MYOFUNCTIONAL CHARACTERISTICS AND ELECTROMYOGRAPHIC OF OBESE CHILDREN AND ADOLESCENTS

Características miofuncionais e eletromiográficas de crianças e adolescentes obesos

Denise Bolzan Berlese[1], Fernando Copetti[2], Angela Regina Maciel Weimmann[3], Pâmela Fantinel Ferreira[4], Leris Salete Bonfanti Haefffner[5]

ABSTRACT

Purpose: to investigate the myofunctional and electromyographic characteristics of obese patients in relation to sex and age group. **Method:** a convenience sample of 28 obese children and adolescents of both sexes, participants in the group of the Obesity Clinic of Pediatrics, University Hospital of Santa Maria, in the period of January to July 2011. The myofunctional characteristics were performed by experienced speech pathologist through the Assessment Protocol Myofunctional with scores (AMIOFE). Electromyographic evaluation of masseter and temporal muscles was obtained using the Lynx Electromyograph and were held three collections for each of the situations (rest, chewing, swallowing and maximum intercuspation). The EMG data were normalized, expressed as a percentage, using the mean of maximal intercuspation of each muscle studied in the assessments. **Results:** most of the obese in this research presented myofunctional characteristics within the normal range, not being statistically significant difference when compared by sex and age. Although the average standard of the electrical activity of masseter and temporal muscles during rest, chewing and swallowing obese according to sex and age showed no statistically significant difference, there is an increased activation of the masseter muscles than the temporal. **Conclusions:** it can be concluded that obese children and adolescents of both sexes have myofunctional characteristics within normal limits and there is an increased activation of the masseter muscles for chewing and swallowing of the temporal muscles.

KEYWORDS: Obesity; Stomatognathic System; Child; Adolescent; Electromyography

(1) Physical Educator, Master in Human Communication Disorders at PPGDCH – UFSM, Santa Maria, RS, Brazil.

(2) Physical Educator, Associate Professor, Centre for Physical Education and Sport UFSM Research Laboratory and Teaching Human Movement, Santa Maria, RS, Brazil; Doctor in Human Movement Science by the Federal University of Santa Maria – UFSM – Santa Maria , RS, Brazil.

(3) Physician, Associated Professor of the Health Science Center – School of Medicine (Department of Pediatrics) and the Post graduation Program in Human Communication Disorders, Federal University of de Santa Maria-UFSM, Santa Maria (RS), Brazil , Doctor in Medicine by the FMRP-USP.

(4) Nutritionist, Master in Human Communication Disorders by PPGDCH UFSM, Santa Maria, RS, Brazil.

(5) Physician, Associate Professor of the Health Science Center – School of Medicine (Department of Pediatrics) and the Post graduation Program in Human Communication Disorders, Federal University of Santa Maria – UFSM, Santa Maria, RS, Brazil; Doctor in Medicine by the FMRP-USP.

Sources of support: CAPES Masters Scholarship

Conflict of interest: non-existent

INTRODUCTION

In the course of human evolution, numerous changes have occurred, among them the use of the stomatognathic system (SS) and changes in body weight. Regarding SE modern man increasingly dispenses the action of an efficient chewing when consuming foods whose consistency is characterized by being more mashed, baked and "soft." Lieberman et al[1] in their study demonstrated that consumption of processed foods decreased the facial growth of mandibular and maxillary arches in humans, in response to the decrease of occlusal and masticatory force necessary for crushing the food.

The increasing number of obese individuals appears to be related to changes in lifestyle and dietary habits associated with ever earlier behavioral

disorders. Research indicates that in recent years there is an epidemic of inactivity and a higher intake of foods with high energy density which explains this increasing prevalence[2]. The high rates of obese children and adolescents and their personal and social repercussions are a major concern among health professionals, since approximately two out of ten young people are already suffering from metabolic syndrome (MS).

Investigate the effects of the excess of weight on the stomatognathic system in young population is a high complexity task[3], mainly because, so far, in the indexed literature, there are few studies addressing the electromyographic and myofunctional characteristics in obese and yet they refer to the adult population[4, 5].

The paucity of research on this topic, besides not having data so far, on the behavior of the stomatognathic system and the electromyographic and myofunctional characteristics in obese children and adolescents and whether there are differences between the sexes, demonstrates the need to develop studies enabling this subject. Based on the above, the present study aimed to investigate the electromyographic and myofunctional characteristics of obese in relation to sex and age group.

METHOD

The study was approved by the Ethics Committee of UFSM under the number 01120243000-10. This descriptive and cross-sectional study was conducted between January to July 2011 and had a convenience sample of 28 obese patients, of both sexes, aged between 08 and 16 years, participants of the Obesity's Group of Pediatrics Ambulatory at the University Hospital of Santa Maria (HUSM). All were enrolled after their or legal representative consent was obtained according to the determinations of the norm 196/1996 of the Ministry of Health. Were excluded the ones that had signs of neurological impairment, who had performed orthodontic treatment, speech therapy or facial surgery or those with craniofacial malformations. According to the age the subjects were denominated as children when were less than 12 years and as an adolescents when were greater for 12 years.

Nutritional status was evaluated through anthropometric parameters. The weight was obtained using a digital scale with 100g precision (Leader ®) and the height using a stadiometer (Tonelli®) fixed on the wall without footnotes. Children and adolescents were evaluated with a minimum of clothing, barefoot and without head props. The nutritional status was classified according the reference BMI growth curves of WHO (1998)[6].

The myofunctional characteristics were evaluated individually by visual inspection and by an experienced speech therapist, using the Assessment Protocol with Myofunctional scores – AMIOFE according to Felicio and Ferreira[7]. Participants were assessed seated in a chair with back, with their feet flat on the floor. The evaluation of the stomatognathic system included: appearance of the face, palate, postural condition of the lips, jaw, cheeks and tongue, as well as performance in mastication and swallowing liquid and solid.

To evaluate the postural condition of the lips, it was considered: normal occlusion and occlusion with tension. For the upright posture of the mandible was considered: normal posture, occlusion of teeth without functional freeway space. The appearance of the cheek was considered normal, increased volume or flaccid / arched mild or severe. The appearance of the palate was considered normal, width decreased mild or severe. To the appearance of the face was considered symmetry between the right and left sides, asymmetry mild or severe. The position of the tongue was evaluated according to the criteria: contained in the oral cavity or interposed to the dental arches.

During chewing, the subject was asked to chew a biscuit (Oreo ® Bono), in a habitual way, being observed if the grinding was bilateral or unilateral preferential and whether there was presence of body movements associated and food escape. Swallowing behavior was observed considering the lips: normal occlusion or occlusion with mild or moderate effort. For the behavior of the tongue was considered if it was contained in the oral cavity, interposed to the dental arches or protruded in excess. For efficiency of liquid and solid bolus was considered: no repeats swallowing of the same bolus and one repetition.

For a higher reliability of the results before performing electromyography was performed the impedance using the voltmeter ICEL-kaise, model SK-100, since the facial adiposity could interfere in the passage of electrical current. When the average impedance was less than or equal to 10 (±1.8) Ω, the electromyographic examination was performed. To facilitate the attachment of the electrode as well as the transmission of electrical activity we remove skin oils using cotton soaked in 70% alcohol.

Electromyography (EMG) was performed with the subject seated in comfortable position with their eyes open, using the EMG equipment (Lynx Electronic Technology Ltda.), with 12 input channels A / D converter and 16-bits input range + / – 2V. We used the filter type Butterworth with cutoff frequency of 10 Hz high pass and low pass of 1000 Hz, sampling frequency of 2 kHz, maximum file size of

2048 samples / channel and sampling time of 1020 seconds. To capture the electromyographic signal according to Hermes et al[8], was used active preamps with differential input (PA1020), by Lynx Electronic Technology Ltd., attached to an electrode Ag / AgCl type DOUBLE (Hal Industria e Comercio Ltda.) The electrodes containing gel, circular self-adhesive with a diameter of 10 mm, contact surface of 2 mm and inter-electrode distance center to center of 20 mm.

The electrodes for performing electromyography of the masseter muscle were placed bilaterally between the lower border of the zygomatic arch and the angle of the mandible. For the temporal muscle the electrodes were placed on its anterior portion, perpendicular to the zygomatic arch and above and behind the frontal process of the zygomatic arch. In all muscles the electrodes were positioned in the longitudinal way of the fibers. Also was fixed a ground electrode on the dorsal surface of the left wrist. The signal interpretation was done by software (AqDAnalysis ® 7.0), which provided the numerical data in RMS (Square root of the average) of the electromyographic signals recorded, expressed in microvolts (uV). This program enables the simultaneous viewing of the record of four muscles, dividing the screen into four windows, facilitating the acquisition of RMS values in accordance with the logging interval of every muscle in the positions.

Three samples were collected for each of the 4 testing situations, to avoid random results: In the resting condition with labial sealing children and adolescents kept sat in a relaxed position of the lips and jaw without contacting the dental arches for 10 seconds. No guidelines were given regarding posture of the tongue. For maximum dental intercuspation children and adolescents were asked to tight their teeth into occlusion with maximum force on a piece of Parafilm ®, folded into 5 parts for a time of 5 seconds without a break and relax only after the verbal command of the examiner[9-11]. In mastication they were asked to chew in the usual way a biscuit (Bono ®, Nestlé Brazil Ltda., Marília, SP, Brazil). The order to start chewing was given by the examiner and the evaluation process began when he or she opened his/her mouth to begin the process of chewing and was stopped when the biscuit was completely swallowed. For swallowing 8 ml of water were used, and the evaluated were instructed to swallow the liquid in a usual way. The process was performed within a time of 30 seconds. To avoid possible muscle fatigue, children and adolescents were asked to remain resting for 2 minutes between each evaluation.

For each subject was chosen the best sign of the three samples obtained from the studied muscles. We considered the signal with less noise interference and a consistent electromyographic record. The electromyographic data were normalized using the average of the maximum intercuspation of each muscle studied in the assessments. Results were expressed in percentage (%) using a simple rule of three in which the value of the maximum intercuspation of each muscle was considered 100%.

The statistics programs were analyzed using Excel 2007 and Stata 10.0. To verify the normality of the variables was used the Shapiro-Wilk test. For parametric variables were used average, standard deviation and analysis of variance (ANOVA). For nonparametric variables was performed percentage and frequency distribution and to check the difference between the group Chi-square and Fisher exact test. For all variables was considered the significance level of $p < 0.05$.

RESULTS

Of the 28 obese subjects included in this study, 46% (13) were male and 54% (15) females and an equal number of children and adolescents. Table 1 shows the myofunctional characteristics of SS according to the sex and age range. Most of them showed occlusion of the lips and a normal vertical jaw posture. The cheek and palate appearance were mild or severe increased in volume and had a mild or severe reduction in the width. The symmetry of the face occurred in over 50% of female adolescents and children, being inversely proportional in male adolescents and children. The tongue is contained in the oral cavity in over 60% of subjects, with exception of the children, in whose 47% of the cases the tongue was interposed to the dental arches.

Table 2 shows the distribution of absolute and relative values of chewing type according to sex and age group. The mastication function was performed bilaterally by most of the subjects investigated without statistically significant difference between groups.

Table 3 shows the distribution of absolute and relative values of the myofunctional characteristics during swallowing of according to sex and age group. For both sexes swallowing occurred with normal occlusion of the lips and the swallowing of solid and liquid bolus occurred without repetition. Regarding the behavior of the tongue, 23% males and 27% females presented it interposed to the dental arches with adaptation or dysfunction.

Table 4 presents the mean and standard deviation, measured in percentage of the electrical activity of the masseter and temporalis muscles during swallowing, chewing and resting according to sex and age group. There was no statistically

significant difference between groups. The male has a higher percentage of muscle activation for functions of chewing, swallowing and rest in all muscles. The children had a higher percentage of activation of right and left temporal muscles during swallowing and chewing functions, while adolescents had higher percentage of activation of right and left masseter muscle for both functions. In the resting condition, both age groups behaved similarly, with the percentage of muscle activation of 3.31% to 5.96%.

Table 1 – Distribution of absolute (N) and relative (%) values of myofunctional characteristics of the structures of the SE of obese according to sex and age range

Myofunctional characteristics of the SS structures	Gender		Age range	
	Male N (%)	Female N (%)	Child N (%)	Adolescents N (%)
Postural condition of the lips				
Normal occlusion	9 (69)	13 (87)	11 (73)	11 (85)
Occlusion volttage	4 (31)	2 (13)	4 (27)	2 (15)
Vertical posture of the mandible				
Normal posture	12 (92)	15 (100)	14 (93)	13 (100)
Oclusion of the teeth without freeway space	1 (8)	0 (0)	1 (7)	0 (00
Appearence of the cheeks				
Normal	7 (54)	4 (27)	6 (40)	5 (38)
Volume increased or sagging / arched / light	4 (31)	9 (60)	5 (33)	8 (62)
Volume increased or sagging / arched / severe	2 (15)	2 (13)	4 (27)	0 (0)
Appearance of the hard palate				
Normal	6 (46)	7 (47)	6 (40)	7 (54)
Decreased width (narrow)/ Light	4 (31)	5 (33)	5 (33)	4 (31)
Decreased width (narrow)/ severe	3 (23)	3 (20)	4 (27)	2 (15)
Face appearence				
Symmetry	5 (38)	8 (53)	9 (60)	4 (31)
Slight Assymmetry	7 (54)	7 (47)	5 (33)	9 (69)
Severe Assymmetry	1 (8)	0 (0)	1(7)	0 (0)
Tongue position				
Contained in the oral cavity	8 (62)	9 (60)	8 (53)	9 (69)
Interposed to the dental arches	5 (38)	6 (40)	7 (47)	4 (31)

Table 2 – Distribution of absolute (N) and relative (%) values of chewing type in obese according to sex and age range

Chewing	Gender		Age range	
	Male N (%)	Female N (%)	Child N (%)	Adolescents N (%)
Bilateral Alternating	11 (85)	12 (80)	14 (93)	9 (70)
Preferred Unilateral	2 (15)	3 (20)	1(7)	4 (30)

Table 3 – Distribution of absolute (N) and relative (%) values of myofunctional characteristics of structures during swallowing of obese according to sex and age range

Myofunctional Features of the SS Structures during Swallowing	Gender		Age range	
	Male N (%)	Female N (%)	Child N (%)	Adolescent N (%)
Lips Behavior				
Normal occlusion	9 (70)	11 (73)	9 (60)	11 (85)
Occlusion with mild exertion	4 (23)	3 (20)	4 (27)	2 (15)
Occlusion with moderate effort	0	0	2 (13)	0 (0)
Tongue Behavior				
Contained in the oral cavity	9 (70)	10 (67)	10 (67)	9 (69)
Interposed to the dental arches	3 (23)	4 (27)	4 (27)	3 (23)
Protuded in ecxess	1 (7)	1 (6)	1 (6)	1 (8)
Eficiency - Solid bolus				
Do not repeat	11 (85)	15 (78)	15 (100)	11 (85)
Repeat once	2 (15)	0 (0)	0 (0)	2 (15)
Eficiency - Liquid bolus				
Do not repeat	13 (100)	15 (100)	15 (100)	12(92)
Repeat once	0	0	0 (0)	1 (8)

Table 4 – Normalized mean and standard deviation, measured in%, of the electrical activity of the masseter and temporalis muscles during swallowing, chewing and rest of obese according to sex and age range

Electrical Activity	Gender		Age range	
	Male X ± SD	Female X ± SD	Child X ± SD	Adolescent X ± SD
Rest				
LT	3,47±1,46	2,87±1,36	3,31±1,16	3,07±1,68
RT	4,46±1,82	4,10±1,80	4,61±1,89	3,98±1,69
LM	6,20±2,60	5,28±2,20	5,59±2,19	5,96±2,70
RM	4,74±1,41	4,71±2,52	4,92±1,57	4,53±2,33
Chewing				
LT	46,11±23,04	39,58±28,87	44,00±25,24	42,16±26,92
RT	45,76±28,03	37,85±27,08	47,55±32,87	36,62±20,28
LM	68,83±57,59	51,38±17,62	54,00±18,36	67,46±59,89
RM	60,05±40,43	56,27±49,85	59,35±45,22	57,24±44,88
Swalling				
LT	8,06±5,50	5,97±4,4	7,44±5,03	6,74±5,22
RT	8,87±5,06	7,74±6,63	9,15±6,28	7,54±5,28
LM	38,51±35,74	30,43±9,48	28,99±9,59	40,53±36,47
RM	47,16±30,93	38,82±16,25	38,35±16,20	48,23±31,56

LT= Left Temporal; RT= Right Temporal; LM= Left Masseter; RM= Right Masseter; X= Mean; SD= Standard Deviation; Anova.

DISCUSSION

The myofunctional characteristics of obese children and adolescents showed, in its majority, adequate in relation to both gender and age. A discussion of these results became limited, since in this study were analyzed only obese and the studies found, are performed in adults, comparing obese with normal weight subjects. Because of facial adiposity observed in people who are overweight, some studies as the De Carli[12] inferred that obese could submit amendments of the stomatognathic System, which etiology was due to higher accumulation of adipose tissue in the oral, pharyngeal and laryngeal region. Figueiredo[5], in his study, found that obese adults had lower SS efficiency compared to normal weight individuals, highlighting that corrections of this alterations could help in the modification of the eating behavior.

The proper behavior of obese during swallowing corroborate the results found by Alves et al[4] that, when evaluating the dynamics of swallowing in obese people noted that there are no differences when compared with people with weight close to ideal. Thus, it is noteworthy that the normal swallowing depends more on the anatomical shape of the mandible and maxilla. Moreover, it tends not to present a uniform standard, and some changes may be due to the adaptation required to fit the facial type[13].

Regarding chewing, it appeared bilateral alternating in all groups evaluated which is consistent with the age range studied, where no changes would be expected, since there is a maturing process of mastication with the passage of age, and the dentition is already fully established which allows an adequate chewing[14]. However Figueiredo[5] in his study, when analyzing the functions of chewing and swallowing in obese adults compared to eutrophic adults, observed significant difference between the groups, with higher incidence of unilateral chewing in the obese group.

Regarding the electromyographic characteristics during rest, we found lower muscle activation. This result was expected, since some electrical activity of the muscles had been observed by Oncins et al[15], even with the jaw at rest in normal subjects. Comparing normal weight and obese adults, Figueiredo[5] showed that there was low electrical activity at rest for both groups withouto significant statistical difference.

The average muscle activation during mastication for all muscles investigated showed up in a similar manner and with low percentage of activation relative to other studies, but these did not involve the obese child population[16,17]. Studies with healthy adults with temporomandibular disorder and obesity showed no evidence of changes in EMG parameters during chewing[5,16].

Miranda et al[18] examining the eletomyographic activity of the masseter muscle in different facial types, during rest and chewing of 47 youth and adults, noted that there was no significant difference in electromyographic activity for the masseter muscle for both sex and age range of participants.

Ferla et al[19], studying the pattern of electrical activity of the anterior temporal and masseter muscles in children mouth and nose breathers, regardless of nutritional status, noted that the level of electrical activity of the nasal breathers group was 47.1 and 40.1% during mastication which is similar to the percentage of activation in this study. Boton et al[20] when checking the electrical activity of oral orbicular, masseter and temporal muscles, at rest, in masticatory and labial isometries of 59 children, mouth and nose breathers, of both genders, found that electrical activity was similar in both groups.

Obese children and adolescents showed higher electrical activity of the masseter muscles in relation to temporal muscles during swallowing. In normal individuals is not necessary that the muscles act with great force for an efficient swallowing, yet the masseter muscle was more active. Although it has to be taken into account that the results obtained during the execution of a test may differ from the one observed in spontaneous swallowing, it seems that there was not this interference since the results were similar among the participants.

Increased activation of the masseter muscle in relation to the temporal muscle was observed in a study conducted in adults with and without normal occlusion, which are similar to the results found in this study, that is, greater activation of the masseter muscle. The authors highlight, however, that the masseters muscles have a higher activity in all oral functions, including swallowing in people without normal occlusion, when is necessary a greater contraction force to stabilize the mandible and facilitate the undulating movement of the tongue[13].

CONCLUSION

According to our results, it was concluded that most children and adolescents with excessive body weight showed normal myofunctional characteristics of the SS, without influence of gender and age group. In relation to the percentage of the electrical activity of the muscles evaluated, obese children and adolescents of both sexes used more masseter muscles for chewing and swallowing than temporal muscles. Additionally, during swallowing, both muscles have decreased their activation.

It is suggested that in the interdisciplinary treatment of obesity in childhood and adolescence, speech therapy need to be incorporated in order to assist the process of ingestion of food allowing an efficient food control that can contribute to weight loss and reducing obesity.

RESUMO

Objetivo: investigar as características miofuncionais e eletromiográficas de obesos em relação ao sexo e faixa de idade. **Método**: amostra de conveniência de 28 crianças e adolescentes obesos, de ambos os sexos, participantes do grupo de Obesidade do Ambulatório de Pediatria do Hospital Universitário do Hospital Universitário de Santa Maria, no período de janeiro a julho de 2011. As características Miofuncionais foram realizadas por fonoaudióloga experiente por meio do Protocolo de Avaliação Miofuncional com Escores (AMIOFE). A avaliação eletromiografica dos músculos masseter e temporal foi obtida utilizando o Eletromiógrafo Lynx e realizada três coletas para cada uma das situações (repouso, mastigação, deglutição e máxima intercuspidação). Os dados eletromiográficos foram normalizados, expressos em percentual, utilizando-se a média da máxima intercuspidação de cada músculo estudado nas avaliações realizadas. **Resultados:** a maioria dos obesos desta pesquisa apresentaram características miofuncionais dentro da normalidade, não sendo observada diferença estatística significante quando comparados por sexo e idade. Embora a média normalizada da atividade elétrica dos músculos masseter e temporais durante o repouso, mastigação e deglutição dos obesos de acordo com sexo e idade não apresentaram diferença estatística significante, observa-se uma maior ativação dos músculos masseter do que os músculos temporais. **Conclusões:** pode-se concluir que crianças e adolescentes obesos, de ambos os sexo têm características miofuncionais dentro da normalidade e que há uma maior ativação dos músculos masseteres para a função da mastigação e deglutição do que os músculos temporais.

DESCRITORES: Obesidade; Sistema Estomatognático; Criança; Adolescente; Eletromiografia

REFERENCES

1. Lieberman DE, Krovitz GE, Yates FW, Devlin M, Claire MS. Effects of food processing on masticatory strain and craniofacial growth in a retrognacthi face. J Hum Evol. 2004;46:655-77.

2. Fernandes IT, Gallo PR, Advíncula AO. Avaliação antropométrica de pré-escolares do município de Mogi-Guaçú, São Paulo: subsídio para políticas públicas de saúde, Rev Bras Saúde Matern Infant. 2006; 6(2):217-22.

3. Fernandes AR, Casonatto J, Christofaro DGD, Ronque VER, Oliveira AR. Risco para o excesso de peso entre adolescentes de diferentes classes econômicas. Rev Assoc Med Bras. 2008;54(4):334-8.

4. Alves LMT, Santos CM, Cassiani RA, Dantas RO. Dinâmica da deglutição de líquido em pessoas obesas. GED gastroenterol endosc dig. 2007;26(6):187-90.

5. Figueiredo AB. Avaliação clínica e eletromiográfica da motricidade orofacial de obesos: um estudo comparativo [dissertação]. São Paulo (SP): Universidade de São Paulo. Curso de Medicina; 2010.

6. OMS. Obesity: preventing and manging the global epidemic. Reporto of a WHO consultation on obesity. Geneva, 1998.

7. Felício CM, Ferreira CL. Protocol of orofacial myofunctional evaluation with scores. International Journal of Pediatric otorhinolaryngology. 2008;72:367-75.

8. Hermens HJ, Freriks B, Disselhorst-Klug C, Rau G. Development of recomendation for SEMG sensor and sensor placement procedures. J. Eletromyographic and kinesiol. 2000;10(5):361-74.

9. Biasotto DA. Estudo eletromiográfico dos músculos do sistema estomatognático durante a mastigação de diferentes materiais [dissertação]. Campinas (SP): Universidade Estadual de Campinas; 2000.

10. Biasotto-Gonzalez DA, Bérzin F. Electromyographic study of patients with masticatory muscles disorders, physiotherapeutic treatment (massage). Braz J Oral Sci. 2005;3(10):516-21.

11. Berretin-Felix G, Genaro KF, Trindade IEK, Trindade ASJ. Masticatory function in temporomandibular dysfunction patients: electromyographic evaluation. J Appl Oral Sci. 2005;13(4):360-5.

12. De Carli A. Ronco e Síndrome da Apnéia Obstrutiva do Sono. Rev científica AMECS. 2000;9(1):55-9.

13. Rahal A, Pierotti S. Eletromiografia e cefalometria na fonoaudiologia. In: Ferreira LP, Befi-Lopes DN, Limongi SCO. Tratado de Fonoaudiologia. São Paulo: Roca, 2004.

14. Lemos CM, Wilhelmsen Niels S, Mion O Júnior. J. Alterações funcionais do sistema estomatognático em pacientes com rinite alérgica: estudo caso-controle. Braz J Otorhinolaryngol. 2009;75(2):268-74.

15. Oncins MC, Freire RMA, Marchesan IQ. Mastigação: análise pela eletromiografia e eletrognatografia. Seu uso na clínica fonoaudiológica. Distúrbios da Comunicação. 2006;18(2):155-65.

16. Mendonça RC, Oliveira AS, Pedroni CR, Bérzin F, Gastaldi AC. Eletromiography assessment of chewing induced fatigue in temporomandibular disordes patients – a pilot study. Braz J Oral Saci. 2005;4(15):894-8.

17. Santos MESM, Oliveira MG, Santos SMMC, Weber JBB, Macagnan FE. Parâmetros clínicos e atividade eletromiográfica em pacientes com disfunção temporomandibular. Rev. Cir Traumatol Buco-Maxilo-Fac. 2006;7(4):65-72.

18. Miranda ALR, Vieira MM, Bommarito S, Chiari BM. Avaliação da atividade eletromiográfica do músculo masseter em diferentes tipologias faciais. Rev Odonto. 2009;17(33):17-25.

19. Ferla A, Silva AMT, Corrêa ECR. Atividade eletromiográfica dos músculos temporal anterior e masseter em crianças respiradoras bucais e em respiradores nasais. Rev Bras Otorrinolaringol. 2008;74(4):588-95.

20. Boton, LM. Atividade eletromiográfica dos músculos faciais de crianças respiradoras nasais e respiradoras orais viciosas e obstrutivas. [dissertação]. Santa Maria (RS): Universidade Federal de Santa Maria; 2010.

Received on: September 20, 2012
Accepted on: March 28, 2013

Mailing Address:
Denise Bolzan Berlese
Campos Universitário, Centro de Ciências da Saúde/Curso de Medicina. Prédio 26 A, 3ª andar, Sala 1353 – Camobi
Santa Maria – RS
CEP: 97105-900
E-mail: debberlese@hotmail.com