Original Article

Artigo Original

Chewing time and chewing strokes in different dentofacial deformities

Tempo e golpes mastigatórios nas diferentes deformidades dentofaciais

Melissa Nara de Carvalho Picinato-Pirola[1]
Francisco Veríssimo de Mello-Filho[2]
Luciana Vitaliano Voi Trawitzki[2]

Keywords

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Time and motion studies
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ABSTRACT

Purpose: To verify whether the number of chewing strokes and the chewing time are influenced by dentofacial deformities in habitual free mastication. **Methods:** Participants were 15 patients with diagnosis of class II dentofacial deformity (GII), 15 with class III (GIII), and 15 healthy control individuals with no deformity (CG). Free habitual mastication of a cornstarch cookie was analyzed, considering the number of chewing strokes and the time needed to complete two mastications. Strokes were counted by considering the opening and closing movements of the mandible. The time needed to consume each bite was determined using a digital chronometer, started after the placement of the food in the oral cavity and stopped when each portion was swallowed. **Results:** There were no differences between groups regarding both the number of strokes and the chewing time. However, with regards to the number of strokes, CG and GII presented a significant concordance between the first and the second chewing situation, which was not observed in GIII. The analysis of time showed significant concordance between the first and second chewing situation in CG, reasonable concordance in GII, and discordance in GIII. **Conclusion:** Dentofacial deformities do not influence the number of chewing strokes or the chewing time. However, class III individuals do not show uniformity regarding these aspects.

Descritores

Mastigação
Má oclusão
Estudos de tempo e movimento
Anormalidades maxilofaciais
Anormalidades do sistema estomatognático

RESUMO

Objetivo: Verificar se o número de golpes e o tempo mastigatório são influenciados pela deformidade dentofacial, na mastigação habitual livre. **Métodos:** Participaram 15 pacientes com deformidade dentofacial classe II (GII), 15 com classe III (GIII) e 15 indivíduos sem a deformidade (GC). Foi analisada a mastigação habitual livre de um biscoito de maisena, considerando o tempo e o número de golpes mastigatórios apresentados durante duas mastigações. A contagem dos golpes foi feita considerando os movimentos mandibulares de abertura e fechamento da mandíbula. O tempo para o consumo de cada mordida do alimento foi investigado por meio de um cronômetro digital, acionado após a colocação do alimento na cavidade oral e paralisado no momento da deglutição final de cada porção. **Resultados:** Não houve diferenças entre os grupos, tanto para a variável referente ao número de golpes, quanto para a relacionada ao tempo. Entretanto, quanto ao número de golpes, observou-se que os grupos GC e GII apresentaram uma concordância significativa entre a primeira e a segunda situação de mastigação, o que não ocorreu com o GIII. Na análise do tempo, houve uma concordância significativa no GC entre a primeira e a segunda situação de mastigação; o GII apresentou uma concordância razoável entre as duas situações de mastigação e o GIII apresentou discordância entre as duas mastigações. **Conclusão:** As deformidades dentofaciais não influenciam no número de golpes mastigatórios e no tempo da mastigação. Entretanto, os indivíduos classe III não apresentam uma uniformidade nesses aspectos.

Correspondence address:
Melissa Nara de Carvalho Picinato-Pirola
Departamento de Oftalmologia, Otorrinolaringologia e Cirurgia de Cabeça e Pescoço da Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo
Av. Bandeirantes, 3900, Ribeirão Preto (SP), Brasil, CEP: 14048-900.
E-mail: melissapicinato@yahoo.com.br

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Research carried out at the Ribeirão Preto School of Medicine, Universidade de São Paulo –USP – São Paulo (SP), Brazil.
(1) Graduate Program (Doctorate degree) in Medical Sciences, Department of Oftalmology, Otorhinolaryngology and Head and Neck Surgery, Ribeirão Preto School of Medicine, Universidade de São Paulo –USP – São Paulo (SP), Brazil.
(2) Department of Oftalmology, Otorhinolaryngology and Head and Neck Surgery, Ribeirão Preto School of Medicine, Universidade de São Paulo –USP – São Paulo (SP), Brazil.
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INTRODUCTION

Mastication is one of the main functions of the stomatognathic system since it represents the initial phase of the digestive process, i.e the preparatory phase for swallowing[1,2]. The masticatory function is influenced by several factors such as food consistency, saliva flow, bite force, severity of malocclusion, missing teeth, and health status of the orofacial structures and of the temporomandibular joint (TMJ)[2-5].

The number of chewing strokes that occur up to the beginning of swallowing will depend on the volume and characteristics of the food ingested, on the neuromuscular conditions, the pattern of facial growth, the need to rush through a meal[2], and on the individual's personality[6]. Studies have demonstrated that there is no relationship between masticatory performance and number of chewing strokes[6,7].

Dentofacial deformities are considered severe malocclusion that require combined treatment with surgery, orthodontics, and orofacial myofunctional therapy[8]. In general, people seek treatment due to esthetic and functional complaints, with mastication being one of the major problems[9,10].

The unfavorable skeletal relations of individuals with dentofacial deformities and the impairment of occlusion lead to impaired chewing[1,11]. Thus, the objective of the present study was to determine whether the number of chewing strokes and the chewing time are influenced by dentofacial deformities in habitual free mastication and if these variables are uniform in two chewing situations. The hypothesis raised was a possible difference between groups with dentofacial deformities and a control group.

METHODS

The study was approved by the Research Ethics Committee of the University Hospital, Faculty of Medicine of Ribeirão Preto, Universidade de São Paulo (HCFMRP-USP), protocol# 11463/2006, and all subjects signed the consent form.

Forty-five adults aged 18 to 35 years were included in the study. Of these, 15 had a diagnosis of class II dentofacial deformity (GII, six men and nine women with average age of 24 years) and 15 had a diagnosis of class III dentofacial deformity (GIII, eight men and seven women with average age of 25 years). All were patients at the Craniomaxillofacial Surgery Outpatient Clinic of HCFMRP-USP with an indication of orthognathic surgery and corresponded to the group with deformity (GD). The dentofacial diagnosis was made by the orthodontics team based on clinical evaluation, analysis of plaster casts and photographic and cephalometric analyses.

The control group (CG) consisted of four men and 11 women aged on average 23 years, with natural dentition, no changes in facial morphology or dental occlusion, with no missing teeth, and no signs or symptoms of TMJ dysfunction. The participants were evaluated clinically by the orthodontics team of the service.

The criterion for inclusion in the GD was the presence of class II (GII) or class III (GIII) dentofacial deformity, with all subjects having an indication for surgical correction of the deformity regardless of occlusal and skeletal changes. All patients were supposed to be under orthodontic treatment with fixed braces on the upper and lower teeth regardless of treatment phase. In addition, the patients were supposed to have no more than one absent tooth on each side of the arcade, with or without an interdental space, due to a tooth extraction for the purpose of orthodontic or dental treatment or due to early losses. Individuals with central or peripheral neurological disorders, with a history of trauma and/or tumors in the head and neck region and individuals wearing full or partial dentures were excluded from the study.

Procedures

For evaluation, the subjects were instructed to use habitual free mastication (with no interference by the examiner) and a cornstarch cookie was offered to each participant (Maizena, Marilan®, *Marília, São Paulo, Brazil*). The individuals were evaluated in sitting position and were filmed with a camera (Handycam-zoom, Sony®, *Manaus, Amazonas, Brazil*) set up on a tripod in front of them at a fixed distance of approximately 1.5m. The images were analyzed by a single examiner considering the number of chewing strokes and chewing time presented during habitual free mastication of the first and second piece of cookie (two chewing situations).

The chewing strokes were counted considering the opening and closing mandibular movements until tooth contact occurred. The time needed to consume each portion of chewed food was measured with a digital chronometer (Intermec, Everett®, Washington, USA). The chronometer was activated after the placement of the food in oral cavity and stopped at the time of the final swallowing of each portion.

The SAS 9.0 software (Version 9, Cary®, NC, USA) was used for statistical analysis. The number of chewing strokes was compared between groups in the two chewing situations using the random effects Poisson model[12]. Chewing time was compared between groups by a mixed effects (random and fixed effects) linear regression model[13].

To determine the concordance of the two chewing situations in terms of number of chewing strokes and chewing time we used the intra-class correlation coefficient (ICC), which measures the degree of concordance between measures within each class[14]. The closer to 1 the coefficient, the greater the concordance between measures within the same class.

RESULTS

When CG, GII and GIII individuals were compared regarding mastication no difference in number of chewing strokes or in chewing time was observed between them, as shown by the results of the first and second chewing situation presented in Table 1.

Regarding the comparison of two chewing situations, CG and GII individuals showed significant concordance between them in terms of number of chewing strokes. In contrast, GIII individuals showed discordance between the two chewing situations. Analysis regarding time revealed significant

Table 1. Number of chewing strokes and chewing time (in seconds) in the first and second situation of mastication

Group	Mastication	Variables	Mean	SD	Minimum	Median	Maximum
CG	1	NS	16.73	9.09	9.00	14.00	43.00
		T	13.27	6.69	7.94	10.31	33.90
	2	NS	15.87	8.32	8.00	15.00	41.00
		T	13.13	6.32	6.94	11.25	31.60
GII	1	NS	15.40	5.44	9.00	14.00	27.00
		T	12.17	3.27	7.44	11.82	17.94
	2	NS	15.07	5.75	8.00	13.00	30.00
		T	12.46	3.73	8.15	11.12	19.94
GIII	1	NS	17.93	8.46	10.00	15.00	41.00
		T	14.28	8.55	5.97	12.19	40.00
	2	NS	14.27	4.35	8.00	14.00	21.00
		T	11.62	3.55	4.85	13.06	15.97

Note: CG = control group; GII = group with class II dentofacial deformity; GIII = group with class III dentofacial deformity; NS = number of strokes; T = time; SD = standard deviation

concordance between the first and second chewing situation in CG. The GII group showed reasonable concordance between the two chewing situations, whereas the GIII group showed discordance (Table 2).

Table 2. Intra-class correlation coefficient (ICC) of number of chewing strokes and time (in seconds) between the first and second situation of mastication

Group	Number of strokes	Time (seconds)
	NG 1 x NG 2	T 1 x T 2
CG	0.81	0.72
GII	0.87	0.56
GIII	0.04	0.04

Note: CG = control group; GII = group with class II dentofacial deformity; GIII = group with class III dentofacial deformity; NS = number of strokes; T = time; 1 = first situation of mastication; 2 = second situation of mastication

DISCUSSION

Several studies have dealt with masticatory function both in normal individuals and in individuals with dentofacial deformities using various methodologies[15-18]. However, literature related to number of chewing strokes and chewing time is scarce.

In the present study, when mastication was compared between CG, GII and GIII subjects, it was observed that the number of chewing strokes and chewing time were similar to all of them. Thus, from the perspective of visual perceptive analysis, it is not possible to state that dentofacial deformities impair chewing in terms of variables such as number of chewing strokes and chewing time. In a previous study, the authors did not detect differences in the number of chewing strokes for the mastication of almonds and dried meat when comparing groups with class I, class II and class III malocclusion and individuals without malocclusion. The authors also stated that malocclusions affect the ability to break food but do not influence the number of chewing strokes necessary to swallow almonds and dried meat[1].

Another study showed that chewing time and duration and mandibular excursion during mastication did not differ between patients with dentofacial deformities and controls. The methodology used by the authors consisted of electromyography and measurements of mandibular movement with a sirognathograph during mastication of artificial food (Gummi-Bears) [19]. The cited study also did not detect differences regarding chewing strokes or chewing time even though the methodology used differed from that used in the present study.

Studies have shown that chewing efficacy is impaired in individuals with dentofacial deformities[15-17]. However, an individual with a good chewing performance does not present a smaller number of chewing strokes than an individual with impaired performance[20]. In the present study, control individuals also showed no variation in number of chewing strokes or chewing time compared to individuals with class II and III dentofacial deformities.

Another aspect investigated in the present study was the uniformity of chewing strokes and chewing time in two situations of free mastication. We observed that individuals without deformities or with class II deformity were able to maintain a uniform chewing pattern regarding the number of chewing strokes and chewing time, a fact that was not observed in individuals with class III deformity. Individuals with class III dentofacial deformity presented greater discordance between the two chewing situations, demonstrating that in these individuals mastication does not occur in a uniform manner.

Some studies have reported that the masticatory process adapts to the food consistency[20-22]. When the same type of food is used, the number of chewing strokes needed to prepare it for swallowing is constant[23]. We used a single type of food as an instrument for evaluation and observed a uniform number of chewing strokes and a uniform chewing time in individuals with no dentofacial deformity and in individuals with class II dentofacial deformity.

Individuals with class III dentofacial deformity have a smaller area of occlusal contact compared to individuals without this deformity[24]. Thus, the occlusal conditions of class III individuals may be less favorable for masticatory function, a fact that may explain the lack of chewing uniformity in these individuals. In the assessment of chewing performance of individuals with malocclusion (class III, class II, class I) and without malocclusion using an artificial food (CutterSil),

it was observed that class III individuals showed lower food trituration[1]. In addition, class III individuals reported greater chewing difficulty, followed by class II and class I individuals[1].

The results showed considerably high standard deviations also in control individuals. This fact may be explained by the "free" chewing of part of the food, which can show this variation among subjects.

The present study provided new data related to the number of chewing strokes and to chewing time in individuals with and without dentofacial deformities. However, the study was carried out using subjective analysis and a single food. New studies could be performed with additional natural foods and more objectively using instruments such as electromyography and sirognathography, among others. In addition, a larger number of participants may add new results and confirm those obtained in the present study.

CONCLUSION

The number of chewing strokes and chewing time are not influenced by dentofacial deformity in habitual free mastication. However, the individuals with no deformities or with class II deformity are able to keep a uniform chewing pattern regarding chewing strokes and chewing time, whereas this does not occur in individuals with class III deformity.

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