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Orientador: Prof. Dr. Fausto Bérzin

Banca Examinadora:
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Profa. Dra. Anamaria Toniolo da Silva
Prof. Dr. Dirceu Costa
Prof. Dr. Fausto Bérzin.
Profa. Dra. Maria Beatriz B. de Araújo Magnani

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A Comissão Julgadora dos trabalhos de Defesa de Tese de DOUTORADO, em sessão pública realizada em 11 de Novembro de 2005, considerou a candidata ELIANE CASTILHOS RODRIGUES CORRÊA aprovada.

PROF. DR. FAUSTO BERZIN

PROFa. DRa. ANA MARIA TONIOLO DA SILVA

PROF. DR. DIRCEU COSTA

PROFa. DRa. MARIA BEATRIZ BORGES DE ARAUJO MAGNANI

PROFa. DRa. AMÉLIA PASQUAL MARQUES

Dedico este trabalho ao meu
amado filho FELIPE,
pelo grande tesouro que ele
representa na minha vida
e, para que ele busque cada
vez mais o seu
aperfeiçoamento,
sempre depositando muito
amor nas suas ações.

"Quando amamos, sempre desejamos ser melhor do que somos.
Quando buscamos ser melhor do que somos, tudo em volta se torna melhor também."
Paulo Coelho

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Não queiras ter Pátria.
Não dividas a Terra.
Não dividas o Céu.
Não arranques pedaços ao mar.
Não queiras ter.
Nasce bem alto.
Que as coisas todas serão tuas.
Que alcançarás todos os horizontes.
Que o teu olhar; estando em toda parte
Te ponha em tudo,
Como Deus.

Cecília Meireles.

SUMÁRIO

LISTA DE ABREVIATURAS

SRB – Síndrome do Respirador Bucal

MBS – Mouth Breathing Syndrome

EMG – Electromyography/Eletromiografia

sEMG – Surface Electromyography

PTI – Physical Therapy Intervention

CPA –Computerized Photographic Analysis

SCM – Sternocleidomastoid

SOC – Sub-occipital

UT – Upper Trapezius

CMRR – Common Mode Rejection Ratio

RMS – Root Mean Square

C7- Sétima vertebra cervical

FHP – Forward Head Posture

MVC – Maximal Voluntary Contraction

COPD – Chronic Obstructive Pulmonary Disease

TMD – Temporomandibular Disorder

GDS – Godelieve Denys-Struyf

PIMax – Pressão Inspiratória Máxima

ECM – Esternocleidomastóideo

M – Músculo

MMSS – Membros Superiores

MMII – Membros Inferiores

RESUMO

A Síndrome da Respiração Bucal (SRB) tem como principais causas malformações craniofaciais, obstrução nasal ou faríngea por rinite alérgica e hipertrofia de adenóides e, hábitos deletérios. A respiração bucal produz adaptações compensatórias da postura corporal, especialmente na postura da cabeça. Por isso, recomenda-se uma abordagem interdisciplinar no tratamento da SRB, não apenas considerando a dentição, esqueleto facial e postura da cabeça, mas também toda a postura corporal. Tratamentos ortodôntico, cirúrgico, medicamentoso e fonoaudiológico têm sido empregados na SRB, porém estes não contemplam diretamente os problemas posturais e ventilatórios decorrentes da obstrução nasal. A fisioterapia, nestes casos, visa restabelecer o alinhamento postural e o equilíbrio muscular, favorecendo também a mecânica muscular diafragmática e a capacidade ventilatória. Este estudo propôs-se a avaliar a eficácia de um programa de intervenção fisioterapêutica sobre os músculos cervicais e postura corporal em crianças respiradoras bucais. Foram realizados exercícios de alongamento e fortalecimento muscular em Bola Suíça combinados com reeducação naso-diafragmática, num período de 3 meses (24 sessões). Dezenove crianças respiradoras bucais, com idade média de 10,6 anos e diagnóstico de obstrução nasal confirmado por exames endoscópicos, participaram do estudo. Para verificar-se a eficácia desta intervenção foram utilizadas as avaliações eletromiográfica e fotográfica computadorizada, antes e após o tratamento. Os sinais eletromiográficos foram coletados nos músculos esternocleidomastóideo, sub-occipitais e trapézio superior durante posição de repouso, alinhamento postural, inspiração nasal e contração isométrica. A análise fotográfica computadorizada permitiu a mensuração de múltiplos ângulos e a quantificação dos resultados do tratamento sobre a postura corporal. Houve redução significativa da atividade eletromiográfica dos músculos avaliados com a fisioterapia. O tratamento também obteve resultados positivos na correção da posição anteriorizada da cabeça e abdução escapular, demonstrados na análise fotográfica computadorizada. Os métodos adotados para avaliação da eficácia da fisioterapia mostraram-se seguros e confiáveis, quando utilizados com devidos cuidados e instrumentações adequadas, evidenciando que esta intervenção mostrou-se efetiva na melhora do equilíbrio muscular e do padrão postural de crianças respiradoras bucais.

ABSTRACT

The Mouth Breathing Syndrome (MBS) has as main causes the craniofacial malformations, nasal or pharyngeal obstruction and, deleterious habits. The mouth breathing produces compensatory postural adaptation, especially on the head posture. Therefore, an interdisciplinary approach for the MBS has been recommended, not only considering the dentition, facial skeleton and head postures, but the whole body posture. Orthodontic, surgical, clinical treatments and speech therapy has been utilized in the MBS, however they do not addressed directly the postural and ventilatory problems resulted from nasal obstruction. Physical therapy, in these cases, seeks to reestablish the postural alignment and muscular balance, favoring the diaphragmatic muscular mechanics and the ventilatory capacity as well. This study proposed to evaluate the efficacy of a physical therapy intervention program on the cervical muscles and body posture in mouth breathing children. The program of Physical therapy consisted by muscular stretching and strengthening exercises on the Swiss ball, along with naso-diaphragmatic re-education, during a three-month period. The study was carried out with 19 mouth breathing children, mean age of 10.6 years, with nasal obstruction diagnosis confirmed by endoscopic exams. To evaluate the efficacy of this intervention, electromyographic recordings and computerized photographic analysis were carried out before and after the physiotherapeutic intervention. The EMG signals were acquired from the sternocleidomastoid, sub-occipitals and upper trapezius muscles in quiet position, nasal inspiration, postural alignment and isometric contraction. The computerized photographic analysis enabled the measurement of multiple angles in order to quantify the results of this intervention on the body posture. The results showed significant reduction in the EMG activity on the assessed muscles after physiotherapy and, the computerized photographic analysis also indicates the treatment efficacy on body posture, particularly in the correction of forward head posture and abducted scapula. The objective methods adopted to verify the efficacy of the physical therapy intervention seemed to be safe and reliable, provided they are utilized with proper care and adequate instrumentation, evidencing that this intervention seemed to be effective on the improvements of the muscular balance and the postural pattern in mouth breathing children.

1. INTRODUÇÃO GERAL

A respiração bucal trata-se de um modo mecanicamente incorreto de respirar e é considerada, por alguns autores, como uma condição patológica e não fisiológica. O seu estabelecimento deve-se a alterações anatômicas (espaço aéreo estreito), obstrução nasal e faríngea, além de hábitos deletérios. (Di Francesco et al, 2004; Lusvarghi, 1999; Nouer et al, 2005)

A restrição das funções de umidificação, filtração e aquecimento normal do ar inspirado tornam a respiração bucal uma forma inadequada de respiração. Como a respiração nasal também tem a função de regular o tônus dos músculos respiratórios e excitar os centros respiratórios, a sua supressão leva a uma redução na amplitude dos movimentos respiratórios. (Tribastone, 2001) Com isso, este modo respiratório afeta a expansão torácica e a ventilação alveolar pela inibição dos nervos aferentes com o bloqueio das vias aéreas superiores, resultando em queda na PaO2 e baixa tolerância ao exercício.(Costa, 1997; Novaes & Vigorito,1993; Weimert, 1986; Yi et al, 2004) Autores mencionam, em casos mais severos, a associação da respiração bucal com infecções respiratórias repetitivas, apnéia obstrutiva do sono e Cor Pulmonale. (Di Francesco et al, 2004; Lusvarghi, 1999; Valera et al, 2003)

Os comprometimentos advindos da respiração bucal, segundo vários autores (Nouer et al, 2005; Novaes & Vigorito, 1993; Valera et al, 2003), podem acarretar prejuízos em diversas áreas, levando os indivíduos a apresentarem características comuns como: alterações craniofaciais, da postura corporal, da musculatura facial, da oclusão, das funções de mastigação e deglutição, distúrbios do sono, da concentração e atenção e, ainda, incidência aumentada de episódios de otites e outras patologias da orelha média, as quais determinam perdas auditivas. A persistência da alteração das vias aéreas superiores, determina um prejuízo na mecânica ventilatória, com desequilíbrio das forças musculares que podem produzir disfunções temporo-mandibulares, torácicas e, conseqüentemente, desvios em todos os eixos posturais. (Chaves et al, 2005; Corrêa & Berzin, 2004; Hruska, 1997; Marins, 2001)

A extensão da cabeça é considerada uma característica postural de respiradores bucais adotada como tentativa para reduzir a resistência das vias aéreas devido ao estreitamento do espaço naso-faríngeo. (Huggare,1997) Esta postura envolve o abaixamento da mandíbula e a descida da língua para o assoalho da boca.(Corrêa & Bérzin, 2004; Rocabado, 1979) A hiperatividade do músculo esternocleidomastóideo tem sido referida como fator preponderante na extensão ou postura anteriorizada da cabeça. (Hruska,1997) . Há, ainda, um maior esforço dos músculos acessórios da inspiração na tentativa de compensar os volumes pulmonares, o que reforça a postura anteriorizada da cabeça e repercute na configuração do tórax e do abdome.

Devido ao caráter sindrômico da respiração bucal, tem sido proposta uma abordagem interdisciplinar no seu diagnóstico e tratamento. (Biscioni et al, 1994; Carvalho, 2005; Di Francesco et al, 2004 , Lusvarghi, 1999; MacConkey, 1991) Entretanto, atualmente, o enfoque terapêutico nesta síndrome tem sido direcionado para as mudanças orofaciais por meio do tratamento ortodôntico e fonoaudiológico. Para uma reabilitação completa destes pacientes, o tratamento das alterações posturais e respiratórias pela fisioterapia devem ser incluídos. (Yi et al, 2004) A intervenção da fisioterapia ainda deve auxiliar na reabilitação odontológica, fonoaudiológica e dos demais profissionais envolvidos, possibilitando resultados terapêuticos mais efetivos e com efeitos em longo prazo nestes pacientes.(Carvalho, 2005; Marins, 2001)

A respiração bucal pode persistir, mesmo quando a sua causa foi eliminada, devido ao hábito residual ou como resultado das adaptações neurais, modificações de longa duração na função muscular das vias aéreas ou das mudanças esqueléticas que persistem após a anormalidade funcional inicial ser resolvida (Leiter & Baker, 1990; Miller, 1984; Nouer et al, 2005). Daí, a necessidade de uma abordagem terapêutica precoce e direcionada a todas as conseqüências da respiração bucal.

A abordagem da fisioterapia na Síndrome da Respiração Bucal deve ser global e direcionada tanto para a correção dos desvios posturais e desequilíbrios musculares como para a melhora da função ventilatória. (Costa, 1997; Ribeiro & Soares, 2003, Yi et al, 2004). Dentre os métodos conhecidos e indicados para reeducação motora postural está a Bola Suíça. As metas do tratamento na Bola Suíça são: estabilização da coluna, autocorreção da postura, simetria corporal, treino proprioceptivo e de percepção corporal, assim como relaxamento e treinamento da respiração diafragmática. (Carrière, 1999; Rocabado & Antoniotti, 1995; Tribastone, 2001)

Para uma avaliação segura dos efeitos da fisioterapia, é necessário o emprego de uma metodologia adequada, como por exemplo, a eletromiografia e a fotografia computadorizada.

A eletromiografia e a fotografia computadorizada são métodos para avaliação muscular e postural, respectivamente, que fornecem informações objetivas tanto para fins diagnósticos como para quantificar resultados terapêuticos da fisioterapia. São considerados métodos confiáveis e, por isso, se adequadamente utilizados, podem contribuir para a obtenção de evidências científicas que sustentem os procedimentos de fisioterapia. Portanto, cuidados metodológicos e adequada instrumentação são necessários para a obtenção de informações corretas e resultados seguros.

Estudos eletromiográficos demonstraram aumento da atividade elétrica dos músculos esternocleidomastóideo e trapézio superior em crianças respiradoras bucais comparado com nasais. (Ribeiro et al 2002; 2003; 2004)

Diante das anormalidades posturais e desequilíbrios musculares decorrentes da respiração bucal, justificou-se a necessidade da atuação da fisioterapia no tratamento destes pacientes. Sendo assim, este estudo propôs-se a verificar a eficácia de um programa de intervenção fisioterapêutica com correção postural e reeducação diafragmática sobre a atividade elétrica dos músculos cervicais e postura corporal em crianças respiradoras bucais, por meio da avaliação eletromiográfica e análise fotográfica computadorizada.

2. PROPOSIÇÃO

2.1. GERAL:

Verificar a eficácia do tratamento fisioterapêutico de correção postural com bola suíça e reeducação diafragmática em crianças respiradoras bucais, por meio de avaliação eletromiográfica e análise fotográfica computadorizada.

2.1. ESPECÍFICOS:

Avaliar a atividade elétrica dos músculos esternocleidomastóideo, sub-occipitais e trapézio (fibras superiores) nas situações de repouso, alinhamento postural e inspiração nasal em crianças respiradoras bucais, antes e após o tratamento fisioterapêutico;

Investigar e mensurar os desvios posturais e sua possível correção em crianças respiradoras bucais, por meio de análise fotográfica computadorizada antes e após tratamento fisioterapêutico;

Analisar a aplicabilidade das avaliações eletromiográfica e fotográfica computadorizada como instrumentos para comprovação de eficácia de procedimentos terapêuticos;

Propor a implementação de um programa de fisioterapia para correção postural com Bola Suíça e reeducação ventilatória em crianças respiradoras bucais.

3. CAPÍTULOS

3.1. ARTIGO 1 – Submetido para publicação no periódico Archives of Physical Medicine and Rehabilitation (ANEXO 7)

Efficacy of physical therapy on cervical EMG muscle activity and on body posture in mouth breathing children

1Eliane CR Corrêa, PT, Msc
2Fausto Bérzin, DDS, PhD
1From the Department of Physical Therapy, Federal University of Santa Maria (Corrêa), RS, Brazil
2From the Department of Morphology of Dental School of Piracicaba, Campinas State University (Bérzin), SP, Brazil
Corresponding author and reprint requests to Eliane Corrêa, R. Tuiuti 2462 apt 803, Santa Maria, RS, CEP 97050420, telephone number 55-32251382, FAX number 55-32208018, e-mail: eliftrs@yahoo.com.br

ABSTRACT

Objective: To evaluate the efficacy of a physical therapy intervention (PTI) program on the cervical muscles and body posture in mouth breathing children.

Design: Intervention study before/after trial.

Setting: Institutional practice and research laboratory

Patients: 19 mouth breathing children recruited either from a public school or from a speech-therapy service.

Intervention: The subjects were submitted to a 12-week program of Physical Therapy consisted by muscular stretching and strengthening exercises on the Swiss Ball, along with naso-diaphragmatic re-education.

Main Outcome Measures: Electromyographic recordings from the sternocleidomastoid, sub-occipitals and upper trapezius muscles and computerized photographic analysis (CPA)

Results: There was a significant reduction in the EMG activity on the assessed muscles during quiet position and aligned posture after treatment. The improvement of the postural deviation as the forward head posture and the abducted scapula were demonstrated through the CPA.

Conclusions: By means of the experimental condition, a specially designed Physical Therapy program with postural exercises using the Swiss ball in combination with breathing exercises seemed to be effective in restoring muscle imbalances and postural disorders measured through surface EMG activity and photographic analysis in a group of mouth breathing children.

Key-words: Mouth breathing; Electromyography; Body Posture; Exercise; Rehabilitation.

INTRODUCTION

Enlarged tonsils and adenoids, allergic rhinitis, and chronic respiratory problems cause a Mouth Breathing Syndrome (MBS), which may be associated with compensatory adaptation of natural head posture[1,2,3,4], as well as whole body posture in children.[5,6,7] Besides postural changes, MBS may cause feeding and speech disturbances, impaired sleep leading to daytime fatigue and somnolence, sleep apnea syndrome, reduced learning and work inefficiency, in addition to decreasing quality of life.[8,9,3]

It is believed that the forward head position adopted by these children is a consequence of their attempt to increase upper airway patency.10 Some studies have described the effectiveness of maxillary expansion, orthodontic treatment, myofunctional therapy, intranasal corticosteroid and surgical procedures (tonsillectomy and adenoidectomy) on nasal airway resistance in mouth-breathing children.[11,12,13,14,15,16,17,18,19,20] As a result, an interdisciplinary approach to treatment has been recommended; considering not only the upper airway obstruction, the dentition, facial skeleton and head posture, but also the body posture abnormalities and muscular imbalance.[6,7,21,22]

Physiotherapy in mouth breathing syndrome is one component of an interdisciplinary team intervention seeking to prevent the impairment and consequences of improper breathing.[7] Naso-diaphragmatic breathing instruction has been used to decrease the activity of accessory muscles of respiration and correct postural imbalances.[23,24,25,26,10,27] It is postulated that optimal breathing capability derives from a posture of optimal muscle balance and that postural re-alignment is beneficial in part by improving the diaphragmatic mechanical advantage.[28]

Swiss ball therapy is one of the more recent methods recommended by physiotherapists for postural reeducation.[29] Being enjoyable, it is adaptable for therapy among children; i.e. stretching and strengthening exercises can be performed in a playful manner. Exercise performed on a movable surface demands higher muscular activity to support the spine and maintain whole body stability than when performed on a stable surface.[30] Despite the popularity of Swiss ball therapy, no studies have investigated its effectiveness in reversing muscle imbalances or correcting postural disturbances in children with Mouth Breathing Syndrome.

The present study was conducted to objectively evaluate and quantify the efficacy of a Physical Therapy intervention program that utilizes traditional stretching and strengthening exercise on the Swiss ball in combination with naso-diaphragmatic breathing exercises, on cervical muscles activity and on body posture in mouth breathing children. The study relies on electromyographic (EMG) signal recording techniques to provide quantitative data for assessing changes in postural muscle activity and computerized photographic analysis for assessing posture. Surface EMG studies have reported higher cervical muscle activity in oral breathers as compared to nasal breathers with the head in its habitual position during quiet sitting.[22] Kinesiologic electromyography is an objective instrument for validation of therapeutic efficacy .[31]

Considering that the most frequent postural deviation described in these children are related to the head (forward posture) and shoulders (forward posture and scapular abduction), with resulting changes in the muscular activity, the postural analysis in conjunction with the EMG evaluation will seek to test whether PTI is effective to adjust the muscular recruitment pattern and to obtain the body posture realignment.

METHODS

Subjects

Nineteen children, 11 males and 8 females, with a mean age of 10.6 (SD = 1.0) participated in this study. The children were recruited either from a public school or from a speech-therapy service. The children who took part in the study had a confirmed upper airway obstruction diagnosis, but in a magnitude that allowed them to breath through their nose when requested during the Physical Therapy Intervention. A clinical diagnosis of nasal airway obstruction without neurological diseases or other medical diagnoses was confirmed through nasopharyngoscopy and oroscopy.

The children selected for the study had confirmed diagnosis of allergic rhinitis (15), septum deviation (4), adenoid hypertrophy (03) and residual mouth breathing post-adenoidectomy (04).

Following the evaluation and PTI, the children were referred for Dental, Otorynolaryngological and Speech treatment.

A clinical postural assessment, based on visual observation, was carried out by a certified physical therapist in order to determine the clinical profile of the children related to their head and shoulder posture. The postural changes found in the nineteen children of this study are presented in the table 1.

Table 1: Abnormal Postural Findings in the Subjects

Postural assessment	Type of abnormality	Frequency (N= 19)
Head	Flexion	9
	Forward	13
	Lateral Tilt	4
Shoulders	Forward	12
	Elevation	8
	Scapular abduction	13
	Medial rotation	11

The Ethical Committee of the Health Science Center, Federal University of Santa Maria, RS, Brazil approved the study .Detailed explanation about the study was given to parents and children, both orally and in a written form. Children's parents were informed about the potential risks and benefits and signed an inclusive informed consent form prior to their children's participation in the study.

Study design

The intervention study before/after trial included a surface electromyography (sEMG) evaluation with bilateral recordings of sternocleidomastoid (SCM), sub-occipitals (SOC) and upper trapezius (UT) muscle activity during quiet sitting position, during attempted postural alignment, and during isometric contraction. A computerized photographic analysis (CPA) was also made in right and left lateral, anterior and posterior views. All the assessment procedures were carried out before and at the end of the 24 sessions of physiotherapy. Both evaluation procedures and Physical Therapy Intervention (PTI) program were conducted by the same physiotherapist.

Surface Electromyography (sEMG)

Surface EMG was recorded bilaterally from the SCM muscle, UT and SOC muscles during the following activities: 1) quiet sitting while maintaining their habitual posture, 2) during a posture alignment test while sitting, and 3) during an isometric voluntary contraction while sitting in an adapted chair. For the posture alignment test, the physical therapist positioned the child in a standard sitting posture with the external auditory meatus, acromium and hip aligned, without back support. An adapted chair was used to provide resistance to head flexion (figure 1), head extension, and shoulder elevation for the isometric contraction tests. The isometric evaluation for the UT was accomplished using the same chair with an external resistance against shoulder elevation placed above the child's shoulder. The EMG activity during isometric contraction was recorded in order to provide data for the normalization procedure.

Figure 1- Isometric test for SCM muscle. The child was instructed to try and tuck his chin towards his chest against a bar which provided resistance.

The electrode's placement and skin preparation followed Cram et al's recommendations. 32 A reference electrode was placed on the wrist of the subjects. The acquisition of EMG signals was carried out using active single differential surface electrodes (Lynx Electronic Technology Ltda)[a], with a contact diameter 10 x 2 mm, parallel bars of pure silver 10mm apart, gain of 100x, input impedance of 10 $G\Omega$ and CMRR of 130dB. The EMG signals amplified and conditioned using Myosystem Br-1 equipment [b], band pass filtering from 20 Hz to 1000 Hz , and sampled using a 12 Bit A/D converter board set to a 4KHz sampling frequency. This equipment is according to the international standardization.[33] The acquisition period was 10 seconds, except for the isometric contraction that it was 05 seconds.

The data were analyzed in the EMG amplitude domain. The Root Mean Square (RMS) values were calculated by the Myosystem Br -1 software. The absolute EMG signal amplitude values (expressed in μV) were normalized with respect to the values obtained in the isometric contraction in order to account for possible differences in electrode repositioning and to make reliable comparisons across subjects.[34]

The acquired amplitude was normalized, computed by:

$$\text{Normalized RMS value} = \frac{\text{RMS Act}}{\text{RMS Max}} \times 100 ,$$

where RMS Act is the amplitude recorded during the activity of interest and RMS Max is the amplitude recorded during isometric contraction.

Computerized Photographic Analysis (CPA):

Postural measurement was accomplished using photographic recordings acquired while the subjects maintained an upright, quiet-standing position. The children were barefoot and given instructions to keep their feet slightly abducted and to look at the camera. Lateral, anterior, and posterior views were made while the subjects were stood assuming their normal posture. No further instructions or reminders were made to the subject regarding their posture. Markers were placed at anatomic landmarks which were first palpated and identified by the examiner. The following anatomical landmarks were identified: superior and inferior scapular angles in left and right sides, acromium, manubrium, ear lobe/external auditory meatus, mentum and coracoid process. Photographs were taken using a Sony Cyber-shot DSC-P31 digital camera (2.0 megapixels) mounted on a tripod 1-m from the floor and 2-m distance from the subject.6 The digital photos were transferred to a PC monitor and then analyzed with ALCimagem software [c] .[7] To assess quantitatively the postural pattern, some reference points and measurements were established and marked such as presented in figure 2 for the lateral view; figure 3 for the anterior view and figure 4 for the posterior view. The measured angles were selected and adapted based on Kendall's evaluation for postural alignment using the plumb-line test.28 In the lateral view, the plumb-line and ear lobe angle was drawn to evaluate the forward head posture; the plumb-line and acromium angle was drawn to measure the forward shoulder posture, the plumb-line and mentum angle was drawn to measure the flexion/extension head; and the plumb-line and scapular prominence was drawn to measure abducted and/or winged scapula. In the anterior view, the angle formed by a vertical line at the manubrium and ear lobe was drawn to evaluate the head tilt and the angle formed by the same vertical line and coracoid process was drawn to evaluate the shoulder height. In the posterior view the angles between superior and inferior scapular angles and C7 were drawn to evaluate scapular abduction/ adduction and forward/elevation shoulder.

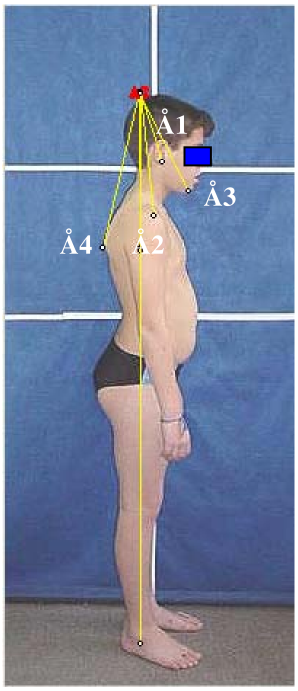


Figure 2 - Measurements of lateral taken to compute the angles formed between plumb line and ear lobe (Å1); plumb-line and acromium (Å2); plumb-line and mentum (Å3); plumb-line and prominence of the scapula (Å4).

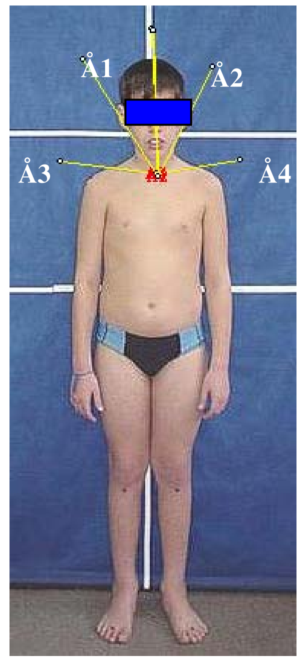


Figure 3 - Measurements of anterior view taken to compute the angles formed between a vertical line through the manubrium and a line through the left (Å1) and right (Å2) ear lobe; and the angles formed between the manubrium and the left (Å3) and right (Å4) shoulder (coracoid process).

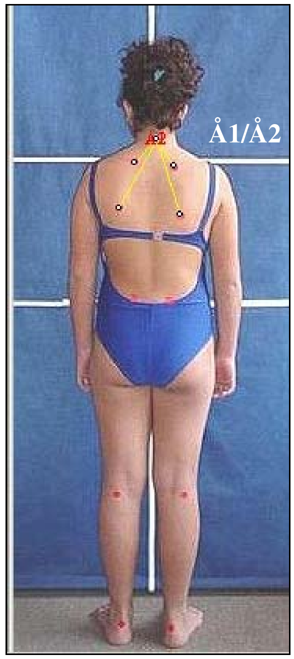


Figure 4- Measurements of posterior view
taken to compute the angles formed between
right and left superior scapular angle and C7 (Å1)
and right and left inferior scapular angle; and C7 (Å2)

Physical Therapy Intervention (PTI)

The Swiss ball, in combination with breathing exercises, was selected as the method for PTI in mouth breathing children considering it requires good body posture alignment for balancing and greater muscular activation levels is demanded on a instable surface. [35,30] Therapeutic exercises on a Swiss ball (55 and 65 centimeters diameter, according to the child's height), diaphragmatic re-education and training exercises24 were performed by the children under the supervision of a physiotherapist. The program was based on Carriere[36] and Steffenhagen[37] exercise program. It consisted of directed movements to restore postural alignment, primarily through stretching of the anterior muscles and strengthening of the posterior muscles of the trunk. The exercises were performed in sitting, supine and prone positions using the Swiss ball. The program also included manual stretching in the SCM and Scalene muscles and naso-diaphragmatic breathing re-education through manual proprioceptive stimulus in different positions on the Swiss ball adapted from techniques described by Bienfait and Rocabado. [38,39]

The subjects participated in the 30-minute training sessions twice a week for 12 consecutive weeks (total of 24 sessions). Subjects were also asked to be attentive to their posture at all times. Attention was focused towards correcting head position, since this is the most important postural disturbance found in mouth breathers.[2,40]

Statistical Analysis

Results obtained in each of tests were organized in Tables that present the mean values and respective standard-deviation of the evaluated muscles before and after PTI. To establish a comparison among the normalized EMG values obtained before and after PTI, the Wilcoxon non-parametric test was used to analyze dependent data. Statistical Analysis System- SAS, release 8.02. was used for data analysis. CPA results obtained before and after PTI were compared using a Student's t-statistic for dependent variables. The significance level of this study was set at *P* less than .05.

RESULTS

The EMG signals were acquired from SCM, SOC and UT muscles in 19 mouth breathing children during quiet position and postural alignment. The results of PTI on the EMG evaluation before and after PTI are shown in the tables 2 and 3. The results of the PTI in these children's posture evaluated through the CPA in lateral, anterior and posterior views are shown on tables 4,5 and 6, respectively.

EMG Amplitude analysis

With the children quietly sitting in their habitual position, the normalized EMG activity was significantly lower after the therapeutic sessions as compared to results obtained before treatment in all the muscles tested. These results are shown on table 2, where it can be observed high levels of EMG activity, particularly on SOC muscles pre treatment. These values are considered hyperactivity, and despite the decrease of EMG activity in all studied muscles, the SOC muscles maintained high EMG levels after PTI for this condition.

Table 2 - Mean values and Standard-deviation of normalized EMG levels (%) during quiet position in the SCM, SOC and UT muscles

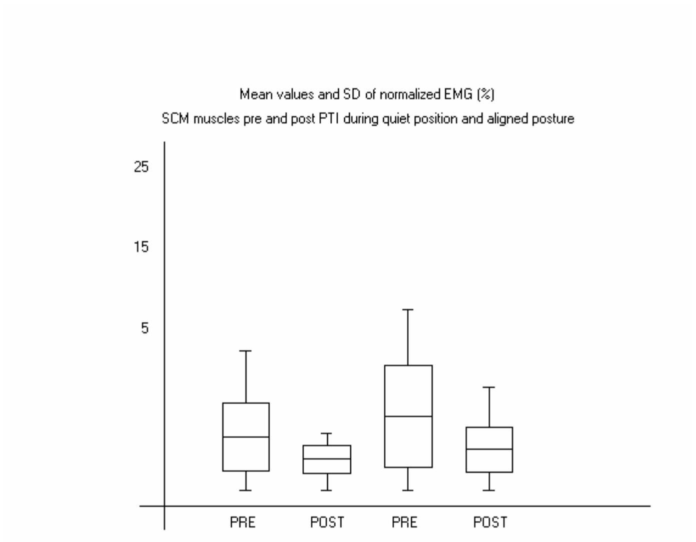
MUSCLES	**PRE**		**POST**		***P*-value**
	Mean	SD	Mean	SD	
SCM (%)	5.3	4.3	2.8	1.5	0.002**
SOC (%)	19.1	13.8	10.5	6.5	0.02*
UT (%)	7.1	13.0	2.3	1.5	0.0002**

SCM – Sternocleidomastoid muscle; SOC – Suboccipital muscles ; UT – Upper Trapezius muscle

*Statistically significant at 5% level (p < 0,05).

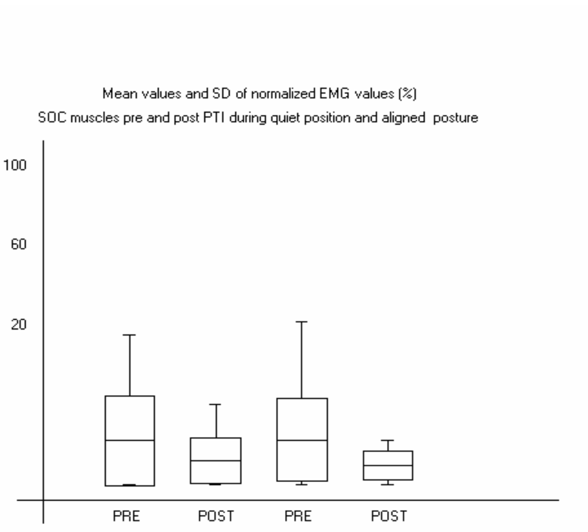
**Statistically significant at 1% level (p < 0,01).

Figure 5 illustrates the difference of EMG activity (mean and standard-deviation values) between pre and post-treatment during quiet position and aligned posture in the tested muscles.



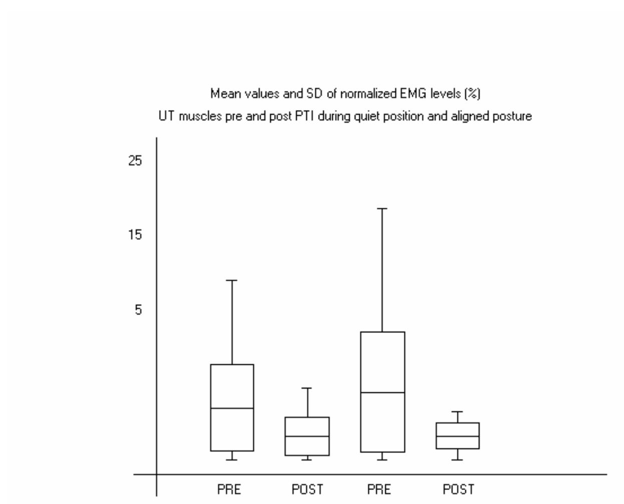
Quiet Position **Aligned Posture**

a)



Quiet Position **Aligned Posture**

b)



Quiet Position **Aligned Posture**

c)

Figure 5 - Mean values and SD of normalized EMG levels (%) on a) SCM ; b) SOC and c) UT muscles during quiet position and aligned posture pre and post PTI.

Table 3 shows the results of EMG activity in the posture alignment. It can be verified values significantly lower after treatment in all the studied muscles. On the SOC and UT muscles, the activity levels recorded before treatment were such increased, considering it should be near to the resting tone. These findings demonstrated that the habitual posture of the examined children was not naturally aligned and they demanded higher muscular activity to be positioned in a correct posture. After PTI, the activity levels decreased significantly in these muscles for positioning the body in an aligned posture.

Table 3 - Mean values and Standard-deviation of normalized EMG levels (%) during aligned posture in the SCM, SOC and UT muscles.

MUSCLES	**PRE**		**POST**		***P*-value**
	Mean	SD	Mean	SD	
SCM (%)	6.7	4.7	3.9	2.9	0.004*
SOC (%)	19.3	11.9	9.6	8.5	0.0007**
UT (%)	8.0	7.6	2.6	1.8	0.0001**

SCM – Sternocleidomastoid muscle; SOC – Suboccipital muscles; UT – Upper Trapezius muscle

*Statistically significant at 5% level ($p < 0,05$).

**Statistically significant at 1% level ($p < 0,01$).

Computerized Photographic Analysis (CPA)

The CPA in the lateral view showed significant difference on the head posture , with a smaller angle between plumb-line and ear lobe, and a significant decrease in the angle between plumb-line and the prominence of the scapula after treatment. (table 4). These changes are indicative of significant improvements in forward head and shoulders posture deviation, respectively.

Table 4 - CPA results (mean values and standard deviation) in the right lateral view pre and post PTI (n=17):

ANGLE	Mean	SD	*P*-value
Angle 1 pre	9.21°	4.51	0.00301**
Angle 1 post	5.99°	3.30	
Angle 2 pre	4.18°	2.53	0.121
Angle 2 post	2.90°	3.13	
Angle 3 pre	17.68°	4.10	0.1027
Angle 3 post	15.83°	3.04	
Angle 4 pre	9.74°	2.25	0.0458*
Angle 4 post	8.82°	2.49	

Angle 1 – Plumb line and external auditory meatus
Angle 2 – Plumb line and acromium
Angle 3 – Plumb line and mentum
Angle 4 – Plumb line and inferior scapular angle

*p<0.05, **p<0,01

CPA in the posterior view showed significant differences between right and left inferior scapular angles and no significant difference between right and left superior scapular angles. (table5). A smaller angle between inferior scapular angles and C7 post than pre PTI infers that the scapular abduction was adjusted with the treatment.

Table 5 - CPA results (mean values and standard deviation) in the posterior view pre and post PTI:

ANGLE	Mean ± SD	*P*-value
Superior scapular angle PRE	103.89° ± 12,92	0.874098
Superior scapular angle POST	103.42° ± 10.12	
Inferior scapular angle PRE	47.09° ± 6.61	0.015864*
Inferior scapular angle POST	44.14° ± 5.98	

*p<0.05

In the anterior view, among the measured angles, only the right shoulder angle was significant larger after treatment (table 6), which indicates that the right shoulder lowered with PTI. There was no significant difference in the specific angles measured for head tilt measurements and the left shoulder angle post- treatment.

Table 6 - CPA results (mean values and standard deviation) in the anterior view pre and post PTI:

ANGLE	Mean	SD	*P*-value
Right tilt head pre	30.19°	2.6	0.379
Right tilt head post	29.66°	3.5	
Left tilt head pre	30.96°	3.2	0.454
Left tilt head post	31.33°	2.6	
Right Shoulder pre	84.73°	3.22	0.0236*
Right Shoulder post	86.37°	3.53	
Left Shoulder pre	85.56°	3.14	0.113
Left Shoulder post	87.07°	4.29	

Head tilt = angle formed between vertical line in the manubrium and a line through the right and left ear angle formed between vertical line in the manubrium and a line through the ear lobe.

Shoulder line = angle formed between a vertical line in the manubrium and the shoulder right and left (clavicle line)

*$p<0.05$

DISCUSSION:

The results obtained in the present study support the efficacy of using this particular PTI program to correct postural and muscular deficits in children with MB Syndrome. This study demonstrated significant changes in EMG activity and angular displacement indicative of improvement in head and shoulder abnormalities, including forward head and shoulder posture, shoulder elevation and scapular abduction. Children easily learn and enjoy Swiss ball exercises. Their adherence to a pleasant Physical Therapy Intervention Program was essential for the beneficial results obtained in this study.

SEMG analysis

Post PTI, cervical muscle EMG values showed significant decrease in activity in all studied muscles during quiet position. Before intervention, during quiet position, the EMG levels in the SCM, SOC and UT muscles were, respectively, 5.3 ,7.1 and 19.2% of their isometric contraction. The SOC muscles presented the highest levels of EMG activity. After Physical Therapy intervention, these values decreased to 2.8, 10.5 and 2.3% on SCM, SOC and UT muscles. It is expected that the decrease observed has an important long term clinical significance for the ideal postural alignment of these children, because beyond the aesthetical concern, the postural deviations adversely influence muscle efficiency and can predispose individuals to musculoskeletal or pathological neuromuscular conditions as they age.[41] Muscular hyperactivity during rest reduces the blood flow to the muscle and leads to changes in length of both the muscle cell and the connective tissue elements[42] and, therefore, can result in chronic muscle pain syndromes. [43]

Muscular inactivity is manifested as complete neuro-muscular silence and has been described as "true" relaxation, according to Basmajian & De Luca.[44] These authors also reported no electrical activity in the Trapezius muscles in a relaxed upright posture, although they stated that upper part of the muscles shows some tension even when no weight is borne by the limb. Cram *et al*[32] stated that different muscle groups have different resting tones (sEMG levels), and the resting tone may vary as a function of posture. There is a "rule of 5", which holds that any sEMG higher than 5 μV (RMS) is considered abnormal. Yet, this rule is considered a very simplistic way to describe the resting sEMG levels. These authors provided some benchmark approach as normal surface EMG amplitudes for certain muscles.[32] As the normative values presented by Cram are not for normalized values of EMG, the resting levels in µV can not be used as a reference values for the current study. Measures for eliminating electrical noise as the use of active electrodes, ground electrodes and appropriate preparation of skin were applied as recommended.[32] Such measures might contribute for a "true" EMG signal acquisition.

In the literature consulted, just the Finsterer's study was found, related to muscular hyperactivity levels. Such study stated that the EMG-interference pattern start at 10% of MVC, which means that this EMG level or higher at rest corresponds to the muscular hyperactivity. [45]

In the current EMG results, only the SOC muscles showed activity level higher than 10% of the isometric contraction or so-called muscular hyperactivity.

The abnormal forward head posture is associated with relatively high levels of muscle activity in the SCM. [32,22,25,46,47,48] In contrast, in this study higher level of activity was found in the SOC and UT muscles than in the SCM. This can be explained because the head is held in front of its center of gravity and the cervical paraspinal muscles are required to provide chronic muscular support for the 15-pound weight of the head.[32] Merletti & Parker[49] showed that surface EMG activity decreased in the paraspinal muscle as the head was moved from a head forward position to one in which the head was positioned well over its center of gravity. Sub-occipital, SCM and Scalene muscles are thought to be in a shortened position in the presence of head protraction.[7] The forward head posture with its associated changes in the position of scapulae, ribs, occipital-atlas joint and other cervical structures may cause upper trapezius dysfunction. [32]

Ribeiro *et al* [22] concluded that the higher muscle activity (SCM and upper trapezius) in mouth versus nasal breathers at rest was probably associated with a forward head position adopted to increase the upper airway patency. The lowering of cervical muscular activity measured at quiet position suggests that the correction of body posture yielded a more normalized muscles balance and electrical activity patterns lower than hyperactivity and closer to the resting levels in the tested muscles.

Good posture is defined as the state of muscular and skeletal balance.[50] The modern concept of recommended posture is based on the supposition that this posture results in minimum stress to the joints of the body, as well as a minimal amount of muscle activity, i.e., the body assumes a position of highest efficiently. [25,,28,51]

A relatively high level of muscle activity (6.7,19.2 and 8% of isometric contraction on SCM, SOC and UT muscles, respectively) was recorded in these subjects prior to the PTI as they were asked to remain in the ideal postural alignment. After intervention, these EMG levels decreased significantly to 3.9, 9.6 and 2.6% on SCM, SOC and UT muscles, respectively. All tested muscles reached levels considered below of the hyperactivity threshold. The EMG results in this study demonstrate that the muscle activity levels decrease after the treatment during the posture alignment. That is, the muscular effort to maintain an aligned posture becomes lower after the PTI.

An anterior inclination of the lumbar spine and pelvis is produced when the individual sits on the Swiss ball. Since the cervical and lumbar spine move in opposite directions, this anterior inclination pelvic causes a posterior displacement of the head and shoulder, thereby facilitating the realignment of the forward head and shoulder posture. [52]

Labile base of support stimulate balance and equilibrium reactions. Continuous post adjustments are required, facilitating smooth coordination of posture and movement.[26] Muscle activation levels are greater and their synergistic relationships differ in exercises while using the Swiss ball. [40] Exercises on an inflatable ball is a modality recommended for postural motor re-education contributing for the maintenance of a correct posture, increasing low back, pelvic and upper thorax stability, for diaphragmatic respiratory training as well as a relaxing aid. [39,29]

Stretching of antagonist prior to strengthening of agonist muscles group programs is recommended as an effective intervention in restoring postural and muscular balance. [25,28,42] Static muscle stretching is efficacious in restoring the resting action potential amplitude and mean power frequency back towards the control levels, suggesting that this form of intervention may decrease muscle spasm. [43]

CPA assessment

The clinical evaluation of body posture is a subjective procedure that follows established clinical guidelines. [28] Postural assessments should also include an objective, quantitative and reliable methodology. Such methods can be found in the literature and comprise the use of radiography, photography [6,53], computerized biophotogrammetry[7], inclinometers [54], and cephalometry (particularly for head posture).[55, 56, 48, 57, 1,58,19,51]

Among of the studies regarding CPA for postural assessment, one study by Penha *et al* [50] utilized postural assessment of 132 girls (4 age groups between 7-10 years old), recruited from a public school (SP/Brazil). The postural assessment consisted in digital photographic analysis of marked anatomic reference points. Some of these points were the same used in the present study; however the authors did not analyze angles to quantify the postural changes. The authors reported a high incidence of postural alterations, attributed mostly to improper postural habits. However, unlike the current study, only head tilt was mentioned among the postural deviations identified, specifically on the head. The authors attributed these alterations to postural development changes and suggested that a spontaneous correction could occur during the child's growth. Additionally, the authors noted the lack of postural standards for children.

However, a photographic evaluation of nasal and mouth breathing children did not find difference on the postural alteration between them until 8 years old, however after this age these abnormalities were significantly higher in the mouth breathers. It seems that in the nasal breathers the postural alignment improved spontaneously after 8 years of age. [6] A biophotogrammetric postural comparison of multiple head posture angles between mouth breathing and nasal breathing children found significant alterations, such as chin retraction and forward head protraction in the obstructive mouth breathers compared to the nasal breathers .[7] Although the forward head posture is considered to be a faulty posture, there is no baseline uniform criteria for its assessment. [58]

CPA were used in this study, since it is a method accessible for a Physical Therapist without the expense of more sophisticated motion analysis devices or the possible risks of repeated radiological assessments.

After PTI, the CPA results in the lateral view showed a better alignment of head posture with a decrease in the angle between plumb-line and ear lobe. There was also a positive result in the scapular position with a decrease in the angle between plumb-line and scapular prominence. The EMG results are in accordance with the photographic assessment; since the EMG activity was significantly lower in all studied muscles. Yet, as the SOC muscles maintained high levels of EMG, it suggests that the forward head posture was partially improved after treatment. Since the SOC are cervical extensors, it indicates that the head extension still persists, but in a minor degree.

The relatively high levels of EMG activity before the Physical Therapy Intervention were associated with a forward head posture for 13 out of 19 subjects (68%). There is also accordance with the result related to plumb-line and scapular prominence angle and EMG, because the EMG activity decreased in the UT muscles after treatment as well as that angle, which measured the forward shoulder posture. Such findings are not surprising because forward head posture is a consequence of shortened cervical extensors and lengthened cervical flexors muscles and the shortened UT is responsible for the forward shoulder and head posture.[28]

In the anterior view, there was a significant increase in the right shoulder angle after PTI, with a lowering in this shoulder height. The angle measurements showed that the right shoulder was higher than the left in the examined children before PTI. The decrease in the UT EMG activity after PTI can be associated to the improvement on the elevated shoulder posture, as measured by the CPA. It has been suggested that there is a natural asymmetry in the shoulders height in the general population in the coronal plane.[53] Concerning to the dominance, in a typical posture pattern, the right shoulder is lower than left in right-hand people.[28] Conversely, in this study, the right shoulder was higher in the right-hand people.

In a study of 132 girls, the shoulder asymmetry was observed in 58 to 82% of them and it was associated to the muscular asymmetry, lateral deviation of vertebral column and pelvic tilt. [50]

A scapular abduction seems to be corrected and it was demonstrated by the angular measurement in the lateral and posterior view, as well by the EMG results. This

PTI result is demonstrated by reduction of the scapular prominence, a smaller angle between right and left inferior angle of scapula and C7, and a lower EMG activity of UT muscles. It is possible that because the UT muscles are in a shortened position in abducted and elevated scapular postures [28], stretching and postural exercises may have been effective in re-establishing their length, and decreasing their level of activity.

Given the scapular abduction is related to the shoulder rotation caused by the predominant action of the anterior serratus and mayor pectoral muscles over the rhomboid and trapezius muscle [50], the results of CPA in the scapular position is explained. Strengthening the posterior scapular stabilizers combined with stretching of the anterior muscles re-established the muscular balance. Wang *et al* [59] studied the effect of passive stretching and resistive exercise with "Theraband" on a group of asymptomatic subjects with forward shoulder posture. This exercise program improved muscular strength producing a more erect trunk posture and increased scapular stability. In the present study, the strengthening exercises for posterior scapular muscles were accomplished on the Swiss-ball in prone position and without a resistive protocol except for the gravity and the weight of the thorax.

Clinical Relevance

The 12-week program was successful in improving the postural alignment and the EMG muscle activity, by decreasing the inadequate muscular recruitment pattern present in the mouth breathing children. However, it is likely that a long-term improvement can only be achieved through a combination of effective medical, surgical, dental and Speech Therapy intervention. The successful removal of the upper airway obstruction may not be enough to promote full recovery of a normal postural and breathing pattern. Instructing and reminding children to adopt a more optimal posture during daily activities may enhance the proprioceptive awareness of their body and inhibition of "inappropriate" muscle activity to establish certain postures and movement patterns. 41 As many children spend much time in an improper postural habit and their muscles adapt to it, parents and teachers should also be educated regarding this problem and its possible negative consequences; including decreased quality of life issues.[50]

CONCLUSION

By means of the experimental condition, a specially designed Physical Therapy program with postural exercises using the Swiss ball in combination with breathing exercises seemed to be effective in restoring muscle imbalances and postural disorders measured through surface EMG activity and photographic analysis in a group of mouth breathing children. More specifically short-term improvements were noted in forward head and shoulders, unilateral shoulder elevation and scapular abduction. Future studies are needed to determine whether these improvements are maintained over long-term follow-up evaluation. Successful treatment of mouth breathing children depends on accurate evaluation and treatment of its multifactorial causes. Physical Therapy can be considered a valuable addition to the clinical armamentarium.

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3.2. ARTIGO 2: Submetido para publicação no periódico Physical Therapy Journal (ANEXO 8)

Effect of postural and breathing exercises on the cervical muscles activity during nasal inspiration in children with Mouth Breathing Syndrome (MBS)

1Eliane CR Corrêa, PT, Msc
2Fausto Bérzin, DDS, PhD
1From the Department of Physical Therapy, Federal University of Santa Maria (Corrêa), RS, Brazil
2From the Department of Morphology of Dental School of Piracicaba, Campinas State University (Bérzin), SP, Brazil
Corresponding author: Eliane Corrêa, R. Tuiuti 2462 apt 803, Santa Maria, RS, CEP 97050420, telephone number 55-32251382, FAX number 55-32208018,
e-mail: eliftrs@yahoo.com.br

ABSTRACT:

Background and Purpose: Mouth breathing mode has been associated to postural disturbances, which augment the breathing disorder through the overuse of inspiratory accessory muscles. The purpose of this study was to evaluate the effect of postural and breathing exercises on the cervical muscles in children with MBS.

Methods: Surface electromyography from the Sternocleidomastoid, Sub-occipitals and Upper Trapezius muscles were recorded during nasal inspiration, before and at the end of three months of the treatment. Muscular stretching and strengthening exercises along with naso-diaphragmatic re-education on the Swiss Ball were the treatment procedures. Nineteen children with MBS, mean age of 10,6 years, both sexes, were the subjects of this study.

Results: There was a significant decrease in the EMG activity during nasal inspiration in all tested muscles after treatment.

Discussion and conclusion: The postural and breathing exercises had a positive effect on the cervical muscles activity, decreasing the inspiratory accessory muscles work.

Key-words: Mouth breathing, respiratory muscles, electromyography, physical therapy, Swiss Ball, diaphragmatic breathing

INTRODUCTION:

Mouth breathing is a mechanically incorrect mode of respiration. The failure in filtering, humidifying and warming inspired air stimulates an increased presence of white blood cells, increasing the hypersensitivity of the lungs and decreasing their volumes and capacity.[1,2,3] Also, there is evidence that the nose obstruction or upper airway blockage determines disturbances in the nasal afferent nerves (sympathic trigeminal and autonomic nerves) with profound effects on respiration and airway caliber in the lungs [4,2,5] , negatively affecting the thoracic expansion and alveolo-pulmonary ventilation. [2,6] Additionally, it causes drop in the PaO2, in the exercise tolerance and, in more severe cases, can be associated with obstructive sleep apnea and Cor pulmonale. [1,7]

The dysfunctional patterns of the Mouth Breathing Syndrome (MBS) constitute a chain reaction of body adaptation to abnormal breathing patterns. Breathing through the mouth facilitates forward head posture, a low and forward tongue position and increased activity of the accessory muscles of respiration (SCM, scalene and pectorals). [8]

This pattern is perpetuated by the decreased activity of the diaphragm and hypotonicity of the abdominal musculature. [8,9]

The patient with MBS has higher activity of accessory musculature of inspiration and, as a consequence, an increased energetic consumption and improper lung ventilation. They also develop hypertrophy in these muscles with impairment in the diaphragm muscle because of its inactivity and lack of synergism with abdominal muscles. [6,10]

The treatment for mouth breathing needs to be addressed for the postural changes, specifically the forward head posture, since it is related with the overuse of primary and secondary muscles of respiration. [11]

More normal breathing pattern can be facilitated by altering the head and neck posture. [8]

The nasal breathing training is justified because the nasal obstruction can induce neuromuscular changes that remain even after the original stimulus has been removed.[12]

A precocious multidisciplinary evaluation has been recommended in the children with MBS in order to avoid the development of complications and to reduce the treatment costs and time. The EMG recordings in the head and neck muscles are utilized as an evaluation method of the muscle activity and its intensity and changes in the contraction-relaxation mechanism in these patients. [13]

The consulted literature depicts the presence of a number of changes concerning the body posture and breathing pattern as a consequence of the mouth breathing mode. Additionally, it has been stated that Physical Therapy may contribute for a more integral and effective therapeutic approach of the multi-disciplinary team to assist children with MBS. Therefore, given the lack of investigation regarding the Physical Therapy in this dysfunction, the aim of this study was to evaluate the effect of postural and breathing exercises, consisted by muscular stretching and strengthening on the Swiss ball and naso-diaphragmatic re-education, on the EMG activity of the cervical muscles during nasal inspiration in children with mouth breathing syndrome.

SUBJECTS AND METHODS:

Subjects

Nineteen children, 11 males and 8 females, with a mean age of 10.6 (SD = 1.0) participated in this study. The children were recruited either from a public school or from a speech-therapy service. The children who took part in the study had a confirmed upper airway obstruction diagnosis, but in a magnitude that allowed them to breath through their nose when requested during the Physical Therapy Intervention (PTI). A clinical diagnosis of nasal airway obstruction without neurological diseases or other medical diagnoses was confirmed through nasopharyngoscopy and oroscopy.

The children selected for the study had confirmed diagnosis of allergic rhinitis (15), septum deviation (4), adenoid hypertrophy (03) and residual mouth breathing post-adenoidectomy (04).

Following the evaluation and PTI, the children were referred for Dental, Otorynolaryngological and Speech treatment.

The Ethical Committee of the Health Science Center, Federal University of Santa Maria, RS, Brazil approved the study .Detailed explanation about the study was given to parents and children, both orally and in a written form. Children's parents were informed about the potential risks and benefits and signed an inclusive informed consent form prior to their children's participation in the study.

Data recording

Cervical muscle EMG activity was recorded bilaterally during nasal inspiration and isometric contraction before and at the end of 12-week physical therapy program.
Surface EMG was recorded bilaterally from the Sternocleidomastoid (SCM), Upper Trapezius (UT) and Sub-occipital (SOC) muscles. Recordings were made during the following activities: 1) nasal inspiration and, 2) during quiet position and 3) during an isometric contraction while sitting in an adapted chair. Previously to EMG acquisition during nasal inspiration test, the nasal airflow was tested in order to verify an audible nasal congestion as the child forcibly inhales through the nose[14], which determined the postponement of the test. The EMG signal collection started with child in a quiet position and in the middle of the EMG tracing (after 5 seconds), he/she should inspire slowly through the nose until the end of the recording. The duration of EMG signal acquisition for this test was 10 seconds. For isometric tests, an adapted chair was used to provide resistance to head flexion (figure 1), head extension, and shoulder elevation during 5 seconds of EMG signal acquisition. The UT isometric contraction was accomplished using the same chair with an external resistance placed above the child's shoulder, while they were asked to do a bilateral shoulder elevation movement. The EMG activity in isometric contraction provided data for the normalization procedure. Six active single differential surface electrodes were placed on the right and left SCM muscles, UT muscles and the SOC muscles. This electrode's placement and skin preparation followed Cram's recommendations[15.] A reference electrode was placed on the wrist of the subjects. The electrodes (Lynx Electronic Technology Ltda)[#], used in the acquisition of EMG signals

have a contact diameter 10 x 2 mm, parallel bars of pure silver 10mm apart, gain of 100x, input impedance of 10 GΩ and CMRR of 130dB. The EMG signals were amplified and conditioned using Myosystem Br-1 equipment[##], with a gain of 50x, band pass filtering from 20 Hz to 1000 Hz , and sampled using a 12 Bit A/D converter board set to a 4KHz sampling frequency. This equipment is in accordance with the international standardization.[16]

Figure 1- Isometric contraction test for SCM muscle. The child was instructed to try and tuck his chin towards his chest against a bar which provided resistance.

The data were analyzed in the EMG amplitude domain. The Root Mean Square (RMS) values, a relatively popular and acceptable method for EMG data processing 17, were calculated by the Myosystem Br -1 software. The absolute EMG amplitude values (expressed in µV) were normalized following some authors' recommendation[15,17] in order to enable comparison of data collection within a subject, as a function of experimental conditions.

The normalized values (expressed in %) resulted from the division of the amplitude parameters obtained from recordings during nasal inspiration by the largest amplitude value obtained in the isometric contraction.

Physical Therapy Intervention (PTI)

The Swiss ball, in combination with breathing exercises, was selected as the method for PTI in mouth breathing children considering it requires good body posture alignment for balancing and greater muscular activation levels is demanded on an unstable surface. [18] Therapeutic exercises on a Swiss ball (55 and 65 centimeters diameter, according to the child's height) consisted of directed movements to restore postural alignment, primarily through stretching of the anterior muscles and strengthening of the posterior muscles of the trunk. The exercises were performed in sitting, supine and prone positions using the Swiss ball as illustrated in figure 2. The program also included manual stretching in the Sternocleidomastoid (SCM) and Scalene muscles and naso-diaphragmatic breathing re-education through manual proprioceptive stimulus in different positions on the Swiss ball. The subjects participated in the 30-minute training sessions twice a week for 12 consecutive weeks (total of 24 sessions). Attention was focused towards correcting head position, since this is the most important postural disturbance found in mouth breathers [1,19,9,20] and the EMG evaluation was addressed to the cervical muscles.

Figure 2 - An example of the exercise on the Swiss Ball for, simultaneously, strengthening the posterior muscles and stretching the anterior muscles of the trunk.

Statistical Analysis

Normalized EMG levels presented by each of tested muscles were organized in Tables that show the mean and respective standard-deviation values obtained before and after PTI. To establish a comparison among the studied groups was used the Wilcoxon non-parametric test to analyze dependent data with Statistical Analysis System (SAS) release 8.02. The significance level was set at 1%.

RESULTS:

The EMG recordings acquired from cervical muscles (SCM, sub-occipitals and Upper Trapezius) during nasal inspiration showed a high level in these muscles activity in children with MBS, which significantly decreased after treatment. Mean values and standard-deviation of normalized EMG data are presented in table 1 and plotted in figure 3. The EMG raw signals of the SCM muscles during nasal inspiration, before and after PTI, are shown in figure 4.

Table 1- Mean values and Standard-deviation of normalized EMG levels (%) during nasal inspiration in the SCM, SOC and UT muscles pre e post PTI

MUSCLES	PRE		POST		P-value
	Mean	SD	Mean	SD	
SCM (%)	11.3	10.3	3.6	2.3	0.0001*
SOC (%)	22.4	16.1	11.7	10.0	0.0018*
UT (%)	8.9	9.3	3.1	2.8	0.0002*

SCM – Sternocleidomastoid muscle SOC – sub-occipitals muscles UT – Upper trapezius muscle

*Statistically significant at 1% level (P < 0,01).

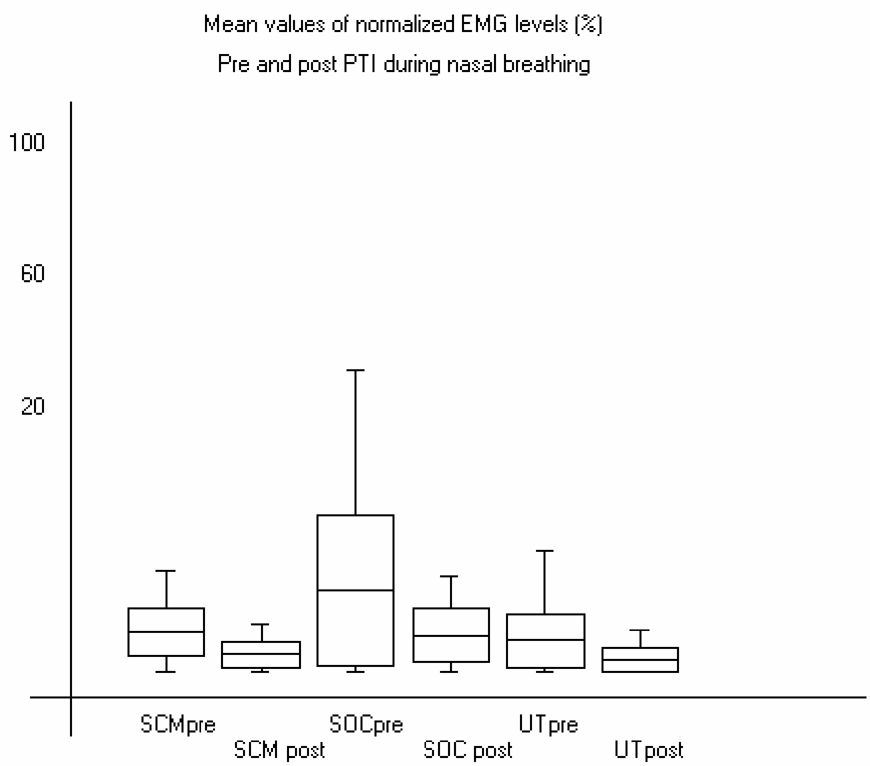

Figure 3 - Mean values and Standard-deviation of normalized EMG data from cervical muscles pre and post PTI during nasal inspiration.

Channel 1: SCM left muscle pre treatment

Channel 1: SCM left muscle post treatment

Channel 2: SCM right muscle pre treatment

Channel 2: SCM right muscle post treatment

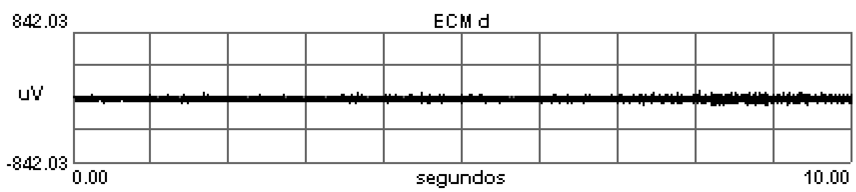

Figure 4 - EMG raw signal of the right and left SCM muscles of a mouth breathing child pre and post treatment.

The EMG levels obtained pre treatment can be considered “hyperactivity” levels because they are higher than 10% of MVC, except the right UT muscle. According to Fisnterer[21], the EMG- interference patterns starts at 10% of Maximal Voluntary Contraction and higher, and this EMG level at rest corresponds to muscular hyperactivity. The post-treatment recordings showed that the muscle activity was adjusted in SCM and UT, but not in the SOC muscles. The lower EMG activity in the SCM and UT means that the muscle recruitment of the inspiratory accessory muscles reduced with the PTI, probably because the diaphragm muscle became able to assume a greater muscular work in the breathing.

The results also demonstrated that after PTI, the EMG activity during nasal inspiration became closer to the EMG levels obtained in quiet position than before PTI. Figure 5 shows the normalized EMG values during quiet position and nasal inspiration pre and post PTI in the evaluated muscles.

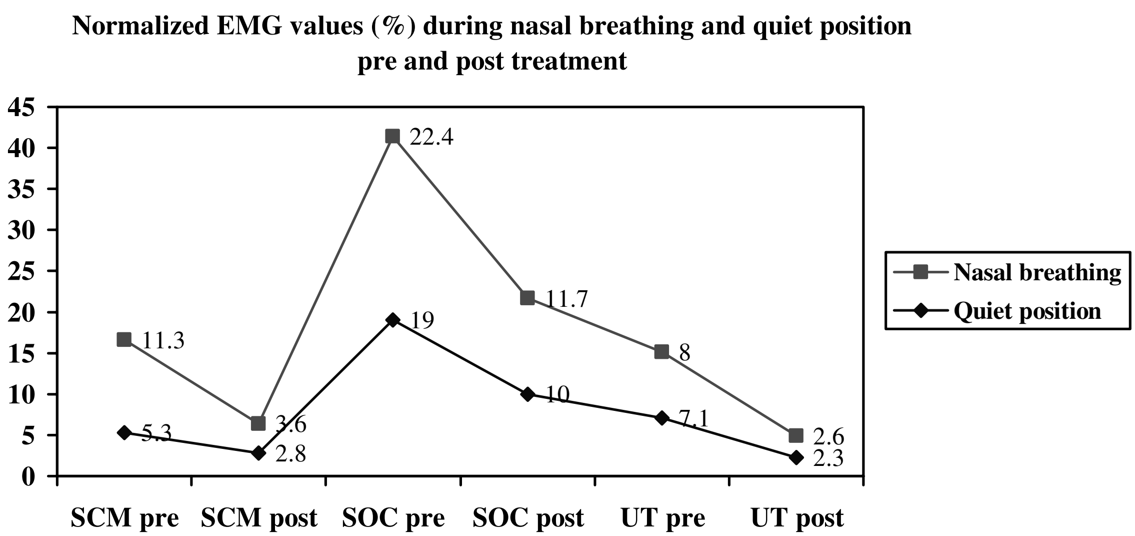

Figure 5 - Comparison between normalized EMG values obtained on cervical muscles during quiet position and nasal inspiration pre and post PTI.

DISCUSSION:

The present study evaluated the effect of the postural and breathing exercises on the cervical muscles during nasal inspiration in mouth breathing children. The results evidenced a positive effect of this intervention, since all muscles presented a significant reduction on the EMG activity levels after PTI. In order to inspire through the nose, the children presented levels of 11.3, 22.4 and 8.9% of isometric contraction on SCM, SOC and UT muscles, respectively before PTI. After PTI, these levels decreased to 3.6, 11.7 and 3.1% on SCM, SOC and UT muscles, respectively. Although the SCM are considered accessory inspiratory muscles [22,23] ,the SOC muscles presented the highest levels of EMG activity, probably because of its function as cervical extensor in the posterior cranial rotation induced by the nasal obstruction[15,19,11,8] However, the greatest difference after PTI was observed on SCM muscles, which is justified by their action as inspiratory accessory muscles. The results also demonstrated that, after treatment, the activity levels during nasal inspiration were closer of those observed in a quiet position that were 2.8, 10.5 and 2.3% of isometric contraction on SCM, SOC and UT muscles, respectively. Such results are in accordance with some authors that stated that SCM has a minor role in respiration and 70% of inspiratory capacity is achieved with no activity of SCM muscle [15,24] , yet sternocleidomastoid recruitment increases when the diaphragm decreases activity owing a low mechanical advantage. [11] Breslin *et al*[25] observed an increase of diaphragm and SCM muscles activity during resistance breathing, however over time, the diaphragm decreased activity and SCM recruitment increased.

Other authors also considered that SCM should be active only in the maximal inspiration, and its activity may be increased due to visceral and mechanical restrictions to respiration .[11,15, 23]

During quiet sitting, it is highly unusual to see large recruitment patterns associated with respiration in the UT, SCM and scalene muscles. The mayor exceptions to this rule are with COPD or patients who breathe in a paradoxical fashion.[15] The nose obstruction, which leads to an abnormal and inefficient breathing through the mouth causes drop in the PaO_2 and in the exercise tolerance. [1] It also determines profound effects on respiration and airway caliber in the lungs due to the disturbances in the nasal afferent nerves. [4,5] Additionally, it has shown the association of mouth breathing with obstructive sleep apnea and Cor pulmonale.[7]

According to Basmajian & De Luca[22], the increase of electrical activity of respiratory accessory muscles in patients with respiratory deficiency is probably some form of compensatory stimulation via the respiratory center of CNS. When the diaphragm is not able to assume the mayor portion of the muscular respiratory work, there is a raise in the proprioceptive impulses to the inspiratory accessory muscles, producing the sensation of dyspnea because of the increased activity in these muscles. [11]

In a long-term, the hyperactivity of neck muscles could be associated to cervical alterations, which as a consequence may cause Temporo-mandibular (TMD) and Cervical Spine Disorders. [20]

Muscle shortness may be a substantial contributor to problems in trapezius and scalene muscles, which may be linked to respiration. Therefore, relaxation of resting tone is considered essential to successful outcomes. Teaching a relaxed respiratory pattern involves teaching the patient to breathe abdominally.[15] This was confirmed by Costa et al[23] that verified SCM muscle was inactive during deep nasal inspiration in individual with diaphragmatic breathing pattern and active during nasal and oral inspiration in individuals with thoracic breathing pattern.

Ribeiro *et al*[10] also found higher activity of the sternocleidomastoid and upper trapezius muscles in children with MBS than in children with nasal breathing mode, suggesting that due to nasal obstruction, there is a change in the head posture and therefore these muscles stay in a contracted state without relaxation or rest. Also, nasal obstruction requires a larger inspiratory effort and, consequently, increases the inspiration accessory musculature EMG activity.

A head extension is considered a compensatory mechanism to increase the pharyngeal airway space, whereas it was demonstrated not be enough for providing a normal breathing pattern. [19]

The forward head posture is influenced by the obstruction of the nasal airways, dyspnea , as well by the short and/or upper thoracic breathing, which increases the SCM activity and induces thoracic elevation, impairing the mechanical effectiveness of diaphragm muscle. This change in head posturing intensifies the inspiratory effort, settling down a vicious cycle of dysfunctional breathing [2,11,26] The increase in the SCM muscles activity seems to be due to not only to the upper airway resistance but also because of the mechanical disadvantage of the diaphragm muscle caused by the postural changes. The head protraction and the shortening of the posterior muscle chain produces higher thoracic convexity, inspiratory position of the chest and medial rotation of shoulders, confirming the postural disturbances resulted from respiratory obstruction in patients with MBS.[9]

There is little evidence about the relationship between specific respiratory muscle recruitment and the sensation of dyspnea, yet it was observed that COPD patients who recruit accessory neck and rib cage muscles in ventilation are more likely to report an increase in the sensation of dyspnea. [25]

Breslin *et al*'s study[25] indicated that a shift in the ventilatory work from the rib cage and accessory muscles to diaphragm may reduce the sensation of dyspnea. The authors reported that resistance breathing resulted in a positive correlation with EMG activity of SCM and dyspnea, which was associated with breathing desynchrony.

A significant mechanical nasal airway obstruction is impossible to overcome by conscious effort, but a person who is mouth breather habitually may benefit by a concerted effort to keep the mouth closed. 1 The mouth breathing persistence even after resolution of the initial functional abnormality (increased nasal resistance) has been mentioned by some authors.[12,26,27] They attributed this to the reflection of neural adaptations and long-lasting modifications of central control of upper airway muscle function and the skeletal changes affecting the posture and the muscular balance, which also requires treatment. Additionally, it is evidenced that some children with adequate upper airways breathe through the mouth due to a habit. The postural and respiratory techniques can influence the respiratory mode as in habitual mouth breathers as in allergic patients. The nasal breathing should be practiced in the inter-crisis period and after the removal of the causative factor of airway obstruction. [2,6]

Basmajian & De Luca[22] pointed out the importance of proprioception in driving the respiratory muscles and reported a study from University of Wisconsin with

EMG from diaphragm and intercostals muscles to evaluate the "abdominal compression reaction" in anesthetized dogs. They observed that such strong abdominal compression determines a caudal movement of diaphragm in the initial phase of inspiration .This is related to sudden inhibition of the abdominal compression reaction and a corresponding decrease in intra-abdominal pressure. Diaphragmatic breathing exercises, which emphasize abdominal rather than the rib cage expansion, are helpful when there is an overuse of the accessory muscles of the neck and upper chest. [28]

Practicing slow diaphragmatic breathing in response to all stimuli (emotional situations, walking up hill or exposure to allergens) can reduce the asthmatic and breathlessness symptoms. [29] Diaphragmatic breathing has been reported as a commonly treatment used for dyspnea because it contributes to the reduction in respiratory rate and tidal volume. [25]

Besides the proprioceptive stimulus for the adequate diaphragmatic work, the PTI needs to be addressed to the body posture, since it is postulated that optimal breathing capability derives from a posture of optimal muscle balance. The postural re-alignment is beneficial in part by improving the diaphragmatic mechanical advantage.[28] An adequate work of breathing demands liberation of the body tensions and increase of the mobility of thoracic joints. According to Hall & Brody, tactile feedback on the abdomen and rib cage along with stretch of the lateral trunk and intercostals muscles should be used in the diaphragmatic re-education. It is also recommended that the diaphragmatic breathing should not be taught, but facilitate with an adequate thoraco-abdominal mechanics. [26]

The abdominal muscles have a double function during breathing, as a support for the lower thoracic expansion and as in the lowering of ribcage. Therefore, abdominal exercises on the Swiss Ball were included in the PTI program, since abdominal muscles strengthening is also indicated to reestablish the appropriate diaphragmatic position and length. [6,11]

Some activity such as gasping, thoracic breathing, breath holding, etc adversely affect the respiratory pattern. Changing the respiratory patterns with effortless diaphragmatic breathing may lead to an improvement in health and performance. The respiratory re-education to correct the mouth breathing is justified because it provides a decrease on the frequency and intensity of dyspnea. [2]

The clinical relevance of this study is with respect of the high incidence of Mouth Breathing Syndrome and its association with asthma[20], respiratory infections and sleep disordered breathing7; the importance of an evaluation including postural and respiratory type 15 to minimize the consequences of the muscular imbalance; and the need of a precocious and complete interdisciplinary evaluation and intervention approach for better therapeutic outcomes with positive impact in the quality of life of these patients. It must be also emphasized the need of prophylactic measures as breast feeding and environment hygiene to diminish the incidence of allergic diseases.

Most of the criticism in the present study is regarding the lack of a clinical assessment of the ventilatory pattern and mechanics along with the EMG evaluation of cervical muscles, even though this was not its purpose. Costa[2] reported some methods for the assessment of the dysfunction resulting from the mouth breathing as measurement of Maximal Inspiratory Pressure and Peak Flow, which can be adapted to be used through the nose. It was also recommended the evaluation of spirometric parameters and thoracic expansibility by means of the diameter of thorax and abdomen measures. Thereby, further studies are demanded to verify the effect of the physical therapy approach on ventilatory mechanics and lung function in mouth breathing children.

CONCLUSION:

The results of the current study evidenced a significant decrease on the EMG activity on tested muscles after treatment in children with MBS. These findings suggest the PTI promoted a better postural alignment, specifically regarding the head forward posture, and an adequate respiratory pattern with less participation of inspiratory accessory muscles. Also, the improvement on the muscular balance seems to contribute for a reduction of the recruitment pattern on cervical muscles in these children during nasal inspiration.

The EMG analysis can be considered a reliable method for this sort of analysis, yet with careful measures regarding to instrumentation for an EMG signal acquisition with quality and for a proper data processing.

Suppliers:

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4. DISCUSSÃO GERAL:

As doenças alérgicas apresentam alta incidência, afetando cerca de 20% da população. A rinite alérgica é a causa mais comum de obstrução nasal crônica em crianças, a qual estabelece um padrão suplente de respiração pela boca. A alergia respiratória contribui para o crescimento adenoideano que, mesmo quando extirpado pode apresentar recidiva e, reforça ainda mais a alteração do padrão respiratório. Portanto, este é um problema de saúde que merece maior atenção tanto no sentido de preveni-lo, como no sentido de proporcionar uma abordagem terapêutica precoce e globalizada com resultados rápidos e efetivos. (Costa, 1997; Lusvarghi, 1999; Marins, 2001; Novaes & Vigorito, 1993).

A implementação de medidas preventivas, como a conscientização da importância do aleitamento materno e a higiene ambiental com prevenção da exposição aos alérgenos e fumaça do tabaco, têm sido recomendados para o controle da ocorrência de afecções alérgicas. A sensibilização da membrana mucosa nasal com edema persistente, pelo aleitamento precoce com leite de vaca, é considerada como o fator primário sensibilizante que desencadeia alergia infantil. (Rickets, 1968; Lusvarghi, 1999) Além disso, a intervenção para a eliminação de hábitos deletérios como chupar dedo ou uso de chupeta, controle do estresse e orientação ergonômica nas creches, ambulatórios e escolas podem contribuir para a prevenção de alterações oclusais e posturais que podem levar ao hábito da respiração bucal ou reforçá-lo. (Lusvarghi, 1999; Marins, 2001; Nouer *et al*, 2005)

Acredita-se que a percepção da importância de uma ação conjunta e uma avaliação integrada entre alergistas, otorrinolaringologistas, dentistas, fonoaudiógos, psicólogos e fisioterapeutas no tratamento da SRB, seja o principal meio de atingir a eliminação definitiva do problema. Pela grande plasticidade do sistema músculo-esquelético, quanto mais cedo a respiração bucal é estabelecida, maiores são as chances da criança desenvolver deformidades. (Lusvarghi, 1999; Marins, 2001) Por isso, a atuação precoce, antes do desenvolvimento de alterações irreversíveis, favorece a eficácia terapêutica.

Este estudo propôs-se a avaliar eficácia da intervenção fisioterapêutica, com a correção postural e reeducação naso-diafragmática, por meio de eletromiografia e análise fotográfica computadorizada.

A eletromiografia é uma ferramenta cinesiológica utilizada para o estudo da função muscular e, além de servir como um recurso diagnóstico, possibilita a avaliação da atividade muscular durante ou como resultado de exercícios e procedimentos terapêuticos. Por isso, tem sido amplamente utilizada na fisioterapia, auxiliando com a avaliação de dados importantes para uma prática clínica efetiva e contribuindo para a obtenção de evidências científicas da eficácia terapêutica.(Portney, 1993; Soderberg & Knutson, 2000) Estudos prévios mostraram maior nível de atividade elétrica nos músculos cervicais em crianças respiradoras bucais em relação às crianças respiradoras nasais. (Ribeiro *et al* 2002, 2003, 2004).

É consenso entre os autores que a respiração bucal acarreta compensações posturais, principalmente a extensão da cabeça para facilitar a passagem do fluxo aéreo. (Carvalho, 2005; Corrêa & Bérzin, 2004; Ribeiro *et al*, 2004; Hall & Brody, 2005; Krakauer & Guilherme, 1998) A associação da respiração bucal com o uso excessivo dos músculos acessórios da inspiração também têm sido relatada. (Corrêa & Bérzin, 2004; Hruska, 1997; Yi *et al*, 2004) Com base nestas considerações, optou-se por um programa de intervenção fisioterapêutica combinando exercícios de correção da postura corporal na Bola Suíça e a reeducação naso-diafragmática. A reeducação respiratória e métodos como Reeducação Postural Global, Hidrocinesioterapia, Iso-stretching, Posturologia , cinesioterapia clássica e método GDS são citados como recursos fisioterapêuticos na SRB. (Carvalho 2005; Costa 1997; Marins, 2001). Yi *et al* (2004) propuseram uma reeducação respiratória e postural baseada em exercícios de relaxamento, alongamento, fortalecimento e conscientização respiratória. Porém poucos estudos foram encontrados na literatura que evidenciam os efeitos da intervenção da fisioterapia na SRB. Costa *et al* (1994a) demonstraram a efetividade da fisioterapia respiratória, com enfoque na reeducação respiratória, por meio da avaliação de pressões respiratórias máximas, Peak Flow e cirtometria toraco-abdominal. Os autores concluíram que o tratamento promoveu o fortalecimento muscular respiratório com melhora da mecânica diafragmática, redução da ação dos músculos acessórios da inspiração, assim como alívio sintomático de pacientes com alergia respiratória. Em 2002, Chaves *et al* propuseram o treinamento respiratório nasal com inspiração nasal a 80% da pressão inspiratória máxima medida através de um nasomanômetro. Este treinamento aumentou a força muscular respiratória, os parâmetros espirométricos e o fluxo nasal. Também há registro de um estudo com biofeedback respiratório em crianças respiradoras bucais para monitorização dos movimentos tóraco-abdominais. Este método também obteve o aumento da PIMax e mudança do padrão bucal para nasal e do padrão ventilatório predominantemente abdominal para misto, porém sem alterações na espirometria e cirtometria. (Barbiero *et al*, 2002) Ribeiro & Soares (2003) verificaram, na avaliação espirométrica de 14 crianças respiradoras bucais, que apenas 21% das crianças apresentavam função pulmonar dentro da normalidade. Após um programa de fisioterapia respiratória e postural, 57% das crianças atingiram valores normais de volumes e capacidades pulmonares. Os autores concluíram que houve uma alta incidência de alteração espirométrica nos respiradores bucais (79%) e que, a correção postural e reeducação diafragmática contribuíram para a melhora do padrão diagragmático e da função pulmonar. Em 2000, Lima *et al* demonstraram a diminuição no recrutamento muscular do ECM com o método reequilíbrio tóraco-abdominal, por meio de alongamento dos músculos inspiratórios acessórios e estímulo diafragmático, com redução do trabalho ventilatório em paciente com DPOC. O método, desenvolvido por Lima, há mais de 10 anos, tem um enfoque biomecânico para o tratamento das disfunções ventilatórias e baseia-se em dois conceitos básicos: a integração das atividades sensório-motora e respiratória e, o movimento respiratório sincrônico e com mínimo esforço.

No presente estudo, a avaliação eletromiográfica evidenciou uma redução na atividade elétrica dos músculos esternocleidomastóideo, sub-occipitais e trapézio superior após a intervenção fisioterapêutica. Com a correção postural e reeducação respiratória, houve uma redução no padrão de recrutamento muscular na posição de repouso, durante inspiração nasal e o alinhamento postural. A postura ideal deve demandar um mínimo esforço muscular (Kendall *et al*, 1993) e a atividade elétrica muscular somente é exigida quando o corpo é deslocado para fora da linha de gravidade (Basmajian & De Luca, 1985). Com isso, pôde-se constatar que a fisioterapia, diminuindo a atividade muscular para o alinhamento da postura, promoveu uma melhora do padrão postural e o reposicionamento corporal no eixo da gravidade.

Foi constatado, na avaliação EMG, que os níveis de atividade muscular no repouso estavam próximos aos níveis do alinhamento postural. E, após a fisioterapia, estes se apresentaram significativamente mais baixos, em ambas as situações. Isto mostra que o nível de atividade muscular numa postura alinhada deve ser similar ao nível de atividade em situação de repouso, ou seja, silêncio elétrico, uma vez que não demanda esforço muscular. (Kendall *et al*, 1993; Basmajian & De Luca, 1985). Antes da fisioterapia, os músculos sub-occipitais e trapézio apresentaram níveis elevados de atividade. Após o tratamento houve uma redução significativa nestes valores, porém os músculos sub-occipitais ainda foram considerados hiperativos. Isto pode ser atribuído à provável manutenção de extensão da cabeça, ainda que em menor grau.

Após o tratamento, os níveis de atividade muscular nos músculos ECM reduziram significativamente em todas as situações testadas. Cabe destacar que na inspiração nasal, a atividade EMG deste músculo diminuiu de 11,3% para 3,6%, evidenciando a redução da sua ação como músculo acessório da inspiração. O músculo trapézio, que também desempenha um papel inspiratório em situações de disfunção ventilatória (Cram *et al*, 1998), diminuiu sua atividade de 7,1 para 2.3% após a fisioterapia. Isso também demonstra a melhora do padrão ventilatório, com menor participação da musculatura acessória. A maior exigência da musculatura acessória da inspiração na SRB ocorre, não só pelo aumento da resistência das vias aéreas, mas também pela postura anteriorizada da cabeça e pela hipofunção diafragmática. Com a redução da atividade EMG nos músculos cervicais, pode-se supor que houve o restabelecimento da função diafragmática com a reeducação e a melhora da postura. Portanto, este programa de tratamento mostrou-se efetivo na redução do esforço da musculatura acessória da inspiração.

O software ALCimagem, um algoritmo matemático que executa uma análise angular em imagens fotográficas, permite avaliar quantitativamente os desvios posturais e monitorar resultados terapêuticos. (Baraúna & Ricieri, 2002) O estudo de Lima *et al* (2004) demonstrou a confiabilidade deste programa por meio de medidas angulares utilizadas na avaliação biofotogramétrica de crianças respiradoras nasais e bucais. Apesar da escassa padronização para a utilização deste método, os pontos anatômicos selecionados para a mensuração dos ângulos neste estudo mostraram-se adequados para a análise fotográfica computadorizada. A determinação das medidas angulares foi fundamentada pelas diretrizes clínicas da avaliação postural orientadas por Kendall (1993).

No que se refere à avaliação da postura corporal, os resultados da intervenção fisioterapêutica foram evidenciados com a redução significativa dos ângulos utilizados para mensurar a anteriorização da cabeça e abdução escapular. Estas foram as alterações mais freqüentemente observadas, em concordância com estudos referentes a postura corporal de crianças respiradoras bucais (Krakauer, 1998; Lima *et al*, 2004; Rocabado, 1979). A anteriorização da cabeça foi mensurada com o ângulo formado entre a linha do fio de prumo e o meato auditivo externo, o qual reduziu significativamente após a fisioterapia. Houve uma redução do grau de extensão cervical, confirmado na análise fotográfica e pela redução da atividade EMG de todos os músculos no alinhamento postural. Porém, como os músculos sub-occipitais mantiveram elevados níveis de atividade após o tratamento, sugere-se que a postura anteriorizada da cabeça foi parcialmente corrigida. Tal resultado pode ser atribuído aos exercícios de auto-alongamento realizados na posição sentada sobre a Bola Suíça e o alongamento da cadeia muscular posterior. A reeducação diafragmática também pode ter contribuído, uma vez que os músculos inspiratórios acessórios deixando de serem recrutados, favorecem o alinhamento da postura da cabeça. Isto vem confirmar os resultados de Costa *et al* (1994b) que verificaram ausência de atividade no músculo ECM durante a inspiração nasal profunda em indivíduos com padrão respiratório diafragmático e presença de atividade durante a inspiração nasal e oral em indivíduos com padrão respiratório torácico.

A correção da abdução escapular com a fisioterapia foi evidenciada pela redução significativa das medidas angulares entre o fio de prumo e a proeminência da escápula na vista lateral e, na vista posterior, entre os ângulos inferiores direito e esquerdo e C7. Estes resultados são concordantes com Kendall *et al*(1993) que estabeleceram que no alinhamento esquelético ideal, na vista lateral, as escápulas devem ser planas contra a coluna superior. Os resultados da análise fotográfica confirmam os achados eletromiográficos, uma vez que a redução da atividade EMG do músculo trapézio indica a correção do seu encurtamento, responsável pela abdução e elevação da escápula, assim como a anteriorização da cabeça. Estes resultados mostram que o alongamento da cadeia anterior em posição supina sobre a Bola Suíça pareceu ser efetivo para recuperação do comprimento muscular dos músculos peitorais e serrátil anterior, cujo encurtamento determina a abdução escapular (Penha *et al*, 2005). Acredita-se ainda que os exercícios com os membros superiores realizados na posição prona sobre a Bola Suíça promoveram o fortalecimento dos músculos estabilizadores da escápula, com conseqüente correção da abdução escapular. Estudos demonstraram que os exercícios executados em superfícies instáveis como a bola, demandam mais alto nível de atividade muscular para manter a estabilidade corporal, o que explica o fortalecimento obtido nesta musculatura. (Marshall & Murphy, 2005; Mori, 2004) O treinamento proprioceptivo e de percepção corporal realizado na Bola Suíça favorece a correção de desvios posturais em crianças, de forma lúdica e divertida. (Carrière, 199; Rocabado & Antoniotti, 1995; Tribastone, 2001) Desta forma, a Bola Suíça revelou-se um método de tratamento postural apropriado a crianças respiradoras bucais.

Além do trabalho postural e de reeducação respiratória, durante os três meses de execução do programa, medidas educativas de cuidados posturais e orientações para reduzir as crises alérgicas e as alterações decorrentes da respiração bucal foram implementadas.(ANEXO 9)

Os resultados deste estudo evidenciam a necessidade e a efetiva contribuição da fisioterapia no tratamento destes pacientes.

A crescente necessidade de comprovação da eficácia dos recursos e procedimentos empregados pela fisioterapia impõe a necessidade da realização de pesquisas com este propósito, contribuindo para que a prática da fisioterapia seja cada vez mais baseada em evidências científicas. A continuidade da investigação científica neste tema poderá confirmar estes resultados em longo prazo, com um número maior de crianças e com métodos de avaliação, cujo enfoque contemple a mecânica ventilatória e a função pulmonar. Considera-se, ainda, de maior relevância a avaliação do impacto da intervenção da fisioterapia sobre a qualidade de vida destes pacientes em estudos posteriores.

Cabe salientar que o sucesso terapêutico na Síndrome do Respirador Bucal depende de uma acurada avaliação que possa fundamentar a elaboração e implementação de um programa de tratamento integral e efetivo.

5. CONCLUSÃO GERAL:

A intervenção da fisioterapia, com a correção postural em Bola Suíça e reeducação diafragmática, promoveu a redução da atividade elétrica dos músculos cervicais tanto na posição de repouso, quanto durante a inspiração nasal e o alinhamento postural.

No que se refere à postura corporal, os resultados obtidos evidenciam a correção da posição anteriorizada da cabeça e da abdução escapular, demonstrada quantitativamente por meio de medidas angulares calculadas pela análise fotográfica computadorizada.

Os métodos adotados para avaliação objetiva da intervenção fisioterapêutica mostraram-se seguros e confiáveis, desde que utilizados com devidos cuidados e instrumentação adequada. A análise fotográfica é um método acessível para a fisioterapia, sem os custos de equipamentos sofisticados de análise de movimento ou possíveis riscos de repetidas avaliações radiológicas. A eletromiografia de superfície permite a monitorização muscular não invasiva e com mínimos riscos para o paciente, porém exige a observação de medidas para garantir a boa qualidade do sinal e um adequado processamento dos dados.

Os resultados indicam que, mediante as condições experimentais deste estudo, a intervenção fisioterapêutica foi efetiva na recuperação do equilíbrio muscular e desvios posturais em crianças respiradoras bucais.

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* De acordo com a norma da Unicamp/FOP, baseada no modelo Vancouver.

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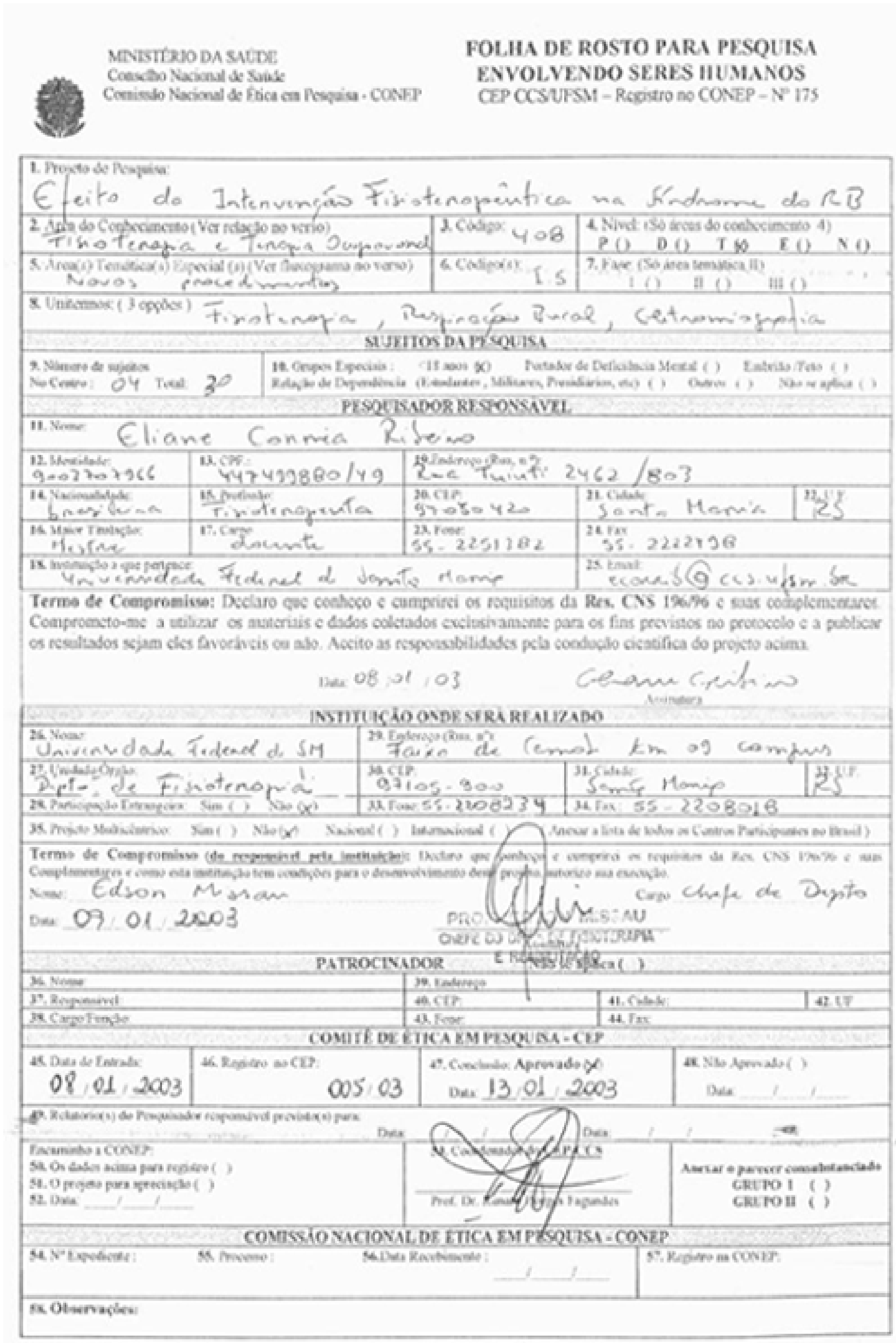
ANEXO 1: Certificado do Comitê de Ética em Pesquisa (005/03) – CCS/UFSM



MINISTÉRIO DA SAÚDE
Conselho Nacional de Saúde
Comissão Nacional de Ética em Pesquisa - CONEP

FOLHA DE ROSTO PARA PESQUISA ENVOLVENDO SERES HUMANOS
CEP CCS/UFSM – Registro no CONEP – Nº 175

1. Projeto de Pesquisa: Efeito da Intervenção Fisioterapêutica na Síndrome do RB

2. Área do Conhecimento (Ver relação no verso): Fisioterapia e Terapia Ocupacional | 3. Código: 408 | 4. Nível: (Só áreas do conhecimento 4) P ( ) D ( ) T (x) E ( ) N ( )

5. Área(s) Temática(s) Especial (s) (Ver fluxograma no verso): Novos procedimentos | 6. Código(s): I.5 | 7. Fase: (Só área temática II) I ( ) II ( ) III ( )

8. Unitermos: (3 opções) Fisioterapia, Respiração Bucal, Cefalometria

SUJEITOS DA PESQUISA

9. Número de sujeitos No Centro: 04 Total: 30 | 10. Grupos Especiais: <18 anos (x) Portador de Deficiência Mental ( ) Embrião /Feto ( ) Relação de Dependência (Estudantes, Militares, Presidiários, etc) ( ) Outros ( ) Não se aplica ( )

PESQUISADOR RESPONSÁVEL

11. Nome: Eliane Correa Ribeiro

12. Identidade: 9007707966 | 13. CPF: 447499880/49 | 19. Endereço (Rua, nº): Rua Tuiuti 2462 /803

14. Nacionalidade: brasileira | 15. Profissão: Fisioterapeuta | 20. CEP: 97050420 | 21. Cidade: Santa Maria | 22. UF: RS

16. Maior Titulação: Mestre | 17. Cargo: docente | 23. Fone: 55 - 2251182 | 24. Fax: 55 - 2222198

18. Instituição a que pertence: Universidade Federal de Santa Maria | 25. Email: ecorreaS@ccs.ufsm.br

Termo de Compromisso: Declaro que conheço e cumprirei os requisitos da **Res. CNS 196/96** e suas complementares. Comprometo-me a utilizar os materiais e dados coletados exclusivamente para os fins previstos no protocolo e a publicar os resultados sejam eles favoráveis ou não. Aceito as responsabilidades pela condução científica do projeto acima.

Data: 08/01/03 Assinatura

INSTITUIÇÃO ONDE SERÁ REALIZADO

26. Nome: Universidade Federal de SM | 29. Endereço (Rua, nº): Faixa de Camobi km 09 campus

27. Unidade/Órgão: Dpto. de Fisioterapia | 30. CEP: 97105-900 | 31. Cidade: Santa Maria | 32. UF: RS

28. Participação Estrangeira: Sim ( ) Não (x) | 33. Fone: 55-2208234 | 34. Fax: 55-2208018

35. Projeto Multicêntrico: Sim ( ) Não (x) Nacional ( ) Internacional ( ) (Anexar a lista de todos os Centros Participantes no Brasil)

Termo de Compromisso (do responsável pela instituição): Declaro que conheço e cumprirei os requisitos da Res. CNS 196/96 e suas Complementares e como esta instituição tem condições para o desenvolvimento deste projeto, autorizo sua execução.

Nome: Edson Moraes Cargo: Chefe de Depto

Data: 09/01/2003

PROF. [illegible] MESTAU
CHEFE DO DEPTO. DE FISIOTERAPIA E REABILITAÇÃO

PATROCINADOR Não se aplica ( )

36. Nome | 39. Endereço
37. Responsável | 40. CEP: | 41. Cidade: | 42. UF
38. Cargo/Função | 43. Fone: | 44. Fax:

COMITÊ DE ÉTICA EM PESQUISA - CEP

45. Data de Entrada: 08/01/2003 | 46. Registro no CEP: 005/03 | 47. Conclusão: Aprovado (x) Data: 13/01/2003 | 48. Não Aprovado ( ) Data: __/__/__

49. Relatório(s) do Pesquisador responsável previsto(s) para: Data: __/__/__ Data: __/__/__

Encaminho a CONEP:
50. Os dados acima para registro ( )
51. O projeto para apreciação ( )
52. Data: __/__/__

53. Coordenador do CEP/CCS
Prof. Dr. [illegible] Fagundes

Anexar o parecer consubstanciado
GRUPO I ( )
GRUPO II ( )

COMISSÃO NACIONAL DE ÉTICA EM PESQUISA - CONEP

54. Nº Expediente: | 55. Processo: | 56. Data Recebimento: __/__/__ | 57. Registro na CONEP:

58. Observações:

ANEXO 2 – TERMO DE CONSENTIMENTO

UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ODONTOLOGIA DE PIRACICABA
PROGRAMA DE PÓS-GRADUAÇÃO EM BIOLOGIA BUCO-DENTAL

Consentimento formal de participação no estudo intitulado **"Efeito da Intervenção Fisioterapêutica na Síndrome do Respirador Bucal: análise eletromiográfica e fotogramétrica"**

Orientador: Prof. Dr. Fausto Bérzin
Doutoranda: Eliane Corrêa Ribeiro

A pesquisadora responsável, doutoranda do Programa de Biologia Buco-dental da Faculdade de Odontologia de Piracicaba, área de concentração em Anatomia, explicará os procedimentos e responderá a qualquer dúvida sobre este termo de consentimento e/ou sobre o estudo. Leia cuidadosamente este documento.

Objetivo do estudo:

Investigar o efeito do tratamento fisioterapêutico de correção postural com bola suíça e reeducação ventilatória em crianças respiradoras bucais, por meio de eletromiografia e fotogrametria.

Explicação do Procedimento:

Inicialmente, meu filho será submetido a uma avaliação postural, em traje de banho, com registro fotográfico nas posições de frente, de costas e em perfil direito e esquerdo (em pé) e avaliação eletromiográfica dos músculos esternocleidomastóideo e trapézio .

Fui informado de que a eletromiografia, por tratar-se de um método não invasivo, em que os exames são realizados com eletrodos de superfície fixados sobre a pele e, cujo equipamento possui isolamento galvânico como medida de biossegurança, é completamente indolor e sem contra- indicação.

Para este exame, será feita a higiene da pele do pescoço e acima do ombro, com álcool etílico 70 % , onde serão colocados os eletrodos de superfície fixados com fita hipoalergênica para curativos, do lado direito e esquerdo. Também será colocado um eletrodo de referência (ligado ao fio terra) untado com gel no seu tórax, para evitar interferências de correntes eletromagnéticas. Os eletrodos captam a atividade elétrica do músculo, a qual é transmitida a um aparelho amplificador e a um computador, onde aparecerá o registro do sinal coletado.

Após a avaliação, meu filho será submetido ao tratamento fisioterápico para correção postural que constará de exercícios com bola terapêutica (suíça) e reeducação muscular ventilatória. O tratamento será realizado durante 03 meses , duas vezes por semana. Os exercícios com a bola servem para alongar e fortalecer os músculos e, desta forma, melhorar a postura corporal. A reeducação muscular ventilatória é uma técnica que estimula o uso do músculo diafragma, localizado no abdômen, para respirar de forma mais adequada e completa.

Ao término do tratamento fisioterápico, serão realizadas as reavaliações postural e eletromiográfica.

Possíveis benefícios:

Ao participar desta pesquisa e submeter-se ao programa de tratamento fisioterápico, meu filho poderá adquirir um melhor alinhamento postural, em virtude do reequilíbrio muscular obtido através da correção postural e a reeducação ventilatória. Esses resultados também produzirão benefícios no sentido de reduzir o esforço durante a respiração.

Desconforto e Risco:

Fui informado que esta pesquisa não trará nenhum tipo risco à saúde de meu filho e que sua identidade será mantida em sigilo absoluto. O único desconforto que poderá trazer é para a retirada da fita hipoalergênica que fixa o eletrodo e, algum constrangimento pelo uso de traje de banho para a avaliação postural.

Seguro Saúde ou de Vida:

Eu entendo que não existe nenhum tipo de seguro saúde ou de vida que possa vir a beneficiar meu filho em função da participação nesta pesquisa.

Liberdade de Participação:

A participação de meu filho nesta pesquisa é voluntária, sendo lhe dado o direito de interromper a sua participação a qualquer momento sem que isso incorra em qualquer penalidade ou prejuízo à sua pessoa.

Sigilo de Identidade:

As informações obtidas nesta pesquisa não serão de maneira alguma associadas à identidade de meu filho e poderão ser utilizadas para fins estatísticos ou científicos desde que sejam resguardadas a sua total privacidade e confidencialidade.

Os responsáveis pelo estudo me explicaram todos os procedimentos, a necessidade da pesquisa e se dispuseram a responder todas as minhas questões sobre a mesma. Eu aceitei autorizar meu filho a participar desta pesquisa, de livre e espontânea vontade.

EU (responsável)____,
portador do RG nº: ______________________________, residente à ____________________________________, nº __________, bairro _______________________ , Cidade: ___________________ - _____ , autorizo meu filho (nome da criança) ____________________, através deste consentimento livre e esclarecido, a participar desta pesquisa, conduzida pela aluna responsável e por seu respectivo orientador.

____

Assinatura do Responsável

Santa Maria, ________ de ____________________ de 2003.

Responsável pela pesquisa:

____

Eliane Corrêa Ribeiro - pesquisadora

ANEXO 3 – AVALIAÇÃO FISIOTERAPÊUTICA

DADOS PESSOAIS:

Nome:...

Data de Nascimento: ..../........./.........   Idade Atual: ....   Sexo:............

Endereço: ____

Telefone: ______________________ Escolaridade: ___________________

Peso: ________________ Altura: ________________

Dominância: (   ) destro   (   ) canhoto

ANAMNESE:

Diagnóstico Otorrinolaringológico:
____

História Médica:
(   ) Rinite alérgica   (   ) asma   (   ) amigdalite   (   ) Pneumonia
(   ) Bronquite   (   ) otite   (   ) sinusite

Hábitos deletérios: (   ) chupeta (   ) chupar dedo (   ) mamadeira

Aspectos físicos:
(   ) mordida aberta anterior (Classe II, 1ª divisão de Angle)
(   ) lábios evertidos ou flácidos
(   ) alargamento da base do nariz
(   ) olheiras
(   ) projeção anterior da língua
(   ) flacidez facial
(   ) mandíbula para trás (retrognatismo)
(   ) ausência de contato labial

Sintomas relacionados a Síndrome de Respiração Bucal
(   ) dorme de boca aberta   (   ) ronco
(   ) espirros freqüentes   (   ) sonolência
(   ) presença de coriza e coceira no nariz   (   ) cansaço
(   ) apnéia do sono
(   ) dificuldade de respirar pelo nariz
(   ) baixo rendimento escolar
(   ) dificuldade de concentração
(   ) dificuldade para deglutir (engolir)
(   ) baixa aptidão física

AVALIAÇÃO POSTURAL:

Alteração mais evidenciada:____

ALINHAMENTO SEGMENTAR

cabeça		Inclinação ant/post		Inclinação lat		rotação		Para frente
ombro		deprimido		Elevado		Para frente		Rot. medial
abdome		Protrusão		cicatrizes				
mmss		Flexão cotovelo		Flexão dedos		pronação		Supinação
coluna		Curvatura total		Lombar		torácica		Cervical
Tórax		Deprimido		Elevado		rotação		Desvio
Dorso sup		Cifose		Plano		Abd. Escap		Elev.escap.
lombar		Lordose		Plana		cifose		
Pelve		Rotação		inclinação		desvio		
Joelhos		hiperextensão		Flexão		Rot. medial		Valgo
						Rot. lateral		Varo
Pés		Pronados		supinados		plano		Hálux valgo
		Rot medial		Rot. lateral		cavo		Dedos em martelo

X = defeito postural presente;E= esquerdo; D = direito; A = ambos; Ant = anterior; Post = posterior.

Data da Avaliação: ..../........./......... **Examinador:...**

ANEXO 4 - AVALIAÇÃO OTORRINOLARINGOLÓGICA

Nome:...
Data de Nascimento: ..../........./......... Idade atual: .... Sexo:.............
Data da Avaliação: ..../........./......... Examinador:...

- **QUEIXA:**

- **Orofaringoscopia:**

- **Rinoscopia:**

- **Ostoscopia:**

- **Laringoscopia:**

- **CONDUTA:**

- **DIAGNÓSTICO:**

ANEXO 5 - AVALIAÇÃO FONOAUDIOLÓGICA:

Nome:..
Data de Nascimento: ..../........./......... Idade atual: .... Sexo:.............
Data da Avaliação: ..../........./......... Examinador:...

Exame Extra-Bucal

- LÁBIOS

Aspecto: (....) normal (....) hipodesenvolvido (....) S (....) I
(....)hiperdesenvolvido (....) S (....) I
Postura: (....) unidos (....) entreabertos (....)separados
(....) simétricos (....)assimétricos..
Tonicidade: Lábio Superior – (....) normal (....) hipotônico (....) hipertônico
Lábio Inferior – (....) normal (....) hipotônico (....) hipertônico
Mobilidade: (....) protrusão (....) estiramento (....) contração (....) vibração (....) sopro (....) assobio (....) lateralização direita (....) lateralização esquerda
Freio Labial: (....) normal (....) alterado

- BOCHECHAS

Aspecto: (....) normal (....) anormal
Postura: (....) simétricas (....)assimétricas...
Tonicidade:Direita – (....) normal (....) hipotônica (....) hipertônica
Esquerda – (....) normal (....) hipotônica (....) hipertônica
Mobilidade: (....) inflar as duas (....) inflar direita (....) inflar esquerda

- MANDÍBULA

Aspecto: (....) normal (....) prognata (....) atrésica
Mobilidade: (....) abrir (....) fechar (....) lateralizar (...)D (...)E

- FACE

Tipo: (....) braquifacial (....) dolicofacial (....) mesiofacial
Perfil:(....) reto (....) convexo (....) côncavo

- ATM

Mobilidade:(....) normal (....) abertura com ruído (....) dor
(....) abertura com desvio (...)D (...)E

Exame Intra-Bucal

- PALATO MOLE

Aspecto: (....) normal (....) curto (....) longo
Mobilidade:(....) adequada (....)inadequada...
Úvula: (....) normal (....) bífida (....) simétrica (....) assimétrica
Amígdalas: (....) normais (....) hipertróficas

- PALATO DURO

Aspecto: (....) normal (....) plano (....) profundo

- LÍNGUA

Aspecto: (....) normal (....) microglossia (....) macroglossia
Postura de repouso: (....) papila palatina (....) entre os dentes (....) soalho da boca
Tonicidade: (....) normal (....) hipotônica (....) hipertônica
Mobilidade: (....) protrusão (....) retração (....) vibração (....) afinar (....) alargar
(....) estalar (....) elevar a ponta (....) abaixar a ponta
(....) lateralização interna (...)D (...)E
(....) lateralização externa (...)D (...)E
Freio Lingual: (....) normal (....) curto (....) alongado

Avaliação das Funções Neurovegetativas

- SUCÇÃO

Eficiente: (....) sim (....) não
Postura: Lábios - (....) protrusão (....) pressão
Língua - (....) normal (....) protruída
Mentalis - (....) normotensão (....) hipertensão
Bochechas - (....) com sulco (....) sem sulco

- MASTIGAÇÃO

Lado de preferência: (....) D (....) E (....) D / E (simetria)
Velocidade dos movimentos: (....) normais (....) lentos (....) rápidos
Movimento empregado: (....) vertical (....) rotatório
Contração do masséter: (....) forte (....) fraca
Lábios: (....) abertos (....) fechados
Mordida: (....) anterior (....) lateral

- DEGLUTIÇÃO

Deglutição: (....) normal (....) atípica
Projeção de língua: (....) ausente (....) anterior (....) unilateral (...)D (...)E
(....) bilateral
Ação perioral: (....) ausente (....) presente
Contração do mentalis: (....) ausente (....) presente
Contração do masséter: (....) forte (....) fraca
Coordenação deglutição x respiração: (....) adequada (....) inadequada
Compensações: (....) ruído (....) flexão cefálica (....) outras................................

- RESPIRAÇÃO

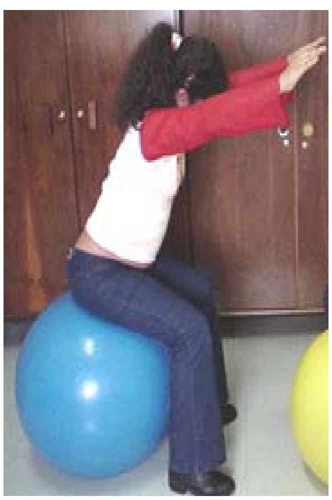
Modo: (....) nasal (....) bucal (....) misto
Tipo: (....) abdominal (....) torácico (....) misto
Teste da água (tempo):.....................................
Espelho de Glatzel:

ANEXO 6 – PROGRAMA DE INTERVENÇÃO FISIOTERAPÊUTICA (parcial):

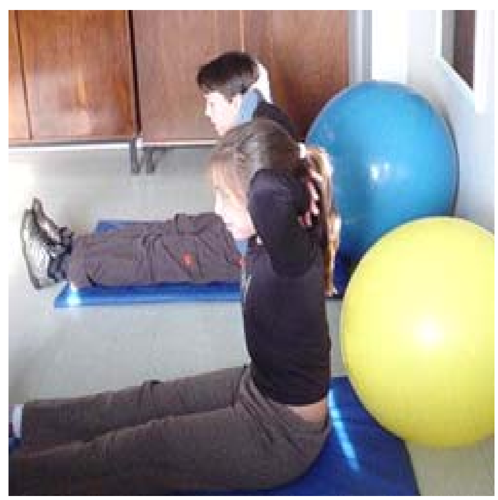
a) Posição Sentada sobre a bola Suíça: (em frente ao espelho)

1- Pula-pula com movimentos de rotação de tronco e cabeça

2- Alongamento músculos laterais do tronco



3- Fortalecimento músculos extensores MMSS e paravertebrais



4- Alongamento cadeia muscular posterior

b) Posição supina sobre a Bola Suíça:

1- Alongamento dos M. escalenos
e esternocleidomastóideos.

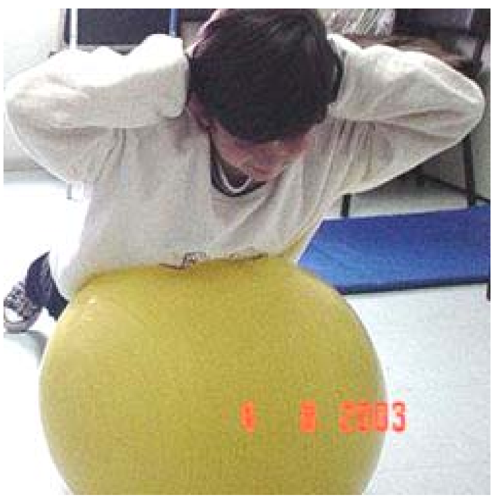
2- Alongamento dos M. peitorais
e estabilização cintura pélvica

3- Ponte sobre a bola (fortalecimento
dos M. glúteos, quadríceps e alongamento
dos M.flexores quadril e anteriores do tronco)

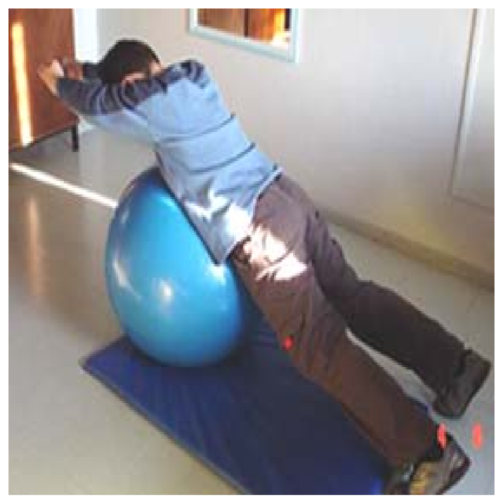
c) Posição prona sobre a Bola Suíça:

1- Ouriço-do-mar: alongamento M. posteriores do tronco e anteriores MMSS.

2- Peixinho: alongamento M.posteriores do tronco, fortalecimento MMSS e MMII



3- Fortalecimento dos M. paravertebrais e alongamento M.peitorais



4- Foguete – fortalecimento dos M. paravertebrais e extensores MMSS

ANEXO 7 - SUBMISSÃO DO ARTIGO 1 PARA PUBLICAÇÃO

Dear Dr. Correa:

Thank you very much for submitting your manuscript entitled "Efficacy of physical therapy on cervical..." to the Archives of Physical Medicine and Rehabilitation.

We are in the process of reviewing the manuscript file to ensure that all submission requirements have been met. If we have any questions or require additional information from you, we will contact you shortly. However, rest assured that your submission is complete if you do not hear from us prior to the Editorial Board's decision.

The Archives staff strives to evaluate submissions as quickly as possible. Sometimes submission volume protracts the assessment time line.

*In any future communication (telephone, email, facsimile, post) with our staff, please refer to the assigned manuscript number 10477. Doing so will facilitate tracking your file. To ensure the confidentiality of the peer review process, the Editorial Board asks that only the designated corresponding author communicate with us.

The Editorial Board reminds authors that it is their responsibility to ensure that their research has received the appropriate institutional review board or ethics approval and that study subjects have provided informed consent to participate. If such approval and/or consent was not obtained, then it is your responsibility to inform the Managing Editor why it was not.

Thank you for giving the Archives of PM&R an opportunity to review your work.
Please feel free to contact me if you have any questions.

Sincerely,

Carolyn R. Sperry
Archives of Physical Medicine and Rehabilitation
Editorial Office
330 N Wabash Ave, Ste 2510
Chicago, IL 60611
312-464-9550 ext. 261
fax 312-464-9554

ANEXO 8 - SUBMISSÃO DO ARTIGO 2 PARA PUBLICAÇÃO

THIS IS AN AUTOMATIC MESSAGE FROM PTJ MANUSCRIPT CENTRAL.

This letter is to acknowledge receipt of the manuscript, "Effect of postural and breathing exercises on the cervical muscles activity during nasal inspiration in children with Mouth Breathing Syndrome (MBS)," by the PTJ Editorial Office.

Please refer to your manuscript number, PTJ-2005-0332, when contacting the Editorial Office.
Physical Therapy accepts a manuscript for consideration for exclusive publication with the understanding that the manuscript, including any original research findings or data reported in it, has not been published and is not under consideration for publication elsewhere, whether in print or electronic form. Reports of secondary analyses of data sets should specify the source of the data.

Manuscripts published in Physical Therapy become the property of the APTA and may not be published elsewhere, in whole or in part, without the written permission of APTA.
When will the Journal complete its review?
New submission: Reviews are completed for 90% of manuscripts within 3 months.
Revision: Reviews typically are completed within 2 months.
Resubmission of a rejected paper: Reviews are completed for 90% of manuscripts within 3 months. Note that this type of paper is considered to be a new submission and therefore is assigned a new manuscript number. Please use this new number in all communications with us.
How can authors check on the status of their manuscript?
The system has already created an "account" for you, with a user ID and password. If you have forgotten your password, just go to ptjournal.manuscriptcentral.com, and click on "Check for Existing Account." DO NOT CLICK ON "CREATE A NEW ACCOUNT." Then ask the system to send you your account information via e-mail.
Once you know your password, you can log in, click on your Author Center, and click on Submitted Manuscripts to find out the status of your manuscript(s).
If you have any problems with the system, you can either click on "Get Help Now" above detailing your problem, or send an e-mail to status@apta.org .
If your problem is urgent, you may call Karen Darley at 703/706-3187; however, we ask that you call only if your problem is urgent.

Thank you for your interest in publishing your work in the Journal.

ANEXO 9: ORIENTAÇÕES PARA PORTADORES DA SÍNDROME DE RESPIRAÇÃO BUCAL –Profa. Eliane Corrêa Ribeiro/ UFSM

RESPIRAÇÃO:

A respiração correta deve ser realizada pelo músculo diafragma (localizado no abdômen). Inspire lenta, suave e profundamente pelo nariz, inflando o abdômen e abrindo as costelas inferiores e expire pela boca (sopre) lentamente. Nunca inspire de maneira brusca, pois isso aumentará o fechamento da via respiratória.

O controle ambiental rigoroso é muito importante para controle da rinite alérgica,que contribui para a respiração bucal. As providências recomendadas por alergistas para melhorar a respiração são: cobrir travesseiros e colchões com tecidos especiais que dificultam a passagem de pó; aspirar bem a casa, evitar carpete, tapete, cortina, e bichos de pelúcia; deixar animais domésticos, como cães e gatos fora de casa. Evitar fumaça de cigarro (não fumar e não conviver com fumantes).

Manter a casa bem ventilada e expor colchões, travesseiros e cobertores ao sol, para eliminar os ácaros.

Realizar a higiene do nariz (assoar) para facilitar a entrada do ar.

A tosse é um mecanismo de defesa dos pulmões, por isso não deve ser reprimida. Para facilitar a eliminação do catarro, é importante ingerir bastante líquido.

POSTURA CORPORAL:

Mantenha a coluna reta, de forma que a orelha, ombro, cotovelo, quadril, joelho e tornozelo estejam alinhados.

Procure não manter o queixo para baixo ou para cima.

Sente com as costas retas, sem arredondar as costas e apoiar-se sobre o sacro (osso da coluna). O apoio deve ser no osso do quadril (abaixo do bum-bum)

Pratique atividade física (com exercícios que ativem a respiração e para alongamento muscular).