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Investigation of the incidence of stylohyoid ligament calcifications with panoramic radiographs

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Abstract

Aim: This study examined and classified patients who were treated at the Faculty of Dentistry at Ankara University Dentistry to determine the incidence of different types of stylohyoid ligament calcification (SLC) using panoramic radiographs. In addition, it also assessed the possible causative symptoms and Eagle's syndrome in cases of styloid process elongation.

Methods: The study consisted of 2000 patients (1161 females and 839 males), aged 3–88 years, who were treated at our clinic. The panoramic radiographs were evaluated as part of this study.

Results: Panoramic radiography examination revealed SLC in 1350 patients. Both-sided (right and left), type 1 SLC was observed in 345 patients, while types 2–4 were found in 203, 418, and 384 patients, respectively.

Conclusion: The incidence of SLC was found to be higher in female patients when compared to male patients. In addition, calcifications were seen more often at age 50–59 years, and the incidence of calcification was found to increase with age. Two Eagle's syndrome cases were diagnosed among a total of 2000 patients. Finally, it was determined that the incidence of calcified stylohyoid ligament is higher in patients with systemic diseases.

Introduction

The stylohyoid apparatus (or stylohyoid complex) consists of the styloid process, the stylohyoid ligament, and the lesser horn of the hyoid bone. The styloid process is slender, pointed, approximately 2.5 cm in length, and projects downwards and forwards from the under surface of the temporal bones inferior aspect.[1]

Several theories on the etiology of the styloid process have been reported. Some authors suggest degeneration of the ligament with the deposition of the calcium salts in the fibrous tissue,[2,3] while others believe that malformation is a consequence of the direct ossification of the cartilaginous cells remaining in the ligament of adult patients.[4]

Coincidentally, stylohyoid ligament calcification (SLC) is generally diagnosed on panoramic radiographs. Pain in the region of the tonsillar fossa after palpation is usually an additional symptom for the diagnosis of SLC.[5]

However, it is not always possible to identify the different types of styloid processes on panoramic radiographs, as they are masked by other structures. Panoramic examination shows that the length of the styloid process varies owing to discrepancies of the panoramic units, usage, as well as patient positioning. Overlapping might occur posteriorly by the upper cervical vertebrae, and anteriorly by the mandible. Furthermore, misdiagnoses might also occur.[6,7]

The most useful imaging techniques that can demonstrate the styloid process include panoramic radiography, posteroanterior skull view, lateral cephalogram, lateral oblique mandible view, Towne's view, computed tomography, and magnetic resonance scanning.[8]

The symptoms and the relative syndrome were first described by Lucke in 1870.[9]

However, Eagle[10] was the first to provide a comprehensive description of the syndrome, linking it to the

elongated styloid process, which was later called Eagle's syndrome. Eagle estimated that approximately 4% of the population had SLC, and that only 4% of these people showed symptoms. The syndrome is reported more frequently in women than in men, with an age distribution greater than 40 years.[11,12]

Eagle's syndrome is confirmed through palpation of the tonsillar fossa, temporary relief after local anesthesia infiltration, and radiographic findings that reveal SLC.[2,12,13] It is always accompanied by symptoms that vary from dysphagia, foreign body sensation, throat pain, ipsilateral otalgia, headache, neck pain during rotation, pain during tongue extension, and facial and carotid pain.[14]

Eagle[10] presented two possible clinical expressions of the syndrome: classical stylohyoid syndrome and stylocarotid syndrome.

The classical stylohyoid syndrome occurs almost always after tonsillectomy. It is characterized by dull and persistent pharyngeal pain (pharyngodynia), especially in the tonsillar fossa, with radiation to the ipsilateral ear. In addition, it is accompanied occasionally by dysphagia and painful swallowing (odynophagia), foreign body sensation, as well as facial and/or cervical pain.[2,8,11] The pain is rarely intense.

However, the stylocarotid syndrome is not correlated with tonsillectomy. It occurs whenever the stylohyoid apparatus compresses the internal and/or external carotid arteries, and especially the perivascular sympathetic fibers.

It is characterized by cervical pain that arises when the internal carotid artery is compressed, provoked, or aggravated by rotation and compression of the neck. In addition, it radiates to the areas vascularized by the ophthalmic artery, besides involving the supraorbital and the parietal regions. On the contrary, if the external carotid artery is irritated, the long styloid process or Eagle's syndrome pain radiates to the infraorbital region. In addition, drowsiness and visual disorders might also be present.[2,8,11]

The differential diagnosis of Eagle's syndrome includes disorders that cause cervicofacial pain, such as trigeminal, sphenopalatine, glossopharyngeal, and laryngeal nerve neuralgias, myofascial pain, mastoiditis, otitis, temporal arthritis, dental pain, chronic tonsillitis or pharyngitis, submandibular sialadenitis or sialolithiasis, esophageal diverticulosis, benign or malignant neoplastic disease, and migraine.[8,11]

The vagueness of the symptoms and the infrequent clinical observations are often misleading. These patients might incidentally be seen by a surgeon, dentist, neurologist, or psychiatrist. The wide range of symptoms of Eagle's syndrome reflects the anatomic diversity associated with the styloid process and its surrounding structures.[8]

Eagle's syndrome can be treated surgically, as well as non-surgically. A pharmacological approach by transpharyngeal infiltration of steroids or anesthetics in the tonsillar fossa has been used. However, styloidectomy is the treatment of choice.[15] The elongated styloid process can be excised via intraoral or external approaches.[8,16]

This present study examined and classified patients treated at the Faculty of Dentistry at Ankara University (Ankara, Turkey) to determine the incidence of different types of SLC using panoramic radiographs. In addition, the study is also assessed the possible causative symptoms and Eagle's syndrome in cases of styloid process elongation.

Materials and methods

The clinical study consisted of 2000 patients (1161 females and 839 males) treated at the Faculty of Dentistry at Ankara University. The routinely-taken panoramic radiographs following clinical examination were evaluated by the same radiologist, who participated in the present study, according to the O'Carroll and Jackson classification.[17] Subsequently, the patients were asked questions regarding the clinical symptoms and anamnesis of SLC and Eagle's syndrome.

The panoramic radiographs of the patients were obtained at 60–80 kVp and 4–12 mA with Planmeca Proline CC (Helsinki, Finland). The films were processed using an automatic processor (Extra-x Velopex; Medivance Instruments, London,UK), with a fresh solution (Eastman Kodak Company, Rochester, NY, USA) mixed according to the manufacturer's instructions.

This study used the O'Carroll and Jackson classification[17] of styloid process calcifications to create a classification model for grading the SLC (Figure 1): (a) type 1, SLC is higher than mandibular foramen (bilateral); (b) type 2, SLC is aligned with mandibular foramen (bilateral); (c) type 3, SLC is lower than mandibular foramen (bilateral); and (d) type 4, SLC has different lengths for the left and the right sides of the patient (including all unilateral calcifications).

The data were analyzed using the SPSS 11.5 program (SPSS, Chicago, IL, USA). The differences were evaluated using the χ^2 and ANOVA tests (significance level was set at $P \leq 0.05$).

Results

This study was performed on 2000 patients, including 1161 (58%) females and 839 (42%) males aged 3–88 years. SLC was observed in the panoramic radiographs of 1350 (67.5%) patients, including 792 females and 558 males. Both-sided (right and left), types 1–4

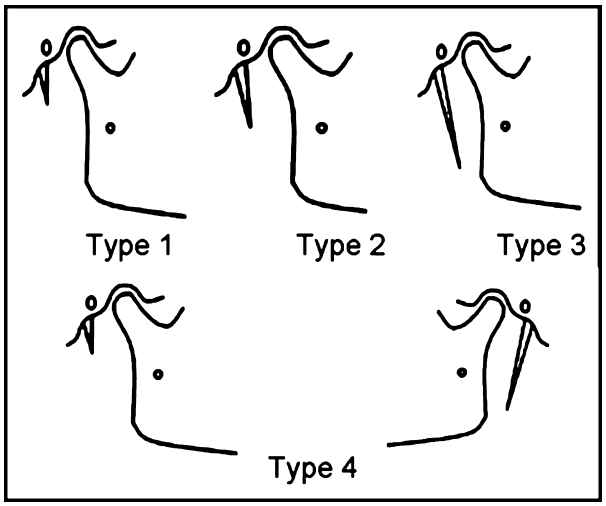

Figure 1. Classification of styloid process calcifications.

SLC were found in 345 (17.2%), 203 (10.1%), 418 (20.3%), and 384 (19.2%) patients, respectively. Types 1–4 SLC included 180 female and 165 male patients, 125 female and 78 male patients, 253 female and 165 male patients, and 234 female and 150 male patients, respectively.

Eagle's syndrome was reported in only two of the 2000 patients who participated in the present study.

The first patient was a 42-year-old female presenting with widespread pain on her right maxilla. Her medical history indicated that she had hypertension and artrosis. Clinical examination for the diagnosis of Eagle's syndrome indicated that the patient had not undergone tonsillectomy. Patient anamnesis revealed that the patient complained of head and cervicofacial pain, painful neck movements, sensation of foreign body in the throat, tinnitus, and otalgia. However, there was no pain during swallowing. The patient also had a cough and irritation in the throat when eating crusty and solid foods. After radiographic examination, type 4 SLC was observed to reach the hyoid while conducting panoramic radiography. Palpation in the tonsillar fossa resulted in pain, which confirmed the diagnosis of Eagle's syndrome.

The patient was directed to the otolaryngologist for surgical removal of the elongated styloid process through an extraoral approach. After a period of 6 months under controlled examination, the patient was declared symptom free (Figure 2).

The second patient with Eagle's syndrome was a 50-year-old female presenting with chronic headache. The patient's medical history revealed hypertension.

All the symptoms, except the presence of pain during swallowing, were the same as those for the first patient.

Figure 2. Panoramic view of the first patient with Eagle's syndrome.

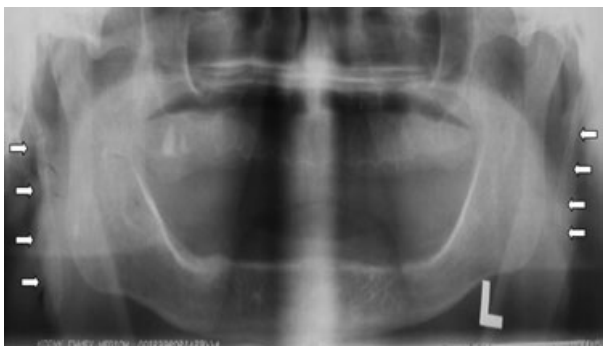

Figure 3. Panoramic view of the second patient with Eagle's syndrome.

Type 4 SLC was observed to reach the hyoid while conducting panoramic radiography. Palpation in the tonsillar fossa resulted in pain, which confirmed the diagnosis of Eagle's syndrome. The patient was directed to the otolaryngologist for surgical removal of the elongated styloid process through an extraoral approach. After a period of 6 months under controlled examination, the patient was declared symptom free (Figure 3).

The distribution of the SLC types with respect to age and sex is shown in Tables 1 and 2, respectively.

A statistically-significant difference between age and SLC can be seen ($P \leq 0.05$), as can the incidence of calcification increasing with age. The incidence of SLC in females was found to be higher when compared to males ($P \geq 0.005$).

The distribution of the SLC types by varied systemic disorders is shown in Table 3. The statistically-significant relation between the presence of a systemic disease and the SLC ($P \leq 0.005$) is shown in Table 4.

However, there is no statistically-significant difference between the sides (right and left) of the SLC and sex ($P \geq 0.05$).

Table 1. Distribution of stylohyoid ligament calcification (SLC) types according to age

Age (years)	SLC (*n*)	Type 1	Type 2	Type 3	Type 4	Total
0–9	87	2	1	4	6	100
10–19	118	35	8	25	49	235
20–29	116	69	40	69	72	366
30–39	83	50	40	67	63	303
40–49	103	82	43	92	82	402
50–59	84	62	48	105	69	368
60–69	43	32	15	39	34	163
70–79	16	10	7	17	9	59
80–89	0	3	1	0	0	4
Total	650	345	203	418	384	2000
						$P = 0.000$

Table 2. Distribution of stylohyoid ligament calcification (SLC) types according to sex

Sex	SLC (*n*)	Type 1	Type 2	Type 3	Type 4	Total
Male	281	165	78	165	150	839
Female	369	180	125	253	234	1161
Total	650	345	203	418	384	2000

Table 3. Distribution of stylohyoid ligament calcification (SLC) types according to varied systemic disorders

Systemic disorders	SLC (*n*)	Type 1	Type 2	Type 3	Type 4	Total
Absent	487	248	149	273	277	1434
Goiter	13	6	4	11	12	46
Heart disease	19	13	3	15	8	58
Hypertension	36	29	18	43	21	147
Diabetes mellitus	12	10	6	9	6	43
Goiter + hypertension	6	0	2	5	3	16
Heart + hypertension	4	7	3	2	7	23
Hypertension + diabetes mellitus	14	5	4	7	7	40
Total	591	318	189	368	341	1807

Table 4. Distribution of stylohyoid ligament calcification (SLC) types according to the presence of a systemic disorder

Systemic Disorder	SLC (*n*)	Type 1	Type 2	Type 3	Type 4	Total
Absent	487	248	149	273	277	1434
Present	163	97	54	145	107	566
Total	650	345	203	418	384	2000
						$P = 0.017$

Discussion

Dentists have become aware of SLC because of the widespread use of panoramic radiographs in recent dental curricula. The normal styloid process length is approximately 20–30 mm. Elongation of the styloid process can be assumed if either the styloid process or the adjacent stylohyoid ligament ossification shows an overall length in excess of 30 mm.[12,18] The prevalence of the styloid process elongation has been reported to be 4%; however, only a small subgroup of these patients became symptomatic (4–10.3%).[19]

O'Carroll and Jackson investigated SLC in 479 patients using panoramic radiographs, and maximal calcification was observed (119 patients) during the 20–29-year period.[19] In accordance with the present study, it was found that the incidence of SLC increases with age.

Ferrario *et al.*[4] analyzed 286 orthopantomographs to study the incidence of calcification of the stylohyoid ligament. The results obtained indicated that the number and the length of calcifications increase with age. The total incidence of calcifications was noted to be high at 84.4%. Furthermore, there was a difference between sex and SLC incidence. Of the patients with SLC, 90 (22.5%) were males, while 150 (37.5%) were females.

Rizatti-Barbosa *et al.*[20] investigated the prevalence of the stylohyoid ligament complex elongation in the panoramic radiographs of 2252 patients in an adult, partially-edentulous Brazilian population of both sexes. A calcified complex was found in 451 of the 2252 patients. A majority of these calcified complexes ($n = 248$, 54.9%) were bilateral. The results obtained suggest that an anatomical variant of the stylohyoid ligament complex was more frequent in the elderly female population, although this abnormality was present among both sexes. It was observed that there was a greater tendency for the abnormality to be present in patients 60–79 years of age. These findings are similar to those of the present study.

Jankowski[21] reviewed the panoramic radiographs of 1662 patients of different races. It was observed that there was no difference in the prevalence of an elongated styloid process (7.8% in Londoners and 8.6% in Hong Kong Chinese). In addition, no significant difference was found in age for an elongated styloid process. A total of 567 (34%) males and 1063 (63%) females showed signs of SLC.

Okabe *et al.*[22] evaluated the clinical significance and the variation of a calcified stylohyoid complex associated with advanced calcification, as detected on panoramic radiographs, for 659 patients of 80 years of age. Of the patients, 262 (39%) were males and 397 (61%) were females.

Ghosh and Dubey[23] operated 35 symptomatic patients with an established diagnosis of elongated styloid process

during the 20-year period using the intraoral trans-tonsillar approach. Of these, 20 were bilateral and 15 were unilateral elongations, and 18 were males and 17 were females. The largest distribution of patients based on age was seen in the fifth decade of life. Pain in the throat was most frequently encountered as the presenting complaint.

Camarda *et al.*[24] analyzed the panoramic radiographs of 150 patients aged 2–21 years in the pedodontia department. Here, SLC was seen more often in the 10–15-year age group. There was no statistically-significant difference between sex and the frequency of SLC. In the present study, 130 calcifications were found in the 0–19-year age group.

Thus, SLC could be observed in every age group.

In the present study, the results indicated that there was a statistically-significant relation between systemic disorder entity and SLC ($P \leq 0.05$). Systemic diseases that occur mainly with progressing age are parallel to increasing SLC. The number of investigated cases related to SLC and systemic disorder must be increased to obtain more definite results.

It is important to note that an elongated styloid process does not necessarily signify Eagle's syndrome, as the majority of individuals exhibiting this anatomical anomaly experienced no symptoms.

Alternatively, the possibility of Eagle's syndrome should be considered when handling cases of cervical pain; however, as this is often excluded in such cases, it results in an underdiagnosis. Consequently, it leads to an underestimation of the incidence of this syndrome. Patients misdiagnosed with Eagle's syndrome might undergo unnecessary treatments; some patients might even undergo various surgical procedures, including serial dental extractions, tuberosity reductions, alveoplasties, and temporomandibular arthroscopies.[25] Thus, it is important for the dental practitioner to be aware of this anomaly and its anatomic basis.

The anatomical regions of the stylohyoid ligament should not be overlooked in the panoramic radiographs, and the clinical findings obtained from the patients should be carefully evaluated in terms of Eagle's syndrome.

The results obtained in the present study suggest the following: (a) although SLC can be observed in every age group, the incidence of calcification increases with age; (b) the incidence of SLC in females is found to be higher when compared to males; (c) SLC on panoramic radiographs can be unrelated to Eagle's syndrome. Thus, for the diagnosis of Eagle's syndrome, radiographic diagnosis alone is inadequate. It is crucial that clinical diagnosis is also performed, in addition to finding the entity of SLC; and (d) panoramic radiography must be carefully evaluated for SLC analysis in patients with systemic disorders.

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