandibular foramen (two-sided); type 2- stylohyoid ligament calcification is aligned with the mandibular foramen (two-sided); type 3- stylohyoid ligament calcification is below the mandibular foramen (two-sided), and type 4- stylohyoid ligament calcification have different lengths for left and right side of the patient that contains all one sided calcifications.

Relevant data were extracted from radiographic evidence of samples; described using descriptive statistics include central and dispersion parameters, tables and point prevalence estimation with corresponding 95% confidence intervals (CI). Chi - square test was used to test the relationship between qualitative variables and presence of calcification. To determine significant differences between quantitative variables and stylohyoid ligament calcification t-test and ANOVA test were used. All statistical tests were done using Stata software, version 11.

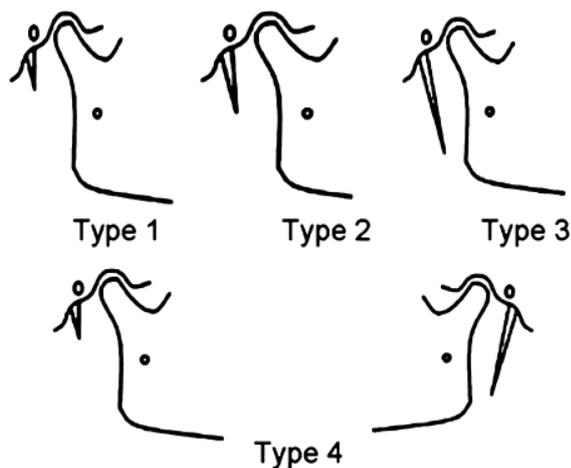


Figure 1. O'Carroll classification of stylohyoid ligament calcifications

Results

A total of 1211 patients were investigated in this study, which 43.5% (527) were male and the rest of 56.5% (684) were female. The mean age of the study population was 31.9 ± 12 years with range of 78 years. Twenty five percent of subjects were 24 years or less, 50% of individuals were 30 years or less and 75% of the subjects were 40 years or less.

The overall prevalence of calcification (including calcification of the left and right unilateral and bilateral calcifications) in patients was 52.2% (632 patients) with 95% CI (49.3-55%). The prevalence of calcification on the right side was 1.9% (95% CI: 1.2-2.9%) and the left side was 2.3% (95% CI: 1.4-3.2). Bilateral calcification was the most common, with an incidence of 48% (95% CI: 45.1-50.8%). The prevalence of calcification according to the type of calcification with 95% confidence intervals (CI) is shown in Table 1. The

prevalence of type 1 calcification is 32.8%. The corresponding values for type 2, type 3 and type 4 are 32.3%, 17.7% and 17.2%, respectively. Figure 2 shows these four types of stylohyoid ligament calcifications in four patients.

Table 1. Prevalence of Calcification according to the type of calcification among study population

Type of calcification	Number	Prevalence (Confidence Interval 95%)
Type 1	207	32.8%(29.1-36.5 %)
Type 2	204	32.3 % (28.6-36 %)
type 3	112	17.7 % (14.8- 20.9 %)
type 4	109	17.2 % (14.3-20.4 %)

Chi-square test showed no significant association between gender and prevalence of calcification ($P=0.351$). The relationship between age and prevalence of calcification using Chi-square test at a significance level of 0.05, was significant ($P<0.001$). And the prevalence of calcification was more often at the age group of 20-40 years (Fig. 3). This was also significant, in the prevalence of different type of calcifications ($P<0.001$), and all types of calcification were more observed at the age group of 20-40 years (Fig. 3).

For evaluation of the relationship between the relative length or extent of stylohyoid ligament calcification and age, we omitted the type 4 from the classification, and used the type 1 to 3 for statistical analysis. However, there was no statistical significance between age and extent of calcification ($P=0.161$). Moreover, the corresponding statistical test for age group was not statistically significant ($P=0.125$).

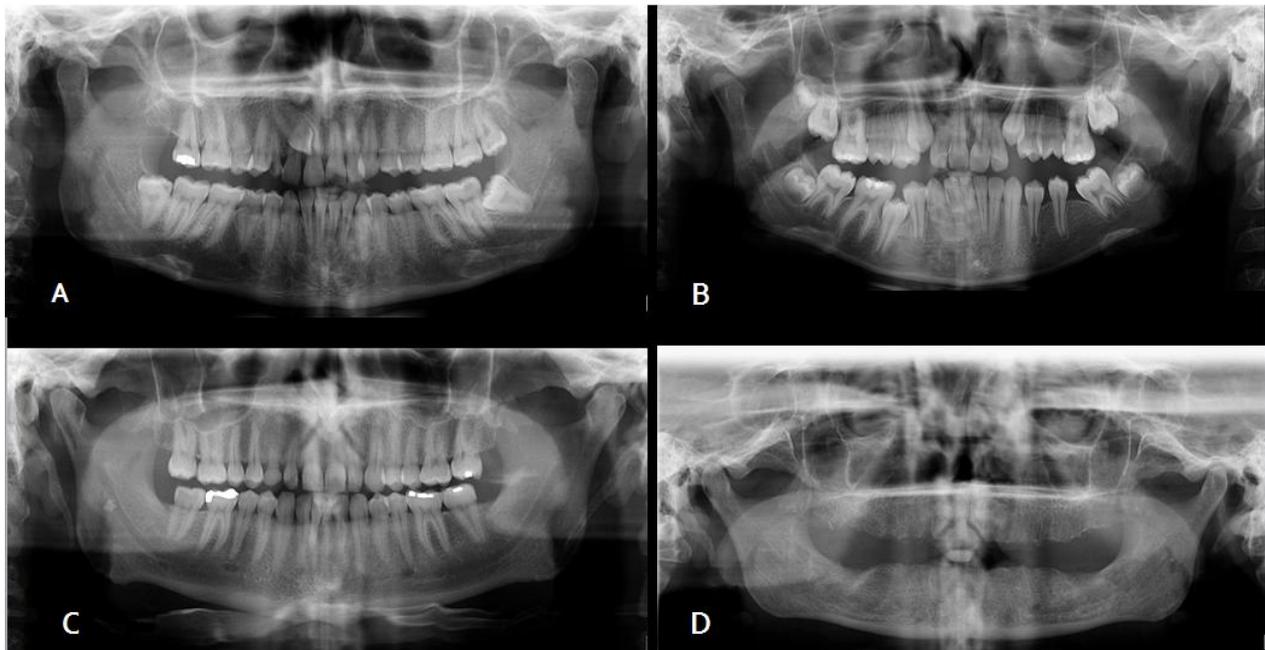


Figure 2. Four types of stylohyoid ligament calcification according to O'caroll classification: (A) type 1 in a 26 year old female patient, (B) type 2 in a 11 year old male, (C) type 3 in a 33 year old female, and (D) type 4 in a 54 year old male

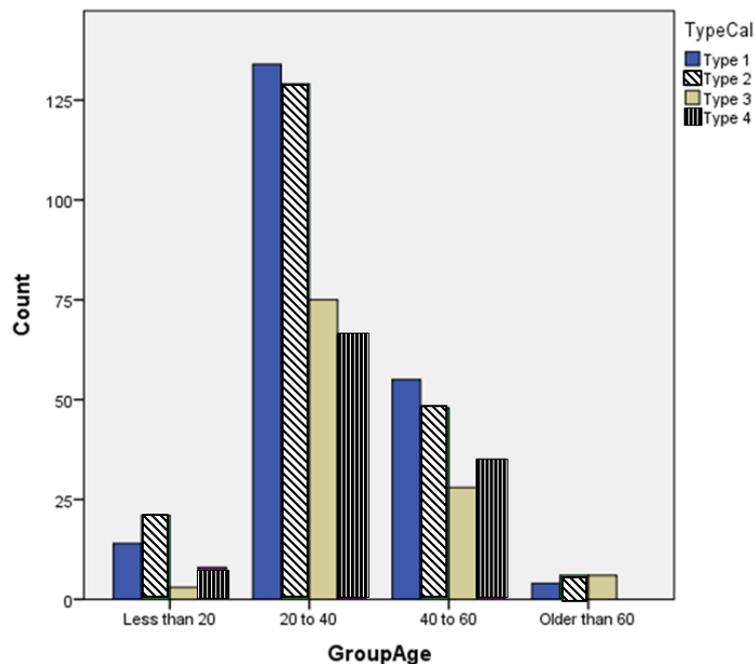


Figure 3. Distribution of four types of stylohyoid ligament calcifications in different age groups

Discussion

Elongation and calcification of stylohyoid complex is often asymptomatic, and its pathogenesis is still unknown but epidemiological studies, as a basis for clinical studies can provide important information on this item (21). Because of the medial angle of the styloid process and superimposition of other skeletal structures, some errors can occur when measuring the length of

styloid (7). Magnification and distortion of panoramic radiographic technique due to angulations may distort this complex, and x-ray image magnification may itself change because of the angle of this process (16,22). The radiographic length of this process is defined between 9 to 57 mm and there is no unique statement for definition of the length of the styloid process (23), so considering a diversity of reports pertained to radiographic length of

this complex, in this study we neglected to measure this process. We used O'Carroll classification in the evaluation of panoramic radiographs instead of millimetric measurements (10).

Based on the results of our study, the overall prevalence of calcification (including unilateral and bilateral) in the subjects was 52.2 % of which 47% was bilateral and the other was unilateral. Radiographic elongated stylohyoid incidence reported in the literature varies from less than 2 percent to more than 30% (6,24-28). However, this obtained percentage is significantly greater than the percentage that has been suggested by other studies. Several studies have been conducted in relation to this calcification and have been suggested that the prevalence of discussed feature is relatively high in Iran (18,29-32). The prevalence obtained in the study of Anbiaee and colleagues (31) in Mashhad was closer to the prevalence in this study. Regional factors such as ethnicity and dietary factors may be important in differences in the prevalence of elongated stylohyoid in other reports. Diverse results could also be due to differences in the selected age structure and sample size. Thus, comparing the results of the prevalence of stylohyoid calcification is impossible because of ethnical, racial and anatomical variations, differences in radiographic devices and differences observers. In this study, most people with calcification had bilateral involvement (48% from 52.2%). This finding has been demonstrated in the majority of previous researches and no conflict over this aspect was found (1,6,16,23,27,33). In another study, the same frequency of unilateral and bilateral calcifications has been reported (34). Scafetal. also stated that 90.5% of cases had unilateral calcification, which was a very large prevalence (35). They demonstrated that muscle tension resulted from occlusal disorders could be a possible factor. However, their study was conducted on edentulous adult population in Brazil with a less sample size.

Only a small percentage of patients (4.2%) in this study had unilateral calcification, and no significant difference was seen in the number of patients with calcification of the right side (1.9%) and the left side (2.3%). This result was also found in the study of Bozkir et al. (27).

The results of this study showed that age is a significant factor that affects the rate of stylohyoid complex calcification exponentially and calcification incidence is more often at the age group of 20-40 years, but the length and the extent of calcification is not necessarily associated with age. Our results was somewhat inconsistent with some studies which reported calcification progress with increasing age (10,16,20,29,31,36-38). However, our results were consistent with some studies which denied any increase in the actual length of the calcified complex with age

(1,34,35). It can, therefore, be concluded that the different types of stylohyoid complex calcification are structural disorders rather than developmental process. So it seems that Dwight's comment, more than 70 years ago, suggesting that "age is not a factor" has remained valid (39).

In the terms of gender, our findings showed no significant differences in the incidence and extent of calcification between two sexes, which were in agreement with many studies (22,25,37,40,41). While some studies have found a little more female tendency for the mineralization of this ligament (1,16), others have reported a higher incidence of these phenomena in men (7,42). These differences in results could be attributed to different genetic pools or methods of randomization in the studies (38). In most of previous studies, about the superiority in a specific sex or age group, the sample sizes were much smaller than that in the present study. So calcification rates identified in the previous studies were less likely to be reliable.

We believe that a simple millimetric measurement considering involved radiological parameters is not an appropriate criteria, so in our anatomical observations all calcified parts beyond the connecting plane of mastoid processes and anterior nasal spine were considered abnormal (16). Because elongated stylohyoid complex is often asymptomatic (43,44) we didn't investigate the clinical characteristics of study population. This study emphasized mainly on the prevalence of stylohyoid complex calcification in Hamadan population, and evaluated the effect of age and gender on the prevalence and extent of calcification.

Aside from the accuracy of the results from different studies, we supposed that the evaluation of elongated styloid processes on panoramic radiographs might be of no value for diagnosis of Eagle's syndrome. The high percentage of elongated stylohyoid ligament mentioned in some reviews and absence of related symptoms could undermine the clinical significance of stylohyoid ligaments calcification.

Conclusion

Elongation of the stylohyoid ligament is common in Iranian population and this finding had same sex distribution. This condition often appears with bilateral involvement. The extent of mineralization did not show a tendency to increase with age.

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References

1. Correll RW, Jensen JL, Taylor JB, Rhyne RR. Mineralization of the stylohyoid-stylomandibular ligament complex: A radiographic incidence study. *Oral Surg Oral Med Oral Pathol* 1979;48:286-91.
2. Öztaş B, Orhan K. Investigation of the incidence of stylohyoid ligament calcifications with panoramic radiographs. *J Invest Clin Dent* 2012;3:30-5.
3. Lengelé BG, Dhem AJ. *Arch Otolaryngol Head Neck Surg* 1988;114:1003.
4. Kosar M, Atalar M, Sabanclogullari V, Tetiker H, Erdil F, Cimen M, Otağ I. Evaluation of the length and angulation of the styloid process in the patient with pre-diagnosis of Eagle syndrome. *Folia morphol (Warsz)* 2011;70:295-4.
5. Diamond LH, Cottrell DA, Hunter MJ, Papageorge M. Eagle's syndrome: a report of 4 patients treated using a modified extraoral approach. *J oral maxillofac surg* 2001;59:1420-6.
6. Ilgüy M, Ilgüy D, Güler N, Bayirli G. Incidence of the type and calcification patterns in patients with elongated styloid process. *J int med res* 2005;33:96-102.
7. More CB, Asrani MK. Evaluation of the styloid process on digital panoramic radiographs. *Indian j radiol imaging* 2010;20:261-5.
8. Watanabe P, Dias F, Issa J, Monteiro S, de Paula F, Tioosi R. Elongated styloid process and atheroma in panoramic radiography and its relationship with systemic osteoporosis and osteopenia. *Osteoporos int* 2010;21:831-6.
9. Kaufman SM, Elzay RP, Irish EF. Styloid process variation: radiologic and clinical study. *Arch Otolaryngol* 1970;91:460-3.
10. Carroll MKO. Calcification in the stylohyoid ligament. *Oral Surg Oral Med Oral Pathol* 1984;58:617-21.
11. Camarda A, Deschamps C, Forest D. I. Stylohyoid chain ossification: a discussion of etiology. *Oral Surg Oral Med Oral Pathol* 1989;67:508-14.
12. Leonhart GP. A case of stylo-hyoid ossification. *Anat Rec (Hoboken)* 1914;8:325-32.
13. Balasubramanian S. The ossification of the stylohyoid ligament and its relation to facial pain. *Br Dent J* 1964;116:108-11.
14. Lavine MH, Stoopack JC, Jerrold TL. Calcification of the stylohyoid ligament. *Oral Surg Oral Med Oral Pathol* 1968;25:55-8.
15. Ruprecht A, Sastry K, Gerard P, Mohammad A. Variation in the ossification of the stylohyoid process and ligament. *Dentomaxillofac Radiol* 1988;17:61-6.
16. Ferrario VF, Sigurta D, Daddona A, Dalloca L, Miani A, Tafuro F, Sforza C. Calcification of the stylohyoid ligament: incidence and morphoquantitative evaluations. *Oral Surg Oral Med Oral Pathol* 1990;69:524-9.
17. Eagle WW. Symptomatic elongated styloid process; report of twocases of styloid process-carotid artery syndrome with operation. *Arch Otolaryngol* 1949;49(5):490-503.
18. Alpoz E, Coskun Akar G, Celik S, Govsa F, Lomcali G. Prevalence and pattern of stylohyoid chain complex pattern detected by panoramic radiographs among Turkish population. *Surg Radiol Anat* 2014; 36:39-46.
19. Zangouei Booshehri M, Ezoddini Ardakani F, Rasooli A, Sarayedar Baser R, Nayer S. Incidence of Stylohyoid Ligament Calcification and Its Length in an Iranian Adult Population. *SSU_Journals* 2011;19:211-8.
20. Shaik MA, Kaleem S, Wahab A, Hameed S. Prevalence of elongated styloid process in Saudi population of Aseer region. *Eur J Dent* 2013;7:449-54.

21. 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.
22. Monsour PA, Young WG. Variability of the styloid process and stylohyoid ligament in panoramic radiographs. *Oral Surg Oral Med Oral Pathol* 1986;61:522-6.
23. Sokler K, Sandev S. New classification of the styloid process length—clinical application on the biological base. *Coll antropolo* 2001;25:627-32.
24. Gossman Jr J, Tarsitano J. The styloid-stylohyoid syndrome. *J oral surg* 1977;35:555-60.
25. Keur J, Campbell J, McCarthy J, Ralph W. The clinical significance of the elongated styloid process. *Oral Surg Oral Med Oral Pathol* 1986;61:399-404.
26. Zaki HS, Greco CM, Rudy TE, Kubinski JA. Elongated styloid process in a temporomandibular disorder sample: prevalence and treatment outcome. *J prosthet dent* 1996;75:399-405.
27. Bozkir MG, Boga H, Dere F. The Evaluation of Elongated Styloid Process in Panoramic Radiographs in Edentulous Patients. *Turkish Journal of Medical Sciences*. 1999;29:481-6.
28. Erol B. Radiological assessment of elongated styloid process and ossified stylohyoid ligament. *J Marmara Univ Dent Fac* 1996;2:554-6.
29. Ghafari R, Dalili Z, Abdolapur S. A study on the frequency of elongated styloid process and eagle's syndrome among patients admitted to Guilan dental school clinic (2005-2006). *Journal of Isfahan Dental School*. 2010;6:108-115.
30. Ghafari R, Hosseini B, Shirani AM, Manochehrifar H, Saghale S. Relationship between the elongated styloid process in panoramic radiographs and some of the general health conditions in patients over 40 years of age in the Iranian population. *Dent Res J (Isfahan)* 2012;9:s52-6.
31. Anbiaee N, Javadzadeh A. Elongated styloid process: Is it a pathologic condition? *Indian J Dent Res* 2011;22(5):673-7.
32. Hosseini B. Relationship between the length of styloid process in panoramic radiographs with some of general conditions (weight, blood pressure...) in patients. *School of Dentistry: Thesis*. Isfahan, Khorasgan Branch the University of Isfahan; 2009.
33. Roopashri G, Vaishali M, David MP, Baig M, Shankar U. Evaluation of Elongated Styloid Process on Digital Panoramic Radiographs. *J contemp dent prac* 2012;13:618-22.
34. Rizzatti-Barbosa CM, Ribeiro MC, Di Hipolito O, Ambrosano GM. Is an elongated stylohyoid process prevalent in the elderly? A radiographic study in a Brazilian population. *Gerodontology* 2005;22: 112-5.
35. Scaf G, Freitas DQd, Loffredo LdCM. Diagnostic reproducibility of the elongated styloid process. *J Appl Oral Sci* 2003;11:120-4.
36. Jaju P, Suvarna P, Parikh N. Eagles syndrome. An enigma to dentists. *J Indian Acad Oral Med Radiol* 2007;19:424-9.
37. Gözil R, Yener N, Calgüner E, Arac M, Tunc E, Bahcelioğlu M. Morphological characteristics of styloid process evaluated by computerized axial tomography. *Ann Anat* 2001;183:527-35.
38. Al-Khateeb TH, al Dajani TMm, Al Jamal GA. Mineralization of the Stylohyoid Ligament Complex in a Jordanian Sample: A Clinicoradiographic Study. *J oral maxillofac surg* 2010;68:1242-51.
39. Dwight T. IX. Stylo-hyoid Ossification. *Ann surg* 1907;46:721-35.
40. Kursoglu P, Unalan F, Erdem T. Radiological evaluation of the styloid process in young adults resident in Turkey's Yeditepe University faculty of dentistry. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005;100:491-4.
41. Omnell K-ÅH, Gandhi C, Omnell ML. Ossification of the human stylohyoid ligament: a longitudinal

- study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;85:226-32.
42. Benazzi A, Bernardi F, Zuccari A. Indagine statistica e radiologica su particolari aspetti del complesso stiloideo. Riv It Odont Prot Dent 1986;5:41-5.
43. Politi M, Toro C, Tenani G. A Rare Cause for Cervical Pain: Eagle's Syndrome. Int J Dent 2009;2009:781297
44. Reddy RS, Kiran CS, Madhavi NS, Raghavendra M, Satish A. Prevalence of elongation and calcification patterns of elongated styloid process in south india. J Clin Exp Dent 2013;5:30-5.

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