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Avaliação da disfunção orofacial, performance mastigatória, oclusão e morfologia craniofacial em crianças e adolescentes

Dissertação de Mestrado apresentada a Faculdade de Odontologia de Piracicaba da UNICAMP para obtenção do título de Mestre em Odontologia, na área de Odontopediatria

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“A dúvida é o princípio da sabedoria”

Aristóteles

Resumo

O conhecimento das influencias funcionais, ambientais e genéticas sobre o crescimento e desenvolvimento craniofacial é abrangente e difícil de quantificar, mas de suma importância para a prevenção de alterações que possam influenciar negativamente o desenvolvimento adequado dos maxilares e estruturas relacionadas. Sendo assim, a pesquisa teve o objetivo de avaliar a relação entre disfunção orofacial, morfologia craniofacial e da oclusão, força de mordida (FM) e performance mastigatória (PM) em crianças e adolescentes. Três estudos foram conduzidos e serão apresentados a seguir na forma de capítulos. O primeiro e segundo estudos buscaram avaliar a relação entre disfunção orofacial, PM, morfologia craniofacial e da oclusão, FM e bruxismo do sono. Para tanto, foram incluídas 316 crianças e adolescentes, de ambos os gêneros, divididas em quatro grupos: sujeitos com dentição mista inicial (n=20), mista intermediária (n=73), mista final (n=89) e permanente (n=134). A PM foi avaliada pela técnica de peneiragem, estimando-se a capacidade individual do sujeito em triturar um alimento-teste e determinando o tamanho mediano das partículas (X_{50}) e a distribuição das mesmas nas diferentes peneiras (*b*). As disfunções orofaciais e a necessidade de tratamento ortodôntico foram avaliadas por meio do instrumento *The Nordic Orofacial Test Screnning* (NOT-S) e pelo Índice de Necessidade de Tratamento Ortodôntico (IOTN), respectivamente. A máxima FM foi mensurada utilizando-se um gnatodinamômetro digital e a morfologia craniofacial foi avaliada por meio de análise cefalométrica em norma lateral e frontal. A presença de bruxismo do sono também foi verificada por meio da avaliação de facetas de desgaste em incisivos e/ou primeiros molares permanentes e do relato de sons de ranger/bater os dentes pelos responsáveis/irmãos. Os resultados foram submetidos à estatística descritiva, testes de normalidade e correlação, análise de variância e regressão linear múltipla para se verificar quais variáveis em estudo contribuíram para a variação em X_{50} e nos escores do NOT-S. A variância de X_{50} e *b* mostrou-se estatisticamente significativa entre os grupos; já os escores do NOT-S não mostraram diferença entre as fases das dentições. Idade, índice de massa corporal, FM e presença de bruxismo relacionaram-se significativamente com uma melhor PM. A presença de selamento labial e maior trespasse vertical relacionaram-se com menores escores totais do NOT-S, enquanto a idade e a presença de bruxismo exacerbaram os escores de disfunção orofacial. Além disso, não foi observada correlação significativa entre morfologia craniofacial e escores de disfunção orofacial. Concluiu-se que o índice de massa corporal, força de mordida e presença de bruxismo contribuíram para uma melhor PM; enquanto o aumento nos escores de disfunção orofacial relacionou-se a uma PM prejudicada. Além disso, o aumento do trespasse vertical e a presença de selamento labial relacionaram-se a menores escores de disfunção orofacial em indivíduos jovens. O terceiro capítulo aborda o estudo do dimorfismo facial e sua relação com as dimensões craniofaciais e dos arcos dentários e espessura ultrassonográfica do músculo masseter em crianças na fase de dentição mista. O estudo envolveu 32 crianças (14♀/18♂), com oclusão normal, e avaliou as dimensões craniofaciais por meio de telerradiografias em norma frontal. Os resultados foram submetidos à estatística descritiva, teste de normalidade, teste "t" e regressão linear múltipla para se verificar a diferença entre os gêneros e quais variáveis contribuíram para a variação da medida da largura facial. Apesar da comparação da largura facial entre gêneros ter mostrado diferença significativa, quando se verificaram quais variáveis em estudo contribuíram para esta variação, observou-se que o índice de massa corporal, espessura do masseter, distância intermolares inferiores e intercaninos superiores e largura intermolar maxilar foram as variáveis significativamente relacionadas com a largura facial, enquanto o gênero não alcançou nível significativo. Concluiu-se assim que as variáveis funcionais e morfológicas do sistema estomatognático mostraram forte relação com a largura da face.

Palavras-chave: Disfunção orofacial, Cefalometria, Oclusão Dentária, Performance mastigatória.

Abstract

Knowledge of the functional, environmental and genetic influences on the craniofacial growth and development is comprehensive and difficult to quantify, but very important to prevent changes that may affect the proper development of the jaws and related structures. Therefore, this study aimed to evaluate the relationship between orofacial dysfunction, occlusal and craniofacial morphology, bite force (BF) and masticatory performance (MP) in children and adolescents. Three studies were conducted and are presented below in the form of chapters. The first and second study aimed to evaluate the relationship among orofacial dysfunction, MP, occlusal and craniofacial morphology, BF and sleep bruxism. The sample included 316 children and adolescents of both genders, divided into four groups: subjects with early (n=20), intermediate (n=73), late mixed (n=89) and permanent (n=134). MP was assessed by sieving technique and verifying the individual's ability to comminute an artificial test food in order to determine median particle size (X_{50}) and distribution of particles in the different sieves ("*b*"). The orofacial dysfunction and need for orthodontic treatment were evaluated using the instrument The Nordic Orofacial Test-Screnning (NOT-S) and the Index of Orthodontic Treatment Need (IOTN), respectively. Maximum BF was measured using a digital gantodinamometer and craniofacial morphology was assessed by means of lateral and posteroanterior cephalometric analysis. The signs and symptoms of sleep bruxism were recorded taking into account the presence of shiny and polish facets on incisors and/or first permanent molar and sibling/parental report of grinding sounds. The results were submitted to descriptive statistics, normality and correlation tests, analysis of variance and multiple linear regression to determine which variables significantly contributed to X_{50} and scores on NOT-S variation. The variance of *b* and X_{50} were statistically significant between groups, whereas scores of NOT-S showed no difference among the stages of dentition. Age, body mass index, BF and the presence of bruxism was significantly correlated with better MP. The presence of closed lip posture and increased overbite measurements were related to lower total scores on NOT-S, whereas age and the presence of bruxism exacerbated orofacial dysfunction scores. In addition, a significant relation between craniofacial morphology and orofacial dysfunction was not found. It was concluded that body mass index, BF and the presence of sleep bruxism contributed to a better PM, while the increase in the scores of orofacial dysfunction was related to a worse PM. In addition, increased overbite measurement and closed lip posture related to lower scores of orofacial dysfunction in young individuals. The third chapter discusses the study of facial dimorphism and its relation with craniofacial and dental arches dimensions and ultrasonographic thickness of the masseter muscle in children in the mixed dentition. The study included 32 children (14♀/18♂) with normal occlusion and craniofacial dimensions were assessed by frontal radiographs. The results were submitted to descriptive statistics, normality test, "*t*" test and multiple linear regression to determine the difference between genders and which variables significantly contributed to the variation in facial width. Although the comparison of facial width between genders have shown significant differences, when the others studied variables were tested, it was observed that body mass index, masseter thickness, lower intermolar distance, upper intercanines distance and maxillary intermolar width were the variables that significantly related to facial width, while gender did not reach significant level. It was concluded that the functional and morphological variables of the stomatognathic system showed a strong relation with face width.

Key words: Orofacial dysfunction, Cephalometry, Dental occlusion, Masticatory performance.

SUMÁRIO

INTRODUÇÃO

As funções que abrangem o sistema estomatognático são o resultado de atividades complexas integradas desempenhadas pelo sistema nervoso central e pelo sistema muscular (Lund, 1991; Miller 2003). Inclui grande número de funções, tais como respiração, mastigação e deglutição e atua como base para interação social relativa à fala, comunicação emocional, expressão facial e aparência. A mastigação é uma das funções que se desenvolve a partir de experiências aprendidas; e quando adequada, proporciona estímulo para o correto desenvolvimento dos maxilares e estruturas relacionadas. Na cavidade oral, o alimento é submetido a vários processos mecânicos e químicos, triturado pelos dentes, diluído pela saliva, e forma o bolo alimentar para então ser deglutido (Van der Bilt *et al*., 2010).

Como ocorre naturalmente na mastigação, a performance pode ser mensurada por meio da determinação da capacidade de triturar um alimento-teste, verificando-se a redução do tamanho de suas partículas (Gavião *et al*., 2007). O uso de peneiras com diferentes aberturas onde as partículas são retidas (técnica de tamises) mostrou ser uma técnica objetiva confiável de quantificar a capacidade individual em reduzir os alimentos a pequenas partículas (Speksnijder *et al.,* 2009; Silva *et al*., 2011). Os termos performance e eficiência mastigatória, considerados por muitos como sinônimos, diferem entre si pelo método utilizado na sua obtenção. A eficiência mastigatória é mensurada investigando o número de ciclos mastigatórios necessários para redução do tamanho das partículas do alimento-teste a um determinado tamanho. Para tanto, o alimento-teste é mastigado por diferentes números de ciclos mastigatórios, ou até que fique pronto para deglutição. Já a performance mastigatória é obtida pela análise da distribuição do tamanho das partículas do alimento-teste mastigado durante um número fixo de ciclos mastigatórios (Silva *et al*., 2011).

Sabe-se que a oclusão é fator de grande importância no desenvolvimento das estruturas orofaciais e, para que haja normalidade, é necessário buscar o adequado desenvolvimento morfológico associado ao desenvolvimento funcional. À medida que a oclusão e a mastigação amadurecem, a anatomia de todos os componentes articulares modifica-se para adaptarem-se às mudanças dos novos padrões de oclusão, guias oclusais, profundidade da fossa e altura cuspídea (Moyers, 1993). A qualidade da função mastigatória é dependente de uma serie de fatores: área oclusal, número de dentes, atividade, dimensões e coordenação dos músculos mastigatórios, dimensões craniofaciais e ação da língua e dos músculos peribucais na manipulação do alimento (van der Bilt *et al.,* 2002). A força de mordida é um dos componentes da função mastigatória e sua magnitude aumenta com o número de dentes em contato oclusal, com o número de dentes irrompidos e com o amadurecimento da dentição (Sonnesen *et al.*, 2001; Sonnesen and Bakke, 2005).

No estudo das discrepâncias esqueléticas transversais, a radiografia póstero-anterior demonstrou ser um método auxiliar de diagnostico de grande importância e confiabilidade (Allen *et al*., 2003; Machado Jr. & Crespo, 2006; Kecik *et al*., 2007). Na prática odontológica, a análise tridimensional é a melhor forma de estudo das estruturas dentofaciais, por meio da avaliação cefalométrica em norma lateral e frontal (Vanarsdall & White, 1994; Betts *et al*., 1995) somado ao estudo de modelos em gesso. Indivíduos portadores de padrão de crescimento facial horizontal são caracterizados por menor altura facial anterior, menor inclinação da mandíbula, ângulo goníaco menos obtuso e paralelismo entre os planos mandibular e palatino; funcionalmente, apresentam maior espessura dos músculos mastigatórios (Castelo *et al*., 2007) que acompanha uma maior amplitude da força de mordida (Raadsheer *et al*., 1996). O crânio masculino adulto apresenta maior angulação, tamanho e espessura dos ossos, capacidade craniana, órbitas mais baixas e menor índice comprimento/largura em homens (Thapar *et al*., 2011). Na mandíbula, os relevos internos e externos são mais acentuados e o ângulo goníaco menos obtuso. Entretanto, estudos anteriores têm relatado que em crianças as diferenças na morfologia craniofacial entre gêneros tornam-se significativas somente a partir dos oito anos de idade (Oueis *et al*., 2002; Slaj *et al*., 2003; Kamegai *et al*., 2005).

As disfunções orofaciais que acometem o sistema estomatognático podem estar associadas a doenças genéticas e congênitas, assim como também podem ser adquiridas, como consequência de doenças, traumas ou persistência de hábitos deletérios, podendo ser bastante comprometedoras. Para a avaliação das características e severidade foi desenvolvido o instrumento *The Nordic Orofacial Test – Screening (NOT-S)*, por Bakke *et al*. (2007), e traduzido e validado para o português por Leme (2010). Nele, funções como respiração, mastigação, deglutição e articulação são avaliadas por meio de entrevista e exame clínico padronizado, o que o torna um instrumento de grande valor para a prática clínica e para a pesquisa científica, pois fornece dados que podem ser comparados entre diversas populações-alvo (Bergendal *et al*., 2009; Botteron *et al*., 2009).

A mastigação influencia o desenvolvimento do sistema mastigatório, podendo haver variações nos valores encontrados em indivíduos com alterações anatômicas e funcionais; é ela que proporciona estímulo para o correto desenvolvimento da maxila, mandíbula, articulações, músculos, dentre outros, daí a importância do correto diagnóstico de alterações morfológicas e disfunções orofaciais que possam estar presentes durante o crescimento e desenvolvimento de indivíduos jovens. Dessa forma, os objetivos desta pesquisa foram:

- Avaliar a performance mastigatória de crianças e adolescentes e relacioná-la às características da oclusão dentária, morfologia craniofacial e força de mordida;
- Comparar as variáveis em estudo (performance mastigatória, bruxismo do sono, oclusão, força de mordida e morfologia craniofacial) entre crianças com e sem disfunção orofacial, bem como nas diferentes fases da dentição;
- Avaliar o dimorfismo sexual e sua relação com as dimensões craniofaciais e dos arcos dentários e espessura ultrassonográfica do músculo masseter em crianças na fase de dentição mista.

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CAPÍTULO 1

Relationship between masticatory performance, bite force, orthodontic treatment need and orofacial dysfunction in children and adolescents

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ABSTRACT

Few studies have evaluated the relationship between masticatory performance and morphological and functional characteristics of the masticatory apparatus in young subjects. **Objectives:** Thus, the aim of this study was to evaluate masticatory performance (MP), maximal bite force (BF), orthodontic treatment need and orofacial dysfunction in children and adolescents. **Design:** The sample consisted of 316 subjects of both genders, aged 6-16 years of age divided in four groups: early, intermediate and late mixed dentition and permanent. MP was evaluated by the individual's ability to comminute an artificial test food in order to determine median particle size (X_{50}) and distribution of particles in the different sieves ("*b*") and BF was determined using a digital gnatodynamometer with fork strength of 10 mm. Orofacial function and orthodontic treatment need was screened using the Nordic Orofacial Test-Screening (NOT-S) protocol and Index of Orthodontic Treatment Need (IOTN), respectively. The results were submitted to descriptive statistics, normality test, analysis of variance and stepwise multiple linear regression to test the relationship between MP and the studied independent variables. **Results:** the variance of X_{50} and *b* between groups was statistically significant. But the evaluation of the variables that significantly contributed to MP variation showed that age, BMI, BF and presence of bruxism negatively related with X_{50} and the scores of NOT-S clinical exam showed positive relation with X_{50}. **Conclusion:** In the studied sample, age, BMI, BF and the presence of bruxism related with a better MP; but the increase in NOT-S scores related significantly with a poorer MP.

KEY WORDS: masticatory performance; orofacial dysfunction; bite force; orthodontic treatment need.

INTRODUCTION

Orofacial function is the result of complex integrated activities of the central nervous system and the neuromuscular system. It includes a several number of vital actions such as breathing, mastigation and swallowing, and acts as the basis for social interaction in terms of speech, emotional communication, facial expression and appearance (Lund, 1991; Miller 2003). Mastication is a developmental function and its maturation occurs from learning experiences. If it is adequate, it gives stimulus and proper function for the normal development of the maxilla and mandible (Ono *et al*., 1992). In the oral cavity, the food is subjected to several mechanical and chemical processes. The food is fractured by the teeth, diluted and broken down by saliva, forming a bolus to finally be swallowed (van der Bilt *et al*., 2010). As mastication reduces the food size and prepares it for swallowing and digestion, its performance can be measured by determining the individual capacity to comminute a test food (Gavião *et al*., 2007). Sieving of fragmented food particles has proven to be a reliable method for quantifying masticatory performance (MP) (Speksnijder *et al*., 2009) after grinding and pulverizing a test food (Lucas and Luke, 1983; Olthoff *et al*., 1984). Artificial foods may be preferred to natural foods for measuring MP because of its physical properties, shape and size of the particles are more reproducible (Gavião *et al*., 2007).

Maximum voluntary bite force measurement is an important tool for assessing the functional state of the masticatory system. Bite force has been used to evaluate oral function in relation to occlusal factors, malocclusion, oral surgery, temporomandibular disorders and neuromuscular diseases, and has been reported to have a large influence on the masticatory performance in subjects with overdentures, in those with full dentures, as well as in subjects with natural dentitions (van der Bilt *et al*., 2008). According to English *et al*. (2002), three main factors may influence masticatory performance: the number and area of occlusal contacts, occlusal forces as reflected by maximum bite force, and the amount of lateral excursion during mastication.

Orofacial dysfunction is a common feature in many genetic and congenital disorders. It may be acquired as a consequence of various diseases, trauma or parafunctional habits and can be severely disabling. Physical changes localized in specific regions of the body may interfere with the overall health, thus affecting the quality of life (Strini *et al.*, 2011). The *Nordic Orofacial Test – Screening* (NOT-S) has been developed by Bakke *et al.* (2007) to evaluate the characteristics and severity of the orofacial dysfunction; which has been translated and culturally adapted to Brazilian Portuguese by Leme (2010).

The possible association of MP and orofacial dysfunction has not been investigated to date. Considering these informations, it becomes relevant to analyze factors that can affect the operation of biological structures, especially those related to physiological oral functions in young subjects. According to our knowledge, the present study is the first to examine the effects of orofacial dysfunction on mastication and, thus, the purpose was to evaluate the relationship between MP, maximal bite force, and orofacial dysfunction in children and adolescents.

METHODS

Sample selection and clinical examination

The sample consisted of 316 subjects aged 6-16 years, selected from public schools of Piracicaba, SP, Brazil, after anamnesis and clinical examination. They were divided in four groups matched for dentition: early mixed dentition (n=20) (9♂/11♀), intermediate mixed dentition (n=73) (30♂/43♀), late mixed dentition (n=89) (42♂/47♀), and permanent dentition (n=134) (57♂/87♀). The children and their parents consented to participate in the study, which was approved by the Ethics Committee of the Piracicaba Dental School (protocol n. 004/2010).

The parents/guardians gave written information using a pre-structured questionnaire. The questions verified the pre-natal, natal and post-natal histories, dental and medical experiences and parafunctional habits (bottle feeding, pacifier use, finger sucking, nail biting, sleep bruxism and enuresis nocturna). The questions could be answered by qualitative (yes/no) and quantitative responses (frequencies characteristics).

Presence of malocclusions, lip posture, and need for orthodontic treatment (using the IOTN-DHC, Index of Orthodontic Treatment Need - Dental Health Component) were all evaluated by a single calibrated examiner, who performed this evaluation in a reserved room arranged by the staff from each school using dental mirror with led light (Uçüncü & Ertugay, 2001).

The signs and symptoms of sleep bruxism were recorded taking into account the following parameters: sibling or parental report of grinding sounds (at least three times a week); presence of shiny and polish facets on incisors and/or first permanent molars (based primarily on palatal surface and incisal edges and working cusps, respectively) observed in clinical examination, taking into account the time of eruption; and no other medical, mental or sleep disorders (e.g., epilepsy, obstructive apnea syndrome). The presence of sleep bruxism was confirmed by both the parental report and the presence of tooth wear, since the latter is a cumulative sign (Castelo *et al.*, 2010A).

Body weight and height were also determined and the body mass index (BMI) was calculated as: BMI = Kg/m^2.

The inclusion criteria were the absence of pain of dental origin, premature tooth loss, anomalies of shape, number, structure and/or changes that might compromise the mesiodistal dimensions, tooth decay, trauma, and soft tissue abnormalities. The exclusion criteria were systemic disturbances in general, ingestion of medicines that could interfere directly or indirectly with muscular activity and uncooperative behavior.

Masticatory performance determination

Masticatory performance was assessed by the determination of the individual capacity of fragmentation of an artificial food denominated Optosil Silicona (Slagter *et al.*, 1993). The components were blended and placed in metal moulds with cubic compartments of 5.6mm using mechanical pressure. The subjects received 17 cubes (3.6 g), which were chewed for 20 mastication cycles, visually monitored by the examiner. The fragmented particles were then expelled from the oral cavity into recipients with plastic sieves covered with a paper filter. The remaining particles were washed with water and disinfected using 70% alcohol dispersion. After drying, the particles were removed from the paper filter, weighed and passed through a series of 10 granulometric sieves with meshes ranging from 5.60 mm to 0.71 mm, connected in decreasing order and closed with a metal base. The particles were placed in the first sieve of the series and the set was maintained under vibration for 20 min. The particles retained on each sieve were removed and weighed on an analytical scale with a precision of 0.001 g. The distribution of the particles by weight was described by a cumulative function (Rosim–Ramler equation). The degree of fragmentation of the material is then given by the median particle size (X_{50}), which is the aperture of a theoretical sieve through which 50% of the weight of the fragmented material could pass (van der Bilt *et al*., 1994).

Maximal bite force measurement

Maximum unilateral bite force was assessed with a digital gnathodynamometer (Digital Dynamometer DDK Kratos, Kratos Equipamentos Industriais Ltda., Cotia, Brazil), using a fork strength of 10 mm connected to a digital device which provided the unilateral maximum BF in Newtons (N). The children were seated in an upright position with their heads in a natural posture, and the fork was unilaterally over the first permanent molars (right and left sides). The children were then instructed to bite the fork as forcefully as possible. The recordings of each side were performed three times, with an interval of two minutes. The final value was determined as the mean of the measurements, with an accuracy of 0.01 N.

Orofacial dysfunction

One calibrated examiner (MCSM) evaluated the presence of orofacial dysfunction using the NOT-S protocol. The protocol contains 12 domains of orofacial function: six assessed by an interview and six by a clinical examination as the participant performs various tasks using a picture manual (Leme & Gavião, 2009; Leme, 2010). The six interview domains were: (I) sensory function, (II) breathing, (III) habits, (IV) chewing and swallowing, (V) drooling, and (VI) dryness of the mouth. The six domains assessed in the clinical examination were: (1) the face at rest, and tasks regarding (2) nose breathing, (3) facial expression, (4) masticatory muscle and jaw function, (5) oral motor function, and (6) speech. Each item has criteria for the respective function. An answer YES or task that meet the criteria for impaired function gave the score 1, thus indicating a dysfunction in the scored domain; answer NO or task that did not meet the criteria, gave the score 0. The total score was the sum of the score of each domain, and could range from 0 to 12 (Bakke *et al*., 2007).

Measurement errors

For assessment of method error of the studied variables, the intraclass correlation coefficient (weight, height and bite force), Pearson correlation coefficient (IOTN-DHC scores) and Spearman correlation coefficients (NOT-S scores) were calculated from 25 subjects not included in the studied sample, in two separate occasions at an interval of 14 days (BioEstat 5.0; Mamirauá, Belém, PA, Brazil) (Table 1).

The intraclass correlation coefficients for masticatory performance were determined between the test food particles retained on each sieve from two assessments, and they varied from 0.55 to 0.98, that is, moderate to almost perfect agreement (Fleiss, 1986).

Statistics

Statistical analysis was performed using SigmaStat 3.1 (Sigma Stat Software Inc., Richmond, CA, USA) and BioEstat 5.0 (Mamirauá, Belém, PA, Brazil) with a 5% significance level. The Kolmogorov-Smirnov test showed that the distributions of the studied variables, except bite force, deviated from normality.

The proportions of individuals divided for dentition according to the studied variables were evaluated using descriptive statistics, and they consisted of means, standard deviations, medians, interquartile ranges and percentages. Differences in MP parameters (X_{50} and "*b*" values) among the four groups were evaluated by means of Kruskal-Wallis test (with Dunn post test).

A backward stepwise linear regression model was used to determine the relationship between X_{50} as the dependent variable and stage of dentition, gender, age, BMI, BF, IOTN scores, presence of overbite, overjet, crossbite, closed lip posture and sleep bruxism, and NOT-S scores as the independent variables.

RESULTS

The descriptive statistics of the demographic, parafunctional and clinical characteristics of the four groups are shown in tables 2 and 3. The distributions of X_{50} and *b* deviated from normality and they are expressed as medians and interquartile ranges in table 4. According to analysis of variance, X_{50} and *b* showed statistically significant group differences. The post-hoc test also showed that permanent dentition group had significantly smaller X_{50} than intermediate and late mixed dentition. Moreover, intermediate and late mixed dentition also showed broader distribution of particles than the early mixed dentition.

Table 5 shows the results of the stepwise linear regression model used to test which independent variables significantly contributed to X_{50} variation. According to the results found, age, BMI, BF and presence of bruxism showed negative relation with X_{50}, that is, the increase in age, BMI, BF and the presence of bruxism related with a better MP. The scores of NOT-S clinical exam showed positive relation with X_{50}, which means that the increase in NOT-S scores related significantly with a poorer MP.

DISCUSSION

Mastication is the first step in the process of digestion, in which the mechanical degradation of the food facilitates the action of the salivary enzymes and prepares the food for swallowing and further processing in the digestive system. Previous studies have shown that several factors potentially influence masticatory performance, including bite force, occlusal contact area, number of functional tooth units and the severity of malocclusions (English *et al*., 2002; Pereira *et al*., 2010; Rios-Vera *et al*., 2010). However, the relation of orofacial dysfunction with MP have not been previously described using a screening protocol, in which sensory function, breathing, habits, chewing and swallowing, drooling and dry mouth are evaluated using clinical examination and an interview. Subjects who report moderate to extreme difficulty in chewing and biting foods with firm to hard consistency may change the consistency of their diet and swallow larger food particles (Sierpinska *et al*., 2007).

Age, increases in body size and dental maturation are the most import sources of variation in MP in growing individuals (Toro *et al.*, 2006). According to the analysis of variance, permanent dentition group showed better MP than intermediate and late mixed dentition. The lack of difference in X_{50} between intermediate and late mixed dentition groups may be related to the transitional nature of the mixed dentition. Moreover, intermediate and late mixed dentition also showed broader distribution of particles than the early mixed dentition. These results indicate that dental maturation leads to a gain in masticatory ability. In the study of Toro *et al*. (2006), the eruption of the first molars could explain the greater improvement in performance observed between the 6 and 9 years old than between the 9 and 12 year old groups and the observed age differences in masticatory performance were strongly associated with increases in body size.

However, not all of these factors are independent and other variables potentially related to MP must be considered in order to determine which of these factors is most important in improving MP in young subjects. When all the studied variables were considered in the regression analysis, the results found did not show a significant relation between MP and stage of dentition. But the increase in age and BMI related with a better MP, in agreement with the results found by Toro *et al*. (2006). The increase in age and body size may lead to an increase in muscle dimensions and maximal bite force (Castelo *et al*., 2010B), which have also been related to improved MP and ability to generate bite forces (Julien *et al*., 1996).

The maximal bite force is the effort exerted between the maxillary and mandibular teeth when the mandible is elevated by the masticatory muscles. Braun *et al*. (1995) and García-Morales *et al*. (2003) observed that maximum bite force related significantly with muscle efficiency and development of the masticatory complex and, therefore, a decrease in its magnitude may be reflected in growth and developmental alterations and related to a reduced MP (Julien *et al*., 1996), corroborating the present results.

The results found showed that orthodontic treatment need did not relate significantly with MP, and IOTN scores were eliminated from the final model. Previous studies have shown that although the esthetic impairments of malocclusions represent the main factor in determining orthodontic treatment demand, individuals with malocclusions may also complain about functional problems (English *et al*., 2002). However, the relative differences in MP between individuals with and without malocclusions remain controversial (Toro *et al*., 2006; Rios-Vera *et al*., 2010). The poorer MP in individuals with malocclusion may be partially justified by the small number and area of occlusal contacts (van den Braber *et al*., 2001; Owens *et al*., 2002). According to Toro *et al*. (2006), occlusal indices measuring the severity of malocclusion are more objective, but also limited in their ability to assess a relation between occlusal morphology and MP and additional prospective studies are needed to fully understand differences in MP between different occlusal classes.

Sleep bruxism also contributed to X_{50} variation, that is, was related to a better MP. This habit is considered to be a parafunctional behavior with multifactorial etiology (Castelo *et al*., 2010A), and the distribution of muscle forces to the teeth and temporomandibular joints may result in several types of complaints, such tooth wear and orofacial pain, as well as hyperactivity and hypertrophy of the masticatory muscles, especially the masseter (Clark *et al*., 1981). The pattern of occlusal wear may be an indicator of bruxism, which could lead to increased contact area and greater occlusal forces during mastication. However, a previous study has shown a lack of difference in bite force magnitude between adults with and without bruxism (Calderon *et al*., 2006), but it is important to note that the majority of the literature found did not involve children, who usually present fewer signs and symptoms of temporomandibular dysfunction.

Orofacial function includes a large number of vital actions such as breathing, chewing and swallowing, and acts as the basis for social interaction in terms of speech, emotional communication, facial expression and appearance. The masticatory process includes the selection of food particles, which is placed on the teeth by jaw, tongue and cheek movements, and then the particles are fractionating, depending on the morphological and functional characteristics of the orofacial structures that generates bite force (Katsuhiko *et al*., 2004). If some of the orofacial functions are compromised, they can negatively impact masticatory process. According to the present results, subjects with higher scores on NOT-S presented larger median particle size of the chewed test food, that is, a poorer MP. The literature suggests that MP is directly associated with dietary intake, the activities of daily living and quality of life, all of which indicate its importance in promoting and preserving oral and general health (Miura *et al*., 1997; Miura *et al*., 2000; Katsuhiko *et al*., 2004; Strini *et al*., 2011). Therefore, it is reasonable to assume that lower MP might also be related to decreasing intake of nutrients and it might well be a more significant problem in young and growing children than it is in aging adults (English *et al*., 2002), and early treatment of orofacial dysfunction is advisable to ensure correct growth and development of the masticatory system.

CONCLUSIONS

The results found in the studied sample provided the following conclusions:

- Age, body mass index, maximal bite force and presence of bruxism showed negative relation with X_{50}, that is, a better MP;
- The scores of NOT-S clinical exam showed positive relation with X_{50}, which means that the increase in NOT-S scores related significantly with a poorer MP.

These factors potentially related with a decrease in masticatory performance must be accompanied to ensure oral and general health in growing individuals.

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TABLES

Table 1. Method error of the studied variables assessed by means of intraclass correlation coefficients (ICC), Pearson and Spearman correlation coefficients from 25 subjects.

Variable	ICC	Pearson correlation coefficient (*p*-value)	Spearman correlation coefficient (*p*-value)
Weight	0.8482	-	-
Height	0.9113	-	-
Bite force (left side)	0.6498	-	-
Bite force (right side)	0.7626	-	-
IOTN	-	0.6936 (0.0001)	-
NOT-S interview score	-	-	0.6544 (0.0013)
NOT-S clinical examination score	-	-	0.7200 (0.0002)
NOT-S total score	-	-	0.7541 (<0.0001)

IOTN – DHC, Index of Orthodontic Treatment Need - Dental Health Component; NOT-S, The Nordic Orofacial Test—Screening.

Table 2. Demographic characteristics and the frequency of sleep bruxism in the studied sample.

Stage of dentition	**n**	**Gender** (♂/♀)	**Age (y)** mean (SD)	**BMI (Kg/m^2)** mean (SD)	**Bruxism** (%)
Early mixed	20	9/11	7.50 (1.05)	16.00 (1.98)	5.00
Intermediate mixed	73	30/43	8.26 (1.33)	17.70 (3.54)	24.66
Late mixed	89	42/47	10.83 (1.13)	18.76 (3.61)	16.85
Permanent	134	57/87	12.27 (1.61)	20.52 (5.00)	16.42

BMI, body mass index; SD, standard deviation.

Table 3. Descriptive statistics of the clinical variables evaluated for the four groups.

Stage of dentition	**BF right side (N)** mean (DP)	**BF left side (N)** mean (DP)	**IOTN DHC** median (IQR)	**Overjet (mm)** median (IQR)	**Overbite (mm)** median (IQR)	**Crossbite** (%)	**Closed lip posture** (%)	**NOT-S interview score** mean (SD)	**NOT-S clinical examination score** mean (SD)	**NOTS total score** mean (SD)
Early mixed	302.11 (108.19)	280.62 (72.56)	3.00 (2.00)	3.00 (2.00)	2.50 (3.00)	20.00	90.00	2.10 (1.07)	0.65 (0.75)	2.75 (1.55)
Intermediate mixed	327.25 (85.60)	312.17 (94.69)	2.00 (2.00)	3.00 (2.00)	2.00 (4.00)	24.66	98.63	1.74 (1.05)	0.71 (0.79)	2.45 (1.25)
Late mixed	360.16 (104.71)	363.20 (91.60)	2.00 (1.00)	3.00 (2.00)	3.00 (2.00)	17.98	94.38	2.10 (1.12)	0.89 (1.04)	2.99 (1.57)
Permanent	378.03 (127.50)	402.79 (295.82)	2.00 (1.00)	3.00 (2.00)	3.00 (2.00)	14.93	94.78	2.17 (1.11)	0.84 (0.83)	3.01 (1.41)

SD, standard deviation; IQR, interquartile range; BF, maximal bite force; IOTN – DHC, Index of Orthodontic Treatment Need - Dental Health Component; NOT-S, The Nordic Orofacial Test—Screening.

Table 4. Medians and interquartile ranges (IQR) for median particle size (X_{50}) and broadness of the particle distribution (*b*) for all groups.

	Early mixed	Intermediate mixed	Late mixed	Permanent
	median (IQR)	**median (IQR)**	**median (IQR)**	**median (IQR)**
$\mathbf{X_{50}}$	4.53	4.80^{A}	4.85^{A}	4.24^{B}
	(1.47)	(1.44)	(1.44)	(1.51)
b	2.47^{A}	2.13^{B}	2.12^{B}	2.21
	(0.61)	(0.51)	(0.53)	(0.35)

A#B ($p<0.05$; Kruskal-Wallis test with Dunn post test).

Table 5. Multiple linear regression analysis with backward stepwise elimination used to test the relationship between masticatory performance (X_{50} as dependent variable) and the studied independent variables. Those independent variables eliminated from the model are not shown.

Dependent variable	**Independent variables**	**Coefficient**	***p*- value**	**Significance of the model**		
				Adj Rsqr	***p*-value**	**Power (α=0.05)**
X_{50}	constant	2.6690	-	0.142	<0.001	1.000
	Ln (Age)	-0.1980	0.013			
	Ln (BMI)	-0.1710	0.032			
	BF right side	-0.0005	<0.001			
	Bruxism	-0.1030	0.011			
	NOT-S – scores from clinical exam	0.0453	0.011			

X_{50}, median size of test food particle; BMI, body mass index; BF, bite force; NOT-S, The Nordic Orofacial Test Screening.
Normality Test: Passed (p = 0.526)
Constant Variance Test: Passed (p = 0.821)

CAPÍTULO 2

Relationship between orofacial dysfunction, occlusal and craniofacial morphology, bruxism and bite force in children and adolescents

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ABSTRACT

Impaired orofacial function may interfere with the overall health and few studies have evaluated the relationship between orofacial dysfunction and form and function of the stomatognathic system using a structured protocol. **Objective.** Thus, the aim of this study was to evaluate the relation between orofacial dysfunction and occlusal and craniofacial morphology, bruxism and maximal bite force in children and adolescents. **Design.** The sample consisted of 316 subjects of both genders, aged 6-16 years of age divided in four groups: early, intermediate and late mixed dentition and permanent. Orofacial dysfunction and orthodontic treatment need were screened using the Nordic Orofacial Test-Screening (NOT-S) protocol containing 12 orofacial function domains and Index of Orthodontic Treatment Need (IOTN), respectively. Bite force was determined using a digital gnatodynamometer with fork strength of 10 mm and craniofacial dimensions were assessed by lateral and posteroanterior cephalograms. The presence of sleep bruxism was also evaluated. The results were submitted to descriptive statistics, normality and correlation tests, analysis of variance and stepwise multiple linear regression to test the relationship between NOT-S scores and the studied independent variables. **Results.** The variance of NOT-S scores between groups was not significant. The evaluation of the variables that significantly contributed to NOT-S scores variation showed that age and presence of sleep bruxism related with higher NOT-S total scores; moreover, the increase in overbite measurements and the presence of closed lip posture related significantly with lower scores. But a significant relation between craniofacial morphology and orofacial dysfunction scores was not found. **Conclusions.** In the studied sample, age and the presence bruxism related with higher scores of orofacial dysfunction, while the increase in overbite measurements and the presence of closed lip posture related significantly with lower NOT-S total score.

KEY WORDS: orofacial dysfunction, occlusal morphology, craniofacial morphology, bruxism.

INTRODUCTION

Orofacial function involves several vital and social functions, and the mouth plays an important role in chewing, swallowing and speech functions. The development of the Nordic Orofacial Test-Screening protocol (NOT-S) was useful to establish common criteria for assessing the impairments that may compromise orofacial functions by a comprehensive instrument (Bakke *et al*., 2007). This test has been shown to satisfactorily identify areas (domains) of orofacial dysfunctions, discriminate between individuals with various degrees of disability and healthy subjects, and to have good inter- and intra-examiner reliability (Bergendal *et al*., 2009).

At the beginning of the digestive process, mastication grinds, humidifies and decreases the size of food particles, producing the food bolus which is then swallowed, ending the oral phase of digestion. This phase, represented by mastication and swallowing, is influenced by dental occlusion and plays an important role in human physiological equilibrium. Dental occlusion is the physical relation between the dental and functional elements of the masticatory system components: superior and inferior dental arches, maxilla, jaw, hyoid bone, tongue, lips, cheek and muscles, and has also an indirect impact over respiration and speech (Moyers, 1991; Proffit *et al*., 1995; Graber and Vanarsdall Jr., 2002; Machado Jr. and Crespo, 2006). Previous studies have evaluated the impact of orofacial dysfunctions on the occlusal and craniofacial morphology in young subjects; however, due to the complexity of these functions, their results may vary (Frassson *et al*., 2006). A previous study suggested that deviations from a regular dental arch form become apparent very early during dentition development and coexist with specific orofacial dysfunctions; they are thus important indicators for the early detection of functional abnormalities (Seemann *et al*., 2011).

The dimensions of the masticatory muscles, dental occlusion, facial morphology, and functional pain are the main factors that may influence the magnitude of bite force. Furthermore, bite force increases with teeth in occlusal contact, with the increasing number of erupted teeth, and with the stages of dental eruption (Sonnesen *et al.*, 2001; Sonnesen and Bakke, 2005; Castelo *et al*., 2010A). The potential influence of bite force on the development of structures and function of the masticatory system has also been reported

(Braun *et al*., 1995). In young subjects with Duchenne muscular dystrophy, a disease that affects orofacial function, bite force has shown to be significantly lower than in control subjects (Botteron *et al*., 2009).

Few studies have evaluated the relation between orofacial dysfunction and form and function of the stomatognathic system using a structured protocol. Thus, the aim of this study was to evaluate the relationship between orofacial dysfunction, occlusal and craniofacial morphology, sleep bruxism and maximal bite force in children and adolescents.

METHODS

Sample selection

The sample comprised 316 children and adolescents of both genders from public schools of Piracicaba, Brazil, and was divided in four groups matched for dentition: early mixed dentition (n=20) (9♂/11♀), intermediate mixed dentition (n=73) (30♂/43♀), late mixed dentition (n=89) (42♂/47♀), and permanent dentition (n=134) (57♂/87♀). The study design, discomforts or risks, as well as the possible benefits, were explained to the children and their parents, and their informed consent was obtained (Ethical Committee of the Piracicaba Dental School, protocol no. 004/2010).

The parents/guardians gave written information using a pre-structured questionnaire. The questions verified the pre-natal, natal and post-natal histories, dental and medical experiences (asthma, bronchitis and/or snoring) and parafunctional habits (bottle feeding, pacifier use, finger sucking, nail biting, sleep bruxism and enuresis nocturna). The questions could be answered by qualitative (yes/no) and quantitative responses (frequencies characteristics).

The exclusion criteria were systemic disturbances in general, ingestion of medicines that could interfere directly or indirectly with muscular activity and uncooperative behavior.

Physical and Clinical Examinations

The children were selected after clinical examination, verifying a healthy state, the presence of all teeth without anomalies and/or alterations of form, structure or number, the normality of oral tissues, presence or absence of tooth wear, occlusal morphology, overbite and overjet measurements. Data on lip posture were evaluated with the child distracted or at rest, when lip separation could be verified. Body weight and height were determined, and the body mass index was calculated as: BMI = Kg/m^2.

The Index of Orthodontic Treatment Need - Dental Health Component (IOTN-DHC) was used for occlusion evaluation. The DHC registers, using a millimeter probe, the occlusal characteristics of a malocclusion that harm the teeth and adjacent structures. There are five levels, from the Degree 1 (there is no need for treatment) up to the Degree 5 (there is a great need for treatment). This index serves as basic guide for an impartial judgment of the malocclusion.

Signs and symptoms of sleep bruxism were considered when (Koyano *et al.,* 2008; Castelo *et al*., 2010B):

1. The children's parents indicated the occurrence of tooth-grinding or tooth-clenching during sleep (at least three times per week).
2. The presence of wear facets polished in incisors and/or first permanent molars;
3. No other medical or mental disorders which could account for abnormal movement during sleep were present (e.g., sleep-related epilepsy, obstructive sleep apnea syndrome).

Orofacial dysfunction

Orofacial dysfunction was evaluated using the NOT-S protocol, which was developed by a working group formed at the *Second Nordic Conference on Orofacial Therapy* in Gothenburg in 2002 and was translated and culturally adapted to Brazilian Portuguese by Leme and Gavião (2009). This protocol consists of a structured interview and a clinical examination, each part with six domains. In the interview, the following functions are assessed: *(I) Sensory Function, (II) Breathing, (III) Habits, (IV) Chewing and Swallowing, (V) Drooling* and *(IV) Dryness of the mouth*. In the examination, the following functions are assessed: *(1) Face at Rest, (2) Nose Breathing, (3) Facial Expression, (4) Masticatory Muscle and Jaw Function, (5) Oral Motor Function* and *(6) Speech*. Each domain contains one to five items, reflecting the complexity of the specific function. NOT-S was applied individually by the same researcher on a vacant class. The NOT-S interview was performed by asking the questions in the screening form. To assess orofacial dysfunction in the clinical examination, the subjects were requested to carry out tasks for each item in conjunction with the illustrated manual. Each item has criteria for the respective function. An answer of YES or a task that met the criteria for impaired function resulted in a score of 1, indicating a dysfunction in the scored domain. An answer of NO or a task that did not meet the criteria resulted in a score of 0. The total score was the sum of the score for each domain and ranged from 0 to 12 (Bakke *et al*., 2007; Leme, 2010).

Maximal Bite Force Measurement

Maximum vertical interocclusal bite forces were measured with a digital gnathodynamometer (Digital Dynamometer model DDK Kratos, Kratos Equipamentos Industriais Ltda., Cotia, Brazil), using a fork strength of 10 mm connected to a digital device which provided the unilateral maximum BF in Newtons (N). The recordings were undertaken three times, with an interval of at least two minutes between each and the fork was placed unilaterally on the first permanent molars. The subjects, seated in an upright position with the head in natural posture, were instructed to bite as forcefully as possible. The bite force was determined as the average of the three measurements (with an accuracy of 0.01N).

Craniofacial Dimensions

The NOT-S scores obtained by the total sample were dichotomized, considering the median values, which were calculated to determinate the centre scores, showing values above, equals and bellow of the respective median. These analyses were undertaken for the selection of subjects who would be invited to perform radiographic examinations at the Radiology Center of Piracicaba Dental School. One hundred seventy two subjects with values on NOT-S score equal or above 3 were invited, but only 21 attempted for radiographic examination.

The radiographic examination was done by a trained technician. The head of the subject was positioned in such a way that when the auricular olives were introduced, the subject remained facing the plate, with the nose slightly touching it, being careful so that the medial sagittal plan remained perpendicular to the horizontal plan. The subject kept his/hers lips relaxed and in habitual occlusion (Rickets, 1960). Lateral and posteroanterior radiographs were analyzed by digitized method (Radiocef Studio2, Radio Memory Ltda., Belo Horizonte, Brazil) by one trained examiner (MBCCA). The following landmarks were identified:

<u>Lateral Cephalogram</u>

- Lower face height: the linear distance from the anterior nasal spine of the maxilla to menton;
- Mandibular length: obtained through the orthogonal projection of both the pogonion and the most posterior point of the mandibular condyle onto the Go-Me mandibular plane;
- Maxillary length: between the center of the pterygomaxillary fissure and the perpendicular projection of point A in the Frankfort Horizontal Plane;
- Mandibular plane angle: the angle between a line formed by gonion and gnathion and sella-nasion line;
- Gonial angle: angle between the lower border of the mandible and the posterior border of the ramus;
- Facial pattern was determined by the Jarabak coefficient [(posterior facial height/anterior facial height) x 100], which classifies growth tendency into hyperdivergent (54 to 58%), neutral (59 to 63%) and hypodivergent (64 to 80%) (Siriwat and Jarabak, 1985).

<u>Posteroanterior Cephalogram</u> (Ricketts, 1981; Allen *et al*., 2003; Kecik *et al*., 2007):

- Face width: distance between the bilateral points marked at the outermost tip of the zygomatic arches;
- Maxillary width: distance between right and left jugale;
- Mandibular width: distance between right and left antegonion;
- Nasal width: distance between the outermost external points in the nostril opening;
- Inclination of the occlusal plane: the degree of divergence between ZR-ZL (bilateral points marked at the outermost tip of the zygomatic arches) and the occlusal plane at molars level.

Measurement errors

For assessment of method error of the studied variables, the intraclass correlation coefficient (weight, height and bite force), Pearson correlation coefficient (IOTN-DHC scores) and Spearman correlation coefficients (NOT-S scores) were calculated from 25 subjects not included in the studied sample, in two separate occasions with an interval of 14 days (BioEstat 5.0; Mamirauá, Belém, PA, Brazil) (Table 1).

Statistics

Statistical analysis was performed using SigmaStat 3.1 (Sigma Stat Software Inc., Richmond, CA, USA) and BioEstat 5.0 (Mamirauá, Belém, PA, Brazil) with a 5% significance level. The Kolmogorov-Smirnov and Shapiro-Wilk tests showed that the distributions of the studied variables, except bite force, deviated from normality.

The proportions of individuals divided for dentition according to the studied variables were evaluated using descriptive statistics, and they consisted of means, standard deviations, medians, interquartile ranges and percentages. Differences in BMI and NOT-S scores among the four groups were evaluated by means of Kruskal-Wallis test, with Dunn post test.

A backward stepwise linear regression model was used to determine the relationship between NOT-S scores as the dependent variable, and stage of dentition, gender, age, BMI, BF, IOTN scores, presence of overbite, overjet, crossbite, closed lip posture and sleep bruxism as the independent variables.

The correlation between each craniofacial dimension evaluated and NOT-S total score was assessed by Spearman correlation test in order to verify the tendency between the variables.

RESULTS

The descriptive statistics of the demographic, parafunctional and clinical characteristics for the four groups are shown in tables 2 and 3. BMI differed significantly among groups (table 2): between early and late mixed, early mixed and permanent and between intermediate mixed and permanent dentition, and also correlated significantly with age (r = 0.31; $p<0.05$; Spearman correlation test). The frequency of sleep bruxism ranged from 5.00 to 24.66%.

The descriptive statistics of the NOT-S scores as well the results of the analysis of variance among dentition groups are shown in table 4. According to the results found, NOT-S interview, clinical examination and total scores did not show significant difference among the four groups.

The results of the stepwise linear regression model used to test which independent variables significantly contributed to NOT-S total score variation are shown in table 5. According to the results found, the increase in age and presence sleep bruxism related with higher NOT-S total scores. Moreover, the increase in overbite measurements and the presence of closed lip posture related significantly with lower NOT-S total score.

The subjects who attempted for radiographic examination were 13 girls and 8 boys, being two, one, five and 13 from groups early, intermediate, late mixed and permanent dentition, respectively. Their descriptive statistics for age, NOT-S scores and craniofacial dimensions are shown in table 6. The analysis of facial pattern showed that 12 subjects were classified in hypodivergent growth tendency, five neutral and four hyperdivergent.

The correlation coefficients between each craniofacial dimension and NOT-S scores did not show a relation between craniofacial morphology and orofacial dysfunction scores.

DISCUSSION

Older subjects presented higher scores on NOT-S, that is, orofacial dysfunction may worsen over the years. Oral habits are common in preschool children, but those that persist may have profound effects on orofacial structures and function (Nowak & Warren, 2000). It is also important to consider that frequency, duration, and intensity of oral parafunctions may be more important than the habit itself (Pereira *et al.*, 2009), and even with the removal of parafunctional habits, the subject may have consequences in orofacial growth which can persist into adulthood. Moreover, orofacial dysfunction may also be acquired as a consequence of various diseases or trauma (Bakke *et al.*, 2007). A previous study showed that adenotonsillar hypertrophy causes obstructive symptoms and affects different functions such as chewing, swallowing, articulation, and voice; those children may present higher scores on NOT-S evaluation, which have decreased after surgery to scores similar to controls (Lundeborg *et al*., 2009).

According to previous studies, teeth and jaw malpositions can be the consequence of myofunctional disorders, mouth breathing and sucking habits (Aznar *et al*., 2006). Moreover, habitual open mouth posture is the primary factor which disturbs dentition development (Seemann *et al*., 2011). In this study, the increase in overbite measurements and the presence of closed lip posture related with lower scores of orofacial dysfunction. Both findings may suggest that open bite and open lip posture are severely disabling. Mouth breathing subjects with everted lower lip and frequent half-open lips in resting position may also show flaccid muscle and lower function on *orbicularis oris* (Marchesan, 2000; Andrade *et al*., 2005; Rodrigues *et al*., 2005). Those subjects can remain the lips closed when asked, although it occurs with *mentalis* muscle hyperfunction to compensate of the alteration on lower lip function (Cattoni *et al*., 2007). In the study of Seemann *et al*. (2011), a narrow maxillary apical base correlated positively with all the orofacial dysfunctions analyzed. However, the evaluation of orthodontic treatment need using an index failed in assesses a relation between orofacial dysfunction and the presence of malocclusion in the present study. According to Toro *et al*. (2006), occlusal index measuring the severity of malocclusion are more objective, but limited in some abilities.

Bruxism is an involuntary masticatory muscle activity that is characterized by clenching and/or grinding of the teeth (ICSD, 1997). Bruxism has a prevalence of about 10% in the general adult population and between 7 to 15% in children, and is usually regarded as one of the possible causative factors, among others, of temporomandibular pain, headache and tooth wear in the form of attrition (Lobbezoo *et al*., 2006; Pizolato *et al*., 2007; Bloomfield and Shatkin, 2009). Causes and consequences of bruxism have been extensively discussed in the literature (Pizolato *et al*., 2007; Castelo *et al*., 2008; Nagamatsu-Sakaguchi *et al*., 2008; Slavicek, 2011), and some authors have found associations with signs and symptoms of temporomandibular disorders (Nagamatsu-Sakaguchi *et al*., 2008; Marklund and Wänman., 2010; Pereira *et al*., 2009) and malocclusion (Fujita et al., 2003; Pereira *et al*., 2009), although these associations remain inconclusive. But depending on its intensity, frequency and duration, sleep bruxism may effects not only the masticatory muscles, but also all the muscles of the craniofacial complex, shoulders and neck (Friedman and Weisberg, 2000; Vélez *et al*., 2007). In present study, a relationship between sleep bruxism and higher scores on NOT-S was observed, and this finding could be due to myofunctional disorders involved with this parafunction (Bazzotti, 1998; Young *et al*., 1999). Moreover, recent researches have indicated a relation between sleep bruxism and respiratory alterations (Bonjardim *et al*., 2005; Magnusson *et al*., 2005; Molina *et al*., 2001). Sleep bruxism has been correlated to hypopnoea (Oksenberg and Arons, 2002) and increasing airway patency (Lavigne *et al*., 2003), which affects the airflow in the bruxist children.

A relation between bite force and orofacial dysfunction was not found, but a previous study observed that young subjects with Duchenne muscular dystrophy, a disease that affects orofacial function, presented lower bite force than matched controls (Botteron *et al*., 2009). The decrease in bite force magnitude among children with malocclusion and subjects with tooth loss and reduced periodontal tissue support seems to be more evident (Johansson *et al*., 2006; Sierpińska *et al*., 2006; Castelo *et al*., 2007), and future studies are needed to establish a relation between orofacial dysfunction and the force exerted by the masticatory muscles.

This study also investigated the relationship between craniofacial dimensions and orofacial dysfunction, but a significant relation between craniofacial morphology and orofacial dysfunction scores was not found, although NOT-S protocol involves a large number of orofacial functions. Some specific dysfunctions have been related to craniofacial alterations in previous studies. It is believed that long standing nasal obstruction may cause mouth breathing, leading to a set of functional dentoalveolar and skeletal changes, characterized by anterior open bite, everted lower lip, narrower maxilla, deeper palatal height, and others (Löfstrand-Tideström *et al*., 1999). Also, the presence of tongue thrust and deleterious oral habits may affect the neuromuscular orofacial balance, causing craniofacial growth abnormalities depending on time period, intensity and frequency of these habits (Jalaly *et al*., 2009).

The use of a reliable and valid screening of orofacial function may help identify areas of impairments in need of further attention, especially in growing subjects, to ensure correct development of the stomatognathic system.

CONCLUSIONS

Older subjects and those who presented sleep bruxism showed higher scores on NOT-S. Moreover, the increase in overbite measurements and the presence of closed lip posture related significantly with lower scores of orofacial dysfunction.

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TABLES

Table 1. Method error of the studied variables assessed by means of intraclass correlation coefficients (ICC), Pearson and Spearman correlation coefficients from 25 subjects.

Variable	ICC	Pearson correlation coefficient (*p*-value)	Spearman correlation coefficient (*p*-value)
Weight	0.8482	-	-
Height	0.9113	-	-
Bite force (left side)	0.6498	-	-
Bite force (right side)	0.7626	-	-
IOTN	-	0.6936 (0.0001)	-
NOT-S interview score	-	-	0.6544 (0.0013)
NOT-S clinical examination score	-	-	0.7200 (0.0002)
NOT-S total score	-	-	0.7541 (<0.0001)

IOTN – DHC, Index of Orthodontic Treatment Need - Dental Health Component; NOT-S, The Nordic Orofacial Test—Screening.

Table 2. Demographic characteristics and the frequency of sleep bruxism in the studied sample.

Stage of dentition	**n**	**Gender** (♂/♀)	**Age (y)** mean (SD)	**Weight (Kg)** mean (SD)	**Height (m)** mean (SD)	**BMI* (Kg/m^2)** mean (SD)	**Bruxism** (%)
Early mixed	20	9/11	7.50 (1.05)	26.61 (5.04)	1.29 (0.07)	16.00 (1.98)	5.00
Intermediate mixed	73	30/43	8.26 (1.33)	31.44 (8.78)	1.32 (0.08)	17.70 (3.54)	24.66
Late mixed	89	42/47	10.83 (1.13)	40.20 (9.92)	1.46 (0.08)	18.76 (3.61)	16.85
Permanent	134	57/87	12.27 (1.61)	50.93 (16.76)	1.56 (0.10)	20.52 (5.00)	16.42

BMI, body mass index; SD, standard deviation.
* $p<0.05$ (Kruskal-Wallis test with Dunn post test). BMI differed significantly between early and late mixed, early and permanent and between intermediate mixed and permanent dentition.

Table 3. Descriptive statistics of the clinical variables evaluated for the four groups.

Stage of dentition	**BF right side (N)** mean (DP)	**BF left side (N)** mean (DP)	**IOTN DHC** median (IQR)	**Overjet (mm)** median (IQR)	**Overbite (mm)** median (IQR)	**Crossbite** (%)	**Closed lip posture** (%)
Early mixed	302.11 (108.19)	280.62 (72.56)	3.00 (2.00)	3.00 (2.00)	2.50 (3.00)	20.00	90.00
Intermediate mixed	327.25 (85.60)	312.17 (94.69)	2.00 (2.00)	3.00 (2.00)	2.00 (4.00)	24.66	98.63
Late mixed	360.16 (104.71)	363.20 (91.60)	2.00 (1.00)	3.00 (2.00)	3.00 (2.00)	17.98	94.38
Permanent	378.03 (127.50)	402.79 (295.82)	2.00 (1.00)	3.00 (2.00)	3.00 (2.00)	14.93	94.78

SD, standard deviation; IQR, interquartile range; BF, maximal bite force; IOTN – DHC, Index of Orthodontic Treatment Need - Dental Health Component.

Table 4. Descriptive statistics of the NOT-S scores for the four groups.

	Early mixed		Intermediate mixed		Late mixed		Permanent	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
NOT-S interview score	2.10 (1.07)	2.00 (2.00)	1.74 (1.05)	2.00 (1.00)	2.10 (1.12)	2.00 (2.00)	2.17 (1.11)	2.00 (2.00)
NOT-S clinical examination score	0.65 (0.75)	0.50 (1.00)	0.71 (0.79)	1.00 (1.00)	0.89 (1.04)	1.00 (1.00)	0.84 (0.83)	1.00 (1.00)
NOT-S total score	2.75 (1.55)	2.00 (2.25)	2.45 (1.25)	2.00 (1.00)	2.99 (1.57)	3.00 (2.00)	3.01 (1.41)	3.00 (2.00)

SD, standard deviation; IQR, interquartile range; NOT-S, The Nordic Orofacial Test—Screening.
$p>0.05$; Kruskal-Wallis test.

Table 5. Multiple linear regression analysis with backward stepwise elimination used to test the relationship between NOTS total scores (as dependent variable) and the studied independent variables. Only significant independent variables are shown.

Dependent variable	Independent variables	Coefficient	*p*- value	Significance of the model		
				Adj Rsqr	*p*-value	Power (α=0.05)
NOT-S total score	constant	2.051	-	0.111	<0.001	1.000
	Ln (Age)	0.963	0.008			
	Overbite	-0.110	0.002			
	Closed lip posture	-1.380	<0.001			
	Sleep bruxism	0.679	<0.001			

NOT-S, The Nordic Orofacial Test—Screening.
Normality Test: Passed (p = 0.206).
Constant Variance Test: Passed (p = 0.122).

Table 6. Clinical characteristics and craniofacial dimensions obtained from 21 subjects and the coefficients obtained by the correlation between craniofacial dimensions and NOT-S total scores.

	Mean (SD)	**Median (IQR)**	**%**	**r***
Age (y)	11.05 (2.06)	-	-	-
NOT-S interview score	-	3.00 (1.00)	-	-
NOT-S clinical score	-	1.00 (1.00)	-	-
NOT-S total score	-	5.00 (1.00)	-	-
Snoring	-	-	35	-
Asthma/ bronchitis	-	-	10	-
Lower face height (mm)	66.03 (6.05)	-	-	-0.20
Mandibular length (mm)	105.43 (4.76)	-	-	-0.27
Maxillary length (mm)	51.62 (3.23)	-	-	-0.01
Mandibular plane angle (°)	32.41 (6.93)	-	-	0.23
Gonial angle (°)	123.87 (6.83)	-	-	0.11
Facial Height Ratio	-	-	65.27 (6.49)	-0.17
Face width (mm)	127.68 (11.10)	-	-	-0.20
Maxillary width (mm)	58.53 (6.29)	-	-	-0.17
Mandibular width (mm)	77.47 (7.01)	-	-	-0.20
Nasal width (mm)	34.17 (12.15)	-	-	-0.32
Inclination of the occlusal plane (°)	-0.22 (4.35)	-	-	-0.03

* Spearman correlation coefficient (p>0.05).

CAPÍTULO 3

Evaluation of sexual dimorphism and the relationship between craniofacial, dental arch and masseter muscle characteristics in mixed dentition

Running title: *Sexual dimorphism and the stomatognathic system*

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SUMMARY

The aim was to evaluate sexual dimorphism and the relationship among craniofacial characteristics, dental arch morphology and masseter muscle thickness in children in the mixed dentition stage. The study sample consisted of 32 children, aged 6-10 years (14♀/18♂) with normal occlusion. Craniofacial characteristics, dental morphology and masseter muscle thickness were evaluated by means of posteroanterior (PA) cephalometric radiographs, dental cast evaluation and ultrasound exam, respectively. The results were analyzed using Shapiro-Wilk test, Mann-Whitney/*t*-test and stepwise linear regression to assess the relations between *face width* and the following independent variables: age, gender, body mass index (BMI), masseter thickness, distances between first molars and canines on dental casts (between cusps/cervical points), nasal, maxillary, mandibular and intermolar widths (PA). Masseter thickness showed no significant difference between the sides left/right. The comparison between genders showed significant difference in *face width*, being larger in boys. The linear regression model showed that *face width* was positively and significantly correlated with the independent variables BMI, masseter thickness, mandibular first molar distances (cusps), mandibular canine distances (cervical points), and maxillary intermolar width; and negatively with maxillary (cusps) and mandibular molar distances (cervical points) and mandibular canine distances (cusps). That is, when the other studied variables were considered, the explanatory variable *gender* did not reach a significant value. In the studied sample, *face width* showed significant relationship with BMI, masseter thickness, first molar and canine distances and maxillary intermolar width; but *gender* did not contribute significantly to *face width* variation.

Key Words: masseter muscle, face, sex characteristics, dental occlusion.

INTRODUCTION

In mastication, there is well integrated neuromuscular activity, which occurs simultaneously with a synchronous contraction of muscles in the movements of closing, opening, laterality and mandibular protrusion. As occlusion and mastication mature, the anatomy of all articular components is modified to adapt to new patterns of changes in occlusion, occlusal guides, fossa depth and cusp height (Moyers and Carlson, 1993) Many factors such as heredity, bone growth, eruption and inclination of teeth, environmental influences, and function affect changes in the size and shape of dental arches (Arslan *et al*., 2007).

The quality of masticatory function is dependent on a number of factors such as occlusal area, number of teeth, activity, size and coordination of masticatory muscles and craniofacial dimensions, and action of the tongue and perioral muscle in handling food (van der Bilt, 2002).It is known that brachycephalic individuals are characterized by lower anterior facial height, lower slope of the mandible, less obtuse gonial angle and parallelism between the palatal and mandibular planes. Functionally, these individuals present greater masticatory muscle thickness (Castelo *et al.,* 2010) and higher bite force (Raadsheer *et al*., 1996; Benington *et al*., 1999; Raadsheer *et al*., 1999). It is well known that the adult male skull has higher angularity, size, bone thickness, cranial capacity and lower orbits; moreover, it has less vertical length, that is, lower values for height/width face index (Thapar *et al*., 2011). In the mandible, the internal and external reliefs are more sharply shaped and have a less obtuse gonial angle. However, previous studies have reported that in children, differences in craniofacial morphology between boys and girls become significant after eight years of age (Oueis *et al*., 2002; Slaj *et al*., 2005; Kamegai *et al*., 2005).

In the study of transversal dimensions, the posteroanterior cephalometric radiograph (PA) has shown to be an aid of great importance and reliability (Allen *et al*., 2003; Machado and Crespo, 2006; Kecik *et al*., 2007), but it has not yet become routinely used in dental practice, since lateral cephalometric study is still the most used method. Therefore, three-dimensional analysis is the best way to study craniofacial anatomical structures (Vanarsdall and White, 1994; Betts *et al*., 1995). Therefore, the aim of this study was to evaluate sexual dimorphism and the relationship between craniofacial characteristics, dental arch morphology and masseter muscle thickness by means of posteroanterior cephalometric radiographs (PA), dental cast evaluation and ultrasound exam, respectively, in children with normal occlusion, in the mixed dentition stage.

MATERIAL AND METHODS

Sample selection, interview and clinical examination

The study sample consisted of 32 children of both genders (14 girls and 18 boys) aged 6 – 10 years, who were to start dental treatment at the Department of Pediatric Dentistry, Piracicaba Dental School, Piracicaba, Brazil. The children and their parents consented to participate in the study, and the research was approved by the Ethics Committee of the Piracicaba Dental School (Protocol No. 023/06). The sample was selected after a complete anamneses and clinical examination, verifying a healthy state, the presence of all teeth without anomalies and alterations of form, structure or number, and the normality of oral tissues. Children with dental caries and/or restorations that could compromise tooth dimensions, systemic disturbances, signs and symptoms of temporomandibular joint dysfunction and history of orthodontic treatment were excluded. Body weight and height were determined, and the body mass index was calculated as: BMI = Kg/m^2.

Finally, only children with normal dental occlusion, in the mixed dentition stage (intermediate period) were selected, taking into account the following parameters: first molars and incisors erupted and occluded; presence of primary molars and canines; molar Angle's Class I - the mesiobuccal cusp of the maxillary first molar occluding in the mesiobuccal groove of the mandibular first molar; normal range for overjet at 3.0 to 3.5 mm and normal range for overbite at 0.5 to 3.5 mm. Children with crowding, midline deviation or transversal discrepancy were also excluded (Lauc, 2003).

Measurement of dental casts

The subjects were sitting in an upright position with the head in natural position for the impression takes. The points were marked on dental casts with pencil edge 0.3 mm and the linear distances were measured by digital caliper (Lauc, 2003) (Digimatic series 500, Mitutoyo, Japan) to the nearest 0.01 mm by one examiner (MCSM). The distance between the mesiolingual cusp tips of the first molars and cusp tips of the canines were measured (or the estimated location if wear facets were present). In addition, the linear distances between the inner lingual points on the gingival margin of the right and left first molars and canines were measured (cervical point).

Measurement of posteroanterior cephalograms

The cephalometric tracings were performed by the determination of points and linear distances on frontal radiographs, which were hand traced on acetate paper and measured using a digital caliper (Digimatic series 500, Mitutoyo, Japan) to the nearest 0.01 mm. The following measurements were recorded (Kecik *et al*., 2007; Ricketts, 1981): face width (ZA-AZ) - distance between the bilateral points to the center of the root of the zygomatic arch; mandibular width (GA-AG) - distance between right and left points at lateral inferior margin of antegonial protuberances; maxillary width (JR-JL) - distance between the jugal process at the intersection of outline of the maxillary tuberosity and zygomatic buttress; nasal width - distance between the inner cortical borders of the nasal cavity; maxillary and mandibular intermolar width - linear measurement between the most prominent lateral point on the buccal surface of the maxillary and mandibular first molars, respectively. The determination of points, landmarks and measurements were done by the same examiner (ASA).

Evaluation of masseter muscle thickness

The masseter muscle thickness was measured bilaterally by ultrasound examination (Just Vision Toshiba™, 56 mm/10 MHz linear transducer, Otawara, Japan), by the same examiner (MR). Briefly, children were seated in an upright position with their heads in natural position; recordings were performed with the muscle relaxed (at rest) and in maximal intercuspal position. The measurements were determined three times, directly on the screen (accuracy of 0.1 mm), and the values averaged. Images were taken on both sides (left and right) and the recording site was established by palpation, between the zygomatic arch and gonial angle. The transducer was placed perpendicular to the muscle fiber direction, using an air-tight inert gel on the skin surface, and moved gradually to obtain optimal visualization (Castelo *et al*., 2007).

Error of the method

The error of measurement (ME) for dental cast measurements and masseter ultrasonographic thickness evaluation was assessed by repeated measurements of 12 subjects (n), on two separate occasions (m1, m2), using the Dahlberg's formula: $S_e = \sqrt{\sum (m1 - m2)^2 / 2n}$. The results are shown in Table 1. The reproducibility of tracings and measurements performed on PA radiographs was assessed by correlation coefficients, which were repeated on 15 radiographs. All the coefficients obtained showed perfect reproducibility (r = 1.00).

Statistical analysis

Statistical analysis was performed using Sigma Stat (3.1 Sigma Stat Software Inc., Richmond, CA, USA) and BioEstat 5.0 (Mamirauá, Belém, PA, Brazil) with a 5% level of significance, and normality was assessed using the Shapiro-Wilk *W*-test.

A paired *t*-test was used to evaluate the difference in masseter muscle thickness between the sides (left/right). Unpaired *t*-test or Mann-Whitney test was used to analyze the differences in age, BMI, measurements of dental casts and craniofacial variables and masseter thickness between genders, were appropriate. Moreover, a multiple linear regression model with backward stepwise elimination was used to verify the relationship between *face width* (as the dependent variable) and age, gender, BMI, dental cast measurements, masseter thickness at rest and maximal intercuspation and posteroanterior cephalometric variables.

RESULTS

The characteristics of the sample according to age, BMI, measurements of dental casts, craniofacial variables and masseter thickness are shown in Tables 2 and 3. Masseter muscle thickness at rest and maximal intercuspal position did not differ significantly between the left and the right sides in both groups. Sexual dimorphism was tested for all studied variables. Only the variable *face width* showed significant difference between genders, being larger in boys (*P*=0.0012), when comparison was made with a *t*-test.

Because muscle thickness did not differ between right/left sides, it was decided to consider the average between the two in the multiple regression analysis. The results of the regression analysis (Table 4) showed that *face width* positively and significantly correlated with BMI, masseter thickness, first mandibular molar distances (between cusps), maxillary canine distances (between cervical points), and maxillary intermolar width; and negatively with first maxillary (cusps) and mandibular molar distances (cervical points) and mandibular canine distances (cusps). However, the explanatory variable ***gender*** did not reach a significant value**.** The model used explained almost 55% of *face width* variability, considering the sample size (coefficient of determination $R^2 = 0.547$), with a power of 1.00.

DISCUSSION

The dental, skeletal and muscle evaluation may contribute to the study of the relationship between form and function of the structures that comprise the stomatognathic system, and also provide the establishment of an appropriate treatment plan. According to Sato *et al*. (1996), posteroanterior analysis provides an assessment of transverse dimensions of the face, making it possible to obtain a broader vision for the diagnosis of changes. Moreover, dental casts have frequently been used in diagnosis, planning and evaluation of established treatment (Hayashi *et al*., 2003; OkTay and Kilic, 2007). The use of both intercanine distance between cusp tips and between cervical points is justified because the latter distance is more reliable and less susceptible to tooth inclination. However the use of ultrasound in scientific research provides reproducible and easy access to the masticatory muscles thickness, obtaining quantitative information on functional ability and determination of structural changes (Castelo *et al*., 2007), without the subject's exposure to radiation.

In the present study, there were no significant differences in dental cast measurements between genders. In adolescents and young adults, previous studies have also found no differences in dental arch measurements between men and women (Kiliaridis *et al*., 2003; Tibana *et al*., 2004). However, in a large sample of children with primary dentition, boys were shown to have larger dental arches than girls, and this difference was high and statistically significant (Azinar *et al*., 2006). Moreover, the study of Arslan *et al*. (2007)

observed sexual dimorphism in arch dimensions in the mixed dentition stage; but after a longitudinal observation until permanent dentition, they observed no sexual dimorphism in dimensional changes.

In addition, there were no significant difference in masseter thickness between boys and girls. However, Kiliaridis *et al*. (2003), who included older subjects aged 7-18 years in their study, observed direct and significant association between masseter thickness and age and gender; that is, the masseter muscle was thicker in older individuals and in males. Similar results were observed by Rani and Ravi (2010) whose study reported that groups of males with skeletal Class I and skeletal Class II had thicker masseter muscles in comparison with females. However, it should be noted that individuals who comprised the present study were children aged up to 10 years, i.e. before the pubertal growth phase, which is believed to be the period of greatest muscle development, especially among boys (Raadsheer *et al*., 1996). Moreover, masseter muscle thickness did not differ significantly between the left and the right sides in both groups, which was expected since the studied sample included only children with normal occlusion (Castelo *et al*., 2007).

When considering the craniofacial morphology, there is a consensus in the literature that in a normal population male subjects have larger skeletal, cranial and facial dimensions than female subjects (Bishara *et al*., 1996). These differences may also manifest in the dimensions of the jaws and their relations among them (Jamison *et al*., 1982). When data for *face width* were compared between boys and girls using the comparison of means, the present study showed that *face width* was larger in boys than in girls in young subjects with mixed dentition. This finding corroborates studies in young children, in which the authors observed that sexual differences in craniofacial morphology become significant after eight years of age (Oueis *et al*., 2002; Slaj *et al*., 2005; Kamegai *et al*., 2005). The other craniofacial measurements, maxillary, mandibular and nasal widths, did not differ significantly between genders.

But when the relationship between *face width* and the various dental, craniofacial and masseter muscles variables was evaluated, the results showed that *face width* was positively correlated with BMI, masseter thickness, first mandibular molars distance (between cusps), maxillary canines distance (between cervical points) and maxillary intermolar width, but not significantly with gender. As previously observed by Kiliaridis *et al*. (2003) wider maxillary arch followed larger masseter muscle thickness in young females, which suggests that the thickness of masseter muscle should be considered as one of the factors affecting facial morphology. Significant correlation between masseter muscle thickness and craniofacial morphology was also reported by the study of Rani and Ravi (2010). The mentioned study reported a significant negative correlation between muscle thickness in the contracted state and mandibular plane angle, i.e., individuals with thicker masseter had a shorter vertical facial pattern. According to the statistical analysis used and corroborating those previous studies, *face width* was closely related to BMI, dental arch morphology and to the attached muscle, but not to the explanatory gender.

Face width related negatively with first mandibular molar distances (between cervical points) and mandibular canine distances (between cusps), showing that the width of the face obtained from PA cephalograms follows the maxillary width, and was negatively related with mandibular width. Furthermore, *face width* was negatively related with first maxillary molar distances (between cusps), but this contradictory result may be due to a possible palatal inclination of these teeth, since the measurement obtained between cusps is less reliable than that taken between cervical points.

Evaluation of the structures that comprise the stomatognathic system may contribute to the study of their relationship, the impact on occlusal and dental health, and also provide the establishment of an appropriate treatment plan in young subjects (Mariúba *et al*., 2011). The inclusion and exclusion criteria limited the sample size, being the limitation of this study. Thus, further studies are required to investigate the relationship between dental, muscular and craniofacial characteristics in young subjects in a larger sample.

CONCLUSIONS

In the studied sample, the width of the face was significantly correlated with BMI, masseter thickness, first molar and canine distances and maxillary intermolar width; but *gender* did not contribute significantly to *face width* variation.

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Table 1. Values obtained for the measurement error (ME) analysis of dental cast measurements and masseter ultrasonographic thickness of 12 subjects assessed by repeated measurements on two separate occasions.

ME	1st maxillary molars width		1st mandibular molars width		Masseter thickness	
	cusp-cusp	**cerv-cerv**	**cusp-cusp**	**cerv-cerv**	**MRE**	**MMI**
Mm	0.30	0.36	1.23	0.11	0.35	0.31

cusp, cusp; cerv, cervical point; MRE, masseter thickness at rest; MMI, masseter thickness at maximal intercuspal position.

Table 2. Mean (±SD) for age, body mass index and measurements of dental casts for both groups.

Gender	Age (months)	BMI (Kg/m²)	Maxillary canines distance		Mandibular canines distance		1st maxillary molars distance		1st mandibular molars distance	
			cusp-cusp	**cerv-cerv**	**cusp-cusp**	**cerv-cerv**	**cusp-cusp**	**cerv-cerv**	**cusp-cusp**	**cerv-cerv**
Female	101.00 (±12.74)	18.46 (±3.12)	33.46 (±1.57)	26.20 (±1.44)	26.71 (±1.65)	21.30 (±1.82)	41.67 (±1.84)	34.35 (±1.39)	36.39 (±2.72)	33.68 (±2.59)
Male	100.39 (±14.43)	17.03 (±2.21)	33.64 (±1.62)	26.38 (±1.68)	26.29 (±1.37)	20.93 (±1.43)	41.44 (±2.12)	33.89 (±2.07)	35.77 (±1.46)	32.8 (±1.33)

P>.05 (*t* test or Mann Whitney Rank Sum test)
BMI, body mass index; cusp, cusp; cerv, cervical point.

Table 3. Mean (±SD) for the thickness of the masseter muscle and craniofacial measurements on posteroanterior cephalograms for both groups.

Gender	**MRE**	**MMI**	**AZ-ZA (mm)**	**AG-GA (mm)**	**JL-JR (mm)**	**Nasal width**	**Maxillary intermolar width**	**Mandibular intermolar width**
Female	15.21 (±1.21)	18.11 (±1.80)	113.53*** (±5.44)	76.60 (±3.90)	58.78 (±3.48)	25.77 (±1.36)	55.54 (±3.95)	54.99 (±4.39)
Male	15.59 (±2.55)	18.03 (±2.50)	121.48*** (±6.73)	77.12 (±4.28)	58.72 (±3.40)	26.14 (±1.87)	57.42 (±2.96)	55.24 (±2.12)

***P<0.001 (*t* test; t=-3.598; 30 degrees freedom; CI = -12.464 to -3.438; power = 0.93).

MRE, masseter thickness at rest; MMI, masseter thickness at maximal intercuspal position; AZ-ZA, face width; AG-GA, mandibular width; JL-JR, maxillary width.

Table 4. Multiple linear regression model with backward stepwise elimination used to verify the relationship between *face width* (as the dependent variable) and BMI, age, dental cast measurements, masseter thickness at rest and maximal intercuspation and posteroanterior cephalometric variables, controlling for gender (those variables eliminated from the model are not shown).

Dependent variable	**Independents variables**	**Coeff**	***P*-value**	**Significance of the model**		
				R^2 adjusted	***P*-value**	**Power of the test**
Face width (AZ-ZA)	Constant	-21.282	-	0.547	0.001	1.000
	BMI	169.232	0.001			
	1st Maxillary molars distance (cusps)	-3.338	0.004			
	1st Mandibular molars distance (cusps)	6.159	0.023			
	1st Mandibular molars distance (cervical points)	-20.672	0.004			
	Maxillary canines distance (cervical points)	3.465	0.003			
	Mandibular canines distance (cusps)	-3.757	0.002			
	MMI	9.761	0.004			
	Maxillary intermolar width	1.218	0.009			
	Gender	4.837	0.179			

BMI, body mass index; MMI, masseter thickness at maximal intercuspal position.

CONCLUSÕES GERAIS

Os resultados encontrados nos estudos realizados permitem-nos concluir que:

- A performance mastigatória mostrou-se significativamente diferente entre fases das dentições avaliadas;
- Os escores de disfunção orofacial (NOT-S) não mostraram diferença entre as fases das dentições;
- A idade, índice de massa corporal, força de mordida e presença de bruxismo do sono relacionaram-se significativamente com uma melhor performance mastigatória;
- A presença de selamento labial e o aumento de trespasse vertical relacionaram-se com menores escores totais do NOT-S, enquanto a idade e a presença de bruxismo exacerbaram os escores de disfunção orofacial;
- Fraca correlação foi observada entre escores de disfunção orofacial e as dimensões craniofaciais relacionadas com uma tendência ao padrão facial hiperdivergente;
- O índice de massa corporal, espessura do músculo masseter, distância intermolares inferiores e intercaninos superiores e largura intermolar maxilar foram as variáveis significativamente relacionadas com a largura facial, enquanto o gênero não alcançou nível significativo em crianças na fase de dentição mista.

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APÊNDICES

APÊNDICE 1

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

As informações que possui este documento o convidam a autorizar, por escrito, a participação do menor ____, com o conhecimento dos procedimentos e riscos pelos quais o menor passará, por vontade própria e sem qualquer intimidação.

1. **Título do trabalho experimental**

"Avaliação das disfunções orofaciais e temporomandibulares, parâmetros mastigatórios e níveis salivares de cortisol e alfa-amilase em crianças e adolescentes".

2. **Responsáveis pela pesquisa**

Profa. Dra. Maria Beatriz D. Gavião (responsável), Profa. Dra. Paula Midori Castelo (co-orientadora dos trabalhos), Maria Carolina Salomé Marquezin e Fernanda Yukie Kobayashi (apresentadoras deste termo) do Depto. de Odontologia Infantil da Faculdade de Odontologia de Piracicaba – UNICAMP.

3. Objetivos

O objetivo deste estudo será avaliar a presença de sinais e sintomas de disfunção temporomandibular e orofacial (alterações musculares, dores na articulação da mandíbula, dificuldades de fala e deglutição) e sua relação com alterações na mastigação em crianças e adolescentes. Além disso, hormônios do estresse presentes na saliva serão verificados.

4. Justificativa

Estudos sugerem que a prevalência de sinais e sintomas de dor e disfunção da articulação temporomandibular (da mandíbula) pode ser relevante e muitas vezes é desconhecida pelos pais e ignorada pelos profissionais de saúde. Daí a importância da avaliação das funções orais (comer, falar, engolir) e de alterações que possam vir a ocorrer.

5. Procedimentos do experimento

Todos os procedimentos da pesquisa serão realizados pelas mesmas pesquisadoras: Maria Carolina Salomé Marquezin e Fernanda Yukie Kobayashi. Seleção da amostra – serão selecionadas 300 crianças e adolescentes de ambos os sexos, do ensino fundamental e médio, junto ao Departamento de Odontologia Infantil e Clínica de Graduação em Odontologia da Faculdade de Odontologia de Piracicaba, após a devida concordância da criança em participar da pesquisa e autorizada pelo responsável), de acordo com os seguintes procedimentos:

Anamnese – por meio de entrevista com o responsável pela criança, serão verificados o histórico pré-natal, natal e pós-natal, histórico dentário, hábitos de sucção (dedos, chupeta, lábios), ranger dos dentes, tipo e tempo de aleitamento e uso de medicamentos.

Exame clínico intrabucal e extrabucal – o material utilizado será o de uso rotineiro da clínica (pinça, sonda exploradora e espelho bucal), além de equipamentos de proteção individual das Dentistas (gorro, máscara, jaleco e luvas). Serão verificadas as condições dos lábios, gengiva, língua, palato, freios labial e lingual, número de dentes e oclusão dentária. Além disso, serão realizadas as medições de peso e altura corporais.

Avaliação das disfunções orofaciais – cada criança será avaliada por meio de um exame físico e questionário seguindo um roteiro específico, verificando-se alterações de fala, deglutição, sucção de dedo ou chupeta, etc.

Avaliação das disfunções temporomandibulares - Os sinais e sintomas de disfunções temporomandibulares (presença de dores ou alterações nos movimentos da mandíbula) serão avaliados por meio de exame clínico e questionário específico.
Avaliação cefalométrica em norma lateral e frontal - Serão realizadas radiografias da cabeça laterais e frontais nas crianças que apresentarem disfunção (alterações) orofacial e/ou temporomandibular como forma de se pesquisar alterações em suas estruturas que já possam estar presentes.
Performance Mastigatória – a capacidade mastigatória de cada criança será verificada pela mastigação de um alimento teste artificial chamado *Optocal plus*, sob supervisão, confeccionado com materail não-tóxico e que não será deglutido (engolido) e, sim, será eliminado, cuspindo em uma peneira para posterior avaliação.
Avaliação da máxima força de mordida - A máxima força de mordida será medida por meio de um aparelho (gnatodinamômetro digital) adaptado para as condições orais de indivíduos jovens; a criança será treinada a mordê-lo com força máxima. Trata-se de técnica indolor, que não provoca nenhum dano físico a criança.

Coleta salivar – A saliva será coletada em casa, pelo pai/mãe/cuidador, por meio de algodão, em dois dias separados, como será explicado posteriormente.

6. Possibilidade de inclusão em grupo controle/placebo

Todas as crianças serão avaliadas e receberão os mesmos procedimentos diagnósticos e de tratamento; portanto, não haverá grupo placebo.

7. Métodos alternativos de diagnóstico ou tratamento da condição

Os métodos conhecidos e já estudados de diagnóstico serão utilizados na pesquisa. Não será objetivo da pesquisa o tratamento da condição (presença de alterações articulares, de fala, deglutição), mas será garantido à criança e ao responsável o esclarecimento sobre sua condição, os riscos à sua integridade física e o encaminhamento para tratamento especializado.

8. Riscos previsíveis

Os procedimentos realizados não oferecem riscos, pois os exames clínicos intra e extra-bucal seguem os passos da rotina clínica, utilizando-se instrumental e material adequados e esterilizados. Os exames de performance mastigatória e de quantificação salivar de hormônios serão realizados sob a supervisão da pesquisadora; os mesmos constituem técnicas indolores, não-invasivas, que não oferecem riscos à criança, pois utilizam materiais que não são perigosos a vida e seguem as regras de assepsia e limpeza preconizadas pela Faculdade de Odontologia de Piracicaba – UNICAMP.

9. Benefícios e vantagens

O tratamento preventivo e/ou curativo (orientações de higiene bucal, profilaxia/"limpeza", aplicação tópica de flúor, tratamento de cárie) necessário estará assegurado à criança, seja realizado pela Cirurgiã Dentista responsável (aluna de pós-graduação em Odontopediatria ou Graduação em Odontologia), ou pelas próprias pesquisadoras, no caso da criança ainda não estar em atendimento na clínica. No caso de presença e/ou persistência de hábitos parafuncionais (sucção de chupeta ou de dedo) e alterações de fala ou deglutição, os responsáveis receberão os devidos esclarecimentos para que procurem orientação fonoaudiológica na rede particular ou pública de atendimento. Na presença de maloclusão (problemas ortodônticos e necessidade de uso de aparelho ortodôntico), bruxismo ou alterações nas funções mastigatórias, os responsáveis serão alertados, bem como a Cirurgiã Dentista responsável para que procurem tratamento especializado na rede particular ou pública, uma vez que tais procedimentos não podem ser ofertados pelas pesquisadoras que ainda não têm essa formação.

10. Acompanhamento e assistência ao sujeito

O responsável pelo sujeito tem a garantia de ser esclarecido sobre a condição da criança, que deverá receber assistência e acompanhamento odontológicos preventivos e/ou curativos adequados pela Cirurgiã Dentista responsável pela criança ou pelas pesquisadoras, dentro de suas atribuições, durante o período de duração da pesquisa, bem como, se necessário, os esclarecimentos para que procure atendimento por profissionais de outras áreas de saúde, como psicólogos, fonoaudiólogos, etc.

11. Garantia de esclarecimentos

O responsável pelo menor tem a garantia de que receberá respostas a qualquer pergunta ou referente aos procedimentos, riscos e benefícios empregados neste documento e outros relacionados à pesquisa, em qualquer momento.

12. Garantia de ressarcimento/indenização/reparação de dano

Não há previsão de ressarcimento ou indenização por dano, pois a participação na pesquisa não trará riscos a sua saúde e integridade. Caso sessões complementares forem necessárias para obtenção de dados, os gastos de transporte e alimentação serão de responsabilidade dos pesquisadores.

13. Garantia de sigilo

Haverá sigilo e anonimato quanto aos dados confidenciais obtidos.

14. Retirada do consentimento

O responsável pelo menor tem a liberdade de retirar seu consentimento a qualquer momento e deixar de participar do estudo, sem qualquer prejuízo ao atendimento odontológico a que a criança esteja sendo ou será submetida na Clínica de Especialização em Odontopediatria ou Clínica de Graduação em Odontologia desta Faculdade.

15. Garantia de entrega de cópia

Este termo de consentimento compõe-se de duas cópias idênticas, sendo uma entregue ao responsável pelo menor e outra que será arquivada pelo Departamento.

16. Consentimento pós-informação

Eu,____, responsável pelo menor ____, certifico que lias informações acima, fui suficientemente esclarecido (a) de todos os itens e estou plenamente de acordo com a realização do experimento e autorizo a execução do trabalho de pesquisa exposto.

Piracicaba, ______ de ______________________ de __________.

Nome (legível): ____

RG: ______________________________ CPF: _________________________________

Endereço: ____ tel: __________________

Assinatura: ____

____

Assinatura e identificação do pesquisador

Atenção: A sua participação em qualquer tipo de pesquisa é voluntária. Em caso de dúvida quanto aos seus direitos, escreva para o Comitê de Ética em Pesquisa da FOP-UNICAMP. Endereço: Av. Limeira, 901 – Piracicaba – SP – CEP 13414-900 ou pelo telefone: 19 - 21065349. Email cep@fop.unicamp.br – Website www.fop.unicamp.br/cep

Para contato com os pesquisadores: E-mails: mariacarol_bariri@hotmail.com e fernandaykobayashi@gmail.com. Telefone para contato: Fernanda Yukie Kobayashi (11) 7371-1555, Maria Carolina Salomé Marquezin (14) 8134-4933. Endereço postal: Setor de Odontopediatria – FOP, Av Limeira 901, Piracicaba – SP, CEP 13414-903.

APÊNDICE 2

IOTN - Index of Orthodontic Treatment Need

COMPONENTE DENTÁRIO

Avaliado por meio da utilização de uma régua específica, o mesmo é dividido em cinco pontuações ou escores, cada um correspondendo a uma das categorias abaixo relacionadas:

Escore 1: nenhuma necessidade de tratamento;

Escore 2: pequena necessidade;

Escore 3: necessidade moderada;

Escore 4: necessidade extremamente grande.

Categoria 5 (extrema necessidade)

5.i impedimento da erupção dos dentes (exceto o terceiro molar) devido a aglomeração, deslocamento, presença de número extrade dentes da primeira dentição e alguma causa patológica.

5.h hipodontia excessiva com implicações restaurativas (mais de um dente por quadrante) requerendo ortodontia pré-protética.

5.a aumento da superposição para acima de 9 mm.

5.m superposição reversa maior que 3,5 mm, com relatos de dificuldade de mastigação e fala

5.p fendas labiais e palatais e outras anormalidades craniofaciais.

5.s primeira dentição inclusa

Categoria 4 (grave necessidade)

4.h hipodontia menos extensa, necessitando de ortodontia pré-restauradora ou ortodôntica para fechamento de espaço (um dente por quadrante).

4.a aumento da superposição para acima de 6 mm, mas menor ou igual a 9 mm.

4.b superposição reversa maior do que 3,5 mm sem nenhuma dificuldade de mastigação ou fala.

4.m superposição reversa maior que 1mm mas menor que 3,5mm, com dificuldade de mastigação e fala.

4.c mordidas cruzadas anterior e posterior com uma discrepância maior que 2mm entre as posições de contato retroverso e a intercúspides.

4.l mordida cruzada lingual posterior sem nenhum contato oclusal funcional em um ou ambos os segmentos bucais.

4.d deslocamentos graves no ponto de contato maiores do que 4mm.

4.e mordidas abertas extremas anterior e posterior maiores do que 4mm

4.f sobremordida completa e aumentada com o trauma gengival ou palatal

4.t dentes parcialmente erupcionados, inclina dos e impactados contra os adjacentes.

4.x presença de número excedente de dentes.

Categoria 3 (moderada necessidade)

3.a aumento da superposição para acima de 3,5mm, mas menor ou igual a 6mm, sem selamento labial.

3.b superposição reversa maior do que 1mm, mas menor ou igual a 3,5mm.

3.c mordidas cruzadas anterior e posterior com discrepância maior do que 1mm, mas menor ou igual a 2mm entre a posição de contato retroverso e a posição intercúspides.

3.d deslocamento no ponto de contato maiores do que 2mm, mas menores ou iguais a 4mm.

3.e mordida aberta lateral e anterior maior do que 2mm, mas menor ou igual a 4mm.

3.f sobremordida completa e profunda nos tecidos gengivas e palatais, mas sem trauma.

Categoria 2 (leve/pequena necessidade)

2.a superposição aumentada acima de 3,5mm, mas menor ou igual a 6mm, com selamento labial.

2.b superposição reversa maior do que 0 mm, mas menor ou igual a 1 mm.

2.c mordida cruzada anterior e posterior com discrepância menor ou igual a 1mm entre a posição de contato retroverso e a intercúspides.

2.d deslocamento do ponto de contato maior do que 1mm, mas menor ou igual a 2mm.

2.e mordida aberta anterior ou posterior maior do que 1mm, mas menor ou igual a 2mm..

2.f aumento da sobremordida maior ou igual a 3,5mm, sem contato gengival.

2.g oclusões pré-normais oi pós-normais sem nenhuma outra anomalia.

Categoria 1 (nenhuma necessidade)

1. más-oclusões extremamente pequenas, com deslocamento do ponto de contato menor do que 1 mm.

APÊNDICE 3

Nordic Orofacial Test - Screening NOT-S

O NOT-S foi desenvolvido por Merete Bakke, Copenhagen; Birgitta Bergendal, Jönköping; Anita McAllister, Linköping; Lotta Sjögreen, Göteborg; and Pamela Åsten, Oslo; com a ajuda da Associação Nórdica de Disfunção e Saúde Oral, NFC.

Esta avaliação está disponibilizada no site **www.mun-h-center.se.**

Deve ser utilizado com o manual ilustrado que pode ser pedido através da loja virtual ou do telefone **+46 31 750 92 00.**

NORDIC OROFACIAL TEST NOT-S – EXAME

O NOT-S é usado quando um paciente tem dificuldade para falar, mastigar ou engolir.

A seção de anamnese é conduzida como uma entrevista estruturada. O examinador faz a pergunta, explica, e faz perguntas adicionais quando necessário, interpreta a resposta e preenche o questionário.

A entrevista do NOT-S contém seis seções: Função Sensorial, Respiração, Hábitos, Mastigação e Deglutição, Salivação e Secura da Boca (I-VI).

O exame do NOT-S contém seis seções: Face em Repouso, Respiração Nasal, Expressão Facial, Músculos Mastigatórios e Função Mandibular, Função motora oral e Fala (1-6).

O manual ilustrado deve ser utilizado durante o exame.

País ___________________________

	Fonoaudiólogo	Dentista	Médico	Fisioterapeuta	Outros	
Examinador	☐	☐	☐	☐	☐	_______________

Data do exame ____/____/________

Data de nascimento ____/____/________ ♀ ☐ ♂ ☐

Nome:____

Primeiro Diagnóstico Médico (especificar somente um):

____

Código de diagnóstico (ICD-10):

____

Posição durante o exame ☐ Sentado ☐ Deitado

Posição da cabeça quando sentado ☐ Normal (reta e vertical) ☐ Outra

Respostas com ajuda de outra pessoa ☐

<u>CÓDIGO PARA AVALIAÇÃO:</u> O ESCORE TOTAL DO NOT-S PODE VARIAR DE 0 A 12	X = SIM 0 = NÃO ---- = NÃO AVALIADO	SE EM UMA SEÇÃO HOUVER UMA OU MAIS RESPOSTAS X, COLOQUE O ESCORE 1 NA CAIXA DA COLUNA À DIREITA

NOT-S	ESCORE TOTAL ☐ ☐

		Pontuação
I	**Função Sensorial** **A**- Escovar seus dentes faz você ter ânsia de vômito? ☐ Isso acontece muitas vezes? .... Desconforto óbvio como enjôo, vômito, ou refluxo – aumento de sensibilidade. **B**- Você coloca tanta comida na boca que fica difícil de mastigar? ☐ Isso acontece todo dia? .... Não consegue perceber quando a boca está cheia – diminuição da sensibilidade.	☐
II	**Respiração** **A**- Você respira normalmente ou usa algum suporte para respirar? ☐ CPAP, Oxigênio, respirador, outros. **B**- Você ronca muito quando dorme? Isso acontece toda noite? .... ☐ Ronco ou apnéia; não se aplica a sintomas de asma ou alergias.	☐
III	**Hábitos** ☐ **A**- Você roe as unhas, ou chupa os dedos ou outros objetos todos os dias? Hábito de sucção de chupeta e dedos não é avaliado abaixo dos 5 anos. ☐ **B**- Você chupa ou morde seus lábios, língua ou bochechas todos os dias? **C**- Você aperta forte seus dentes ou os range durante o dia? ☐	☐
IV	**Mastigação e Deglutição** ☐ **A**- Não come com a boca .... Tubo nasogástrico, gastrostomia, outros – pular perguntas B-E ☐ **B**- Você acha difícil comer alimentos com certa consistência (mais duros)? Excluir alergias e dietas especiais como vegetarianismo e intolerância ao glúten ☐ **C**- Você demora mais do que 30 minutos para comer uma refeição completa? ☐ **D**- Você engole grandes pedaços sem mastigar? .... ☐ **E**- Você costuma tossir durante as refeições? .... ☐ Acontece em quase todas as refeições.	☐
V	**Salivação** **A** - Você fica com saliva no canto da boca ou escorre saliva para o queixo todos os dias? ☐ Tem que limpar a boca, não se aplica enquanto dorme.	☐
VI	**Secura da boca** **A**- Você precisa beber algum tipo de líquido para conseguir comer uma torrada? ☐ **B**- Você sente dor na mucosa (pele) da boca ou na língua? .... ☐ Dor recorrente ou sensação de formigamento pelo menos uma vez na semana; não se aplica a dor de dente ou vesículas (lesões bolhosas) na boca.	☐
Nome:	ENTREVISTA NOT-S	Soma:

		Pontuação
1	**Face em repouso** **Observe a figura por um minuto, começando agora.** Observação de um minuto. Avalie A-D Figura 1 **A**- Assimetria .... ☐ (considerar tanto osso quanto tecidos moles) **B**- Desvio da posição dos lábios .... ☐ (boca aberta ou outros desvios em mais de 2/3 do tempo) **C**-Desvio da posição da língua .... ☐ (ponta da língua visivelmente entre os dentes em mais de 2/3 do tempo) **D**- Movimentos involuntários .... ☐ (repetidos movimentos involuntários da face)	☐
2	**Respiração nasal** ☐ Figura 2 **A**- Feche a boca e faça 5 profundas inspirações pelo nariz (cheire) Não consegue fazer 5 inspirações sucessivas pelo nariz. Se o paciente não consegue fechar os lábios, o paciente ou o examinador pode, manualmente ajudar a manter os lábios fechados. Não avaliar se o paciente estiver resfriado.	☐
3	**Expressão facial** Figura 3 **A**- Feche os olhos bem forte .... ☐ Os músculos faciais não estão ativados, esteticamente, em simetria. Figura 4 **B**- Mostre seus dentes .... ☐ Os lábios e os músculos faciais não são simetricamente ativados então os dentes são facilmente visíveis. Figura 5 **C**- Tente assobiar/soprar .... ☐ Não consegue fazer biquinho com os lábios simetricamente.	☐
4	**Músculos mastigatórios e função mandibular** Figura 6 **A**- Morda forte com seus dentes do fundo .... ☐ Não se pode registrar atividade simétrica quando dois dedos ficam pressionando os músculos mandibulares (m. masseter dos dois lados). Figura 7 **B**- Abra a boca o máximo que conseguir .... ☐ Não consegue abrir a boca numa distância correspondente à largura do dedo indicador e do dedo do meio da mão esquerda do paciente. Se os dentes anteriores estiverem ausentes, use a largura de três dedos (indicador, dedo do meio e anelar) como medida.	☐
5	**Função motora oral** Figura 8 **A**- Ponha sua língua para fora o quanto puder .... ☐ Não consegue alcançar a borda do vermelhão dos lábios com a ponta da língua. Figura 9 **B**- Lamba os seus lábios .... ☐ Não consegue usar a ponta da língua para molhar os lábios e não consegue alcançar os cantos da boca. Figura 10 **C**- Encha sua boca de ar e segure por pelo menos 3 segundos ... ☐ Não consegue encher a boca de ar sem vazamento de ar ou sem fazer barulhos. Figura 11 **D**- Abra a boca bem grande e diga ah-ah-ah! .... ☐ Não se nota elevação da úvula e o palato mole é observado.	☐

<table>
<tr><td>6</td><td colspan="2">Fala</td><td></td><td></td></tr>
<tr><td></td><td></td><td>A- Não fala ....
Pular perguntas B-C.</td><td>☐</td><td></td></tr>
<tr><td></td><td>Figura 12</td><td>B- Conte alto até 10 ....
A fala não é clara com um ou mais sons indistinguíveis ou nasalidade anormal.
Abaixo de 5 anos de idade exclua sons de R, S da avaliação.</td><td>☐</td><td></td></tr>
<tr><td></td><td>Figura 13</td><td>C- Diga PATAKA, PATAKA, PATAKA ....
Não avalie este item em crianças menores de 5 anos de idade.</td><td>☐</td><td>☐</td></tr>
<tr><td colspan="2">Nome:</td><td><u>EXAME NOT-S</u></td><td colspan="2">Soma:</td></tr>
</table>

ANEXOS

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 **"Avaliação das disfunções orofaciais e temporomandibulares, parâmetros mastigatórios e níveis salivares de cortisol e alfa-amilase em crianças e adolescentes"**, protocolo nº 004/2010, dos pesquisadores Maria Beatriz Duarte Gavião, Fernanda Yukie Kobayashi, Maria Carolina Salomé Marquezin 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 31/03/2010.

The Ethics Committee in Research of the School of Dentistry of Piracicaba - State University of Campinas, certify that the project **"Orofacial and temporomandibular dysfunction evaluation, masticatory parameters and salivary cortisol and amylase levels in children and adolescents"**, register number 004/2010, of Maria Beatriz Duarte Gavião, Fernanda Yukie Kobayashi, Maria Carolina Salomé Marquezin 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 03/31/2010.

Prof. Dr. Pablo Agustin Vargas
Secretário
CEP/FOP/UNICAMP

Prof. Dr. Jacks Jorge Junior
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 2

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.

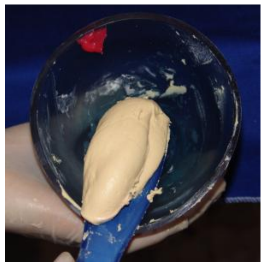
Profa. Cínthia Pereira Machado Tabchoury
Secretária
CEP/FOP/UNICAMP

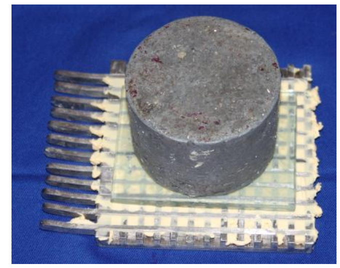
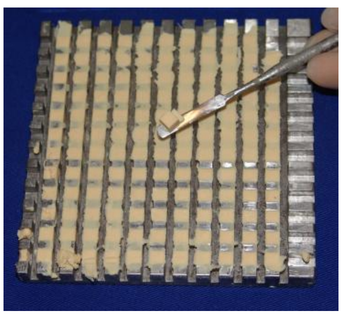
Prof. Jacks Jorge Júnior
Coordenador
CEP/FOP/UNICAMP

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.

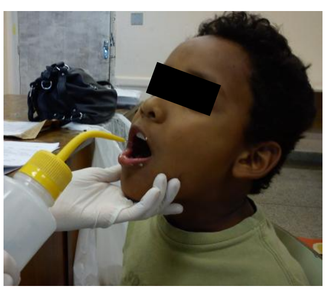
ANEXO 3

Performance Mastigatória







ANEXO 4

Nordic Orofacial Test NOT-S – Exame