Original Article

Artigo Original

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Orofacial Myofunctional Evaluation Protocol for older people: validity, psychometric properties, and association with oral health and age

Protocolo de Avaliação Miofuncional Orofacial para pessoas idosas: validade, propriedades psicométricas e associação com saúde oral e idade

Keywords

Aged
Stomatognathic System
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Evaluation

ABSTRACT

Purpose: To develop a comprehensive assessment protocol for identifying, classifying and grading changes in stomatognathic system components and functions of older people, to determine its psychometric properties and verify its association with oral health and age. **Methods:** The content validity of the Orofacial Myofunctional Evaluation with Scores for Elders protocol (OMES-Elders) was established based on the literature. The protocol contains three domains: appearance/posture, mobility, and functions of the stomatognathic system. Eighty-two healthy elder volunteers (mean age 69±7.24 years) were evaluated using the OMES-Elders. A test-screening for orofacial disorders (reference) was used to analyze the concurrent validity (correlation test), sensitivity, specificity and accuracy (*Receiver Operating Characteristic Curve:* ROC curve) of the OMES-Elders. The association of the OMES-Elders scores with the Oral Health Index (OHX) and age in the sample was tested. **Results:** There was a significant correlation between the OMES-Elders and the reference test ($p < 0.001$). Reliability coefficients ranged from good (0.89) to excellent (0.99). The OMES-Elders protocol had a sensitivity of 82.9%, specificity of 83.3% and accuracy of 0.83. The scores of the protocol were significantly lower in individuals with worse oral health (OHX ≤ 61%), although individuals with adequate oral health (OHX ≥ 90%) also had myofunctional impairments. The predictors OHX and age explained, respectively, 33% and 30% of the variance in the OMES-Elders total score. **Conclusion:** As the first specific orofacial myofunctional evaluation of older people, the OMES-Elders protocol proved to be valid, reliable and its total score was associated with oral health and age.

Descritores

Idoso
Sistema Estomatognático
Mastigação
Deglutição
Saúde Oral
Avaliação

RESUMO

Objetivo: Desenvolver um protocolo de avaliação abrangente para identificar, classificar e graduar as mudanças nos componentes e funções do sistema estomatognático em pessoas idosas, determinar suas propriedades psicométricas e verificar a associação com a saúde oral e a idade. **Método:** A validade de conteúdo do protocolo de Avaliação Miofuncional Orofacial com Escores para Idosos (AMIOFE-I), que contém três domínios, aparência/postura, mobilidade e funções do sistema estomatognático, foi estabelecida com base na literatura. Oitenta e dois voluntários idosos (média de idade 69±7,24 anos) foram avaliados usando o AMIOFE-I. Um teste de triagem de distúrbios miofuncionais (referência) foi empregado para as análises de validade concorrente (teste de correlação), sensibilidade, especificidade e acurácia (*Receiver Operating Characteristic Curve:* curva ROC) do AMIOFE-I. Também foi analisada a associação dos escores do AMIOFE-I com o índice de saúde oral (ISO), determinado na amostra, e à idade. **Resultados:** Houve uma significante correlação entre o AMIOFE e o teste de referência. Os coeficientes de confiabilidade variaram de bom a excelente. O AMIOFE apresentou sensibilidade de 82,9%, especificidade de 83,3% e acurácia de 0,83. Os escores do AMIOFE-I foram significantemente menores em indivíduos com piores ISO (≤ 61%), contudo aqueles com adequada saúde oral (ISO ≥ 90%) também tinha prejuízos miofuncionais. Os preditores ISO e idade explicaram respectivamente 33% e 30% da variância no escore total do AMIOFE-I. **Conclusão**: O protocolo AMIOFE-I, o primeiro específico para a avaliação miofuncional de idosos, mostrou-se válido, confiável e seu escore total foi associado à saúde oral e à idade.

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INTRODUCTION

The older population is growing in worldwide. Older people have decreased sensitivity, muscle force/strength, oral motor ability and salivary flow[1-8]. These changes combined with dental problems, either acquired or degenerative disease, impair functions such as mastication, deglutition, and speech, and are risk factors for malnutrition, dehydration, health problems, disabilities, social isolation, and poor quality of life, resulting in additional health care costs[7,9-14].

Thus, health programs aimed at promoting orofacial functions are needed due to the physiological and functional decline of the stomatognathic system caused by aging. In general, safe swallowing and efficient mastication are the ultimate goals of these programs[2,3,9,10].

Even though objective measures such as bite force, tongue strength, masticatory performance, electromyography, and ultrasonography help understand the problems that affect the stomatognathic system[1,4,8,9], clinical evaluation is indispensable for the diagnosis of orofacial myofunctional disorders (OMD)[15-18]. Several scales have been developed and validated to reliably measure physical performance, functional disability, comorbidity, nutrition status and cognitive function in older people[19]. Although orofacial functions and dysfunctions are in general measured using either a screening tool (e.g. The Nordic Orofacial Test-Screening, NOT-S)[15] or highly specific instruments, such as the clinical evaluation of oropharyngeal dysphagia[3,7]. Furthermore, the effects of aging and oral health status on orofacial functions have not been concomitantly assessed in a comprehensive way.

The biopsychosocial importance of mastication, deglutition, facial expression and speech, and the absence of an instrument to evaluate orofacial structures and functions which enable the examiner to express his/her perception of the physical characteristics and orofacial behaviors of older people based on an ordinal scale, have prompted us to develop a new protocol.

The validation of methods for clinical assessment is recommended for evidence-based practice. The validity of an instrument is an estimate of how well it performs the assessment, and the criterion validity is determined by comparing the instrument in question to another taken as reference[20].

The objectives of this study were to develop the Orofacial Myofunctional Evaluation with Scores for Elders protocol (OMES-Elders), to determine its psychometric properties, and verify the association of its scores with an oral health index and with elderly's age.

METHODS

Participants

Eighty-two elder volunteers participated in the study (12 men, 70 women, aged 60-90 years, mean age = 68.8±7.2 years). All participants performed daily functions independently. The protocol study was approved by the ethical review board of the University (Process N. 192.14.11.2008). All individuals gave written informed consent to participate in the study and there was no dropout in this study. The sample size was calculated to reject the null hypothesis (one-tailed test). Previously obtained descriptive statistics were used to estimate the minimum number of individuals required for statistical analysis with 80% statistical power (type II error, beta) and with alpha (type I error) set at 5%. The minimum number of individuals required for the OMES-Elders total score was 15.

Inclusion criteria were: no hearing or visual impairments, or understanding or expression difficulties that could affect the tests, no intellectual disabilities, no emotional or neurological disorders (including motor speech disorders); no diabetes; and no dental or orofacial pain, or history of trauma and surgery in the head and neck.

Participants provided information about comfort (absence of pain or sensitivity), aesthetics (contentment with appearance), functionality (ability to eat unrestricted diet). They were assessed by a dentist for the Oral Health Index (OHX)[21] determination, as follows: Presence/absence of active carious lesions, secondary caries around restorations; periodontal (pocket depth, inflammation and subgingival calculus); wear and tear, loss by wear of enamel, dentine or cementum, loss of dimension or integrity of restoration; occlusion (presence of a minimum of ten pairs of articulating teeth, natural or prosthetic); mucosa inflammation, ulceration or other pathology; dentures, if present, lack of retention, stability, presence of wear and freeway space. Each item assessed could be either acceptable (positive score) or unacceptable (zero score). After the assessment, the sum of the scores was divided by the maximum score possible, and then multiplied by 100 in order to obtain the OHX. The larger the OHX, the better is the oral health.

Construction of the OMES-Elders protocol

The previously validated OMES-Expanded protocol[18] was the basis for the development of the OMES-Elders protocol (Appendix A). The content validity of the OMES-Elders, which involves the definition of the object of interest and the judgment of the relevance of each variable for the age groups, was established based on the literature[1-3,7,9,10,22]. The OMES-Elders scales were based on the psychophysical method, i.e., the level of measurement depends on pre-established conditions, so that the relationships between attributes will be represented by the relationships between numbers[23].

Orofacial myofunctional evaluation

The evaluations were performed during one session and later complemented by analysis of recorded images. The participants sat on a chair with a backrest and with their feet resting on the floor at a standardized distance (1m) from the lens of the camera (GR-SXM357UM JVC Compact VHS CAMCORDER, Manaus, Brazil), which was mounted on a tripod set at face, neck and shoulders height[16,18].

The OMES-Elders protocol is presented in Appendix A.

Predetermined scores of the OMES-Elders protocol were attributed to the following items, with the highest scores indicating normal patterns without deviation:

Appearance/posture of face, cheeks, maxillo-mandibular relationship (vertical and horizontal), mentalis muscle, lips,

tongue, and hard palate width. The scores were attributed using a four-point scale.

Mobility: Participants were asked to perform movements with their lips, tongue, mandible, and cheeks following the examiner's model. A six-point scale was used to assess mobility; 1 indicated a task that was not performed and 6 normal mobility.

Breathing Mode: The examiner determined whether the participants inspired and expired through the nostrils or the mouth, or through both pathways during situations of rest and mastication. A four-point scale from 1 (severe alteration) to 4 (normal) was used.

Deglutition was evaluated with the liquids as follows:

Task 1: Firstly, participants were asked to bring a cup containing 200 mL of room temperature water to their mouth and, after placing water in the mouth, to lower the cup so that their entire face could be seen. Then, participants were asked to swallow in the usual manner. This task aimed to determine lip behavior and identify other signs of alterations.

Task 2: Participants were asked to repeat the procedures described in Task 1, but this time the examiner placed the index finger under individual's chin and the thumb under individual's lower lip (in the mentalis muscle region) and immediately after deglutition, the examiner separated the individual's lips. This task aimed to observe tongue position.

In addition, the presence of other signs of swallowing disorders such as movement of the head or other parts of the body, sliding jaw, facial muscle tension, food escaping from the lips, coughing, and noise during swallowing were also recorded. A presence/absence scale (1/2) was used for each sign.

Deglutition efficiency, defined as the ability to impel the bolus from the oral cavity into oropharynx, was assessed separately for solid and liquid boluses. A scale of 1-3 was used; 1 indicated four or more swallowing events, 2 indicated two to three deglutition repetitions, and 3 indicated no more than one deglutition repetition of the same bolus.

Deglutition of solid food was evaluated during chewing, but the task 2 was not performed.

Mastication: Participants were instructed to chew a Bono® chocolate-filled cookie (Nestle, São Paulo, Brazil) in the usual manner. The masticatory type was evaluated by the percentage of chewing strokes occurring on each side of the oral cavity. Participants with natural teeth or with removable dentures that remain stable during chewing were evaluated using a 10-point scale with 1 indicating a failure to chew and 10 indicating bilateral and alternate chewing.

When the displacement of the prosthesis during chewing was observed, the scores assigned would range from 8-1 (see Appendix A). The presence of other behaviors and signs of alteration in the masticatory pattern was also analyzed. A presence/absence scale (1/2) was used for each sign.

Speech was evaluated using a recorded sound and images sample of each participant. Participants were asked to count from 1-10 and to repeat the syllables /pa/, /ta/, /ka/ three times. We observed the speech production and intelligibility. A scale of 1-4 was used, with 1 indicating severe alteration, 2 moderate, 3 mild and 4 a normal pattern.

Reference test

The *Nordic Orofacial Test-Screening* (NOT-S) used as reference in the study contains 12 domains of which six are interview-based, and six are based on clinical orofacial examination. During the examination, the score 0 (zero) represented normal condition and the score 1 (one) was assigned when impairments⁄impediments were observed in the domain evaluated. A final score of 12 represented alteration in all items (15).

Examiners

Two examiners, speech-language pathologists, previously trained and non-familiar with the individuals, participated in the study. Examiner 1 performed all evaluations using the OMES-Elders and NOT-S protocols, whereas Examiner 2, who has confirmed reliability values for orofacial assessment in a previous study[16] and was blind to the outcome of the other examiner's, performed the evaluations in a percentage of the sample for reliability analysis. Forty percent of the sample were randomly selected (20% for each protocol) and reevaluated by examiner 1, using video-recorded images[16,18], and by examiner 2 using the OMES-Elders protocol. An interval of at least 15 days between evaluations performed by the same examiner was observed to avoid memory effects. These data were used to determine intra- and inter-examiner reliability and agreement.

Data analysis

Reliability and agreement

Examiner reliability was calculated using the split-half method to determine the consistency and stability of the intra- and inter-results. Weighted kappa coefficients were calculated to estimate intra and inter-examiner agreement.

Analysis of validity criteria of the OMES-elders protocol

To determine whether the OMES-Elders protocol measured the parameters for which it was proposed, concurrent validity was calculated against the examination part of the NOT-S protocol[15], using the Spearman's correlation coefficient.

Analysis of sensitivity and specificity

Firstly, it should be noted that the NOT-S score equal to 12 indicates an alteration in all items and zero indicates no change in any item, whereas the OMES-Elders score of 246 indicates total absence of OMD and the score of 55 indicates the highest degree of OMD. So, it is necessary to select a cut-off point score for the OMES-Elders to indicate positive diagnosis of OMD, as well as the accuracy of the method. Therefore, the receiver operating characteristic (ROC) curve was used to determine the cut-off point and the ability of the OMES-Elders to predict OMD (sensitivity) and asymptomatic controls (specificity). The ROC was constructed with the grouping of the NOT-S score of 0 to 3 compared with the NOT-S score of 4 to 12. On original study[15], 37% of the healthy controls groups had false positive diagnostic when NOT-S scores different

from zero were assumed to indicate OMD: 30% of the healthy controls had one point, and 7% had two points. Thus, scores up to 3 were adopted as an absence of relevant OMD.

Analysis of association of OMES-elders scores with the OHX and age

Participants were divided into three groups according to the OHX: I (33 to 61%), II (62 to 89.99%) and III (90 to 100%). Their data were analyzed by One-way ANOVA; Tukey's significant difference was used as post-hoc test. Items with no composite scores (appearance of palate and breathing) were included for calculation of the OMES-Elders total score, but not individually analyzed due to level of measurement.

Additionally, the effect of predictors OHX and age on categories and total OMES-elders scores of the whole sample was examined by multiple regression analysis.

Statistical analysis

The MedCalc software (Ostend, West Flanders, Belgium) was used to calculate weighted kappa coefficients to estimate intra and inter-examiner agreement, as well as the accuracy, sensitivity and specificity values of the OMES-Elders protocol by ROC curve analysis.

The Spearman's correlation coefficient, examiner reliability, one-way ANOVA and multiple regression analysis (General Linear Models) were performed using the Statistica 13 software (Dell Software Inc., Aliso Viejo, United States of America). For all analysis, the significance level was set at 0.05.

RESULTS

Demographic characteristics and the OMES-Elders scores (mean ± standard error) for the orofacial items evaluated according to OHX classification are listed in Table 1. According to clinical examination, forty-six participants used mucosa-supported prostheses and 17 used implanted or tooth-supported prostheses; four had a minimum of ten pairs of articulating teeth, natural or prosthetic, and 15 had more than ten pairs of articulating teeth, but only four of them had complete dentition.

Reliability and agreement

The reliability coefficients for the evaluations performed using the OMES-Elders protocol were 0.91 (between examiners) and 0.99 (intra-examiner, test and retest). The intra-examiner 1 reliability

Table 1. Orofacial myofunctional evaluation with scores for elders protocol (OMES-Elders), according to the oral healthy Index (OHX). Mean and standard error (SE) of scores of orofacial items and categories

N = 82			Group I	Group II	Group III	
N			23	35	24	
OHX (%)			33 to 61	62 to 89.9	90 to 100	
Women (n)			17	29	24	
	Mi.	Mx.	Mean(SE)	Mean(SE)	Mean(SE)	*P*
Age			69.6(1.5)	69.2(1.2)	67.5(1.5)	0.47
Appearance/Posture						
Face	2	8	5.0(0.2)	5.1(0.2)	5.6(0.2)	0.08
Cheeks	2	8	6.0(0.2)	6.2(0.1)	6.5(0.2)	0.19
Jaws	3	12	9.8(0.2)^{a}	10.9(0.2)^{b}	11.0(0.2)^{b}	**<0.001**
Mentalis muscle	2	8	6.2(0.2)	6.4(0.2)	6.5(0.2)	0.57
Lips	3	12	8.0(0.4)^{a}	8.6(0.3)^{a,b}	9.4(0.4)^{b}	**0.03**
Tongue	2	8	5.9(0.2)	6.3(0.2)	6.0(0.2)	0.21
Palate*	1	4	3.9(0.1)	3.7(0.1)	3.8(0.1)	--------
Parcial score	*15*	*56*	*44.7(0.1)^{a}*	*47.2(0.8)^{ab}*	*48.8(0.9)^{b}*	***0.011***
Mobility						
Lips	4	24	17.3(0.6)	17.5(0.5)	18.7(0.6)	0.15
Tongue	6	36	19.2(1.2)	20.8(1.0)	22.0(1.2)	0.27
Jaw	5	30	20.5(0.9)	20.5(0.7)	19.2(0.9)	0.45
Cheeks	4	24	18.0(0.8)	17.5(0.6)	19.4(0.7)	0.15
Parcial score	*19*	*114*	*75.1(10.5)*	*76.4(1.9)*	*79.4(2.3)*	*0.42*
Functions						
Breathing*	1	4	3.9(2.4)	3.8(1.9)	3.8(3.8)	--------
Swallowing	10	34	25.5(0.1)	27.5(0.1)	27.7(0.1)	0.09
Mastication	5	18	11.0(0.1)^{a}	13.5(0.1)^{b}	15.5(0.1)^{b}	**<0.0001**
Speech	5	20	18.0(0.6)	19.2(0.5)	18.7(0.6)	0.12
Parcial score	*21*	*76*	*58.4(0.4)^{a}*	*64.0(0.3)^{b}*	*65.7(0.4)^{b}*	***0.0001***
Total score	55	246	178.3(1.2)^{a}	187.6(1.0)^{ab}	194.6(1.2)^{b}	**0.003**

*No composite scores were not individually included in the ANOVA due to level of measurement
Caption: P: probability in the one-way ANOVA. $P < 0.05$ indicates statistically significant difference. Medians with different superscript (a, b) differ at post-hoc test; Mi.: Minimum score, Mx: Maximum score in the OMES-Elders protocol

Table 2. Effects of the oral health index (OHX) and age on the categories and OMES-Elders scores

N = 82	R	R²	OHX		PF	Age		PF
			ß	CI		ß	CI	
Appearance	0.43	0.18	0.25*	0.04 to 0.45	0.66	-0.31**	-0.52 to -0.11	0.85
Mobility	0.23	0.05	0.14	-0.08 to 0.36	0.24	-0.16	-0.38 to 0.06	0.29
Functions	0.52	0.28	0.40**	0.20 to 0.59	0.98	-0.29**	-0.48 to -0.10	0.84
OMES	0.48	0.23	0.33**	0.13 to 0.53	0.91	-0.30**	-0.50 to -0.10	0.83

**P*-value 0.05; ***P*-value 0.01
Caption: OHX: Oral Health Index; R: correlation coefficient; *R2*: coefficient of determination (percentage of variability of the dependent variable explained by predictors); ß: regression coefficient; CI: 95% confidence interval in the equation; PF: Power for function

coefficient was 0.89 for the evaluations performed using the NOT-S. The weighted kappa values showed good (0.61-0.80) and very good (0.81-1.00) agreement in the test–retest with the OMES-expanded protocol and between examiners.

Criterion validity of the OMES-elders protocol

There was a significant correlation between the OMES-Elders and NOT-S protocols (r = -0.81, $p < 0.001$). The correlation was negative because the two scales are inverse.

Sensitivity and specificity of OMES-elders protocol

The ROC analysis showed that the OMES-Elders total score was significantly different than chance for the detection of the presence of OMD [AUC = 0.826, $P < 0.001$, CI: 0.73-0.90], with the score of 202 as the cut-off point. The sensitivity and specificity values were, respectively, 82.89% (CI: 72.5-90.6%) and 83.33% (CI: 35.9-99.6%).

Association of OMES-elders scores with the OHX and age

The groups divided according to the OHX had no significant difference in mean age ($P > 0.05$). The group I had mean scores significantly lower than the group III in the category appearance/posture and total OMES-Elders ($P < 0.01$), and significantly lower scores than the other two groups in stomatognathic system functions. There was no statistical difference between the groups II and III.

There was no significant difference between groups in the category mobility. In general, all groups had reduced mobility of stomatognathic system components, with the lowest score for tongue, whose scores ranged from 53% (group I) to 61% (group III) in relation to the maximum score of the protocol (Table 1).

The multiple regression analysis showed that the participants' oral health and age were significantly associated with the categories appearance/posture, functions, and total OMES-Elders. There was no significant association between predictors and mobility category. Table 2 shows the degree to which the predictors are related to the OMEs-Elders scores.

DISCUSSION

This study showed that the OMES-Elders protocol is valid and reliable for OMD assessment. The analysis revealed a clear influence of both oral health and age on orofacial functional status.

We adopted the NOT-S as a reference test in this study because this is the only instrument validated to screen a set of orofacial characteristics and abilities, over a wide range of age[15]. The items evaluated clinically in the NOT-S and OMES-Elders protocols are different, thus preventing a redundancy that would tend to inflate validity estimates[16]. For example, NOT-S does not include a clinical examination of deglutition and mastication, which are determined based on patient self-report during the interview.

A detailed analysis of movement precision and orofacial functions by an examiner, as proposed in the OMES-Elders protocol, provides more accurate and relevant information about functional adaptations (or maladaptations) associated with oral status and physiological changes.

Unlike the NOT-S[15] that involves dichotomous judgments based on an absence/presence scale (zero/one), the OMES-Elders protocol enables the ranking of orofacial myofunctional status because it uses an ordinal level of measurement with at least four response options. This is advantageous in clinical practice providing additional diagnostic and therapy-relevant information, as well as it may be useful for intervention follow-up. Moreover, the categories (appearance/posture, mobility or functions) can be analyzed by combining their items[16]. When multiple items are combined for analysis, the composite scores may be treated as continuous variables[24] which enable the use of more powerful statistical techniques[23,24].

A validation study also requires reliability estimates[18]. In our study, the OMES-Elders proved to be a reliable instrument for OMD diagnosis, according to the test-retest and inter-examiner evaluations. Moreover, the protocol showed good ability to correctly recognize individuals with and without OMD.

The orofacial myofunctional status was associated with both OHX and age. The multiple regression analysis showed that age had the strongest effect on the appearance/posture (31%), while oral health had the strongest effect on the functions category (40%). Overall, the higher the OHX and the lower the age, the better are the OMES-elders scores.

The analysis of the groups with different OHX and similar mean age shows that the group I (lowest OHX), had significantly lower scores than group III for appearance/posture (highest OHX), and lower scores than groups II and III for category functions.

The impairments were more pronounced in the jaw and lip appearance/posture, and mastication function. These items are greatly influenced by the dental (e.g. number of remaining teeth, vertical dimension of occlusion, pairs of functional occlusal contacts, edentulism, presence of removable or fixed

prostheses) and periodontal status (pocket depth, inflammation and subgingival calculus)[1,5,6,11,25].

In contrast, mobility was neither different between groups nor significantly associated with both age and OHX in the 82 participants. In fact, all groups had reduced score in this category. Particularly, the tongue was more negatively affected than other components and its weakness associated with aging has been linked to sarcopenia[4,8]. Moreover, mobility tasks encompass combined sensory ability, muscle strength, and precision of movement, which are in general reduced in older adults and can impair orofacial functions, negatively affecting the nutritional status and systemic health[1,3-8].

The OMES-Elders protocol is specific for the identification and grading of OMD, without determining the underlying etiology. Therefore, it may be used for health promotion planning and for measuring the outcome of strategies aimed at reducing oral functional disorders. Further studies could investigate the effect of physical and mental problems on OMES-Elders scores.

CONCLUSION

In conclusion, the OMES-Elders protocol is valid for the assessing orofacial myofunctional status in older people without physical or cognitive impairment. It enables determination of disorder degree and has adequate psychometric properties. The scores were associated with both the oral health index (OHX) and age. The higher the OHX and the lower the age, the better the OMES-elders scores on the categories appearance/posture, functions, and total OMES-Elders.

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Author contributions

CMF Conception of the study and protocol design, guidance on the development of the research, statistical analysis, interpretation of results and writing, revision and approval of the manuscript; MRFL Conception of the study and protocol design, data collection and analysis, interpretation of results and writing, revision and approval of the manuscript; APMM Aid in data collection, analysis, revision and approval of the manuscript; JTLF Aid in data collection, revision and approval of the manuscript.

Appendix A. Orofacial Myofunctional Evaluation with Scores for Elders Protocol (OMES-Elders)

APPEARANCE AND POSTURE/ POSITION

FACE		**Scores**
Symmetry between sides	Normal	(4)
Dysfunction: Asymmetry	Light	(3)
	Moderate	(2)
	Severe	(1)
Greater side	Right I Left	
Nasolabial sulcus	Normal	(4)
Dysfunction: Marked nasolabial sulcus	Light	(3)
	Moderate	(2)
	Severe	(1)
SUM [Maximum Score (MS) = 08]		

CHEEK		**Scores**
Volume	Normal	(4)
Dysfunction: Asymmetry between right and left sides	Light	(3)
	Moderate	(2)
	Severe	(1)
Tension	Normal	(4)
Dysfunction: Flaccid / Drooping	Light	(3)
	Moderate	(2)
	Severe	(1)
SUM (MS = 08)		

MAXILLO-MANDIBULAR RELATIONSHIPS		**Scores**
Vertical: Mandibular posture with freeway space	Normal	(4)
Dysfunction: Teeth in occlusion or contact edges	*Clenching*	(3)
Dysfunction: Open mouth	Light	(3)
	Moderate	(2)
	Severe	(1)
Anteroposterior		
Maxilla	Normal	(4)
Dysfunction: Maxilla Protrusion	Light	(3)
	Moderate	(2)
	Severe	(1)
Mandible	Normal	(4)
Dysfunction: Mandible Protrusion	Light	(3)
	Moderate	(2)
	Severe	(1)
SUM (MS = 12)		

Appendix A. Continued...

MENTALIS MUSCLE		**Scores**
Contraction not apparent (*with lips closure*)	Normal	(4)
Dysfunction: contraction apparent	Light	(3)
	Moderate	(2)
	Severe	(1)
Volume: Adequate	Normal	(4)
Dysfunction: Increased	Light	(3)
	Moderate	(2)
	Severe	(1)
SUM (MS = 08)		

LIPS		**Scores**
Sealing with no apparent muscles contraction	Normal	(4)
Dysfunction: Sealing *With effort or no labial closure*	Light	(3)
	Moderate	(2)
	Severe	(1)
Volume Harmonious	Normal	(4)
Dysfunction: Reduced volume and stretched	Light	(3)
	Moderate	(2)
	Severe	(1)
Labial commissures		
At the level of the rima of the mouth and symmetric	Normal	(4)
Dysfunction: Below of the rima of the mouth and/or asymmetrics	Light	(3)
	Moderate	(2)
	Severe	(1)
SUM (MS = 12)		

TONGUE		**Scores**
Position		
Contained in the oral cavity	Normal	(4)
Dysfunction: (a or b)		
(a) Compressed by tense dental occlusion/ clenching	Light	(3)
Compressed by tense dental occlusion/ clenching plus marks	Moderate	(2)
Compressed by tense dental occlusion/ clenching with marks and pain	Severe	(1)
(b) Between teeth At limit of the incisal surfaces, with reduced occlusion vertical dimension (OVD)	Light	(3)
At limit of the incisal surfaces or on the floor of mouth, with normal freeway space	Moderate	(2)
Exceeds the incisal surfaces, vestibular cusps or edges	Severe	(1)
Volume/Size		
Compatible with the oral cavity	Normal	(4)
Dysfunction: Increased	Light	(3)
	Moderate	(2)
	Severe	(1)
SUM (MS = 08)		

Appendix A. Continued...

PALATE		**Scores**
Width	Normal	(4)
Dysfunction: Decreased width	Light	(3)
	Moderate	(2)
	Severe	(1)
SUM (MS = 04)		

MOBILITY PERFORMANCE

TONGUE	Horizontal		Lateral		Vertical	
	Protrusion	Retrusion	To right	To left	Raising	Lowering
Normal (precise)	(6)	(6)	(6)	(6)	(6)	(6)
Insufficient ability (IA)	(5)	(5)	(5)	(5)	(5)	(5)
IA plus associated movements	(4)	(4)	(4)	(4)	(4)	(4)
IA with tremors	(3)	(3)	(3)	(3)	(3)	(3)
IA, associated movement and tremor	(2)	(2)	(2)	(2)	(2)	(2)
Task no performed	(1)	(1)	(1)	(1)	(1)	(1)
SUM (MS = 36)						

LIPS	Horizontal		Lateral	
	Protrusion	Retrusion	To right	To left
Normal	(6)	(6)	(6)	(6)
Insufficient ability (IA)	(5)	(5)	(5)	(5)
IA and associated movements	(4)	(4)	(4)	(4)
IA with tremor	(3)	(3)	(3)	(3)
IA, associated movement and tremor	(2)	(2)	(2)	(2)
Task no performed	(1)	(1)	(1)	(1)
SUM (MS = 36)				

JAW	Vertical		Lateral		Horizontal
	Opening	Closing	Right	Left	Protrusion
Normal	(6)	(6)	(6)	(6)	(6)
Insufficient ability (IA)	(5)	(5)	(5)	(5)	(5)
IA and associated movements	(4)	(4)	(4)	(4)	(4)
IA with tremor	(3)	(3)	(3)	(3)	(3)
IA, associated movement and tremor	(2)	(2)	(2)	(2)	(2)
Task no performed	(1)	(1)	(1)	(1)	(1)
SUM (MS = 30)					

Appendix A. Continued...

CHEEKS	To Inflate	To Suck	To Retract	To transfer the air from right to left
Normal	(6)	(6)	(6)	(6)
Insufficient ability (IA)	(5)	(5)	(5)	(5)
IA and associated movements	(4)	(4)	(4)	(4)
IA with tremor	(3)	(3)	(3)	(3)
IA, associated movement and tremor	(2)	(2)	(2)	(2)
Task no performed	(1)	(1)	(1)	(1)
SUM (MS = 24)				

FUNCTIONS

BREATHING (mode)		**Scores**
Nasal breathing	Normal	(4)
Dysfunction: Mouth breathing	Light	(3)
	Moderate	(2)
	Severe	(1)
Result (MS = 04)		

SWALLOW: Lips behavior		**Scores**	
Consistence		**Liquid**	**Solid**
Lips closure	Without effort	(6)	(6)
Dysfunction: Lips closure with effort	Light	(4)	(4)
	Moderate	(3)	(3)
	Severe	(2)	(2)
Dysfunction: Absence of lips closure	Does not perform the function	(1)	(1)
Result (MS = 12)			

SWALLOW: Tongue behavior				**Scores**
Contained in the oral cavity	Normal			(4)
Between alveolar margins (without prosthesis) and/or follow jaw position	To compensate reduced occlusion vertical dimension (OVD)			(3)
Between dental arches (with prosthesis) and/or follow jaw position	To compensate reduced OVD			(3)
	No OVD reduction			(2)
Exceeds the incisal surfaces and/or vestibular cusps				(1)
Interposition place	Right	Left	both	
	Anterior	Posterior	Total	
Result (MS = 04)				

Appendix A. Continued...

SWALLOW: Other behaviors and signs of alteration	**Scores**	
	Present (1)	Absent (2)
Movement of the head and other parts of the body		
Sliding jaw		
Tension of facial muscles		
Food escape		
Gagging		
Noise		
SUM (MS = 12)		
SWALLOW: Efficiency	**Scores**	
Consistency	Liquid	Solid
Does not repeat swallowing the same food	(3)	(3)
One repetition	(2)	(2)
Multiple swallows	(1)	(1)
SUM (MS = 06)		
Result Deglutition (scores sum) (MS = 34)		

Masticatory Type (according to distribution of chew strokes)		**Scores**
Bilateral	Alternate (Chew strokes occurring 50% of the times on each side of the oral cavity, or 40% on one side and 60% on the other)	(10)
	Simultaneous chews on both sides (only for user of stable removable denture)	(10)
Unilateral	Preference-grade 1 – (61% to 77% of the times on the same side)	(7)
	Preference-grade 2 – (78% to 94% the times on the same side)	(5)
	Chronic (95% or more of the time on the same side)	(3)
Anterior	Masticatory strokes occurring in the region of the incisors and canines	(2)
Function not performed	Individual did not chew	(1)
Result (MS = 10)		

Masticatory Type: with prosthesis displacement		**Scores**
Bilateral	Simultaneous	(8)
	Alternate (50%/50% or 40%/60%)	(7)
Unilateral	Preference-grade 1 – (61% to 77%)	(5)
	Preference-grade 2 – (78% to 94%)	(3)
	Chronic (95% to 100%)	(2)
Anterior		(1)
Function not performed	Individual did not chew	(1)
Result (MS = 08)		

Appendix A. Continued...

Mastication: other behaviors and signs of alteration	**Scores**	
	Present (1)	Absent (2)
Movement of the head and of other parts of the body		
Altered posture		
Contraction of facial muscles that do not contribute to chew		
Food escape		
SUM (MS = 08)		
Mastication Result (scores sum) (MS = 18)		
Time spent to ingest the food =		

Speech	***Phonetic inventory***	***Place of articulation***	***Sound***	***Jaw opening-closing movement***	***Intelligibility***
Normal	Adequade (4)	Precise (4)	Precise (4)	Normal range (4)	Clarity (4)
Alterations	Changed	Changed (frequency)	Distortion (frequency)	Reduced displacement	Reduced
Light	(3)	(3)	(3)	(3)	(3)
Moderate	(2)	(2)	(2)	(2)	(2)
Severe	(1)	(1)	(1)	(1)	(1)
SUM (MS = 20)					

OMES-Elders total score - SUM (MS = 246):