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Original Article

TMJ in facial class III deformity. Condylar morphology relations

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Abstract: Class III dentofacial deformities (DF-III) are classified as a severe functional and esthetic anomaly. This work aims to describe the condylar morphology of subjects with DF-III and indication of correction through orthognatic surgery. A descriptive study was designed in the Division of Oral and Maxillofacial Surgery of the Universidad de La Frontera, Chile, where 14 patients were examined with conventional cephalometric studies to determine the surgical indication; then, cone beam CT images were recorded for the morphometric analyses on the coronal and axial slices, considering linear measurements in the middle, basal and anteroposterior areas. The data were analyzed with the student's t-test, considering $p < 0.05$ statistically significant. The results revealed condylar size differences of less than 1 mm between the left and right condyles, considering average widths of 17.03 mm in the right condyle and 17.86 mm in the left condyle. Vertically, the observed averages were 17.17 mm in the right condyle and 17.04 mm in the left condyle; no statistical differences were observed. It can be concluded that there are no differences in the measurements when the two condyles are compared in this type of subject.

Keywords: Mandibular condyle, facial deformity, TMJ

Introduction

Facial deformities are well known pathologies defined as diseases with esthetic and functional involvement. The etiology of the Class III dentofacial deformity (DF-III) has been oriented toward the genetic aspects as well as toward environmental conditions that influence the development of the facial skeleton [1].

It has been considered that mandibular condylar heads are growth centers highly relevant to the development of DF-III [2], and although they are not the only center of mandibular growth, they play an important role in the development of the middle and lower face.

The conditions in which the temporomandibular joint (TMJ) is found in subjects with facial deformities have been studied by other authors [3], concluding that subjects with class II facial characteristics present smaller condyles than subjects with class III facial characteristics. This condition allows the relationship between the size of the condylar head and the type of facial deformity to be determined. Recently, Olate [4] determined that in patients with a diagnosis of condylar hyperplasia there are differences of 2 mm or more between the bilateral condylar sizes, directly influencing the position of the chin with the resulting facial asymmetry.

The aim of this study was to determine the morphological characteristics of the mandibular condyle in patients with DF-III.

Materials and methods

A descriptive study of 14 patients was designed in the Division of Oral and Maxillofacial Surgery of the Universidad de La Frontera, Chile. The subjects presented voluntarily in search of surgical treatment to deal with a facial anomaly through orthognathic surgery. The study was approved by the research ethics committee of the Universidad de La Frontera with protocol No. 066/13.

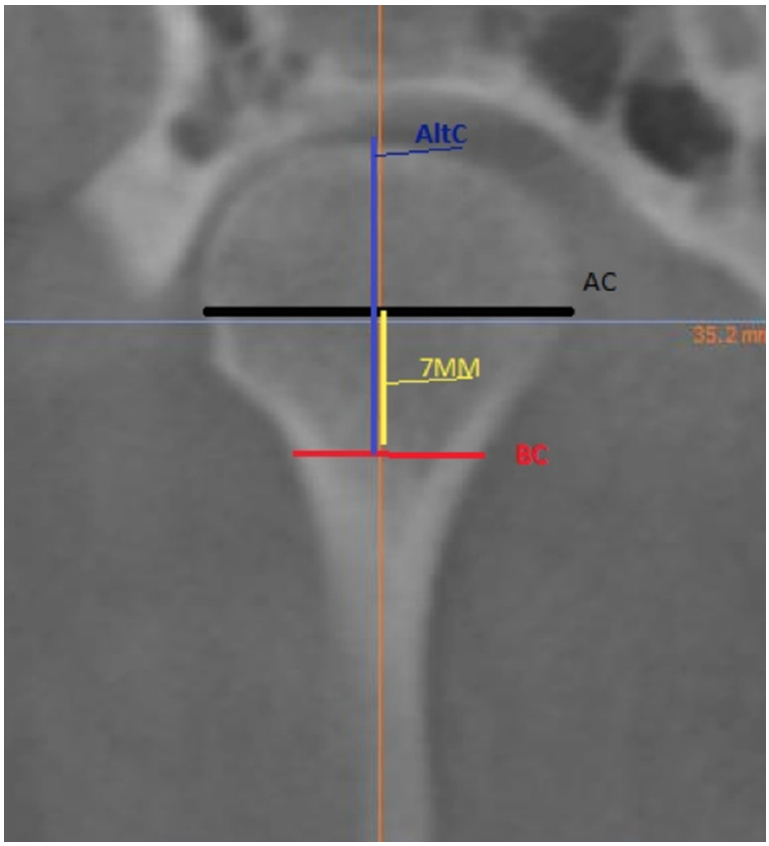

Figure 1. Coronal image of the middle sector of the right mandibular condylar head, illustrating the measurements taken.

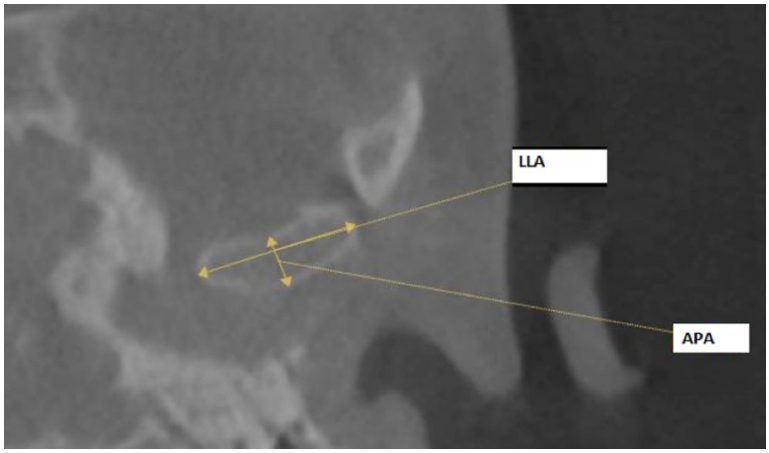

Figure 2. CBCT image, axial view, identifying the mid-lateral and anteroposterior distance of the right mandibular condylar head.

The diagnosis of DF-III was made using conventional methods of facial analysis and lateral and panoramic x-ray images, with an SNA angle less than 80° being identified to define the basis of the diagnosis of DF-III. The cephalometric study proposed by McNamara [5] was then used to confirm the findings.

Subjects of both genders between 18 and 35 years of age were included, with an indication of bimaxillary orthognatic surgery related to the anterior repositioning of the maxilla and posterior repositioning of the mandible. All the subjects underwent cone beam computed tomography (CBCT) with the PAX Zenith 3D (Vatech Co., Gyeonggi-Do, Korea). The data were exported as DICOM format in the software EZ3D2009 (E-WOO Technology Co., Ltd. Korea).

For the image capture, the subjects were placed with a natural head position, maintaining maximum intercuspidation. For the condylar morphology analysis, linear measurements were taken at three different times with at least a 1-week interval between them. Then the intraobserver analysis and interobservations were made to determine statistical error.

The measurements were analyzed on the axial, coronal and sagittal planes with the following orientations: 1. Mid-lateral distance: Coronal image obtained from the widest point of the condyle and its immediately posterior and anterior images (0.3 mm slices). The measurement was obtained from a longitudinal line perpendicular to the axial axis of the condyle that begins and ends on the most medial cortical and most lateral point of the condyle. An average was obtained from the three measurements that resulted in the final number for the condyle. 2. Superior-inferior distance: Coronal image obtained from the highest point

Table 1. Analysis of averages of measurements taken of the mandibular condyles of 15 subjects with DF-III diagnosis

Lineal measurement	Right condylar head (mm)	Left condylar head (mm)	Difference (mm)
Maximum mid-lateral, coronal view	17.03	17.86	0.83
Mid-lateral of the condylar base, coronal view	9.02	8.44	0.58
Maximum vertical distance, coronal view	17.17	17.04	0.13
Maximum mid-lateral, axial view	16.99	16.69	0.30
Maximum anteroposterior, axial view	6.55	7.00	0.45

of the condyle and its immediately posterior and anterior images (0.3 mm slices). The measurement was obtained from a longitudinal line perpendicular to the mid-lateral axis that begins at the highest cortical point and end at the lowest point of the condylar head. An average was obtained from the three measurements that resulted in the final number for the condyle. 3. The distance between the geometric center of the condyle and the axial mid-plane: Point measured with a line that passes through the geometric center of the condylar process and the perpendicular line at the sagittal mid-plane evaluated on the axial image, identifying the mid-lateral and anteroposterior distance (**Figures 1** and **2**).

The data were analyzed descriptively and with the student's t-test, considering $p < 0.05$ to be statistically significant.

Results

The measurements were taken without complications or alterations to the proposed protocol. The correlation analysis showed no statistical difference between the measurements, right side and left side, taken in this study ($p < 0.05$). In terms of averages, the analyses made on the coronal dimension of the condylar head of subjects with DF-III appear in **Table 1**.

In the coronal analysis, it was observed that the mandibular condyles presented a maximum mid-lateral distance ranging from 13.9 mm to 21.3 mm. The right-side condyles exhibited a width of 17.02 mm (±2.25 mm) and the left-side condyles a width of 17.86 mm (±2.77 mm) (difference of 0.84 mm). No important variations were observed between the genders, showing that men presented a condylar width of 17.03 mm (±2.25 mm) and women 17.86 (±2.77 mm).

The mid-lateral distance at the base of the condylar head determined that on the right side there was an average distance of 9.02 mm and on the left side 8.42 mm with a difference of 0.6 mm. The maximum vertical superior-inferior distance of the condylar head was 17.17 mm (±2.02 mm) in right condyles and 17.27 mm in left condyles (±2.71 mm).

The measurements taken on the axial slice from the CBCT, analyzed at the point of maximum mid-lateral distance, determined that this distance was 16.96 mm (±2.50 mm) on the right and 16.91 (±3.51 mm) on the left. In this same image the maximum anteroposterior distance was determined, revealing that for right condyles there was a distance of 6.54 mm (±0.68 mm) and in left condyles a distance of 6.99 mm (±1.02 mm). No significant differences were observed in the comparative analyses of the left and right condyles in the studies on the condylar width as well as on the condylar height.

Discussion

The involvement of the TMJ and in particular the mandibular condyles in the genesis of and relationship with facial deformities has been examined in some studies. For the morphological methodology in condylar measurement, Henriques [6] Indicated that in asymptomatic subjects there were no significant differences in the condylar position when the patient was positioned in maximum intercuspidation or when the patient in in centric relation, indicating that the morphometric analysis could be reliable in both situations. Additionally, pathological conditions of the joint such as the displacement of the articular disk can influence the decrease in condylar size in the mid-lateral direction [7]. In this study, no significant clinical history of TMJ dysfunction was recorded,

although dealing with subjects with extreme skeletal situations requiring surgery; it is possible for some morphological variations to be associated with low-level TMJ dysfunction. Nevertheless, the variations observed in the condylar morphology (left vs. right side) were less than 1mm in all directions.

Saccucci [8] reported that when there were variations in the maxillomandibular bone morphology they observed condylar variations, meaning the condylar volume is significantly associated with the low or elevated mandibular plane, whereas another study by Saccucci [9] determined that condylar size and volume was significantly different in class I, II and III subjects, pointing to the implications in dentoskeletal development. The studies by Saccucci [8, 9] did not specify any surgical indication in those patients, which could link different levels of expression of the disease.

Our results showed that the size of the condylar head in subjects with DF-III with a surgical indication presents only slight variations between the two sides. In the most extreme case, variations of up to 0.83 mm were observed in the mid-lateral evaluation and 0.13 mm in the vertical evaluation. Results from Olate [4], in subjects diagnosed with condylar hyperplasia showed differences of 2.72 mm in the mid-lateral direction and 3.94 in the vertical direction, indicating that for every 1 mm of difference in the width of the condylar head, there was 2.24 mm of contralateral deviation of the chin. This analysis may permit speculation that in our sample up to 1.7 mm of chin deviation could be expected, which is not clinically significant [10].

In this hand, Vitral & Telles [11] determined that in subjects with a dental diagnosis of class II division 1, there was no statistically significant condylar volume asymmetry when the bilateral condyles were compared; however, in later investigations Rodriguez [12] indicated that there may be differences in the condylar symmetry in class II subjects, whereas class III might not present significant bilateral differences. These findings are significant, since they permit speculation that possible morphological changes between the right and left condyles in Class III subjects with an indication for orthognatic surgery could be associated mainly with changes in joint components (articular disk for example) more than with intrinsic changes of the mandibular condyle. In fact, Hasegawa [13] reported that changes in the shape and size of the mandibular condyle vary according to the previous position of the articular disk, whereas Karlo [14] indicated that condylar morphology was associated with the subject's age, where subjects under 7 may exhibit rounder condyles and older subjects more oval-shaped condyles.

Olate [4] reported that the mid-lateral distance of condyles with hyperplasia was 19.32 mm and without hyperplasia it was 16.60 mm. The results of this study show averages of 17.5 mm approximately for the mid-lateral distance of the condyle of subjects with DF-III, which places it within an intermediate growth. Conversely, Sacucci [9] showed volumetric differences of 2520 mm^3 (both condyles) for Class II subjects, 2580 mm^3 (right side) and 2449 mm^3 (left side) for class I group and 2592 mm^3 (right side) and 2570 mm^3 (left side) for class III group, with no statistically significant differences, reporting a relative homogeneity in condylar volumes.

With this preliminary results, it can be concluded that the mandibular condyle morphology of subjects with DF-III before orthognathic surgery no show differences between the both, left and right, mandibular condyles. The clinical implications must be analyzed in future studies.

Disclosure of conflict of interest

None.

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