

Cone beam computed tomography images in diagnosis of unilateral bifid mandibular condyle and eagle's syndrome

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Abstract: The cone beam computed tomography (CBCT) allows a high precision evaluation of the morphology and possible variations of the condyle and guvguu anatomical structures previous to orthodontic/surgical treatment. The objective of this study is v report an unusual case of the right bifid mandibular condyle and the elongated of the right styloid process associated with the calcification of the stylohyoid ligament using CBCT imaging technology. It is important for orthodontists and maxillofacial surgeons to be aware regarding the identification of these anatomical variabilities to determine diagnostic criterias of possible pathological processes such as temporomandibular joint disorder.

Keywords: Cone beam computed tomography, Styloid process, Estylohyoid ligament, Bifid mandibular condyle, Diagnostic Imaging.

I. Introduction

Morphological alterations of facial anatomical structures appear during the embryonic period or by trauma. When it does not occur during embryological development, the individual's age and sex tend to contribute to variations in morphology, besides functional forces and the type of malocclusion [1]. Among these variations, the bifid mandibular condyle is characterized by a rounded bone projection, with an oval and biconvex superior surface in the axial plan varying in form from a shallow groove to the formation of two lobulations oriented either mediolaterally or anteroposteriorly. This anatomic variation can cause disc degeneration despite the age-related factors of the patient [2]. A recent systematic review shows a prevalence of around 0.31% to 1.82% with a predominance of unilateral occurrences, twice as more on the left side. The condyle, besides its articular function, acts as an adaptive growth environment even under the functional weight supported by cartilage [3]. The majority of bifid condyle cases are asymptomatic and detected by incidental radiological findings. Its etiology still is uncertain, however, some authors associate it with traumatic and congenital factors, possibly leading towards functional limitation [4,5].

As well as the bifid condyle, the elongated of the styloid process of the temporal bone is an anatomical anomaly characterized by the bone projection previous to the stylomastoid foramen, that composes the stylohyoid complex together with the smaller protuberances of the hyoid bone and stylohyoid ligament, that when calcified can also be associated with the Eagle syndrome. Described as a syndrome in 1937 by Watt Weems Eagle, the diagnostic is defined by the investigation of feeling of foreign body in the throat associated with discomfort when swallowing; digital palpation in the tonsillar fossa region and radiographic image revealing the styloid process' length to be bigger than 2.5 to 3 cm. When this measure is superior to 4 cm, it can be associated with headache and neck pain [6,7] Studies show an incidence varying from 4 to 28% of abnormal length regarding this process and it is associated with the calcification of the stylohyoid complex between 22 and 84% of cases reported. This formation has an unknown etiology, however factors such as remains of Reichert's cartilage embryological tissue or traumatic by reaction due to bone metaplasia can be related to this bone projection [6,7,8]. The elongated and/or calcification of these structures can result in the compression of the neurovascular system that encircles the stylohyoid complex such as facial, auriculotemporal, lingual, glossopharyngeal and hypoglossal nerves, tympanic string and carotid artery with an incidence around 4 to 10%, when associated with painful symptomatology. In the majority of these cases the frequency is unilateral[8,9,10].

For diagnosis, there is a consensus in literature that the cone beam computed tomography (CBCT) is a very useful advanced imaging exam due to the quality and precision in the topographical-anatomical and

morphometric descriptions to identify malformations that can occur in the mandibular condyle and in the complex styloid process, as well as their relationships with adjacent anatomical structures when compared to panoramic radiographs [4,6,7,8]. The reproducibility of the anatomical features of structures, such as the mandibular condyle and its orientation with the articular fossa; length, angle, shape and position of the styloid process; the exact location of the stylomastoid foramen and the distance from the ascending mandibular ramus can be evaluated by CBCT images. Czaco et al (2020) reports the interest of surgical specialists in the investigation of these anatomical malformations in CBCT, since it provides an increase of options for surgical approaches, such as techniques for resection of the elongated styloid process. In this context, a rare case of bifid condyle and elongation of the styloid process on the right side associated with the calcification of the stylohyoid ligament will be described from the point of view of the cone beam computed tomography[11].

II. Case Presentation

A 34-year-old female patient attended the orthodontist with intermittent pain complaints involving the middle portion of the face to the right ear. She also told a history of clicking sounds when yawning. There was no medical history. In the intraoral clinical examination, the patient presented class III dental malocclusion with a significant maxilla-mandibular discrepancy. She was referred to an imaging clinic to make the orthodontic documentation for the orthodontic planning regarding orthognathic surgery for correction of facial and dentoskeletal deformity arising from mandibular prognathism. In addition, incidental findings were revealed on the panoramic radiograph by the bifurcated image on the right mandibular condyle, significant elongation of the styloid process on the right side, and radiopacity suggestive of calcification of the stylohyoid ligament.

With the purpose of obtaining greater details of the morphological alterations of the bone structures observed in the panoramic radiograph, the cone beam computed tomography (CBCT) was indicated. All images were acquired on the Carestream 8100 3D Cone Beam Tomography. Then, the images of the patient's right temporomandibular joint (TMJ) were visualized in the axial, coronal and sagittal reformatting, as well as 3D reconstruction being evaluated by a calibrated examiner. In frontal reformatting, images showed the presence of a deep vertical depression on the upper condylar surface on the right side, resulting in the appearance of two heads, with a heart-shaped (Fig 1A). CT scans taken with the mouth open and closed revealed the mediolateral orientation of the bifid condyle, with a greater diameter in the lateral portion with the presence of preserved joint space (Figs 1B-C).

According to tomographic images, the elongated styloid process was classified by Langlais (1986)⁷ as type II, characterized by the union of two mineralized segments through a pseudo-articulation (Fig 2A). It was also observed an elongated styloid apophysis with the distal reaching the C2 and passing through the margin at the level of C3, extending from the inferior surface of the temporal bone, medially and anteriorly to the stylomastoid foramen. The measurement of the styloid process was performed from the anatomicalporion, with 40 mm in length (Figura 2B). Em relação a calcificação do ligamento estilo-hióideo, foi definido como padrão completamente calcificado, caracterizado pela opacificação circular e corticalizada, com uma direção medial e anterior progressiva (Fig 2C)(Fig 3A-B).

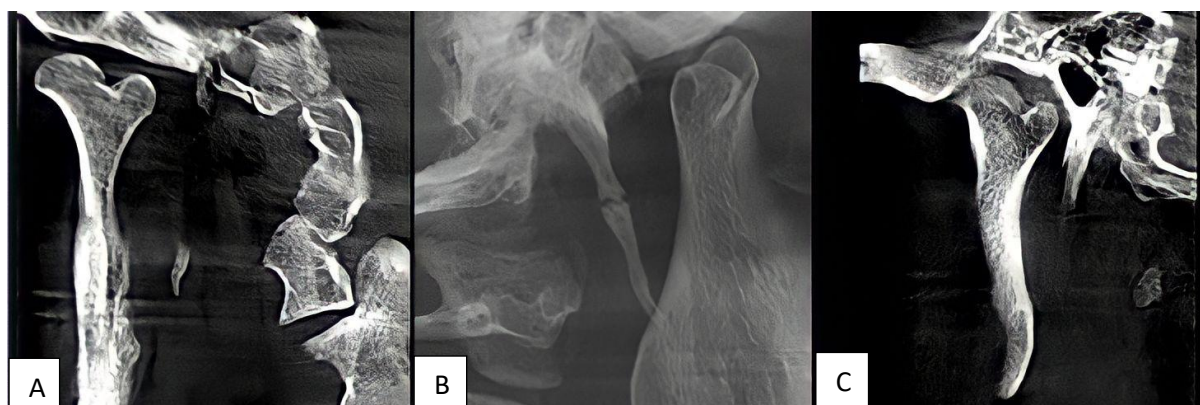


Figure 1. CBCT images of the right temporomandibular joint. Coronal section shows the condylar morphology bifurcated by a sharp depression resulting in a "double" head with asymmetrical portions (A). In the panoramic view, open mouth position, note the mid-lateral orientation (B). With the mouth closed, it signals the right mandibular condyle centered in the joint cavity (C).

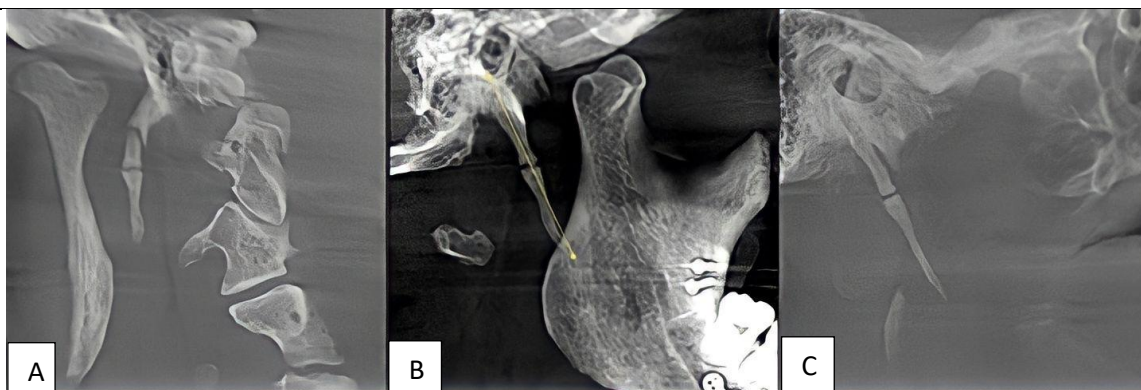


Figure 2. The sagittal section characterizes the elongation of the right styloid process by the union of two mineralized segments through a pseudo-joint (A). Elongated styloid process (Length 4 cm) is observed posteriorly to the external acoustic meatus, descending and anteriorly, superimposing the mandibular ramus. Note its position anteriorly and medially to the stylomastoid foramen (B). In the coronal section, the circular hyperdense image reveals calcification of the stylohyoid ligament (C).

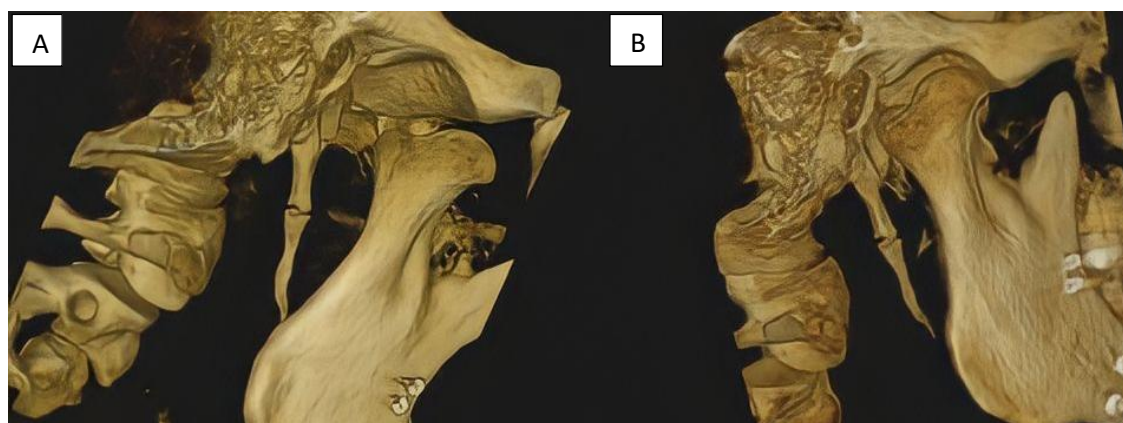


Figure 3. Three dimensional images of the patient's right temporomandibular joint in an open (A) and closed mouth position (B) contemplating the three morphological variations: bifid mandibular condyle, elongation of the styloid process and calcification of the stylohyoid ligament.

III. Discussion

The identification of variations in the maxillofacial region occurs especially when performing orthodontic planning and orthognathic surgery[12]. It is interesting to note from literature that show the diagnosis of incidental findings in these anatomic structures due to the high precision in CBCT images [3,4]. The present study reveals a detailed description of tomographic images of the bifid mandibular condyle and elongation of the right styloid process associated with calcification of the stylohyoid ligament diagnosed during orthodontic/orthognathic planning. To date, there are no studies of case reports with anatomical variations of these bone structures.

It is unclear in the literature about the relationship of bifid mandibular condyle between other bone anomalies or temporomandibular disorders [2,4,13,14] There are some studies about the developmental abnormality of condylar heads and they showed that this variation can be detected only through a routine radiographic examination. In the present rare report, imaging exams of a patient, 34 years old, revealed a bifid mandibular condyle on the right side. With the use of tomography images, in sagittal reformatting, it was possible to show two condylar heads oriented mediolaterally in the right side of mandibula's patient. In a systematic review [3], 80.1% of studies have reported that medial-lateral orientation was the highest occurrence, similar to the condylar position of this case report that also used the CBCT for an appropriate diagnosis to identify the elongation of the right styloid process associated with calcification of the stylohyoid ligament.

In this present study, incidental findings were observed in tomographic images of the stylohyoid complex on the right side characterized by a 40mm long thick styloid process and circular ossification of stylohyoid ligament, which connects the styloid process to the lesser horn of the right hyoid bone. Anatomically, this elongated is projected forward and downward, superimposing the mandibular ramus[6,13,15]. The patient's history consists of pain in her right temporomandibular joints involving the middle third of the face. Although

these malformations are common findings, the incidence of patient's pain complaints varies from 4 to 10% [16, 17]. Studies report that the relationship between these malformations and painful symptoms is associated with Eagle's syndrome [18,19,20].

The imaging diagnosis of styloid process elongation according to Langais et al (1986) described type I as an interrupted and elongated image; type II, formed by two segments joined by pseudo-articulation and type III characterized by two or more non-continuous segments. Studies report that the pseudo-articulation type is the least frequent [6,10]. The tomographic image of the right styloid process in this case revealed two pseudo-articulated hyperdense segments. There is a consensus in the literature about the use of computed tomography to provide data regarding the length, angulation and mineralization pattern of malformations involving the stylohyoid complex [6,7]. Although the CBCT scan can't visualize soft tissue, it is an excellent indication to evaluate soft tissue calcifications, such as of the cartilaginous tissue², that could be observed in the coronal reformatting tomography of this case, which showed a hyperdense, circular and cortical image which connects the styloid process with the smaller portion of the hyoid bone on the right side.

From anatomic view, Czaco et al (2020) relate the presence of anomalies associated with the prolongation of the articular process, such as *Ponticulusposticus* characterized by a small bone bridge that occurs due to calcification of ligaments in the first cervical spine, Atlas. These authors show that a temporal malformation called *Recessusprocessusstyloideus* can also be observed within this projection [21]. Although these anomalies were not described in our patient that was diagnosed to elongation of the right styloid process associated with the calcification of the stylohyoid ligament rather, it is interesting that CBCT images revealed a bifid mandibular condyle in the same side of mandibular process [22].

According to Borrás-Ferreres et al (2018) [3], treatment of asymptomatic bifid condyle is not necessary, however in symptomatic cases, treatment is similar to the temporomandibular dysfunction, with the use of non-steroidal anti-inflammatory drugs, analgesics, physical therapy and occlusal splint. In patients with limited mouth opening associated with ankylosis, surgical intervention is necessary. The treatment of elongation of the styloid process and bifid condyle, is directly related to the degree of anatomical alteration and patient discomfort. Conservative treatment may be indicated in asymptomatic cases and surgical procedures when there are painful symptoms [12,23]. In the present report, a sagittal osteotomy of the mandibular ramus was performed to correct the mandibular protrusion and mentoplasty. After 06 months of surgical follow-up, there was no report of painful symptoms in the cervicofacial region, as well as joint noises during oral functions.

Although orthodontists are not responsible for the treatment of congenital anomalies in the condyle and styloid process, it is important to carefully evaluate the entire volume of CBCT examination, of these bone structures in the three dimensions, for the diagnosis not only for the purpose of examining the malocclusion [23,24]. Galletta et al (2019) emphasize the importance of CBCT as well as magnetic resonance imaging as an essential indicator in the location and extent of the neurovascular complex in relation to these malformations.

IV. Conclusion

A This case reported showed diagnoses of unilateral bifid mandibular condyle and Eagle's syndrome based on CBCT findings. The accuracy of the dentist's diagnosis depends on the ability to identify and provide follow up related to these anatomical variations of the maxillofacial region, to be enabling the most appropriate therapeutic approach.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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