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Raquel Parreiras Ferreira

AVALIAÇÃO DA INFLUÊNCIA DA DISCREPÂNCIA ENTRE A RELAÇÃO CÊNTRICA E A MÁXIMA INTERCUSPIDAÇÃO HABITUAL NAS MEDIDAS CEFALOMÉTRICAS E CONDILARES

Belo Horizonte
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Dissertação apresentada ao Programa de Pós-graduação em Odontologia da Pontifícia Universidade Católica de Minas Gerais, como requisito parcial para obtenção do título de Mestre em Odontologia, Área de Concentração em Clínicas Odontológicas – Ênfase: Prótese Dentária.

Orientador: Ildeu Andrade Jr.
Coorientador: Paulo Isaias Seraidarian

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Prof. Dr. Martinho Campolina Rebello Horta — **Coordenador do Programa de Pós-graduação em Odontologia - Mestrado**

Aos meus pais e irmãos,
pela força, confiança e amor incondicionais.

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RESUMO

O objetivo deste estudo foi determinar se há diferença significativa entre medidas cefalométricas e condilares obtidas com o paciente em máxima intercuspidação habitual (MI) em comparação àquelas obtidas em relação cêntrica (RC). Tomografias Computadorizadas de Feixes Cônicos (TCFC) foram realizadas em 18 pacientes (9 homens e 9 mulheres, RC≠MIH 1,0 - 1,5mm) que seriam submetidos a tratamento ortodôntico. TCFC foram realizadas com os pacientes na posição MIH (T1) e utilizando o *jig* para atingir a RC (T2). Houve diferenças estatisticamente significantes entre medidas cefalométricas no plano sagital (SNB e ANB) e vertical da mandíbula (SNGOGN e Y-Axis) ($p<0,05$), embora os resultados possam ser de baixa relevância clínica. Não houve diferença significativa entre as medidas condilares realizadas nos planos sagital, coronal e axial. Esses dados sugerem que as análises cefalométricas e condilares possam ser realizadas na posição mandibular de MIH, quando a discrepância for inferior a 1,5mm.

Palavras chave: Cefalometria. Relação cêntrica. Tomografia computadorizada cone-beam.

ABSTRACT

The objective of this study was to determine whether there are significant differences between cephalometric and condylar measurements obtained with a patient in maximum intercuspation (MI) compared to those obtained in centric relation (CR). Cone Beam Computer Tomographies (CBCT) were performed in 18 patients (9 men and 9 women, RC ≠ MI 1.0 to 1.5 mm) to be submitted to orthodontic treatment. CBCTs were taken with the patient in MI (T1) and using the jig to achieve the CR (T2). There were statistically significant differences between cephalometric measurements in the sagittal (SNB and ANB) and vertical (SNGoGn and Y-Axis) planes ($p<0.05$), although the results might be of low clinical relevance. There was no significant difference between condylar measurements in the sagittal, coronal and axial planes. These data suggest that the condylar and cephalometric analysis can be performed on the mandibular position of MI, when the discrepancy is less than 1.5mm.

Keywords: Cephalometrics. Centric relation. Cone-beam computed tomography.

SUMÁRIO

1 INTRODUÇÃO

Na dentição natural a mandíbula pode assumir duas posiçõescêntricas diferentes que têm sido fonte de controvérsias no planejamento e tratamento ortodôntico: a relação cêntrica (RC) e a máxima intercuspidação habitual (MIH) (CORDRAY, 2006); sendo que estas posições, normalmente, não são coincidentes na maioria da população (CRAWFORD, 1999).

A RC é definida como a posição mais ântero-superior que os côndilos possam atingir na fossa, assentados contra o disco articular na parede posterior da eminência. (CRAWFORD, 1999). Esta posição vem sendo descrita como a mais estável e confortável posição mandibular em que as articulações podem receber cargas mastigatórias sem desconforto algum (DAWSON, 1995). Entretanto, esta posição músculo-esquelética e ligamentosa das articulações só poderá ser mantida se estiver em harmonia com uma estável condição oclusal, denominada relação de oclusão cêntrica (OKESSON, 2008).

A posição de MIH refere-se ao relacionamento oclusal independente da posição condilar (THE GLOSSARY OF PROSTHODONTIC TERMS, 2005), sendo esta a posição mandibular utilizada durante a realização das telerradiografias. Entretanto, se algum contato oclusal mudar o arco de fechamento mandibular em RC, os côndilos serão deslocados para permitir o relacionamento maxilomandibular em MIH (SARINNAPHAKORN et al., 1997; HUANG et al., 2006), que persistindo, criará uma discrepância entre a RC e a MIH. A maioria dos pacientes possui este reflexo de fechamento, que é determinado por um mecanismo proprioceptivo (LUCIA, 1964). Quando há discrepância entre as posições mandibulares RC e MIH, poderá haver diferença entre os resultados das cefalometrias realizadas nestas duas relações oclusais, o que poderia interferir na avaliação da discrepância maxilomandibular e, possivelmente, no diagnóstico ortodôntico. (SHILDKRAUT et al., 1994; AFZAL et al., 2005).

A cefalometria é a combinação de medidas lineares e angulares desenvolvida por meio de traçados obtidos de telerradiografias faciais frontais e/ou laterais, sendo utilizadas para o diagnóstico das discrepâncias dento esqueléticas do complexo craniofacial, auxiliando, assim, o planejamento ortodôntico (THE GLOSSARY OF PROSTHODONTIC TERMS, 2005; WILLIANSOM et al., 1978; DOWNS, 1948). Estes exames de imagem deveriam ser realizados com a mandíbula na posição de

relação cêntrica (RC), o que em tese, facilitaria o alcance do objetivo de todo tratamento reabilitador que é a oclusão de RC (ROTH, 1981) ou o mais próximo possível da mesma (STOREY, 1996).

Com a introdução da Tomografia Computadorizada de Feixes Cônicos (TCFC) no final dos anos 90, imagens dento-maxilo-faciais tridimensionais de alta resolução e precisão se tornaram uma realidade, assim com a reconstrução volumétrica de dados (FRONGIA et al., 2012; GRIBEL et al., 2011). Com isto, uma avaliação em 3D da articulação temporomandibular (ATM) se tornou possível com maior precisão sobre o delineamento das imagens (FERREIRA et al., 2010).Além disso, a TCFC apresenta baixa dose de radiação, baixo custo, melhor acesso e melhor resolução espacial quando comparada com a Tomografia Convencional (TC). Os dados da imagem da TCFC podem ser usados para simular radiografias panorâmicas e cefalometrias laterais e póstero-anteriores (KUMAR et al.,2008), proporcionando uma melhora nos planejamentos reabilitadores, inclusive ortodônticos, justificando, assim, a técnica de escolha para o desenvolvimento deste estudo.

O presente estudo prospectivo randomizado teve como objetivo comparar as medidas cefalométricas e as medidas condilares obtidas em MIH com as obtidas em RC por meio de TCFC e avaliar se houveram diferenças estatísticas que influenciariam o diagnóstico e planejamento ortodôntico.

2 OBJETIVOS

2.1 Objetivo Geral

Avaliar a influência da discrepância entre RC e MIH nas medidas cefalométricas e condilares em pacientes pré-tratamento ortodôntico.

2.2 Objetivos Específicos

a) Comparar possíveis diferenças cefalométricas lineares e angulares entre as posições mandibulares de RC e MIH;
b) Comparar possíveis diferenças nas medidas condilares horizontais e verticais, utilizando cortes tomográficos sagitais, coronais e axiais entre as posições mandibulares de RC e MIH.

3 ARTIGO

Periódico será submetido ao American Journal of Orthodontics and Dentofacial Orthopedics.

Estrato Qualis do periódico na área de Odontologia A1.

Normas para submissão de artigos podem ser visualizadas no endereço eletrônico: www.ajodo.org.

Does the discrepancy between the centric relation and maximum intercuspation alter the cephalometric and condylar measurements?

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Introduction: The objective of this study was to determine whether there are significant differences between cephalometric and condylar measurements obtained with a patient in maximum intercuspation (MI) compared to those obtained in centric relation (CR). **Methods:** Cone Beam Computer Tomographies (CBCT) were performed in 18 patients (9 men and 9 women, RC ≠ MI 1.0 to 1.5 mm) to be submitted to orthodontic treatment. CBCTs were taken with the patient MI (T1) and using the *Lucia jig* to achieve the CR (T2).**Results:** There were statistically significant differences between cephalometric measurements in the sagittal (SNB and ANB) and vertical (SNGoGn and Y-Axis) planes ($p<0.05$), although the results might be of low clinical relevance. There was no significant difference between condylar measurements in the sagittal, coronal and axial planes. **Conclusion:** These data suggest that the condylar and cephalometric analysis can be performed on the mandibular position of MI, when the discrepancy is less than 1.5mm.

Key words: Cephalometry. Centric relation. Cone-beam computed tomography.

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INTRODUCTION

In natural dentition the mandible can assume two different centric positions that have been a source of controversy in orthodontic planning and treatment: the centric relation (CR) defined as the more stable and comfortable mandibular position where the temporomandibular joint (TMJ) can receive masticatory loads without any discomfort[1] when maintained in harmony with a stable occlusal condition, denominated the centric occlusion relation,[2] and the maximum intercuspation (MI)[3], the most common mandibular position used in cephalometrics, which refers to the occlusal relationship independent of the condylar position[4]. These positions are not normally coincident in the majority of the population.[5]

Accordingly, if any occlusal contact changes the mandibular closing arch in CR, the condyles will be shifted to permit the maxillomandibular relationship in MI; [6,7]which if it persists, will create a discrepancy between the CR and the MI. The majority of patients present this closing reflex, which is determined by a proprioceptive mechanism.[8] When there is a CR-MI discrepancy, there may be a difference between the cephalometric results carried out in these two occlusal relationships, which could interfere in the evaluation of the maxillomandibular discrepancy and, possibly, lead to a misdiagnosis. [9,10,11]

These image exams should be carried out with the mandible in centric relation (CR), which in theory, would facilitate the objective of every restorative treatment, which is the occlusion of centric relation[12] or the closest one to it. [13]

Recently, cone beam computed tomography (CBCT) has become available for a more accurate diagnosis of possible discrepancies between the condyle and the articulating fossa in the CR and MI position. [14]

The present prospective randomized clinical study aims to compare, by means of CBCT, the cephalometric and the condylar measurements obtained in MI with those obtained in CR, and evaluate if there were statistical differences that would influence the orthodontic diagnosis and planning.

METHODS

The present study was submitted to the Ethics Committee in Research of Humans of the Pontifical Catholic University of Minas Gerais and was approved under the protocol CAAE – 0417.0.213.000-12.

The exclusion criteria were individuals with preliminary orthodontic treatment, endocrine-metabolic diseases, hyperthyroidism or hypothyroidism, autoimmune diseases, juvenile rheumatoid arthritis, and/or signs and/or symptoms of TMJ disorders, such as pain, clicking, noises and articulatory shifts during the mandibular movements of opening and closing.

The sample consisted of 18 randomly selected patients (9 men and 9 women, average age 16 years, CR ≠ MI between 1.0 - 1,5mm) who were going receive orthodontic treatment in the Department of Orthodontics of the Pontifícia Universidade Católica de Minas Gerais - PUC Minas.

As a standard protocol to achieve the CR, all patient used a *Lucia jig*[8], made of Durallay resin (Reliance Dental Mfg.Co, Worth, IL, USA) by the same investigator (RPF), which allows posterior occlusal contact in the recordings in CR.

Two CBCTs were carried out on each patient, one in MI (T1), and the other with the *jig* in CR (T2) (FIG. 1, 2, 3).

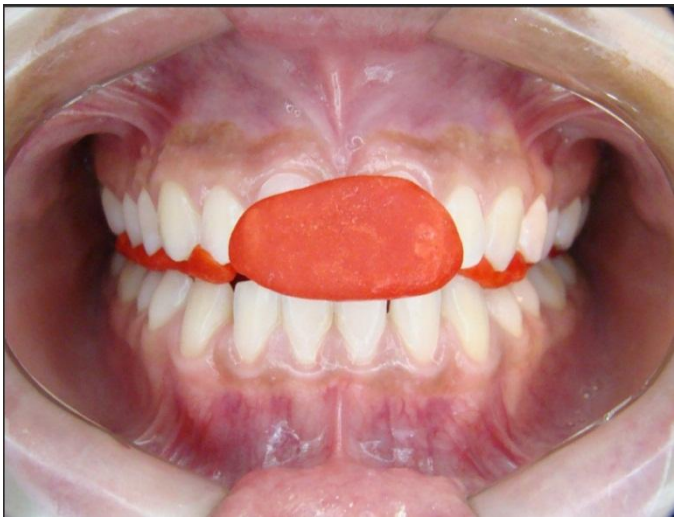

Figure 1: Frontal view of the jig in CR.

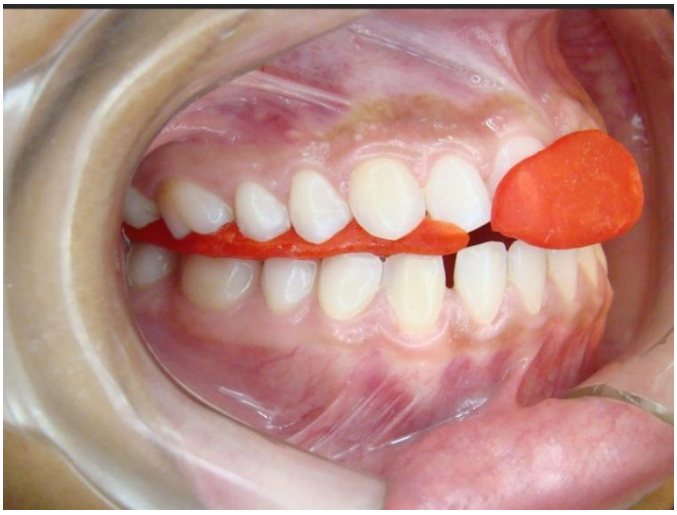

Figure 2: Right side view with the Jig in CR.

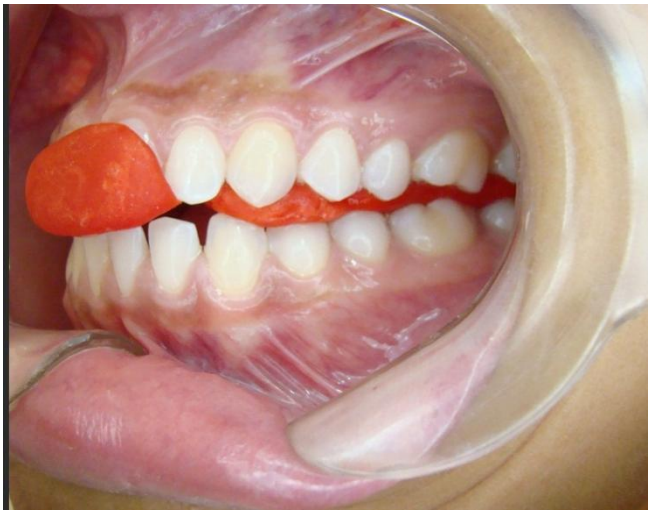

Figure 3: Left side view with the Jig in CR.

All images (T1 and T2) were taken in a Modeli-Cat Next Generation tomograph. The cephalometric tracings and the sagittal, axial and vertical condylar measurements were carried out by the same investigator (RPF).

The CBCT images (T1 and T2) were transferred to the Dolphin software (Dolphin 3D imaging Software 11.5 Premium) and were orientated three dimensionally. In the frontal section, the vertical orientation was given by the median sagittal plane and the horizontal by the two frontozygomatic sutures. In the sagittal section, in the right side view, the horizontal orientation was given by the Frankfurt plane and in the medial view, the orientation left from the joint line crista galli-basion (front limit of the foramen magnum in the median sagittal plane), as described previously.[15]

The cephalometric radiographs were generated from the CBCT using the orthogonal projection and the chosen cephalometric points for this study were: porion, orbitale, sella, nasion, B point, pogonion, anatomical gnathion, menton, gonion, A point, U6 occlusal, L6 occlusal, L1Tip, U1Tip. The tracings were automatically generated by the software as well as the cephalometric measurements: ANB, SNA, OCC PLANE TO SN, SN-GOGN, FMA (MP-FH), Y-AXIS (SGN-SN) (FIG. 4 and 5).

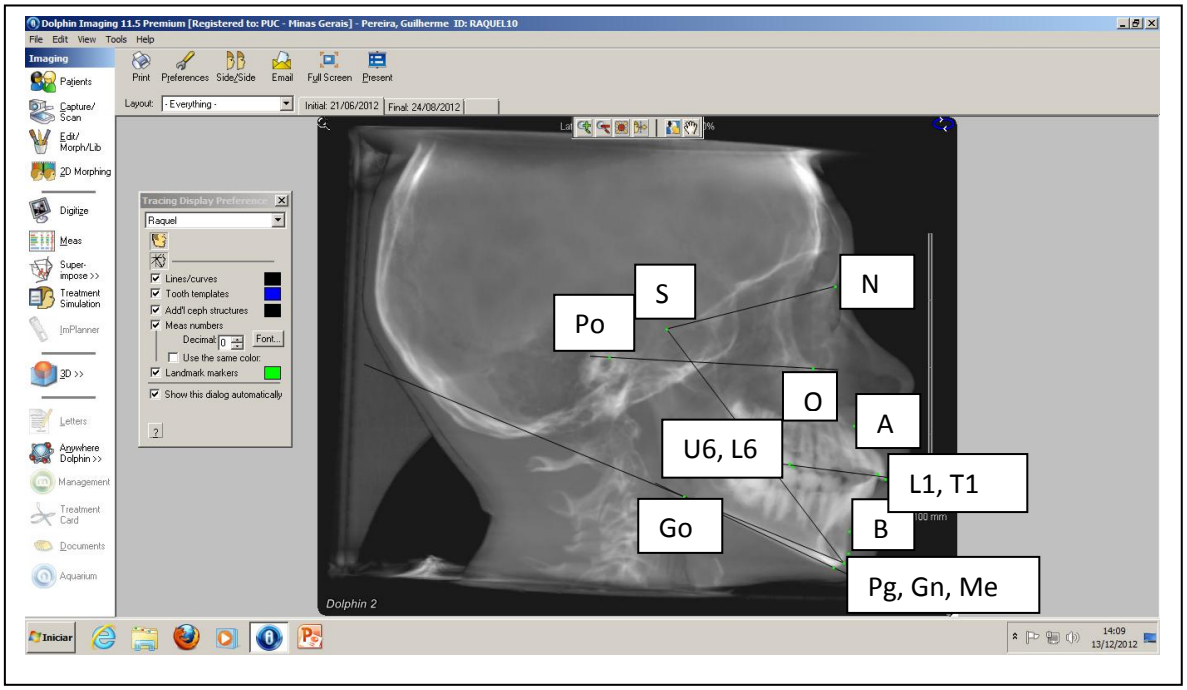

Figure 4: Cephalometric points and traces: Porion (Po), Orbitale (O), Sella (S), Nasion (N), B point (B), pogonion (Pg), anatomical gnathion (Gn), menton (Me), gonion (Go), A point (A), U6 occlusal (U6), L6 occlusal (L6), L1Tip (L1), U1Tip (U1).

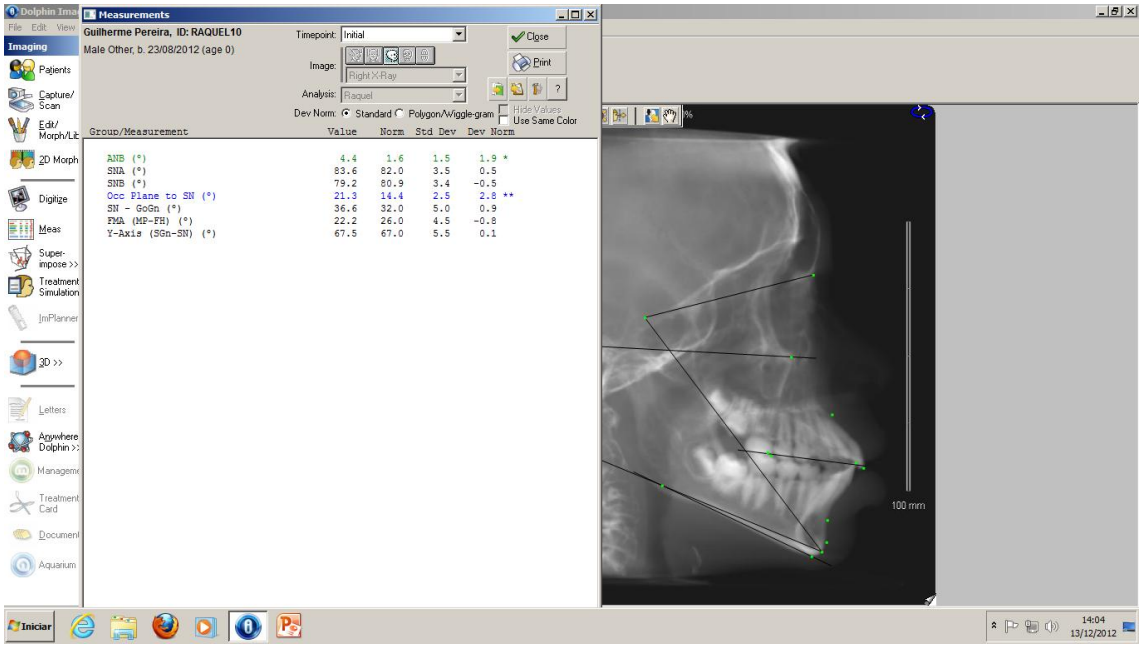

Figure 5: Cephalometric measurements: SNA, SNB, ANB, OCC PLANE TO SN, SN-GOGN, FMA (MP-FH), Y-AXIS (SGN-SN).

The condylar variations between the CR and MI positions were also evaluated with the same Dolphin software. The section lines, sagittal (red), coronal (green) and axial (blue) were standardized and activated through the equal slices-volume layout. In the sagittal section, the blue and green lines became reference lines for condylar measurements: in the coronal section, the red and blue lines, and in the axial section the red and green lines.

The red line standardizing the sagittal section was a tangential line to the side edges of the right and left orbits. The green line was a vertical tangential line to the nasion point, in the side view of the tomography, and the blue line was placed passing by the infra-orbital sutures, in the frontal view of the tomography (FIG. 6, 7, 8). The distance from the highest point of the condyle to the blue line and from the most anterior point of the condyle to the green line were obtained by the option “digitilize measure – line”, providing vertical and horizontal condylar measurements (FIG. 9).

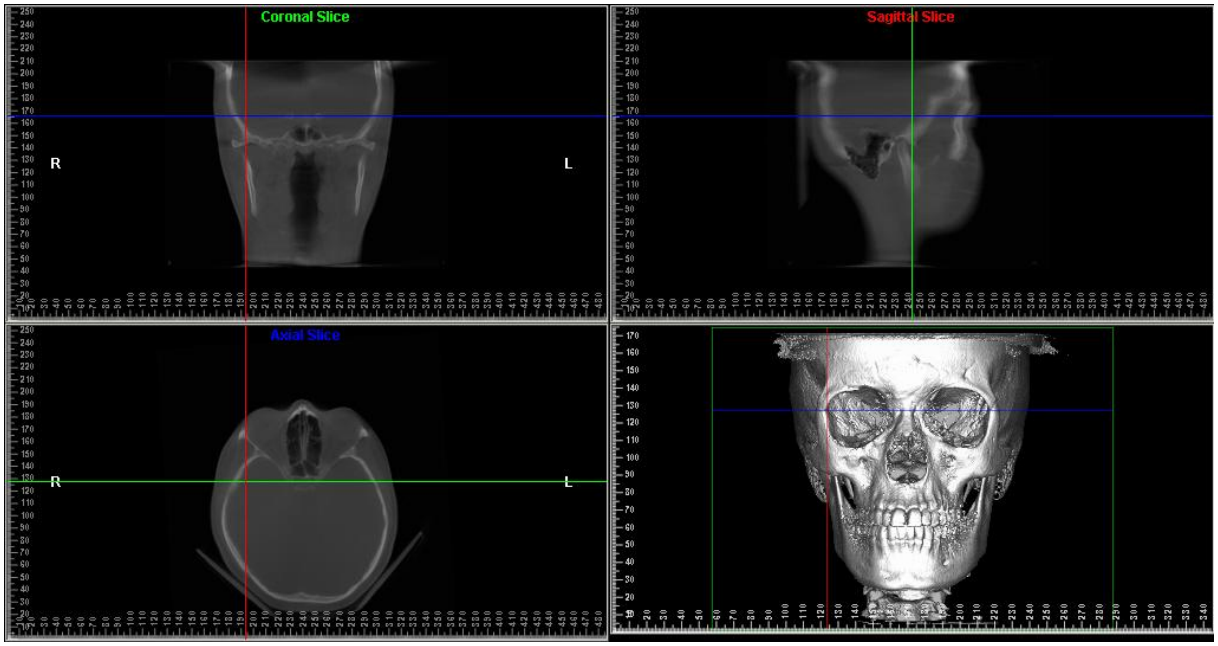

Figure 6: Red line standardizing the sagittal section: a tangential line to the side edge of the right orbit for measurement of the right condyle. Blue line joining the frontozygomatic sutures.

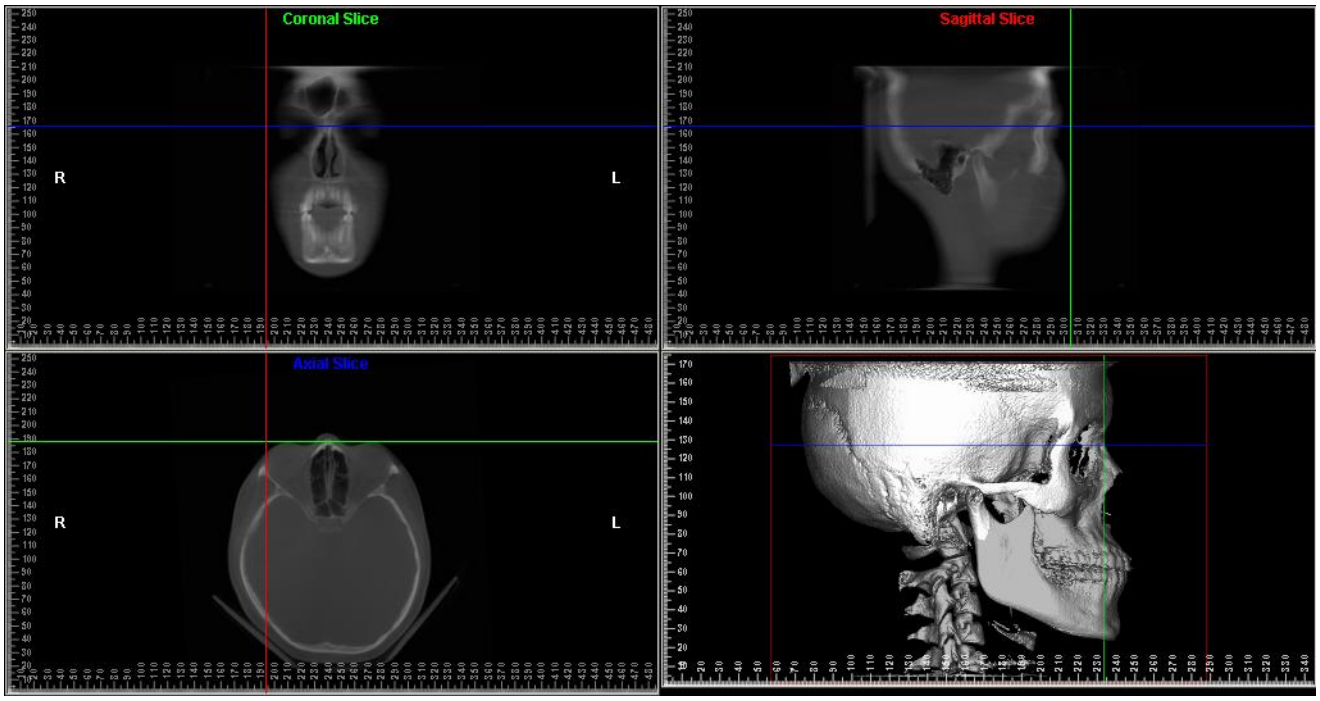

Figure 7: Side view of the tomography, showing the green tangential line to the nasion point.

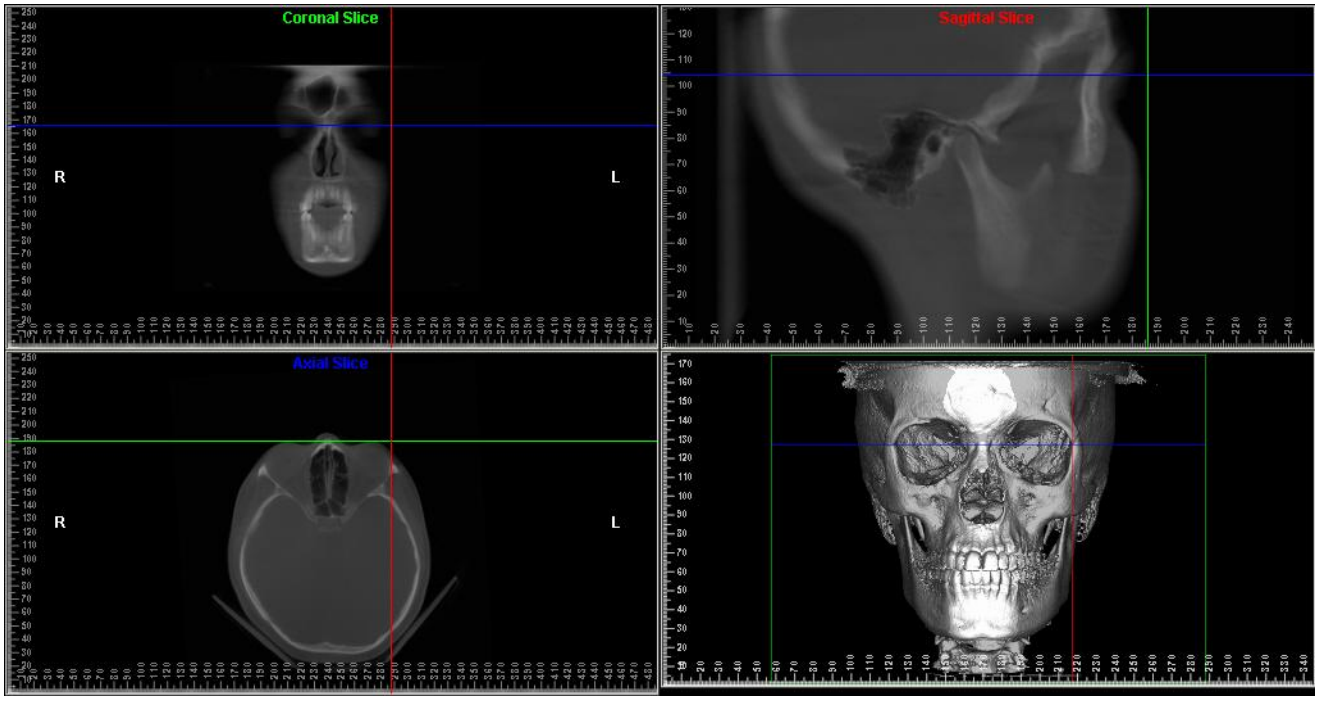

Figure 8: The red line standardizing the sagittal section, which is a tangential line to the side edge of the left orbit to measure the left condyle. The blue line, joining the frontozygomatic sutures.

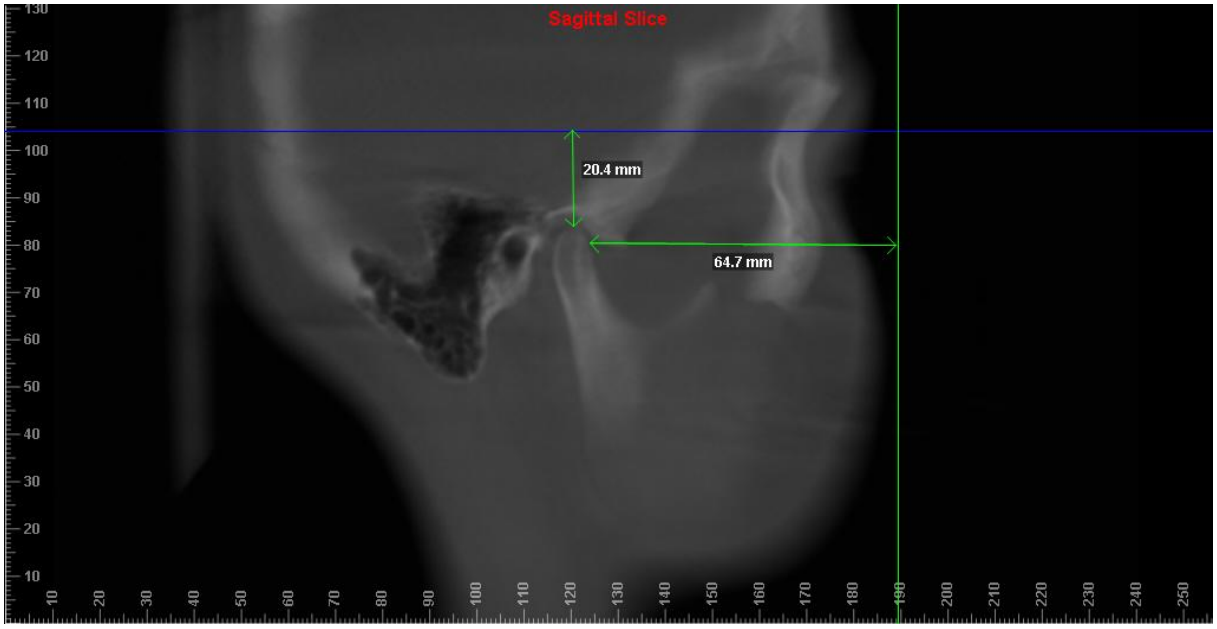

Figure 9: Visualization of the sagittal section, right side, with the reference lines, green and blue and the horizontal and vertical condylar measurements.

The green line standardizing the coronal section was a tangential line to the vertebral column. The red line was positioned on the median line, centralized and the

blue line was maintained passing by the infra-orbital sutures (FIG. 10, 11). For vertical and horizontal condylar measurements, the option “digitilize measure – line” measure the distance from the highest point of the condyle to the blue line and from the most anterior point of the condyle to the red line (FIG.12).

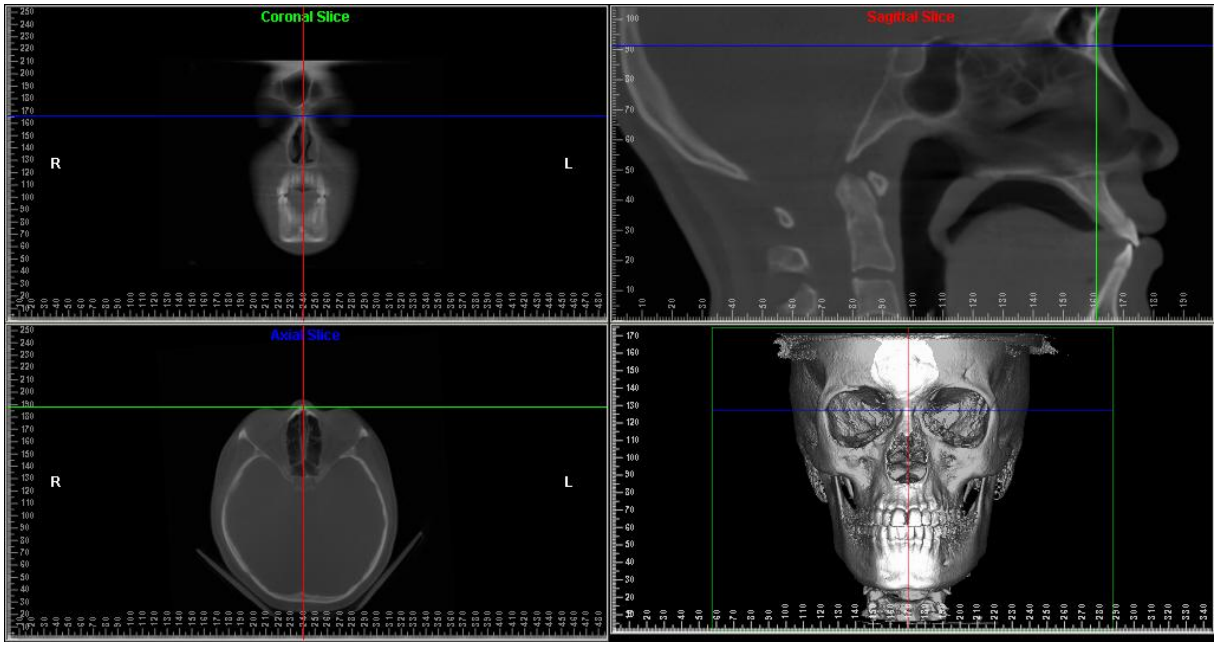

Figure 10: Frontal view of the tomography with the red line centralized. The blue line joining the frontozygomatic sutures.

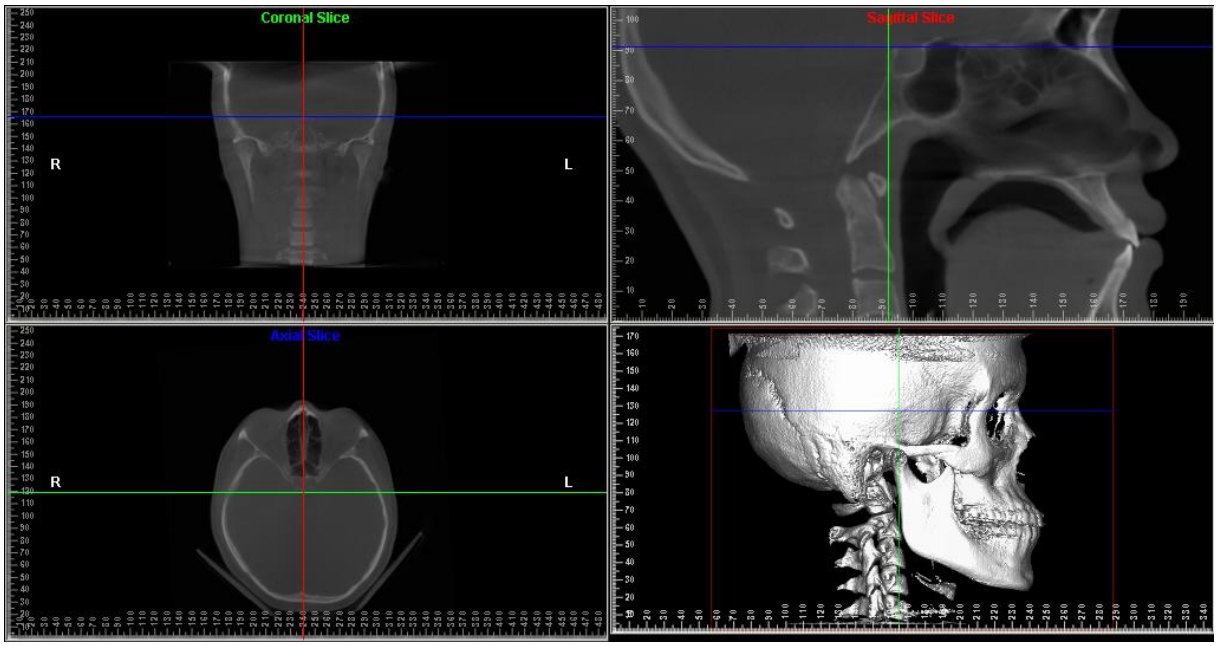

Figure 11: The green line standardizing the coronal section: a tangential line to the vertebral column.

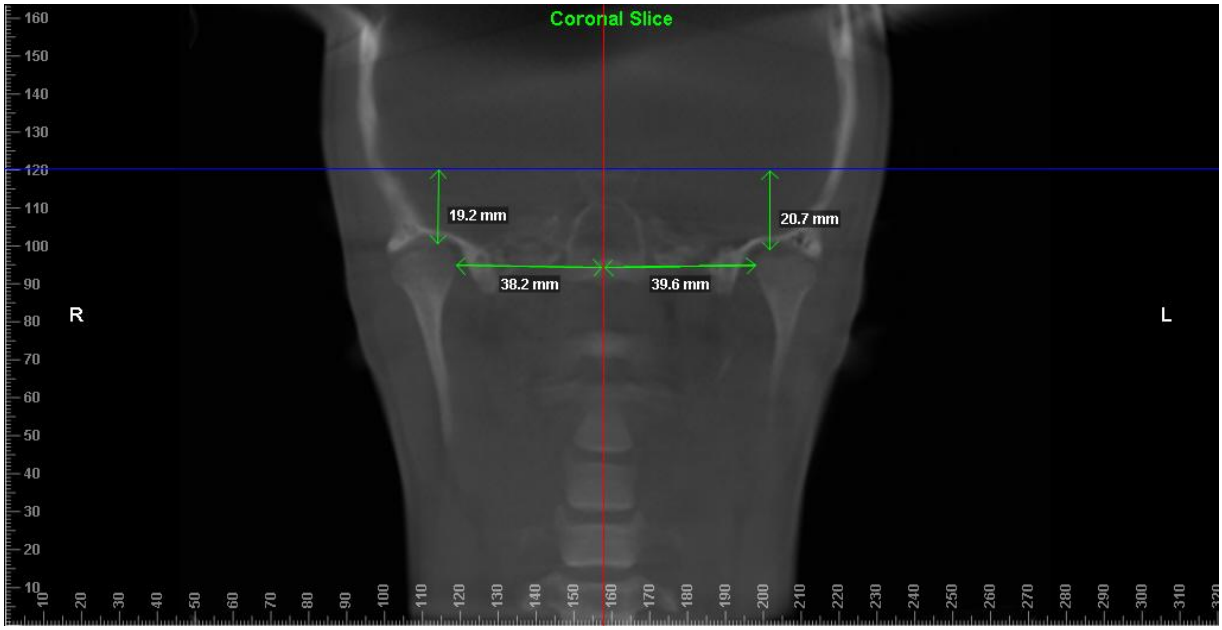

Figure 12: Visualization of the coronal section with the reference lines, red and blue and the horizontal and vertical condylar measurements.

The blue line standardizing the axial section was a tangential line to the lower edge of the articular eminence. The red line was a median and centralized plane and the green one was a tangential line to the nasion point. (FIG. 13, 14). For vertical and horizontal condylar measurements, the option “digitilize measure – line” measured the distance of the highest point of the condyle to the green line and of the most anterior point of the condyle to the red line (FIG.15).

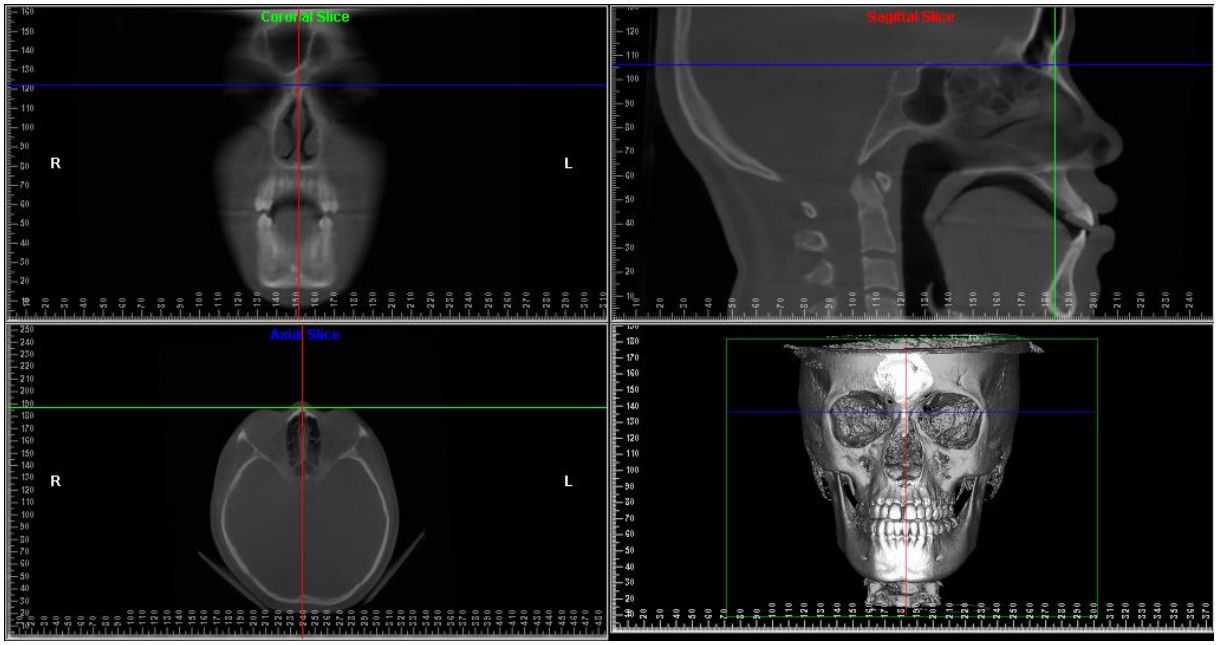

Figure 13: Frontal view with the red line: a central reference for the axial section.

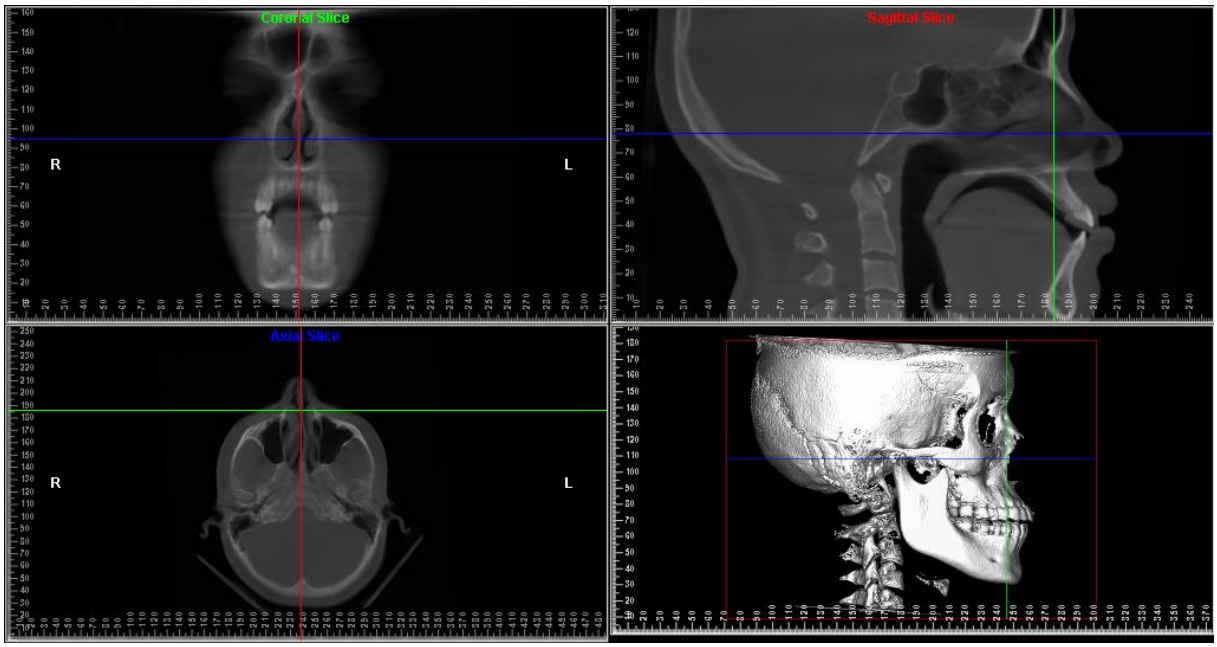

Figure 14: The blue line standardizing the axial section: a tangential line to the lower edge of the articular eminence. The reference green line positioned at the nasion point.

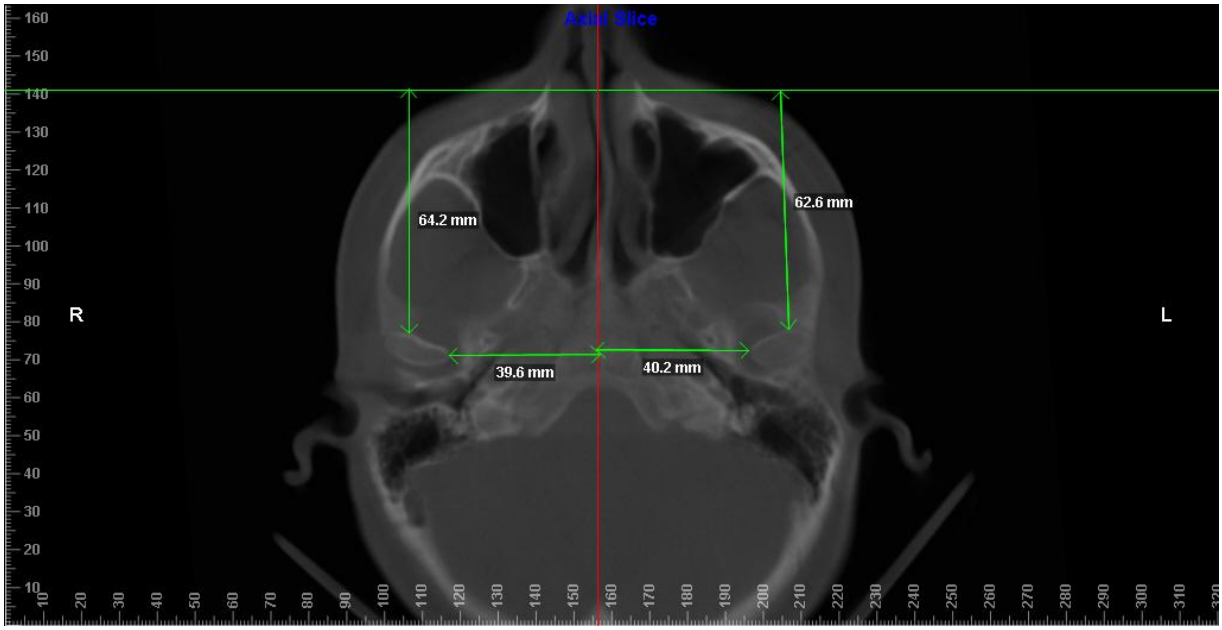

Figure 15: Visualization of the axial section with the reference red and green lines, and the horizontal and vertical condylar measurements.

Statistical analysis

The D'Agostino - Pearson test demonstrated a normal distribution.

The paired t test was used to assess the existence of differences between T1 and T2.

The paired t test was also used to evaluate the existence of systematic and random errors. No statistically significant difference (*P>0.05*) was found between the analyses in any of the variables.

The level of significance was established at 5%. The statistical tests were carried out utilizing the software GraphPad Prism 5.00 (GraphPad Software, San Diego, California, USA).

RESULTS

Sagittal effects in the mandible

There were statistically significant differences between T1 and T2 (*P <0.05*) in the cephalometric measurements SNB (-1,32º) and ANB (+1,01º) (Table 1).

Vertical effects in the mandible

The results showed a significant increase (*P<0.05*) in the angles SNGOGN (+1,79º) and Y-Axis (+1,54º), which suggests inferior and posterior rotation of the mandible. There was no significant increase (*P>0,05*) in the FMA angle (+0,88º).

Linear sagittal effects of the condyles

The sagittal condylar effects are listed in the table. SRH, SLH and SLV presented average increases of 0.27mm, 0.03mm and 0.20mm, respectively. The SRV presented a reduction of -0,48mm. None of these differences was statistically significant (*P>0.05*).

Linear coronal effects of the condyles

The coronal condylar effects are listed in the table. CRH, CLH and CLV presented average increases of 0.12mm, 0.01mm and 0.41mm, respectively. The CRV presented a reduction of -0.58mm. None of these differences was statistically significant (*P>0.05*).

Linear axial effects of the condyles

The axial condylar effects are listed in the table. ARH, ARV ALH and ALV presented average increases of 0.49mm, 0.27mm, 0.15mm and 0.25mm respectively. None of these differences was statistically significant (*P>0.05*).

Table 1 – Comparison between the cephalometric measurements on T1 and T2.

Dimensions	T1		T2		Average of the differences (T2-T1)	Value of p[1]
	Average	SD	Average	SD		
ANB	4.15	1.9	5.16	1.9	1.01	<0.05
SNA	84.02	4.3	83.77	4.2	-0.25	ns
SNB	79.87	4.1	78.55	3.8	-1.32	<0.05
OCC-SN	16.85	3.9	17.20	3.9	0.35	ns
SNGOGN	31.84	5.7	33.63	5.1	1.79	<0.05
FMA	21.45	3.6	22.33	3.7	0.88	ns
Y AXIS	68.23	4.0	69.77	4.0	1.54	<0.05

SD - standard deviation
[1] Value of p obtained by the paired t test: T2 *versus* T1. ns - not significant (p>0,05)

Table 2 – Comparison between the condylar measurements on T1 and T2

Dimensions	T1		T2		Average of the differences (T2-T1)	Value of p[1]
	Average	SD	Average	SD		
SRH	69.59	4.1	69.86	4.4	0.27	ns
SRV	26.22	2.6	25.74	1.9	-0.48	ns
SLH	68.74	4.1	68.77	4.0	0.03	ns
SLV	26.93	2.4	27.13	1.7	0.20	ns
CRH	39.61	1.6	39.73	2.1	0.12	ns
CRV	26.43	2.9	25.85	1.8	-0.58	ns
CLH	38.72	2.8	38.73	2.4	0.01	ns
CLV	26.83	2.5	27.24	1.9	0.41	ns
ARH	39.63	1.8	40.12	1.9	0.49	ns
ARV	68.24	4.1	68.51	4.6	0.27	ns
ALH	38.63	2.8	38.78	2.8	0.15	ns
ALV	67.51	3.9	67.76	3.9	0.25	ns

SD - Standard deviation

[1] Value of p obtained by the paired t test : T2 *versus* T1. Horizontal Condylar Measurement, sagittal/ coronal/ axial section, right condyle (SRH), (CRH), (ARH), vertical condylar measurement, sagittal/coronal/axial section, right condyle (SRV), (CRV), (ARV), horizontal condylar measurement, sagittal/ coronal/axial section, left condyle (SLH), (CLH), (ALH), vertical condylar measurement, sagittal/coronal/axial section, left condyle (SLV),(CLV), (ALV).

ns - not significant (p>0.05)

DISCUSSION

Orthodontic treatment seeks to correct the skeletal and dental malocclusions of individuals. The cephalometric analysis of Downs, Steiner, Ricketts, Tweed, etc…, which were developed to establish the ideal, were done with patients in MI. Although these patients might not have their condyles physiologically positioned in the respective fossas, their profiles and occlusions were accepted as normal and, accordingly, constituted the patterns to which we should compare our patients.[16]

As every orthodontic treatment should accurately diagnose the skeletal and dental disharmonies to define the treatment plan, the orthodontists should be sure that their orthodontic records represent the true anatomical position of all the parts of the stomatognathic system and the relationships between them.

The first objective of this study was to evaluate if there was a difference between the cephalometric measurements in CR and MI. The second step was to analyse if there were any statistical differences that could impact orthodontic diagnosis and planning. There are few studies in the literature evaluating the interrelationship between CR, MI and cephalometry. A previous study showed that the centrically related cephalometric analysis offer greater accuracy of information[17], with a significant difference MI and CR.[9] Faced with this notable discrepancy, cephalometric analysis obtained in the CR mandibular position should be carried out to achieve correct diagnoses and treatment plans.[10]

The results of this study showed statistically significant differences between some cephalometric measurements obtained in CR and MI in the sagittal and vertical planes of the mandible (SNB and ANB; SNGOGN and Y-Axis, respectively). However, these results seems to be of low clinical relevance, as the standards for all the cephalometric measurements present variations of ± 2 graus[18]. Accordingly, this study suggests that cephalometric analysis and their evaluations should continue to be carried out in MI when the anteroposterior CR-MI discrepancy is less than 1.5mm, since it is a easy procedure and with a cost-benefit ratio for the patient, which contrasts with a previous study done with conventional cephalograms.[10]

The limitations associated with the bidimensional images of cephalometry are distortion, enlargement, overlap of different craniofacial structures and image defects, which can affect angular and linear measurements. For this reason, this study evaluated and compared all the cephalometric and condylar measurements with CBCT, which permits the orthodontist more effective and reliable measurements and analyses.[19,20] Another reason for the utilization of CBCT in this study is due to the accuracy in the visualization of craniofacial structures, such as the TMJ, with minimum distortion, at low cost and lower radiation dosage when compared to the conventional CT.[14,21]

The second objective of this study was to analyse if there was any three dimensional modification in the condyle-fossa relations. The results demonstrated that there was no significant CR-MI discrepancy between all the condylar measurements carried out in all planes. However, new studies are necessary to evaluate the impact of CR-MI discrepancies larger than 1.5mm, in the condyle-fossa relation, as the discrepancy between the CR and MI positions is physiologically

acceptable when it is 1 to 2 mm in the anteroposterior direction and less than 0.5 mm transversally and vertically at the condylar level.[22]

Moreover, the clinical applicability of the MI and CR mandibular positions is subject to different opinions due to the existence of contradictory results in the literature.[23,17] Many authors support the use of the CR in restorative occlusal therapies and orthodontic planning[10,15] while others suggest an individual analysis for each clinical situation to determine the ideal mandibular position.[24,25] Therefore, extensive prosthetic restorations, occlusal adjustment, unstable MI with the presence of signs and/or symptoms of disharmony in the stomatognathic system and large CR-MI discrepancies should be planned in CR.[17,25]

CONCLUSION

Based on this clinical trial with CBCT to assess the impact of CR≠MI ≤ 1.5mm in cephalometric and condylar measurements, the following conclusions can be drawn:

a) There were significant differences between the cephalometric analysis carried out in CR and MI, but of low clinical relevance, as the standards for all the cephalometric measurements present variations of ± 2 degrees;
b) There were no significant differences in condilar position between CR and MI in all 3 spatial planes.

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REFERENCES

1. DAWSON PE. New definition for relating occlusion to varying conditions of the temporomandibular joint. J Prosthetic Dent 1995 Dec;74(6):619-27.
2. OKESSON JP. Management of temporomandibular disorders and occlusion.6th ed. St. Louis: Mosby; 2008. p.(83-96).
3. CORDRAY FE. Three-dimensional analysis of models articulated in the seated condylar position from a deprogrammed asymptomatic population: a prospective study. Part 1. Am J Orthod Dentofacial Orthop, St Louis, 2006 May;129(5):619-30.
4. THE ACADEMY OF PROSTHODONTICS. The Glossary of Prosthodontic terms, 8th edition (GPT-8). J Prosthet Dent 2005 July;94(1):10-92.
5. CRAWFORD SD. Condylar axis position, as determined by the occlusion and measured by the CPI instrument, and signs and symptoms of temporomandibular dysfunction. Angle Orthod1998 Jan;69(2):103-16.
6. SARINNAPHAKORN L, MURRAY GM, JOHNSON CWL, KLINENBERG IJ The effect of posterior tooth guidance on non-working side arbitrary condylar point movement. J Oral Rehab,Australia,1997 Sept;24(9):678-90.
7. HUANG BY, WHITTLE T, PECK CC, MURRAY GM. Ipsilateral interferences and working-side condylar moviments. Arch Oral Biol,Australia, 2005 July;51(3):206-14.
8. LUCIA VO. A technique for recording centric relation. J Prosthet Dent,New York, 1964 May-June;14(3):492-505.
9. SHILDKRAUT M, WOOD DP, HUNTER WS. The CR-CO discrepancy and its effect on cephalometric measurements. Angle Orthod1994 Jan;64(5):333-42.
10. AFZAL A, QAMRUDDIN I. Relation between centric slide and Angle's classification. J Col Physic Surg-Pakist,Karachi, 2005 May;15(8):481-4.
11. HIDAKA O, ADASHI S, TAKADA k. The difference in condylar position between centric relation and centric occlusion in pre-treatment Japanese orthodontic patient. Angle Orthod,Japão, 2002 Feb;72(4):295-301.
12. ROTH RH. Functional occlusion for the orthodontist. J Clin Orthod 1981 Jan;15:32-51.
13. STOREY AT. Centric relation treatment (Letters).Angle Orthod, Texas, 1996;66(4):244-6

14. FERREIRA AF, HENRIQUES JCG, ALMEIDA GA, MACHADO AR, MACHADO NAG, FERNANDES NETO AJ.Comparative analysis between mandibular positions in centric relation and maximum intercuspation by cone beam computed tomography (CONEBEAM). J Appl Oral Sci,Uberlândia,2010 Feb;17(sp):27-34.
15. KUMAR V, LUDLOW J, CEVIDANES LHS, MOL A. *In vivo* Comparison of Conventional and Cone Beam CT Synthesized Cephalograms. Angle Orthod,2008 Nov;78(5):873-9.
16. WILLIANSON EH, CAVES SA, EDENFIELD RJ, MORSE PK. Cephalometicanalysis : Comparisons between maximum intercuspation and centric relation. Am J Orthod,Georgia,1978;74(6):672-7.
17. WOOD CR. Centrically related cephalometrics. Am J Orthod 1977;71(2):156-72.
18. DOWNS WB. Variations in facial relationships: Their significance in treatment and prognosis. Am J Orthod1948;34:814-40.
19. FRONGIA G, PIANCINO MG, BRACCO P. Cone-Beam Computed Tomography: Accuracy of Three-dimensional Cephalometry Analysis and Influence of Patient Scanning Position. J Craniofacial Surg 2012 July;23(4):1038-43.
20. GRIBEL BF, GRIBEL MN, FRAZAO DC, MACNAMARA Jr. JA, MANZI FR. Accuracy and reliability of craniometric measurements on lateral cephalometry and 3D measurements on CBCT scans. Angle Orthod 2011 Jan;81(1):26-35.
21. LUDLOW JB, IVANOVIC M. Comparative dosimetry of dental CBCT devices and 64-slice CT for oral and maxillofacial radiology. Oral Surg Oral Med Oral Pathol Oral Radiol,North Carolina, 2008 Mar;20(10):1-9.
22. WILLIANSON EH. Centric relation: a comparison of muscle-determined position and operator guidance. Am J Orthod,Georgia, 1980;77(9):133-45.
23. HENRIQUES JCG, FERNANDES NETO AJ, ALMEIDA GA, MACHADO NAG, LÉLIS ER. Cone-beam tomography assessment of condylar position discrepancy between centric relation and maximal intercuspation. Braz Oral Res 2012 Jan-Feb;26(1):29-35.
24. KESHVAD A, WINSTANLEY RB. An appraisal of the literature on centric relation. Part III. J Oral Rehab 2001 Jan;28(1):55-63.

25. CARLSSON GL. Insights into occlusal problems through the use of centric relation procedures. Part two. Northwest Dent, 2007 Mar-Apr;86(2):31-4,37-9.

4 CONSIDERAÇÕES FINAIS

Esta dissertação intitulada “Avaliação da influência da discrepância entre relação cêntrica e máxima intercuspidação habitual nas medidas cefalométricas e condilares” é parte dos requisitos para a obtenção do título de Mestre em clínicas odontológicas, ênfase em prótese dentária, pela Pontifícia Universidade Católica de Minas Gerais (PUC Minas).

O intuito deste trabalho foi determinar se há diferença significativa entre medidas cefalométricas e condilares obtidas em MIH em comparação àquelas obtidas em RC, e verificar qual seria a ideal para se realizar um planejamento ortodôntico reabilitador.

De acordo com as normas vigentes na PUC Minas esta dissertação gerou o artigo *“A discrepância entre a relação cêntrica e a máxima intercuspidação habitual altera as medidas cefalométricas e condilares?”*

Os pacientes foram devidamente informados da importância deste estudo, como também do uso das TCFC em dois momentos. Para tal, foi realizada uma parceria com a Clínica Mineira de Radiologia Odontológica que ofereceu este exame de imagem tridimensional, pelo mesmo custo da documentação ortodôntica tradicional bidimensional. Todas as tomografias foram custeadas pela pesquisadora responsável, Raquel Parreiras Ferreira, não tendo custo algum para os pacientes. As TCFCs e todo o trabalho experimental realizado sobre elas foram executados em condições idênticas e de forma padronizada, utilizando o programa Dolphin 3D imaging Software 11.5 Premium, oferecido pela clínica de ortodontia da PUC Minas, sendo esperado que a distribuição fosse normal. Essas condições viabilizam e justificam a utilização dos testes estatísticos realizados nessa pesquisa, pois os resultados dos experimentos obedecem a uma distribuição normal.

O curto intervalo de tempo para execução deste estudo e a dificuldade de se conseguir uma amostra com os critérios de inclusão acima mencionados, revelaram-se um obstáculo (112 pacientes foram triados, 25 selecionados e 7 foram descartados pois não aceitaram realizar o tratamento). Entretanto, ao final a amostra coletada se mostrou homogênea em relação ao sexo dos indivíduos (9 homens e 9 mulheres). Quanto a faixa etária, apenas 2 partícipes apresentavam idade superior a 18 anos. Como este estudo foi realizado em um espaço de tempo muito pequeno, não houve qualquer influência do crescimento sobre a amostra.

REFERÊNCIAS

AFZAL, A.; QAMRUDDIN, I. Relation between centric slide and Angle's classification. **Journal of the College of Physicians and Surgeons-Pakistan,** Karachi, v.15, n.8, p. 481-484, May 2005.

CORDRAY, F.E. Three-dimensional analysis of models articulated in the seated condylar position from a deprogrammed asymptomatic population: a prospective study. Part 1.**American Journal Orthodontic and Dentofacial Orthopedics,** St Louis, v.129, n.5, p. 619-630, May 2006.

CRAWFORD, S.D. Condylar axis position, as determined by the occlusion and measured by the CPI instrument, and signs and symptoms of temporomandibular dysfunction. **The Angle Orthodontist,** v.69, n.2, p.103-116, Jan. 1998.

DAWSON, P.E. New definition for relating occlusion to varying conditions of the temporomandibular joint. **TheJournal of Prosthetic Dentistry,** v.74, n.6, p.619-627, Dec. 1995.

DOWNS, W.B. Variations in facial relationships: Their significance in treatment and prognosis. **American Journal of Orthodontics,** v.34, p.814-840, 1948.

FERREIRA, A.F.et al.Comparative analysis between mandibular positions in centric relation and maximum intercuspation by cone beam computed tomography (CONEBEAM). **Journal of Applied Oral Science,** Uberlândia,v.17, n.sp, p. 27-34, Feb. 2010.

FRONGIA, G.; PIANCINO, M.G.; BRACCO, P. Cone-Beam Computed Tomography: Accuracy of Three-dimensional Cephalometry Analysis and Influence of Patient Scanning Position. **The Journal of Craniofacial Surgery**, v.23, n.4, p. 1038-1043, July 2012.

GRIBEL, B.F. et al. Accuracy and reliability of craniometric measurements on lateral cephalometry and 3D measurements on CBCT scans. **The Angle Orthodontist**, v. 81, n.1, p. 26-35, Jan. 2011.

HUANG, B.Y. et al. Ipsilateral interferences and working-side condylar moviments. **Archives or Oral Biology,** Australia, v.51, n.3, p. 206-214, July 2005.

KUMAR, V. et al.*In Vivo* Comparison of Conventional and Cone Beam CT Synthesized Cephalograms. **The Angle Orthodontist,** v.78, n.5, p. 873-879, Nov. 2008.

LUCIA, V.O. A technique for recording centric relation. **TheJournal of Prosthetic Dentistry,** New York, v.14, n.3, p. 492-505, May/June 1964.

OKESSON, J.P. **Management of temporomandibular disorders and occlusion.** 6th ed. St. Louis: Mosby, 2008.

ROTH, R.H. Funcional occlusion for the orthodontist. **Journal of Clinical Orthodontics,** v.15, p. 32-51, Jan.1981.

SARINNAPHAKORN, L. et al. The effect of posterior tooth guidance on non-working side arbitrary condylar point movement. **Journal of Oral Rehabilitation,** Australia,v.24, n.9, p. 678-690, Sept. 1997.

SHILDKRAUT, M.; WOOD, D.P.; HUNTER, W.S. The CR-CO discrepancy and its effect on cephalometric measurements. **The Angle Orthodontist,** v.64, n.5, p. 333-342, Jan. 1994.

STOREY, A.T. Centric relation treatment (Letters). **The Angle Orthodontist**, Texas, v.66, n.4, p. 244-246, 1996.

THE ACADEMY OF PROSTHODONTICS. The Glossary of Prosthodontic terms, 8th edition (GPT-8). **The Journal of Prosthetic Dentistry,** v.94, n.1, p. 10-92, July 2005.

WILLIANSON, E.H. et al. Cephalometric analysis: Comparisons between maximum intercuspation and centric relation. **American Journal of Orthodontics,** Georgia,v.74, n.6, p. 672-677, 1978.