

DOES DUAL-TASKING, SWALLOW PERFORMANCE AND ATTENTION, INFLUENCE DYSPHAGIA IN PARKINSON DISEASE?

A DUPLA TAREFA, DESEMPENHO NA DEGLUTIÇÃO E ATENÇÃO, INFLUENCIA A DISFAGIA EM PACIENTES COM DOENÇA DE PARKINSON?

Alana Verza Signorini¹; Sílvia Dornelles²; Luciana Grolli Ardenghi³; Gerson Maahs⁴; Carlos Roberto de Mello Rieder⁵

ABSTRACT

The primary purpose of this study was to investigate the effect of dual-tasking on swallowing performance and attention in patients with Parkinson Disease (PD). Twenty six participants were included, thirteen patients with PD and thirteen controls matched by age and education. All subjects were evaluated at single swallowing task and attentional dual-tasking. Swallowing parameters were analyzed by using Fiberoptic Endoscopic Evaluation Swallowing Safety Study (FEES). The attentional dual-tasking was realized using an adaptation of "Stroop color test" on video. Images about swallowing parameters in both conditions were analyzed by three experienced evaluators using literature definitions. Both groups underwent cognitive screening using MoCA. Although significant difference between swallowing parameters in both conditions were not found, in PD group there was an association between changes in parameters according to graduation and cognitive performance. The results show the dual-tasking influence worsening in PD patients with low scores on cognitive screening and low graduation. The results suggest more attention to PD patients that have worse cognitive status and / or low levels of education as the worsening of dysphagia and aspiration risk in performing dual-tasks to feed themselves.

Keywords: dysphagia; attention; dual-task; deglutition; deglutition disorders.

RESUMO

O objetivo principal deste estudo foi investigar o efeito da dupla tarefa atencional no desempenho da deglutição em pacientes com doença de Parkinson (DP). Vinte e seis participantes foram incluídos, treze pacientes com DP e treze controles pareados por idade e escolaridade. Todos os sujeitos foram avaliados em tarefa única de deglutição e dupla tarefa atencional. Os parâmetros da deglutição foram analisados por meio do Fiberoptic Endoscopic Evaluation Swallowing Safety Study (FEES). O attentional dual-tasking foi realizado usando uma adaptação do "Stroop color test" em vídeo. Imagens sobre os parâmetros de deglutição em ambas as condições foram analisadas por três avaliadores experientes utilizando definições da literatura. Ambos os grupos foram submetidos a triagem cognitiva usando MoCA. Embora não tenha sido encontrada diferença significativa entre os parâmetros da deglutição nas duas condições, no grupo DP foi encontrada associação entre alterações nos parâmetros de acordo com a graduação e desempenho cognitivo. Os resultados mostram que a influência da dupla tarefa piorou nos pacientes com TP, com baixa pontuação na triagem cognitiva e baixa graduação. Os resultados sugerem maior atenção para os pacientes com DP que apresentam pior estado cognitivo e / ou baixos níveis de escolaridade como o agravamento da disfagia e risco de aspiração na realização de tarefas duplas para se alimentar.

Palavras Chave - disfagia; atenção; dupla tarefa; deglutição, distúrbios de deglutição.

¹Program of Graduate Studies in Medical Sciences (Master degree), School of Medicine, Universidade Federal do Rio Grande do Sul – UFRGS – Porto Alegre (RS), Brazil. Speech therapist. alanass@gmail.com

²Professor of the Speech Therapy Course from Universidade Federal do Rio Grande do Sul. Master in Human Communication Disorders from Universidade Federal de Santa Maria and Doutor in Children's and Adolescents' Health from Universidade Federal do Rio Grande do Sul - UFRGS – Porto Alegre (RS), Brazil. dornella@gmail.com

³Program of Graduate Studies in Medical Sciences (Doctor degree), School of Medicine, Universidade Federal do Rio Grande do Sul – UFRGS – Porto Alegre (RS), Brazil; Speech therapist. lucianaardenghi@yahoo.com.br

⁴Otorhinolaryngology Professor, Faculdade de Medicina da, Universidade Federal do Rio Grande do Sul. Otorhinolaryngology doctor and Surgeon of Head and Neck. Master and Doctor in Surgery – Porto Alegre (RS), Brazil. gerson.maahs@gmail.com

⁵Neurology Service, Clinics Hospital of Porto Alegre, Universidade Federal do Rio Grande do Sul – UFRGS – Porto Alegre (RS), Brazil. carlosrieder@gmail.com

Endereço para correspondência: Alana Verza Signorini – Universidade Federal do Rio Grande do Sul- César Lombroso Street, 29/201– Porto Alegre/RS– Brazil– Zip Code 90420-130. E-mail: alanass@gmail.com

INTRODUCTION

Dysphagia is a common condition in Parkinson's Disease (PD), which affects more than 80% of the individuals¹. The main swallowing alterations which are evidenced impair oral and pharyngeal phases,² with direct impact over health, nutritional status and quality of life of those individuals^{3,4,5}, associated with high mortality rate and morbidity^{6,7,8}.

The clinical diagnosis is usually made when symptoms are more severe, or when consequences are more serious, such as aspiration pneumonia⁹. Thus, precocious detection, as well as dysphagia management of PD before it is aggravated, may be crucial for reduction and prevention of severe complication¹⁰.

In order to have safe swallowing, it is necessary the use of cognitive resources such as attention. The description of changes in swallowing performance with increase of cognitive demand is a way to explore the role of attention in swallowing¹¹.

Specific cognitive characteristics, such as attention and executive function division or alternation in PD were specifically associated with difficulties in dual-tasking skills, in other tasks, but swallowing^{12,13}.

Considering that individuals with PD may present alteration in cognitive and swallowing functions, it can be assumed that the concomitance in the performance of tasks which demand attention could contribute to worse performance of one and/or another¹⁴.

Some studies have already tried to elucidate the role of cognition through performance of dual-tasking in swallowing of PD patients.

Brodsky et al.¹¹ proposed the evaluation of the cognition influence in PD patients' swallowing, through clinical evaluation. The patients were instructed to swallow 5ml of water, while they were listening and paying attention to a list of pseudowords.

Troche et al.¹⁴ performed a study with dual-tasking. They proposed that 20 PD patients swallowed 10 ml of liquid concomitant with the performance of a digit span task, through videofluoroscopy. The study results support the theory that there is cognitive influence in swallowing plan when sharing attention, however, the study was not controlled by variables which could interfere on it: education and age.

Therefore, the purpose of this study is to evaluate the influence of an attentional dual-tasking performance on swallowing of PD individuals.

METHODS

The project was approved by the Research and Ethics Committee from Clinical Hospital in Porto Alegre, RS, Brazil (HCPA), n. 1.096.232. All subjects of the sample were instructed about the project and signed Free and Clarified Consent Form, at the direction of the users.

Participants

To calculate the sample size it was considered the significance level of 5%, power of 90% and standard effect size of a standard deviation in the results from both evaluations (isolated and dual-task), in relation to the oropharyngeal swallowing duration, it was obtained a minimum of 13 individuals per group. The calculation was performed through the program WinPepi version 11.43 and based on the study by¹¹.

A total of 26 individuals were included in the sample, 13 with PD and 13 healthy subjects paired by sex, age and education, being the control group (CG). The discriminative power analysis was developed through pairing, by sex, age and education of the participants from the CG and from the EG. This strategy reduces the influence of the intervenient variables during the comparison of the groups' results, as the variables variability is controlled.

All individuals were included by convenience sample. The PD patients were selected from the ambulatory of Movement Disorders in the Neurology Department from HCPA. The individuals from the CG were paired through chronological age, considering ± 4 years, and through education, with difference of ± 2 years, captured from the otorhinolaryngology ambulatory, receiving as complementary evaluation the instrumental swallowing.

The PD subjects were evaluated always in the ON medication moment.

Inclusion/exclusion criteria

The inclusion criteria, exclusive for the EG were: 1) PD diagnosis by a neurologist from the origin ambulatory; 2) evaluation by scales UPDRS and H&Y; 3) absence of *deep brain stimulation (DBS)*.

As exclusive criterion for the CG: 4) absence of neurological comorbidities.

The inclusion criteria for both groups were: 5) absence of malformation and/or surgical intervention such as significant resection of tissue or laryngeal structure or

laryngeal reconstruction; 6) absence of former esophagus pathologies and esophageal tract surgical intervention, as well as esophageal reconstructions; 7) absence of additional neurological comorbidities; 8) absence of attention deficit; 9) to be literate.

Study design

All subjects were initially submitted regarding swallowing as a simple task and, then, as dual-tasking. All procedures were performed in the same day and room, without any noise which could cause distraction.

Procedures on condition simple task

The patients with PD were submitted to the evaluation named Unified Parkinson's Disease Rating Scale (UPDRS)¹⁵. The stage of disease was established through *Hoehn & Yahr Degree of Disability Scale (H&Y)*¹⁶.

All subjects were submitted to cognitive screening through the test *Montreal Cognitive Assessment (MOcA)*¹⁷.

The swallowing evaluation was performed through the functional swallowing videonasoendoscopy or Fiber optic Endoscopic Evaluation Swallowing Safety – FEES (Study). The routine of FEES examination performance followed the Langmore protocol^{18,19}. Both groups were submitted to this examination, with offer of 3 to 5ml of colored pasty food, with safe volume and consistence. Pasty food was composed of water and thickener, classified as level IV of International Dysphagia Diet Standardisation Initiative (IDDSI) – extremely thickened.

The examination was performed by an otorhinolaryngologist, with the help of a speech therapist. This examination allows the visualization of the oropharyngeal region, while offering food, enabling the analysis of swallowing disorders during its reflex trigger and the duration of the oropharyngeal swallowing.

The characteristics of the used nasal endoscopy device were: Maschida ENT-III, with 3.2 mm; Light Source Xenon Storz; Video Monitor Storz; DVD (DiscVideo Digital) Recorder R170 Samsung; Media DVD 4.7 GB Maxprint- envelope.

Procedures on condition of dual-tasking

To accomplish the proposed attentional dual-task, it was performed an adjustment to video format of the activity 'Stroop color test'. The 'Stroop color test' is consid-

ered a classical paradigm in behavioral neurosciences, for clinical and experimental situations which aim at evaluating selective attention²⁰. The adaptation to video allows to be closer to the patients' real daily life situation, such as watching television while eating.

The individuals were instructed and trained to think about the color of the word that appeared on the video. After understanding the task, it was applied again as a dual-task, concomitantly with offering 3 to 5ml of pasty food, analyzed through nasal endoscopy.

Analysis of the swallowing parameters

The examination, as isolated task and as dual-task, was recorded on DVD to subsequent image analysis. The images were analyzed by three speech therapists, expert in the swallowing area and the parameters were defined based on literature, through an adapted protocol^{21, 22, 23}. The used criteria were total transit time, measured in seconds (considering multiple voluntary swallowing, including oral and pharyngeal phase – the oral phase was considered as initial when food was at oral cavity and the examiner said a clue to record on DVD), number of swallows, premature spillage, pyriform and valecule sinus stasis after voluntary swallowing, penetration, aspiration, cough or throat clearing (all measured in number of occurrences).

Data analysis

The quantitative variables were described through average and standard deviation or median and interquartile amplitude. The qualitative variables were described through absolute and relative frequencies. To compare the averages between the groups, the t-student test for independent samples was applied. In case of asymmetry, the Mann-Whitney test was used. In the comparison of proportions, the Pearson chi-squared test and the Fisher's exact test were applied. In the comparison between the tasks, the Wilcoxon's test (continual with asymmetric distribution) and the McNemar's test (categorical) were used. The variables associations were evaluated through the Spearman correlation coefficients. The selected significance level was 5% ($p \leq 0.05$) and the analyses were performed through the software SPSS version 21.0.

RESULTS

The demographic data are presented on table 1.

Table 1 – demographic data

Variables*	Parkinson Group (n=13)	Control Group (n=13)	p
Age (years)	62.2 ± 7.3	61.9 ± 7.8	0.918
Sex – n(%)			1.000
M	8 (61.5)	8 (61.5)	
F	5 (38.5)	5 (38.5)	
Years of study	8.4 ± 3.6	10.2 ± 4.9	0.304
MoCA	22.2 ± 4.9	21.1 ± 4.8	0.549

* described through average ± standard deviation or n (%)

The study sample consisted of 26 subjects, organized in two groups. They presented age average between 62.2 ± 7.3 , and in the CG the age average was between 61.9 ± 7.8 . The MOcA results were higher for patients with PD (22.2 ± 4.9) than for the CG (21.1 ± 4.8), with $p = 0.549$. Both groups presented scores < 26 in the cognitive screening, in the EG it was 84.6% and in the CG it was 76.9%.

In relation to the PD patients' clinical characteristics, 69% of them were in the H&Y staging between 1 and 2.25 and they presented UPDRS average score of 66.4 ± 38.8 . The disease time in years was 9 ± 4 .

The results regarding the swallowing biomechanics evidenced altered parameters under condition of swal-

lowing unique task in the PD group. These results were statistically significant for the parameters of total transit time, stasis in vallecula region and number of swallows, comparing the EG and the CG (Table 2).

In the comparison between the swallowing biomechanics parameters for the dual-task condition in the EG and in the CG, there were no statistically significant results to distinguish both populations, considering that the PD did not influence the dual-task dynamics, controlling age and education. (Table 2).

About the parameters cough, throat cleaning, penetration and aspiration, there were no observed significant results in this study, being zero occurrences, neither under isolated condition nor under double-task condition.

Table 2 – Comparison between single and dual task on groups

Variables*	Parkinson group (N=13)			Control group (N=13)			
	Single task	Dual task	P	Single task	Dual task	P	
3ml	Stasis val.		1.000			1.000	
	Yes	6 (46.2)	5 (38.5)	0 (0.)	1 (7.7)		
	No	7 (53.8)	8 (61.5)	13 (100)	12 (92.3)		
	Stasis os		1.000			1.000	
	Yes	2 (15.4)	3 (23.1)	0 (0.0)	1 (7.7)		
	No	11 (84.6)	10 (76.9)	13 (100)	12 (92.3)		
5ml	Ttt	6 (3 – 12.5)	5 (3 – 8)	0.229	3 (2.5 – 4.5)	3 (2 – 4)	0.558
	N swallow.	1 (1 – 2.5)	1 (1 – 2)	0.394	1 (1 – 1)	1 (1 – 1)	0.317
	Premature spillage	1 (7.7)	3 (23.1)	0.625	1 (7.7)	3 (23.1)	0.500
	Stasis val.		0.625			0.125	
	Yes	7 (53.8)	9 (69.2)	0 (00)	4 (30.8)		
	No	6 (46.2)	4 (30.8)	13 (100)	9 (69.2)		
5ml	Stasis ps		0.219			1.000	
	Yes	3 (23.1)	7 (53.8)	0 (0.0)	1 (7.7)		
	No	10 (76.9)	6 (46.2)	13 (100)	12 (92.3)		
	Ttt	8 (6.5 – 13.5)	7 (4 – 14.5)	0.418	3 (2.5 – 3.5)	4 (2.5 – 7)	0.574
	N swallow.	2 (1 – 3)	2 (1 – 2.5)	0.288	1 (1 – 1)	1 (1 – 1)	1.000
	Premature spillage	3 (23.1)	6 (46.2)	0.375	2 (15.4)	1 (7.7)	1000

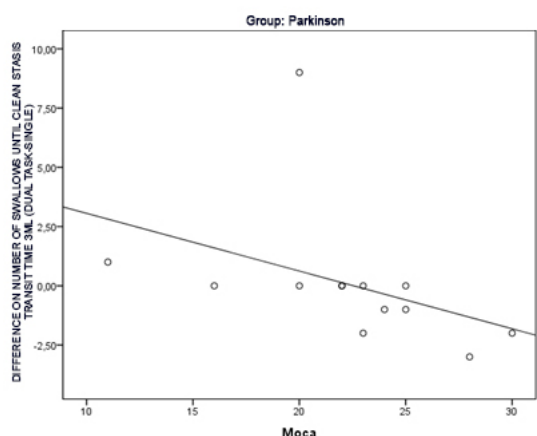
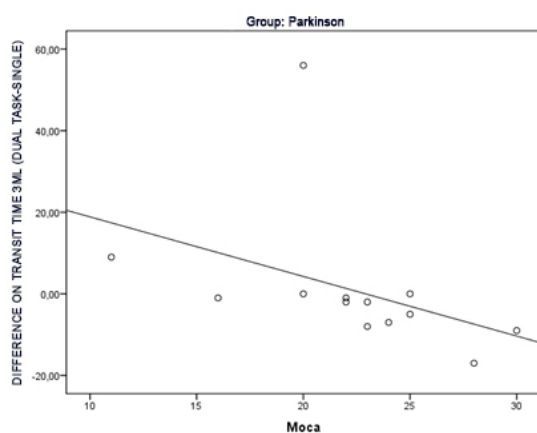
*Ttt – total transit time; Stasis val. – stasis in vallecula; Stasis sp; stasis in pyriform sinus; N swallow – number of swallows.

Comparing PD group in relation to variation between single task and dual-task, it was observed influence of education in the parameter oral transit time and number of swallows. It was observed proportional association between education and transit time until swallow for 3ml ($rs=-0,584$; $p=0,036$). This relationship also appeared in the parameter number of swallows in the same volume, being higher as lower the education rate ($rs=-0.564$; $p=0.045$).

The same was observed about the MoCa scores relationship and the parameters of total time of transit and number of swallows, for 3ml in both tasks. Patients with worse cognitive performance presented higher total time of transit and of number of swallows in the dual-tasking, in relation to the isolated task (Figure 1).

In relation to the disease time, it was observed the necessity to increase the number of swallows with the offer of 5ml, according to the extension, with directly proportional relation ($rs=-0.633$; $p=0.020$).

There was no performance difference in the dual-task for both groups, considering sex and age. There was no difference also for disease staging (H&Y) and for UPDRS



$rs=-0,750$; $p=0,003$ $rs=-0,788$; $p=0,001$

Figures 1 – Association in the PD performance MoCA with time of transit and number of swallows.

DISCUSSION

Although there are high levels of dysphagia in PD, the influence in the dual-task performance during swallowing was not completely explored and realized, as well as the influence of cognition and, more specifically, attention to the swallowing biomechanics. In the present study, it was evaluated the influence of the dual-task characterized by the performance of an attention test, at the same time as swallowing, controlled with education and age.

Even with no significant difference in swallowing patterns when the groups were compared in isolated task and dual-task, in patients with PD, there was correlation between the swallowing pattern changes, according to education and cognitive performance evaluated through the MoCA. These occurrences seems to indicate that the necessity of adjustments in swallow biomechanical while being in a dual task also demanding attention is harder to be done compared with higher education patients.

Patients with worse cognitive performance and with lower education level presented higher time of oral transit and increase in the number of swallows in the swallowing moment, with the dual-tasking. It is interesting to emphasize that although there are no statistical differences between the CG and the EG regarding education and cognition, these variables only influenced swallowing with dual-tasking in patients with PD. Shows impact in swallow only in patients with Parkinson disease when education level is lower in a demand of dual task competing for attention.

In the discussion about the altered parameters which are significant for this study, it is considered as proper the total time of swallowing as the maximum of four seconds, and effective swallowing when it happens only once, without the necessity of multiple swallowing. Similarly, the stasis absence, after swallowing, is considered as normality pattern for the tested volume and consistency. It is expected that in healthy swallowing, only one swallow is able to clean the pharynx, with no stasis^{22, 24, 25, 26}.

The parameters, considering the definition of dysphagia, and also the findings for the PD group, agree with literature, defining this sample with dysphageal patterns, in the condition of isolated task and kept under dual-tasking^{2, 4, 22, 27}.

The study by¹¹ verified results of higher triggering time of swallowing reflex under condition of atten-

tion division in a PD sample without cognitive disorders, but it must be considered that the task which is concurrent to swallowing was auditory and only the parameter swallowing time was considered.

The initial hypothesis for the present study was that the PD patients would present worse dual-tasking performance than the CG. However, the presence of dysphagia in PD, under isolated task, would explain the not worse swallowing with the dual-tasking. In other words, the patients included in this study, as they present dysphagia, would hide possible worsening caused by the dual-tasking.

The findings by¹⁴ agree with the idea of influence of cognitive tasks on swallowing. However, these results are different from the present study results, because the patients with medium cognitive impairments presented worse swallowing performance than the ones with worse cognitive performance. It can be considered the methodological difference and the possible interference of not controlling some variables with the paired groups.

The overlapping tasks performance, cognitive or motor, occurs in cortical level, so one intervenes in each other. Regardless the ease to perform the dual-tasking, it requires neural processing, being damaged if the required actions exceed the individual cognitive system skills or if they involve simultaneously neural circuits which are specific for both actions²⁸⁻³¹.

A study proposed the performance of dual-tasking in PD with a verbal and a motor task, with both hands. The study with the CG considered the performance of the dual-tasking as an automatic performance of the primary task or as a new task, more complex than the isolated one. It should be also considered the performance attention, requiring strategies to perform the tasks³².

The performance in the dual-tasking for PD patients with low education and worse performance in MocA may be explained by the no acclimatization of the primary task, as a consequence of the dual-tasking, as well as because of the exceeding of the individual cognitive skills. Thus, the damage in the primary task and/or in the secondary task may occur because both tasks require concomitantly, in similar way, skills for performance^{29,32}.

In relation to the socio-demographic data, such as age and sex, they were not observed in any group. So, it is possible that these variables do not interfere in the dual-tasking performance. The results for the association between time of disease and necessity to increase the number of swallows is related to dysphagia worsening³³.

CONCLUSION

The dual-tasking negatively influenced the PD patients who presented worse education level and worse cognitive performance evaluated by MocA. These results suggest that researchers should be more attempt to the PD patients who present worse cognitive status and/or low education level, regarding dysphagia worsening and aspiration risks in the performance of dual tasks when they are eating.

CONFLICT OF INTEREST

The authors declares that there is no conflict of interest.

REFERENCES

- Potulska A, Friedman A, Krolicki L, Spychala A. Swallowing disorders in Parkinson's disease. *Parkinsonism Relat Disord* 2003;9(6):349-53.
- Volonte MA, Porta M, Comi G. Clinical assessment of dysphagia in early phases of Parkinson's disease. *Neurol Sci* 2002 Sep;23(2):121-2.
- Stroudley J, Walsh M. Radiological assessment of dysphagia in Parkinson's disease. *Br J Radiol* 1991 Oct;64(766):890-3.
- Silveira DN, Brasolotto AG. Reabilitação vocal em pacientes com doença de Parkinson: fatores interferentes. *Pró-Fono Revista de Atualização Científica*, 2005 Maio/Ago;17(2):241-50.
- Mu L, Sobotka S, Chen J, Su H, Sanders I, Nyirenda T, et al. Parkinson disease affects peripheral sensory nerves in the pharynx. *J Neuropathol Exp Neurol* 2013 Jul;72(7):614-23.
- Marik PE, Kaplan D. Aspiration pneumonia and dysphagia in the elderly. *Chest* 2003;124:328-36
- Fernandez HH, Lapane KL. Predictors of mortality among nursing home residents with a diagnosis of Parkinson's disease. *Med Sci Monit* 2002;8:241-6.
- Akbar U, Dham B, He Y, Hack N, Wu S, Troche M, et al. Incidence and mortality trends of aspiration pneumonia in Parkinson's disease in the United States, 1979-2010. *Parkinsonism Relat Disord* 2015 Sep;21(9):1082-6.
- Manor Y, Giladi N, Cohen A, Fliss DM, Cohen JT. Validation of a swallowing disturbance questionnaire for detecting dysphagia in patients with Parkinson's disease. *Mov Disord*. 2007;22:1917-21
- Young MA, Reynolds JC. Respiratory complications of gastrointestinal diseases. *Gastroenterol Clin North Am* 1998;27:721-46.
- Brodsky MB, Abbott KV, McNeil MR, Palmer CV, Grayhack JP, Martin-Harris B. Effects of Divided Attention on Swallowing in Persons with Idiopathic Parkinson's Disease. *Dysphagia* 2012;27:390-400.
- Lord S, Rochester L, Hetherington V, Allcock LM, Burn D. Executive dysfunction and attention contribute to gait interference in 'off' state Parkinson's Disease. *Gait and Posture*, 2010;31(2):169-74.
- Wild LB, de Lima DB, Balardin JB, Rizzi L, Giacobbo BL, Oliveira HB, et al. Characterization of cognitive and motor performance during dual-tasking in healthy older adults and patients with Parkinson's disease. *J Neurol* 2013 Feb;260(2):580-9.
- Troche MS, Okun MS, Rosenbek JC, Altmann LJ, Sapienza CM. Attentional resource allocation and swallowing safety in Parkinson's disease: A dual task study. *Parkinsonism and Related Disorders* 2014 Apr;20(4):439-43.
- Goetz CG, Tilley BC, Shaftman SR, Stebbins GT, Fahn S, Martinez-Martin P, et al. Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale (MDS-UPDRS): scale presentation and clinimetric testing results. *Mov Disord* 2008;23(15):2129-70.
- Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. *Neurology* 1967;17(5):427-42
- Zadikoff C, Fox SH, Tang-Wai DF, Thomsen T, de Bie RM, Wadia P, et al. A comparison of the mini mental state exam to the Montreal cognitive assessment in identifying cognitive deficits in Parkinson's disease. *C.Mov Disord*. 2008 Jan;23(2):297-9.

18. Langmore SE, Schatz K, Olsen N. Fiberoptic endoscopic examination of swallowing safety: a new procedure. *Dysphagia* 1988;2:216-9.
19. Bastian RW. The videoendoscopic swallowing study: an alternative and partner to the videofluoroscopic swallowing study. *Dysphagia* 1993;8:359-67.
20. Tucci CHC, Andreza AC. O uso do "Stroop ColorWord Test" na esquizofrenia: uma revisão da metodologia. *Revista Psicolog.* 01(01):101-18.
21. Santoro PP, Tsuji DH. Avaliação funcional da deglutição por fibronasofaringolaringoscopia na doença de Parkinson: aspectos qualitativos e quantitativos. São Paulo. Tese - Faculdade de Medicina da Universidade de São Paulo; 2003.
22. Padovani AR, Moraes DP, Mangili LD, de Andrade CRF. Protocolo fonoaudiológico de avaliação do risco para disfagia (PARD). *Rev. soc. bras. fonoaudiol.*, 2007 Sep;12(3):199-205.
- 23 - Molfenter SM, Steele CM. Temporal Variability in Swallowing. *Dysphagia* 2012;27:162-177.
24. Doria S, Abreu MAB, Buch R, Assumpção R, Nico MAC, Ekley CA, et al. Estudo comparativo da deglutição com nasofibrolaringoscopia e videodeglutograma em pacientes com acidente vascular cerebral. *Rev. Bras. Otorrinolaringol.* 2003 Oct;69(5):636-42.
- 25 - Leslie P, Carding PN, Wilson JA. Investigation and management of chronic dysphagia. *BMJ* 2003;326(7386):433-6.
- 26 - Marchesan IQ. O que se considera normal na deglutição. In: Jacobi JS, Levy DS, Silva LMC. *Disfagia: avaliação e tratamento*. Rio de Janeiro: Revinter; c2003
27. Leopold NA, Kagel MC. Pharyngo-esophageal dysphagia in Parkinson's disease. *Dysphagia* 1997;12(1):11-18.
28. Serrien DJ, Pogoyan AH, Brown P. Cortico-cortical coupling patterns during dual task performance. *Exp Brain Res* 2004;157(1):79-84.
29. Bowen A, Wenman R, Mickelborough J, Foster J, Hill E, Tallis R. Dual-task effects of talking while walking on velocity and balance following a stroke. *Age Ageing* 2001;30(4):319-23.
- 30 - Barbosa JMM, Prates BSS, Gonçalves CF, Aquino AR, Parentoni AN. Efeito da realização simultânea de tarefas cognitivas e motoras no desempenho funcional de idosos da comunidade. *Fisioter Pesqui* 2008;15(4):374-9.
31. Johannsen L, Li KZ, Chechlacz M, Bibi A, Kourtzi Z, Wing AM. Functional neuroimaging of the interference between working memory and the control of periodic ankle movement timing. *Neuropsychologia* 2013;51(11):2142-53
32. Teixeira NB, Alouche SR. O desempenho da dupla tarefa na doença de parkinson.v. 11 n. 2, 2007 ISSN 1413-3555 Dupla tarefa na Doença de Parkinson *Rev. bras. fisioter* 2007 Março/Abril;11(2):127-132.
33. Luchesi KF, Kitamura S, Mourão LF. Dysphagia progression and swallowing management in Parkinson's disease: an observational study. *Braz J Otorhinolaryngol.* 2015;81:24-30.