PERCEPTION OF PROFESSIONALS IN THE ASSESSMENT OF CORONOID HYPERPLASIA BY COMPUTED TOMOGRAPHY

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ABSTRACT
Coronoid Hyperplasia (CH) is a non-neoplastic and relatively rare enlargement of the coronoid process that may limit mandibular movement as a consequence of the close association between the hyperplastic coronoid process and the anterior region of the zygomatic bone. Computed tomography (CT) is extremely useful for the observation of this association and plays an important role in diagnosing and planning surgical treatment. Once the CT scan is performed, the data can be viewed in many different arrangements, including multiplanar (MPR) and 3D rendering, although the resolution of the latter may not be as good as that of the former. Our aim is to analyze the importance of and preference for multiplanar and 3D reconstruction images for diagnosing and interpreting Coronoid Hyperplasia (CH), by comparing the opinions of oral surgeons and oral radiologists who analyzed both temporomandibular joints (TMJ) in 20 patients. Three images of each TMJ comprised the set of scans (MPR, 3D reconstructions with maximum intercuspation and 3D reconstructions with maximum mouth opening). After each analysis, the members of the two groups answered a questionnaire about the usefulness of each examination and classified the association between the head of mandible and mandibular fossa. Hypomotility was present in 55.2%. Both groups stated that both MPR and 3D reconstructions, particularly the latter, were fundamental for diagnosing CH and that they would request them in order to interpret CH correctly. The examiners were found to differ significantly regarding their opinion of MPR; only radiologists considered MPR to be less elucidative for the diagnosis of CH.

Key words: *temporomandibular joint disorders; computed tomography.*

PERCEPÇÃO DE PROFISSIONAIS NA AVALIAÇÃO DA HIPERPLASIA CORONÓIDE PELA TOMOGRAFIA COMPUTADORIZADA

RESUMO
A Hiperplasia Coronóide (HC) é um aumento não-neoplásico e relativamente raro do processo coronóide que pode limitar o movimento mandibular, como conseqüência da íntima relação entre o processo coronóide hiperplásico e a região anterior do osso zigomático. A tomografia computadorizada (TC) é extremamente útil para a observação dessa relação, desempenhando assim um papel importante no diagnóstico e planejamento do tratamento cirúrgico. Uma vez que a TC é realizada, os dados podem ser vistos em muitos arranjos diferentes, incluindo o multiplanar (MPR) e a reconstrução em 3D, no entanto, a resolução desta última pode não ser tão boa quanto a primeira. Nosso objetivo é analisar a importância e a preferência por reconstruções de imagens multiplanares (MPR) e 3D para diagnosticar e interpretar a Hiperplasia Coronóide (HC), comparando cirurgiões buco-maxilo-faciais com radiologistas orais. Ambas as articulações temporomandibulares (ATM) de 20 pacientes foram analisadas pelos 2 grupos. Três imagens de cada ATM compreenderam o conjunto de exames (MPR, reconstruções 3D em máxima intercuspidação e reconstruções 3D com abertura máxima da boca). Após cada análise, os grupos responderam a um questionário sobre a utilidade de cada exame e classificou a relação entre a cabeça da mandíbula e da fossa mandibular. A Hipomobilidade esteve presente em 55,2%. Ambos os grupos afirmaram que tanto MPR e as reconstruções em 3D, especialmente a última, foram fundamentais para diagnosticar CH e as requisitariam para interpretar a HC corretamente. Foi encontrada uma diferença significativa entre os examinadores sobre a MPR; apenas o grupo de radiologistas considerou que este exame não é tão elucidativo para o diagnóstico da CH.

Key words: *articulação têmporo-mandibular; tomografia computadorizada.*

INTRODUCTION

Temporomandibular joint (TMJ) dysfunction is a common disease that causes many people to seek treatment at dental care centers to restore proper, pain-free TMJ movement. However, it may be mistakenly diagnosed as a different pathology. Some patients in fact present Coronoid Hyperplasia (CH), which is a non-neoplastic, relatively rare enlarge-

ment of the coronoid process[1] that may limit mandibular movement as a result of the close association between the hyperplastic coronoid process and the anterior region of the zygomatic bone[2,3].

CH may be more common than is believed, but because it is mostly painless, patients only seek treatment if the inability to open the mouth is severe enough to compromise mastication[4-7]. However, the disease gradually becomes more severe during the second decade of life. It can be unilateral (with only one hyperplastic coronoid process) or bilateral.

In radiographs, a hyperplastic coronoid process is generally large and long, projecting into the infratemporal fossa, with normal trabecular bone[8]. Radiographs are thus inappropriate to diagnose it[9]. Computed tomography (CT), in contrast, is extremely useful for the observation of the association between the hyperplastic coronoid process and the zygomatic bone[4,10,11], and thus plays an important role in diagnosing and planning surgical treatment. Treatment consists of surgical correction of CH. Coronoidectomy is the method of choice, followed by intense physiotherapy [12,13].

Once the CT scan is performed, the data can be viewed in many different arrangements, including multiplanar (MPR) and 3D rendering, although the resolution of the latter may be lower than that of the former. The literature does not discuss which of these arrangements dental specialists consider most useful, or whether they would always use both of them to make a safe, correct diagnosis of CH. The purpose of this study was to analyze the importance of and the preference for MPR and 3D reconstruction images in diagnosing CH, by comparing the opinions of oral surgeons and radiologists.

MATERIAL AND METHODS

Sample

Archival images of spiral CT scans of 152 patients with signs and symptoms of TMJ dysfunction were analyzed. Said patients had been referred to the Dentomaxillofacial Imaging Department of a Dentistry and Medical Clinic, for CT scan of the TMJ, requested by specialized professionals (orthodontists and oral surgeons) with diagnostic purposes. This was a multicenter study which was approved by the Research Ethics Committee of the School of Dentistry of the University involved.

Among the 152 patients, 20 cases diagnosed with CH were selected. The diagnosis was initially made by an independent oral surgeon specialized in oral maxillofacial radiology, who made the diagnosis based on clinical (limitation of mouth opening) and imaging information. The diagnosis of CH was made when the coronoid process in patients with closed mouth exceeded the zygomatic process and in multiplanar images (MPR) whenever it exceeded the height of the condyle. All diagnoses were revised and confirmed by 3 different independent oral maxillofacial radiologists, who did not take part in the experiment. Age, sex and race were not considered when selecting the sample. The selected images were obtained through multiplanar (Fig. 1) and 3D reconstruction (Figs. 2 and 3).

CT acquisition

The images were acquired by a fourth generation Toshiba Auklet™ CT scanner (Tustin, CA, USA) with a matrix size of 512 X 512. Technical parameters were as follows: 120 kVp, 250 mA, 2 mm slice width, 1 mm pitch factor.

Eighty-eight axial 2 mm slices were obtained with 1 mm reconstruction intervals and a pixel size of 0.4688 mm. The images were acquired as follows: a) maximum intercuspation position; and b) maximum mouth opening (patients were instructed to open the mouth to their limit and immediately bite a mouth block - 40x30x20mm or 30x25x18mm Maquira, Maringá, Brazil - throughout the acquisition).

The acquired images were sent to an Alatoviewä workstation (Tustin, CA, USA), where volume reconstruction was carried out. Only multiplanar and 3D reconstructions were used in this study. The images were converted from DICOM to TIFF format, transferred to a conventional computer and stored on CD.

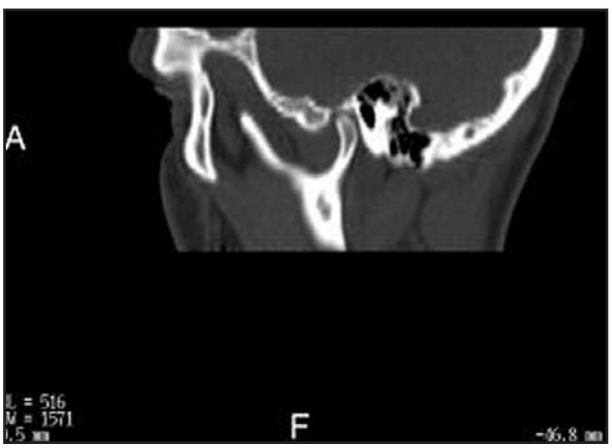

Fig. 1: Multiplanar Reconstruction: right side at maximum intercuspation position.

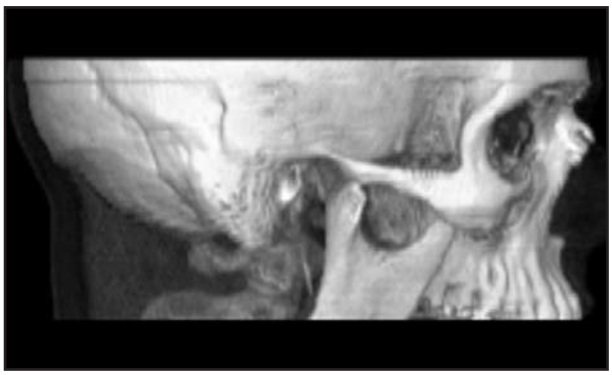

Fig. 2: 3D Reconstruction: right side at maximum mouth opening.

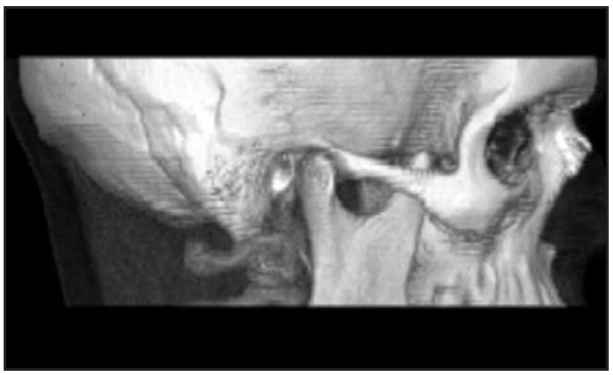

Fig. 3: 3D Reconstruction: right side at maximum intercuspation position.

Image analysis

Image analysis was performed by two groups of examiners with at least twenty years' experience in their specialties. One group included five oral maxillofacial radiologists and the other group included five oral and maxillofacial surgeons, all of who were renowned professors and PhDs in their areas.

Both groups received 20 sets of scans (20 cases), composed of multiplanar reconstructions (MPR at maximum intercuspation position, right side and left side) and 3D reconstructions (right side and left side at maximum intercuspation and maximum mouth opening). A total of three images of 40 TMJs were analyzed (Figs. 1, 2 and 3).

After analyzing the images of each of the 20 cases, each examiner answered a questionnaire about the comparison between MPR and 3D reconstructions. Each examiner thus answered 20 questionnaires. The questionnaire was composed of the following questions:

1) Do you think that 3D reconstructions were more elucidative than MPR to correctly diagnose and interpret these images of CH? Score 1 – Yes; Score 2 – No.
2) Do you think that MPR was more elucidative than 3D reconstructions to correctly diagnose and interpret these images of CH? Score 1 – Yes; Score 2 – No.
3) How important are these imaging methods, analyzed separately or simultaneously, to help establish a correct diagnosis and interpretation of CH? Score 1 – Very important; Score 2 – Not so important; Score 3 – Not important.
4) Would you request one or both of these imaging tests to analyze CH? Score 1 – Yes; Score 2 – No.
5) By interpreting 3D reconstructions of maximum mouth opening, it was possible to conclude that the patient had: Score 1 – Hypermobility; Score 2 – Hypomobility; Score 3– Normal jaw movement; Score 4 – It was not possible to establish a diagnosis.

In relation to the question 5, the following classification was explained for each examiner before evaluation:

Normal: the uppermost portion of the head of mandible is below the bottommost portion of the articular tubercle of temporal bone.

Hypermobility: the uppermost portion of the condylar process is beyond the bottommost portion of the articular tubercle of temporal bone.

Hypomobility: the uppermost portion of the condylar process does not reach the bottommost portion of the articular tubercle of temporal bone.

The data obtained were tabulated and submitted to statistical analysis by the Analysis of Means (ANOM), Kruskal-Wallis test and Fisher's exact test.

RESULTS

The answers to questions 1 and 2 were transformed into dichotomous variables: "yes" represented Score 1 (examiner agrees) and "no" represented Score 2 (examiner disagrees). Thus, the tables that represent questions 1 and 2 show the percentage of affirmative answers.

For the analysis of question 3, means or medians of the scores were used. The answer to question 4 was also transformed into a dichotomous variable: "yes" represented Score 1 (examiner would request imaging tests) and "no" represented Score 2 (examiner would not request imaging tests). The tables that

represent question 4 also show the percentage of affirmative answers.

Tables 1 and 2 show the proportion of affirmative answers to questions 1 and 2 and 4, as well as the mean score for the answers to question 3 for both groups.

For the analysis of question 5, a graph that expresses in percentage hypermobility, hypomobility or normal jaw movement (relation between the head of mandible and mandibular fossa) was used and showed that 55.2% of the cases had hypomobility, 24.1% had normal mobility and 20.7% had hypermobility (Fig.4). The Kruskal-Wallis test was used to compare the scores for both groups (oral radiologists and oral surgeons), revealing no significant difference between them either for the right side (p=0.934) or the left side (p=0.064). Diagnosis of mandibular movement was based on the relation between the head of mandible and the mandibular fossa, analyzed by both groups upon observation of 3D reconstructions.

The answers to each question provided by the five examiners in each group were compared by means of statistical analysis. ANOM was used to calculate a general average for the five examiners and an interval that indicated which examiners had similar opinions and which had different ones. ANOM compares group means to the overall mean, providing a graphic procedure for comparing a collection of means, rates or proportions to determine whether any of them differ significantly from the overall

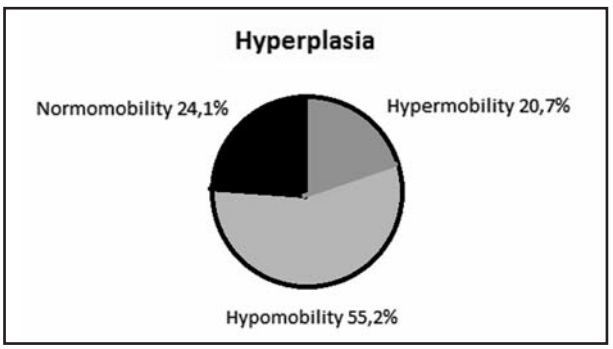

Fig. 4: Percentage of the jaw movement (relation between the head of mandible and mandibular fossa).

Table 1: Percentages of affirmative answers and scores for oral surgeons.

Surgeon	Question 1 (3D better)	Question 2 (MPR better)	Question 3 (need for the examinations)	Question 4 (indication for the examinations)
1	95	65	1.00	100
2	70	25	1.40	85
3	55	60	1.05	100
4	70	85	1.00	100
5	45	55	1.05	100
Mean	67	58	1.10	97
Median	70	60	1.05	100
SD	19	22	0.17	7

Table 2: Percentages of affirmative answers and scores for oral radiologists.

Radiologist	Question 1 (3D better)	Question 2 (MPR better)	Question 3 (need for the examinations)	Question 4 (indication for the examinations)
1	35	60	1.00	100
2	55	45	1.15	95
3	60	15	1.00	100
4	90	40	1.10	100
5	95	35	1.65	100
Mean	67	39	1.18	99
Median	60	40	1.10	100
SD	25	16	0.27	2

mean, rate or proportion. ANOM is a type of multiple comparison procedure.

The groups were compared (radiologists and oral and maxillofacial surgeons). Since questions 1 and 2 and 4 dealt with proportions, the proportion test was used to compare them. No significant difference (p=1.000) was observed between groups with regard to question 1 (3D better). Regarding question 2 (MPR better), the oral and maxillofacial surgeons had a higher percentage of affirmative answers than the radiologists. This was confirmed by the proportion test, which revealed statistically significant differences between groups (p=0.006).

For the analysis of question 3, the Kruskal-Wallis test was used to compare the scores, revealing no significant difference between them (p=0.194). For question 4, Fisher's exact test was used, revealing no significant difference between groups (p=0.621).

DISCUSSION

Diagnosis of CH is only possible by image examination. Most authors highlight the role of CT with coronal slices and sagittal reconstructions in the analysis of this disease. They also highlight the relation between the hyperplastic coronoid processes and zygomatic arches.[1,4,10-12,14-17] We confirm, based on this and other preliminary studies, that CT is essential for distinguishing CH from TMJ dysfunctions through different imaging exams. This is of particular importance because upon further investigation, many supposed TMJ disorders are found to be CH. Our data confirm this, as 7.6% of the "TMJ problems" were in fact CH pathologies.

In the present study, MPR and 3D reconstructions showing hyperplasia of the coronoid process were analyzed by experienced oral maxillofacial radiologists and oral maxillofacial surgeons, the specialists that deal with this type of pathology, and their preferences were compared.

Tables 1 and 2 show that both the oral surgeons and the oral radiologists stated that imaging methods, combined or not, were essential for diagnosing and interpreting CH correctly (Question 3), and that they would request these tests to analyze and diagnose the condition (Question 4).

The proportion test revealed no significant difference between groups with regard to Question 1. The percentage of affirmative answers was higher for 3D images than for MPR images. This means that both the oral surgeons and the oral radiologists consider that in most of the cases, 3D images were more elucidative than MPR images to diagnose and interpret CH correctly. This agrees the findings of Guimarães and Marie [18] (2005), who highlighted the use of 3D reconstructions for the analysis of the relation between hyperplastic coronoid processes and zygomatic arches and bones.

Regarding Question 2 (MPR better), the oral surgeons had a higher percentage of affirmative answers than the radiologists. This was confirmed by the proportion test, which revealed statistically significant differences between groups. We believe that the difference is due to the fact that oral surgeons are more familiar with this imaging method, since it is used in a variety of clinical situations in Oral and Maxillofacial Surgery.

Both groups considered the two imaging methods, combined or not, very important for analyzing CH, as shown by the percentage of answers to question 3 (need for these examinations). The Kruskal-Wallis test revealed no significant difference between groups. Participants would also request one or both of the imaging tests to analyze CH. Fisher's exact test revealed no significant difference between groups for Question 4 (indication of examinations).

When the oral surgeons and the oral radiologists analyzed the 3D reconstructions to evaluate mandibular movement, hypomobility was present in 55.2% of the cases analyzed (Graph 1) on the same side of the affected TMJ. This agrees with the findings of some authors, who report that limited mouth opening was often due to CH rather than to TMJ dysfunctions, as was believed at first.[2,9,16,19]

Imaging examinations are essential for analyzing clinical cases of limited mouth opening with no pain, as shown in this and in other preliminary research. These examinations would allow practitioners to analyze soft and bony structures of TMJ, as well as the relation between the coronoid process and zygomatic bone. By requesting such examinationss, specialists would avoid overlooking the possibility of hyperplasia of the coronoid process.

We conclude that both groups of examiners believe that the combination of MPR and 3D reconstructions are fundamental to correctly diagnose and interpret CH, especially the latter, and would request one or both examinations to diagnose it. A significant difference was found between the examiners regarding the use of MPR (p=0.006), with only the oral radiologists considering that it is not so elucidative for the diagnosis of CH.

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