IJD ISSN:1806-146X

Mandibular condyle morphology on panoramic radiographs of asymptomatic temporomandibular joints

Christiano Oliveira[1]
Renata Tarnoschi Bernardo[2]
Ana Lúcia Álvares Capelozza[3]

1- DDS, MSc – Postgraduate Student, Department of Stomatology
2- DDS – Former Student
3- DDS, PhD – Professor, Department of Stomatology

Correspondência:

RESUMO

Palavras-chave:

ABSTRACT

Key words:

INTRODUCTION

The temporomandibular joint (TMJ) is one of the most complex articulations of the human body, working bilaterally and simultaneously, connecting the mandible to the cranium. Specific anatomic components of the TMJ include the mandibular condyle, the mandibular fossa and articular eminences of the temporal bone, and the soft tissue components of the articular disk, its attachments, and the joint cavity.[1]

Temporomandibular disorder (TMD) is a term that refers to a number of clinical conditions affecting the TMJ and is the most common non-tooth-related orofacial pain condition.[2] Imaging of the TMJ may reveal osseous or positional abnormalities, but even when abnormalities are seen, it is not clear how frequently these radiographs influence a clinician's decision making and how they impact on patient care.[3]

Panoramic radiography (PR) is a simple, low-cost method to evaluate the bony structures of the TMJ, and is one of the most commonly used techniques by dentists and dental specialists.[1] Its principle is based on the tomographic concept of imaging a section of the body while blurring images outside the desired plane, so that the TMJ and teeth are in focus, but adjacent structures are blurred.

The validity of panoramic radiographs (PR) in the diagnosis of TMJ conditions has been questioned in the literature.[2-11] It has been demonstrated that this imaging modality displays an image of the joint with several shortcomings due to anatomic variations and technique limitations.[4-6] However, it is not uncommon in the clinical practice the uncertainty or misinterpretation of condylar morphologic variations seen on PR, which may lead to unnecessary concerns, or even unnecessary treatments, of healthy TMJs.

This work aims to assess the frequency of different shapes of the mandibular condyle on panoramic radiographs of subjects without TMJ symptomatology, and to correlate the condylar morphology with age and gender, as well as evaluate the bilateral occurrence of the same shape within each subject.

METHODS

Panoramic radiographs of 283 subjects (112 males, 171 females) were included in this study, corresponding to a total of 566 mandibular condyles. All subjects were asymptomatic for orofacial pain and had their radiographic exams taken for other purposes. All radiographs were acquired in the same machine at Bauru School of Dentistry – University of São Paulo, were technically appropriate, and allowed suitable visualization of condyles on both sides.

A single observer analyzed the radiographs on a view box, in a dim light environment. With the aid of translucent tracing paper over the radiographs, the observer outlined the condyles, which were further classified into four groups, according to their shape: (A) flat, (B) pointed, (C) angled, and (D) round (FIG.1).

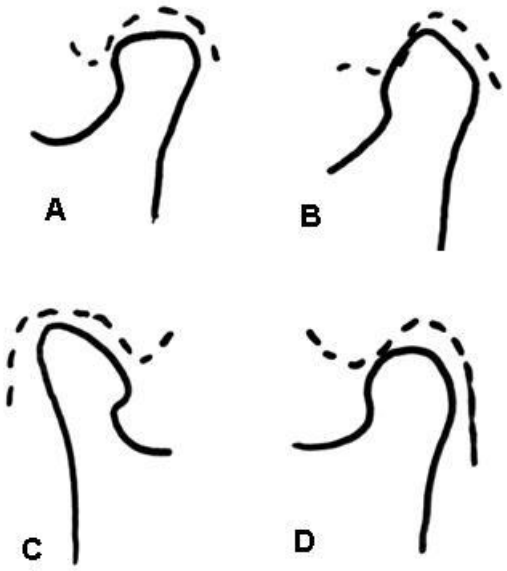

Fig.1 – Examples of condyle outlines grouped, according to the shape as: (a) (A) flat, (B) pointed, (C) angled, and (D) round.

It was also recorded whether the same shape appeared bilaterally or different shapes were seen within each subject.

Information on gender and age were subsequently associated with each exam. Subjects were classified into 5 groups according to age: 20-29, 30-39, 40-49, 50-59, and 60-69 years. Qui-square and Fischer´s test were used for comparisons among shape groups, bilateral presentation of shapes, age groups, and gender. *P* values lower than .05 were considered statistically significant.

RESULTS

Round and angled condylar shapes were the most frequent among the total number of condyles studied (40.99% and 32.16%, respectively), followed by the pointed shape (22.79%). Flat condyles were seen in 4.06% of the sample. The difference between males and females in relation to frequency of the morphologic groups was not statistically significant (table I)

	Flat (%)	Pointed (%)	Angled (%)	Round (%)
Males	13 (5.80%)	41 (18.30%)	80 (35.71%)	90 (40.18%)
Females	10 (2.92%)	88 (25.73%)	102 (29.82%)	142 (41.52%)
Total	23 (4.06%)	129 (22.79%)	182 (32.16%)	232 (40.99%)

Table I – Distribution of morphologic groups of condyles, according to gender. The difference between genders was not significant (p<.05).

When condylar morphology was compared between the age groups, statistical significant difference was observed. In the groups 20-29 and 30-39 years of age, there was a markedly predominance of round shapes. Subsequent age groups showed a more even distribution among the angled and round shapes. The age group 60-69 years presented a nearly equal distribution of pointed, angled, and round shapes (Table II).

	Flat	Pointed	Angled	Round
20-29	10 (5.21%)	47 (24.48%)	54 (28.13%)	81 (42.19%)
30-39	1 (1.09%)	21 (22.83%)	25 (27.17%)	45 (48.91%)
40-49	3 (3.00%)	10 (10.00%)	44 (44.00%)	43 (43.00%)
50-59	3 (3.49%)	21 (24.42%)	31 (36.05%)	31 (36.05%)
60-69	6 (6.25%)	30 (31.25%)	28 (29.17%)	32 (33.33%)
Total	23 (4.06%)	129 (22.79%)	182 (32.16%)	232 (40.99%)

Table II – Distribution of morphologic groups of condyles, according to age. The difference between age groups was significant (p=.0157).

The occurrence of the same shape bilaterally represented nearly two thirds of the subjects. The youngest age group (20-29 years) showed the highest prevalence of bilateral presentation of morphology, whilst the oldest age group (60-69 years) showed the lowest prevalence. However, the difference among age groups was not statistically significant (Table III).

	Bilateral	Unilateral
20-29	76 (79.17%)	20 (20.83%)
30-39	34 (73.91%)	12 (26.09%)
40-49	32 (64.00%)	18 (36.00%)
50-59	34 (79.07%)	9 (20.93%)
60-69	30 (62.5%)	18 (37.50%)
Total	206 (72.79%)	77 (27.21%)

Table III – Bilateral or unilateral occurrence of shape of the condyles among subjects, according to age. The difference between age groups was not significant (p>.05).

DISCUSSION

The current study shows that the mandibular condyles of asymptomatic patients may present different condylar morphologies on PR. Round, followed by angled, is the most common shape, especially among younger individuals. As age increases, a better distribution of shapes can be noted, and the frequency of pointed, round, and angled condyles become much similar. Flat condyles on PR, however, seem to be uncommon for all age groups among asymptomatic subjects.

The interpretation of these findings must be carried out with much cautious. It is important to understand the limitations of the PR in depicting the actual morphology of the condyle. The lateral pole of the condyle is usually projected on the film last, so it forms the anterior part of the image.[6] The anterior-posterior distance between the medial and lateral poles on the image may increase when the condyles have greater horizontal angulation, and decrease as vertical angle increases. Individual variations in condylar angulation result in image distortions, indicating that it is not possible to accurately recognize specific areas of condylar morphology.[6,7]

As early as in 1969, Yale[4] had emphasized the wide range of condylar shape variations and distortion artifacts observed on conventional radiographic exams. The author classified the shape of the superior aspect of the mandibular condyle, as seen in a posterior view, into four main groups: flat, convex, angled, and round. The convex shape was the most frequent (57.7%), followed by flat (25%), angled (11.5%), and round (3%). The flat shape frequency tended to increase with age, and the convex type had a reverse tendency. Although such results are based on posterior views of the condyles and therefore may not be directly compared with the present study, the author suggested that due to an oblique relation of the central beam with the various condylar axis, conventional radiographic images do not display real anterior and posterior borders.

PR has been used as the initial imaging technique for TMJ screening when the clinical examination suggests some form of joint pathology.[8] Although it depicts only the lateral and medial thirds of the condylar head, bony lesions occur more frequently in the lateral third.[8] Subjects with disc displacement without reduction had statistically significant lower condylar heights and distally inclined condyles compared with those with displacement with reduction and normal disc position, irrespective of PR machine used.[8]

The morphology of the condyle from three different PR machines and conventional tomography has been evaluated, and it has demonstrated that a statistically significant difference in shape

must be expected from different techniques.[9] A study compared PR with cone beam computed tomography (CBCT) images of the TMJ bony structures and concluded that CBCT provides superior reliability and greater accuracy than TMJ panoramic projections in the detection of condylar cortical erosion.[10]

The reliability and validity of the PR of mandibular condyle morphology has been assessed using the MRI and clinical examination as the gold standard.[11] The results showed that the specificity of PR is low, which means that raters found deformations in too many joints, including asymptomatic joints. Remodeling of the TMJ may occur in both asymptomatic or symptomatic joints, and consequently the significance of the deformation is questionable, even if a reliable and valid imaging modality is used.

Although many investigators used PR to assess changes in the condyles, the inherent anatomic diversity of the articulation associated with factors that influence 2-dimensional image presentation, such as superimposition, beam projection angle, and patient positional changes, throw into doubt the validity of those studies.[10] Even in a high risk population referred for the diagnosis and management of facial pain and jaw dysfunction, panoramic imaging had little impact on the diagnosis, further investigation, or treatment. Other than ruling out significant structural changes in bone, the use of PR may not add to the diagnosis or clinical management of TMD patients.[2] Findings that can be associated with disorders are usually limited to fractures, obvious erosions, sclerosis, and osteophytes of the condyle.

The flat shape was the least frequent morphology among asymptomatic subjects in this study. It may be argued that such feature could be related TMJ disorders. However, the frequency of flat condyles among symptomatic individuals should be determined in order to suspect any relation to pathological conditions. The prevalence of bone change in the condyle (e.g. erosion, osteophyte, and deformity) was compared between patients with and without TMJ disorders.[12] Bone alterations were seen in 11.6% of dental patients (without symptomatology) and 17.7% of TMD patients. Although the difference was statistically significant, it showed that even among TMD patients, those with bone changes were few, and most patients were confirmed to have the disease state even without bone loss. Condylar deformity was nearly as common among TMD and dental patients. No correlation of bone alterations with sex, age, dental or oclusal conditions was demonstrated.[12]

Our results show that nearly two thirds of the subjects presented the same shape type in both condyles. Although one can note that the highest prevalence of bilateral occurrence of the same shape was in the youngest group, and the lowest prevalence in the oldest group, the difference among age groups was not statistically significant. Condylar symmetry on PR has been studied by means of Fourier analysis, which allows an assessment of the shape regardless of size. It has been shown that most individuals present condylar shape symmetry. However, significant condylar shape asymmetry may occur in both male and female asymptomatic individuals.[5] The morphologic variation of left and right condyles may occur due to PR technical limitations and anatomical variation. A degree of asymmetry must be expected in biological descriptions, which may increase proportionally to the complexity of the organism.[5]

Current management of TMJ disorders relies heavily on clinical evaluation, with minor influence from information obtained through TMJ imaging.[1] Computed tomography and MRI are helpful to overcome limitations of PR, however, their clinical use is limited to a small number of patients, and are usually used as a second choice.[7,10] Although the use of TMJ conventional radiographic imaging has decreased, it is still common to find misinterpretation of PR in regard to the shape of the mandibular condyle, with wrong associations with TMJ disorders.

REFERENCES

1.Lewis EL, Dolwick MF, Abramowicz S, Reeder SL. Contemporary imaging of the temporomandibular joint. Dent Clin N Am 2008; 52:875-90.

2.Epstein JB, Caldwell J, Black G. The utility of panoramic imaging of the temporomandibular joint in patients with temporomandibular disorders. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2001; 92:236-9.

3.Muir CB, Goss AN. The radiologic morphology of painful TM joints. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1990; 70:355-9.

4.Yale SH. Radiographic evaluation of the temporomandibular joint. J Am Dent Assoc 1969; 79:102-7.

5.Ferrario VF, Sforza C, Miani Jr. A, Sigutà D. Asymmetry of normal mandibular condylar shape. Acta Anat 1997; 158:266-73.

6.Fallon SD, Fritz GW, Laskin DM. Panoramic imaging of the temporomandibular joint: an experimental study using cadaveric skulls. J Oral Maxillofac Sur 2006; 64:223-9.

7.Ruf S, Pancherz H. Is orthopantomography reliable for TMJ diagnosis? An experimental study on a dry skull. J Orofac Pain 1995; 9:365-74.

8.Ahn SJ, Kim TW, Lee DY, Nahm DS. Evaluation of internal derangement of the temporomandibular joint by panoramic radiographs compared with magnetic resonance imaging. Am J Orthop Dentofacial Orthop 2006; 129:479-85.

9.Mawani F, Lam EWN, Heo G, McKee I, Raboud DW, Major PW. Condylar shape analysis using panoramic radiography units and conventional tomography. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005; 99:341-8.

10.Honey OB, Scarfe WC, Hilgers MJ, Klueber K, Silveira AM, Haskell BS, Farman AG. Accuracy of cone-beam computed tomography imaging of the temporomandibular joint: comparisons with panoramic radiology and linear tomography. Am J Dentofacial Orthop 2007; 132:429-38.

11.Schmitter M, Gabbert O, Ohlmann B, Hassel A, Wolff D, Rammelsberg P, Kress B. Assessment of the reliability and validity of panoramic imaging for assessment of mandibular condyle morphology using both MRI and clinical examination as the gold standard. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006; 102:220-4.

12.Takayama Y, Miura E, Yuasa M, Kobayashi K, Hosoi T. Comparison of occlusal condition and prevalence of bone change in the condyle of patients with and without temporomandibular disorders. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008; 105:104-12.