PREVALENCE OF MORPHOLOGICAL ALTERATIONS OF THE STYLOID PROCESS IN PATIENTS WITH TEMPOROMANDIBULAR JOINT DISORDER*

Simone Maria Ragone Guimarães[1], Antonio Carlos Pires Carvalho[2], Josemar Parreira Guimarães[3], Marden Batista Gomes[4], Mariana de Mello Melquíades Cardoso[4], Henrique Nogueira Reis[4]

Abstract **OBJECTIVE: To assess radiographically the prevalence of morphological alterations of the styloid process in patients with temporomandibular joint disorders. MATERIALS AND METHODS: We have analyzed 1,500 panoramic x-ray films of temporomandibular joint from both male and female patients with no age limit, who were attended in the Service of Temporomandibular Joint Disorder of Faculty of Odontology at Universidade Federal de Juiz de Fora, MG, Brazil, in the period between 1997 and 2003. RESULTS: Eighty-three (5.53%) of the analyzed patients (74 female and 9 male), predominantly in the age range between 41 and 50 years (32.5%), presented with, at least, one of the joint sides with morphological alteration of the styloid process. As far as the type of styloid process in concerned, 113 elongated, 21 pseudoarticulated and 19 segmented were observed. Also, it was noticed that the morphological alterations of the styloid process develop in a symmetrical fashion. CONCLUSION: In individuals with temporomandibular joint disorder, styloid process alterations occur symmetrically and in a different way for each patient, independently from sex and age.**
Keywords: Styloid process; Temporomandibular joint disorder; Radiography.

Resumo *Prevalência de alteração morfológica do processo estilóide em pacientes com desordem temporomandibular.* **OBJETIVO: Avaliar, radiograficamente, a prevalência de alterações morfológicas do processo estilóide em pacientes com desordens temporomandibulares. MATERIAIS E MÉTODOS: Foram analisadas 1.500 radiografias panorâmicas da articulação temporomandibular de pacientes de ambos os sexos e sem limitação de idade, que foram atendidos pelo Serviço de Desordem Temporomandibular da Faculdade de Odontologia da Universidade Federal de Juiz de Fora, MG, no período de 1997 a 2003. RESULTADOS: Oitenta e três (5,53%) dos pacientes da amostra apresentaram pelo menos um dos lados da articulação com alteração morfológica do processo estilóide, sendo 74 do sexo feminino e 9 do sexo masculino, concentrados na faixa dos 41 a 50 anos de idade (32,5%). Com relação ao tipo morfológico do processo estilóide, verificaram-se 113 alongados, 21 pseudo-articulados e 19 segmentados. Constatou-se, também, que as alterações morfológicas do processo estilóide desenvolvem-se de forma simétrica. CONCLUSÃO: Em pacientes com desordem temporomandibular as alterações do processo estilóide ocorrem de forma diferenciada e de maneira simétrica em cada paciente, independentemente do sexo e da idade.**
Unitermos: Processo estilóide; Desordem temporomandibular; Radiografia.

INTRODUCTION

Anatomical and physiological knowledge of temporomandibular joints and adjacent structures, of bone, muscular, ligamentous parts, as well as of articular disk, is necessary for craniomandibular dysfunctions diagnosis and etiology determination, aiming at interpreting morphological alterations and diseases[1]. Amongst craniomandibular dysfunctions, temporomandibular disorders and Eagle syndrome, also called styloid process syndrome or carotid artery syndrome, deserve to be mentioned[1].

The Eagle syndrome includes anatomical variants of the styloid process and/or stylohyoid ligament which may cause clinical manifestations similar to those from temporomandibular disorders. On its turn, temporomandibular disorders are associated with many complex temporomandibular joint structural and functional characteristics and present symptoms similar to those of the Eagle syndrome[2].

Several symptoms have been attributed to the Eagle syndrome, including cervical pain, otalgia, pain and foreign body sensation in the throat, pain on rotation of the neck, headache, cervicofacial pain, pain during deglutition, shoulders pain, among others[3]. Amongst the symptoms presented by patients with temporomandibular disorder, the following present more frequently: arthralgia, joint clicking, headache, otalgia, muscular pain, sonitus, limited mouth motions, limited excursive motion, and others[4].

The styloid process is a slender, cylindrical bone (protrusion)[5]. It is situated

* Study developed at Faculdade de Odontologia da Universidade Federal de Juiz de Fora Service of Diagnosis and Guidance for Patients with Temporomandibular Joint Disorders, Juiz de Fora, MG, as a part of requirements for conclusion of Masters Program in Sciences – Radiology – at Faculdade de Medicina da Universidade Federal do Rio de Janeiro.

1. Surgeon-Dentist, Specialist and Master in Radiology, Professor of Radiology at Faculdade de Odontologia da Universidade Federal de Juiz de Fora.

2. MD, Doctor in Radiology, Adjunct Professor at Faculdade de Medicina da Universidade Federal do Rio de Janeiro.

3. Surgeon-Dentist, Master and Doctor in Orthodontics, Coordinator for the TMJ Service at Faculdade de Odontologia da Universidade Federal de Juiz de Fora.

4. Surgeon-Dentists, Members of the Interdisciplinary Team of TMJ Service at Faculdade de Odontologia da Universidade Federal de Juiz de Fora.

Mailing address: Dra. Simone Maria Ragone Guimarães. Avenida Rio Branco, 2406/1103, Centro. Juiz de Fora, MG, Brazil. 36016-200. E-mail: odontoimagem@acessa.com

Received September 27, 2005. Accepted after revision March 20, 2006.

above the common carotid artery, between the external and internal branches, immediately proximal to the internal jugular vein and the facial nerve[1]. The styloid process length may vary, but the mean length is 25 mm; also, it may be absent[6], as well as present elongated.

Langlais *et al*.[7] have classified the styloid process elongation and/or stylohyoid ligament calcification into three types, according to their radiographic appearance: elongated — the styloid process and the stylohyoid ligament appear like a continuous, 2.5–3.2 cm-length structure; pseudoarticulated — the process seems to be joined to the stylomandibular or stylohyoid ligament by means of a single pseudo-joint, typically situated above the mandible angle; segmented — the styloid process and ligaments consist of several mineralized segments.

The differential diagnosis between Eagle syndrome and temporomandibular joint dysfunction may be performed on the basis of clinical history, digital styloid process palpation in the area of the tonsillar fossa, local anesthesia infiltration[5,8], as well as visualization of the styloid process on x-ray or computed tomography[9]. Besides palpation, mouth opening test, intra- and extra-oral inspections, and algesic area observation[1], in 1937, Eagle[10] suggested the diagnostic confirmation through the classical triad of foreign body sensation in the throat, palpable stiffness in the tonsillar region, and radiographic image with styloid process elongation.

Imaging studies like panoramic, modified panoramic, transfacial, transcranial, transorbital x-rays, and tomography are the basis for the temporomandibular disorders diagnosis[3]. However, several authors[3,5,11,12] recommend the panoramic x-ray for visualization and analysis of the styloid process as well as its variations in size and shape. Arellano[13] has asserted that the panoramic x-ray presents limitations like images amplification, overlapping and unclearness.

Therefore, by associating temporomandibular disorders with Eagle syndrome, this study is intended to radiographically evaluate patients with temporomandibular joint disorders for the presence of morphological alterations of the styloid process and/or stylohyoid ligament likely to influence the diagnosis of this joint disorder.

MATERIALS AND METHODS

This study has encompassed the analysis of 1,500 temporomandibular joint x-rays of both male and female patients with no age range limit, attended at Faculdade de Odontologia da Universidade Federal de Juiz de Fora – Service of Diagnosis and Guidance for Patients with Temporomandibular Disorders (Juiz de Fora, MG, Brazil) between August/1977 and March/2003. All the studies were performed in a Rotograph Plus with fixed 10 mA and (Dabi Atlante) model appliance, according to the patient's physical complexion (varying between 60 kVp and 85 kVp). A Kodak ® film with a curved 12.7 x 30.5 cm. intensifying screen was employed. The film processing was manually made employing the time-temperature method.

The x-ray images have been analyzed and those presenting at least an one-sided morphological alteration of the styloid process were selected. The morphological types (variations) have been evaluated and classified according Langlais et al. criteria[7] as follows: normal, elongated, segmented and pseudoarticulated (Figure 1).

The Cramer's V correlation coefficient was utilized for evaluating the association between nominal, qualitative variables (categorical).

RESULTS

From the group of 1,500 x-rays, 83 patients (5.53%) presented with at least an

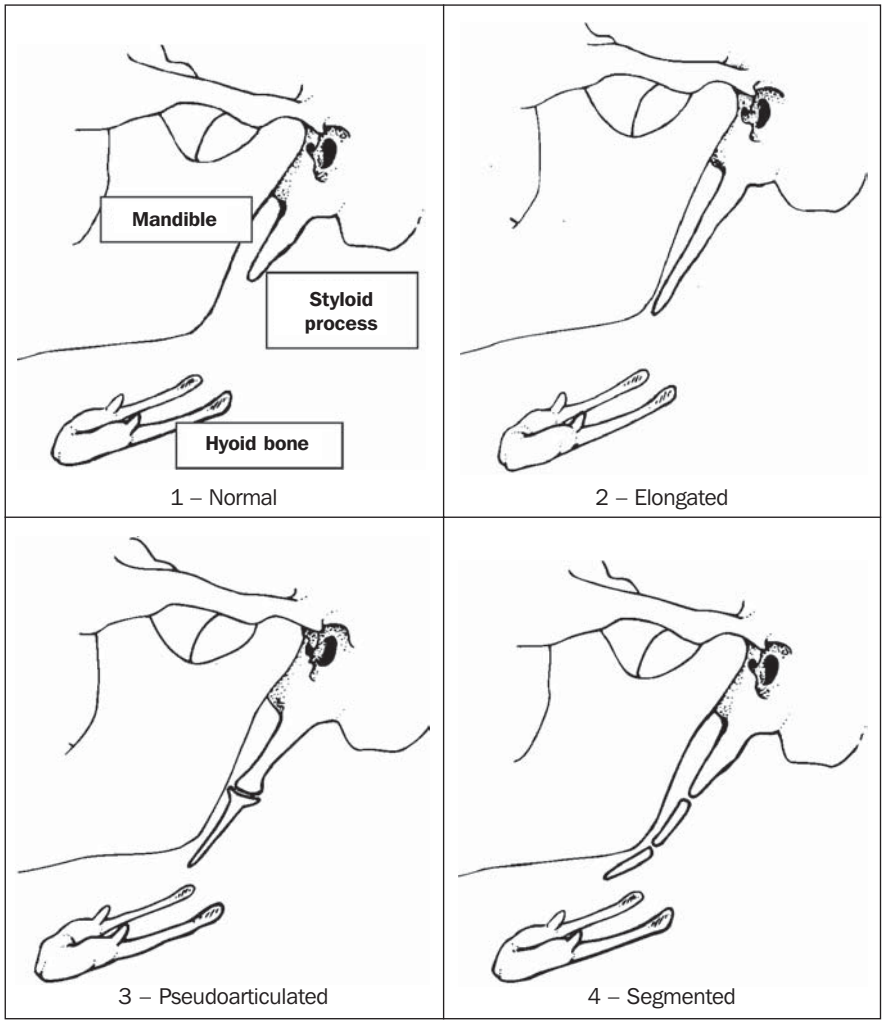

Figure 1. Scheme for classification of morphological alterations of the styloid process[7] (modified by the author).

one-sided morphological alteration of the styloid process, with a female prevalence (74 patients), i.e. 89.2% of the sample, and in only 9 male patients. In spite of this distribution by sex, there was not a predominance (in %) of a sex in relation to the other, although the sample had a higher number of women.

The distribution by age range can be seen on Table 1, where a higher number of patients (32.5%) in the age range between 41 and 50 years is shown. There was no patient with less than 10 years of age presenting morphological alteration of the styloid process.

Table 1 Study sample distribution by age range (n = 83).

Age range	Frequency (n)	(%)
1 (up to 10 anos)	0	0
2 (11 to 20 anos)	5	6
3 (21 to 30 anos)	12	14.5
4 (31 to 40 anos)	14	16.9
5 (41 to 50 anos)	27	32.5
6 (51 to 60 anos)	13	15.7
7 (61 to 82 anos)	12	14.5
n	83	100

The general classification of the styloid process morphological pattern can be seen on Table 2, the elongated type being the most frequent (n = 113), with 59 right-sided, and 54 left-sided.

As regards the symmetry (Table 3), it was found that 56% (n = 47) of morphological alterations of the styloid process are elongated, bilateral (2/2). The second more incident were the right-sided elongated and left-sided normal types (2/1), with 12% (n = 10) of the sample. The third more incident type was the pseudoarticulated bilateral one (3/3), in nine patients (10.8%).

Table 2 Styloid process morphological alterations in the study sample (n = 83).

Styloid process morphological type	Total frequency (n)	Right-sided		Left-sided	
		N	%	N	%
1 – Normal	13	3	3.6	10	12.0
2 – Elongated	113	59	71.1	54	65.1
3 – Pseudoarticulated	21	9	10.8	12	14.5
4 – Segmented	19	12	14.5	7	8.4
Total	166	83	100.0	83	100.0

Table 3 Bilateral styloid process morphological type classification (n = 83).

Right/left styloid process morphological type	Frequency (n)	(%)
1/2 – Normal/elongated	2	2.4
1/3 – Normal/pseudoarticulated	1	1.2
2/1 – Elongated/normal	10	12.0
2/2 – Elongated/elongated	47	56,6
2/3 – Elongated/pseudoarticulated	1	1.2
2/4 – Elongated/segmented	1	1.2
3/3 – Pseudoarticulated, bilateral	9	10.8
4/2 – Segmented/elongated	5	6.0
4/3 – Segmented/pseudoarticulated	1	1.2
4/4 – Segmented, bilateral	6	7.2
Total	83	100.0

DISCUSSION

Many studies[1,2,4,14] have been developed for a better understanding of the disorders associated with temporomandibular joints, whose morphological alterations may result in an array of signs and symptoms which complicate the diagnosis, and, consequently, the therapeutic conduct[2].

In spite the fact of several studies performing the measurement of the styloid process, this has not been the aim of the present study, since the analyzed x-ray images (modified, panoramic for temporomandibular joint) presented distortions and amplification in their processing[13]. However, in several published studies[3,5,11,12] the panoramic radiography has been utilized for observation and process analysis, because it is an easy-to-perform examination, besides being widely available for patients. For Arellano[13], Basekim *et al*.[6] and Heitz *et al*.[15], computed tomography is the most effective method for evaluating the styloid process length and morphological alterations, since this examination provides 2D and 3D reconstructions of the whole temporomandibular joint[16]. However, based on the results of the present study, one may consider that the modified radiography for the temporomandibular joint and the panoramic x-ray are good imaging methods for visualizing morphological alterations of the temporomandibular joint, including the styloid process. The great limitation of this examination is the impossibility of measuring the process extent, however this has not been a determining factor in the diagnosis of the syndrome[17] (Figure 2).

In the whole sample of the present study, it was found that 15.7% of the patients were male, and 84.3%, female, with the majority of them (65.2%) in the age range between 21 and 50 years. Both results confirm the reports from Okeson[14] and Saad & Barros[1] about temporomandibular disorders.

Among the patients with temporomandibular disorder, 5.53% presented at least one side of the temporomandibular joint with morphological alteration of the styloid process[18]. However, Zaki *et al*.[19] have found, also in patients with temporomandibular disorder, an even more significant incidence (27%). For Eagle[17], in 4% of the patients with morphological alteration of the styloid process, only 4% presented symptoms compatible with the Eagle syndrome.

In absolute numbers, the incidence of morphological alterations of the styloid process was higher in women (74) when

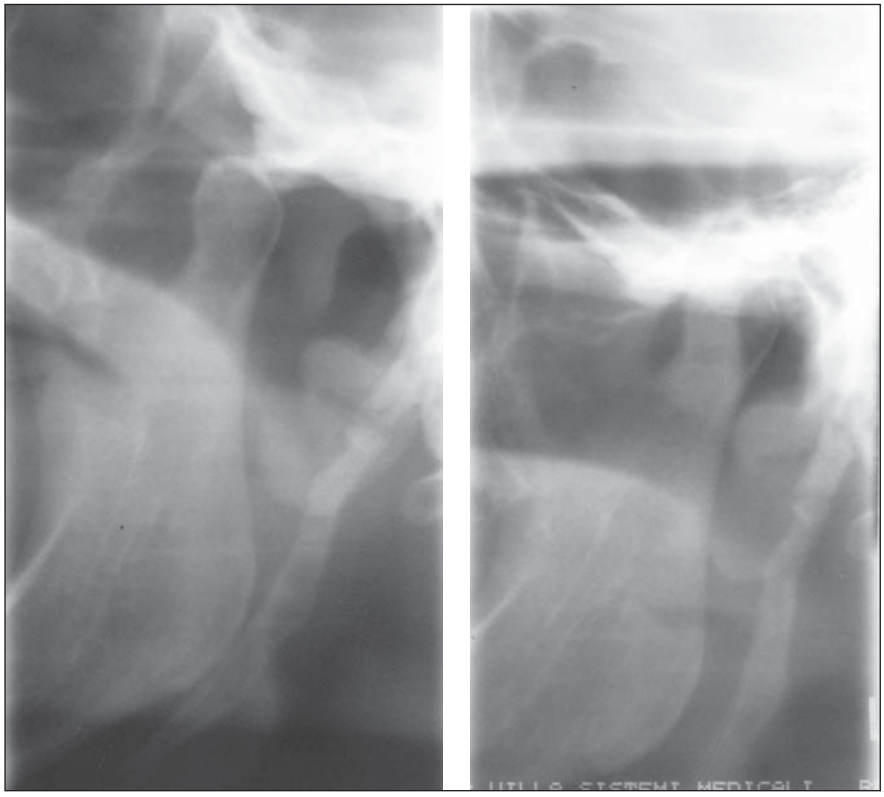

Figure 2. Left temporomandibular joint x-ray image, demonstrating morphological alteration of the styloid process.

compared with men (9). However, once the V Cramer test was applied, it was found that the prevalence is similar for both female and male patients. This result is different from the findings of Gozil *et al*.[20], Eagle[10] and Aral *et al*.[21], who have reported a higher male incidence, and also differ from those of Hernandez *et al*.[22], who have found a higher female incidence.

In the present study, 32.5% of the patients presented with morphological alterations of the styloid process, and the majority of patients were in the age range between 41 and 50 years for both sexes. In the other age ranges (21–30 years, 31–40 years, 51–60 years and 61–82 years) the mean incidence was 15%. This result is in disagreement with the studies of Zaki *et al*.[19] and Aral *et al*.[21] (31–40 years), Basekim *et al*.[6] (34 years) and Gozil *et al*.[20] (31–50 years). In the present study, only five patients (6% of the sample) in the age range between 11 and 20 years presented with such alteration. Also in this study, in a total of 1,500 patients, there was no patient less than 10 years old with morphological alteration of the styloid process. However, in the referred scientific literature[8] there is a case report on a ten-year old patient.

With this great variation in the presence of morphological alterations of the styloid process in several age ranges, and based on several studies results[6,18,21,23], including the present ones, it should be considered that the styloid process elongation or stylohyoid complex mineralization develops in a particular fashion for each individual, independently from sex and age [23].

Most of the studies found in the literature about morphological alterations of the styloid process are clinical case reports[8,10–12,15,21,22,24] and rather than evaluating the styloid process morphology, they analyze the symptomatology and the presence of the process elongation.

Based on the studies of Langlais *et al*.[7], the 83-patient sample was studied for the morphological type of each styloid process. The elongated pattern was the most frequent one (113), and the other morphological type (normal, pseudoarticulated and segmented) have not demonstrated significant differences, confirming the findings of several authors[6,20,23]. Similarly to the study of Aral *et al*.[21], in the present study there was no predominance of one of the sides in the morphological alteration of the styloid process.

It is important to highlight the relevance of the diagnosis in the craniomandibular dysfunctions by means of clinical and imaging studies[6,9,13,14,16], aiming at establishing the final diagnosis, since the treatment for temporomandibular disorders is primarily symptomatic, with conservative and reversible therapies[19], and the treatment for Eagle syndrome involves surgical excision[5,20,22,24,25], with intra- or extra-oral approach[24] for the elongated styloid process or the calcified stylohyoid ligament removal. However, Camarda *et al*.[25] have asserted that many patients may tolerate the symptoms of the elongated styloid process, without being submitted to surgery.

In agreement with several authors[1,5,24], it is believed that, in cases of orofacial pains, there is a necessity of interdisciplinary intervention and cooperation of radiologists, otorhinolaryngologists, surgeon-dentists, neurologists, orthopedists, ophthalmologists, phonoaudiologists, physiotherapist and psychologists[16], each professional acting in his/her specialty for definition of the diagnosis and appropriate therapeutical conduct.

CONCLUSIONS

Radiographically seen, the prevalence of morphological alteration of the styloid process in patients with temporomandibular disorder was of 5.53% (in 9 (10.8%) male and 74 (89.2%) female patients). A higher frequency was found in the age range between 41 and 50 years (32.5%).

The morphological types of the temporal bone styloid process radiographically seen were: 113 elongated, 21 pseudoarticulated and 19 segmented, totaling 153 styloid processes of 83 patients, 13 being considered as normal. Also, it was found that there is a correlation between the right and the left patterns, i.e., the morphological alteration is symmetrical.

REFERENCES

1. Saad PA, Barros JJ. *In:* Barros JJ, Rode SM. Tratamento das disfunções craniomandibulares – ATM. 1ª ed. São Paulo: Livraria Editora Santos, 1995;341–345.

2. Ash MM, Ramfjord SP, Schimideserder J. Oclusão. 1ª ed. São Paulo: Livraria Editora Santos, 1998;55.
3. Rodrigues JRC, Chilvarquer F. Avaliação clínica e radiográfica de pacientes portadores de apófise estilóide alongada e calcificada e com disfunção dolorosa da ATM. Anais SBPqO 1991;7:57.
4. Rocha APF, Nardelli MR, Rodrigues MF. Epidemiologia das desordens temporomandibulares: estudo da prevalência da sintomatologia e sua inter-relação com a idade e o sexo do pacientes. Rev Serviço-ATM-FO/UFJF 2002;2:1:5–9.
5. Noronha MJR, Gandelmann I, Araújo Jr GP, Shunemann WG. Alongamento do processo estilóide. Síndrome de Eagle. Rev Bras Otorrinolaringol 1987;53:60–63.
6. Basekim CC, Mutlu H, Gungor A, *et al*. Evaluation of styloid process by three-dimensional computed tomography. Eur Radiol 2005;15:134–139.
7. Langlais RP, Langland OE, Nortjé CJ. Diagnostic imaging of the jaws. 1st ed. Baltimore: Williams & Wilkins, 1995;620–622.
8. Galán IR, Galán CR, Diez FA. Sindrome estilohióideo en la infancia. An Esp Pediatr 1999;50: 507–508.
9. Lee HA. Three-dimensional computed tomography imaging of Eagle's syndrome. Am J Otolaryngol 2004;25:109.
10. Eagle WW. Elongated styloid process. Report of two cases. Arch Otolaryngol 1937;25:584–587.
11. Reis SSPM, Carvalho PL, Reis HSM. Processo estilóide alongado – relato de dois casos. J Bras Oclus ATM & Dor Orofac 2001;1:296–300.
12. Slavin KV. Eagle syndrome: entrapment of the glossopharyngeal nerve? Case report and review of the literature. J Neurosurg 2002;97:216–218.
13. Arellano JCV. Metodologia no diagnóstico da disfunção da articulação temporomandibular. J Bras Oclus ATM & Dor Orofac 2002;2:78–86.
14. Okeson JP. Fundamentos de oclusão e desordens temporomandibulares. 4ª ed. São Paulo: Artes Médicas, 2000;119–121.
15. Heitz C, Rocha JRM, Souza PHC, Costa NP. Mineralização atípica do complexo estilóide: relato de caso. Rev Bras Prótese e Implante 1999;6: 31–37.
16. Sá ACD, Zardo M, Paes Jr AJO, *et al*. Alongamento do processo estilóide (síndrome de Eagle): relato de dois casos. Radiol Brasil 2004;37:385–387.
17. Eagle WW. Elongated styloid process; symptoms and treatment. Arch Otolaryngol 1958;67:172–176.
18. Goldstein GR, Scopp IW. Radiographic interpretation of calcified stylomandibular and stylohyoid ligaments. J Prosthet Dent 1973;30:330–334.
19. 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.
20. Gozil R, Yener N, Çalguner E, Araç M, Tunç E, Bahcelioglu M. Morphological characteristics of styloid process evaluated by computed axial tomography. Ann Anat 2001;183:527–535.
21. Aral IL, Karaca I, Gungor N. Eagle's syndrome masquerading as pain of dental origin. Case report. Aust Dent J 1997;42:18–19.
22. Hernandez C, Rodriguez MM, Sano R, Vargas S, Monasterio MV. Síndrome de Eagle: a propósito de un caso. Acta Otorrinolaringológica 2000;12: 57–62.
23. 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;59:1420–1426.
24. Trevisan DRS. Análise dos aspectos do complexo estilohióideo na radiografia panorâmica. J Bras Oclus ATM & Dor Orofac 2002:2:105–115.
25. Camarda AJ, Deschamps C, Forest D. I. Stylohyoid chain ossification: a discussion of etiology. Oral Surg Oral Med Oral Pathol 1989;67:508–514.