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FACULDADE DE ODONTOLOGIA DE PIRACICABA

ANNICELE DA SILVA ANDRADE

CARACTERÍSTICAS MUSCULARES, ESQUELÉTICAS E DENTÁRIAS EM CRIANÇAS COM MORDIDA CRUZADA POSTERIOR ANTES E APÓS A EXPANSÃO RÁPIDA DA MAXILA

Tese apresentada à Faculdade de Odontologia de Piracicaba, da Universidade Estadual de Campinas, para obtenção do título de Doutora em Odontologia, Área de Concentração em Odontopediatria.

Orientadora: Prof[a]. Dr[a]. Maria Beatriz Duarte Gavião

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RESUMO

O objetivo da presente pesquisa foi avaliar as características musculares, esqueléticas e dentárias em crianças antes e após o tratamento da mordida cruzada posterior (MCP) com expansão rápida da maxila. No capítulo 1, a espessura do músculo masseter e medidas esqueléticas e dentárias foram avaliadas em crianças, de ambos os gêneros (7-10 anos), divididas nos seguintes grupos: grupo com MCP bilateral (n=13), grupo com MCP unilateral (n=18) e grupo com oclusão normal (ON, n=32). Para avaliação da espessura muscular do masseter foi utilizado o equipamento de ultrasom, nas posições de repouso e máxima intercuspidação. Modelos de gesso e cefalogramas posteroanteriores foram obtidos e 5 medidas esqueléticas (largura maxilar, largura mandibular, razão maxilar/mandibular e os ângulo J-CO-AG), bem como 5 medidas dentárias (largura intermolar maxilar e mandibular, razão entre as larguras intermolares superior/inferior e a distancia rafe palatina-1os molares superiores de ambos os lados) foram analisadas. Os resultados demonstraram que os grupos com MCP bilateral e unilateral apresentaram atresia maxilar esquelética e dentária devido principalmente à constrição da base apical maxilar. Não houve diferenças significativas entre os grupos MCP bilateral e MCP unilateral, entretanto, somente o grupo MCP unilateral apresentou um maior ângulo J-CO-AG (no lado cruzado) em relação ao grupo com ON. As diferenças em relação à espessura muscular do masseter não foram significativas nem entre os lados e nem entre os grupos. Correlações significativas entre medidas esqueléticas e dentárias foram observadas apenas no grupo com ON. No capítulo 2, a atividade eletromiográfica (EMG) dos músculos mastigatórios e as medidas esqueléticas e dentárias foram avaliadas em crianças com MCP funcional (n=17), antes e após o tratamento com expansão rápida da maxila; este grupo foi comparado com crianças com ON (n=15). A atividade EMG do masseter e temporal anterior foi registrada com eletrodos de superfície durante a mastigação habitual por 20 s. Foram realizadas as mesmas medidas transversais esqueléticas e dentárias citadas no capítulo 1. Todos os exames foram realizados antes (T1) e após a expansão maxilar (T2). O intervalo médio entre os tempos foi de 10,6 meses. Os resultados demonstraram que a atividade EMG dos músculos mastigatórios aumentou significativamente após o tratamento, bem como a maioria das medidas transversais esqueléticas e dentárias, sendo os efeitos esqueléticos mais significativos do que os dentários. De acordo com os estudos, concluiu-se que crianças com MCP apresentam diferenças entre as variáveis esqueléticas e dentárias em relação ao grupo com ON. O tratamento da MCP através da expansão rápida da maxila corrigiu essas diferenças, bem como promoveu o aumento das atividades EMG dos músculos masseter e temporal anterior durante a mastigação habitual. Estes achados indicam que o tratamento precoce da MCP favorece a obtenção de condições morfológicas e funcionais adequadas para um melhor desenvolvimento do sistema estomatognático.

Palavras-chave: mordida cruzada posterior, expansão rápida da maxila, cefalometria

ABSTRACT

The aim of the present research was to evaluate the muscular, skeletal and dental characteristics in children before and after the treatment of posterior crossbite (PCB) by rapid maxillary expansion. In chapter 1, the masseter muscle thickness and the skeletal and dental measurements were evaluated in children, from both genders (7-10 years), divided in the following groups: group with bilateral PCB (n=13), group with unilateral PCB (n=18) and normal occlusion group (NO , n=32). The ultrasound equipment was used for the evaluation of masseter muscle thickness, in rest and maximal intercuspation positions. Dental casts and posteroanterior cephalograms were obtained and five skeletal (maxillary width, maxillary to mandibular width ratio, manibular width and J-CO-AG angles) and five dental measurements (maxillary intermolar width, maxillary to mandibular intermolar width ratio, mandibular intermolar width and distances from midpalatal raphe to upper first molar in both sides) were analyzed. The results showed that the groups with bilateral and unilateral PCB presented skeletal and dental atresia due to the constriction of maxillary apical base. There were no significant differences between the bilateral and unilateral PCB groups, however, only the unilateral PCB group presented a larger J-CO-AG angle (on crossbite side) in relation to the NO group. The differences related do masseter muscle thickness were not significant nor between sides nor between groups. Significant correlations between skeletal and dental measurements were observed only in the NO group. In chapter 2, the electromyographic (EMG) activity of masticatory muscles and the skeletal and dental measurements were evaluated in children with functional PCB (n=17) before and after the treatment with rapid maxillary expansion; this group was compared to children with NO (n=15). The EMG activity of masseter and anterior temporalis was recorded with superficial electrodes during habitual chewing for 20 s. The same transversal skeletal and dental measurements cited in chapter 1 were used. All exams were performed before (T1) and after (T2) maxillary expansion. The mean interval between times was 10.6 months. The results showed that the EMG activity of masticatory muscles significantly increased after treatment, as while as the majority of transversal skeletal and dental measurements, being the skeletal effects more significant than the dental ones. According to the studies, it was concluded that children with PCB present differences between skeletal and dental measurements in relation to the NO group. The PCB treatment with rapid maxillary expansion corrected these differences, and induced an increase in EMG activities of masseter and anterior temporalis muscles during habitual chewing. These findings indicate that early treatment of PCB create morphological and functional conditions proper to a better development of stomatognathic system.

Key-words: posterior crossbite, rapid maxillary expansion, cephalometry

SUMÁRIO

I. INTRODUÇÃO

A mordida cruzada posterior (MCP) caracteriza-se por uma alteração na oclusão dos arcos dentários no sentido transversal (Moyers, 1991). De acordo com dados epidemiológicos, a presença da mordida cruzada posterior no inicio da dentição decídua e mista na população brasileira situa-se entre 8-22% (Grando et al., 2008; Macena et al., 2009).

A discrepância transversal e instabilidade oclusal, características da mordida cruzada podem abranger um dente, um grupo de dentes ou todo o arco dentário. A origem pode estar associada a fatores dento-alveolares, musculares ou esqueléticos, sendo o diagnóstico diferencial de suma importância para a escolha e sucesso do tratamento (Moyers, 1991).

Os principais fatores etiológicos da MCP são diminuição do arco dentário (causado principalmente por hábitos de sucção deletérios) e hereditariedade. Além disso, alguns autores relacionam a etiologia da MCP com má posição dentária, macroglossia, disfunções temporomandibulares, distúrbios de erupção e trauma (Vadiakas 1991).

A MCP pode ser classificada como dentária (apresenta maxila normal e inclinação apenas de um ou mais dentes) e esquelética (presença de constrição maxilar). Além disso, tanto as MCP dentárias como as esqueléticas podem apresentar-se com desvio mandibular para o lado da mordida cruzada, causado pela presença de um contato prematuro que desencadeia o desvio lateral mandibular para evitar interferências oclusais. Nestes casos, estas maloclusões também podem ser denominadas mordidas cruzadas posteriores funcionais (Kecik et al., 2007).

O sistema estomatognático constitui uma entidade fisiológica e funcional integrada por um conjunto de órgãos e tecidos, cuja biologia e fisiopatologia são absolutamente interdependentes. A oclusão é um fator importante na função mastigatória e no desenvolvimento anatômico e funcional do sistema estomatognático (Gavião et al., 2001). Dessa forma, para haver crescimento e desenvolvimento equilibrado do sistema mastigatório em crianças, o tratamento das maloclusões deve ser estabelecido tão logo as alterações sejam diagnosticadas.

A análise da musculatura mastigatória em indivíduos com alterações oclusais pode fornecer dados úteis sobre o impacto funcional das discrepâncias morfológicas. A atividade muscular pode ser verificada pela eletromiografia (EMG) de superfície, a qual permite a análise dos principais músculos mastigatórios (masseter e temporal anterior) com resultados semelhantes aos obtidos com registro intramuscular (Belser & Hannam, 1986).

Outro método de avaliação dos músculos mastigatórios é a ultrassonografia, pois permite acesso fácil e reprodutível da espessura dos músculos mastigatórios, obtendo-se a informação quantitativa de sua capacidade funcional e a determinação de alterações estruturais (Bakke et al., 1992; Kiliaridis et al., 1991;Bertram et al., 2003), sem que haja exposição do sujeito a radiações. Por meio da avaliação da espessura dos músculos mastigatórios, estudos demonstraram que a função destes exerce influência sobre o desenvolvimento das estruturas ósseas faciais (Kitai et al. 2002; Kiliaridis et al., 2003) e que a presença de alterações das estruturas dentofaciais também refletirá em alterações na função e morfologia muscular (Castelo et al., 2007).

Segundo Podesser et al., 2007, a mordida cruzada posterior está relacionada freqüentemente a problemas esqueléticos, e não somente a displasias dentárias, envolvendo a maxila, a mandíbula, ou ambos. No estudo das discrepâncias esqueléticas transversais, a radiografia póstero-anterior demonstrou ser um método auxiliar de diagnóstico de grande importância e confiabilidade (Allen et al., 2003; Kecik et al., 2007), mas que ainda não se tornou de uso rotineiro na prática odontológica, uma vez que o estudo cefalométrico em norma lateral ainda é o mais utilizado. Portanto, a análise em norma frontal pode ser considerada adequada no estudo anatômico das estruturas craniofaciais e, particularmente, neste tipo de maloclusão (Vanarsdall & White, 1994).

Em crianças, a disjunção maxilar é um procedimento amplamente aceito e recomendado para a correção da mordida cruzada posterior associada à atresia maxilar (Haas, 1961; Werts, 1970; Chung & Font, 2004). A abertura da sutura palatina mediana promove um aumento da largura maxilar e do perímetro do arco dental, possibilitando a coordenação das bases dentárias superior e inferior e correção da mordida cruzada.

Apesar da análise dos músculos mastigatórios fornecer dados proveitosos do impacto funcional das discrepâncias morfológicas e permitir a avaliação funcional dos tratamentos de problemas oclusais, acreditamos serem necessárias maiores investigações sobre o comportamento destes músculos e das características esqueléticas e dentárias em crianças com mordida cruzada posterior antes e após a expansão rápida da maxila.

Assim, os objetivos da presente pesquisa foram:

- Avaliar a espessura do músculo masseter e medidas transversais esqueléticas e dentárias em crianças com mordida cruzada posterior, comparando-as com crianças com oclusão normal.
- Avaliar antes e após do tratamento com expansão rápida da maxila a atividade elétrica dos músculos mastigatórios durante a mastigação e as medidas esqueléticas e dentárias em crianças com mordida cruzada posterior, comparando-as com um grupo de oclusão normal.

II. CAPÍTULOS

Capítulo 1: “Muscular, skeletal and dental characteristics in children with posterior crossbite”

Capítulo 2: “The effects of rapid maxillary expansion on electromyographic, skeletal and dental changes in children with functional posterior crossbite”.

Esta tese está baseada na Resolução CCPG/002/06/UNICAMP que regulamenta o formato alternativo para dissertações de Mestrado e teses de Doutorado e permite a inserção de artigos científicos de autoria ou co-autoria do candidato

Capítulo 1

ORIGINAL ARTICLE

Muscular, skeletal and dental characteristics in children with posterior crossbites

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ABSTRACT

Objective: To evaluate the differences between the muscular, skeletal and dental variables in children with normal occlusion and with uni or bilateral posterior crossbites.

Materials and Methods: Children of both sexes (mean age 8.8 years) were divided into the following groups: bilateral posterior crossbite (BPCB, n=13), unilateral posterior crossbite (UPCB, n=18) and normocclusion (NOccl, n=32) groups. The masseter muscular thickness was measured with real-time ultrasound and posteroanterior cephalograms and study models were taken in order to obtain the five skeletal and five dental measurements evaluated.

Results: The ultrasonographic evaluation did not show statistically significant differences among groups, nor between sides in the three groups. Four skeletal (maxillary width, maxillary to mandibular width ratio and J-CO-AG angles) and four dental measurements (maxillary intermolar width, maxillary to mandibular intermolar width ratio and distances from midpalatal raphe to upper first molar in both sides) were significantly different between the NOccl group and the crossbite groups. The differences between the BCPB and UPCB were not statistically significant; however, only the UPCB group presented a bigger J-CO-AG angle (in crossbite side) than the NOccl group. Significant correlations between the skeletal and dental measurements were observed only in the NOccl group.

Conclusions: Although posterior crossbite patients present significant skeletal and dental differences in relation to normoclusive subjects, the same did not happen with muscle thickness; the posteroanterior cephalogram represent a valuable tool for a differential evaluation of uni and bilateral posterior crossbites.

KEY WORDS: cephalometry, malocclusion, dental casts

INTRODUCTION

The prevalence of posterior crossbites in children varies between 8% to 22%.[1,2] Various etiologies are associated, including prolonged retention or premature loss of deciduous teeth, abnormalities in tooth anatomy or eruption sequence, crowding, palatal cleft, oral digit habits, oral respiration or breathing during critical growth periods and malfunctioning temporomandibular joints.[3]

It is well known that the posterior crossbite does not confine itself to dental problems but is more often related to an underlying skeletal component.[4] The most common form is a unilateral presentation with a functional shift of the mandible toward the crossbite side, which occurs in 80% to 97% of cases.[5] This malocclusion can influence the normal growth of the mandible and the condyle in both the crossbite side[6] and in the contralateral one.[7] Moreover, these morphologic problems can be associated to asymmetric electromyographic activity, different thickness of the elevator muscles on each side of the jaw, different bite force magnitude, and more TMJ symptomatology in crossbite subjects.[8]

Considering that posterior crossbites can present different degrees of dentoalveolar and/or skeletal problems, the differential diagnosis is of fundamental importance in planning treatment. Traditionally, orthodontists have focused on clinical exam and dental casts' analysis to establish the treatment plan for the correction of posterior crossbite. However, the dental arches are not an accurate means of assessing the transverse skeletal dimension[9] and for radiographic evaluation of transverse skeletal discrepancies, the posteroanterior (PA) cephalogram represents the most readily available and reliable diagnostic tool. To our knowledge, there is no scientific evidence about the muscular, dental and skeletal differences between patients with bilateral and unilateral posterior crossbites.

On this background, the purpose of the present study was to assess the muscular thickness, the skeletal and dental dimensions in children with uni or bilateral presentation of posterior crossbite, comparing them to normocclusive subjects.

METHODS

Subjects

A cross-sectional study design was used with subjects recruited as a convenience sample of 63 children aged 7-10 years. The Research Ethical Committee of the Dental School approved the project (protocol 020/2006 and 023/2006). Complete orthodontic documentation (lateral and posteroanterior cephalometric radiographs, study models, extraoral front and profile photographs, and intraoral photographs) was obtained. The children were distributed into three groups: bilateral posterior crossbite (BPCB group, n=13), unilateral posterior crossbite (UPCB group, n=18), and a control group of children with normal occlusion (NOccl group, n=32). All children of PCB group had maxillary transverse discrepancy with indication of rapid maxillary expansion. Children with crossbite resulting from dental inclination were not considered.

Ultrasound imaging (USI)

The masseter evaluation was conducted using the Just-Vision 200 digital ultrasonography system (Toshiba Corporation, Japan). The images were obtained with a high-resolution real-time 56mm/10-MHz linear-array transducer), and measured directly on screen with an accuracy of 0.1 mm. For each side (left and right/ normal and crossbite side) the recordings were performed twice with the muscles at rest and in maximal clenching with an interval of at least 2 minutes between measurements. The locations for USI were determined by palpation, following the orientations: masseter - level halfway between the zygomatic arch and gonial angle, close to the level of the occlusal plane; anterior portion of the temporal muscle - in front of the anterior border of the hairline.[10]

Measurements of dental casts

The following measurements were recorded:

- Maxillary intermolar width: the linear measurement between the inner lingual points on the gingival margin of the right and left maxillary first molars.[11]
- Mandibular intermolar width: the linear measurement between the inner lingual points on the gingival margin of the right and left mandibular first molars.[11]
- The maxillary to mandibular intermolar ratio was calculated by dividing the maxillary intermolar width by the mandibular intermolar width.[11]
- Raphe - 1^{st} upper molar: the linear measurement between the inner lingual point on the gingival margin of the first upper molar and the midpalatal raphe. This measurement was obtained in both right/left (NOccl and BPCB groups) and crossbite/normal (UPCB) sides.

The points were marked with pencil edge 0.3 mm and the linear distances measured by digital caliper (Digimatic series 500, Mitutoyo, Japan, to the nearest 0.01 mm), by a single trained and calibrated examiner (MCSM).

Measurements of PA cephalograms

The cephalograms in PA projection were hand-traced with a 0.3 mm pencil on 0.003 mm matte acetate tracing paper. All tracings were performed by one author (GHG) and were subsequently measured by another investigator (ASA) using a digital caliper (Digimatic series 500, Mitutoyo, Japan). The following landmarks were identified and the measurements examined were:

- Maxillary width (J-J): distance between right and left jugale.[12]
- Mandibular width (AG-AG): distance between right and left antegonion.[12]
- Maxillo-mandibular skeletal width ratio: the ratio equaling (J-J divided by AG-AG) was used to compare maxillary and mandibular skeletal widths.[12]

- J-CO-AG: angle formed by J, geometric center of the orbit (CO) and AG on both sides. CO: The geometric center of the area defined by tangents to the most superior, lateral, inferior, and medial points on the outline of the orbital margin.[12]

Error of the method

The error of the method for measurements of dental casts and the ultrasound examination was calculated by evaluation of two repeated measurements, with an interval of 15 days between them, using the Dahlberg's' formula EM= √Σ(x1-x2)2/2n. The values ranged between 0.11 and 0.42 for dental casts, and between 0.31 and 0.35 for ultrasound examination, which were considered to be acceptable. In PA cephalograms, 15 radiographs were re-traced and re-measured to obtain the correlation coefficient (correlation of Pearson / Spearman) between the measurements. The coefficients ranged between 0.99 and 1.00.

Statistical Analysis

The data analyses were performed by the software Sigma Stat 2.0 (Software Inc., Richmond, EUA). Shapiro-Wilks test was used to verify data normality. Intragroup comparisons were carried out considering the right and left sides for the NOccl and BPCB groups and the crossbite and normal sides for the UPCB group. Paired t-test was used for these comparisons. Intergroup comparisons were carried using One-way ANOVA+Tukey or Kruskall-Wallis+Dunn. The relationship between skeletal and dental measurements was evaluated by Spearman rank correlation or Pearson's coefficient analysis, as appropriate. The significance level was set at $p < 0.05$.

RESULTS

Table 1 shows the data regarding the masseter muscle thickness. The differences between sides in the three groups were not statistically significant, so the mean values were used for the intergroup comparisons. The muscle thickness in both conditions, at rest and at maximum clenching was similar in the three groups.

Table 1: Mean ± SD of masseter muscular thickness (mm) at rest and maximum clenching in NOccl, BPCB and UPCB groups.

	Rest		*Maximum Clenching*	
GROUPS	*Right or crossbite side*	*Left or normal side*	*Right or crossbite side*	*Left or normal side*
NOccl	10.18 (1.74)	10.35 (1.76)	11.96 (1.74)	12.07 (1.25)
BPCB	10.47 (1.48)	10.68 (1.21)	11.58 (1.36)	12.04 (1.28)
UPCB	10.86 (1.66)	10.56 (1.41)	11.99 (1.49)	11.92 (1.47)

There were no significant differences between sides nor between groups ($p>0.05$)

The measurements of PA cephalograms are shown in table 2. The BPCB and UPCB groups presented a smaller maxillary width and a smaller maxillary/mandibular skeletal width ratio than the NOccl group. The differences between BPCB and UPCB were not significant. The mandibular width was similar in the three groups. The J-CO-AG angles were bigger in both sides of the crossbite groups than on the NOccl group. However, statistical difference in the crossbite side vs. right side (NOccl group) was observed only in the UPCB, but not in the BPCB group.

Table 2: Mean (±SD) of radiographic cephalometric measurements in posteroanterior cephalograms

	NOccl	BPCB	UPCB
Maxillary width (JL-JR) (mm)	64.53 (3.28)^{A}	58.55 (2.91)^{B}	58.10 (3.04)^{B}
Mandibular width (AG-AG) (mm)	77.94 (3.89)^{A}	74.65 (6.65)^{A}	77.58 (4.42)^{A}
JL-JR: AG-AG (%)	79.90 (4.50)^{A}	79.04 (8.61)^{B}	75.01 (4.14)^{B}
J-CO-AG in right or crossbite side (degrees)	5.34 (2.34)^{A}	5.96 (1.66)^{AB}	7.14 (1.83)^{B}
J-CO-AG in left or normal side (degrees)	5.09 (2.15)^{A}	6.62 (2.06)^{B}	6.56 (2.19)^{B}

Different letters indicate statistical difference between groups ($p<0.05$; ANOVA + *Tukey* or Kruskal-Wallis + *Dunn).*

Table 3 shows the dental measurements. The posterior crossbite groups exhibited a smaller maxillary intermolar width and a smaller maxillary/mandibular intermolar width ratio than the NOccl group, but the differences between BPCB and UPCB were not significant. There were no differences in the mandibular intermolar width among the three groups. The distances from midpalatal raphe to 1st upper molars on both sides were smaller in the BPCB and UPCB groups, which did not differ between each other.

Table 3: Mean ±SD of dental casts' measurements (mm) in NOccl, BPCB and UPCB groups.

GROUPS	*Maxillary 6-6 width*	*Mand. 6-6 width*	*Maxillary:mandibular intermolar width (%)*	*Raphe-1st upper molar Right or crossbite side*	*Raphe-1st upper molar Left or normal side*
NOccl	34.09^{A} (1.80)	33.18 ^{A} (1.99)	102.90 ^{A} (5.46)	17.20 ^{A} (1.17)	17.34 ^{A} (1.13)
BPCB	30.76^{B} (1.94)	33.30 ^{A} (2.81)	92.91 ^{B}(8.85)	15.66 ^{B} (1.02)	16.02^{B} (1.18)
UPCB	30.32^{B} (2.45)	33.09 ^{A} (2.06)	91.61 ^{B}(4.25)	15.13 ^{B} (1.26)	15.56 ^{B} (1.36)

Different letters indicate statistical difference between groups ($p<0.05$; ANOVA + *Tukey* or Kruskal-Wallis + *Dunn*)

The correlations between the skeletal and dental measurements are shown in table 4. A positive significant correlation between maxillary skeletal width and maxillary intermolar dental width was observed only in the NOccl group. Similar results were observed when maxillary/mandibular width ratio was considered.

Table 4: Correlation coefficients (r) between skeletal and dental arch measure ments in NOccl, BPCB and UPCB groups.

	DENTAL MEASUREMENTS		
GROUPS	*Maxillary 6-6 width (mm)*	*Maxillary:mandibular intermolar width (%)*	**SKELETAL MEASUREMENTS**
NOccl	0.61*	0.43*	*Maxillary width (JL-JR) (mm)*
BPCB	0.36	-0.25	
UPCB	0.44	0.29	
NOccl	0.23	0.45*	*JL-JR: AG-GA (%)*
BPCB	-0.08	0.27	
UPCB	-0.00	-0.08	

*p<0.05 (Pearson's or Spearman's correlation)

DISCUSSION

The present study show that there are significant skeletal and dental differences between posterior crossbite patients and normocclusive subjects, however the same does not happen with masseter muscle thickness, since no differences in this variable were found between groups, or between sides in the three groups evaluated. This finding is in accordance with those obtained by the studies of Castelo et al[13] and Andrade et al,[14] in which posterior crossbite were not associated with alterations in masseter muscle thickness. On the other hand, Kiliaridis et al[15] observed that the masseter muscle was significantly thinner on the crossbite side in children with a unilateral crossbite, and after treatment of the malocclusion, this difference was corrected. The discrepancies among the results in different studies may be due to differences between the samples, the location of the measuring points, and the use of different imaging techniques.[16] Moreover, there is a large inter-individual variation in masseter muscle thickness due to a variable number of muscle fibers, variation in fiber size, or both.[17,18] Taken together, these findings indicate that it is too early to draw any firm conclusions regarding the muscle thickness alterations in patients with posterior crossbites.

The analyses of skeletal measurements made from PA cephalograms reveal that crossbite patients have a narrow maxilla and a smaller maxillary to mandibular width ratio than the NOccl group. This smaller ratio was due to the skeletal maxillary constriction, since there were no differences in mandibular widths among the three groups. These results are in accordance with those obtained by Cross and McDonald; [19] these authors reported that crossbite patients had a small maxillary width and a normal mandibular width, when compared to control subjects. Brin et al[20] also found that facial and maxillary widths were below normal in children with unilateral posterior crossbite; they indicated that the cause of unilateral crossbite was a deficient maxilla, a similar finding also reported by Huertas and Ghafari .[12] However, Langberg et al[21] found that adults with posterior crossbite had a relative maxillary arch deficiency and not an absolute deficient maxilla, indicating that patients develop a unilateral posterior crossbite because of a large mandible and not because of a deficient maxilla. These different results can be explained by the sample selection criteria and the different age groups.

In the present study, the criterion for selection of BPCB and UPCB groups was a posterior crossbite with evidence of significant skeletal involvement as judged clinically by an experienced orthodontist. This approach can minimize the composition of a heterogeneous sample with different skeletal and dentoalveolar contributions to the posterior crossbite. In these groups, it was observed that the maxilla was smaller than the NOccl group, and this resulted in a smaller maxillary to mandibular width ratio. This measurement is more appropriate to use with children because their greater variability in physical size for subjects of similar age, as compared with adults. Moreover, this ratio can be used to evaluate posterior crossbite patients independently if the problem is the maxilla or the mandible. The radiographic measurements recorded in our study were very similar to the normative data of children with and without posterior crossbite obtained by the well-controlled studies of Huertas et al[12] and Allen et al.[11] Taken together, these results reinforce the idea that clinical impressions about transversal problems apparently anticipate the cephalometric findings. The PA cephalograms did not reveal significant differences between the BPCB and UPCB groups, although the J-CO-AG angle (in crossbite side) had been different from the respective control group only in the UPCB. This result indicates the presence of a skeletal or positional asymmetry. Some authors suggested that the mandible has only positional asymmetry in unilateral posterior crossbite patients, [22] whereas others noted additional skeletal asymmetry.[23]

The dental casts' analysis showed that posterior crossbite patients had a smaller maxillary intermolar width and a smaller maxillary to mandibular intermolar width ratio than the NOccl group. The differences in mandibular intermolar width were not significant. These results indicate that the main problem was the constricted maxillary arch and not the mandible arch. Most studies[19, , 24] comparing a crossbite group with a normal occlusion sample also reports this finding. It is important to point out that the target of correction in posterior crossbite patients tends to be the maxilla, even if the mandible is the discrepant jaw, because maxillary expansion is feasible but restraining transverse growth of the mandible is difficult. The analyses of the distances from midpalatal raphe to upper first molar reveal that the BPCB and UPCB group had a symmetrically-constricted maxillary arch. These distances in both sides were smaller than the NOccl group, but there were no differences between the BPCB and UPCB groups. This indicates that posterior crossbites with skeletal constriction of the maxilla represents a symmetrical problem, both in the unilateral and bilateral manifestations. The similar skeletal and dental measurements observed in the BPCB and UPCB groups also indicates that there was no difference regarding the severity of maxillary constriction between these malocclusions. The different clinical manifestation is probably due to the mandibular functional shift that occurs in approximately 80% of children with unilateral posterior crossbite.[25] The absence of skeletal and dental asymmetry in the maxilla of posterior crossbite patients was also reported by Langberg et al.[21] However, in some cases, the unilateral posterior crossbite is due to an asymmetrically-constricted dentoalveolar process,[26] but in these cases there is no skeletal alteration of the maxilla. The present investigation did not evaluate this type of malocclusion.

There was no correlation between muscle thickness and skeletal or dental arch widths in the three groups. Although an association between the functional capacity of the masticatory muscles and craniofacial morphology has been reported, [27, 28] significant correlations between the masseter thickness and the skeletal and dental variables evaluated in this study are not usual. Kiliaridis et al[15] observed a significant association between the masseter thickness and the maxillary dental arch only in adult females but no in males. Their sample consisted of individuals with minor malocclusions and without skeletal problems, thus limiting direct comparisons of our results. The present data show significant correlations between the transverse skeletal and dental measurements only in the NOccl group, but not in the crossbite patients. Allen et al[11] found that correlations between the skeletal and dental measurements of the maxilla in a control group were moderate, but only low correlation coefficients were found in posterior crossbite patients. The present study found a significant correlation between these measurements only in the NOccl group. The absence of significant correlations in the posterior crossbite patients is probably due to the dentoalveolar compensations usually observed in crossbite patients with skeletal discrepancies.[12] This finding might conceptually support the functional matrix premise of functional requirements influencing optimal form.[28]

CONCLUSIONS

- Children with skeletal posterior crossbites exhibited significant transverse skeletal and dental differences in relation to the normal occlusion group, but the same did not happen with muscle thickness.
- Both the unilateral and bilateral manifestations of posterior crossbites were related to a symmetrically-constricted maxilla.
- An integrated analysis of clinical exam, dental casts and PA cephalograms should be performed to the correct diagnosis and management of posterior crossbites.

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Capítulo 2

The effects of rapid maxillary expansion on electromyographic, skeletal and dental changes in children with functional posterior crossbite – A longitudinal study

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ABSTRACT

Objective: To evaluate the long-term effects of rapid maxillary expansion (RME) on EMG activities of masticatory muscles and on transverse dimensions of skeletal and dental structures in children with functional posterior crossbite (FPCB).

Materials and Methods: The sample consisted of 17 FPCB patients (mean age, 8.8 years) who had undergone RME with Hyrax expander, compared with 15 normocclusive subjects (NOccl group) matched by age and gender. The EMG activity of masseter and anterior temporalis was recorded simultaneously from both muscles during habitual chewing. Moreover, serial dental casts and posteroanterior cephalograms were taken from all subjects. The data were collected before (T1) and 10 months after treatment (T2).

Results: EMG analysis showed that the activity of both masticatory muscles has significantly increased after treatment. The analysis of dental casts and posteroanterior cephalograms reveal that RME produced significantly favorable long-term changes in almost all the skeletal and dental measurements. The skeletal changes were greater than the dental ones.

Conclusions: These results indicate that RME can significantly increase the maxillary transverse skeletal and dental dimensions in young patients with FPCB, and these changes provided a significant improvement of EMG activity of masticatory muscles, which should be considered in both the treatment and stability of FPCB.

KEY-WORDS: masticatory muscles; electromyography; malocclusion

INTRODUCTION

Posterior crossbite in the deciduous and mixed dentition represents a common problem in pediatric dental clinical practice. Its prevalence ranges from 8% to 22% (Grando et al., 2008; Macena et al., 2009).This malocclusion may originate from different combinations of skeletal and dentoalveolar components (Allen et al., 2003), but the most common form is a unilateral presentation with a functional shift of the mandible toward the crossbite side, which occurs in 80% to 97% of cases (Thilander et al., 1984; Schroder & Schroder 1984). This condition is described as a functional posterior crossbite (FPCB). The early treatment of FPCB is advisable, because the subsequent adaptation of the neuromusculature to the acquired mandibular position can cause asymmetric mandibular growth, facial disharmony, and several functional changes in the masticatory muscles and TMJ (Bishara et al., 1994; Sonnesen et al., 1998; Egermark et al., 2005).

Most studies indicates that the target of correction in posterior crossbite patients tends to be the maxilla, even if the mandible is the discrepant jaw, because maxillary expansion is feasible and its expansion resolves the transverse maxillary deficiency and allows the mandible to regain a normal maximum intercuspation position. (Huertas & Gharafa 2001; Kecik et al., 2007). The maxillary expansion can be obtained by appliances classified as slow or rapid. The rapid maxillary expansion (RME) constitutes a routine clinic procedure used to correct the constricted maxillary arch by maximizing skeletal movement and minimizing dental movement, while allowing for physiological adjustment of the midpalatal suture during separation (Ciambotti et al., 2001, Chung & Font 2004).

The sagittal and vertical changes due to RME have been extensively studied (Sandikçioğlu and Hazar, 1997; Akkaya et al. 1999; Cozza et al., 2001, Garib et al. 2007), but only a few studies have reported the longitudinal transverse skeletal changes induced by this procedure (Krebs 1964; Haas 1980, Cameron et al., 2002). Moreover, its effects on the musculature are still unclear. One study revealed that the electromyographic (EMG) activity of anterior temporal and superficial masseter during swallowing increased after RME (Arat et al., 2008a).

De Rossi et al. reported that these masticatory muscles exhibited an increased EMG activity during rest, dental clenching and habitual chewing after removing the RME appliance. These two studies had no control group against which to make adequate comparisons. To our knowledge, no published study has compared the EMG activity of masticatory muscles during habitual chewing after the complete retention period of RME, using both a treated and control group.

In light of these facts, the present study was designed to evaluate the effects of RME on skeletal and dental measurements, and on masticatory EMG activity in children with functional posterior crossbite, comparing them to data obtained in a normal occlusion sample.

METHODS

Subjects

A longitudinal study design was used with subjects recruited in a convenient sample of 32 children, aged 7-10 years, who were to start dental treatment at the Department of Pediatric Dentistry, Piracicaba Dental School, University of Campinas. The Research Ethics Committee of the Dental School approved the project (Protocol Nos. 020/2006 and 023/2006).

The children were divided into two groups: children with functional posterior crossbite (FPCB group,) consisting of 17 subjects aged from 7 to 10 years (8.65±1.23); The control group consisted of 15 children with normal occlusion (NOccl group) aged from 7 to 10 years (mean age 8.64±1.15 years). After reaching agreement, anamnesis was conducted to verify the medical and dental history. The exclusion criteria for both groups were the presence of symptoms of craniomandibular dysfunction, major dental reconstructions, previous or current orthodontic treatment, caries, and/or severe periodontal pathology or missing teeth. Only subjects with unilateral presentation of posterior crossbite with a functional shift of the mandible toward the crossbite side were selected. Children with crossbite resulting from dental inclination were not considered.

The children in FPCB group were submitted to rapid maxillary expansion with Hyrax appliance, which is constituted of a screw for palatal expansion (split screw, 9 mm, reference code 65.05.011; Dental Morelli, Sorocaba, SP, Brazil) solded in a frame work of wire bonded to the deciduous canines with light-cured composite (Z100. 3M do Brasil Ltda Produtos Dentários; Sumaré, SP, Brazil) and banded to the first upper molars with glass ionomer cement (Vidrion C, S.S. White, Rio de Janeiro, RJ, Brasil). The appliance was activated by adjusting a screw a quarter turn (0.25mm) every 12 hours. When the palatal cusps of the posterior upper teeth were occluding the buccal cusps of the lower posterior teeth, the screw was fixated using acrylic resin (Jet, Artigos Odontológicos Clássico Ltda, São Paulo, Brazil). Occlusal radiography was performed to confirm the opening of the median palatine suture. After the correction, the patients wore the fixed appliance for four months on average, and occlusal radiography was again performed to verify the new bone formation in the median palatine suture. After, the disjunctive appliance was removed and patients wore a removable retainer (Hawley appliance) for 6 months.
All data (EMG activity, dental casts and posteroanterior cephalograms analysis) were recorded in the following times: T1: before treatment and T2: 6 months after using the removable retainer. The average interval between T1 and T2 was 10.6 months. Children of both groups presented bilateral chewing pattern without a preferred chewing side before treatment, determined by the visual spot-checking method (Christensen and Radue, 1985).

Electromyographic evaluation

The activities of the right and left masseter and anterior temporal muscles were measured by the EMG System do Brazil Ltda (São Paulo, SP, Brazil) MCS-V2 Electromyograph, using a differential double electrode, a bandpass filter at 20 to 1000 Hz, and a subsequent amplification of 50 times with a common mode rejection ratio of 130 dB to 60 Hz. The data were sent to a 14-bit A/D converter and sampled at 2000 Hz. A differential double electrode was used, with 100 times pre-amplification and two contacts measuring 10.0 x 1.0 mm, with a distance of 10.0

mm between them, impedance upwards of 10GΩ and a common rejection value of 130dB to 60Hz, crafted in silver and fixed in a resin capsule measuring 40x20x5 mm. During the experiment, the child remained comfortably seated, with a straight back and head oriented in the Frankfort plane parallel to the floor. Both the skin and the electrodes were cleaned with 70 percent GL ethyl alcohol in order to eliminate any residues of grease or pollution.

The electrodes were placed on the masseter and anterior temporalis in the following orientations: masseter - level halfway between the zygomatic arch and gonial angle, close to the level of the occlusal plane; anterior portion of the temporalis muscle - in front of the anterior border of the hairline. A ground electrode was also used on the right hand to reduce electromagnetic interferences and other acquisition noise. The muscle activity was recorded during two chewing sequences (chewing gum) of 20 seconds and the means of root mean square (RMS) were used. The mean of two measurements was considered. The methodology for signal treatment was in accordance with Merletti *et al.,1999*. The children were instructed to chew in their habitual manner.

To reduce the variability intra- and inter-subjects, the normalization of EMG potentials was calculated for the RMS (Root Mean Square, µV) values by converting absolute (liable to constitutional interferences) into relative values. The values during mastication were expressed as a percentage of the maximum clench, unit of (µV/ µV) X100.

Measurements of posteroanterior cephalograms

The cephalograms in posteroanterior projection were hand-traced with a 0.3 mm pencil on 0.003 mm matte acetate tracing paper. All tracings were performed by one author (GHG) and were subsequently measured by another investigator (ASA) using a digital caliper (Digimatic series 500, Mitutoyo, Japan). The following landmarks were identified and the measurements examined were:

- Maxillary width (J-J): the linear measurement between left and right J points (bilateral points located at the depth of concavity of the lateral maxillary contour, at the junction of the maxilla and zygomatic buttress) (Allen et al., 2003).
- Mandibular width (AG-AG): the linear measurement between left and right AG points (bilateral points at the inferior margin of the antegonial protuberance) (Allen et al., 2003).
- Maxillo-mandibular skeletal width ratio: the ratio equaling (J-J divided by AG-AG) was used to compare maxillary and mandibular skeletal widths (Allen et al., 2003).
- J-CO-AG: angle formed by J, geometric center of the orbit (CO) and AG on both sides. CO: The geometric center of the area defined by tangents to the most superior, lateral, inferior, and medial points on the outline of the orbital margin (Allen et al., 2003).

Measurements of dental casts

The following measurements were recorded:

- Maxillary intermolar width: the linear measurement between the inner lingual points on the gingival margin of the right and left maxillary first molars (Huertas & Ghafari 2001)
- Mandibular intermolar width: the linear measurement between the inner lingual points on the gingival margin of the right and left mandibular first molars (Huertas & Ghafari 2001).
- The maxillary to mandibular intermolar ratio was calculated by dividing the maxillary intermolar width by the mandibular intermolar width (Huertas & Ghafari 2001).
- Raphe - 1st upper molar: the linear measurement between the inner lingual point on the gingival margin of the first upper molar and the midpalatal

raphe. This measurement was obtained in both right/left (NOccl) and crossbite/normal (UPCB) sides.

The points were marked with pencil edge 0.3 mm and the linear distances measured by digital caliper (Digimatic series 500, Mitutoyo, Japan, to the nearest 0.01 mm), by a single trained and calibrated examiner (MCSM).

In order to calculate the relative skeletal and dentoalveolar changes induced by RME, the ratio between the skeletal and dental effects was expressed as a proportion by dividing the increase in maxillary apical base width (J-J) by the increase in maxillary intermolar width. These results were then converted to a percentage. This ratio was calculated only in the PCB group after RME.

Error of the method

The error of the method for measurements of dental casts was calculated by evaluation of two repeated measurements, with an interval of 15 days between them, using the Dahlberg's' formula $EM = \sqrt{\Sigma(x1 - x2)2/2n}$. The values ranged between 0.11 and 0.42, which were considered acceptable. In PA cephalograms, 15 radiographs were re-traced and re-measured to obtain the correlation coefficient (correlation of Pearson / Spearman) between the measurements. The coefficients ranged between 0.99 and 1.00.

Statistical Analysis

The data analyses were performed by the software Sigma Stat 2.0 (Software Inc., Richmond, EUA). Shapiro-Wilks test was used to verify data normality. Intragroup comparisons were carried out considering the right and left sides for the NOccl and the crossbite and normal sides for the UPCB group. Paired t-test was used for these comparisons. Intergroup comparisons were carried unpareid t-test. The significance level was set at $p < 0.05$.

RESULTS

The EMG activities of masseter and anterior temporalis during habitual chewing are shown in table 1. The comparison of NOccl and FPCB groups before RME reveal that there were no statistical differences between groups, nor between sides in both groups. The treatment by RME produced significantly greater increments in EMG activities of both masseter and anterior temporalis when compared with the normocclusive subjects. These increments were also evident when the final forms of NOccl and FPCB groups were compared.

Table 1. EMG activity [RMS normalized means ± SD (%)] of masticatory muscles during habitual chewing

Muscles	T1 (initial)				T2 (final)				T2-T1 (changes)			
	NOccl (n=15)		*FPCB (n=17)*		*NOccl (n=15)*		*FPCB (n=17)*		*NOccl (n=15)*		*FPCB (n=17)*	
	Right	*Left*	*Crossbite side*	*Normal side*	*Right*	*Left*	*Crossbite side*	*Normal side*	*Right*	*Left*	*Crossbite side*	*Normal side*
Masseter	53.26±27.3	56.8 ±26.3	42.4 ±18.6	41.0± 14.6	59.8±51.8¥	58.0± 30.8∞	105.57±24.8¥	102.3±30.9∞	6.58±49.5*	1.2±40.7**	63.1±29.6*	61.2±30.8**
Anterior tempo-ralis	55.1 ±32.2	57.08±31.3	69.4±71.5	51.2±33.4	57.4±35.5¥	78.1± 70.1∞	122.0± 57.4¥	115.3±32∞	2.3 ±39.3*	21.1±70.7**	52.5±87.0*	64.1±45.0**

*indicates significant differences between groups (right/crossbite side) and ** (left/normal side) in T2-T1 (changes) ($p<0.05$; unpaired t-test)

¥ indicates significant differences between groups (right/crossbite side) and ∞ (left/normal side) in T2 (final) ($p<0.05$; unpaired t-test)

30

The measurements of PA cephalograms are shown in table 2. Before treatment, the FPCB group presented a smaller maxillary width and a smaller maxillary/mandibular skeletal width ratio than the NOccl group. The mandibular width was similar in the groups. The J-CO-AG angle in the crossbite side was bigger in the FPCB than on the NOccl group. The RME induced significantly greater increments in maxillary width and maxillary/mandibular skeletal width ratio when compared with the controls. The J-CO-AG angle in the crossbite side was significantly reduced. The comparisons of final forms 6 months after the retention period reveal that there were no differences between groups for all the skeletal measurements.

Table 2: Mean (±SD) of radiographic cephalometric measurements in posteroanterior cephalograms in NOccl and FPCB groups

	T1 (initial)		T2 (final)		T2-T1 (changes)	
Skeletal measurements	*NOccl (n=15)*	*FPCB (n=17)*	*NOccl (n=15)*	*FPCB (n=17)*	*NOccl (n=15)*	*FPCB (n=17)*
Maxillary width (J-J) (mm)	62.3± 3.4*	57.9± 3.0*	62.7± 2.4	61.3± 3.0	0.4± 2.0[¥]	3.4± 2.1[¥]
Mandibular width (AG-AG) (mm)	79.9 ±4.4	77.6± 4.6	81.3± 3.3	79.5± 3.6	1.4 ±2.1	1.9± 2.6
J-J: AG-AG (%)	78.1 ±3.7*	74.7 ±4.1*	77.2± 2.8	78.3± 3.7	-0.9± 2.5[¥]	3.5± 3.7[¥]
J-CO-AG in right or crossbite side (degrees)	6.2± 2.2*	7.6 ±2.3*	5.8 ±1.4	5.0 ±1.7	-0.4 ±1.9[¥]	-2.6± 2.0[¥]
J-CO-AG in left or normal side (degrees)	5.9 ±2.3	6.1 ±1.5	5.8± 1.5	5.4± 1.7	-0.1 ±1.8	-0.7± 1.8
Skeletal (J-J): dental (6-6) effects %						68%

indicates significant differences between groups in T1 (inicial) (p<0.05; unpaired t-test)*

[¥] indicates significant differences between groups in T2-T1 (changes) (p<0.05; unpaired t-test*)*

Table 3 shows that FPCB patients exhibited a smaller maxillary intermolar width and a smaller maxillary/mandibular intermolar width ratio than the NOccl group before treatment. The distances from midpalatal raphe to 1st upper molars on both sides were smaller in the FPCB than on the NOccl group, indicating the presence of a narrow superior arch in FPCB patients. The differences between sides were not statistically significant in both FPCB and NOccl groups, indicating the absence of dentoalveolar asymmetries in both groups. The treatment by RME produced significantly greater increments in all dental measurements when compared to controls, in exception of the intermolar mandibular width, which did not differ between groups. After the retention period, the FPCB and NOccl groups exhibited similar dental measurements.

Table 3: Mean ±SD of dental casts' measurements (mm) in NOccl and FPCB groups

	T1 (initial)		**T2 (final)**		**T2-T1 (changes)**	
Dental measurements	*NOccl (n=15)*	*FPCB (n=17)*	*NOccl (n=15)*	*FPCB (n=17)*	*NOccl (n=15)*	*FPCB (n=17)*
Maxillary 6-6 width	33.7± 2.0*	30.2±2.46*	34.0± 2.0	35.2± 2.6	0.32± 0.37¥	5.0 ±1.2¥
Mandibular 6-6 width	33.0± 2.7	32.9± 2.01	32.6±1.6	33.1± 1.8	-0.41 ±1.89	0.1 ±0.8
Maxillary:mandibular intermolar width (%)	102.3±6.9*	91.6±4.38*	104.3 ±4.8	106.3 ±3.9	1.95± 4.56¥	14.7± 2.6¥
Raphe-1st upper molar (right or crossbite side)	16.9 ±1.2*	15.1± 1.3*	17.3± 1.1	17.7± 1.4	0.37± 0.62¥	2.5± 1.3¥
Raphe-1st upper molar (left or normal side)	17.0 ±1.2*	15.5± 1.4*	17.3± 1.5	18.0± 1.5	0.25 ±0.85¥	2.6 ±1.1¥

indicates significant differences between groups in T1 (inicial) (p<0.05; unpaired t-test)*

¥ indicates significant differences between groups in T2-T1 (changes) (p<0.05; unpaired t-test*)*

DISCUSSION

The anatomical effects of RME are often considerable, while the functional aspects of this procedure are still unclear. The present longitudinal study assessed the muscular, skeletal and dental changes that occurred in FPCB patients who were treated with RME, compared with those observed in a control group. The EMG analysis revealed that the EMG activities of masticatoty muscles on both crossbite and normal sides increased significantly in FPCB group after RME. Before treatment, no significant differences were found between groups, nor between sides in the FPCB and NOccl groups. The comparisons between sides are in agreement with those obtained by Alarcón et al. (2001) and De Rossi et al. (2009), who found no significant differences between sides in crossbite patients during habitual chewing. This could mean that during chewing there is a symmetric function of the masticatory muscles and therefore chewing can be predominantly bilateral, despite the presence of posterior crossbite, as is also considered by Ingervall and Thilander 1975; Salioni et al., 2005 and Andrade et al., 2009. It is important to point out that children of both groups in the present study had a bilateral chewing pattern without a preferred chewing side, determined by the visual spot-checking method (Christensen and Radue, 1985).

A recent systematic review about posterior crossbite and functional changes reported that posterior crossbite patients could have a masticatory pattern that is unique and different from normocclusive subjects (Andrade et al., 2009). The anterior temporalis muscles are usually the most active and the masseter less active in the crossbite subjects than in the normocclusive ones. The present results exhibited this pattern; however, the differences between groups before treatment did not reach a statistical significance. This was probably due to the specific age group of the present sample, which was in the early mixed dentition, while the majority of studies have studied older age groups. This suggests that some time is required before EMG activities are significantly affected by the malocclusion. The comparisons after treatment showed that RME induced a significant bilateral increase in both masseter and anterior temporal muscles. In accordance with these results, De Rossi et al. (2009) observed a significant increase in EMG activity of masticatory muscles (habitual chewing) after removing the disjunctive appliance, although this was statistically significant for only the temporalis muscles. Similarly, Arat et al. (2008a) reported that although the masticatory muscles activities (unilateral chewing) are reduced immediately after RME, they return to pretreatment levels 6 weeks after expansion. Moreover, these authors found that the increasing trend also continued 12 weeks after expansion. Unfortunately, these studies did not include a longer observation period and did not include a control group, so their results are not totally comparable with ours.

The significant increase in masticatory muscles activities after the retention period of RME indicates that the functional capacities of those muscles improved. The fact that an increase in EMG activity is related to an increase in bite force support this idea (Hickman et al., 1998; Bakke et al., 1999). Moreover, Sonnesen and Bakke (2007) also found that treatment of unilateral crossbite patients is able to increase the bite force levels to those observed in children with normal occlusion. The additional EMG activity observed in the present study can be related to the proprioceptive feedback mechanism resulting from an improved dental occlusal contact area, obtained after FPCB treatment. The stability of occlusal contacts is one of the most important factors influencing the maximal EMG activities of masticatory muscles (Jimenez 1987; Wang et al., 2009). Positional receptors in the masticatory muscles and temporomandibular joint that interact with receptors in the periodontal ligament to control muscle activity could also be involved in the increase of EMG activities after the treatment of malocclusion (Sheikholeslam et al., 1982; Helsing 1988), since both the musculature and TMJs are significantly affected by RME(Arat et al 2008a, 2008b, 2008c). Further studies are necessary to investigate if the increased EMG activity will persist for a longer period, and if these EMG changes would improve the masticatory performance of these patients.

The comparisons of skeletal and dental measurements between FPCB and NOccl groups revealed significant differences before treatment, and significant changes achieved by RME. Before treatment, the FPCB group showed a deficiency in maxillary transverse measurements and in maxillary intermolar width when compared with normal subjects. These differences represent the main indications for RME (Cameron et al., 2002). In the present study, the criterion for selection of FPCB group was a posterior crossbite with clinical evidence of skeletal maxillary constriction and functional shift as judged clinically by an experienced orthodontist. Although both the slow and rapid expander appliances are equally capable of correcting FPCB, the authors have used the rapid method, since this procedure widened the palate more reliably, maximizing the skeletal effects and minimizing the dental effects (Ciambotti et al., 2001). The posterior crossbites were corrected and the opening of the midpalatal suture occurred in all patients following expansion. Similar results were reported by other studies that used RME. (da Silva Filho 1995; Ciambotti et al., 2001).

The present data show a significant increase in the skeletal dimension of the maxillary apical base after RME, demonstrating that the method represented a reliable way of effecting maxillary transverse expansion. RME appliances generate heavy forces, as much as 2 to 5 kg per activation (Wertz 1970). These heavy forces maximize skeletal separation of the midpalatal suture by overwhelming the suture before any dental movement or physiologic sutural adjustment can occur (Hass 1970 and Wertz 1970). However, the skeletal changes seen in all patients were less than those observed at the occlusal level. This is in agreement with studies that reported higher transverse effects at the occlusal level than at the maxillary apical base level after RME (Ladner & Muhl 1995; Da Silva Filho 1995). This additional dental expansion results from buccal tipping of the maxillary posterior teeth (Ladner & Muhl 1995; Hass 1970 and Wertz 1970), which is probably related to the significant resistance imposed by the circum-maxillary suture network that attaches the maxilla to the rest of the skull (Wertz, 1970).

The relationship between the observed skeletal and dentoalveolar changes can be expressed as a proportion by dividing the increase in maxillary apical base width (J-J) by the increase in maxillary intermolar width. The data from Tables 2 and 3 show that this proportion was 68% per cent in the present study. Previous studies reported that the proportion between the amount of skeletal and dental expansion turns around 25 and 53 per cent (Ciamboti et al., 2001, Chung et al., 2004, Podesser et al., 2007). The different measurements used and the younger age group could explain the higher value observed in the present study. Evidence shows that the orthopedic effect of RME therapy is influenced by treatment timing (Wertz 1970 and Melsen 1975). Skeletal outcomes of greater magnitude and stability can be obtained when the expander is used before the pubertal growth spurt, with transverse changes shifting to the dentoalveolar level when RME therapy is performed after the pubertal peak (Baccetti et al., 2001).These authors also showed that RME treatment during early developmental stages gives more skeletal and more stable long-term results. Moreover, Wertz and Dreskin showed that maxillary skeletal expansion underwent no relapse in younger patients, whereas the older patients lost most of the width increase that had been achieved through palatal expansion.

Therefore, the previous and the present findings support the view that early treatment is advisable to optimize the skeletal expansion obtained after RME.

RME constitutes a routine clinical procedure in orthodontics, with its main purpose to normalize the constricted maxillary arch. This procedure can open the intermaxillary suture, increase the basal bone width and the dental arch perimeter. Previous longitudinal studies have shown that these effects can induce a normalization of both dental and skeletal components of the craniofacial complex (Geran et al., 2006; Cameron et al., 2002). However, the reasons for this long-term stability are still unclear. The present investigation indicates that the improved masticatory muscle function could be an important factor in the maintenance of the positive skeletal and dental effects observed after RME. The increased loading of the jaws due to masticatory muscle hyperfunction may lead to increased sutural growth and bone apposition, resulting in turn in an increased transversal growth of the maxilla and broader bone bases for the dental arches(Katsaros, 2001) More studies are necessary to establish the main factors related to the functional aspects, stability or relapse of posterior crossbites.

CONCLUSIONS

1. A significant increase in EMG activities of the anterior temporalis and masseter muscles during habitual chewing was observed after RME in FPCB patients.
2. The correction of FPCB by RME in young patients was accomplished by a combination of more skeletal than dental effects.
3. The early treatment of FPCB is advisable to optimize conditions for function and development of the stomatognathic system.

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III. CONCLUSÕES GERAIS

De acordo com os resultados do presente trabalho, concluiu-se que:

- Crianças com mordida cruzada posterior apresentaram menores dimensões nas medidas transversais esqueléticas e dentárias em relação ao grupo com oclusão normal.

- O tratamento precoce com expansão rápida da maxila favoreceu não apenas a correção das discrepâncias transversais, como também promoveu um aumento da atividade EMG dos músculos masseter e temporal anterior durante a mastigação.

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* De acordo com a norma da UNICAMP/FOP, baseada no modelo Vancouver.
Abreviatura dos periódicos em conformidade com o Medline.

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Apêndice 1

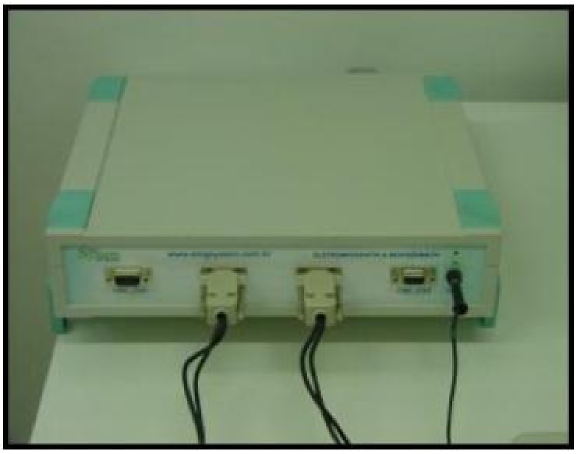


Figura 1: Sistema de aquisição de sinais EMG SYSTEM DO BRASIL Ltda.

Figura 2: Eletrodos de barras paralela

Figura 3: Palpação do músculo temporal anterior para a fixação dos eletrodos

Figura 4: Palpação do músculo masseter para a fixação dos eletrodos

Figura 5: Eletrodos já posicionados nos músculos temporal anterior e masseter

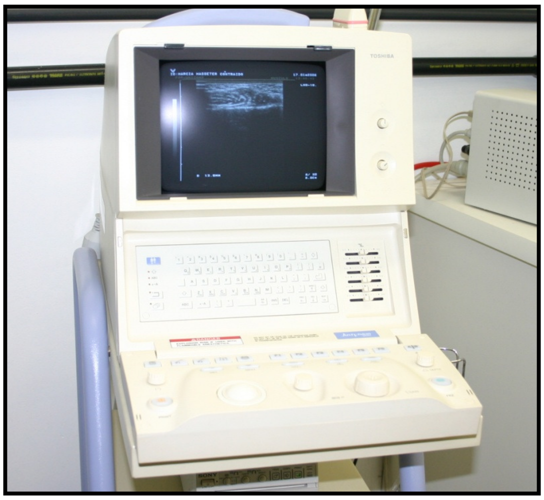


Figura 8: Equipamento de ultra-som digital Just Vision 200, da Toshiba Corporation, Japão

Figura 9: Posição do transdutor no músculo temporal anterior

Figura 10: Posição do transdutor no músculo masseter

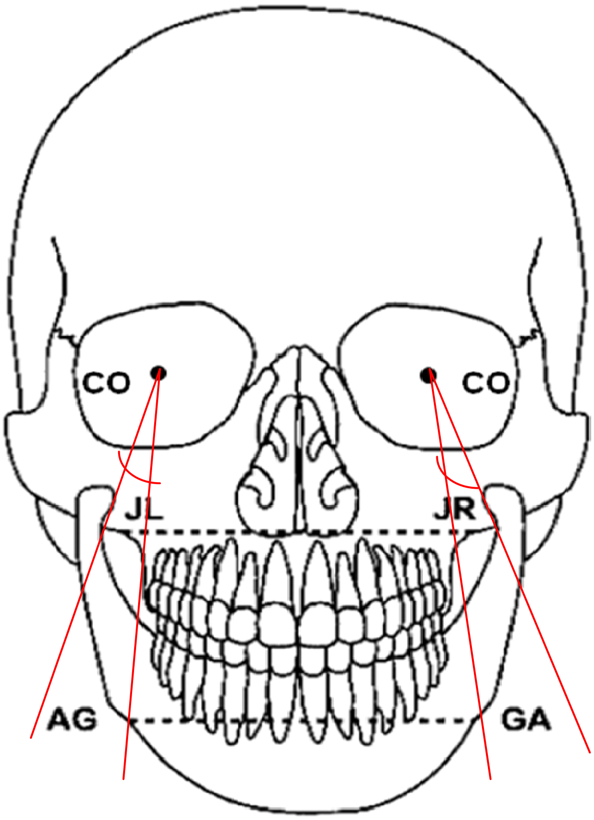
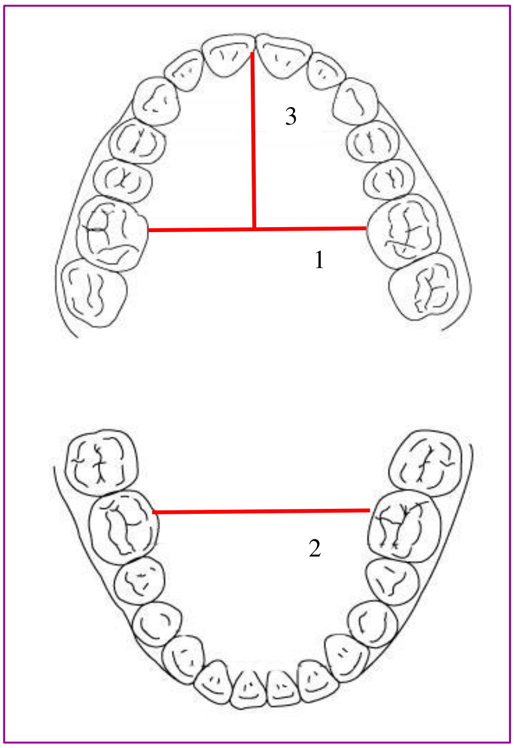


Figura 11: Pontos cefalométricos utilizados na radiografia posteroanterior



1: Largura intermolar superior

2: Largura intermolar inferior

3: Distância entre a rafe palatina e cervival dos 1º Molares Superiores.

Figura 12: Traçados realizados nos modelos de estudo

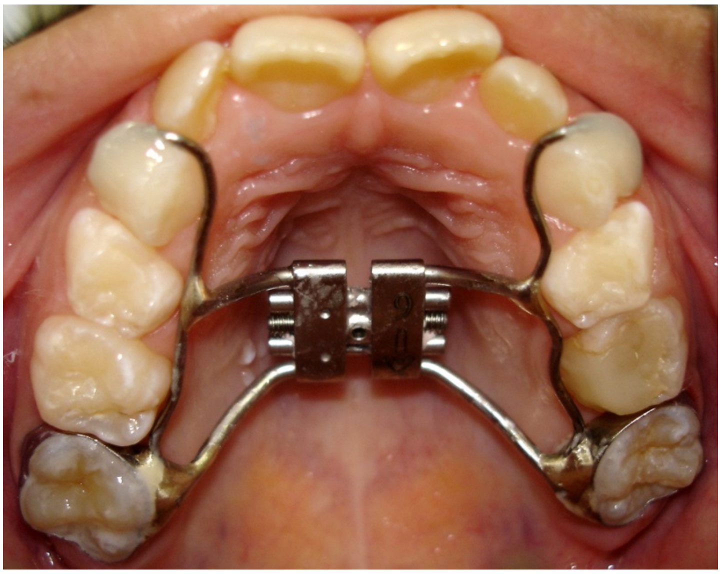


Figura 13: Aparelho do tipo Hyrax modificado

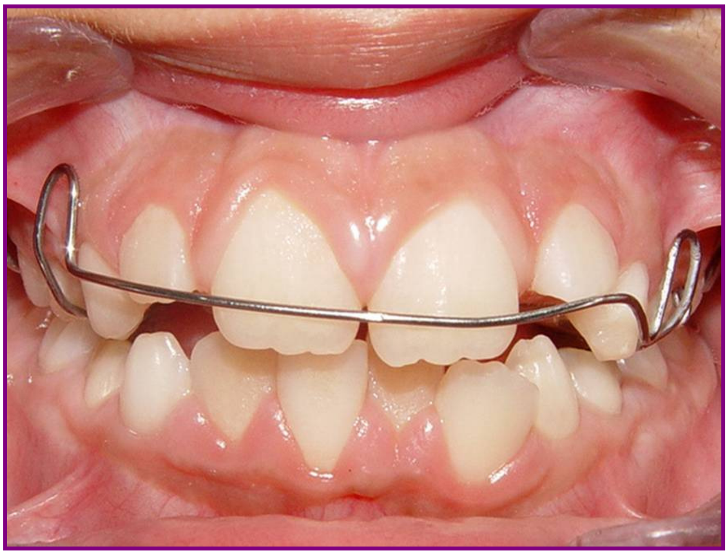


Figura 14: Aparelho removível

Apêndice 2

(Ficha Clínica)

Universidade Estadual de Campinas - UNICAMP

Faculdade de Odontologia de Piracicaba - FOP

Programa de Pós-Graduação em Odontologia - Odontopediatria

Nº

Data:

IDENTIFICAÇÃO

Nome: ______________________ **Apelido:** ______________

Idade: ____ **anos e** ____ **meses** **Data de nascimento:** / /

Sexo: ( ) masculino ( ) feminino **Raça:** ( ) branco ( ) negro ( ) mulato

Naturalidade: ______________________ **Nacionalidade:** ______________

Pai: ____

Mãe: ____

Irmãos: ____

Endereço: ____

____

Bairro: ______________________ **CEP:** - ______________

Cidade: ______________________ **Estado:** ______________

Fones: **Casa (** **)** ______________

Celular (**)** ______________

Trabalho (**)** ______________

Outro (**)** ______________

Motivo da consulta: ____

____

Informações adicionais: ____

Período disponível: ______________

HISTÓRIA MÉDICA

I) HISTÓRIA PRÉ-NATAL

A) Gravidez: ( ) Normal ( ) Anormal: ______________________________

B) Manifestações durante a gravidez

Doenças: ______________________________

Medicamentos: ______________________________

II) HISTÓRIA NATAL

Parto: ( ) Normal ( ) Fórceps ( ) Cesariana

Complicações durante o parto: ______________________________

Nascimento: ( ) A termo ( ) Prematuro: ___ meses

III) HISTÓRIA PÓS- NATAL

Doenças sistêmicas ( ) Não ( ) Sim

( ) Alergia: ____________________ ( ) Diabete: ____________________

( ) Rinite alérgica: ____________________ ( ) Problemas renais: ____________________

( ) Resfriados frequentes: ____________________ ( ) Discrasias sanguíneas: ____________________

( ) Sinusite: ____________________ ( ) Febre reumática: ____________________

( ) Amigdalite: ____________________ ( ) Problemas cardíacos: ____________________

( ) Verminose: ____________________ ( ) Hepatite: ____________________

( ) Anemia: ____________________ ( ) Asma: ____________________

( ) HIV: ____________________ ( ) Outras: ____________________

Doenças da infância

( ) Catapora ( ) Rubéola ( ) Sarampo ( ) Caxumba

( ) Coqueluxe ( ) Outras: ______________________________

Está sendo submetido a algum tipo de tratamento ? ( ) Não ( ) Sim

( ) Psicológico: ______________________________

( ) Otorrinolaringológico: ______________________________

( ) Fonoaudiológico: ______________________________

( ) Homeopático: ______________________________

(   ) Outros: ____________________

Está tomando algum tipo de medicamento ?   (   ) Não   (   ) Sim

(   ) Antibióticos   (   ) Antinflamatórios   (   ) Analgésicos

(   ) Anticonvulsivo   (   ) Antialérgico   (   ) Descongestionante

(   ) Vitaminas   (   ) Outros: ____________________

Doenças na família

(   ) Diabetes: ____________   (   ) Problemas cardíacos: ____________

(   ) Problemas respiratórios: ____________   (   ) Problemas hematológicos: ____________

(   ) Outros: ____________________

Já ficou hospitalizado: (   ) Não   (   ) Sim

Motivo: ____________________

Cirurgia: ____________________

Declaro que as informações acima são verdadeiras e comprometo-me a informar a cirurgiã dentista sobre qualquer alteração na saúde do menor sobre minha responsabilidade enquanto o mesmo estiver sob tratamento odontológico.

Data   /   /

____

Assinatura do pai, mãe ou responsável

HISTÓRIA DENTAL

I) INFORMAÇÕES GERAIS

(   ) Nunca recebeu nenhum tratamento odontológico

(   ) Recebe ou recebeu tratamento na escola

(   ) Recebe ou recebeu tratamento no posto de saúde

(   ) Recebe ou recebeu tratamento em clínica particular

Já tomou anestesia? (   ) Não   (   ) Sim   Teve algum tipo de problema? (   ) Não   (   ) Sim

(   ) Outros: ____________________

Problemas manifestados:

( ) Prevenção ( ) Cárie ( ) Tratamento de canal ( ) Traumatismo

( ) Sangramento gengival ( ) Não sabe ( ) Outros: ____________________

Já recebeu tratamento ortodôntico? ( ) Não ( ) Sim: ____________________

Comportamento no dentista: ( ) Bom ( ) Regular ( ) Ruim

Observações: ____________________

Características comportamentais:

( ) Normal ( ) Alegre ( ) Extrovertido ( ) Agitado ( ) Atento

( ) Desanimado ( ) Irritado ( ) Desatento ( ) Triste ( ) Calmo

( ) Tímido ( ) Medroso ( ) Ansioso ( ) Outros: ____________________

II) INFORMAÇÕES PREVENTIVAS

Higiene Dental: ( ) Escova ( ) Fio dental ( ) Outros Frequência: __________

Informação sobre higiene bucal: ( ) Não ( ) Sim, por: ____________________

Responsável pela escovação: ( ) Pais ( ) Criança ( ) Ambos

ÁGUA FLUORETADA: ( ) NÃO ( ) SIM

Soluções para bochecho: ( ) Não ( ) Sim: ____________________

III) QUESTIONÁRIO PARA DIAGNÓSTICO DE DTM

Seu (sua) filho (a) tem ou teve:

Dor de cabeça?	( ) Não	( ) Sim	Quando ?
Dor de ouvido?	( ) Não	( ) Sim	Quando?
Apito no ouvido?	( ) Não	( ) Sim	Quando?
Dor nos olhos?	( ) Não	( ) Sim	Quando?
Dor no pescoço?	( ) Não	( ) Sim	Quando?
Dor nos ombros?	( ) Não	( ) Sim	Quando?
Dor na mandíbula?	( ) Não	( ) Sim	Quando?

Sente dor quando mastiga ou abre a boca? (   ) Não   (   ) Sim: ______________________

____

Tem dificuldade para engolir? (   ) Não   (   ) Sim**:** ______________________________

____

Tem algum problema para abrir a boca? (   ) Não   (   ) Sim

Quando:

(   ) Conversa   (   ) Boceja   (   ) Grita

Quando abre a boca percebe algum barulho no ouvido? (   ) Não   (   ) Sim:

____

Aperta ou range os dentes? (   ) Não   (   ) Sim   Quando? (   ) Noite   (   ) Dia

Sente a mandíbula cansada? (   ) Não   (   ) Sim   Quando?

EXAME CLÍNICO

I) EXAME FACIAL (VISUAL)

Simetria Facial: simétrica (   )   assimétrica (   )

Perfil Facial: reto (   )   convexo (   )   côncavo (   )

Tipo Morfológico: mesofacial (   )   braquiofacial (   )   dolicofacial (   )

Observações extra-bucais:

____

II) EXAME BUCAL E FUNCIONAL

Saúde Bucal: boa (   )   regular (   )   má (   )

Higiene Bucal: boa (   ) regular (   )   má (   )

Lado da Mordida Cruzada Posterior (   ) direita   (   ) esquerda   (   ) bilateral

Em R.C: (   ) direita   (   ) esquerda   (   ) bilateral

Maloclusões (   ) mordida aberta   (   ) mordida profunda   (   ) mordida cruzada anterior

(   ) outras: ____

Desvio da linha média (   ) Ausente   (   ) Superior   (   ) direita   (   ) esquerda

(   ) Inferior   (   ) direita   (   ) esquerda

Desvio Mandibular (   ) Ausente   (   ) abertura   (   ) direita   (   ) esquerda

(   ) fechamento   (   ) direita   (   ) esquerda

Interferências Dentais (   ) OC:

6 V IV III 2 1	1 2 III IV V 6
6 V IV III 2 1	1 2 III IV V 6

(   )Ausente

(   ) RC:

6 V IV III 2 1	1 2 III IV V 6
6 V IV III 2 1	1 2 III IV V 6

(   )Ausente

Lateralidade direita:

6 V IV III 2 1	1 2 III IV V 6
6 V IV III 2 1	1 2 III IV V 6

Lateralidade esquerda:

6 V IV III 2 1	1 2 III IV V 6
6 V IV III 2 1	1 2 III IV V 6

Protrusão

6 V IV III 2 1	1 2 III IV V 6
6 V IV III 2 1	1 2 III IV V 6

Hábitos Bucais: Não (   )   Sim (   )

Sucção de dedo	( )	Esporádico	( )	Noite	( )	Contínuo	( )
Sucção de chupeta	( )	Esporádico	( )	Noite	( )	Contínuo	( )
Sucção de lábios	( )	Esporádico	( )	Noite	( )	Contínuo	( )
Mordedura de lábios	( )	Esporádico	( )	Noite	( )	Contínuo	( )
Onicofagia	( )	Esporádico	( )	Noite	( )	Contínuo	( )
Bruxismo	( )	Esporádico	( )	Noite	( )	Contínuo	( )

Outros (   ): ______________________________

Deglutição:	( ) típica	( ) atípica	
Fonação:	( ) normal	( ) anormal	
Amígdalas:	( ) normais	( ) hipertróficas	( ) operadas
Adenóides:	( ) normais	( ) hipertróficas	( ) operadas
Respiração:	( ) nasal	( ) bucal	( ) ambas
Freio Labial Superior:	( ) inserção normal	( ) baixa	( ) alta
Freio Labial Inferior:	( ) inserção normal	( ) baixa	( ) alta
Freio lingual:	( ) inserção normal	( ) inserção anormal	
Lábio Superior:	( ) normal	( ) hipotônico	( ) hipertônico
Lábio Inferior:	( ) normal	( ) hipotônico	( ) hipertônico

Outras informações: ____

Ruídos articulares: Não ( ) Sim ( )

Estalido ( ) Direito ( ) Esquerdo ( )

Crepitação( ) Direito ( ) Esquerdo ( )

Dor durante palpação:

ATM: Não ( ) Sim ( ) Direita ( ) Esquerda ( )

Masseter : Não ( ) Sim ( ) Direito ( ) Esquerdo ( )

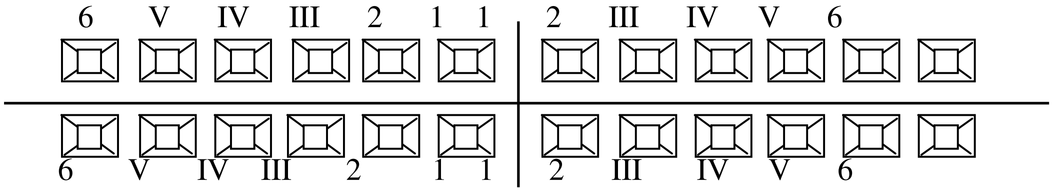
Temporal : Não ( ) Sim ( ) Direito ( ) Esquerdo ( )

Trapézio: Não ( ) Sim ( ) Direito ( ) Esquerdo ( )

Esternocleidomastóideo: Não ( ) Sim ( ) Direito ( ) Esquerdo ( )

III) Exame Dental

Odontograma



(/) Dente Ausente (azul) Restauração insatisfatória

(vermelho) Cárie (verde) Restauração satisfatória

( ) número
Anomalias Dentais: ( ) forma
( ) tamanho
( ) estrutura

Alterações de cor: ______________________________

Análise dos Modelos

Data:

Forma dos arcos dentais: Superior: ____________ Inferior: ____________

Classificação de Angle: ______________________________

Lado Direito: ____________ Lado Esquerdo: ____________

Observação: ______________________________

____

Relação ântero-posterior dos molares decíduos: Lado Direito: Lado Esquerdo:

Relação ântero-posterior dos caninos decíduos: Lado Direito: Lado Esquerdo:

Sobremordida: ______ mm normal ( ) moderado ( ) profundo ( )

Sobressaliencia: ______ mm **Mordida aberta:** ______ mm

Desvio da linha mediana: ausente ( ) presente ( ) : ______________

Anormalidades na posição individual dos dentes: ______________

Apêndice 3

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Nome da criança: ____

Por este instrumento de autorização, na qualidade de ___________________ autorizo que o (a) menor _______________________________________ participe da pesquisa *"Correção da mordida cruzada posterior na fase de dentição mista: avaliação longitudinal eletromiográfica, cefalométrica e ultra-sonográfica"*, conduzida pelas alunas Annicele da Silva Andrade e Moara De Rossi, aluna da pós-graduação da Faculdade Odontologia de Piracicaba - Universidade Estadual de Campinas, sob a orientação da Profa. Dra. Maria Beatriz Duarte Gavião.

- Tenho conhecimento que a pesquisa tem o objetivo de: 1) Corrigir a mordida cruzada posterior (dentes fora da posição adequada), através de um aparelho que ficará fixo nos dentes e que será ativado pelo responsável para aumentar o tamanho da maxila, de modo que o cruzamento dos dentes seja corrigido. 2) Avaliar, através de radiografias, o padrão facial (forma do rosto) e as possíveis alterações esqueléticas antes do tratamento e as possíveis correções após a o tratamento da mordida cruzada posterior. 2) Avaliar, a atividade elétrica e a espessura dos músculos da mastigação através de aparelhos especiais (eletromiógrafo e ultra-som), antes e após a correção da mordida cruzada posterior, para verificar o efeito do tratamento na forma e função dos músculos da mastigação. Estes aparelhos são inócuos, não causam desconforto e efeitos prejudiciais.
- Estou ciente de que esta pesquisa é científica e os dados poderão ser publicados em jornais, revistas e/ou congressos científicos no país e no exterior, mantendo-se o sigilo e respeita o código de Defesa do Menor e do Adolescente.

Declaro que fui devidamente esclarecido (de forma oral e por escrito) que:

- Serão feitos:

- anamnese, através de preenchimento das fichas para obtenção de dados pessoais

- exame clínico, com instrumentos utilizados normalmente no exame odontológico
- documentação ortodôntica, consistindo de exame radiográfico, onde todas as normas se segurança em relação à radiação serão observadas; moldagem para obtenção e análise dos modelos de estudo e obtenção de modelos de trabalho, durante as fases do tratamento. Estou ciente de que a moldagem pode provocar certo incômodo, mas que serão contornados através de técnicas preconizadas para tal e que o material utilizado para a moldagem é inócuo. Serão também realizadas fotografias da face, de frente e de perfil, sendo que os pesquisadores garantem o sigilo em relação à identificação.
- o voluntário receberá o tratamento para a correção da mordida cruzada posterior, através expansão rápida da maxila, uma terapia amplamente aceita e recomendada para a correção da mordida cruzada posterior esquelética. A criança utilizará um aparelho fixado aos dentes superiores, sendo que as ativações do aparelho deverão ser feitas, de 12 em 12 horas, pelos responsáveis pelo menor. O paciente deverá retornar semanalmente à Faculdade de Odontologia para que os pesquisadores acompanhem o tratamento e determinem o momento em que as ativações não serão mais necessárias.
- Após a correção da mordida cruzada, a criança deverá permanecer com o aparelho, sem ativá-lo, por mais 4 meses para que não ocorra recidiva. Durante os quatro meses, a criança deverá retornar quinzenalmente à Faculdade de Odontologia para que os pesquisadores acompanhem o tratamento. Após esse período o aparelho será removido e a criança deverá utilizar, por 6 meses, um aparelho removível para contenção. Durante o uso da contenção removível os retornos à Faculdade de Odontologia deverão ser mensais.
- Todos os cuidados sobre os desconfortos iniciais com o uso do aparelho serão devidamente informados, bem como a orientação e monitoração da higiene adequada, de modo que não ocorram problemas gengivais.
- As avaliações da musculatura serão feitas, com o auxílio da eletromiografia e ultra-sonografia, antes do tratamento, após a remoção do aparelho disjuntor e seis meses após o uso da contenção removível. Os exames permitem avaliar a espessura e a atividade da musculatura, sendo dados importantes para o diagnóstico e prognóstico do tratamento. Os exames serão realizados na própria Faculdade de Odontologia. Serão demonstrados

aos voluntários e seu responsáveis os materiais e as técnicas de todo o tratamento e também de todos os exames, fazendo-se simulações e treinamentos.

- Todo o tratamento e monitoração serão realizados pelos responsáveis pela pesquisa.
- O voluntário deverá apresentar características que indiquem o tratamento a ser instituído, portanto haverá apenas um grupo, constituído por voluntários com o mesmo tipo de alteração do menor sob minha responsabilidade.
- Todos os dados confidenciais serão mantidos em sigilo, sendo que os resultados e as imagens não revelarão a identidade do voluntário, de modo a não causar constrangimento ou prejuízo ao mesmo e aos responsáveis.
- Não haverá nenhum custo financeiro ao voluntário, quer no tratamento em si como nos exames que serão realizados.
- Não há riscos previsíveis
- Tenho plena liberdade de recusar e tenho liberdade que o menor sob minha responsabilidade participe desta pesquisa, ou o próprio voluntário, podendo de retirá-lo desta pesquisa a qualquer momento, sem nenhuma penalização ou prejuízo.
- Não é previsto o ressarcimento de despesas ou indenização, uma vez que não há riscos previsíveis, e a participação na pesquisa não causa despesas ao voluntário.
- O voluntário terá como benéfico a correção da posição inadequada dos dentes, receberá tratamento educativo e preventivo da cárie dentária e de problemas na gengiva, tratamento curativo, quando houver presença de cárie

Assino este documento de livre e espontânea vontade, estando ciente do seu conteúdo e recebendo uma cópia.

Piracicaba, ______ de ________________ de 200____

____

ASSINATURA DO PAI/MÃE/RESPONSÁVEL

____

Profª Drª Maria Beatriz Duarte Gavião

____

Annicele Andrade/Moara De Rossi

- Informações para contato com as pesquisadoras:
  Profa. Dra. Maria Beatriz Duarte Gavião – (19) 3412 5368 mbgaviao@fop.unicamp.br
  Annicele Andrade/ Moara de Rossi – (19) 3412 5287 annicele@fop.unicamp.br
  moderossi@yahoo.com.br
- Em caso de dúvida quanto a questões éticas, entrar em contato com o Comitê de Ética em Pesquisa (CEP) da Faculdade de Odontologia de Piracicaba (FOP) UNICAMP, Av. Limeira, 901, Vila Areião, CEP: 13414-900, Piracicaba - SP. Telefone: 3412 5349 / cep@fop.unicamp.br

Anexo 1

COMITÊ DE ÉTICA EM PESQUISA

FACULDADE DE ODONTOLOGIA DE PIRACICABA

UNIVERSIDADE ESTADUAL DE CAMPINAS

CERTIFICADO

O Comitê de Ética em Pesquisa da FOP-UNICAMP certifica que o projeto de pesquisa "**A relação entre o padrão mastigatório e a maloclusão do tipo classe II, subdivisão de Angle**", protocolo nº **020/2006**, dos pesquisadores **MARIA BEATRIZ DUARTE GAVIÃO, ANNICELE DA SILVA ANDRADE e PAULA MIDORI CASTELO**, satisfaz as exigências do Conselho Nacional de Saúde – Ministério da Saúde para as pesquisas em seres humanos e foi aprovado por este comitê em 10/12/2007.

The Ethics Committee in Research of the School of Dentistry of Piracicaba - State University of Campinas, certify that the project "**The relationship between masticatory pattern and Angle class II subdivision malocclusion**", register number **020/2006**, of **MARIA BEATRIZ DUARTE GAVIÃO, ANNICELE DA SILVA ANDRADE and PAULA MIDORI CASTELO**, comply with the recommendations of the National Health Council – Ministry of Health of Brazil for research in human subjects and therefore was approved by this committee at 10/12/2007.

Profa. Cínthia Pereira Machado Tabchoury
Secretária
CEP/FOP/UNICAMP

Prof. Jacks Jorge Júnior
Coordenador
CEP/FOP/UNICAMP

Nota: O título do protocolo aparece como fornecido pelos pesquisadores, sem qualquer edição.
Notice: The title of the project appears as provided by the authors, without editing.

COMITÊ DE ÉTICA EM PESQUISA

FACULDADE DE ODONTOLOGIA DE PIRACICABA

UNIVERSIDADE ESTADUAL DE CAMPINAS

CERTIFICADO

O Comitê de Ética em Pesquisa da FOP-UNICAMP certifica que o projeto de pesquisa "**Correção da mordida cruzada posterior na fase de dentição mista: avaliação longitudinal**", protocolo nº **023/2006**, dos pesquisadores **MARIA BEATRIZ DUARTE GAVIÃO, BRUNA ANTUNES GONÇALVES, MARIA CAROLINA SALOMé MARQUEZIN e MOARA DE ROSSI**, satisfaz as exigências do Conselho Nacional de Saúde – Ministério da Saúde para as pesquisas em seres humanos e foi aprovado por este comitê em 10/12/2007.

The Ethics Committee in Research of the School of Dentistry of Piracicaba - State University of Campinas, certify that the project "**Treatment of posterior crossbite in the mixed dentition: electromyographic, cephalometric and ultrasonographic longitudinal evaluation**", register number **023/2006**, of **MARIA BEATRIZ DUARTE GAVIÃO, BRUNA ANTUNES GONÇALVES, MARIA CAROLINA SALOMé MARQUEZIN and MOARA DE ROSSI**, comply with the recommendations of the National Health Council – Ministry of Health of Brazil for research in human subjects and therefore was approved by this committee at 10/12/2007.

Cínthia Machado Tabchoury
Profa. Cínthia Pereira Machado Tabchoury
Secretária
CEP/FOP/UNICAMP

Prof. Jacks Jorge Júnior
Coordenador
CEP/FOP/UNICAMP

Nota: O título do protocolo aparece como fornecido pelos pesquisadores, sem qualquer edição.
Notice: The title of the project appears as provided by the authors, without editing.

Anexo 3

Detailed Status Information

Manuscript #	**033010-176**
Current Revision #	**0**
Submission Date	**2010-03-30 15:13:39**
Current Stage	**Initial QC Started**
Title	**Muscular, skeletal and dental characteristics in children with posterior crossbites**
Running Title	**Characteristics of posterior crossbite**
Manuscript Type	**Original Article**
Special Section	**N/A**
Corresponding Author	**Maria Beatriz Gavião (University of Campinas, Piracicaba Dental School)**
Contributing Authors	**Annicele Andrade , Gustavo Gameiro , Moara DeRossi , Maria Carolina Marquezin , Paula Castelo**

Anexo 4

Resolução CCPG/002/06 a qual dispõe a respeito do formato das dissertações de mestrado e teses doutorado aprovados pela UNICAMP

INFORMAÇÃO CCPG/OO2/06[6]

Tendo em vista a necessidade de revisão da regulamentação das normas sobre o formato e a impressão das dissertações de mestrado e teses de doutorado e com base no entendimento exarado no Parecer PG n° 1985/96, que trata da possibilidade do formato alternativo ao já estabelecido, a CCPG resolve:

Artigo 1º - O formato padrão das dissertações e teses de mestrado e doutorado da UNICAMP deverão obrigatoriamente conter:

I. Capa com formato único ou em formato alternativo que deverá conter informações relativas ao nível (mestrado ou doutorado) e à Unidade de defesa, fazendo referência à Universidade Estadual de Campinas, sendo o projeto gráfico das capas definido pela PRPG.
II. Primeira folha interna dando visibilidade à Universidade, a Unidade de defesa, ao nome do autor, ao título do trabalho, ao número de volumes (quando houver mais de um), ao nível (mestrado ou doutorado), a área de concentração, ao nome do orientador e co-orientador, ao local (cidade) e ao ano de depósito. No seu verso deve constar a ficha catalográfica.
III. Folha de aprovação, dando visibilidade à Comissão Julgadora com as respectivas assinaturas.
IV. Resumo em português e em inglês (ambos com no máximo 500 palavras).
V. Sumário.
VI. Corpo da dissertação ou tese dividido em tópicos estruturados de modo característico à área de conhecimento.
VII. Referências, formatadas segundo normas de referenciamento definidas pela CPG da Unidade ou por critério do orientador.
VIII. Todas as páginas deverão, obrigatoriamente, ser numeradas, inclusive páginas iniciais, divisões de capítulos, encartes, anexos, etc... As páginas iniciais poderão ser numeradas utilizando-se algarismos romanos em sua forma minúscula.
IX. Todas as páginas com numeração "impar" serão impressas como "frente" e todas as páginas com numeração "par" serão impressas como "verso".

§ 1º - A critério do autor e do orientador poderão ser incluídos: dedicatória; agradecimento; epígrafe; lista de: ilustrações, tabelas, abreviaturas e siglas, símbolos; glossário; apêndice; anexos.

§ 2º - A dissertação ou tese deverá ser apresentada na língua portuguesa, com exceção da possibilidade permitida no artigo 2° desta Informação.

§ 3º - As dissertações e teses cujo conteúdo versar sobre pesquisa envolvendo seres humanos, animais ou biossegurança, deverão apresentar anexos os respectivos documentos de aprovação.

Artigo 2º - A critério do orientador e com aprovação da CPG da Unidade, os capítulos e os apêndices poderão conter cópias de artigos de autoria ou de co-autoria do candidato, já publicados ou submetidos para publicação em revistas científicas ou anais de congressos sujeitos a arbitragem, escritos no idioma exigido pelo veículo de divulgação.

[6] Disponível em: http://www.prpg.unicamp.br/ccpg_inf002_06.pdf

§ único - O orientador e o candidato deverão verificar junto às editoras a possibilidade de inclusão dos artigos na dissertação ou tese, em atendimento à legislação que rege o direito autoral, obtendo, se necessária, a competente autorização, deverão assinar declaração de que não estão infringindo o direito autoral transferido à editora.

Artigo 3º - Dependendo da área do conhecimento, a critério do orientador e com aprovação da CPG da Unidade, a dissertação ou tese poderá ser apresentada em formato alternativo, desde que observados os incisos I, II, III IV, V e VII do artigo 1º.

Artigo 4º - Para impressão, na gráfica da Unicamp, dos exemplares definitivos de dissertações e teses defendidas, deverão ser adotados os seguintes procedimentos:

§ 1º - A solicitação para impressão dos exemplares de dissertações e teses poderá ser encaminhada à gráfica da Unicamp pelas Unidades, que se responsabilizarão pelo pagamento correspondente.

§ 2º - Um original da dissertação ou tese, em versão definitiva, impresso em folha tamanho carta, em uma só face, deve ser encaminhado à gráfica da Unicamp acompanhado do formulário "Requisição de Serviços Gráficos", onde conste o número de exemplares solicitados.

§ 3º - A gráfica da Unicamp imprimirá os exemplares solicitados com capa padrão. Os exemplares solicitados serão encaminhados à Unidade em, no máximo, cinco dias úteis.

§ 4º - No formulário "Requisição de Serviços Gráficos" deverão estar indicadas as páginas cuja reprodução deva ser feita no padrão "cores" ou "foto", ficando entendido que as demais páginas devam ser reproduzidas no padrão preto/branco comum.

§ 5º - As dissertações e teses serão reproduzidas no padrão frente e verso, exceção feita às páginas iniciais e divisões de capítulos; dissertações e teses com até 100 páginas serão reproduzidas no padrão apenas frente, exceção feita à página que contém a ficha catalográfica.

§ 6º - As páginas fornecidas para inserção deverão ser impressas em sua forma definitiva, ou seja, apenas frente ou frente/verso.

§ 7º - O custo, em reais, de cada exemplar produzido pela gráfica será definido pela Administração Superior da Universidade.

Artigo 5º - É obrigatória a entrega de dois exemplares para homologação.

Artigo 6º - Esta Informação entrará em vigor na data de sua publicação, ficando revogadas as disposições em contrário, principalmente as Informações CCPG 001 e 002/98 e CCPG/001/00.

Campinas, 13 de setembro de 2006

Profa. Dra. Teresa Dib Zambon Atvars
Presidente
Comissão Central de Pós-Graduação

ANEXO 5

UNIVERSIDADE ESTADUAL DE CAMPINAS

FACULDADE DE ODONTOLOGIA DE PIRACICABA

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DECLARAÇÃO

As cópias dos artigos de minha autoria e co-autoria, já publicados ou submetidos para publicação em revistas científicas ou anais de congresso sujeitos a arbitragem, que constam na minha Dissertação/Tese de Doutorado intitulada "CARACTERÍSTICAS MUSCULARES, ESQUÉTICAS E DENTÁRIAS EM CRIANÇAS COM MORDIDA CRUZADA POSTERIOR ANTES E APÓS A EXPANSÃO RÁPIDA DA MAXILA", não infringem os dispositivos da Lei n° 9.610/98, nem o direito autoral de qualquer editora.

Piracicaba 29 de abril de 2010

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