

Original articles

Masticatory profile in children from three to five-years old

Perfil mastigatório em crianças de três a cinco anos de idade

Aline Stanislawski Silva⁽¹⁾

Mônica Carminatti⁽¹⁾

Bárbara de Lavra-Pinto⁽¹⁾

Renata Franzon⁽¹⁾

Fernando de Borba Araújo⁽¹⁾

Erissandra Gomes⁽¹⁾

⁽¹⁾ Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, RS, Brasil.

Conflict of interest: non-existent

ABSTRACT

Purpose: to describe the characteristics of the chewing profile in children from 3 to 5-years old, correlating it with the chronological age, gender, oral habits, feeding introduction and dental aspects of them.

Methods: transversal study performed with 60 children of both genders. A pediatric dentistry dental aspects evaluated, followed by evaluation of chewing performed by a speech therapist using French bread and the elaborate protocol for this study. Data analysis was carried through visual observation and video recording and late analysis by blind raters. The responsible answered a questionnaire about the oral habits and food introduction.

Results: at the 10 items evaluated chewing occurred toggle between the standard expected for all variables. A statistical difference between the posture of lips of three- and four years compared to the five years of age ($p < 0.001$). The predominant mandibular movements of the rotary type evolved with increasing age ($p = 0.008$). No association was found between dental aspects and mastication of children. Association was found between: girls and boys chewing characteristics ($p < 0.001$); masticatory evolution according to age ($p = 0.008$); to present oral habits for the item cut so ($p = 0.003$) and was mixed respiratory significant factor in the child hold his mouth open chewing ($p = 0.01$) and to carry out the jaw movements of maceration predominantly ($p = 0.04$).

Conclusion: for the studied sample, the chewing so presented itself gradually in its evolution and improvement. Found in chewing differentiation according to age, gender, oral habits and breathing mode.

Keywords: Mastication; Child; Dentition; Stomatognathic System

RESUMO

Objetivo: descrever o perfil mastigatório em crianças de três a cinco anos de idade, correlacionando-o com a idade cronológica, gênero, hábitos orais, introdução alimentar e aspectos dentários.

Métodos: estudo transversal realizado com 60 crianças de ambos os gêneros. Um odontopediatra avaliou o aspecto dentário, seguida da avaliação da mastigação realizada por uma fonoaudióloga, utilizando-se pão francês e o protocolo elaborado para este estudo. A coleta de dados da mastigação foi realizada por meio de registro em vídeo e posterior análise por avaliadores cegos. Os responsáveis responderam o questionário sobre os hábitos orais e introdução alimentar.

Resultados: nos 10 itens avaliados na mastigação ocorreu alternância entre o padrão esperado para todas as variáveis. Foi observada diferença estatística entre a postura de lábios das crianças de três e quatro anos quando comparadas com as de cinco anos de idade ($p < 0,001$). Os movimentos mandibulares predominantes do tipo rotatório evoluíram conforme o aumento da idade ($p = 0,008$). Não foi encontrada associação entre os aspectos dentários e a mastigação das crianças. Foi verificada associação entre: a mastigação de meninas e meninos ($p = 0,001$); a evolução mastigatória conforme a idade ($p = 0,008$); apresentar hábitos orais para o item modo de corte ($p = 0,003$) e ser respirador oronasal foi fator significativo para a criança realizar a mastigação de boca aberta ($p = 0,01$) e para realizar os movimentos mandibulares de maceração predominantemente ($p = 0,04$).

Conclusão: para a amostra estudada, o modo mastigatório apresentou-se gradativo em sua evolução e aperfeiçoamento. Foi encontrada diferenciação na mastigação conforme a idade, gênero, hábitos orais e modo respiratório.

Descritores: Mastigação; Criança; Dentição; Sistema Estomatognático

Received on: October 19, 2015
Accepted on: March 23, 2016

Mailing address:

Erissandra Gomes
Rua Ramiro Barcelos, 2492
Porto Alegre/RS
E-mail: erifono@hotmail.com

INTRODUCTION

The mastication is considered one of the most important studied functions of the stomatognathic system¹ and it may influence children's social, nutritional and psychological functions². It is a process divided in phases of incision, trituration and pulverization^{1,3,4}. This function occurs through firm and rhythmic movements of the osteodental arcs which advance toward each other. This may be obtained through the following mandibular movements: opening, when the mandible goes down from the intercuspatation position; laterality, movement through which the mandible moves laterally from the midline; closure; the protrusion/retrusion movements and the rotation combined, proper of mastication^{1,5}.

The physiological mastication process starts with the food cutting through the incisor teeth and, then, with closed lips, without noise and without exaggerated participation of the perioral muscles, performing food lateralization, in alternated bilateral way and with rotation mandibular movements^{3,6,7}. Mastication, with bilateral alternating food distribution, facilitates the periodontal tissues stability and harmonizes occlusion, with synchrony of the activities of the mastication muscles^{1,3}.

The stomatognathic system maturity and the teething development are complex patterns which are acquired and they improve the mastication process^{1,4}. The children's mastication pattern is different from the adults' pattern⁸. From about five to six months, the mastication is performed with vertical movements, the tongue kneads food against the palate; with seven months, the lateralization movements start; and from about 12 to 18 months, the mandible will start rotational movements, with conditions to perform bilateral mastication with closed lips⁴. However, to perform mastication, it is necessary that the first dentition is established⁹. The deciduous teething is complete after the occlusion of the second molars, about two years and a half/three years old, and it does not change until six years old, with the eruption of the first permanent molar¹⁰. It is known that the constancy of an altered function in the growth and craniofacial development period enable gradual changes in the skeletal and dental structures which may result in real dentofacial asymmetries in the adult phase¹¹.

Studies about the mastication function in children present data about the side of preferential mastication¹²⁻¹⁶, proprioception (escape of food)¹⁵, way of incision¹⁵, lips posture^{12,14,15,17}, participation of perioral

musculature^{12,14,17} and predominant mandibular movement^{12,14,17,18}.

Thus, the purpose of this study was to describe the mastication profile of children from three to five years old, and to correlate this data with chronological age, gender, oral habits, food introduction and dental aspects.

METHODS

This research was approved by the Central Ethics Committee at Federal University of Rio Grande do Sul (UFRGS), number 19236. The children's parents and/or guardians signed the Consent Term. All subjects who participated in the present research and who presented alterations related to dental and speech therapy aspects were submitted to screening at the specific services, according to the demand.

This is a cross-sectional study performed with 60 children from three to five years old, both genders, who attended the clinic for children and young people at the Faculty of Odontology at UFRGS. The excluded children were the ones who have already received or were receiving speech therapy treatment; the ones who did not performed all the study proposed stages; children with any disorder, syndrome or anomaly, as well as neurological or cognitive deficits verified in direct observation and/or information referred by parents, and children in orthodontic or orthopedic maxillary functional treatment.

The data collection was performed by researchers from speech therapy and odontology areas. The professionals from both areas were blinded to the evaluation performed by the other area's professional, in order not to present pre-trial interferences. First, the children were evaluated by a pediatric dentist who used the pattern protocol by the clinic for children and young people, to evaluate the children's dental aspects (occlusion and dental caries). The dental caries diagnosis, as well as the severity, were based on the dmft index¹⁹. It was calculated the deciduous rotted teeth, extracted because of decay and obturated. The children were classified in three dmft categories, according to a reference study²⁰: dmft 0 = no decay; dmft 1 – 5 = low severity; dmft > 6 = high severity. It was also checked when there was tooth loss. In the evaluation of dental occlusion, it was observed the following malocclusions¹⁹: anterior and/or posterior open-bite; over bite; anterior and/or posterior, unilateral or bilateral crossbite.

The children were classified in four groups, considering the teething alterations: a) teeth free of dental

caries, occlusive alterations and dental loss; b) incisor tooth with high level of dental caries, occlusive alteration or dental loss; c) posterior tooth with high level of dental caries, occlusive alteration or dental loss; d) incisor and posterior teeth with high level of dental caries, occlusive alteration or dental loss.

It was used specific protocol to evaluate the mastication function, created for this research, based on nutritional studies^{12,21,22}. This protocol considers the analysis of ten evaluated items, which were classified with scores from one (best result) to three (worst result). The score three was considered the proper pattern for all items. It was analyzed the following aspects:

Lips posture during mastication: with sealing lips (3), alternating the presence and absence of sealing lips (2), not sealing lips (1). It was considered mastication with sealing lips the cases when the child remained with sealing lips;

Food incision (type of cutting): centralized (3), variable (2), lateralized to the right or to the left (1). It was considered centralized incision when the child used the anterior teeth, for food cutting; variable, when the child used either the anterior teeth, or the lateral teeth for food cutting; and lateralized to the right or to the left when it was performed lateralized incision, use of lateral incisor with canine and also pre-molar and molar, for one side;

Cutting method: cutting with teeth (3), using the teeth with the help of the hands and/or head to obtain a piece of food (2), no biting, using only one hand to obtain the necessary portion (1). It was considered cutting with teeth when the child used only the teeth to take a piece of bread to ingest; use of teeth and hands when the child bit the food, pulled it with the hand and tore it at the same time; and used only one hand to obtain a piece of food, when the child was taking small portions with the help of the hands;

Usual mastication patterns: bilateral alternated (3), bilateral with low alternation (2), unilateral to the right or to the left (1). It was considered the alternated bilateral mastication when it was performed in both sides, not simultaneously, in a proportional way. It was considered mastication as bilateral with low alternation when it was performed in both sides, but not in a balanced way. The unilateral mastication to the right or to the left was considered when the mastication cycles were performed at the same side with the same portion of food;

Predominant mastication movements: rotational (3), vertical (2), maceration (1). It was considered rotational

movement when the child performed, mainly, from the phase of opening to the movement down of the mandible from the intercuspitation position and, then, lateral movement from the midline and, finally, closure movement; it was considered as vertical movement the cases when the child performed mainly opening and closure movements; and maceration when the child performed predominantly food knead with exaggerated participation of the tongue muscles;

Perioral musculature: absence of exaggerated mouth, mentalis and buccinator orbicularis muscles contraction during mastication (3), it alternates absence and presence of exaggerated contraction (2), presence of muscles exaggerated contraction;

Amount of ingested food: medial (3), it alternates from excessive/reduced to medial amounts (2), excessive and/or reduced (1). It was considered medial amount when the ingested food in the bite was visibly compatible with the size of the child's oral cavity, and excessive or reduced when the food portion was great or small for the child's cavity;

Speed of mastication movements: proper (3), it alternated from proper to rapid/slow (2), rapid or slow (1). Such analysis was performed in subjective way.

Interposition of the lower lip: not performed (3), alternated movements with and without interposition (2), predominantly performed (1). It was considered as lip interposition when the child performed inferior lip contraction while performing food mastication;

Proprioception to perceive food on the lips: with no residues on the lips (3), with residue, but soon removed (2), did not remove the residues from the lips (1). It was considered the fingers, tongue or lips use or not to remove the food which occasionally was out of the oral cavity.

Besides, it was analyzed the quantity of mastication cycles necessary for each child to swallow the bolus. The cycles were counted, corresponding to a complete mandibular movement, from the opening to the breakdown of the food which is through the teeth¹, in three ingested portions for further comparative analysis, with the first portion discarded.

To the mastication speed, and also the subjective aspect which was part of the protocol, it was performed a mean of the two incisions time. For the speed analysis, it was measured the necessary time for the child to swallow each of the two portions; next, it was calculated their mean.

The mastication function evaluation was performed through direct observation and through video camera

recording, which was positioned one meter and a half from the chair back, where the children remained seated. It was offered 25g of bread (solid) and the child was guided to bite a piece of bread and to eat it as usual. The analysis of the filming regarding mastication was performed by two calibrated evaluators, from the speech therapy area, separately. In cases of lack of consensus in the evaluations, another evaluator from the area analyzed the situation. The considered results were the ones with more agreement.

At the same moment the children were evaluated, their guardians responded a questionnaire about oral habits²⁰ to obtain data about breastfeeding, oral habits (soother, baby bottle, finger, onicophagy, objects into the mouth and oronasal breathing), as well as demographic (age and sex) and socioeconomic information (family income and parents' education). The condition of oronasal breathing was evaluated through clinical evaluation performed by a speech, language and hearing therapist. For this evaluation, it was used the breathing item of the Orofacial Myofunctional Evaluation Protocol (AMIOFE)²³.

For the statistical analyzes, it was used the software Statistical Package for Social Science (SPSS) v.18.0 for Windows. For the categorical variables, it was performed analyzes of absolute frequency and relative frequency in percentage and for the quantitative variables, it was calculated the mean and the standard deviation. For the groups' comparison, the used tests were Student's t-test, ANOVA or Chi-Square test, depending on the variable. To analyze the variables correlation, it was used the Pearson's coefficient ® , and to verify the inter-observer reliability, the Kappa test was selected. The significance level was 5%.

RESULTS

The sample consisted of 60 children, 31 (51.7%) male, with mean age 4.7 ± 0.1 years. From these children, 53 (88.3%) were breastfed up to the age mean of 1.4 ± 1.1 years old.

The baby bottle introduction was performed in 54 (91.7%) children with age mean of seven months (minimum=0; maximum=3). The soother was referred by 27 (45%) children, and the mean age of this device beginning was four months (minimum=0; maximum=5.3). The mean age for baby bottle withdrawal was 3.9 ± 1.4 years, coinciding with the period of soother cessation, 3.6 ± 1.6 years.

In relation to introduction to food, 55 (91.7%) children started fruit ingestion with mean age of 6 ± 3 months, 56 (93.3%) started eating salty porridge with 7 ± 3 months and 57 (95%) started eating grains and pieces with 9 ± 3 months. The use of cups started with 57 children (95%) with age mean of 1.9 ± 1.3 years. It is important to highlight that the guardians of some children did not know how to answer the data above, so these variables could not be analyzed.

The results from the mastication function evaluation protocol are described in the Table 1. The sum of the evaluation protocol items was 23 ± 2.9 (minimum=17; maximum=29), with $IC_{95\%}$ of 22.2-23.7. The inter-observer concordance through the kappa coefficient calculated for each item was: lips posture in mastication ($k = 0.897$); food incision ($k = 0.899$); cutting mode ($k = 0.531$); usual mastication pattern ($k = 0.754$); predominant mastication movements ($k = 0.637$); perioral musculature ($k = 0.486$); amount of ingested food ($k = 0.941$); mastication speed ($k = 0.644$); lower lip interposition ($k = 0.797$); proprioception to perceive food on the lips ($k = 0.813$). Such analysis demonstrated that four items presented an almost perfect concordance and, in other four items, the concordance was high; for two items, the agreement was moderate.

Local de inserção da tabela 1 (autores: não inserir as tabelas aqui, é apenas uma marcação)

In addition to the items evaluated by the protocol, it was verified that the children performed a mean of 33.3 ± 2.3 mastication cycles with mean speed of 32.3 ± 2.4 seconds to the first swallowing. It is highlighted that for this analysis it was used the second and third food portions, discarding the first one.

Contrasting the mastication data with breastfeeding, there were no significant data. The comparison between mastication and breastfeeding time did not present significance in any of the protocol items, as dividing the children in breastfed up to 6 months or more, as dividing them for up to 12 months or more. Considering other suction ways, such as baby bottle, pacifier use and finger sucking, there was also no means influence. There was no correlation between the food introduction mean age and devices introduction with the protocol total mean ($p > 0.05$).

Oral habits presence in the past or present moment (finger sucking, onicophagy, use of soother or cloth singly or concomitantly) were significant for the item cutting way ($p = 0.03$). To be oronasal breather was a

Table 1. Analysis of the evaluated aspects in the mastication protocol (n=60)

Items	n (%)	Score (Mean±SD)
Lips posture in mastication		2±0.8
With lips closure	16 (26.7)	
Alternating presence and absence of lips closure	26 (43.3)	
With no lips closure	18 (30.0)	
Food incision (cutting type)*		2.5±0.8
Centralized	41 (68.3)	
Variable	10 (16.7)	
Lateralized to the left or right	7 (11.7)	
Cutting way		2±0.4
Cutting with teeth	7 (11.7)	
Using teeth and help of hands and/or head to obtain a piece of food	51 (85.0)	
No biting, using only the hands to obtain the necessary portion	2 (3.3)	
Usual mastication pattern		1.7 ±0.7
Alternated bilateral	8 (13.3)	
Bilateral with little alternance	25 (41.7)	
Unilateral to the left or right	27 (45.0)	
Predominant mandibular movements		2.1 ±0.8
Rotational	25 (41.7)	
Vertical	17 (28.3)	
Maceration	18 (30.0)	
Perioral musculature		2.7±0.8
Absence of exaggerated contraction	47 (78.3)	
Alternating absence and presence of exaggerated contraction	11 (18.3)	
Presence of exaggerated contraction	2 (3.3)	
Quantity of ingested food		2.4±0.8
Medial	35 (58.3)	
Alternating between excessive/reduced and medium quantity	15 (25.0)	
Excessive and/or reduced	10 (16.7)	
Mastication speed		2.6±0.7
Proper	46 (76.7)	
Alternating between proper and rapid/slow	6 (10.0)	
Rapid or slow	8 (13.3)	
Lower lip interposition		2.8±0.4
Does not perform	50 (83.3)	
Alternating moments with and without interposition	9 (15.0)	
Predominantly performs	1 (1.7)	
Proprioception to perceive the food on the lips		2+0.1
Did not leave residues on the lips	24 (40.0)	
Left residue but soon removed it	12 (20.0)	
Did not remove residue from the lips	24 (40.0)	

*Two children did not perform food incision.

Legend: SD = standard deviation

significant aspect for the children to perform chewing with the mouth open ($p=0.01$) and to perform the maceration mandibular movements predominantly ($p=0.04$), as well as for the protocol final score ($p=0.02$).

About the studied children gender, it was verified that the mean of amount of mastication cycles and speed of cycles were not different in the groups ($p>0.05$). However, the girls presented higher indexes in all protocol analyzed items (Table 2), with significant

difference in the lips posture ($p=0.01$), predominant mandibular movements ($p=0.04$), perioral musculature ($p=0.03$) and lower lip interposition ($p=0.01$), as well as for the sum of all items ($p=0.001$).

Table 3 shows the analysis of the mastication evaluation, according to the age group. It was observed statistical significance between the children with three and four years old, and the children with five years old ($p=0.001$), who kept the lips closed during mastication. The mandibular movements, predominantly rotational presented development according to age increase ($p=0.008$), fact which also occurs in the total score of the evaluated items, which developed according to age ($p=0.008$). In the other items, the results were not significant among the age groups, even with some difference among them. The mean of the cycles quantity and speed did not differ among the groups, per age ($p>0.05$).

In the Table 4, there are the scores of each mastication items, divided by the teething classification. It was not observed significant association between the sum and the means of each mastication evaluated items, when comparing the groups with and without alterations (dental caries, occlusion and dental loss) ($p>0.05$). In a more detailed analysis about the cutting type, it was verified that the food incision was not influenced by the incisor loss, that is, the children with or without dental loss preferred to perform centralized incision; however, the aspect of presenting anterior open bite showed more influence in incision, although without significance for this study. It was also observed that most children preferred food cutting with the help of hands and/or head, including the ones without anterior alterations (anterior open bite or overbite). When

compared the incision of the six subjects with anterior incisor loss and the cutting mode, it was verified that all subjects performed bite using teeth/hands/head to obtain a piece of food. Besides, the two children who did not bite the food, tore it using the hand, with no anterior alterations.

DISCUSSION

In relation to lips posture during mastication, some researchers verified that most children perform mastication with closed lips^{12,14,15}. However, when compared deciduous and mixed dentition, the proportion of open lips in the first dentition is significantly higher than in the group with mixed dentition¹². A research evidenced that the way of mastication is gradual in its development and improvement. It was analyzed the mastication of 51 children, observing that the lips posture varied according to the age. Most children from two to three years old remained with the lips open, the children from three to four years old presented semi-opened lips posture and the children from four to five years old remained with closed lips¹³. A study mentioned that the absence of lip sealing during mastication may interfere in foods lateralization, modifying the mandibular movements during mastication²⁴. In this study the children presented predominant rotational movement, similar with another research¹⁸, although it is observed high level of difficulty in keeping lips sealed during mastication.

About the food cutting way, most subjects performed incision in a centralized way, as it is observed in other studies as well¹³⁻¹⁵, however they performed the cutting with the teeth and the help of hands or head to tear

Table 2. Analysis of mastication assessment according to gender (n=60)

Items of the mastication evaluation protocol	male (n=32)	female (n=28)
Lips posture in mastication (Mean±SD)	1.7±0.1	2.2±0.1
With lips closure (n=16)	6	10
Alternating presence and absence of lips closure (n=26)	13	13
With no lips closure (n=18)	13	5
Food incision (cutting type)* (Mean±SD)	2.5±0.1	2.5±0.1
Did not perform (n=2)	1	1
Centralized (n=41)	22	19
Variable (n=10)	5	5
Lateralized to the left or right (n=7)	4	3
Cutting way (Mean±SD)	2.2±0.1	2.1±0.05
Cutting with teeth (n=7)	5	2
Using teeth and help of hands and/or head to obtain a piece of food (n=51)	26	25
No biting. using only the hands to obtain the necessary portion(n=2)	1	1
Usual mastication pattern (Mean±SD)	1.6±0.1	1.7±0.1
Alternated bilateral (n=8)	3	5
Bilateral with little alternance (n=25)	14	11
Unilateral to the left or right (n=27)	15	12
Predominant mandibular movements (Mean±SD)	1.9±0.1	2.3±0.1
Rotating (n=25)	10	15
Vertical (n=17)	10	7
Maceration (n=18)	12	6
Perioral musculature (Mean±SD)	2.6±0.1	2.9±0.1
Absence of exaggerated contraction(n=47)	22	25
Alternating absence and presence of exaggerated contraction (n=11)	8	3
Presence of exaggerated contraction (n=2)	2	0
Quantity of ingested food (Mean±SD)	2.3±0.1	2.6±0.1
Medial(n=35)	17	18
Alternating between excessive/reduced and medium quantity (n=15)	8	7
Excessive and/or reduced (n=10)	7	3
Mastication speed (Mean±SD)	2.6±0.1	2.8±0.1
Proper(n=46)	23	23
Alternating between proper and rapid/slow (n=6)	3	3
Rapid or slow (n=8)	6	2
Lower lip interposition(Mean±SD)	2.7±0.1	2.9±0.03
Does not perform (n=50)	23	27
Alternating moments with and without interposition (n=9)	8	1
Predominantly performs (n=1)	1	0
Proprioception to perceive the food on the lips (Mean±SD)	1.8±0.1	2.1±0.1
Did not leave residues on the lips (n=24)	11	13
Left residue but soon removed it (n=12)	4	8
Did not remove residue from the lips (n=24)	17	7
Total Score (Média±DP)	22.1±0.4	24.3±0.5

*Two children did not perform food incision.

Legend: SD = standard deviation

Table 3. Analysis of the mastication assessment according to age group (n=60)

Items of the mastication evaluation protocol	3:0 - 3:11 months (n=16)	4:0 - 4:11 months (n=16)	5:0 - 5:11 months (n=28)
Lips posture in mastication (Mean±SD)	1.6±0.7	1.6±0.6	2.4±0.6
With lips closure (n=16)	2	1	13
Alternating presence and absence of lips closure (n=26)	5	7	14
With no lips closure (n=18)	9	8	1
Food incision (cutting type)* (Mean±SD)	2.4±1	2.4±0.8	2.6±0.7
Did not perform (n=2)	2	0	0
Centralized (n=41)	11	9	21
Variable (n=10)	2	4	4
Lateralized to the left or right (n=7)	1	3	3
Cutting way(Mean±SD)	1.9±0.4	2.1±0.4	2.1±0.3
Cutting with teeth (n=7)	1	3	3
Using teeth and help of hands and/or head to obtain a piece of food (n=51)	13	13	25
No biting, using only the hands to obtain the necessary portion(n=2)	2	0	0
Usual mastication pattern (Mean±SD)	1.7±0.8	1.8±0.6	1.6±0.7
Alternated bilateral (n=8)	3	2	3
Bilateral with little alternance (n=25)	6	9	10
Unilateral to the left or right (n=27)	7	5	15
Predominant mandibular movements (Mean±SD)	1.6±0.8	2.1±0.9	2.4±0.7
Rotating (n=25)	3	7	15
Vertical (n=17)	4	3	10
Maceration (n=18)	9	6	3
Perioral musculature (Mean±SD)	2.9±0.2	2.7±0.6	2.7±0.5
Absence of exaggerated contraction(n=47)	15	12	20
Alternating absence and presence of exaggerated contraction (n=11)	1	3	7
Presence of exaggerated contraction (n=2)	0	1	1
Quantity of ingested food (Mean±SD)	2.3±0.8	2.4±0.9	2.5±0.7
Medial (n=35)	8	10	17
Alternating between excessive/reduced and medium quantity (n=15)	5	2	8
Excessive and/or reduced (n=10)	3	4	3
Mastication speed (Mean±SD)	2.6±0.6	2.6±0.8	2.7±0.7
Proper (n=46)	11	12	23
Alternating between proper and rapid/slow (n=6)	4	1	1
Rapid or slow (n=8)	1	3	4
Lower lip interposition (Mean±SD)	2.7±0.6	2.7±0.4	2.9±0.3
Does not perform (n=50)	12	12	26
Alternating moments with and without interposition (n=9)	3	4	2
Predominantly performs (n=1)	1	0	0
Proprioception to perceive the food on the lips (Mean±SD)	1.8±0.8	1.9±0.9	2.1±0.9
Did not leave residues on the lips (n=24)	4	5	15
Left residue but soon removed it (n=12)	5	4	3
Did not remove residue from the lips (n=24)	7	7	10
Total Score(Mean±SD)	21.6±0.9	22.2±2.8	24.1±2.4

*Two children did not perform food incision.

Legend: SD = standard deviation

Table 4. Percentage of each item score of mastication with the dentition classification (n=60)

Items of the mastication evaluation protocol	Dentition classification			
	Free of dental caries. occlusive alteration and dental loss (n=26)	Incisors with high severity caries. occlusive alteration or dental loss (n=16)	Posteriors with high severity caries. occlusive alteration or dental loss (n=2)	Incisors and posteriors with high severity caries, occlusive alteration or dental loss (n=16)
Lips posture in mastication (Mean±SD)	1.9±0.7	2±0.9	3±0.0	1.8±0.7
With lips closure (n=16)	6	6	2	2
Alternating presence and absence of lips closure (n=26)	12	5	0	9
With no lips closure (n=18)	8	5	0	5
Food incision (cutting type)* (Mean±SD)	2.4±1	2.6±0.6	3±0.0	2.5±0.8
Did not perform (n=2)	2	0	0	0
Centralized (n=41)	18	10	2	11
Variable (n=10)	3	5	0	2
Lateralized to the left or right (n=7)	3	1	0	3
Cutting way (Mean±SD)	2±0.4	2.1±0.3	2±0.0	2.1±0.3
Cutting with teeth (n=7)	3	2	0	2
Using teeth and help of hands and/or head to obtain a piece of food (n=51)	21	14	2	14
No biting, using only the hands to obtain the necessary portion (n=10)	2	0	0	0
Usual mastication pattern (Mean±SD)	1.6±0.7	1.5±0.6	2.5±0.7	1.9±0.7
Alternated bilateral (n=8)	3	1	1	3
Bilateral with little alternance (n=25)	10	6	1	8
Unilateral to the left or right (n=17)	13	9	0	5
Predominant mandibular movements (Mean±SD)	2±0.8	2.4±0.9	3±0.0	1.9±0.8
Rotating (n=25)	8	11	2	4
Vertical (n=17)	9	1	0	7
Maceration (n=18)	9	4	0	5
Perioral musculature (Mean±SD)	2.9±0.3	2.7±0.6	2.5±0.7	2.6±0.6
Absence of exaggerated contraction(n=47)	23	12	1	11
Alternating absence and presence of exaggerated contraction (n=11)	3	3	1	4
Presence of exaggerated contraction (n=2)	0	1	0	1
Quantity of ingested food (Mean±SD)	2.4±0.9	2.2±0.6	3±0.0	2.7±0.7
Medial (n=35)	16	5	2	12
Alternating between excessive/reduced and medium quantity (n=15)	4	10	0	1
Excessive and/or reduced (n=10)	6	1	0	3
Mastication speed (Mean±SD)	2.5±0.8	2.6±0.7	3±0.0	2.7±0.7
Proper (n=46)	25	16	2	3
Alternating between proper and rapid/slow (n=6)	4	2	0	0
Rapid or slow (n=8)	4	4	0	0
Lower lip interposition (Mean±SD)	2.9±0.3	2.7±0.4	3±0.0	2.7±0.6
Does not perform (n=50)	23	12	2	13
Alternating moments with and without interposition (n=9)	3	4	0	2
Predominantly performs (n=1)	0	0	0	1
Proprioception to perceive the food on the lips (Mean±SD)	1.8±0.9	1.9±0.9	2.5±0.7	2.2±0.9
Did not leave residues on the lips (n=24)	8	6	1	9
Left residue but soon removed it (n=12)	6	3	1	2
Did not remove residue from the lips (n=24)	12	7	0	5
Total Score	22.5±2.8	22.9±2.9	27.5±2.1	23.2±2.7

* Two children did not perform food incision.

Legend: SD = standard deviation

the food. A study to evaluate if the absence of incision modifies the individual pattern of the other mastication phases²⁵ detected that when the incision is performed with the incisor teeth, the following phases are performed with less effort and with alternated bilateral movements, without predominance of side, and when the cutting is manual or pre-fractioned, the mastication effectiveness decreases.

The results characterization regarding the mastication preference showed that most children presented a preferential side during usual mastication, agreeing with other researches^{11,16,26}. Other studies indicated predominance of bilateral mastication^{12-14,17}. According to literature, in unilateral mastication there is higher mandible development at the balancing side and higher jaw development at the working side²⁷. It avoids, at the inactive side, presence of dental cuspid physiological wear, enabling improper occlusal interference and favoring the formation of bacterial dental plaques³.

The perioral musculature participation should be discreet during mastication, as well as it is observed in this study and in others^{12,14}. The literature points that mastication, when performed with exaggerated participation of the periobicular musculature and of the mental contraction, is usually sign of inefficient mastication. Such fact may be associated with tongue posteroanterior movement during mastication, because the musculature is in hyperfunction to contain the tongue movement²².

The volume of the large ingested portions is pointed as determinant with higher amplitude of mandibular movements in mastication and association with head movements during this function²⁸. In this study, it was observed that the children who ingested a medial amount of food, according to the size of their oral cavities, presented result similar to the findings of another study, which characterized the mastication function in children with deciduous and mixed dentition¹⁴.

The rapid mastication is a signal of small amount of mastication cycles, what means bad grinding and food pulverization, been swallowed before the homogeneous bolus formation. The slow mastication may be related to temporomandibular articulation disorders and mandibular movements limitations²⁹. The mastication speed was considered as proper in the children of this research, different from another study which observed that the slow mastication was significantly higher in children with deciduous teething, when compared with children with mixed teething¹².

From the evaluated children, most of them did not perform lower lip interposition, as well as it was observed in another study in which only a few children performed mastication with lower lip interference¹².

This research performed with mixed and deciduous dentition children showed that most of the children did not use the hands to remove food residue from the oral cavity, removing it with the tongue or lips¹⁴. In this study some children presented proper proprioception to perceive food on the lips, they did not leave food on the lip and others did not remove bread residues.

Considering the relationship between mastication and aspects related to diet, a study performed with 144 children from three to five years old investigated the association between breastfeeding and quality of mastication function. The findings showed positive correlation among such variables, agreeing with another research³⁰, however, in the present study, it was not observed such association. In this study, the children who were breastfed for at least 12 months presented mastication mean scores significantly higher, similarly to another study²¹.

The oral habits presented influence in relation to food cutting mode. It is known that these habits may damage the stomatognathic system stability, through excessive masseter, temporal and pterygoid muscles work, as medial as lateral, what may cause painful symptomatology and modification in coordination and potential¹.

Another important aspect regards food introduction in children's routine, from diet amount to quality. A study³¹ reveals that mastication performance is different with different food texture. There is great importance of stimulation through manipulation of a solid food diet to favor bone and dental growth. The mastication enables the functional and muscular balance of the stomatognathic system and its decrease, because of a soft consistency diet which will favor the unbalance of this system in higher or lower mastication intensity⁵. Another research, however, reveals that there was no association between food habits and mastication evaluation, supporting the present study¹⁷.

In relation to children breathing way, it was observed that oral and nasal breathers perform mastication without lips closure significantly more frequently than nasal breathers, as well as to perform mandibular movements predominant of maceration. The literature points that oral and nasal breathers present negative interference in the mastication time, food residues in the oral cavity, lips posture and noise during mastication³².

When it is correlated the mastication development with the age, a study performed with children in the same age group demonstrated that the food knead decrease depends significantly the age¹³. Another study which evaluated the mastication function verified that the children with deciduous and mixed dentition presented difficulty to lateralize the bolus, and this preference tends to disappear as they grow up³³.

In relation to gender, the studied literature diverges from the findings of the present study. It was not verified gender relevance in the statistics of the mastication pattern for the deciduous and mixed dentition¹² and when it was analyzed the mixed dentition, boys and girls present the same mastication aspect in this phase¹⁸.

It was understood that, in this evaluation, having high severity caries was a factor which should be considered to the group's classification, because the caries severity can mutilate the teeth and influence mastication. The caries, dental loss and unilateral crossbite are important conditions to unilateral mastication¹. The solid occlusive relations and stability are basic for the mastication function, and they can influence the proper mastication, because quality and quantity of dental contacts inform the central nervous system the type of bite which should be established⁵.

In this study, the mastication evaluation was contrasted with the dental and occlusive classification, with no observed association between these variables, as it can be observed in another study with subjects of a different age group³⁴. Researches which used electromyography for evaluation verified that there was not difference between posterior crossbite and preferential mastication side^{35,36}.

In relation to dental caries, a study which evaluated, among other aspects, the relationship between dental caries and mastication in 12 years old students verified that as higher the caries severity is, higher is the impact on dissatisfaction about mastication³⁷. It was also verified in another research³⁸.

It is interesting to highlight that in this study the incisor loss was not a determining factor to incision absence with central incisor, parameter which is not verified in the studied literature. A hypothesis may be related to recent incisor loss, what was not verified in the evaluation. Besides, the fact that the children who did not bite the food presented the central incisor shows that this is not always a determining factor the presence or absence of teeth to present proper mastication. The

incentive to the proper manner to perform feeding may also be an important factor regarding mastication.

Such findings are extremely important for the clinical practice to be attempt to the differences that may be found according to the subjects' age groups and the presence or absence of structural and/or functional aspects of the stomatognathic system. It should be highlighted that the sample consisted, mostly, of children with about five years old. Moreover, the different environment and the fact that they were being evaluated may have influenced the mastication behavior. In the clinical scope, it is crucial that the evaluation of each individual's evaluation is performed carefully, looking at the history and way of daily life, including diet habits, and also orofacial myofunctional evaluations, in order to trace the best therapeutic plan according to the presented aspects.

CONCLUSION

From this study results, it was verified that in the 10 evaluated mastication items there was alternation among the expected pattern for all variables. For the studied sample, the mastication way was gradual in its development and improvement. It was found difference in mastication according to age, gender, oral habits and breathing way.

REFERENCES

1. Bianchini EMG. Mastigação e ATM. In: Marchesan IQ (org). Fundamentos em fonoaudiologia: aspectos clínicos da motricidade oral. Rio de Janeiro: Guanabara- Koogan; 2005. p.46-57.
2. Barbosa Tde S, Tureli MC, Nobre-dos-Santos M, Puppim-Rontani RM, Gavião MB. The relationship between oral conditions, masticatory performance and oral health-related quality of life in children. Arch Oral Biol. 2013;58(9):1070-7.
3. Cattoni DM. Alterações da mastigação e deglutição. In: Ferreira LP, Befi-Lopes DM, Limongi SCO, organizadores. Tratado de fonoaudiologia. São Paulo: Roca; 2004. p. 77-8.
4. Tanigute CC. Desenvolvimento das funções estomatognáticas. In: Fundamentos em fonoaudiologia: aspectos clínicos da motricidade oral. 2. ed. Rio de Janeiro: Guanabara; 2005. p.1-9.
5. Okeson JP. Tratamento das desordens temporomandibulares e oclusão. 6. ed. Rio de Janeiro: Elsevier, 2008.

6. Junqueira P. Avaliação Miofuncional. In: Fundamentos em fonoaudiologia: aspectos clínicos da motricidade oral. 2. ed. Rio de Janeiro: Guanabara; 2005. p.19-27.
7. Lucena CV, Silva HJ. Mastication: Physiology and Development Aspects. *Neurobiologia*. 2011;74(2):139-44.
8. Schwaab LM, Nilman CW, Gisel EG. Comparison of chewing cycles in 2-, 3-, 4-, and 5-year-old normal children. *Am J Occup Ther*. 1986;40(1):40-3.
9. Limongi SCO. Considerações sobre a importância dos aspectos morfológicos e emocionais no desenvolvimento e profilaxia dos órgãos fonoarticulatórios. In: Lacerda ET, Cunha C. Sistema sensorio motor oral: perspectivas de avaliação e terapia. São Paulo: EDUC; 1987. p. 58-75.
10. Berkovitz BKB, Holland GR, Moxhan BJ. Anatomia, embriologia e histologia bucal. In: Berkovitz BKB, Holland GR, Moxhan BJ. Estruturas dento-ósseas. 3.ed. Porto Alegre: Artmed; 2004. p. 8-57.
11. Pizzol KEDC. Influência da mastigação unilateral no desenvolvimento da assimetria facial. *Rev Uniara*. 2004;15:215-22.
12. Gomes FCS, Melo LF de, Chiappetta ALML. Aspectos do padrão mastigatório na dentição decídua e mista em crianças de três a nove anos. *Rev. CEFAC*. 2006;8(3):313-9.
13. Vieira RA, Lório AP, Assencio-Ferreira VJ. Características mastigatórias em crianças de 2 a 5 anos. *Rev. CEFAC*. 2003;5(1):59-62.
14. Gomes LM, Bianchini EMG. Caracterização da função mastigatória em crianças com dentição decídua e dentição mista. *Rev. CEFAC*. 2009;11(3):324-33.
15. Freitas VS de, Gregio FN, Pereira FA. Características mastigatórias em crianças na dentição mista. *Rev. CEFAC*. 2003;4(1):55-8.
16. Garcia DGB, Benevides SD, Araujo RP, Ribeiro CO, Mello SMF. Mastigação habitual e atividade eletromiográfica dos músculos masseter e temporal em escolares de 7 a 12 anos. *Rev. CEFAC*. 2014;16(6):1928-35.
17. Lima RMF, Freire OCB, Filho JLN, Stampford S, Cunha DA, Silva HJ. Padrão mastigatório em crianças de 5 a 7 anos: suas relações com crescimento craniofacial e hábitos alimentares. *Rev. CEFAC*. 2006;8(2):205-15.
18. Gomes LM, Bianchini EMG. Caracterização da função mastigatória em crianças com dentição decídua e dentição mista. *Rev. CEFAC*. 2009;11(3):324-33.
19. World Health Organization. Oral health surveys, basics methods. Geneva: World Health Organization; 1997.
20. Hallett KB, O'Rourke PK. Pattern and severity of early childhood caries. *Community Dent Oral Epidemiol*. 2006;34(1):25-35.
21. Pires SC, Giugliani ERJ, Silva FC. Influence of the duration of breastfeeding on quality of muscle function during mastication in preschoolers: a cohort study. *BMC Public Health*. 2012;12(1):934.
22. Whitaker ME, Trindade Júnior AS, Genaro KF. Proposta de protocolo de avaliação clínica da função mastigatória. *Rev. CEFAC*. 2009;11(3):311-23.
23. Felício CM, Ferreira CLP. Protocol of orofacial myofunctional evaluation with scores. *Inter J Ped Otorhinolaryngol*. 2008;72(3):367-75.
24. Felício CM, Trawitzki LVV. Interfaces da Medicina, Odontologia e Fonoaudiologia no Complexo Cérvico-Craniofacial. Barueri: Pró-Fono; 2009.
25. Tagliaro ML, Calvi C de L, Chiappetta, AL de ML. A fase de incisão no processo da mastigação: enfoque clínico. *Rev. CEFAC*. 2004;6(1):24-8.
26. Sproesser JG. Características das relações interoclusais em indivíduos com mastigação realizada preferencialmente sobre um dos lados e sintomas de disfunção temporomandibular. *JBA*. 2002;2(5):26-31.
27. Berrentin-Felix G, Trindade Jr AS, Alves TCNV. Anatomofisiologia do sistema estomatognático e suas aplicações clínicas. In: Cunha ACP, Santos-Coluchi GG, Souza LBR. Ortodontia e fonoaudiologia na prática clínica. Rio de Janeiro: Revinter; 2011. p.191-221.
28. Häggman-Henrikson B, Eriksson PO. Head movements during chewing: relation to size and texture of bolus. *J Dent Res*. 2004;83(11):864-8.
29. Cattoni MD, Tessitore A. Diagnóstico das alterações de respiração, mastigação e deglutição. In: Fernandes FDM, Mendes BCA, Navas ALP (org.). 2. ed. Tratado de fonoaudiologia. São Paulo: Rocca; 2009.
30. Neu AP, Silva AMT, Mezzomo CL, Busanello-Stella AR, Moraes AB. Relação entre o tempo e o tipo de amamentação e as funções do sistema estomatognático. *Rev. CEFAC*. 2013;15(2):420-6.

31. Gisel EG. Chewing cycles in 2-to 8-year-old normal children: a developmental profile. *Am J Occup Ther.* 1988;42(1):40-6.
32. Silva MAA, Natalini V, Ramires RR, Ferreira LP. Análise comparativa da mastigação de crianças respiradoras nasais e orais com dentição decídua. *Rev. CEFAC.* 2007;9(2):190-8.
33. Picinato-Pirola MNC, Mello-Filho FV, Trawitzki LVV. Tempos e golpes mastigatórios nas diferentes deformidades dentofaciais. *J. Soc. Bras. Fonoaudiol.* 2012;24(2):130-3.
34. Pastana SG, Costa SM, Chiappetta ALML. Análise da mastigação em indivíduos que apresentam mordida cruzada unilateral na faixa-etária de 07 a 12 anos. *Rev. CEFAC.* 2007;9(3):339-50.
35. Andrade AS, Gavião MBD, Gameiro GH, Rossi M. Characteristics of masticatory muscles in children with unilateral posterior crossbite. *Braz Oral Res.* 2010;24(2):204-10.
36. Trawitzki LVV, Felício CM, Puppim-Rontani RM, Matsumoto MAN, Vitti M. Mastigação e atividade eletromiográfica em crianças com mordida cruzada posterior. *Rev. CEFAC.* 2009;11(3):334-40.
37. Peres KG, Latorre MRDO, Traebert J, Panizzi N. Impacto da cárie e da fluorose dentária na satisfação com a aparência e com a mastigação de crianças de 12 anos de idade. *Cad Saúde Pública.* 2003;19(1):323-30.
38. Wong HM, McGrath CP, King NM, Lo EC. Oral Health-Related Quality of Life in Hong Kong Preschool Children. *Caries Res.* 2011;45(4):370-6.