UNIVERSIDADE FEDERAL DE GOIÁS
FACULDADE DE MEDICINA
PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIAS DA SAÚDE

OLAVO CESAR LYRA PORTO

Referências cefalométricas tridimensionais da simetria dentoesquelética

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Dissertação de Mestrado apresentada ao Programa de Pós-Graduação da Faculdade de Medicina da Universidade Federal de Goiás para obtenção do Título de Mestre em Ciências da Saúde

Orientador: Prof. Dr. Carlos Estrela
Co-orientador: Prof. Dr. Jairo Curado de Freitas

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Dedicatória

Dedico este trabalho aos meus pais que tanto se esforçaram e me apoiaram durante a minha formação.

Deus não escolhe os capacitados. Ele capacita os escolhidos. Fazer ou não fazer algo só depende da nossa vontade e perseverança. (Albert Einstein)

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Sumário

Símbolos, siglas e abreviaturas

%	Porcentagem
&	“e” comercial
*	Asterisco
“	Aspas
±	Variação estatística de desvio-padrão (para mais e para menos)
≤	Menor e igual
<	Menor
≥	Maior e igual
>	Maior
∑	Somatório
$\sqrt{\ }$	Raíz quadrada
®	Marca registrada
2D	Bidimensional
3D	Tridimensional
ALARA	Baixo quanto razoavelmente possível (do inglês: As Low As Reasonably Achievable)
CIRO	Centro Integrado de Radiologia Odontológica
cm	Centímetro
DP	Desvio-padrão
EUA	Estados Unidos da América
GHz	Giga-hertz
Inc	Incorporation
KVp	Quilovoltagem pico
mA	Miliampère
mm	Milímetros
nº	Número
º	Graus
p	Nível de significância
TC	Tomografia computadorizada
TCFC	Tomografia computadorizada de feixe cônico
$\bar{X}$	Média

Resumo

Objetivo: verificar a simetria facial e dentoesquelética por meio de fotografia frontal e tomografia computadorizada de feixe cônico, respectivamente, em indivíduos brasileiros portadores de má oclusão Classe I de Angle. **Material e Método:** a amostra do estudo foi selecionada de um banco de imagens de 47 pacientes (22 mulheres e 25 homens) com idade entre 11 e 16 anos em um serviço privado de radiologia. Todas as imagens foram obtidas de pacientes com indicação de tratamento ortodôntico no período de janeiro de 2009 a dezembro de 2010. Medidas cefalométricas foram obtidas por meio de reconstruções multiplanares (axial, coronal e sagital) com auxilio do programa Vista Dent3DPro 2.0. O valor mínimo, o máximo, a média e o desvio-padrão das medidas foram determinados e a diferença estatística entre as medidas do lado esquerdo e direito foi analisada por meio do teste-t e Mann-Whitney. Foram considerados significativos valores de $p < 0,05$. **Resultados:** As medidas cefalométricas mostraram dados homogêneos. O lado direito e esquerdo exibiram variações nas análises cefalométricas tridimensionais. 61,70% dos pacientes foram considerados simétricos na avaliação fotográfica frontal. **Conclusão:** Indivíduos brasileiros com classe I de Angle apresentaram simetria facial na maioria dos pacientes, com variações entre o lado direito e esquerdo.

Palavras-chave: Cefalometria tridimensional, diagnóstico por imagem, imaginologia, simetria dentoesquelética, tomografia computadorizada de feixe cônico.

Abstract

Objective: To evaluate dentoskeletal symmetry in cone beam computed tomography (CBCT) scans of Brazilian individuals with Angle class I malocclusion. **Materials and methods**: Forty seven patients (22 girls) aged 11 to 16 years (14 years) seen in a private radiology service (CIRO, Goiânia, GO, Brazil). All the CBCT images were acquired from January 2009 to December 2010. Cephalometric measurements were made by multiplanar reconstructions (axial, coronal and sagittal) using Vista Dent3DPro 2.0 (Dentsply GAC, New York, USA). The minimum, maximum, mean and standard deviation values were described in tables, and the Student *t* test was used to define statistical significance ($p<0.05$). **Results**: Data were homogeneous, and the differences between right and left sides were not significant. **Conclusion**: The cephalometric measures of Brazilian individuals with Angle class I malocclusion can be used to define facial symmetry and three-dimensional standard references, which might be useful for orthodontic and surgical planning.

Keywords: Cone-beam computed tomography, image diagnosis, three-dimensional cephalometry, dentoskeletal symmetry, imaging.

1. Introdução

A análise da assimetria esquelética por meio de radiografias cefalométricas e panorâmicas em indivíduos que necessitam de tratamento ortodôntico constitui constante desafio e requer cuidado.

O conhecimento do modelo e direção de crescimento craniofacial, da anatomia esquelética, do posicionamento dentário e suas relações com as bases ósseas, e a avaliação de perfil são essenciais dentro de um adequado planejamento[1]. As grandezas lineares e angulares, objeto da cefalometria, a partir de medidas ósseas, dentárias e faciais favorecem o estabelecimento de estratégias de diagnóstico e tratamento.

A teleradiografia cefalometrica lateral permite ao profissional obter medidas cefalométricas que expressam a normalidade entre os indivíduos considerados portadores de faces harmônicas[2]. Takahashi *et al.* (2005)[3] analisaram em telerradiografias cefalométricas as estruturas esqueléticas da face no sentido craniocaudal (vertical) com o objetivo de obter os valores médios de normalidade de jovens brasileiros, descendentes de xantodermas e leucodermas, com oclusão normal; verificar a presença ou ausência de dimorfismo entre os gêneros; e investigar a existência de diferenças ou semelhanças entre os grupos raciais estudados. Os resultados sinalizaram, em algumas das grandezas cefalométricas, a presença de dimorfismo entre os gêneros e diferenças entre os grupos raciais. Todavia, nas análises cefalométricas de perfil, a avaliação tem sido realizada no individuo em norma lateral, a qual não permite determinar o real grau de assimetria da face.

A radiografia póstero-anterior permite verificar aspectos como as medidas cefalométricas do lado esquerdo e direito, porém, devido à quantidade de distorções e sobreposições de imagens, não tem conquistado popularidade similar as das radiografias cefalométricas lateral. Este fato basea-se na ausência de uma análise confiável para a tomada de uma decisão terapêutica, seja cirúrgica ou ortodôntica[4].

Falhas de interpretações em imagens podem estar associadas à sobreposição de estruturas anatômicas e ser favorecidas pelas distorções nas imagens radiográficas. O correto manejo do paciente durante a aquisição da imagem também constitui um fator de risco, o qual pode afetar a sua qualidade. As radiografias bidimensionais apresentam limitações que podem comprometer ou dificultar o planejamento e o resultado do tratamento proposto[4-6].

O advento da tomografia computadorizada de feixe cônico (TCFC) trouxe várias perspectivas ao planejamento, desenvolvimento e acompanhamento dos tratamentos odontológicos em múltiplas especificidades[7-21]. Farman & Scarfe (2006)[16] relataram que os vários sistemas de TCFC permitem reconstruções comparáveis com as tradicionais projeções cefalométricas. No entanto, ressaltaram que a precisão do diagnóstico e eficácia das imagens a partir de TCFC deveriam ser comparadas com as imagens cefalométricas convencionais e, que critérios de seleção baseados em evidências deveriam ser desenvolvidos para TCFC com aplicação ortodôntica.

Quando se utiliza a radiação ionizante, os principios de ALARA (tão baixo quanto razoavelmente possível) devem ser respeitados, requerendo atenção para obteção a melhor relação custo-benefício possível entre informação e dosagem[22,23].

Considerando que a análise cefalométrica envolve medidas lineares e angulares de tecidos duros e moles do complexo craniofacial, a possibilidade da aquisição de imagens por TCFC tem contribuido nas análises de assimetrias faciais[24]. A referência cefalométrica convencional e o uso de mensurações tridimensionais (3D) em imagens de TCFC demonstraram diferentes perspectivas entre os modelos de exames[25,26].

Neste sentido Swennen *et al.*[27] *e* Swennen & Schtyser[28], em 2006, propuseram um método cefalométrico em três dimensões. Em 2011 Cheung *et al*[29] desenvolveram um novo modelo de análise cefalométrica tridimensional aplicável a deformidades dentofaciais e estabeleceram um parâmetro de normas de mensurações cefalométricas em chineses adultos. Cavalcanti *et al.* (2004)[30] avaliaram a precisão de algumas medidas craniofaciais, ósseas e tegumentares, por meio de tomografia computadorizada (TC), obtidas pela técnica de volume utilizando uma estação de trabalho independente e um programa de computação gráfica. As mensurações em 3D-TC proporcionaram uma avaliação real das mudanças no crescimento e no desenvolvimento.

O objetivo do presente estudo foi verificar a simetria facial e dentoesquelética em indivíduos portadores de má oclusão Classe I de Angle por imagens fotograficas frontais e por meio de tomografia computadorizada de feixe cônico, respectivamente.

2. Proposição

O objetivo do presente estudo foi verificar a simetria facial e a simetria dentoesquelética de indivíduos brasileiros portadores de má oclusão Classe I de Angle por imagens fotograficas frontais e por meio de tomografia computadorizada de feixe cônico, respectivamente.

3. Material e método

Seleção da amostra

Foram examinadas imagens de um banco de dados de uma clínica radiológica privada (Centro Integrado de Radiodontologia, CIRO, Goiânia, Goiás, Brasil) cujos pacientes foram encaminhados para avaliação radiológica com finalidade ortodôntica. Os critérios de inclusão envolveram exames de indivíduos portadores de má oclusão Classe I de Angle, presença de apinhamento, ausência de cárie dentária, periodontites marginais e apicais. Foram excluídos do estudo indivíduos portadores de má oclusão Classe II e III de Angle, com ausência de dentes, de alterações de desenvolvimento dentário/esquelético, de lesão dentária/óssea traumática e de tratamento ortodôntico prévio.

A amostra consistiu em 47 imagens de pacientes (22 mulheres e 25 homens) com idade entre 11 e 16 anos (média de 14 anos). Este estudo foi aprovado pelo Comitê de Ética em Pesquisa local (Universidade Federal de Goiás, Brasil, Processo # 296/2011).

Método de determinação de simetria facial

Todas as fotografias foram obtidas pelo mesmo operador sendo utilizada uma máquina fotográfica digital Sony Cyber-Shot DSC-S85, 4 megapixels, macro de 4 cm, super HAD CCD™ 1/1,8 polegadas, lente Carl Zeiss® Vario-

Sonnar®, flash circular Canon, tripé Zenit TZ-40 a distância de 1,5 m entre a máquina e o paciente. De todos os 47 pacientes foram realizadas fotografias frontais da face e os mesmos foram instruídos a manter os labios em posição relaxada e levemente selados, e uma postura ereta, “natural e normal”, com ambos os braços livres ao lado do tronco. Essa posição corresponde à “posição natural de cabeça” de Broca[50] .

As imagens fotográficas frontais foram submetidas a análise subjetiva visual quanto a presença de simetria facial, por cinco especialistas em ortodontia utilizando um computador com sistema operacional *Microsoft Windows®* XP *Professional* (*Microsoft Corporation*, Redmond, WA, EUA), com processador Intel Core® 2 Duo 1,86 Ghz-6300 (*Intel Corporation*, EUA), placa de vídeo NVIDIA GeForce 6200 turbo cache (NVIDIA *Corporation*, EUA) e monitor EIZO - S2000 FlexScan, resolução de 1600 x 1200 pixels. Foram classificados como simétricos somente aqueles pacientes cujas faces houveram concordância em pelo menos três avaliadores.

Método de obtenção da imagem

As imagens de TCFC foram obtidas em clínica radiológica privada (Centro Integrado de Radiologia Odontológica - CIRO, Goiânia, Goiás, Brasil) com o tomógrafo i-CAT (*Imaging Sciences Internationa*l, Hatfield, PA, EUA). Os volumes foram reconstruídos com 0,25 mm de voxel isométrico, tensão de tubo de 120 kVp e corrente do tubo de 3,8 mA. O tempo de exposição foi de 40 segundos (dimensão de escaneamento de 13 cm), escala de cinza (14 *bits*), distancia focal: 0,5 mm e aquisição de imagem com rotação única de 360°. As imagens foram analisadas com o *programa* Xoran versão 3.1.62 (Xoran *Technologies*, Ann Arbor, MI, EUA), próprio do tomógrafo i-CAT em um computador com sistema operacional *Microsoft Windows*® XP *Professional* (*Microsoft Corporation*, Redmond, WA, EUA), com processador Intel Core® 2 Duo 1,86 Ghz-6300 (*Intel Corporation*, EUA), placa de vídeo NVIDIA GeForce 6200 turbo cache (NVIDIA *Corporation*, EUA) e monitor EIZO - S2000 FlexScan, resolução de 1600 x 1200 pixels. Após a reconstrução do rawdata foram gerados os arquivos DICOM para cada paciente.

Medidas cefalométricas

Após obtenção das imagens tridimensionais, os arquivos DICOM foram importados para o programa VistaDent 3D Pro 2.00 (Dentsply GAC, Nova York, EUA). Foram selecionados para o estudo 17 pontos cefalométricos para avaliação da simetria dentoesquelética. A identificação dos pontos cefalométricos foi realizada por um operador (especialista em ortodontia) calibrado e com mais de cinco anos de experiência com o programa utilizado. O método adotado consistiu na marcação de pontos da maxila, mandíbula e articulação têmporo mandibular (ATM), com auxilio das reconstruções multiplanares axial, coronal e sagital (Figura 1). Ferramentas de aprimoramento de imagem e aumento máximo foram utilizadas para assegurar que cada ponto cefalométrico fosse marcado precisamente em todas as reconstruções multiplanares. Após a identificação dos pontos cefalométricos (Quadro 1) e imagem ilustrativa (Figura 2) foram definidos os planos de referência (Quadro 2) e iustração (Figura 3). Automaticamente as medidas lineares foram mensuradas pelo próprio programa (Quadro 3, Figuras 4 e 5). Os valores obtidos foram transcritos para uma tabela do *Microsoft Office Excel®* versão 2010.

Erro do método

Para verificar o erro do método ao realizar as mensurações por meio das reconstruções multiplanares, todas as medidas foram repetidas e a fórmula de *Dahlberg* ($s = \sqrt{\sum d^2/2n}$) aplicada, na qual "*d*", representa a diferença entre as medidas duplicadas e "*n*". Com esse teste verificou-se ausência de significância estatística[49].

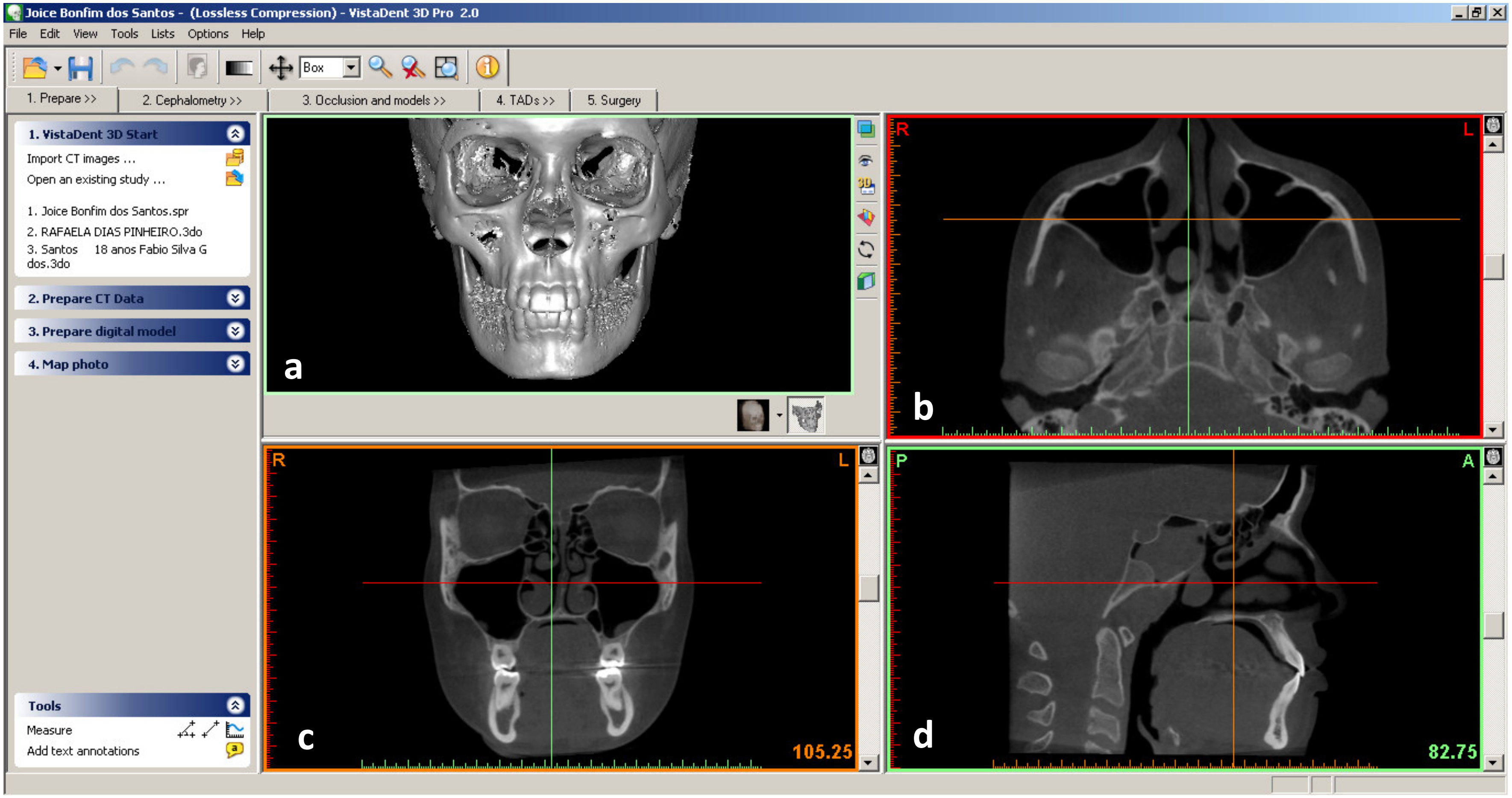

Figura 1. Módulo cefalométrico 3D do programa VistaDent 3D Pro 2.00 (Dentsply GAC, Nova York, EUA). Reconstrução 3D (a), reconstrucões multiplaneres: axial (b), coronal (c) e sagital (d).

Quadro 1. Pontos cefalométricos.

Pontos cefalométricos	Descrição dos pontos cefalométricos
Porio D (Po D)	Ponto mais superior do meato acústico direito
Porio E (Po E)	Ponto mais superior do meato acústico esquerdo
Orbitare D (Or D)	Ponto mais inferior da borda infraorbital direita
Orbitare E (Or E)	Ponto mais inferior da borda infraorbital esquerda
Espinha Nasal Anterior (ENA)	Ponto mais anterior da espinha nasal anterior da maxila
Espinha Nasal Posterior (ENP)	Ponto mais posterior da espinha nasal posterior da maxila
Capitulare D	Centro da cabeça da mandíbula direita
Capitulare E	Centro da cabeça da mandíbula esquerda
Condilio D (Co D)	Ponto mais superior e posterior do côndilo mandibular direito
Condilio E (Co E)	Ponto mais superior e posterior do côndilo mandibular esquerdo
#16	Ponto mais profundo da fossa central do primeiro molar superior direito
#26	Ponto mais profundo da fossa central do primeiro molar superior esquerdo
#36	Ponta da cúspide disto-vestibular do primeiro molar inferior esquerdo
#46	Ponta da cúspide disto-vestibular do primeiro molar inferior direito
Gônio D (Go D)	Ponto médio da borda posterior do ângulo da mandíbula do lado direito.
Gônio E (Go E)	Ponto médio da borda posterior do ângulo da mandíbula do lado esquerdo.
Gnatio (Gn)	Ponto mais anterior e inferior da sínfise mandibular

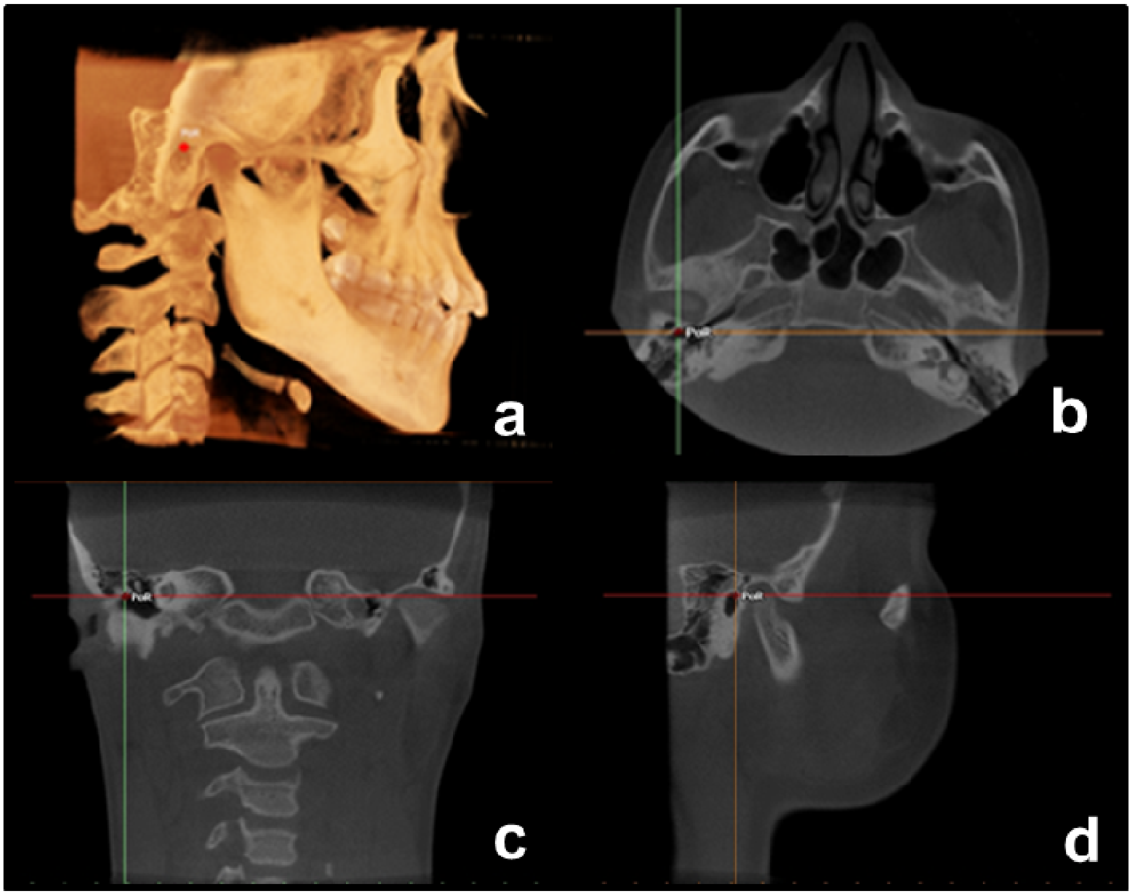

Figura 2. Imagem ilustrativa de ponto cefalométrico porio direito (Po D) identificado na reconstrução 3D (a), multiplanares axial (b), coronal (c) e sagital (d).

Quadro 2.Planos utilizados como referência das medidas cefalométricas

Planos de referência	Descrição dos planos
Plano Horizontal de Frankfurt (PHF)	Estabelecido unindo os pontos pórios direito e esquerdo ao ponto orbitare esquerdo
Plano Coronal (PC)	Estabelecido unindo os pontos pórios direito e esquerdo sendo perpendicular ao Plano Horizontal de Frankfurt
Plano Sagital Mediano(PSM)	Estabelecido unindo os pontos espinha nasal anterior e posterior sendo perpendicular ao Plano Horizontal de Frankfurt
Plano Horizontal Maxilar (PHM)	Estabelecido unindo os pontos espinha nasal anterior e posterior sendo perpendicular ao Plano Sagital Mediano
Plano Mandibular (PMD)	Estabelecido unindo os pontos gônio direito e esquerdo ao ponto gnatio

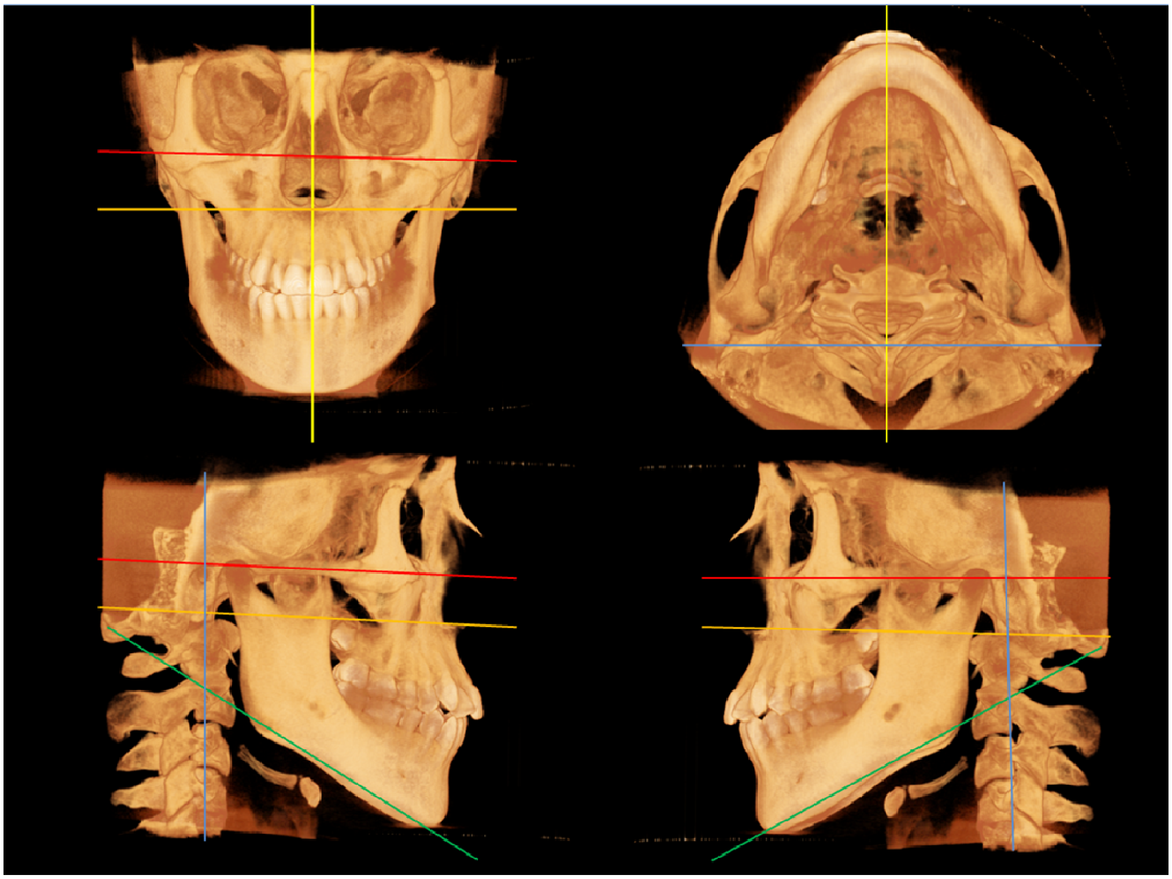

Figura 3. Imagem ilustrativa das reconstruções tridimensionais dos planos de referência horizontal de Frankfurt (vermelho), coronal (azul), sagital Mediano (amarelo), horizontal maxilar (alaranjado) e mandibular (verde).

Quadro 3. Medidas cefalométricas.

Maxilares	Descrição
#16-Plano Coronal	Fossa central do #16 ao Plano Coronal
#26-Plano Coronal	Fossa central do #26 ao Plano Coronal
#16-Plano Sagital	Fossa central do #16 ao Plano Sagital
#26-Plano Sagital	Fossa central do #26 ao Plano Sagital
#16-ENA	Fossa central do #16 à Espinha Nasal Anterior
#26-ENA	Fossa central do #26 à Espinha Nasal Anterior
#16-Altura Plano Maxilar	Fossa central do #16 ao Plano Horizontal Maxilar
#26-Altura Plano Maxilar	Fossa central do #26 ao Plano Horizontal Maxilar
#16-Altura PHF	Fossa central do #16 ao Plano Horizontal de Frankfurt
#26-Altura PHF	Fossa central do #26 ao Plano Horizontal de Frankfurt
Mandibulares	
#36- Plano Coronal	Cúspide disto-vestibular do #36 ao Plano Coronal
#46- Plano Coronal	Cúspide disto-vestibular do #46 ao Plano Coronal
#36-Gn	Cúspide disto-vestibular do #36 ao ponto Gnatio
#46-Gn	Cúspide disto-vestibular do #46 ao ponto Gnatio
#36-Altura Plano Mandibular	Cúspide disto-vestibular do #36 ao plano mandibular do lado esquerdo
#46-Altura Plano Mandibular	Cúspide disto-vestibular do #46 ao plano mandibular do lado direito
Condilio D-Gn	Condilio ao ponto Gnatio
Condilio E-Gn	Condilio ao ponto Gnatio

Condilio D-GoD	Condilio direito ao ponto Gonio direito
Condilio E-Go E	Condilio esquerdo ao ponto Gônio esquerdo
Go D-Gn	Gônio direito ao ponto Gnatio
Go E-Gn	Gônio esquerdo ao ponto Gnatio
PHF-Go D	Plano Horizontal de Frankfurt ao ponto Gônio direito
PHF-Go E	Plano Horizontal de Frankfurt ao ponto Gônio esquerdo
ATM	
Capitulare D- Plano Sagital	Capitulare D ao Plano Sagital Mediano
Capitulare E-Plano Sagital	Capitulare E ao Plano Sagital Mediano
Capitulare D- Plano Coronal	Capitulare D ao Plano Coronal
Capitulare E- Plano Coronal	Capitulare E ao Plano Coronal
Capitulare D-PHF	Capitulare D ao Plano Horizontal de Frankfurt
Capitulare E-PHF	Capitulare E ao Plano Horizontal de Frankfurt

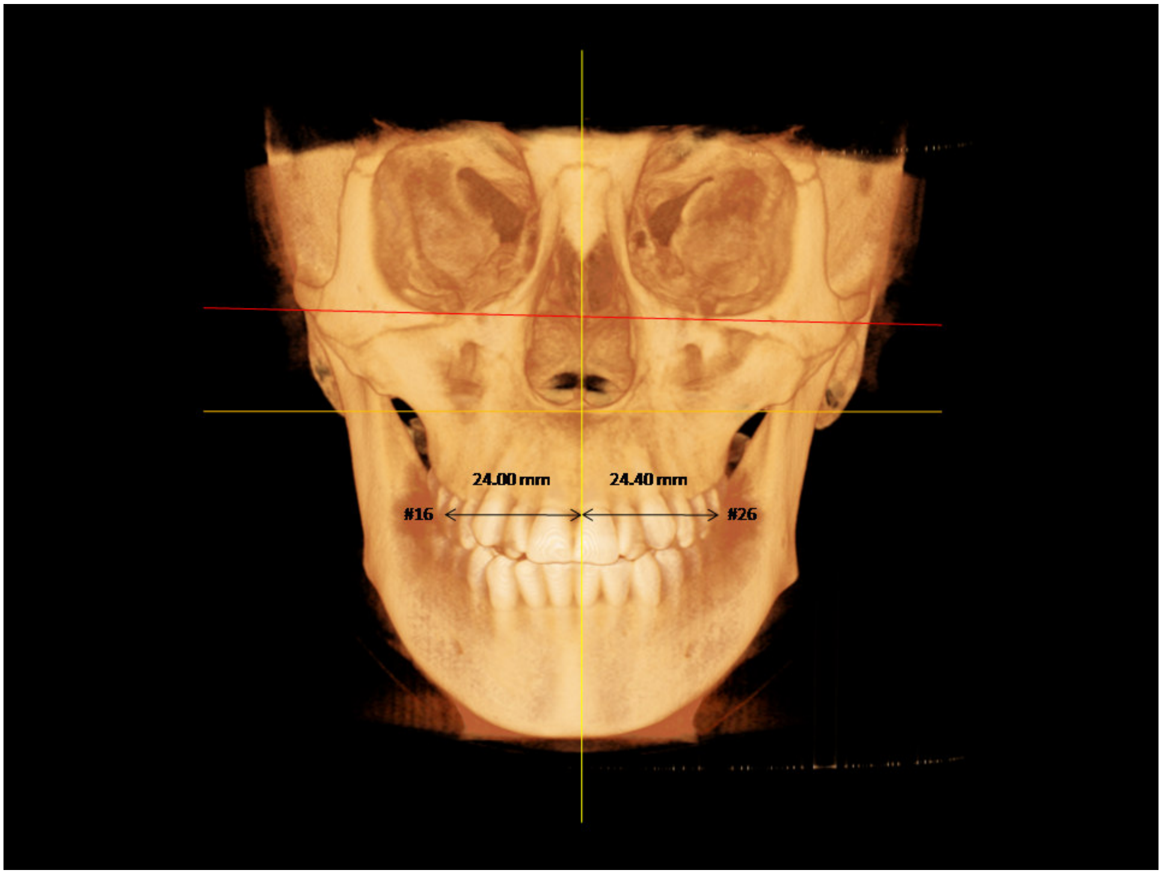

Figura 4. Imagem ilustrativa tridimensional das medidas cefalométricas entre os pontos #16 e #26 ao plano sagital (amarelo) realizadas nas reconstruções multiplanares.

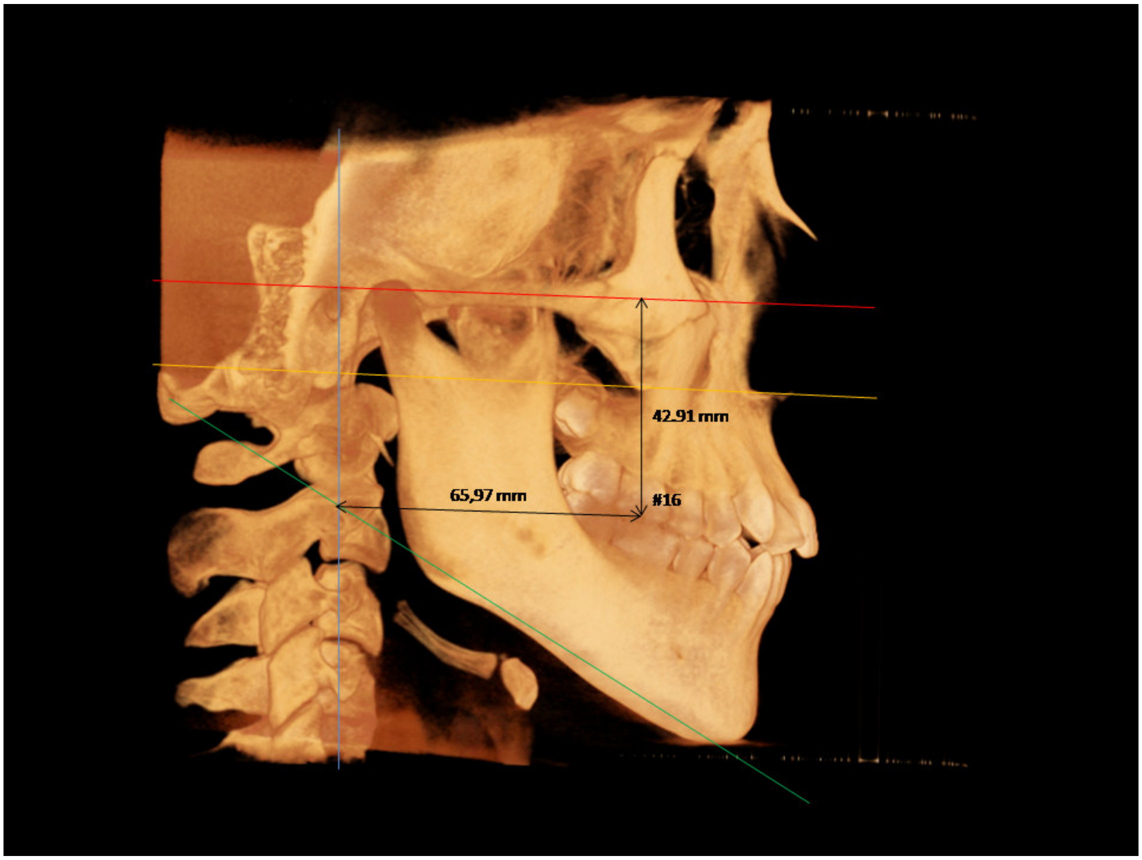

Figura 5. Imagem ilustrativa tridimensional das medidas cefalométricas do ponto #16 ao plano horizontal de Frankfurt (vermelho) e ao plano coronal (azul) realizadas nas reconstruções multiplanares.

Análise estatística

A análise estatística das medidas foi realizada utilizando o software Statistical Package for the Social Sciences, versão 20 (SPSS, Chicago, IL, EUA). Os valores mínimos, máximos, as médias e desvios-padrões das medidas foram descritas em tabelas e a diferença estatística entre os grupos foi analisada por meio do teste-t e Mann-Whitney. Foram considerados significativos valores de $p < 0,05$.

4. Resultados

As análises fotográficas frontais foram considerados 29 pacientes simétricos (61,70%) e 18 pacientes assimétricos (39,30%). Os resultados estão descritos nas tabelas 1 e 2. A tabela 1 apresenta os valores mínimos, máximos, médias e desvios-padrões das medidas cefalométricas encontrados na maxila, mandíbula e ATM. A tabela 2 mostra as diferenças entre as medidas do lado esquerdo e direito.

Tabela 1. Médias e desvios-padrões de medidas cefalométricas em indivíduos com Classe I de Angle (n= 47).

Medidas cefalometricas	Valores mínimos e máximos (mm)				Média e desvio-padrão $(\bar{X} \pm S)$		
Maxilares							
	Mínimo	Máximo	Mínimo	Máximo			
	#16		#26		#16 $(\bar{X} \pm S)$	#26 $(\bar{X} \pm S)$	*P*
#16/26-Plano Coronal	51,30	71,11	52,63	70,35	61,56 ± 4,47	61,22 ± 4,12	0,702
#16/26-Plano Sagital	19,96	26,47	19,56	26,51	23,33 ± 1,45	23,48 ± 1,51	0,633
#16/26-ENA	38,60	51,74	38,36	51,37	44,75 ± 2,85	44,94 ± 2,91	0,745
#16/26-PHM	15,10	25,69	14,61	27,44	20,56 ± 2,85	20,54 ± 2,79	0,631
#16/26-PHF	31,97	49,21	31,32	47,82	40,36 ± 3,48	40,27 ± 3,45	0,908
Mandibulares							
	#46		#36		#36 $(\bar{X} \pm S)$	#46 $(\bar{X} \pm S)$	*p*
#16/26-Plano Coronal	50,72	71,27	52,21	69,05	61,62 ± 4,33	61,60 ± 4,59	0,903
#16/26-Gn	45,24	59,05	44,79	57,05	49,68 ± 2,50	49,74 ± 2,85	0,913
#16/26-Altura-GoGn	22,12	30,77	21,84	31,40	25,81 ± 2,19	25,92 ± 1,99	0,807
	Direito		Esquerdo		Esquerdo $(\bar{X} \pm S)$	Direito $(\bar{X} \pm S)$	*P*
Condilio-Gn	101,24	127,48	100,27	126,6	117,11 ± 4,74	117,42 ± 4,71	0,752
Condilio-Go	42,18	59,12	43,58	60,20	49,42 ± 3,33	49,84 ± 3,50	0,557
Go-Gn	76,45	92,85	77,61	90,4	84,51 ± 3,37	84,66 ± 3,44	0,831
PHF-Go	43,12	62,98	41,94	63,94	51,42 ± 4,23	51,88 ± 4,28	0,602
ATM							
	Direito		Esquerdo		Direito $(\bar{X} \pm S)$	Esquerdo $(\bar{X} \pm S)$	*P*
Capitulare-PSM	43,83	51,43	42,55	51,25	47,84 ± 1,90	47,29 ± 2,17	0,195
Capitulare-Plano Coronal	6,66	12,96	5,93	13,18	10,18 ± 1,37	9,45 ± 1,32	0,01
Capitulare-PHF	3,27	11,61	3,40	11,65	7,33 ± 1,99	7,31 ± 1,79	0,955

Tabela 2. Médias e desvios-padrões(*DP*) das diferenças das medidas entre os lados esquerdo e direito em indivíduos com Classe I de Angle (n= 47).

Maxilares	Mínimo	Máximo	$\bar{X} \pm s$
#16/26- Plano Coronal	0,05	3,02	1,07 ± 0,76
#16/26- Plano Sagital	0,02	3,07	1,13 ± 0,68
#6-ANS	0,06	2,19	0,93 ± 0,64
#6-PHM	0,01	5,43	1,50 ± 1,38
#6-PHF	0,05	2,52	0,87 ± 0,68
Mandibulares			
Coronal Plane	0,06	3,65	1,15 ± 0,81
Condilio-Gn	0	4,33	1,37 ± 1,11
Condilio-Go	0,01	4,01	1,38 ± 0,95
Go-Gn	0,02	4,53	1,38 ± 1,14
PHF-Go	0,01	5,35	1,55 ± 1,14
#6-Gn	0,01	3,43	0,83 ± 0,77
Altura-GoGn	0,05	5,33	0,98 ± 0,90
ATM			
Capitulare-PSM	0,10	4,31	1,43 ± 1,13
Capitulare-Plano Coronal	0,04	2,45	0,90 ± 0,54
Capitulare-Frankfurt	0,15	2,12	0,99 ± 0,56

5. Discussão

A harmonia estética facial é uma preocupação milenar da raça humana. Este trabalho analisou a face em uma visão frontal, de forma subjetiva por meio de fotografias padronizadas e verificou a simetria dentoesquelética por meio de TCFC. Nos indivíduos brasileiros com classe I de Angle observou-se simetria facial em 61,70% a partir da análise facial fotográfica subjetiva, as medidas cefalométricas tridimensionais apresentarem variações entre o lado direito e esquerdo.

O planejamento ortodôntico estrutura-se a partir da aquisição de medidas lineares e angulares de tecidos do complexo craniofacial. As radiografias cefalométricas obtidas em norma lateral e frontal póstero-anterior, bem como as radiografias panorâmicas têm sido comumente utilizadas como exame complementar em especialidades odontológicas, particularmente na ortodontia[26,31-38]. Todavia, essas medidas normalmente são obtidas de imagens bidimensionais de estruturas tridimensionais.

O surgimento da TCFC trouxe novas perspectivas ás análises cefalométricas[27-30,39]. Baseado nos riscos e benefícos deste recurso de diagnóstico, e nos métodos a serem explorados com a riqueza de informações das imagens tridimensionais, evidenciarao a necessidade de se obter um padrão cefalométrico mais preciso.

As medidas cefalométricas do presente estudo foram obtidas com o auxílio de um software (VistaDent 3D Pro 2.00, (Dentsply GAC, Nova York, EUA) que permitiu a navegação pelos planos axial, sagital e coronal. Estas medidas realizadas por meio de TCFC tem demonstrado maior nível de acurácia, maior confiabilidade, ausência de distorções e magnificação quando comparadas com exames bidimensionais[26,27,40-43].

Análises cefalométricas tridimensionais são avaliadas com o objetivo de se obter medidas de referências. Sievers *et al.* (2012)[44] examinaram 70 pacientes e utilizaram um índice de Katsumata *et al.* (2005)[24] para quantificar a assimetria em pacientes com classe I e Classe II de Angle. Para calcular esse índice determinaram-se as distâncias dos pontos craniométricos aos planos sagital mediano, coronal e axial. O plano sagital mediano foi definido pelos pontos Sela, Nasio e Dent. O plano axial foi definido pelos pontos Sela, Nasio e perpendicular ao plano sagital mediano. O plano coronal foi definido apenas pelo ponto Dent e perpendicular aos outros dois planos. Os pacientes classe II não foram mais assimétricos do que os pacientes classe I.

No presente estudo foram utilizados pontos e medidas para verificar a simetria com referência em cinco planos. Os planos sagital mediano, coronal, horizontal de Frankfurt, maxilar e o plano mandibular foram utilizados como referência para obtenção das medidas cefalométricas. Baseado em modelo distinto do proposto por Katsumata *et al.* (2005)[24], o plano sagital mediano foi estabelecido pela união dos pontos espinha nasal anterior e espinha nasal posterior sendo perpendicular ao plano horizontal de Frankfurt. O plano coronal foi estabelecido pela união dos pontos Pório direito e esquerdo estando perpendicular ao plano horizontal de Frankfurt.

As várias possibilidades de marcação dos pontos craniométricos e as diferentes maneiras de obtenção das medidas cefalométricas tridimensionais dificultam o estabelecimento de normas e valores padrões, o que torna difícil a comparação dos resultados apresentados com os estudos anteriores[24,27,44,45]. Por outro lado, alguns estudos apresentaram algoritmo para demonstrar que é viável o uso da cefalometria tridimensional, bem como transpor as medidas de referência da cefalometria bidimensional para a avaliação tridimensional[26,41,46].

Os valores de referencia obtidos no presente estudo são complementares a outras análises de simetria dentoesqueléticas, como análise clínica, e análise em modelos de estudo. Discrepâncias de tamanho dentário podem ocorrer e, como consequência, causar desvios da linha media dentária, o que também determina a assimetria. A análise da discrepância de Bolton tem sido proposta com o uso de modelos digitais obtidos a partir de TCFC para verificar o nível de influência dentária na assimetria. Tarazona *et al.* (2012)[47] avaliaram a reprodutibilidade e confiabilidade do índice de Bolton em modelos digitais obtido por meio de TCFC e por um método de digitalização dos modelos tradicionais. Embora os dois métodos mostraram-se clinicamente aceitáveis, o método usando TCFC revelou precisão e reprodutibilidade. Sanders *et al. (*2010)[48] compararam o grau de assimetria dentoesqueléticas em pacientes portadores de má oclusão Classe II subdivisão e oclusão normal empregando TCFC. Na análise proposta foram marcados 34 pontos anatômicos e avaliado a assimetria dentária e dento alveolar, assimetria das bases ósseas e côndilos. Dentre as medidas lineares e angulares obtidas determinaram-se as distancias entre o ponto de contato dos incisivos centrais superiores e inferiores ao plano sagital mediano para definir a assimetria dento alveolar. A obtenção dessas medidas foi essencial para o efetivo diagnóstico da simetria dentoesquelética.

As assimetrias podem causar desvios estéticos e funcionais que variam de acordo com a severidade das mesmas. Dessa forma, o estabelecimento do grau de severidade por meio de medidas cefalométricas torna-se essencial como auxíliar em plano de tratamento ortodôntico. Observa-se desta forma, o potencial de aplicações e recursos associados à TCFC. Entretanto, deve-se aplicar os princípios de radioproteção quando de sua indicação.

Futuros estudos serão necessários no intuito de se determinar a expressão clinica das diferenças e respectivos desvios-padrões. Nos indivíduos estudados observou-se simetria facial, sendo que as medidas cefalométricas mostraram variações entre o lado direito e esquerdo. Apesar destas variações de amplitude, as mesmas podem servir como referência tridimensional para quantificar e identificar o grau de simetria dentoesquelética capaz de favorecer o planejamento ortodôntico e cirúrgico.

6. Conclusão

Baseado na metodologia indivíduos brasileiros com classe I de Angle apresentaram simetria facial na maioria dos pacientes, com variações entre o lado direito e esquerdo.

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Artigo:

Three-Dimensional Cephalometric Reference

Of Dentoskeletal Symmetry

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THREE-DIMENSIONAL CEPHALOMETRIC REFERENCE OF DENTOSKELETAL SYMMETRY

ABSTRACT

Objective: To evaluate dentoskeletal symmetry in cone beam computed tomography (CBCT) scans of Brazilian individuals with Angle class I malocclusion. **Materials and methods**: Forty seven patients (22 girls) aged 11 to 16 years (14 years) seen in a private radiology service (CIRO, Goiânia, GO, Brazil). All the CBCT images were acquired from January 2009 to December 2010. Cephalometric measurements were made by multiplanar reconstructions (axial, coronal and sagittal) using Vista Dent3DPro 2.0 (Dentsply GAC, New York, USA). The minimum, maximum, mean and standard deviation values were described in tables, and the Student *t* test was used to define statistical significance ($p<0.05$). **Results**: Data were homogeneous, and the differences between right and left sides were not significant. **Conclusion**: The cephalometric measures of Brazilian individuals with Angle class I malocclusion can be used to define facial symmetry and three-dimensional standard references, which might be useful for orthodontic and surgical planning.

Keywords: Cone-beam computed tomography, image diagnosis, three-dimensional cephalometry, dentoskeletal symmetry, imaging.

INTRODUCTION

The assessment of skeletal asymmetry using cephalometric and panoramic radiographs of individuals that need orthodontic treatment is a constant challenge and requires attention. Knowledge about craniofacial growth and growth direction, skeletal anatomy, tooth positions, tooth relations with bone structures and facial profile are essential for accurate treatment planning.[1] Cephalometry focuses on linear and angular dimensions defined by measurements of bones, teeth and face, and cephalometric findings inform diagnosis and help to establish treatment strategies.

Dentists use lateral cephalometric radiographs to define normal cephalometric references of individuals considered to have harmonious faces[2]. Posteroanterior radiographs are useful for other evaluations despite their limitations, such as image distortions and superpositions. However, there is no reliable method to analyze surgical or orthodontic choices[4]. Inaccurate image interpretation may be associated with the superposition of anatomical structures and increased by distortions of radiographic images. The correct management of patients during image acquisition is a risk factor that may affect quality. Two-dimensional radiographs have limitations that may interfere with treatment planning and affect results negatively[4-6].

The introduction of cone beam computed tomography (CBCT) in dentistry created several possibilities for planning, treatment and follow-up in numerous specialties[7-21]. Farman and Scarfe[16] reported that several CBCT systems may be used to obtain reconstructions that are similar to conventional cephalometric projections. According to the authors, the diagnostic precision and image efficacy of CBCT may be compared to conventional cephalometric images, and evidence-based selection criteria should be developed for CBCT use in orthodontics. Cephalometric analysis has been used to evaluate linear and angular measures of hard and soft tissues of the craniofacial complex, while CBCT images have been helpful in the analysis of facial asymmetries[24]. New examination models may be developed by combining the use of conventional cephalometric references and three-dimensional CBCT images[25,26]. This study evaluated the dentoskeletal symmetry of individuals with Angle class I malocclusion using three-dimensional images.

MATERIALS AND METHODS

Sample selection

Three-dimensional images of 47 patients (22 girls) aged 11 to 16 years (mean age, 14 years) were retrieved from a database and evaluated. All the images had been acquired in a private radiology clinic (CIRO, Goiânia, GO, Brazil) for orthodontic treatment planning. Inclusion criteria were: Angle class I malocclusion; crowding; no dental caries; and no apical or marginal periodontitis. Exclusion criteria were: Angle class II or III malocclusion; missing teeth; previous bone or dental trauma; and previous orthodontic treatment. This study was approved by the local Ethics in Research Committee (Federal University of Goiás, Brazil, # 296/2011).

Method to determine facial symmetry

The frontal photos of patients were assessed by three specialists in orthodontics, who chose 47 clinically symmetrical patients. Facial symmetry was defined according to the visual analysis of the face and the digital photos. After clinically symmetrical patients had been selected, their cephalometric measures were obtained.

Image Acquisition Method

The CBCT images were acquired in a private radiology clinic (CIRO, Goiânia, GO, Brazil) using an i-CAT scanner (*Imaging Sciences Internationa*l, Hatfield, PA, USA). The volumes were reconstructed using 0.25-mm isometric voxel resolution, 120 kVp tube-voltage and 3.8 mA current. Exposure time was 40 seconds, the field of view was 13 cm; images were acquired at 14 bits gray scale, at a focal distance of 0.5 mm and a single 360-degree rotation. The images were examined using the Xoran 3.1.62 software (Xoran Technologies, Ann Arbor, MI) in a workstation with Intel Core® 2 Duo 1.86 Ghz-6300 processor (Intel Corporation, Santa Clara, CA), NVIDIA GeForce 6200 turbo cache video card (NVIDIA Corporation, Santa Clara, CA), EIZO - S2000 FlexScan monitor (1600x1200 pixels resolution) and Microsoft Windows XP professional SP-2 operating system (Microsoft Corp, Redmond, WA). After reconstruction, data were stored in individual DICOM files for each patient.

Cephalometric Measures

After three-dimensional acquisition, the DICOM files were imported to VistaDent 3D Pro 2.00 (Dentsply GAC, New York, NY). Seventeen cephalometric landmarks, selected according to a specific protocol for dentoskeletal symmetry evaluation, were identified by a calibrated operator, who had more than five years' experience, and plotted using axial, coronal and sagittal multiplanar reconstructions (Table 1) and (Figure 1 and 2) . After that, the reference planes were determined (Table 2) and (figure 3), and the linear measures were automatically calculated by the software (Table 3) and (Figure 4 and 5). Values were recorded using a Microsoft Office Excel® 2010 spreadsheet, and image upgrading tools and maximum magnification were used to make sure that every cephalometric landmark was precisely plotted on each multiplanar reconstruction.

Statistical Analysis

The Statistical Package for the Social Sciences, version 20 (SPSS, Chicago, IL, USA) was used for statistical analysis. Minimum, maximum, mean and standard deviation values of the measures were described in tables, and the Student *t* test was used to determine statistical significance ($p<0.05$).

The Student *t* test for independent samples was used to evaluate the significance of measurements made at different time points when data had a normal distribution, and the Mann-Whitney test was used for nonparametric data. Both tests evaluated the means of two measurements, made by the same examiner, at 2-week intervals (intraexaminer variations). There were no significant differences ($p>0.05$) between the two samples.

RESULTS

Results are summarized in Tables 4 and 5. Table 4 shows the minimum, maximum, mean and standard deviation values of the cephalometric measurements made in the maxilla, mandible and temporomandibular joint (TMJ). Table 5 shows the differences between left and right measurements.

DISCUSSION

Facial harmony, an ancient esthetic concern of human beings, was confirmed by the analysis of face photographs of Brazilians with Angle class I malocclusion, despite the differences in cephalometric measures between the right and left sides.

Orthodontic treatments are planned according to linear and angular measures of the craniofacial complex. For decades, measurements were made on two-dimensional images. Lateral and posteroanterior cephalometric radiographs, as well as panoramic radiographs, were often used as complementary tests by specialized dentists, mainly in orthodontics[26,31-38]. Measures were usually obtained from two-dimensional images of three-dimensional structures.

CBCT has redefined cephalometric analysis[27-30,39], and methods may have to be adapted to its risks and benefits, as well as to its three-dimensional images, so that the accuracy of cephalometric measurements may be improved.

This study used VistaDent 3D Pro 2.00 (Dentsply GAC, Nova York, NY), which enables navigation in the axial, sagittal and coronal planes to make cephalometric measurements. Measurements made using CBCT images are more accurate and reliable because the images have better magnification and less distortion than two-dimensional images[26,27,40-43].

Three-dimensional cephalometric analyses have been evaluated to define reference values. Sievers et al. (2012)[44] examined 70 patients and used the index defined by Katsumata et al. (2005)[24] to measure asymmetry in patients with class I and class II malocclusion. The index was calculated using the distances from the craniometric landmarks to the midsagittal, coronal and axial planes. The midsagittal plane was defined by the Sela, Nasio and Dent landmarks; the axial plane was defined by the Sela and Nasio landmarks and was perpendicular to the midsagittal plane. Only the Dent landmark was used to determine the coronal plane, which was perpendicular to the other two planes.

Individuals with Angle class II malocclusion were not more asymmetric than those with class I malocclusion.

In this study, landmarks and measures were used to evaluate symmetry according to five planes: midsagittal, coronal, Frankfurt horizontal, maxillary and mandibular. These planes were used as references for cephalometric measurements. The midsagittal plane was defined by the anterior and posterior nasal spines and was perpendicular to the Frankfurt horizontal plane, according to a model that differs from the one described by Katsumata et al. (2005)[24]. The coronal plane joined the right and left porion and was perpendicular to the Frankfurt horizontal plane.

Different methods to locate craniometric landmarks and to make three-dimensional cephalometric measurements interfere with the definition of reference values, which complicates comparisons with results of previous studies[24,27,44,45]. Some studies have used algorithms to demonstrate the uses of three-dimensional cephalometry and to derive two-dimensional cephalometric references for three-dimensional evaluations[26,41,46]. New cephalometric methods using three-dimensional images have been suggested. [27-29] Cheung *et al.*[29] developed a model of cephalometric analysis of dentofacial abnormalities and defined new cephalometric references for Chinese adults. Cavalcanti *et al.*[30] evaluated the accuracy of craniofacial bone and tissue measurements made with 3D computerized tomography (CT) and a volume technique using an independent workstation running graphic tools. The 3D-CT measures provided an accurate evaluation of growth and developmental changes. Takahashi *et al.* (2005)[3] assessed the facial skeletal structures using the vertical view of cephalometric lateral radiographs to define the mean normality values for young

Brazilians whose ancestors were white or Asian and whose occlusion was normal and to evaluate differences between sexes and ethnic groups under study. Their results suggested that there are differences between sexes in some of the cephalometric measures for both ethnic groups and differences between the two ethnic groups under study.

The reference values obtained in this study are complementary to other dentoskeletal symmetry findings, such as those provided by clinical and model analyses. Tooth size discrepancies may result in midline deviations, which also lead to asymmetry. The Bolton discrepancy analysis of digital CBCT models has been used to evaluate the effect of teeth on asymmetry. Tarazona et al. (2012)[47] examined the reproducibility and reliability of the Bolton index when using digital CBCT models and digitized images of conventional models. Although both methods proved to be clinically acceptable, CBCT results were accurate and reproducible. Sanders et al. (2010)[48] compared the degree of dentoskeletal asymmetry in patients with class II subdivision malocclusion or subjects with normal occlusion using CBCT. Thirty four landmarks were scored to evaluate dental, dentoalveolar, bone and condyle asymmetries. The distances between the contact points of the maxillary and the mandibular central incisors and the midsagittal plane were measured, together with linear and angular measurements, to define dentoskeletal asymmetry. These measurements were essential for the precise diagnosis of dentoskeletal symmetry.

Asymmetries may result in esthetic and functional deviations of variable intensity. Thus, the use of cephalometry to define severity is an essential tool in orthodontic planning. CBCT may be used for cephalometric analysis, but this three-dimensional tool exposes patients to radiation. Therefore, care should be taken to ensure the best cost-benefit ratio between information and dose[22,23], and decisions should respect the as-low-as-reasonably-achievable principles (ALARA).

Further studies should be conducted to determine the clinical significance of differences and their standard deviations. The faces of the subjects included in our study were symmetrical, but cephalometric measurements revealed differences between the left and right sides. Despite this discrepancy, CBCT images may be a three-dimensional guide to the identification and measurement of dentoskeletal asymmetries during orthodontic and surgical planning.

CONCLUSION

The faces of individuals with Angle class I malocclusion were symmetrical. Cephalometric measurements revealed differences between the right and left sides.

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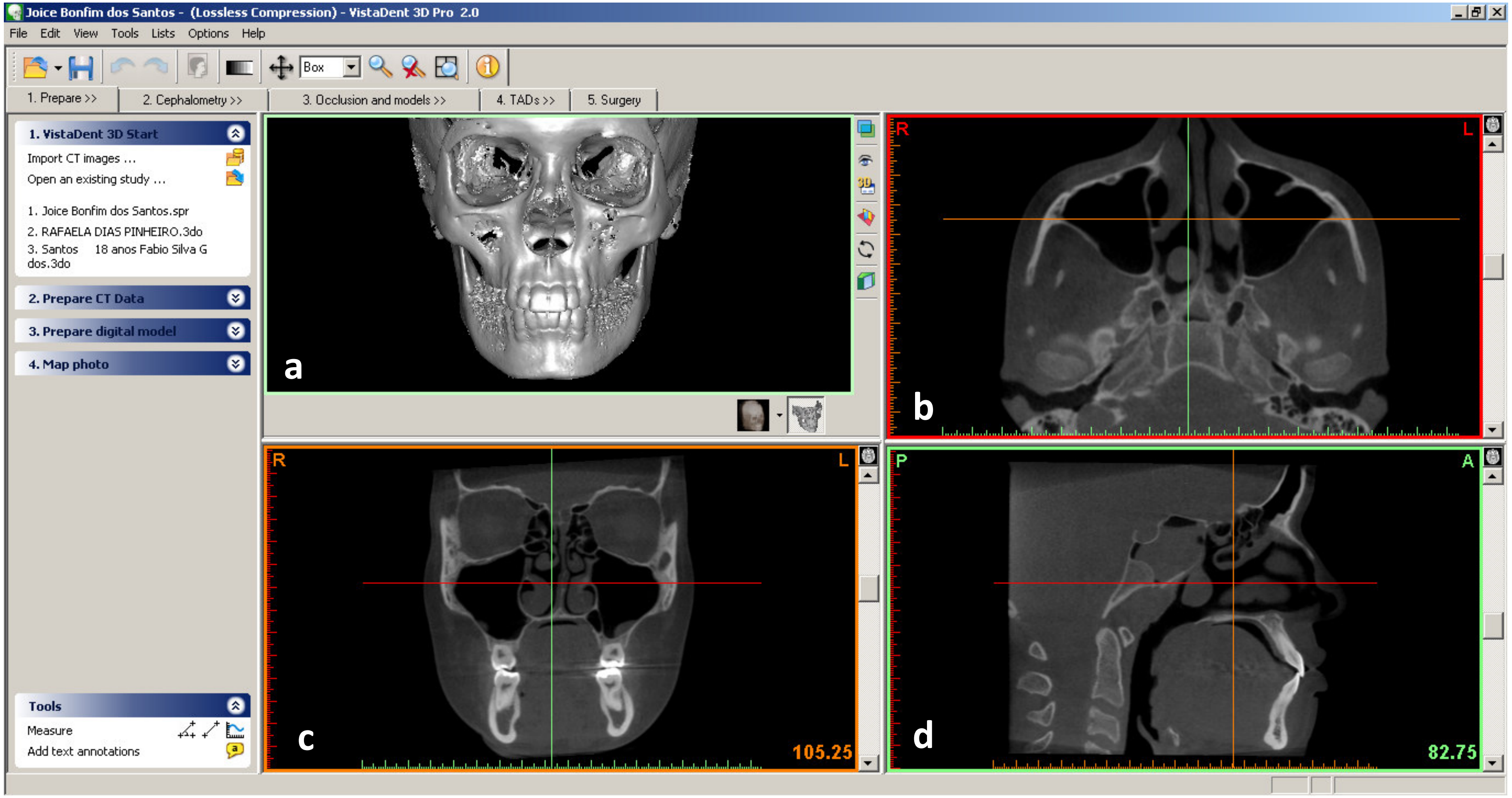

Figure 1. 3D cephalometric module of VistaDent 3D Pro 2.00 software (Dentsply GAC, New York, USA). 3D reconstructions (a), Axial image (b), coronal image (c) and sagittal image (d).

Table 1. Used cephalometric points.

Cephalometric points	Description of the cephalometric points
Porion R (Po R)	Most superior point of the right acoustic meatus
Porion L (Po L)	Most superior point of the left acoustic meatus
Orbital R (Or R)	Most inferior point of the right infraorbital rim
Orbital L (Or L)	Most inferior point of the left infraorbital rim
Anterior Nasal Spine (ANS)	Most anterior midpoint of the anterior nasal spine of the maxilla
Posterior Nasal Spine (PNS)	Most posterior midpoint of the posterior nasal spine of the palatine bone
Capitulare R	Central point of the right condyle
Capitulare L	Central point of the left condyle
Condylion R (Co R)	Most postero-superior point of the right condyle
Condylion L (Co L)	Most postero-superior point of the left condyle
#3	Most deeper point of the right maxillary first molar central fossa
#14	Most deeper point of the left maxillary first molar central fossa
#19	Most superior point of the disto-buccal cusp of the maxillary first molar
#30	Most superior point of the disto-buccal cusp of the maxillary first molar
Gonion R (Go R)	Midpoint of the posterior border of the right mandibular angle
Gonion L (Go L)	Midpoint of the posterior border of the left mandibular angle
Gnathion (Gn)	Most anterior and inferior point on the contour of the mandibular symphysis

Table 2. Planes used as cephalometric measures references

Reference planes	Planes description
Frankfurt Horizontal Plane (FHP)	Established by connecting right and left porion to left orbit points
Coronal Plane (CP)	Established by connecting right and left porion points, perpendicular to Frankfurt Horizontal Plane
Midsagittal Plane (MSP)	Established by connecting anterior and posterior nasal spine points, perpendicular to Frankfurt Horizontal Plane
Maxillary Horizontal Plane (MxP)	Established by connecting anterior and posterior nasal spine points, perpendicular to Median Sagittal Plane
Mandibular Plane (MdP)	Established by connecting right and left gonion to gnathion points

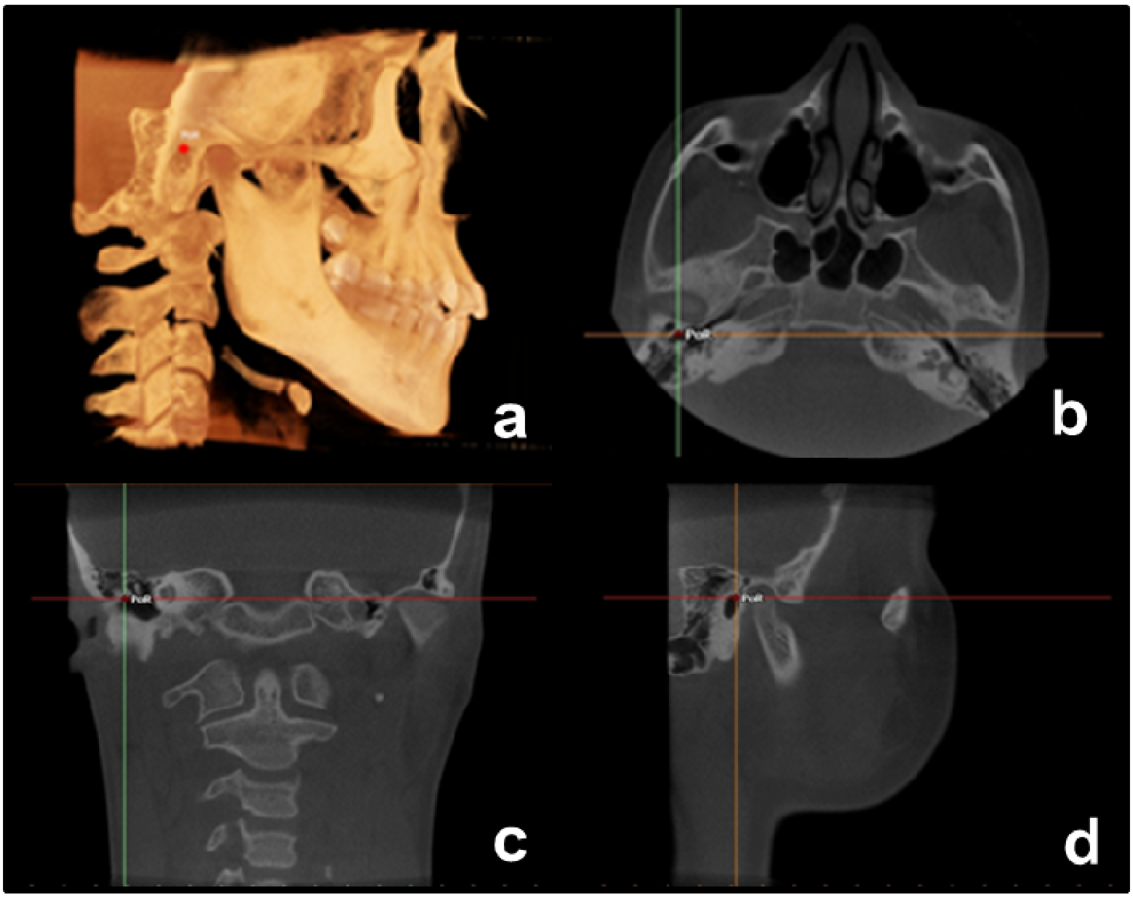

Figure 2. Right porion cephalometric point (PoR) identified in the 3D reconstruction (a), axial (b), coronal (c) e sagittal (d) multiplanar reconstructions.

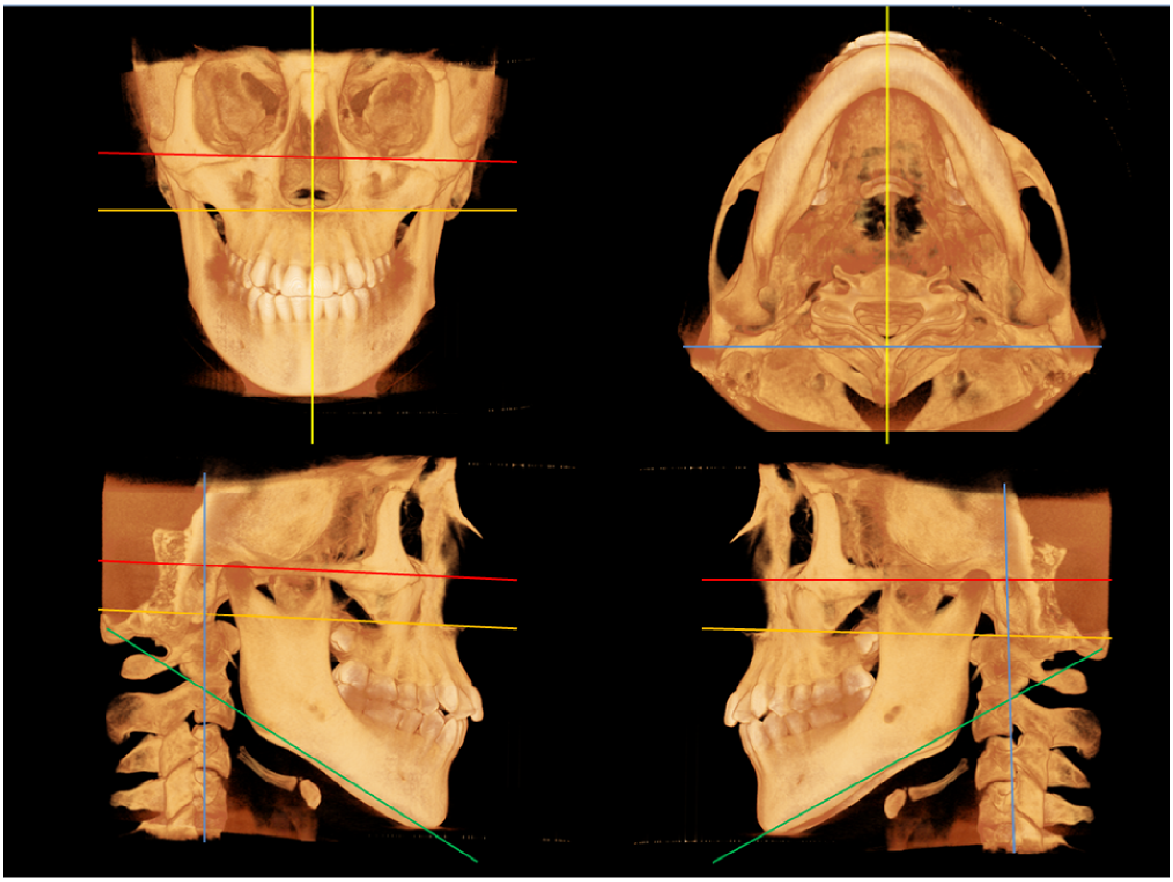

Figure 3. Three-dimensional reconstructions of the reference planes: Frankfurt Horizontal Plane (red), Coronal Plane (blue), Midsagittal Plane (yellow), Maxillary Plane (orange) and Mandibular (green).

Table 3. Cephalometric measures

Maxillary	Description
#3-CP	Central fossa of 3 to coronal plane
#14-CP	Central fossa of 14 to coronal plane
#3-MSP	Central fossa of 3 to Midsagittal plane
#14-MSP	Central fossa of 14 to Midsagittal plane
#3-ANS	Central fossa of 3 to anterior nasal spine
#14-ANS	Central fossa of 14 to anterior nasal spine
#3-MxP height	Central fossa of 3 to maxillary plane
#14-MxP height	Central fossa of 14 to maxillary plane
#3-FHP height	Central fossa of 3 to Frankfurt horizontal plane
#14- FHP height	Central fossa of 14 to Frankfurt horizontal plane
Mandibular	
#19- Cr-Pl	Disto-buccal cusp of 19 to coronal plane
#30- Cr-Pl	Disto-buccal cusp of 30 to coronal plane
#19-Gn	Disto-buccal cusp of 19 to gnathion
#30-Gn	Disto-buccal cusp of 30 to gnathion
#19-MdP height	Disto-buccal cusp of 19 to left mandibular plane
#30-MdP height	Disto-buccal cusp of 30 to left mandibular plane
CoR-Gn	Right condylion to gnathion
CoL-Gn	Left condylion to gnathion
CoR-Go R	Right condylion to right gonion
CoL-Go L	Left condylion to left gonion
GoR-Gn	Right gonion to gnathion
GoL-Gn	Left gonion to gnathion
FHP-Go R	Frankfurt horizontal plane to right gonion
FHP-Go L	Frankfurt horizontal plane to left gonion

TMJ	
Capitulare R-MSP	Right Capitulare to midsagittal plane
Capitulare L-MSP	Left Capitulare to midsagittal plane
Capitulare R- CP	Right Capitulare to coronal plane
Capitulare L- CP	Left Capitulare to coronal plane
Capitulare R-FHP	Right Capitulare to Frankfurt horizontal plane
Capitulare L-FHP	Left Capitulare to Frankfurt horizontal plane

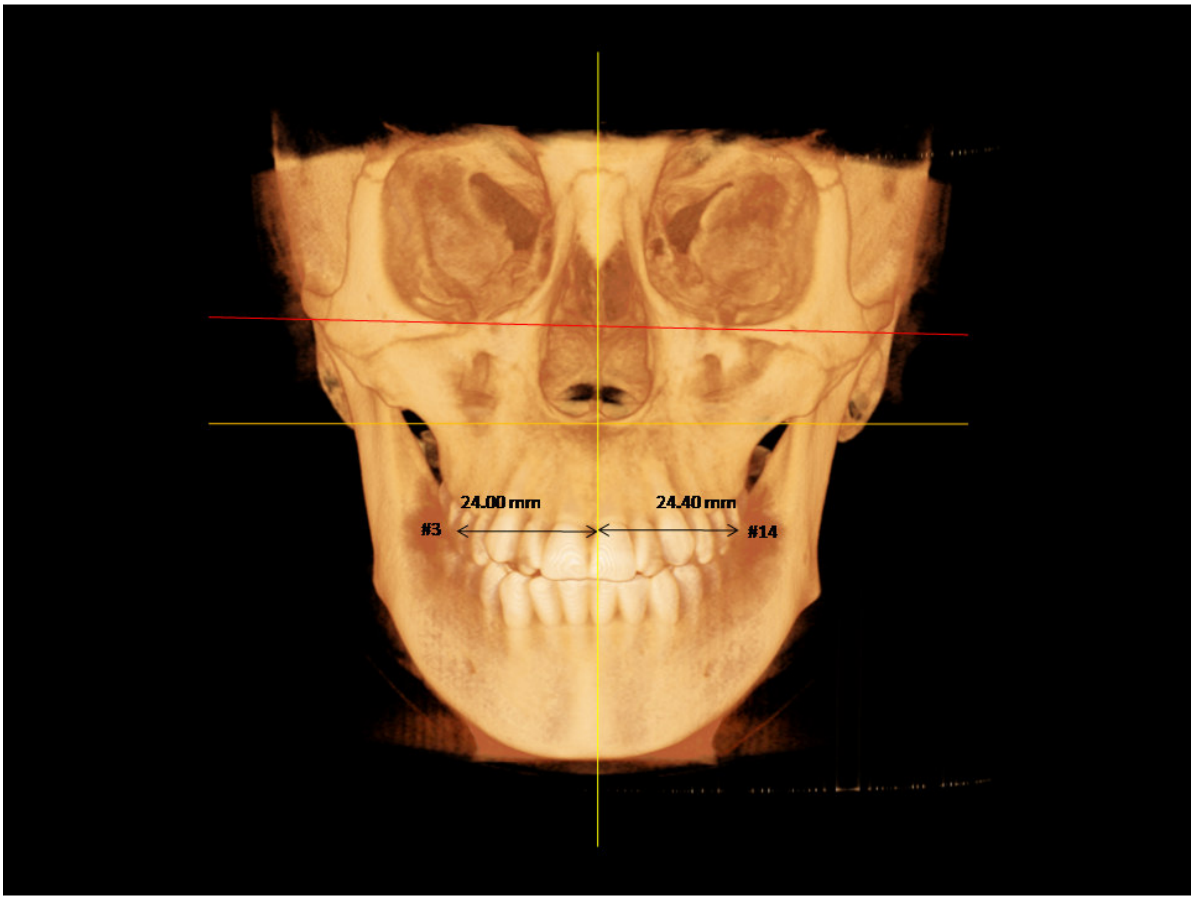

Figure 4. Three-dimensional image of the cephalometric measures between #3 and #14 points to Midsagittal plane.

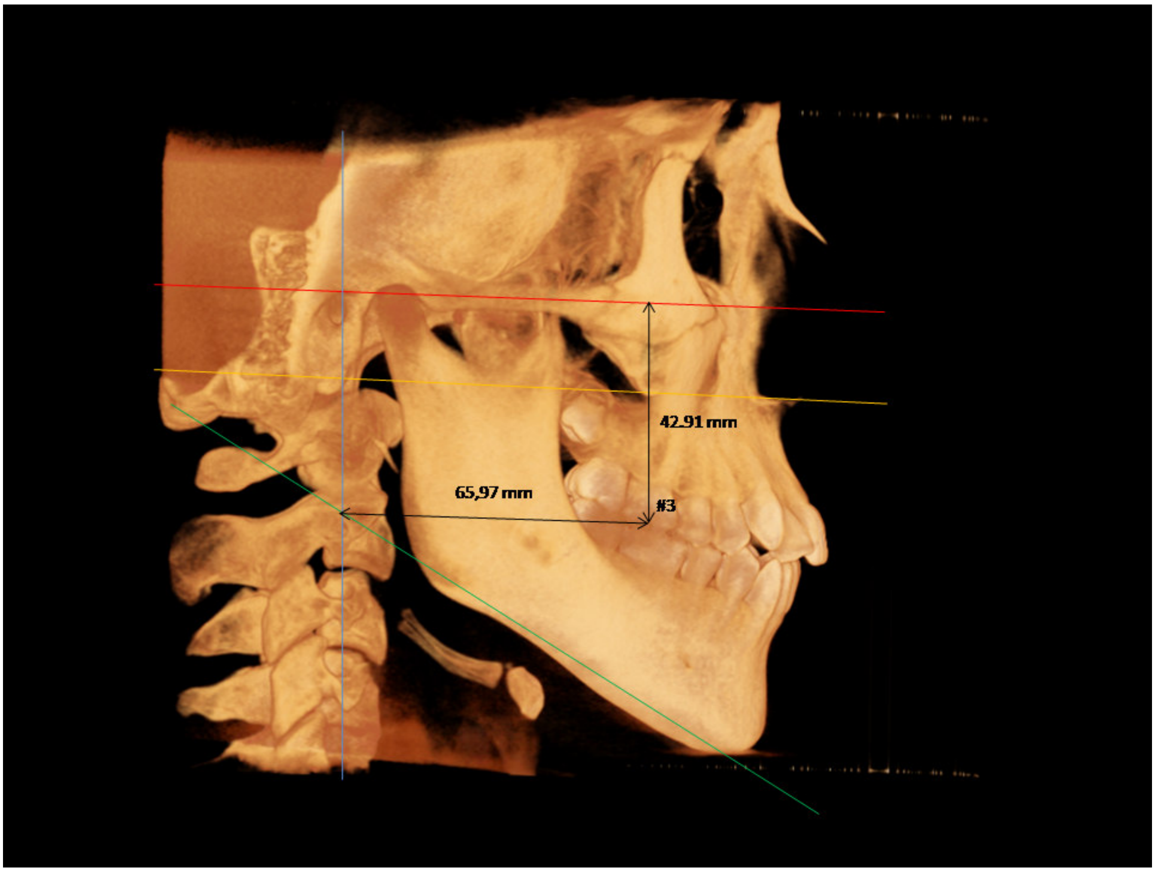

Figure 5. Three-dimensional image of the cephalometric measures from #3 point to Frankfurt Horizontal Plane and Coronal Plane.

Table 1. Minimum, maximum, mean (X) and standard deviation (S) values of cephalometric measures. N=47

Measures	Minimum and maximum values (mm)				Mean and standard deviation $(\bar{X} \pm S)$		
Maxillary							
	Minimum	Maximum	Minimum	Maximum			
	#3		#14		#3 $(\bar{X} \pm S)$	#14 $(\bar{X} \pm S)$	*P*
#3#14-CP	51.30	71.11	52.63	70.35	61.56 ± 4.47	61.22 ± 4,12	0.702
#3#14-MSP	19.96	26.47	19.56	26.51	23.33 ± 1.45	23.48 ± 1,51	0.633
#3#14-ANS	38.60	51.74	38.36	51.37	44.75 ± 2.85	44.94 ± 2,91	0.745
#3#14-MxP	15.10	25.69	14.61	27.44	20.56 ± 2.85	20.54 ± 2,79	0.631
#3#14-FHP	31.97	49.21	31.32	47.82	40.36 ± 3.48	40.27 ± 3,45	0.908
Mandibular							
	#30		#19		#30 $(\bar{X} \pm S)$	#19 $(\bar{X} \pm S)$	*P*
#30#19-CP	50.72	71.27	52.21	69.05	61.60 ± 4.59	61.62 ± 4.33	0.903
#30#19-Gn	45.24	59.05	44.79	57.05	49.74 ± 2.85	49.68 ± 2.50	0.913
#30#19-MdP	22.12	30.77	21.84	31.40	25.92 ± 1.99	25.81 ± 2.19	0.807
	Right		Left		Right $(\bar{X} \pm S)$	Left $(\bar{X} \pm S)$	*P*
Co-Gn	101.24	127.48	100.27	126.6	117.42 ± 4.71	117.11 ± 4.74	0.752
Co-Go	42.18	59.12	43.58	60.20	49.84 ± 3.50	49.42 ± 3.33	0.557
Go-Gn	76.45	92.85	77.61	90.4	84.66 ± 3.44	84.51 ± 3.37	0.831
FHP-Go	43.12	62.98	41.94	63.94	51.88 ± 4.28	51.42 ± 4.23	0.602
TMJ							
	Right		Left		Right $(\bar{X} \pm S)$	Left $(\bar{X} \pm S)$	*P*
Capitulare-MSP	43.83	51.43	42.55	51.25	47.84 ± 1.90	47.29 ± 2.17	0.195
Capitulare-CP	6.66	12.96	5.93	13.18	10.18 ± 1.37	9.45 ± 1.32	0.01
Capitulare-FHP	3.27	11.61	3.40	11.65	7.33 ± 1.99	7.31 ± 1.79	0.955

Table 2. Minimum and maximum difference of the cephalometric measures of left right sides and respective mean (*X*) and standard deviation (S). N = 47

Maxillary	Minimum	Maximum	$\bar{X} \pm S$
#3#14- CP	0.05	3.02	1.07 ± 0.76
#3#14- MSP	0.02	3.07	1.13 ± 0.68
#3#14-ANS	0.06	2.19	0.93 ± 0.64
#3#14-MxP	0.01	5.43	1.50 ± 1.38
#3#14-FHP	0.05	2.52	0.87 ± 0.68
Mandibular			
Coronal Plane	0.06	3.65	1.15 ± 0.81
Co-Gn	0.00	4.33	1.37 ± 1.11
Co-Go	0.01	4.01	1.38 ± 0.95
Go-Gn	0.02	4.53	1.38 ± 1.14
FH-Pl-Go	0.01	5.35	1.55 ± 1.14
#30#19-Gn	0.01	3.43	0.83 ± 0.77
#30#19-MdP	0.05	5.33	0.98 ± 0.90
TMJ			
Capitulare-MSP	0.10	4.31	1.43 ± 1.13
Capitulare-CP	0.04	2.45	0.90 ± 0.54
Capitulare-FHP	0.15	2.12	0.99 ± 0.56

9. Anexos

Anexo 1. Parecer do comitê de ética

Goiânia, 31 /08 /11

PARECER CONSUBSTANCIADO REFERENTE AO PROJETO DE PESQUISA, PROTOCOLADO NESTE COMITÊ SOB O N.: 296/11

I – Identificação
– Título do projeto: Avaliação comparativa entre as medidas cefalométricas bidimensionais e as tridimensionais geradas por tomografia computadorizada do feixe cônico
– Pesquisador Responsável: Olavo Cesar Lyra Porto
- Pesquisadores Participantes: Carlos Estrela; José Valadares Neto; Iuri de Oliveira Castro
– Instituição onde será realizado o estudo: Faculdade de Odontologia da UFG
– Data de apresentação ao CEP/UFG: 08/08/11
– Área Temática: Grupo III

Comentários do relator frente à Resolução CNS 196/96 e complementares em particular sobre:

II – Estrutura do Protocolo
DV; Folha de rosto CEP-UFG; Folha de rosto da CONEP com assinatura do responsável pela pesquisa e do responsável pela instituição; Termos de compromisso; Projeto de Pesquisa; Instrumento de coleta de dados.

III – Projeto de pesquisa

OBJETIVO: Comparar as medidas cefalométricas lineares e angulares em imagens bidimensionais e tridimensionais geradas por tomografia computadorizada de feixe cônico. Em Específico: - 1)- Comparar as 17(dezessete) medidas cefalométricas lineares e angulares em imagens bidimensionais e tridimensionais geradas por tomografia computadorizada de feixe cônico relacionadas na análise do Board Brasileiro de Ortodontia e Ortopedia Facial. 2)- Comparar as medidas bilaterais e medianas das imagens bidimensionais e tridimensionais geradas por tomografia computadorizada de feixe cônico.

<u>Análise das questões éticas:</u>
A amostra será composta por exames de TCFC de 52 pacientes com idade entre 10 e 16 anos, encaminhados ao serviço de radiologia para planejamento inicial do tratamento ortodôntico. O presente projeto possui infraestrutura, recursos financeiros e humanos para sua viabilização e concretização. O intuito é que ele seja finalizado, sem interrupções. Todavia, mediante a impossibilidade do pesquisador responsável em acompanhar o seu desenvolvimento em casos extremos, por motivo de doença ou óbito, se faz necessário suspendê-lo ou encerrá-lo. O centro de Radiologia possui um banco de dados de tomografia computadorizada de feixe cônico com exames realizados desde

2007 até o presente momento. O responsável pela instituição autoriza o uso do banco de imagens que será utilizado neste projeto. Os dados coletados serão utilizados exclusivamente para os fins previstos neste projeto e publicar-se-á os resultados sejam eles favoráveis ou não.

-Critérios de Inclusão e exclusão: Inclusão: indivíduos saudáveis, má oclusão Classe I de Angle, apinhamento leve a moderado, ausência de cárie e periodontites marginais e apicais. Os fatores de exclusão do estudo envolverão pacientes gestantes, com problemas sistêmicos, que sofreram injuria dental traumática ou com histórico de tratamento ortodôntico.

- Garantia da Privacidade e Confidencialidade: A pesquisa será realizada sem conter qualquer indicador da identidade do participante, garantindo plenamente o sigilo quanto a sua privacidade e confidencialidade. Os dados serão armazenados pelo pesquisador responsável no período de cinco anos.

- Cronograma: Adequado

- Orçamento – Este projeto de pesquisa esta vinculado ao Programa de Ciências da Saúde da Faculdade de Medicina da UFG e conta com o apoio de fomento da CAPES-Coordenação de Aperfeiçoamento de Pessoal de Nível Superior número 711410.

- Avaliação de riscos e benefícios: Relatam que não apresenta riscos para os sujeitos envolvidos, pois se trata de uma amostra de um banco de dados secundários onde as imagens foram obtidas no período de 2009 e 2010. O projeto auxiliará no diagnóstico, planejamento terapêutico e prognóstico das alterações dentárias e esqueléticas da face.

- Análise da metodologia e sua adequação aos objetivos da pesquisa: A metodologia encontra-se adequada.

- Verificação das condições para realização da pesquisa. Os currículos dos pesquisadores são compatíveis com a pesquisa proposta e as condições são adequadas.

IV – Termo de Consentimento Livre e Esclarecido

Esta pesquisa desenvolver-se-á em base de dados secundários não aplicar-se-á o TCLE.

VI – Parecer do CEP:

Protocolo "APROVADO"

VI – Data da reunião: 31 de outubro de 2011

Assinatura do(a) relator(a):

Assinatura do(a) Coordenador(a)/ CEP/UFG: Joao S. Souza
Prof. João Batista de Souza
Coordenador do Comitê de Ética em Pesquisa
Pró-Reitoria de Pesquisa e Pós-Graduação/UFG

Anexo 2. Publicações no biênio 2010/2011

1. DECURCIO D.A.; BUENO, M.R.; ALENCAR, A.H.G.; PORTO, O.C.L.; AZEVEDO, B.C.; ESTRELA, C. Effect of root canal materials on dimensions of cone beam computed tomography images. J Aplied of Oral Sciences 2012; 20(2): 260-7.
2. ESTRELA, C.; BUENO, M. R. ; SILVA, Júlio Almeida ; Porto, Olavo Cesar Lyra ; Leles, C.R. ; Azevedo, Bruno Correa . Effect of intracanal posts on dimensions of cone beam computed tomography images of endodontically treated teeth. Dental Press Endodontics, v. 1, p. 28-36, 2011.
3. ESTRELA, C.; DECURCIO, D. A. ; SILVA, J. A. ; Porto, OCL ; ALENCAR, A. H. G. ; ESTRELA, C. R. A. . Caracterização da imagem do canal radicular preenchido com hidróxido de cálcio na tomografia computadorizada de feixe cônico. ROBRAC (Goiânia. Impresso), v. 20, p. 92-96, 2011.
4. ESTRELA, C.; VALLADARES NETO, J. ; BUENO, M. R. ; GUEDES, Orlando Aguirre ; Porto, Olavo César Lyra ; PECORA, Jesus Djalma . Linear measurements of human permanent dental development stages using Cone-Beam Computed Tomography: a preliminary study. Dental Press Journal of Orthodontics, v. 15, p. 44-78, 2010.
5. ESTRELA, C;BUENO, M. R. ; SILVA, Júlio Almeida ; Porto, Olavo Cesar Lyra ; Leles, C.R.; Azevedo, Bruno Correa . Effect of intracanal posts on dimensions of cone beam computed tomography images of endodontically treated teeth. Dental Press Endodontics, v. 1, p. 28-36, 2011.
6. ESTRELA, CARLOS ; BUENO, MIKE REIS ; PORTO, OLAVO CÉSAR LYRA ; RODRIGUES, CLEOMAR DONIZETH ; PÉCORA, JESUS DJALMA . Influence of intracanal post on apical periodontitis identified by cone-beam computed tomography. Brazilian Dental Journal (Impresso), v. 20, p. 370-375, 2009.

7. GUEDES, Orlando Aguirre ; Rabelo, L.E.G. ; Porto, OCL ; ALENCAR, A. H. G. ; ESTRELA, C. . Avaliação radiográfica da posição e forma do forame mentual em uma subpopulação Brasileira. ROBRAC (Goiânia. Impresso), v. 20, p. 160-165, 2011.
8. VALLADARES-NETO, J. ; ESTRELA, C. ; BUENO, M. R. ; GUEDES, Orlando Aguirre ; Porto, Olavo Cesar Lyra ; PECORA, Jesus Djalma . Mandibular condyle dimensional changes in subjects from 3 to 20 years of age using Cone-Beam Computed Tomography: a preliminary study. Dental Press Journal of Orthodontics, v. 15, p. 172-181, 2010.

Anexo 3 . Normas de publicação do periódico

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Vardimon A D, Graber T M, Voss L R 1989 Stability of magnetic versus mechanical palatal expansion. European Journal of Orthodontics 11: 107–115

References to books are given as follows:
Moorrees C F A 1959 The dentition of the growing child. Harvard University Press. Cambridge
Solow B, Greve E 1979 Craniocervical angulation and nasal respiratory resistance. In: McNamara J A (ed.) Nasorespiratory function and cranial growth. Monograph No. 9, Craniofacial Growth Series, Center for Human Growth and Development, University of Michigan, Ann Arbor, pp. 6–54
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