ความยาวกระดูกสไตลอยด์ที่ยาวผิดปกติจากภาพรังสีปริทรรศน์แบบดิจิทัล
Elongated Styloid Process Detected on Digital Panoramic Image

วิจิตรศักดิ์ โชลิตกุล[1], ชัยธร วิพันธ์พงษ์[2], มานา นราธิปกร[2], มัณฑนา ศักดิ์ชลาธร[2], นิรดา อินทร์สุข[2]
นิธิวัฒน์ จุลสินธนาภรณ์[2], ภัทรมน ภิญโญเมธากุล[2], ปวีณสุดา กณาพันธ์[2], พิสุทธิ์ พินิจวัฒน์[2], วริศรา ศุภณาฤกษ์[2]
[1]ศาสตราจารย์คลินิก คณะทันตแพทยศาสตร์ มหาวิทยาลัยรังสิต
[2]นักศึกษาทันตแพทยศาสตร์ชั้นปีที่ 6 คณะทันตแพทยศาสตร์ มหาวิทยาลัยรังสิต
Wichitsak Cholitgul[1], Chaiyathorn Vipanpong[2], Mana Naratippakorn[2], Manthana Sakchalathorn[2], Nirada Insook[2]
Nitiwat Junlasinthanaporn[2], Pattaramon Pinyometakul[2], Paweensuda Kanaphantu[2]
Phisut Phinichwathana[2], Varisara Suppanarurk[2]
[1]Clinical Professor, Faculty of Dental Medicine, Rangsit University
[2]Dental students, Faculty of Dental Medicine, Rangsit University

ซม. ทันตสาร 2558; 36(2) : 57-67
CM Dent J 2015; 36(2) : 57-67

บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาลักษณะภาพรังสีและคลินิกของความผิดปกติของกระดูกสไตลอยด์ที่ตรวจพบจากภาพรังสีปริทรรศน์แบบดิจิทัลในผู้ป่วยไทยกลุ่มหนึ่งที่มีอายุตั้งแต่ 20 ปีขึ้นไป

วัสดุและวิธีการ: ศึกษาจากภาพรังสีปริทรรศน์ของผู้ป่วยแบบย้อนหลังจำนวน 2100 ราย ที่มีอายุตั้งแต่ 20 ปีขึ้นไปทั้งสองเพศที่มาทำการตรวจรักษาที่คณะทันตแพทยศาสตร์ มหาวิทยาลัยรังสิต ช่วงปี 2548-2556 การศึกษากระทำโดยการดูรูปร่าง รูปแบบของความยาวกระดูกสไตลอยด์ที่ผิดปกติ และทำการวัดโดยใช้โปรแกรมคอมพิวเตอร์โรเมกซิส โดยมีนักศึกษาทันแพทย์จำนวนสองคนร่วมกันทำการสังเกตและการวัดภายใต้การดูแลของ

Abstract

Objective: The purpose of this study was to evaluate the clinical and radiological findings of elongated styloid processes that appear in panoramic images of the Thai population over 20 years of age.

Materials and Methods: The panoramic images of 2,100 patients over 20 years of age at Rangsit University, were studied. The configuration and dimension of the styloid processes were observed and measured by two observers. Demographic data, medical and dental history were also retrospectively recorded. Chi square test was used

Corresponding Author:

วิจิตรศักดิ์ โชลิตกุล
วท.บ. ทบ. อท. ศาสตราจารย์คลินิก คณะทันตแพทยศาสตร์
มหาวิทยาลัยรังสิต 12000

Wichitsak Cholitgul
Clinical Professor, Faculty of Dental Medicine,
Rangsit University, Patumthani 12000, Thailand
E-mail: ***wichitsak@rsu.ac.th***

รังสีทันตแพทย์ที่มีประสบการณ์มากกว่า 30 ปี การวัดและการศึกษาจะกระทำโดยผ่านจอมอนิเตอร์ ส่วนลักษณะทางคลินิกที่สัมพันธ์กับความยาวผิดปกตินั้นจะทำการตรวจย้อนหลังจากแฟ้มประวัติผู้ป่วย ข้อมูลต่าง ๆ จะถูกบันทึกและนำมาทดสอบค่าทางสถิติด้วยวิธีทดสอบไคสแควร์

ผลการศึกษา: ผู้ป่วยจำนวน 278 คนจะพบความยาวผิดปกติของกระดูกสไตลอยด์ โดยบางคนอาจพบข้างเดียวหรือพบทั้งสองข้างรวมกันทั้งสิ้น 442 ตำแหน่งคิดเป็นร้อยละ 10.52 และมักพบมากที่สุดในผู้ป่วยในช่วงอายุ 20-29 ปี ทั้งสองเพศ และพบผู้ป่วยชายมากกว่าผู้หญิงเล็กน้อย เมื่อทดสอบทางค่าสถิติพบว่าไม่มีความแตกต่างกันทั้งอายุและเพศอย่างมีนัยสำคัญทางสถิติ ความยาวของกระดูกสไตลอยด์ที่วัดได้จะอยู่ในช่วง 30.10-82.90 มิลลิเมตร โดยมีค่าเฉลี่ย 37.20 มิลลิเมตร ลักษณะรูปร่างที่พบส่วนใหญ่มีลักษณะเรียวเล็กร้อยละ 55.20 เป็นแท่งร้อยละ 31.45 และไม่สามารถกำหนดรูปร่างได้ ร้อยละ13.35 ตามลำดับ ส่วนอาการผิดปกติทางคลินิกที่มีความสัมพันธ์กับความยาวผิดปกติของกระดูกสไตลอยด์นั้นพบได้น้อยมาก.

สรุป: จากการศึกษาครั้งนี้สรุปได้ว่าความยาวผิดปกติของกระดูกสไตลอยด์จากภาพรังสีปริทรรศน์แบบดิจิทัลนั้นมีประมาณร้อยละสิบ ที่พบส่วนใหญ่ในประชากรอายุน้อย โดยส่วนมากจะเป็นเพศชายและความยาวตลอดจนรูปร่างที่ตรวจพบจะมีลักษณะหลากหลาย การตรวจพบความผิดปกติดังกล่าวจากภาพรังสีจะไม่มีความสัมพันธ์กับการที่ตรวจพบทางคลินิกแต่อย่างใด

คำสำคัญ: ความยาวผิดปกติของกระดูกสไตลอยด์ การถ่ายภาพรังปริทรรศน์ กลุ่มอาการอีเกิล

for the statistic analysis.

Results: Elongated styloid processes were observed in 278 individuals with 442 processes (10.52%) and mostly found in the age group 20-29 years and male patients were dominated. There was no statistically significant between the gender and age group. The length of the processes were varied from 30.10 millimeters to 82.90 millimeters (mean 37.20 millimeters). They displayed taper shape 55.20%, rod 31.45% and irregular 13.35%. Rarely cases were reported to have varieties of clinical findings.

Conclusion: From our study, the elongated styloid processes were found about 10% of the population that mostly presented in young population with male patients were dominated. They displayed varieties of configuration and length. Most of image findings were not related to clinical findings and systemic conditions.

Keywords: elongated styloid process, panoramic radiography, Eagle's syndrome

Introduction

Styloid process arises from the second brachial cartilage (Reichert cartilage) which is divided into four cartilaginous fragments.[1-3] Upper portion which develops into the styloid process, a central portion from which the styloid ligament in derived; a lower portion from which the lesser horn of the hyoid bone originates finally a basic portion from which part of the hyoid bone is formed.

The styloid process is a cylindrical, long cartilaginous bone, pointed bony process projecting downwards, forwards, and slightly medially located on the temporal bone and immediately in front of the stylomastoid foramen.[4-7] The tip of the process is situated laterally from the pharyngeal wall and immediately behind the tonsil fossa, and critically between the internal and external carotid arteries. Three muscles and two ligaments are attached to the styloid process.[7] The stylohyoid ligament itself extends from the tip of the styloid process to the lesser cornu of the hyoid bone. The stylomandibular ligament extended from the styloid process to the angle of the mandible. The three muscles includes the stylopharyngeous, stylohyoid and styloglossus. The nerve supply come from the glossopharyngeal, facial, and hypoglossal nerve, respectively.[8,9] Elongated styloid process is term defines a styloid process that longer than normal from symptomatic elongation of the styloid process or mineralization (ossification or calcification) of the stylohyoid ligament complete.[9] The average length ranges from 20-30 mm.[10] The styloid process length which is longer than 30 mm is considered to be elongated.[11] The styloid process elongation may cause symptoms like dull aching pain localized in either or both sides of the throat. The pain may be referred to the ear or mastoid region of the affected side during the face movement. It may cause pain on swallowing (dysphagia) or an abnormal sensation of foreign body in the pharynx. More uncommonly symptoms, such as tinnitus or otalgia may occur like TMJ pain and dysfunction. When these symptoms are presented it is call Eagle's syndrome. It is assumed that these signs and symptoms are due to compression of styloid process on some neural and vascular structures. In rare cases it may cause stroke from the compression of carotid arteries.

The elongated styloid process can be diagnosed by both physical and radiographic examinations. Panoramic radiography is the most common projection to detect an elongated styloid process.[7] Thus precise knowledge about the anatomy of both normal and abnormal styloid is important for clinicians, surgeons, and radiologists. In order to be able to detect diseases or abnormalities that are related to the patient with elongated styloid process and to be able to give proper treatment and enriching the patient's knowledge about their existing condition.

Furthermore, there are few studies of this important overlooked anatomical structure in Thailand. Hence, the aim of this study was to find the prevalence of elongated styloid process on and the other findings on panoramic radiographs. This finding is important in raising awareness of the dentists to recognize the abnormal length and morphology of styloid process which related to the clinical findings. In addition, the information from this study can also be used to supplemental differential diagnose with other diseases that have similar symptoms.

Materials and Methods

Digital panoramic radiographs of 2,100 patients with bilateral symmetry or unilateral of styloid processes were selected by purposive sampling. The clinical findings were collected retrospectively from the files of the patients during 2005-2013 at the

Department of Radiology, Faculty of Dental Medicine, Rangsit University. All data of the patients included past medical history, dental history, extraoral and intraoral examination. The total panoramic radiographs of the 2,100 patients with dental problems had originally been taken for routine examination and not for the elongation of styloid process. All patients had the radiographic examination with panoramic radiography in the same machine through out the study (Planmeca Oy, 0080 Helsinki, Finland).

The study was conducted according to the Human Ethics Guidelines approved by the institution, following which only those subjects were included for whom clinical examination and panoramic radiographs were prescribed as a part of a diagnostic work up.

Two of dental students evaluated the styloid processes that supervised by one experienced oral radiologist from panoramic radiographs via the computer monitor with the help of the measuring tools on the accompanying software (Romexis software version 2.4 R on Windows operating system). The dental students were informed to measure the length of the styloid processes two times in a period of one month and record the length in consensus. All data of the patients recorded including configuration, length and associated findings and fulfilled in the protocol. The calibration among the three viewers to view the images was made prior to the study by using standard reference radiographs. The dental students were informed to review the anatomical structures of the styloid process and the right position of styloid process in digital panoramic radiographs. The type of diseases and defects related to elongated styloid process were also reviewed and studied.

The criteria to determine the length of styloid process of over 30 mm. will be considered as elongated styloid process which measured the distance from the point where the styloid process left the tympanic plate to the tip of the process, regardless of whether or not the styloid process is segmented. The digital measurement of all styloid processes were conducted, discussed and reevaluated by two observers throughout the study. The configuration of the styloid process was also observed and types of the configuration are classified and adapted according to Langlais, et al 1995.[12] Data are presented as mean and standard deviation (SD) or as a percentage for categorical variables. The statistic analyses were performed using SPSS v.15.0 software (SPSS, Chicago, IL) and Chi-square test.

Characteristic of an elongated styloid processes were divided into two groups according to the calcification/ossification originated as either from the temporal bone or from hyoid bone with homogeneous radiopaque shadow was classified as continuous calcification/ossification whereas radiopacity shadow appeared in some part of stylohyoid ligament was classified as partially calcificataion/ossification (Figure 1A-1B).

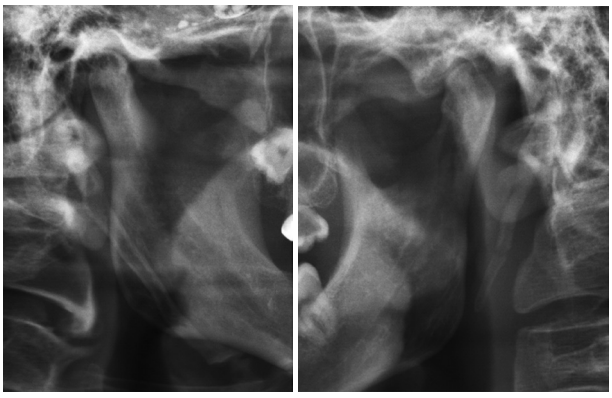

Figure 1 *Pattern of elongated styloid process found in this study. Continuous calcification or ossification (A) and partially calcification/ossification (B)*

รูปที่ 1 *ลักษณะของกระดูกสไตลอยด์ยาวผิดปกติที่พบในการศึกษาครั้งนี้ได้แก่ ลักษณะที่มีการสะสมหินปูนหรือเนื้อเยื่อกระดูกมีลักษณะต่อเนื่องกัน(A) และมีการสะสมหินปูนหรือเนื้อเยื่อกระดูกบางส่วน(B)*

Results

Panoramic radiographs of all 2,100 Thai patients with1405 male and 695 female patients including age groups are summarized in Table 1. The youngest patient was 20 and the oldest was 87 years old. The mean age of the patients was 42 (20-76) in male and 39 (20-87) in female. The largest group in this study was 20-29 years of age, followed by 40-49 and 50-59 years of age respectively. The findings of elongated of the styloid processes from panoramic images were found totally 442 sides (10.52%) from the overall study of 4,200 sides of the selected patients. The patients with age group of 20-29 are the most frequent findings (4.30%) and male patients were dominated compared to those the female patients and all data is presented in Table 2. There was no statistic significant between gender and age group with the Chi Square Test ($p>0.05$).

The number of 278 individuals having elongated styloid process with bilateral were found in 164 patients (59.00%) and unilateral were found in 114 patients (41.00 %) respectively. The findings of bilateral elongated styloid processes were found in male 98 patients, unilateral right in 32 and unilateral left in 32 with totally of 163 patients (58.63%). The female patients were found with the number of bilateral findings in 66 , unilateral right in 21 and unilateral left in 29 with totally of 115 patients (41.37%).

The length of the styloid processes appeared related to the age groups and gender are presented in Table 3.The length of styloid processes between 30-34 millimeters are the most frequent findings followed by the length between 35-39 millimeters. The shortest one was 30.10 millimeters and the longest one was 82.90 millimeters with the mean length of 37.20 millimeters (Figure 2).

Table 1 *Number of patients related to age group and gender (N=2100)*

ตารางที่ 1 *จำนวนผู้ป่วยที่จำแนกตามกลุ่มอายุและเพศของผู้ป่วยที่ทำการศึกษา (N=2100)*

Gender	Age group							Total
	20-29	30-39	40-49	50-59	60-69	70-79	≥ 80	
Male	635	144	235	201	134	45	11	1405 (66.89%)
Female	282	77	110	112	84	22	8	695 (33.11%)
Total	917	221	345	313	218	67	19	2100 (100%)

Table 2 *Number of elongated styloid processes found on panoramic images (N=4200)*

ตารางที่ 2 *ตัวเลขแสดงจำนวนความยาวผิดปกติของกระดูกสไตลอยด์ที่พบในภาพรังสีปริทรรศน์ (N=4200)*

Age group	Gender		Total
	Male	Female	
20-29	93 (2.20%)	88 (2.10%)	181 (4.30%)
30-39	33 (0.78%)	13 (0.30%)	46 (1.08%)
40-49	54 (1.29%)	25 (0.60%)	79 (1.89%)
50-59	45 (1.07%)	37 (0.88%)	72 (1.95%)
60-69	20 (0.48%)	12 (0.30%)	32 (0.78%)
70-79	14 (0.33%)	6 (0.14%)	20 (0.47%)
≥ 80	2 (0.05%)	0 (0.00%)	2 (0.05%)
Total	261 (6.20%)	181 (4.32%)	442 (10.52%)

The characters of an elongated styloid processes were also observed as continuously form were found in 381sites (86.20%) and partially were found in 61 sites (13.80%). The configuration as taper configuration were the most frequent findings found in 244 sites (55.20%) followed by rod shape in 139 (31.45%) and irregular shape in 59 sites (13.35%) respectively (Figure 3A-3C).

Table 3 *Length of styloid processes of both genders found on panoramic images (N=442)*

ตารางที่ 3 *จำนวนความยาวผิดปกติของกระดูกสไตลอยด์ที่พบในผู้ป่วยทั้งสองเพศ (N=442)*

Gender					
Length (mm.)	Male		Female		Total
	Right	Left	Right	Left	
30-34	65	66	31	41	203 (46.00%)
35-39	41	40	27	23	131 (29.60%)
40-44	17	15	10	16	58 (13.10%)
45-49	5	6	7	4	22 (5.00%)
50-54	-	5	1	2	8 (1.80%)
55-59	1	4	1	3	9 (2.00)
≥ 60	4	1	5	1	11 (2.50%)
Total	133 (30.10%)	137 (30.99%)	82 (18.55%)	90 (20.36%)	442 (100%)

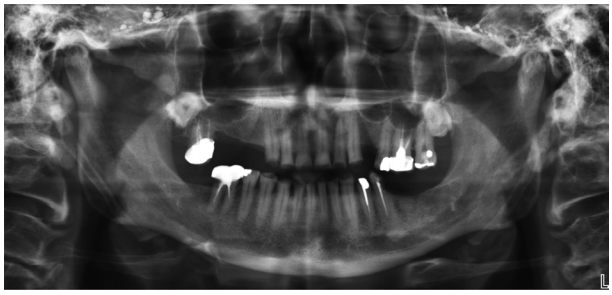

Figure 2 *The length of bilateral elongated styloid processes presented on both sides of the image measured on the right with 79.00 mm. and 82.90mm. on the left side.*

รูปที่ 2 *กระดูกสไตลอยด์ยาวผิดปกติที่พบทั้งสองข้างในผู้ป่วยรายเดียวกันที่วัดในข้างขวาได้ยาว 79.00 มิลลิเมตร และ ข้างซ้ายวัดได้ 82.90 มิลลิเมตร*

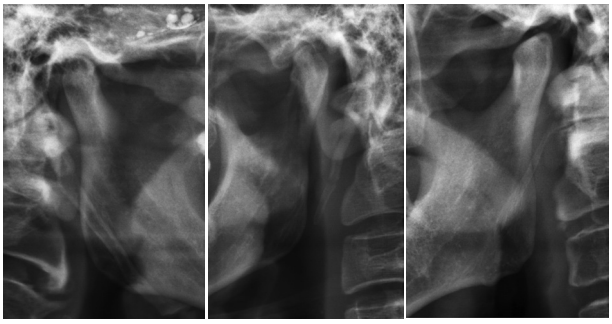

Figure 3 *Three characters of elongated styloid processes detected on panoramic images, taper (A) rod (B) and irregular shape (C).*

รูปที่ 3 *รูปร่างของกระดูกสไตลอยด์ยาวผิดปกติทั้งสามแบบที่ตรวจพบจากภาพรังสีแบบปริทรรศน์ได้แก่ รูปร่างเรียวเล็ก (A) เป็นแท่ง (B) และไม่สามารถบอกรูปร่างได้ (C)*

Table 4 *Clinical findings of patients with elongated styloid processes (N=278)*

ตารางที่ 4 *ลักษณะทางคลินิกของผู้ป่วยที่พบร่วมกับความยาวผิดปกติของกระดูกสไตลอยด์ที่ปรากฏในภาพรังสี (N=278)*

Clinical findings					
Age group	Hypertension	Hypotension	Headache	Cardiac Disease	Total
20-29	-	-	1	-	1
30-39	-	-	-	-	-
40-49	4	-	2	-	6
50-59	8	1	1	2	12
60-69	6	-	-	1	7
70-79	4	-	3	2	9
≥ 80	-	-	-	-	-
Total	22	1	7	5	35 (12.60%)

Retrospective Clinical signs and symptoms of the patients associated with the image findings of elongated styloid processes were recorded as hypertension were found in 22 patients followed by heart diseases in 5, head and neck migraine in 7, and hypotension is found only 1 patient. Number and type of the clinical findings appeared in overall 35 patients are shown in Table 4.

Discussion

Elongated styloid process is a term used since the publication by Eagle in reports concerning findings in both dentomaxillofacial and ear-nose-throat patients. This term denotes a styloid process exceeding its normal length. Eagle's definition was the normal styloid process measures between 25 to 30 millimeters. His method of measurement was not described, but his examples showed lateral radiographs of the skulls.[13] Today's reports concerning the styloid process of its length are mostly based on panoramic radiographs. However, the geometry does not correspond to that Eagle's method yet the values given in these studies relating to anatomy, clinical epidemiology or anthropology for normal and elongated styloid processes are similar to those proposed by Eagle. From the previous studies have shown that the elongated styloid processes were considered to be present when the measurement of 30 millimeters or more[7,13,14-18] and some study had a report of measurement of 40 millimeters or more.[10]

In our study, the findings of elongated of the styloid process was only 13.80 % and mostly presented in the age group of 20-29 that relatively similar to some studies[19] and quite different from than those previous studies.[5,20-21] Also in this study, it was observed that there was an increase in the length of the styloid process in the patients with the age group of 20-29 years. These findings were not in consistent with studies conducted by various authors indicated that the increase of the length of styloid process with an increase in the age.[5,22] The different findings may be due to several factors, such as dissimilarities in the sampling criteria, variations in image interpretation and diagnostic criteria and influence of the differences geographical areas including lifestyles, nutrition, habits and races. Our study was carried out in the university campus which most subjects were university students, staff and employee included for whom clinical examination and panoramic radiographs were prescribed as a part of a diagnostic routine check up. So the main groups were the young to middle age patients. There was also something to be concerned about using panoramic machine. Accurate determination using two-dimensional radiographic procedures can be difficult due to projection geometry considerations and patient positioning. Panoramic radiography may distort the dimensions of styloid process and magnification of the radiographic image may vary with the angulations of the process itself.[23] Therefore, a simple measurement in millimeters is not a suitable criterion due to the radiologic factors involved. Taking this factor into consideration, to determine the length of styloid process, ruler measurement was not chosen.[4]

The elongation of the styloid processes in the radiographs was determined according to the method proposed by Ferrario et al.[23] However, the reliability of the measurement from panoramic radiographs can be concluded that there was some more magnification in the horizontal aspect than the vertical aspect.[24] Naturally the styloid process lines medial angulations and superimposition of other skeletal structures, some errors may occur when measuring the length of the styloid.

Our study showed that for elongated styloid pro-

cess, 58.63 % of cases were bilateral and 41.37% of cases were unilateral, which was different from the previous findings in which a bilateral elongation in 75% and a unilateral elongation in 25% of cases were reported.[5,19] However the presented of bilateral or unilateral elongated styloid processes are not the important role to develop the various clinical signs or symptoms. In our study, no statistically significant difference was observed between genders in the unilateral or bilateral elongation of the styloid process. This was in agreement with the reports of previous studies.[23,25,26] The hypothesis from some study suggested that elongation of the styloid process had no effect on mandibular protrusive movements[5], which was similar to the findings of some study.[4]

The average length of the styloid process in our study is 37.20 millimeters that quite similar to the previous studies[7,17,18] and some what longer than the other study in Thailand that report of average measurement of 34.45 millimeters.[16] In contrary, the average length in our study was shorter than some report.[10] In addition, our study found that most of the calcification of the styloid ligament from our study begin and run downward from the base of the skull with some cases begin at the lesser horn or lesser canu of the hyoid bone and in fewer still in the central area of the ligament.

Furthermore, our study also found that the degree of mineralization continuously originated from the styloid process along the stylohyoid ligament so called taper and rod shapes were found in 86.10% and partially mineralization in either in the central or from the lesser canu of hyoid bone were found only 13.80.%. This finding quite different from the other study that reported Type I with "partially mineralized" styloid process was observed more frequently in the population studied.[5] There was no exactly explanation about the degree and site of the mineralization happened on the styloid process, ligament or the lesser canu.

The length of an elongated styloid process is not the criteria for the development of the signs or symptoms of styloid process syndrome. An awareness of clinical and radiologic presentation of styloid process elongation is important to all health practitioners involved in the diagnosis and treatment of head and neck pain. Apart from the Eagle syndrome, other clinical manifestations that may result from calcified styloid process are glossopharyngeal neuralgia, carotidynia, pulsatile tinnitus, dysphonia, and globus pharyngeus. The pathophysiology behind the pain due to an elongated styloid process was found to be compression of the neural elements such as the glossopharyngeal nerve, lower branch of the trigeminal nerve, and/or the chorda tympani, by the elongated styloid process. The compression further leads to proliferation of granulation tissue that causes continuous pressure on surrounding structures and results in pain.[27]

From our study, we found that the elongated styloid processes were not related to the clinical signs and symptoms of the patients as they did not developed head and neck pain or the tenderness. The clinical findings as hypertension were found with a small number of the population in only 22 cases that most presented in the patients over 40 years of both genders. So we suggested that an elongation of the styloid process may not be the important criteria to make the decision of Eagle or stylohyoid syndrome. There was a report in the previous study to indicate the significant relationship between the length of styloid process and high blood pressure.[28] This condition can be due to the anatomy of the area, for example, compression of the external carotid artery of symptomatic patients was viewed on angiographic images.[29] In addition, Oztas et al 2012[30] reported

that there was a significant relation between systemic disorders (e.g., hypertension, heart disease) and styloid ligament calcification. However, in a study by Okabe et al 2006[31] reported that there was no significant correlation between blood pressure and the elongation of the styloid process. The same study also reported that there was no significant correlation between the frequency of the heartbeat and the elongation of the styloid process which agrees with the findings. Since the muscle tension from occlusal disarrangements and changes in bone height in partial or complete edentulous patients can be a probable factor in the incidence of elongated styloid process,[17] the association between the number of teeth present in the mouth and the elongation of the styloid process was studied, but no significant correlation was found between the two, which was consistent with the study conducted by Okabe et al 2006.[31]

Conclusion

From our study, the elongated styloid processes were found about 10% of the panoramic images that mostly presented in young population with male patients were dominated. They displayed varieties of configuration length and degree of mineralization. Most of image findings were not related to clinical findings and systemic conditions excepted for some patients with signs and symptoms of systemic condition. Even there were small numbers of patients of elongated styloid processes related to the systemic conditions, this finding is important in raising awareness of the dentists to recognize in clinical practice. Therefore, further studies and large samples are also needed to clarify the etiology of this defect. Panoramic radiography is useful for detection of an elongated styloid process and /or ossification of stylohyoid ligaments in patients with or without clinical signs and symptoms.

References

1. Fini G, Gasparini G, Filippini F, Becelli R, Marcotullio D. The long styloid process syndrome or Eagle's syndrome. *J Craniomaxillofac Surg* 2000; 28: 123-127.
2. Das S, Suhaimi FH, Othman F, Latiff AA. Anomalous styloid process and its clinical implications. *Bratis Lek Listy* 2008; 109: 31-33.
3. Shigematsu H, Hoshino M, Oku Y, Kikuchi K, Kusama K, Sakashita H. A case of styloid process syndrome with complete bilateral ossification of the stylohyoid ligament. *J Oral Maxillofac Surg Med Pathol* 2013; 25: 143-146.
4. 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: 491-494.
5. Bagga MB, Kumar C A, Yeluri G. Clinico-radiologic evaluation of styloid process calcification. *Imaging Sci Dent* 2012; 42: 155-161.
6. Lavine MH, Stoopack JC, Jerrold TL. Calcification of the stylohyoid ligament. *Oral Surg Oral Med Oral Pathol* 1968; 25: 55-58.
7. Sudhakara RR, Kiran CS, Madhavi NS, Raghavendra MN, Satish A. Prevalence of elongation and calcification patterns of elongated styloid precess in South India. *J Clin Exp Dent* 2013; 5: 30-35.
8. Marano PD, Fenster GF, Gosselin CF. Eagle's syndrome necessitating bilateral styloid amputation. *Oral Surg*1972; 25: 874-878.
9. Feldman VB. Eagle's syndrome: a case of symptomatic calcification of the stylohyoid ligaments. *J Can Chiropr Assoc* 2003; 47: 21-27.

10. Balcioglu H A, Kilic C, Akyol M, Ozan H, Kokten G. Length of the styloid process and anatomical implications for Eagle's syndrome. *Folia Morphologica* 2009; 68: 265-270.
11. Keur JJ, Campbell JP, McCarthy JF, Ralph WJ. The clinical significance of the elongated styloid process. *Oral Surg Oral Med Oral Pathol* 1986; 61: 399-404.
12. Langlais RP, Langland OE, Nortjé CJ, editors. *Diagnostic Imaging of the jaws*. Malvern: Williams and Wilkins, 1995: 617-648.
13. Eagle WW. Symptomatic elongated styloid process; report of two cases of styloid process-carotid artery syndrome with operation. *Arch Otolaryngol* 1949; 49: 490-503.
14. Basekim CC, Mutlu H, Gungor A, Silit E, Pekkafali Z, Kutlay M, et al.Evaluation of styloid process by three dimensional computed tomography. *Eur Radiol* 2005; 15: 134-139.
15. Jung T, Tschernitschek H, Hippen H, Schneider B, Borchers L. Elongated styloid process: when is it really elongated? *Dentomaxillofac Radiol* 2004; 33: 119-124.
16. Pichetshote K, Bowornwaraporn B, Cholitgul W. *Clinical and radiological Findings of Elongated Styloid Process*. A reseach submitted in fullfillment for the degree of Doctor of Dental Surgery, Faculty of Dentistry, Chulalongkorn University, 2011.
17. Scaf G, Freitas DQ, Loffredo Lde C. Diagnostic reproducibility of elongated styloid process. *J Appl Oral Sci* 2003; 11: 120-124.
18. Bozkir MG, Boga H, Dere F. The evaluation of elongated styloid process in panoramic radiographs in edentulous patients. *Turk J Med Sci* 1999; 29: 481-485.
19. More CB, Asrani MK. Evaluation of the styloid process on digital panoramic radiographs. *Indian J Radiol Imaging* 2010; 20: 261-265.
20. Gokce C, Sisman Y, Ertas ET, Akgunlu F, Ozturk A. Prevalence of styloid process elongation on panoramic radiography in the Turkey population from cappadocia region. *Eur J Dent* 2008; 2: 18-22.
21. Phulambrikar T, Rajeshwari A, Rao BB, Warhekar A, Reddy P. Incidence of elongated styloid process: a radiographic study. *J Indian Acad Oral Med Radiol* 2011; 23: S344-S346.
22. Reddy RS, Kiran CH, Madhavi NS, Raghavendra MN, Satish A. Prevalence of elongation and calcification patterns of elongated styloid process in South India. *J Clin Exp Dent* 2013; 5: 30-35.
23. Ferrario VF, Sigurta D, Daddona A, Dalloca L, Miani A, Tafuro F, et al. Calcification of the stylohyoid ligament: incidence and morphoquantitative evaluations. *Oral Surg Oral Med Oral Pathol* 1990; 69: 524-529.
24. Carter LC. Soft tissue calcification and ossification. In White SC, Pharoah MJ, editors. *Oral Radiology-Principles and Interpretation*. Saint Louis : Mosby-Elsevier, 2009: 526-540.
25. 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.
26. Omnell KA, Gandhi C, Omnell ML. Ossification of the human stylohyoid ligament: a longitudinal study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1998; 85: 226-232.
27. Ceylan A, Koybasioglu A, Celenk F, Yilmaz O, Uslu S. Surgical treatment of elongated styloid process: experience of 61 cases. *Skull Base* 2008; 18: 289-295.

28. Ghafari R, Hosseini B, Shirani A M, Manochehrifar H, Saghaie 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* 2012; 9 (Suppl): S52-S56.
29. Ohtsuka K, Tomita H, Murakami G. Anatomical study of the tonsillar bed-hetopographical relationship between the palatine tonsil and the lingual branch of the glossopharyngeal nerve. *Nihon Jibiinkoka Gakkai Kaiho* 2002; 97: 1481-1493.
30. Oztas B, Orhan K authors. Investigation of the incidence of stylohyoid ligament calcification with panoramic radiographs. *J Investig Clin Dent* 2012; 3: 30-35.
31. 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: 191-199.

HEINE QUALITY
MADE IN GERMANY

HEINE Binocular Loupes and Illumination

Comfort, Performance, Flexibility.

HIGH MAGNIFICATION AND SHARP, CRISP IMAGES WITH POWERFUL LED ILLUMINATION

HEINE binocular loupes set a benchmark for design, hightech materials and precise manufacturing methods. They provide exceptional image quality and edge-to-edge definition and a large field of view.

Various magnifications (from 2X to 6X), working distances, wearing modes (unique S-Frame, Lightweight Headband and Headband Professional L) and LED Loupe Light illumination systems are available. They provide homogenous, reflex-free illumination even in deep cavities. State-of-the-art LED technology and design!

HEINE Binocular Loupes are used in many disciplines: e.g. General Medicine, Dermatology, Surgery, Cosmetic Surgery, Neurosurgery, ENT, Ophthalmology, Veterinary Medicine, Dentistry etc.

HEINE

ACCORD
CORPORATION LIMITED
A HENRY SCHEIN® COMPANY
"Together in partnership, we deliver the best in dentistry"

บริษัทแอคคอร์ด คอร์ปอเรชั่น จำกัด
33/2-8 ซ.รองเมือง 4 แขวงรองเมือง
เขตปทุมวัน กรุงเทพฯ 10330
โทร. 0 2613 8081-90 แฟกซ์: 0 2216 3235
www.accorddental.com