




Relationship between orofacial mobility and severity of pharyngeal residues in oropharyngeal dysphagia in individuals with Parkinson's disease

Relação entre a mobilidade orofacial e a gravidade dos resíduos faríngeos na disfagia orofaríngea em indivíduos com doença de Parkinson

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ABSTRACT

Purpose: To relate the findings of the speech therapy assessment, based on tongue and lip mobility and the severity of pharyngeal residues, and compare them with the results of the instrumental assessment in patients with Parkinson's disease. **Methods:** This was a cross-sectional, retrospective study based on data collected from medical records. Data were collected from 42 dysphagic individuals with Parkinson's disease, including the speech therapy assessment of tongue and lip mobility, oral status, spontaneous cough, and the pharyngeal signs observed in the fiberoptic endoscopic evaluation of swallowing in four food consistencies, classified according to the International Dysphagia Diet Standardization Initiative (IDDSI). The severity of pharyngeal residues after swallowing was assessed using the Yale Pharyngeal Residue Severity Rating Scale (YPRSRS). A simple linear regression model was used to analyze the data, with a significance level of 5%. **Results:** There was a significant relationship between reduced tongue and lip mobility and pharyngeal residue severity ($p = 0.002$). The coefficient of determination indicated that reduced tongue and lip mobility accounted for 21% and 20%, respectively, of the severity of pharyngeal residues in the sample. In addition, there was no difference in signs of dysphagia when comparing individuals with reduced orofacial mobility and those with adequate mobility. **Conclusion:** The regression model indicated that there was a significant relationship between reduced tongue and lip mobility and the severity of pharyngeal residue after swallowing in patients with Parkinson's disease.

Keywords: Parkinson's disease; Swallowing disorders; Dysphagia; Aspiration pneumonia; Speech-language pathology

RESUMO

Objetivo: Relacionar os achados da avaliação fonoaudiológica, com base na mobilidade de língua e lábios, e a gravidade dos resíduos faríngeos, e compará-los com os resultados da avaliação instrumental em pacientes com doença de Parkinson. **Métodos:** Trata-se de um estudo transversal e retrospectivo, com base na coleta de dados em prontuário. Foram coletados dados de 42 indivíduos disfágicos com doença de Parkinson, em relação à avaliação fonoaudiológica de mobilidade de língua e lábios, estado oral, tosse espontânea e os sinais faríngeos observados na videoesndoscopia da deglutição em quatro consistências alimentares, classificadas conforme o *International Dysphagia Diet Standardisation Initiative*. A gravidade dos resíduos faríngeos após a deglutição foi avaliada utilizando a *Yale Pharyngeal Residue Severity Rating Scale*. Para a análise dos dados, aplicou-se o modelo de regressão linear simples, adotando-se o nível de significância de 5%. **Resultados:** Houve relação significativa entre a redução da mobilidade da língua e dos lábios e a gravidade dos resíduos faríngeos ($p = 0,002$). O coeficiente de determinação indicou que a redução da mobilidade da língua e dos lábios foi responsável por 21% e 20%, respectivamente, da gravidade dos resíduos faríngeos na amostra. Não houve diferença nos sinais de disfagia ao comparar indivíduos com mobilidade orofacial reduzida e aqueles com mobilidade adequada. **Conclusão:** O modelo de regressão indicou que houve relação significativa entre a redução da mobilidade de língua e lábios com a gravidade das ocorrências de resíduos faríngeos após a deglutição, em pacientes com doença de Parkinson.

Palavras-chave: Doença de Parkinson; Transtornos de deglutição; Disfagia; Pneumonia aspirativa; Fonoaudiologia

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INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disease characterized by neuron degeneration primarily in the brain region known as the substantia nigra⁽¹⁾. This degeneration is caused by the abnormal buildup of proteins within neurons, such as alpha-synuclein, resulting in cell death and a decrease in dopaminergic neurotransmitters⁽¹⁾. It is estimated that around six million people worldwide are affected by PD⁽²⁾. The disease is more prevalent among older individuals, and its causes may be linked to genetic and environmental factors⁽³⁾.

Motor symptoms stand out among the symptomatological characteristics of PD, including tremor at rest, bradykinesia, stiffness, and postural changes⁽¹⁾. PD also presents non-motor symptoms, such as cognitive deterioration and sleep disorders⁽⁴⁾, and complex dysfunctions, such as dysarthria, sialorrhea, and oropharyngeal dysphagia, the latter characterized by impaired swallowing efficiency and safety^(5,6).

Dysphagia worsens as PD progresses, becoming one of the main factors for hospitalization⁽⁷⁾. This condition is often associated with episodes of aspiration pneumonia due to the compromised mechanism that protects the lower airways while the food bolus is transported^(7,8). Inefficient swallowing can lead to nutritional impairment and involuntary weight loss, further aggravating the person's clinical condition^(9,10).

Swallowing disorders can significantly contribute to fragility and dependence⁽⁷⁾. Adequate nutrient intake depends on an efficient oral state and functional oral motor control⁽¹¹⁾. When these functions are compromised, there is a tendency to restrict eating to foods that are easier to chew, increasing the risk of malnutrition^(12,13).

In the context of PD, dysphagia is associated with sensorimotor changes that interfere with the coordination of the muscles responsible for controlling and transporting the food bolus to the pharyngoesophageal transition⁽¹³⁾. Reductions in orofacial mobility, cough flow, and pharyngeal reflex compromise swallowing efficiency and safety^(5,7). These difficulties often result in pharyngeal residues after swallowing, which can be clinical predictors of aspiration episodes^(13,14), a condition that worsens the clinical status and negatively affects the food-related quality of life⁽⁷⁾.

Hence, this study hypothesized that reduced tongue and lip movements may negatively impact, in part, the occurrence of pharyngeal residues after swallowing in this group. It aimed to relate the findings of speech-language-hearing assessment based on tongue and lip mobility and the severity of pharyngeal residues, and compare them with the results of the instrumental assessment in patients with PD.

METHODS

This cross-sectional retrospective study was based on data collected from medical records. The research was conducted at the Speech-Language-Hearing Department of the Federal University of Rio Grande do Norte (UFRN), Brazil, where data were collected from services provided between 2019 and 2024. All participants who agreed to participate in the research signed an informed consent form provided before the procedures. The study was approved by the Research Ethics Committee of the Onofre Lopes University Hospital, under approval number 6,978,470.

The sample consisted of 42 individuals diagnosed with PD, chosen by convenience among those treated at the said location. All participants had clinical complaints of oropharyngeal dysphagia and had been referred by other health professionals and/or sectors of the hospital, without a standardized protocol, for investigation.

Exclusion criteria were concomitant acute or progressive neurological diagnoses; use of deep brain stimulation; advanced dementia; history of head and neck oncological treatment; tracheostomy; history of orotracheal intubation; and history of hospitalization in the last 12 months prior to the examination.

All participants had prescriptions for dopaminergic medications. However, due to outpatient demand, it was impossible to infer whether all were on medication at the time of the assessment.

Clinical assessment

A trained researcher performed the clinical speech-language-hearing assessment before the instrumental examination. She used a specific protocol to analyze orofacial myofunctional aspects, cough production efficiency, and the patient's oral status.

The subjective orofacial myofunctional aspects involved tongue and lip mobility tests. The researcher asked the patients to protrude and retract the closed and open lips and protrude and lateralize the tongue. The normality criterion was the ability to perform the desired commands correctly⁽¹⁵⁾. The patients were also asked to emit a strong, spontaneous cough to verify their pharyngeal cleaning capacity (efficient/weak).

The oral status included intraoral inspection, description of denture use, and occlusal support through the Eichner Index (EI)⁽¹⁶⁾. The latter was determined by the vertical contact components between the bilateral molar zones and categorized into three types: Class A (contact between four occlusal support zones), Class B (contact between one and three occlusal support zones), and Class C (no occlusal contact). The mouth-gastric-respiratory motor function protocol (MBGR, in Portuguese)⁽¹⁷⁾ was used as the observation standard to assess oral hygiene.

Instrumental assessment

A resident physician performed the fiberoptic endoscopic evaluation of swallowing, accompanied by an otorhinolaryngologist and a speech-language-hearing pathologist, according to the institution's protocol. They used a flexible fiberoptic rhinolaryngoscope, Olympus® brand, 3.2 mm in diameter, model LF-P, with a micro-camera and light source attached. The patients were instructed to remain seated, with their torsos erect and feet supported throughout the examination. No topical anesthetic was applied when the instrument was introduced into the nasal cavity down to the hypopharynx.

The speech-language-hearing pathologist offered four food consistencies, classified according to the International Dysphagia Diet Standardization Initiative (IDDSI)⁽¹⁸⁾, in the following order: level 2 (mildly thick liquid), level 4 (extremely thick liquid), level 0 (thin liquid), and level 7 (regular solid). The liquids were offered twice in a 5 ml spoon and once in a 10 ml spoon, thickened with an instant cornstarch product, dyed with aniline blue, and artificially flavored with diet juice. The solid food was a single serving of 8-g crackers, at will.

The study analyzed pharyngeal signs of dysphagia, namely posterior oral leakage, pharyngeal residues after swallowing, penetration, and laryngeal aspiration. The following were considered for analysis from the first offer: posterior oral leakage, due to premature food in the hypopharynx before triggering the swallowing reaction⁽¹⁹⁾; pharyngeal residues, due to the remaining colored food in the valleculae and pyriform sinuses after swallowing, according to the Yale Pharyngeal Residue Severity Rating Scale (YPRSRS)⁽²⁰⁾; laryngeal penetration, due to residual colored food in the vocal fold⁽²¹⁾; laryngeal aspiration, when there was residual colored food below the vocal folds⁽²¹⁾.

The professionals performed all analyses in real time, and the images were stored on a computer in the clinic to be reviewed as often as they deemed necessary after the examination.

Data analysis

Descriptive and inferential statistics were used for data analysis in JAMOV[®] software, version 2.3. The normality of

data distribution was verified using the Shapiro-Wilk test. Non-normally distributed numerical data were described by medians and the 25-75 interquartile range (IQR). The Chi-square or Fisher's exact test analyzed dichotomized categorical variables, depending on the distribution of expected frequencies.

Simple linear regression was applied to verify whether the categorical variables of the clinical speech-language-hearing assessment would be predictors for the YPRSRS scale in the instrumental swallowing assessment. The assumptions were verified based on multicollinearity and homoscedasticity analyses. The reference values for the model were the respective normality of each analysis. The coefficient of determination (R^2), the F statistic (for the quality of the model), and the Student's t-test were extracted from the model. All analyses used a 5% significance level.

RESULTS

The sample consisted of 42 patients with PD and clinical complaints of dysphagia, aged 48 to 88 years, with a mean age of 69 ± 10.3 years, mostly over 60 years (83%), with a predominance of males (57.1%), and between stages I and IV of the Hoehn and Yahr scale⁽²²⁾. Table 1 presents the characteristics of the sample regarding sex, age, and oral status. Eleven of the 23 patients who used dentures (26%) were still in class B or C of the EI.

The median YPRSRS scale in the sample was 3 (IQR: 2-4), with a predominance of 58% of residues classified as "trace to light residues" (YPRSRS: 2-3), while 19% of the participants did not present pharyngeal residues after swallowing. In the speech-language-hearing assessment, six (14.3%) patients reported difficulty swallowing their saliva. Reduced tongue and lip mobility was significantly related to the severity of pharyngeal residues in the sample. The quality of the model indicated that these variables were predictors of the increase in pharyngeal residues on the scale. The coefficient of determination showed that reduced tongue and lip mobility were responsible for 21.4% and 20.7%, respectively, of the variation in the YPRSRS scale. Table 2 presents the regression model between speech-language-hearing assessment variables and the YPRSRS.

The sample was divided into two groups according to the reduced orofacial mobility to analyze instrumental examination findings. Hence, 24 patients (57.1%) were in the group with reduced orofacial mobility, and 18 patients (42.9%) were in the

Table 1. Description of sample characteristics, such as sex, age, and oral status

Variables	n (%)
Sex	
Males	24 (57.1)
Females	18 (42.9)
Age (years)	69.0 ± 10.3
Denture use	
Yes	23 (54.8)
No	19 (45.2)
Types of dentures	
Partial	14 (60.9)
Complete	9 (39.1)
Eichner Index	
Class A	21 (50.0)
Class B or C	21 (50.0)
Oral Hygiene	
Good	22 (52.4)
Moderate or Poor	20 (47.6)

Subtitle: n = number of participants; % = percentage

Table 2. Regression analysis between the findings of the speech-language-hearing assessment and the severity of pharyngeal residues

Speech-language-hearing assessment	n (%)	Severity of pharyngeal residues (YPRSRS)		
		R^2	Quality of the model	p-value
Tongue mobility				
Preserved	19 (45.2)	0.214	10.9	0.002*
Reduced	23 (54.8)			
Lip mobility				
Preserved	20 (47.6)	0.207	10.5	0.002*
Reduced	22 (52.4)			
Cough efficiency				
Efficient	31 (73.8)	0.012	0.51	0.477
Weak	11 (26.2)			
Postural control				
Adequate	28 (66.7)	0.030	1.24	0.273
Unstable	14 (33.3)			

*Simple linear regression t-test

Subtitle: n = number of participants; % = percentage; YPRSRS = Yale Pharyngeal Residue Severity Rating Scale; R^2 = Coefficient of determination

Table 3. Comparison of pharyngeal signals per food consistency level between groups

Pharyngeal signs of dysphagia per food consistency level (IDDSI)	Groups		p-value
	Reduced OMC	Adequate OMC	
	n = 24 (%)	n = 18 (%)	
Thin liquid (level 0)			
Posterior oral leakage			0.372
Present	14 (58.3)	8 (44.4)	
Absent	10 (41.7)	10 (55.6)	
Laryngeal penetration			0.834
Present	6 (25.0)	4 (22.2)	
Absent	18 (75.0)	14 (77.8)	
Laryngeal aspiration			0.729
Present	2 (8.3)	1 (5.6)	
Absent	22 (91.7)	17 (94.4)	
Mildly thick liquid (level 2)			
Posterior oral leakage			0.929
Present	11 (45.8)	8 (44.4)	
Absent	13 (54.2)	10 (55.6)	
Laryngeal penetration			0.069
Present	4 (16.7)	0 (0.0)	
Absent	20 (83.3)	18 (100)	
Laryngeal aspiration			0.209
Present	2 (8.3)	0 (0.0)	
Absent	22 (91.7)	18 (100)	
Extremely thick liquid (level 4)			
Posterior oral leakage			0.418
Present	9 (37.5)	9 (50.0)	
Absent	15 (62.5)	9 (50.0)	
Laryngeal penetration			0.069
Present	4 (16.7)	0 (0.0)	
Absent	20 (83.3)	18 (100)	
Laryngeal aspiration			0.498
Present	2 (8.3)	0 (0.0)	
Absent	22 (91.7)	18 (100)	
Regular solid (level 7)			
Posterior oral leakage			0.109
Present	7 (29.2)	1 (5.6)	
Absent	17 (70.8)	17 (94.4)	
Laryngeal penetration			0.729
Present	2 (8.3)	1 (5.6)	
Absent	22 (91.7)	17 (94.4)	
Laryngeal aspiration			0.834
Present	1 (4.2)	1 (5.6)	
Absent	23 (95.8)	17 (94.4)	

Subtittle: n = number of participants; % = percentage; OMC = oral-motor control; IDDSI = International Dysphagia Diet Standardization Initiative

group without changes. There was no significant difference in pharyngeal signs of dysphagia between the groups with PD. It was observed that PD patients, even with adequate orofacial mobility, had pharyngeal signs of dysphagia with different food consistencies. Table 3 shows the comparison of pharyngeal signs of dysphagia with four food consistencies between the groups.

DISCUSSION

This study found a significant relationship between reduced tongue and lip mobility and the severity of pharyngeal residues in individuals with PD. Thus, the results suggest that subjective

speech-language-hearing assessment may be useful and complementary to the objective assessment of swallowing.

The swallowing function requires an integrated coordination of sensory and motor components of orofacial, pharyngeal, and laryngeal structures⁽²³⁾. Tongue and lip movements play an important role in transporting the food bolus from the oral to the pharyngeal phase of swallowing⁽²³⁾. Most individuals with PD in the sample had reduced tongue and lip mobility (54% and 52%, respectively), suggesting a significant oral motor impairment for the necessary movements of control, formation, transport, and propulsion of food in the oral cavity^(5,8).

Characteristic PD motor symptoms, such as stiffness and bradykinesia, significantly affect the muscles of the

stomatognathic system⁽¹²⁾. Dysphagia gradually worsens as the disease progresses^(7,8), a development that can be explained, in part, by the increased presence of pharyngeal residues after swallowing^(13,24). The recurrence of these residues is associated with clinical predictors of laryngeal penetration and aspiration⁽²⁵⁾.

In this study, 58% of the participants had pharyngeal residues after swallowing. Most of these residues were classified as mild (YPRSRS: 3), in agreement with data previously published in studies with PD patients^(13,14). However, even with preserved orofacial mobility in the clinical assessment, the presence of residues can be attributed to reduced hyolaryngeal elevation, decreased pharyngeal sensitivity, and reduced cough expiratory flow^(23,26). Thus, the findings related to orofacial mobility complemented other aspects of the evaluation of swallowing biomechanics in patients with PD.

The comparison of pharyngeal signs with different food consistencies in the fiberoptic endoscopic evaluation of swallowing found no differences between the groups. PD patients with adequate orofacial mobility did not present signs of penetration or aspiration with thick liquids (levels 2 and 4). Although it is tempting to associate liquid thickening with greater swallowing safety, other factors may also contribute to this result. Laryngeal vestibule closure has already been associated with greater or lesser capacity to protect the lower airways in PD⁽²⁷⁾. Moreover, mild signs of dysphagia in the sample may also have influenced these findings. In summary, the results suggest that sensorimotor performance in the pharyngeal phase is as relevant as in the oral phase in dysphagia associated with PD^(13,14,23).

Posterior oral leakage is common in PD. This difficulty may be caused by inefficient oral motor control and delayed swallowing reflex, especially concerning thin liquids⁽²⁶⁾. It is also one of the main signs of dysphagia in the early stages of the disease⁽¹³⁾. This study observed posterior oral leakage with all food consistencies in both groups. Oral leakage may be one of the first clinical complaints of dysphagia, even with supposedly adequate orofacial mobility, as it becomes a recurrent swallowing difficulty⁽²⁸⁾.

Food stasis in the pharyngeal recesses has also been associated with episodes of laryngeal aspiration in PD^(13,14). Consequently, aspiration pneumonia is one of the main causes of death in patients with this pathology⁽⁵⁾. This more severe dysphagia is associated with a longer time since diagnosis and decreased tongue strength and expiratory flow, which are essential for expelling residues^(5,8,9). Therefore, early speech-language-hearing assessment and intervention are essential to prolong the patient's food-related quality of life⁽²⁸⁾.

Most participants in this study used dentures due to tooth loss, including individuals under 65 years old. This finding is consistent with the literature, which indicates a higher prevalence of edentulism in older adults with dysphagia and PD than in those without the disease⁽¹³⁾. Adequate denture fitting and use play an important role in rehabilitating the oral preparatory and oral phases of swallowing, increasing the efficiency in forming and transporting the food bolus⁽²⁹⁾. The integrity of orofacial mobility is also directly associated with the presence of teeth, helping maintain the anatomical structure and functioning of the oral cavity⁽³⁰⁾. Toothless individuals have abnormal tongue movement patterns, which can compromise the adequate transport of the food bolus, especially when ingesting solid foods⁽³⁰⁾.

The study limitations include the lack of blinding among evaluators in the instrumental examination. Moreover, it could not be inferred whether all participants were on medication

at the time of the evaluation, which may have influenced the findings. Another point was the subjective evaluation of tongue and lip mobility, considering that objective data could increase the number of individuals with reduced mobility. Thus, it is suggested that future research assesses more in-depth the relationship between subjective findings of speech-language-hearing assessment and the results of the examinations, with more participants and blinding methods to increase data reliability.

CONCLUSION

The regression analysis model indicated a significant relationship between reduced tongue and lip mobility and the severity of pharyngeal residues in individuals with PD. The analysis revealed that reduced tongue and lip mobility contributed decisively to the presence and severity of residues.

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