Radiographic Evaluation of Calcification in the Stylohyoid Chain in a Group of Children and Adolescent¶

BİR GRUP ÇOCUK VE ADOLESAN ÜZERİNDE RADYOGRAFİK OLARAK STYLOHYOİD ZİNCİRİN KALSİFİKASYONUN ARAŞTIRILMASI

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Summary

Purpose: The purpose of this study was to examine the calcification in the stylohyoid chain in a sample of the child and adolescent patient population of the University of Ankara, Faculty of Dentistry.

Material and Methods: Eight hundred thirty-six panoramic radiographs and data from the pediatric and adolescent patients, who were referred to University of Ankara, Faculty of Dentistry out patient clinics were retrospectively evaluated. Patients were identified into three groups as having no calcification, calcification positive and unknown. The subjects who were found calcification also divided as unilateral or bilateral. The age, sex and localization of the patients were recorded. The correlations among the groups were statistically analyzed by using McNemar's chi-squared test. Significance was set at a p value of <0.05.

Results: The mean age of the 836 patients evaluated in the study was 11,3 years, with a range of 4 to 20 years. 448 patients were female while three hundred eighty eight patients were male. Of all 836 patients, 481 patients showed calcification; 187 patients had no calcification. 168 patients were described as unknown. 304 patients had bilateral calcification where only 177 patients had unilateral calcification.

Conclusion: Although the calcification was more often seen in females than males in Turkish children, there was no statistical significance found according to sex. The results suggest that the calcification in the stylohyoid chains are establishing during childhood and there was a sharp increase in incidence of calcification with starting from 10 years age group. The results of statistical tests for Turkish population showed; there are no statistically significant differences among the groups with respect to sex, age, and localization ($p< 0.05$).

Key Words: Stylohyoid chain, calcification, children, prevalence

Özet

Amaç: Bu çalışmanın amacı; Ankara Üniversitesi Diş Hekimliği Fakültesi'ne başvuran bir grup çocuk ve adolesan hasta üzerine radyografik olarak Stylohyoid zincirin kalsifikasyonun araştırılmasıdır.

Materyal ve Metod: Ankara Üniversitesi Diş Hekimliği Oral Diagnoz Kliniği'ne başvuran çocuk ve adolesan 836 hastanın panoramik radyografileri ve dataları retrospektif olarak incelenmiştir. Hastalar; kalsifikasyonsuz, kalsifikasyon mevcut ve belirlenme-yen adı altında 3 gruba ayrılmıştır. Kalsifikasyon bulunan hastalarda kendi arasında unilateral ve bilateral olarak 2i alt gruba ayrılmıştır. Hastaların yaş, cinsiyet ve kalsifikasyonların lokalizasyonları (sağ ve sol) olmak üzere kaydedilmiştir. Bu gruplar istatistiksel olarak McNemar'ın χ^2 testi kullanılarak incelenmiş ve p değeri < 0.05 olduğu durumlar anlamlı fark olarak değerlendirilmiştir.

Bulgular: İncelenen 836 hastanın ortalama yaş değeri 11,3 iken yaş aralığı 4 ile 20 arasındaydı. 448 hasta kız iken, 388 hasta erkeklerden oluşmakta idi. 481 hastada kalsifikasyon pozitif iken, 187 hasta kalsifikasyonsuz, 168 hasta ise belirlenememiştir.304 hastada bilateral kalsifikasyon var iken 177 hastada unilateral kalsifikasyon mevcuttu.

Sonuç: Stylohyoid zincirin kalsifikasyonu kızlarda erkeklere oranla daha fazla bulunmasına rağmen, istatistiksel olarak anlamlı bir fark bulunamamıştır. Çalışmanın sonucunda, Stylohyoid zincirin kalsifikasyonun çocukluk döneminden itibaren başladığı ve 10 yaşından sonra kalsifikasyonda yüksek bir artış belirlenmiştir. İstatistiksel testler Türk popülasyonunda kalsifikasyonun yaşa, cinsiyete, lokalizasyona göre farklılık oluşturmadığı bulunmuştur ($p< 0.05$).

Anahtar Kelimeler: Stylohyoid zincir, kalsifikasyon, çocuk, prevalans

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The human stylohyoid chain, which includes the stylohyoid process (SP), the stylohyoid ligament (SHL), and the hyoid bone (HB) have been studied for at least 400 years. SP is a cylindrical spur of bone fused to the inferior aspect of the temporal bone and located immediately anterior and medial to the stylomastoideum foramen. Laterally; facial, hypoglossal nerves, the occipital artery and posterior belly of digastric muscle are found. Medially, lingual, facial, superficial temporal, maxillary, internal carotid arteries, as well as internal jugular vein and sphenomandibular

ligament are present (1-5). The components of the stylohyoid chain are embryologically derived from cartilage in four segments-the tympanohyal, stylohyal ceratohyal and hypohyal-and the single median basihyal cartilage (6,7). The styloid process develops from the first two segments, the tympanohyal and stylohyal. The tympanohyal is calcifies at birth but not yet attached to the temporal bone. The attachment is believed to take place during the first year of life. The stylohyal appears just after birth and calcifies slowly. These two segments fuse at puberty, but in some cases fusion is delayed or does not occur at all (8). Dwight described the SHL as arising from the third segment, known as the ceratohyal, and the lesser cornu of the HB as a arising from the fourth segment or hypohyal (7). Embryologically, these structures are derived from the epihyal cartilages, also known as Reichert's cartilages, ossify in two parts. These structures also can vary in length of the SP, ossification and segmentation of the SHL, enlargement of the lesser cornu of the HB, thickness of the bony parts, angle, and extreme form (2-5,7)

There are several theories concerning the ossification in the SHL in man. The SP usually ossifies 5 to 8 years after birth and variations in ossification and fusion of all elements may present varying radiographic appearances of the entire chain. the ossification process may be explained as the reactive hyperplasia which states that if the SP is stimulated or as a second theory a traumatic stimulus that induces certain ligamentous sections to undergo metaplastic changes. The theory of anatomic variance involves the SP and SHL as ossified structures that develop in formative years after birth (1,7). Several symptoms associated with an elongated SP and/or ossified SHL were first described by Eagle. Eagle has described two syndromes in which produces pain in the pharynx and hypopharynx in one and throughout the distribution of the internal or external carotid artery in the other (10-12). There are many previous studies about elongated SP and calcification of SHL in different populations and age groups (1,4,5,7-9,13-20). The Turkish population studies and case reports also conducted and presented in the literature (1,21-26), but as far as we know there is no solely report for Turkish children and adolescence about this issue.

Hence, it was consider worthwhile to examine the calcification in the stylohyoid chain retrospectively in a sample of the child and adolescence patient population of the University of Ankara, Faculty of Dentistry.

Material and Methods

This study was based on the panoramic radiographs of the children and adolescence who referred to University of Ankara, Faculty of Dentistry for evaluation of their problems. 836 panoramic radiographs and data of these subjects were evaluated retrospectively for the calcification in the stylohyoid chain. Selection criteria for patients were third molar evaluation, need for extensive restorative dental procedures, swelling, asymmetry, missing or supernumerary teeth, severe generalized caries, mixed dentition analysis and examination for TMJ disorders. Cases who had maxillofacial fracture history or having maxillofacial anomalies were not included in the study.

All radiographs were taken with a film-based PM 2002 CC Proline (Planmeca, Helsinki, Finland) panoramic radiography imaging unit at machine settings of 62 kVp, 5 mA, and a half-value layer of 2.47 mm of aluminum, using a T-Mat G/ Lanex medium film/screen combination (Eastman Kodak Co., Rochester, NY, USA). Exposed films were processed according to manufacturer's recommendations using an automatic film processor (Velopex,. England) with Kodak ReadyMatic chemistry. Blind fashion to the clinical status of the patient, an oral and maxillofacial radiologist examined the radiographs on a standard viewing box in a darkened room. The age, sex, and localization were recorded for all patients.

The study population classified into three group; as described in O Carroll's study (8). Patients were identified as having no calcification if the area that might be occupied by the process

and ligament was seen on the film and showed no radiographic evidence of calcification. Patients who showed radiographic evidence of calcification anywhere in the four segments (these segments were described at introduction) were identified as having calcification. The patients in whom some parts of the complex were missing from the film or obscured and who showed no evidence of calcification in the rest of the complex were tabulated as "calcification unknown". No clinical examination was performed. Besides this classification; the calcification group also divided as unilateral (Figure 1) or bilateral (Figure 2). Statistical comparison of sex, age and localization was performed using chi-square test and the null hypothesis for comparing two proportions. $P< 0.05$ was considered significant. Analysis of data was made by using the Microsoft Excel (Redmond, WA, US) spread sheet program and SPSS 11.0 (SPSS Inc, Chicago, Illinois, USA) for WINDOWS.

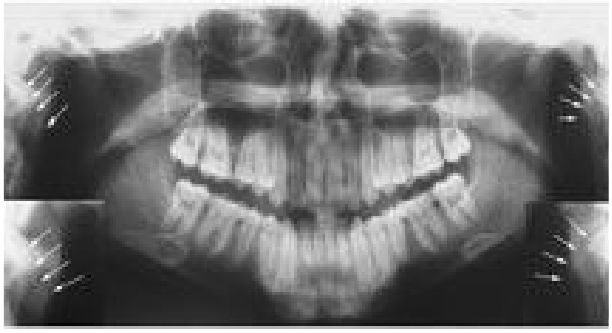

Figure1. Panoramic radiograph showing bilateral calcification in the stylohyoid chain in a 13-year-old boy.

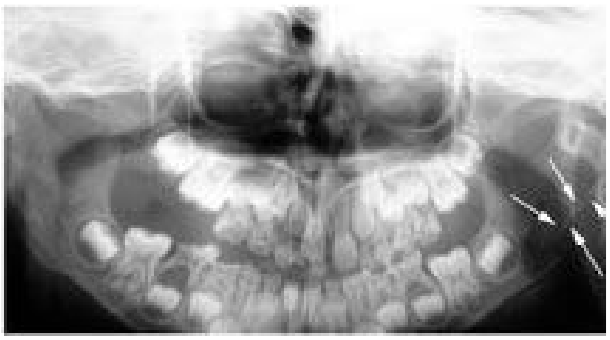

Figure2. Panoramic radiograph showing unilateral calcification in the stylohyoid chain in a 7-year-old girl.

Results

The mean age of the 836 patients evaluated in the study was 11.3 years, with an age range 4 years to 20 years. The study population was divided into 5 groups as; (4,6,7), (5,8,9), (10-12), (13-15), (16-20). The age distribution of the study population is indicated in Figure 3. four-hundred forty-eight (53.58%) were female; 338 (46.42%) were male. On–hundred sixty-eight patients (20.01%) were classified as "calcification unknown"; 187 (22.36%) had no radiographic evidence of calcification; 481 (57.53%) showed evidence calcification. There was a sharp increase in incidence of calcification with starting from 10 years age group (Figure 3). Table 1 showing the distribution of calcification, none and unknown groups. Tables should be read as follows for the first block of Table 1: Sixty-Five patients showed calcification in the 4-6 age group; this presented 7.78% percent of the sample: 34.4% of this age group had calcification: 13.5% of the patients with calcification were in this age group. All other age groups and data should be read like this which is described above. Three-hundred and four patients (36.3% of the overall sample) had bilateral calcification; 177 (21,17%) had unilateral calcification. Female patients with calcification were 34.21% of the sample, while males accounted for 23.32% (Table 2). Incidence of calcification among females was 63.9%, among males it was 50.25%. The Chi-square test were showed no statistical significant differences with respect to sex (p= 0.814), localization (p= 0.411) and age (p= 0.227).

Discussion

The SP is a long cylindrical cartilaginous bone from which the styloid, the styloglossus and the stylopharyhgeus muscles originates well as the stylohyoid and the stylomandibular ligaments. The SHL is a band of connective tissue, originating from the apex of the SP and is attached inferiorly to the lesser horn of the HB (1-3). Since the ligament is cartilaginous there is a potential for ossification of varying degrees. When a whole ligament ossifies from the SP down to the lesser

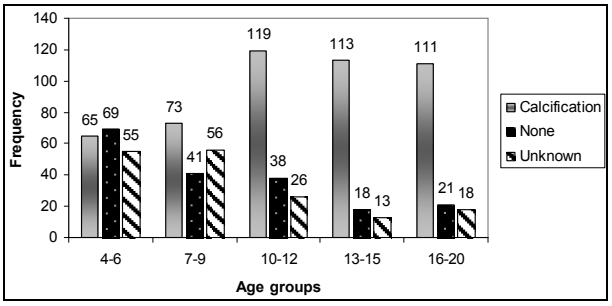

Figure 3. The distribution of the study population according to age showing incidence of calcification.

Table 1. Distribution of calcification according to age.

	Calcification	None	Unknown	Total
4-6				
Number	65	69	55	189
%	7,78	8,25	6,57	
% by age group	34,4	36,5	29,1	
% by involvement	13,5	36,9	32,73	
7-9				
Number	73	41	56	170
%	8,73	4,9	6,7	
% by age group	42,9	24,11	32,9	
% by involvement	15,17	21,92	33,33	
10-12				
Number	119	38	26	183
%	14,23	4,54	3,11	
% by age group	65,02	20,77	14,2	
% by involvement	24,74	20,32	15,47	
13-15				
Number	113	18	13	144
%	13,51	2,15	1,55	
% by age group	78,47	12,5	9,02	
% by involvement	23,5	9,62	7,73	
16-20				
Number	111	21	18	150
%	13,22	2,63	2,15	
% by age group	74	14	12	
% by involvement	23,07	11,22	10,71	
TOTAL	481	187	168	836
Percentage	57,53	22,36	20,01	100

horn, it forms a solid structure (1). Several authors were classified the presence of anatomic variations of the SP and ossification of the SHL (5,13,18,20) while the others examine SHL as calcified, not calcified and elongated (7,8,16). Mostly, the investigators tried to determine; the length of SP and SHL from radiographs, the variations in length with age and sex, the relationship of elongated SP and ossified SHL to symptoms of styloid and stylohyoid syndrome (1-26). Segmentation of the SP is a variation of normal structure and should not be mistaken for a fracture of the process (5,13). The fractures of this somewhat solid structure are seen in many occasions involving a sudden jerk of the head (e.g. in fights, traffic accidents) (1,27). Eagle in 1937, described the syndrome, identifying two forms based on the symptoms of his patients. The first category, corresponding to the properly called Eagle's syndrome or stylalgy, is characterized by a pharyngeal pain localized in the tonsillar fossa and sometimes irradiating to the HB (10). The second category, corresponding to the stylo-carotid syndrome, is characterized by persistent pain irradiating in the carotid territory. It was also noted that an elongated SP or an ossified SHL can impinge upon vital structures, and even cause difficulty endotracheal intubation associated with general anesthesia (1,10,14,17).

There are numerous studies were made about the length of SP and SHL (1,5,7,13,16,18,21). In this study no attempt was done in order to determine the length, but instead of this, it was deemed to conduct a study about calcification of SHL for Turkish children population. Previous studies have been made about calcification of SHL in children for foreign populations. O Carroll (8) analyzed the incidence of calcification in orthopantomographs of 479 patients. The patients' age range for the study was 4-78 years. In this study 142 patients were in the 0-20 age group. 55.63% of this age group was found as calcified.

Table 2. Distribution of calcification by sex.

	Calcification	None	Unknown	Total
Females				
Number	286	85	77	448
%	34,21	10,16	9,21	
% by sex	63,9	18,98	17,18	
% by involvement	59,46	45,45	45,83	
Males				
Number	195	102	91	388
%	23,32	12,2	10,88	
% by sex	50,25	26,28	23,45	
% by involvement	40,54	54,54	54,17	
TOTAL	481	187	168	836
Percentage	57,53	22,36	20,01	100

Omnell et al (7) studied on 600 patients who had received orthodontic care for minor malocclusions. They conducted a subsample in which the records from each patient included three cephalometric taken when the patients were between 8 and 12, 13 and 19, and 20 and 43 years old. Initially at 8-12 age group 58% of the sample were found calcified. Camarda et al (19) examined panoramic radiography of 150 patients who varied in age from 2 to 21 years which is similar with our study. Partial and whole ossifications were seen in 40.7% of the SP. MacDonald-Jankowski (13) also reported about calcified Stylohyoid complex in two different populations which was indicated as 12% and 23.6% for Londoners and Hong Kong Chinese. Ferrarion et al (16) studied the incidence of calcification of the SHL in orthopantomographs of 256 patients. The total incidence of calcification was noted to be high at 84.4%. They also noted the number and the length of calcification increased with age and there was no relationship to sex. Monsour (5) reported a series of 1200 patients in their study and they determined the most common variation was segmentation (37%) of SHL.

Besides these studies in foreign population, there were only few reports found in the literature for Turkish population. Erol (21) investigated 900 panoramic radiographs for elongated SP and found out 20 cases as extended 30 mm in length. 8 cases were bilateral elongated while 4 cases unilateral elongated. Ilguy et al (25) examined 860 panoramic radiographs. They identified 59 elongated SP and SHL in 32 patients (3.7%), most being bilateral. Gözil et al. (1) evaluated the computerized tomography images of 105 subjects for ossification of SHL. They classified SP and ossified SHL according to their shapes and lengths. Type D in their study was the calcified type which has a percent of 20.9% of their study population. In our study, 57.53% patients were found as calcified and we figured out that there is a sharp increase in incidence of calcification with starting from 10 years age group. In this study, although a slight sex predilection appeared for females, statistically it was found that sex is not a factor for calcification in this study. This finding is in agreement with the findings of previous studies (5,13,16) but in contrast to O Carroll's (8) study which is mentioned as a slight predilection for females but no statistical comparison was given in that study.

In conclusion, this study found that calcification of stylohyoid chain in most patients is established during childhood like the foreign populations in Turkish population. In addition, the calcification of stylohyoid chain increases rapidly in prepuberty period. Hence, other similar studies have to be made in order to investigate this finding detailed.

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