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Avaliação proprioceptiva na Doença de Parkinson

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Dissertação apresentada ao Programa de Pós-Graduação em Ciências da Reabilitação da Universidade Federal de Ciências da Saúde de Porto Alegre, como requisito parcial à obtenção do título de Mestre em Ciências da Reabilitação.

Orientador: Dr. Carlos Roberto de Mello Rieder

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AVALIAÇÃO PROPRIOCEPTIVA NA DOENÇA DE PARKINSON

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compreensão e amor incondicional.

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“O movimento é nossa arma e nossa arte,
através dele nós fazemos ciência”

Nívea Flor

RESUMO

Estudos sugerem a existência de alterações na propriocepção de indivíduos com Doença de Parkinson (DP) e que a mesma esteja associada com a instabilidade postural presente nestes. Porém, existem poucos estudos avaliando a propriocepção cinético-postural dos membros inferiores desta população e qual sua relação com os sintomas motores presentes na DP. O objetivo deste estudo foi verificar a existência de alterações proprioceptivas em indivíduos com DP e a relação destas com os déficits motores, instabilidade postural, gravidade da doença e capacidade cognitiva. Trata-se de um estudo com delineamento transversal controlado, que avaliou pacientes com DP e comparou com pacientes saudáveis pareados por idade e sexo. A análise estatística foi realizada por meio de estatística descritiva e pelos testes Wilcoxon, Mann-Whitney, Kruskall-Wallis e Correlação de Spearman, assumindo-se nível de significância máximo de 5% ($p \leq 0,05$), pelo Programa SPSS 18.0. Utilizou-se o *Montreal Cognitive Assessment* (MoCA) para avaliação do estado mental, o estado funcional foi mensurado através da *Unified Parkinsons Diseasae Rating Scale* (UPDRS), a instabilidade postural pelo *Pull Test e* análise estabilométrica e o estadiamento da doença pela escala de *Hohen & Yahr*. A propriocepção cinético-postural foi avaliada utilizando-se o equipamento *Biodex® Multi-JointSystem 4 Pro*, onde foi verificado a capacidade de atingir os ângulos alvo de 45º e 75º de flexão de joelhos, sem auxílio da visão, e então foi registrada uma média dos erros angulares. Foram incluídos um total de 40 indivíduos no estudo, sendo 20 no grupo com DP (PG) e 20 no grupo controle (CG). Os grupos não diferiram significativamente quanto a cognição e escolaridade. Verificou-se que pacientes com DP apresentaram maiores erros angulares nas avaliações proprioceptivas do que indivíduos do CG ($p=0,002$). As oscilações do centro de pressão foram maiores nos indivíduos com DP em relação aos controles ($p=0,002$).. As alterações proprioceptivas estavam associadas com pior desempenho na avaliação cognitiva, com a presença de tremor como sintoma dominante e pior estado funcional no UPDRS. Os achados indicam a presença de alterações na propriocepção em indivíduos com DP e sua associação com prejuízos motores e cognitivos. A partir dos resultados do presente estudo, sugere-se que no processo de reabilitação dos indivíduos com DP sejam consideradas as alterações proprioceptivas.

Palavras-chave: Propriocepção; Doença de Parkinson; Equilíbrio: Estabilidade postural; capacidade motora, cognição

ABSTRACT

Studies suggest that there are alterations in proprioception in individuals with Parkinson disease (PD) and that it is associated with postural instability present in these individuals. However, there are few studies evaluating the kinetic postural proprioception of the lower limbs of this population and of its relationship with the present motor symptoms in PD. The aim of this study was to verify the existence of proprioceptive deficits in individuals with PD and their relationship with cognitive ability, motor symptoms, postural instability and severity of disease. This is a controlled cross-sectional study that evaluated patients with PD and compared with healthy individuals matched for age and sex. Statistical analysis was performed using descriptive statistics and the Wilcoxon, Mann-Whitney, Kruskal-Wallis and Spearman correlation tests, assuming maximum level of significance of 5% ($p \leq 0.05$) by SPSS 18.0 program. The participants were evaluated by Montreal Cognitive Assessment (MoCA) to assess mental status, functional status by Diseasae Unified Parkinson's Rating Scale (UPDRS), postural instability by Pull Test and stabilometric analysis and staging of the disease by Hohen & Yahr scale. The kinetic postural proprioception was evaluated using the equipment Biodex® Multi-JointSystem 4 Pro, which found the ability to reach the target angles of 45 ° and 75 ° of knee flexion, without visual support, and was then recorded an average the angular errors.. A total of 40 individuals were included in the study, 20 in the group with PD (PG) and 20 in the control group (CG). The groups did not differ significantly regarding cognition and education. It was found that PD patients had worse scores on proprioceptive ratings than participants in the CG ($p=0.002$). The oscillations of the center of pressure were higher in patients with PD compared to controls ($p=0.002$). Proprioceptive deficits were associated with poorer performance in cognitive assessment, with tremor as the dominant symptoms and worse functional status in UPDRS. The findings indicate the presence of changes in proprioception in individuals with PD and their association with motor and cognitive impairments.

Key words: Proprioception; Parkinson's Disease; Balance; postural instability; motor capacity, cognition.

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LISTA DE ABREVIATURAS E SIGLAS

DP	Doença de Parkinson
SNc	Substância Negra *pars compacta*
NB	Núcleos da Base
SMA	Área Motora Suplementar
MoCA	Avaliação Cognitiva de Montreal
UPDRS	Escala Unificada da Doença de Parkinson
COP	Oscilação do Centro de pressão

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1 INTRODUÇÃO

A Doença de Parkinson (DP) é uma doença neurodegenerativa que acarreta importante comprometimento no sistema motor dos indivíduos, envolvendo alterações na marcha, postura e equilíbrio, assim como influenciando negativamente na capacidade cognitiva destes (JANCOVIC, 2008; MONGEON; BLANCHET; MESSIER, 2009). Estudos sugerem a existência de alterações na propriocepção de indivíduos com DP e que a mesma esteja associada com a instabilidade postural presente nestes (MONGEON; BLANCHET; MESSIER, 2009; ADAMOVICH et al., 2001; CONTERAS-VIDAL; GOLD, 2004). Porém, existem poucos estudos avaliando a propriocepção cinético-postural dos membros inferiores desta população e de que forma essas alterações proprioceptivas possam contribuir para o prejuízo motor das pessoas com DP.

Para que se possa planejar estratégias adequadas no processo de reabilitação motora dos indivíduos com DP é fundamental reconhecer o quanto e de que forma as alterações proprioceptivas possam influenciar no quadro motor dos pacientes com DP.

Portanto, o objetivo geral deste estudo foi avaliar a propriocepção cinético-postural dos joelhos de indivíduos com DP em comparação com indivíduos saudáveis. Os objetivos específicos foram: comparar a instabilidade postural, nível de escolaridade e cognição entre indivíduos saudáveis e com DP; relacionar os resultados da avaliação proprioceptiva com a capacidade motora, tipo de sintoma inicial da DP, instabilidade postural, tempo de doença, estágio da doença, histórico de quedas e com a presença de período *on/off* e de dicinesias.

2 REVISÃO DA LITERATURA – CONTEXTUALIZAÇÃO

2.1 DOENÇA DE PARKINSON

2.1.1 Histórico da Doença

A Doença de Parkinson (DP), descrita inicialmente em 1817 pelo médico inglês James Parkinson é uma doença neurodegenerativa, crônica e progressiva, caracterizada pela redução da dopamina, como consequência da perda progressiva de neurônios dopaminérgicos da substância negra do mesencéfalo. Esta neurodegeneração repercute diretamente nos núcleos da base levando ao comprometimento motor característico da DP (tremor de repouso, rigidez muscular, bradicinesia e instabilidade postural) (JANCOVIC, 2008; MONGEON; BLANCHET; MESSIER, 2009).

2.1.2 Prevalência e Incidência da DP

A DP apresenta sua prevalência aumentada com a idade e geralmente afeta indivíduos acima dos 50 anos, embora não seja rara a incidência mais precoce (JANCOVIC, 2008). Afeta ligeiramente mais homens do que mulheres, sendo que a prevalência desta na população geral é de 100 a 150 casos por 100 mil habitantes, e a cada ano ocorrem 20 novos casos por 100 mil habitantes nos Estados Unidos (PAULSON; STERN, 1996).

No Brasil, a DP é a segunda doença neurodegenerativa mais comum em idosos, com prevalência estimada de 3,3% dos indivíduos acima dos 65 anos (BARBOSA et al., 2006).

2.1.3 Diagnóstico e Etiologia da DP

O diagnóstico da DP é basicamente clínico e baseado na história e exame clínico, necessitando uma combinação de bradicinesia com rigidez muscular e/ou tremor de repouso (HUGHES et al., 1992, 2002). O diagnóstico definitivo necessitaria estudo de necropsia. Em algumas ocasiões a DP é difícil de ser

diferenciada de outras síndromes parkinsonianas. A resposta ao tratamento com a levodopa auxilia no diagnóstico da DP, pois os pacientes com DP, diferente das outras formas de parkinsonismo, geralmente apresentam uma resposta satisfatória ao uso desta droga (GELB; OLIVER; GILMAN, 1999).

A etiologia da DP ainda não é bem definida, sendo basicamente associada a fatores genéticos e a exposição a ambientes tóxicos (BECKRIS; MATA; ZABETIAN, 2010; JANCOVIK, 2008). Pode-se observar em estudos anatomopatológicos, uma grande perda de células dopaminérgicas da substância negra *pars compacta* (SNc) e acúmulo de material proteico nas células remanescentes (corpos de Lewy). Essas alterações levam a uma desregulação das alças de controle do movimento nos núcleos da base, determinando maior inibição dessas estruturas sobre o comportamento motor iniciado no córtex. No entanto, as alterações patológicas não são restritas à substância negra, estando presentes também em outros núcleos do tronco cerebral (por exemplo, núcleo motor dorsal do vago), córtex cerebral e até mesmo em neurônios periféricos, como os do plexo mioentérico (BRAAK et al., 2003; GIBB; LEES, 1988; LANG; LOZANO, 1988).

2.1.4 Sintomas da DP

Com a progressão da doença além dos sintomas comuns (tremor de repouso, rigidez muscular, bradicinesia e instabilidade postural), os pacientes podem apresentar fácies amímica, postura em flexão, marcha com passos curtos, arrastados e com ausência do balançar dos braços, hipotensão ortostática e blefaroclonia (tremor das pálpebras fechadas) (MORRIS, 2000; PAULSON; STERN, 1996).

Aos sintomas motores comumente se associam alterações cognitivas e de comportamento, como tendência ao isolamento, ansiedade, distúrbios do sono, fadiga, problemas de memória e depressão, fatores que corroboram para o sedentarismo e a dependência funcional, interferindo assim na qualidade de vida destes indivíduos (DUCAN et al., 2013; MULLER et al., 2013; OPARA et al., 2012).

2.1.4.1 Alterações cognitivas na DP

Indivíduos com DP podem apresentar certo grau de alteração cognitiva com a evolução da doença, sendo que Emre (2004) afirma que a demência associada a DP é presumivelmente causado pelos mesmos tipos de alterações fisiopatológicas que provocam os sintomas motores.

Poewe e Wenning (1996) descrevem que a alteração cognitiva associada à DP é caracterizada pela redução ou falta de iniciativa para atividades espontâneas; incapacidade de desenvolver estratégias exitosas para a resolução de problemas; lentificação do processamento global da informação; prejuízo da percepção visuoespacial; dificuldades de conceitualização; dificuldade na geração de listas de palavras.

A demência associada à DP, na ocasião do diagnóstico, geralmente é de grau leve a moderado, mas com a evolução da doença pode agravar-se e apresentar lentificação psicomotora e do processamento cognitivo global, disfunção executiva (prejuízo na abstração, na formação de conceitos, na geração espontânea de palavras), disfunções construtivas e das funções vísuoespaciais, baixo rendimento em algumas tarefas matemáticas e prejuízo secundário da memória, em que o armazenamento da informação está relativamente bem preservado (EMRE, 2003, 2004).

Os pacientes com DP apresentam um melhor desempenho em tarefas de reconhecimento em comparação a tarefas de evocação livre, o que sugere que a capacidade de armazenamento está preservada, mas a estratégia frontal para acessá-la encontra-se deficiente (PILLON et al., 2001).

2.1.5 Escalas para Avaliação da DP

Atualmente existem diversas escalas validadas pela literatura científica para avaliação dos sintomas motores e não motores decorrentes da DP e também para verificação do impacto da doença na qualidade de vida dos indivíduos e seus cuidadores. As escalas utilizadas no presente estudo estão descritas a seguir.

2.1.5.1 Avaliação cognitiva de Montreal (MoCA) (ANEXO A):

A avaliação Cognitiva Montreal (MoCA) foi desenvolvida como um instrumento breve de rastreio para defeito cognitivo leve. O mesmo permite o acesso a diferentes domínios cognitivos: atenção e concentração, funções executivas, memória, linguagem, capacidades visuo-construtivas, capacidade de abstração, cálculo e orientação. A pontuação total é de 30 pontos; sendo a pontuação de 26 ou mais considerado normal (NASREDDINE et al., 2005).

2.1.5.2 UPDRS (*Unified Parkinson's Disease Rating Scale)* (ANEXO B):

A escala unificada de avaliação da DP foi criada por Fahn e colaboradores em 1987 e é amplamente utilizada para monitorar a progressão da doença e a eficácia do tratamento medicamentoso. Esta escala surgiu devido a necessidade de se obter um método uniforme para avaliar os sinais da DP. Esse instrumento avalia os sinais, sintomas e determinadas atividades do portador de DP por meio de auto relato e da observação clínica.

A UPDRS é composta por 42 itens, divididos em quatro partes: atividade mental, comportamento e humor, atividades da vida diária, capacidade motora e complicações da terapia medicamentosa, sendo que para o presente estudo será utilizada apenas a dimensão que avalia a capacidade motora dos indivíduos. A pontuação em cada item varia de 0 a 4, sendo que o valor máximo indica maior comprometimento pela doença e o mínimo, normalidade.

2.1.5.3 Escala de Hoehn & Yahr (ANEXO C):

Esta escala foi desenvolvida em 1967 e atualmente é a mais utilizada para avaliar o estado geral do portador de DP. Em sua forma original compreende cinco estágios de classificação para avaliar a gravidade da DP e abrange, essencialmente, medidas globais de sinais e sintomas que permitem classificar o indivíduo quanto o nível de incapacidade. Uma versão modificada da HY foi desenvolvida mais recentemente e é composta por 8 estágios, que variam de 0 (sem

sinais da doença) ao 5 (paciente utiliza cadeira de rodas ou acamado exceto se auxiliado), tendo como estágios intermediários o 1.5 e 2.5 (HOEHN; YAHR, 1967).

2.1.6 Tratamento da DP

2.1.6.1 Tratamento farmacológico

O tratamento farmacológico da doença consiste basicamente em minimizar o desequilíbrio de neurotransmissores ao nível estriatal, ou seja, aumentar a atividade dopaminérgica e reduzir a colinérgica, visando o controle dos sintomas, com o objetivo de manter o indivíduo com autonomia, independência funcional e equilíbrio psicológico, o que se obtém com a reposição da dopamina estriatal (CHUNG et al., 2010; POEWE et al., 2010).

O uso da levodopa alivia alguns dos sintomas relacionados a parte motora da DP. Porém, à medida que a doença progride, torna-se necessário aumentar a dose e diminuir o intervalo das tomadas. Embora seja o recurso de primeira linha no tratamento da DP, em longo prazo surgem limitações ao seu emprego, representadas por flutuações motoras. Essas se referem a respostas motoras inesperadas à administração do fármaco, como encurtamento da duração do efeito (fenômeno do *wearing off*) ou interrupção súbita de sua ação, levando à situação de alternância entre resposta medicamentosa e falta de resposta (fenômeno *on-off*) (CHUNG et al., 2010; POEWE et al., 2010).

2.1.6.2 Tratamento não farmacológico

O tratamento não farmacológico também é fundamental para a manutenção da qualidade de vida dos indivíduos com DP, sendo que estes devem possuir acompanhamento com diversos profissionais da saúde, dentre eles o nutricionista, fisioterapeuta, terapeuta ocupacional e fonoaudiólogo, bem como receber informações sobre a doença e apoio psicológico, tanto para o paciente quanto para seu cuidador e pessoas que com ele convivem (MORRIS, 2000; DUCAN et al., 2013).

2.2 INSTABILIDADE POSTURAL E QUEDAS NA DP

Com a evolução da doença a instabilidade postural torna-se um sintoma mais frequente e limitante. O paciente passa a ter dificuldades para mudar a direção dos movimentos, fato que associado à rigidez, à alteração postural e ao prejuízo na coordenação de tronco, acaba acometendo a marcha e o equilíbrio e levando a quedas frequentes (MAKI; HOLLIDAY; TOPPER, 1994; MANCINI et al., 2008; MCVEY et al., 2009).

Em consequência das alterações decorrentes da doença os pacientes tendem a deslocar seu centro de gravidade para frente e assim apresentam dificuldades na realização dos movimentos compensatórios adequados para readquirir equilíbrio. Os distúrbios motores também acarretam as quedas que tendem a aumentar de frequência e gravidade com a progressão da doença (LEE et al., 1995; ROCHI et al., 2006).

As quedas são uma das principais consequências da DP e são queixas comuns de pacientes e cuidadores, já que quase 70% dos pacientes relatam pelo menos um episodio de queda durante um ano e 50% relatam mais de uma queda por ano (MATINOLLI et al., 2009). As quedas ocorrem mais frequentemente quando o paciente com DP tenta mudar de direção durante a marcha, no início dela e após levantar de uma cadeira (JOBST et al., 1997; MATINOLLI et al., 2009).

As quedas podem causar lesões ou fraturas de quadril e os indivíduos acabam por desenvolver o medo de cair, que pode resultar em uma restrição das atividades de vida diárias que, por sua vez, pode contribuir para a institucionalização, perda da independência, aumento da mortalidade e isolamento social (HAUSDORFF, 2009).

Os mecanismos relacionados com a instabilidade postural na DP não estão esclarecidos, porém, sugere-se que as alterações proprioceptivas estejam ligadas a este sintoma motor (HEWETT; PATERNO; MYER, 2002).

2.3 PROPRIOCEPÇÃO

2.3.1 Função da Propriocepção

O termo propriocepção foi descrito pela primeira vez, por Sherrington, em 1906, como sendo o resultado de todas as aferências oriundas de receptores, denominados proprioceptores, que estão localizados nos tendões e músculos, bem como de outros mecanorreceptores presentes nas articulações e na pele (DIETZ, 2002). Essas aferências seriam projetadas ao sistema nervoso central para seu processamento, resultando na regulação do controle motor e de reflexos corporais (HEWETT; PATERNO; MYER, 2002), sendo que a função primária dos proprioceptores é detectar eventos inesperados e, a partir destes, iniciar uma rápida resposta eletromiográfica compensatória (PEARSON, 2000).

A orientação do corpo no espaço e a locomoção dependem das informações aferentes dos sistemas visual, vestibular e proprioceptivo (DIETZ, 2002), sendo que os proprioceptores situados nas cápsulas articulares são os responsáveis por enviar dados sobre a posição relativa das várias partes do corpo, em conjunto com os impulsos de exteroceptores cutâneos, especialmente os de tato e pressão (LEWIS; BYBLOW, 2002).

A propriocepção desempenha um papel essencial no controle motor normal dos indivíduos (KHUDADOS; CODY; O'BOYLE, 1999), bem como na compensação das forças gravitacionais (MESSIER et al., 2003), sendo essencial durante o movimento humano e locomoção (TAN; ALMEIDA; RAHIMI, 2011). Os núcleos da base (NB) são uma parte importante desta rede multissensorial que processa e integra vários estímulos responsáveis em produzir uma ação motora precisa (CONTRERAS-VIDAL, 1999; NAGY et al., 2006).

2.3.2 Avaliação Proprioceptiva

A avaliação da propriocepção pode ser realizada através de diversos testes de senso de posição, também chamado de artroestesia ou propriocepção cinético-postural, e dos testes de cinestesia (HUBBARD; KAMINSKI, 2002). O senso de posição é a capacidade de reproduzir um determinado ângulo articular e/ou comparar a posição inicial e final de um membro, e a cinestesia é a capacidade de

perceber o movimento, detectando sua direção, amplitude e velocidade, ambos sem auxílio visual (CARPENTER; BLOEM, 2001; FIORIO et al., 2007).

As avaliações proprioceptivas são ferramentas importantes para investigar o processamento e integração sensorial e o impacto destas sobre a precisão dos movimentos voluntários, sendo que, atualmente, os testes mais utilizados para essa avaliação são realizados com auxílio de equipamentos como o dinamômetro isocinético, goniômetro ou aparelho de movimentação passiva contínua (CARPENTER; BLASIER; PELLIZZON, 1998; KONCZACK et al., 2007; MONGEON; BLANCHET; MESSIER, 2009).

A integridade da propriocepção da articulação do joelho é essencial para o controle neuromotor dos membros inferiores, sendo o teste proprioceptivo um importante método de avaliação diagnóstica e prognóstica (BENNELL et al., 2005) para o risco de quedas e alterações na estabilidade postural e marcha.

2.4 PROPRIOCEPÇÃO NA DP

Na DP o funcionamento do circuito NB-cortex é prejudicado devido, em parte, à degeneração progressiva dos neurônios dopaminérgicos da substância negra, colaborando para os déficits no processamento e integração sensorial frequentemente presentes nestes indivíduos (ADAMOVICH et al., 2001; ALMEIDA et al., 2005; FIORIO et al., 2007; JACOBS; HORAK, 2006; KONCZAK et al., 2007; ZIA; CODY; O'BOYLE, 2000).

Estudos sugerem a existência de déficits proprioceptivo na DP, pois pacientes quando testados sem auxílio do sistema visual e comparados com controles pareados, apresentam redução na capacidade de realizar atividades com os membros superiores (MONGEON; BLANCHET; MESSIER, 2009), maiores erros quando solicitados a encontrar alvos (ADAMOVICH et al., 2001; CONTRERAS-VIDAL; GOLD, 2004; JOBST et al., 1997; KHUDADOS; CODY; O'BOYLE, 1999; ZIA; CODY; O'BOYLE, 2002) e dificuldade na manutenção da orientação e controle postural (JACOBS; HORAK, 2006; VALKOVIC; KRAFCZYK; BOTZEL, 2006; VAUGOYEAU et al., 2007). Porém, os resultados dos estudos ainda são contraditórios, como por exemplo no estudo de Tagliabue, Ferrigno e Horak (2009), que não encontrou diferença na propriocepção entre os indivíduos com e sem DP, discordando dos demais autores acima citados.

Outros aspectos que até o momento não estão claros neste contexto é o quanto a influência do sistema visual e da cognição interferem nos aspectos proprioceptivos e quais as alterações motoras decorrentes da doença estão relacionadas com a alteração proprioceptiva destes indivíduos. Apesar de tantas questões a serem esclarecidas a quantidade de pesquisas nesta área ainda é escassa, principalmente quando se trata da análise proprioceptiva dos membros inferiores de indivíduos parkinsonianos.

Quanto ao efeito da medicação dopaminérgica sobre a propriocepção dos indivíduos com DP, os estudos existentes acabaram gerando resultados discordantes. Alguns resultados, como no estudo de Almeida et al. (2005), referem um efeito benéfico da medicação dopaminérgica sobre a propriocepção de indivíduos com DP, enquanto outros estudos relataram uma piora no processamento proprioceptivo após a terapia de reposição de dopamina (JACOBS; HORAK, 2006; O'SUILLEABHAIN; BULLARD; DEWEY, 2001).

Estes resultados discordantes fez com que autores sugiram que os déficits sensório-motores podem não ter uma origem dopaminérgica ou que a disfunção dopaminérgica no interior dos NB não é diretamente responsável por estas alterações (JACOBS; HORAK, 2006; TUNIK; FELDMAN; POIZNER, 2007; VALKOVIC; KRAFCZYK; BOTZEL, 2006).

No estudo de Jacobs e Horak (2006) os autores supõem que os distúrbios da propriocepção na DP podem ocorrer primariamente devido a uma disfunção na área motora suplementar (SMA), pois este é um dos principais locais de saída dos NB, sensível à dopamina e contribui significativamente no planejamento e orientação dos movimentos (ECKERT et al., 2006). Além disso, as células do SMA apresentaram uma perda da seletividade nas respostas neuronais ao movimento articular passivo de diversas articulações em estudo realizado em dois macacos com DP induzida (1-metil-4-fenil-1,2,3,6-tetrahidropiridina, MPTP-induzida), demonstrando a importante contribuição da SMA no processamento adequado das entradas proprioceptivas (ESCOLA et al., 2002).

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4 ARTIGO

KNEE PROPRIOCEPTION IS IMPAIRED IN PARKINSON'S DISEASE PATIENTS

(Em processo de submissão ao periódico *Gait and Posture*)

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Abstract

Introduction: Changes in proprioception may contribute to postural instability in individuals with neurological disorders. Objectives: The aim of this study was to evaluate proprioception in the lower limbs of patients with Parkinson's disease (PD) and its association with cognitive ability, motor symptoms, postural instability and severity of disease. Methodology: This is a cross-sectional controlled study that evaluated and compared PD patients and healthy individuals matched for age and sex. Participants were evaluated by anamnesis, scales for assessment of cognitive (MoCA), motor ability (UPDRS), disease stage (Hohen & Yahr scale), postural instability (Pull Test and stabilometric analysis) and knees proprioception. Results: A total of 40 individuals were included, 20 with Parkinson's disease (PG) and 20 healthy controls (CG). PD patients have greater angular errors on proprioceptive ratings than participants in the CG (p=0.002). The oscillations of the center of pressure (p=0.002) were higher in individuals with PD than controls. Proprioceptive errors in PD were associated with worst cognitive status, presence of tremor as the dominant symptom and motor impairment. Conclusion: The findings shows that PD individuals present proprioceptive deficits and that this is related with cognition and motor symptoms.

Keywords : Proprioception; Parkinson's disease; balance; postural instability; motor capacity, cognition.

Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disease with motor characteristics as the rest tremor, rigidity, bradykinesia and postural instability.[1]

The mechanisms of postural instability are not well understood. It has been suggested that losses in proprioception may be related to this, resulting in no proper regulation of control motor and bodily reflexes.[2] The integrity of the knee joint proprioception, for example, is essential for the neuromotor control of the lower limbs. In this sense the assessment of proprioception shall play an important role in assessing the changes in postural instability, gait and risk of falls.[3]

Few studies have assessed proprioception in individuals with PD compared to healthy individuals.[4-13] The relationship aspect of proprioception with the severity and laterality of motor symptoms and type of predominant symptoms (akinetic rigid versus tremor) were not been evaluated in previous studies.

The present study aimed to evaluate the knee proprioception in individuals with PD and its association with motor symptoms, cognitive status, postural instability and severity of disease.

Methodology

Study design

Controlled cross-sectional study, approved by the Ethics Committee of Universidade Federal de Ciências da Saúde de Porto Alegre, number 988/12, and according to Code of Ethics of the World Medical Association (Declaration of Helsinki).

Subject

This study was composed of individuals with Parkinson's disease (PG) and a control group (CG) consisted of healthy individuals matched for age and sex.

The number of participants needed for this research was defined by calculation based on the results of the study of Dumam et al. (2012)[14], that evaluated the kinetic postural proprioception in individuals with knee osteoarthritis and established the target angle of 45º of knee flexion. This author found a standard

deviation of 1.60° angular error for the left knee and a standard deviation of 1.24° angular error in the right knee proprioception. We adopt a margin of error of 0.5 for each standard deviation and assume a significance level of 0.05, therefore the total number of individuals suggested for this study was 20 participants in each group.

All participants who agreed to participate in the study signed the Informed Consent Form and were scheduled for the procedure.

The PG was composed of individuals of both sexes with a clinical diagnosis of PD according to London Brain Bank Criterias, ranked between stages 1 and 3 according to the Hoehn & Yahr staging scale.[15] For both groups the inclusion criteria were: being older than 45 years, ability to walk alone without the assistance of devices, having a score of 26 points or higher on Montreal Cognitive Assessment Scale[15], and cognition for understanding the tasks.

Individuals with a history of knee surgery or lower limb fractures in the past 6 months, amputation of any part of the leg, presenting any restricting pain at the time of the assessment; non-right-handed individuals, or yet individuals who had any other neurological disease or Diabetes Mellitus, were excluded in both groups.

PD patients were classified into tremulous form or akinetic rigid kind depending on the predominant symptoms assessed by the UPDRS scale.

Assessment procedures

All ratings were performed 1 hour after use of antiparkinsonian medication with patients in ON moment.

Participants belonging to PG were assessed through an interview and scales for assessment of cognitive ability (Montreal Cognitive Assessment - MoCA)[16], motor function (Unified Parkinson's Disease Rating Scale - UPDRS), postural instability (Pull Test and stabilometric analysis) and disease stage (Hohen & Yahr scale)[15].

The kinetic postural proprioception of flexion and extension knee was assessed by an isokinetic dynamometer, Biodex® Multi-Joint System 4 Pro. The researcher who conducted the proprioceptive assessment of participants were blinded as to the other ratings, which were performed by a second evaluator.

The CG participants responded to an anamnesis and MoCA Scale[16], these were subsequently evaluated for kinetic postural proprioception and postural instability.

Assessment of static balance

Assessment of static balance was carried out by analyzing the oscillations of the center of pressure (COP), using a baropodometer model FootWork® IST/AM3 Intermetique.

This system is capable of measuring plantar pressures statically and dynamically. The baropodometer consists of a pressure platform using capacitive sensors, with 4mm of thickness and active area of 490mm x 490mm, with a sampling rate of 40 Hz.

Participants were instructed to remain immobile for 30 seconds, with self-selected lateral spacing of the foot and in *quasi-static* posture on the platform of baropodometer, with constant gaze at one point on the wall located 3 meters in front of the person at eyes level. Three measurements were performed with a minute of interval between each other.

Proprioceptive assessment

To perform the evaluation of kinetic postural proprioception, the protocol used in the isokinetic dynamometer was the same for both groups evaluated, and followed the manufacturer's guidelines where, for the test of position sense of the knee, participants remained seated with the chair tilted to 70º, hips and knees flexed, and the leg attached by the region of the ankle in the specific support equipment. The lower limb to be tested was stabilized and the knee remained aligned with the mechanical axis of the dynamometer through a point marked on the lateral femoral condyle in the sagittal plane (Figure 1). The protocol was apllied by a single examiner blinded to the other tests and the orientations for the assessment remained the same for all participants.

----- Insert figure 1 -----

The equipment was programmed to the proprioceptive assessment of the right and left side, using the angles of 45° and 75° of knee flexion as parameters to be tested. Participants remained blindfolded for the visual system therefore not causing any influence on the test results. Initially the lower limb was positioned in the reference angle (90° of knee flexion), subsequently the target angle was reached

enabled by the device with a speed of 10°/s, remaining in this position for 15 seconds for memorization of the patient.

Once the position was memorized, the limb passively returned to the reference angle remaining in this position for 10 seconds to rest, and, only then, the participant was asked to place the limb on the memorized target angle pressing the stop button of the equipment to record the angle reached. This process was initially performed so the participants could become familiar with the test.

Soon after, three attempts were performed, and subsequently calculated the difference between each original target angle and the angle reached, afterwards was obtained the angular errors and, finally an average of proprioceptive errors being made from the three attempts for each lower limb.

Statistical Analysis

For data analysis only non-parametric tests were used, thus eliminating the requirement of normal distribution. To compare the control and patient groups, we used the test for paired samples Wilcoxon. For comparisons of variables within the group of patients were used tests for independent samples Mann-Whitney or Kruskall-Wallis, depending on whether the comparison was between two or more variables, respectively. The Spearman correlation was used to assess the relationship between two quantitative characteristics of the patients. The analyzes were performed in SPSS software version 18. Significance level used was 5%.

Results

The sample consisted of 40 participants (20 PD patients and 20 controls matched for age and gender). The sociodemographic characteristics of the sample are presented in Table 1.

There was no statistically significant difference between the PD group and control in cognition ($p = 0.072$) and education level ($p = 0.228$). The mean duration of disease among individuals with PD was 6.1 years (Table 1). Half of the participants (10) presented initial symptoms in the right side and the other in the left. All participants in the PG were performing some kind of physiotherapy treatment for motor disorders arising from DP and no individual CG performed physiotherapy for being healthy subjects.

The predominance of motor manifestations at the time of assessment by laterality remained in the same proportion. As for the initial symptom of PD in most participants (55%) the first noticeable symptoms of the disease was rigidity, based on the reports of the participant during the application of anamnesis.

About the analysis of center of pressure, the oscillations of the COP were higher in patients with PD compared to controls (p=0.002).

---- Insert Table 1 ----

Proprioceptive analysis

PD patients have higher angular errors in proprioceptive assessments than participants in the control group (Table 2 and Figure 2, p=0.002). A worse performance in the assessment of proprioception in patients with PD compared to controls was observed when analyzed both the right (p=0.050), and the left side (p=0.004).

These differences between PG patients an CG were observed even when the side of less parkinsonism symptoms analyzed, with p=0.040 on the right side and p=0.006 on the left side.

-------- Insert figure 2 and table 2 ------

Analysis of factors related to proprioception

The study of factors correlated with proprioception angular errors in PD are shown in Table 3 and described separately below.

Analysis of MoCA: the angular errors in the proprioceptive tests are related to lowest scores on MoCA (p=0.003). This observation was maintained even when assessed for laterality (p=0.024 right, p=0.017 left).

Predominant Motor Symptom: Regarding the type of parkinsonian symptoms (tremor, rigidity or bradykinesia) that most interfered in proprioception, it was observed that patients with tremor as the predominant symptom have larger angular errors proprioceptive (p=0.017).

Disease staging by Hoenh & Yahr: It was verified that there is a statistically significant negative correlation between proprioceptive deficits and the degree of staging of the non-dominant side of the individual (r= - 0.461, p=0.041) and in the bilateral analysis (r= - 0.054, p= 0.011).

Functional Motor Scale (UPDRS): A worsening of proprioception was found in the dominant side with statistically significant correlation with the degree of functionality assessed by the UPDRS (r=0.539 and p=0.014).

Other variables: Duration of disease, presence of dyskinesias and motor fluctuations did not influence the proprioceptive angular errors as well as the oscillations of the COP and the pull test results.

Discussion

In the present study PD patients showed higher angular errors in proprioception compared with healthy individuals. PD patients also presents higher postural instability when evaluated by the oscillations of COP. PD patients showed a higher impairment in finding the knee target angle than controls. This deficit in reaching known targets has also been found in other studies[4,5,6,8]. This results corroborate the idea of the existence of a proprioceptive deficit in PD patients. The proprioception impairment in PD patients was present even in the side of less parkinsonian involvement.

At the time of proprioceptive assessment all parkinsonian individuals were in the ON state of dopaminergic medication. The influence of antiparkinsonian medication on proprioception is not well established. Some authors suggest that the same may have negative influence on the proprioceptive system in PD.[4,17,18] Although some studies have suggested that proprioception impairment in PD patients could be related to dyskinesias induced by levodopa,[18] our study have showed that the same was observed even in patients without dyskinesias.

In our study PD patients and control group did not differ in MoCA scores and education level. However in PD group the cognition status was related with proprioception. In PD patients lower cognitive scores were associated with higher angular errors in proprioceptive tests. This outcome could be attributed to the fact

that patients with lower cognitive performance would have less ability to concentrate on the test and thus the perception of angular changes measured in proprioception. However, all patients had understanding for testing, since all doubts were clarified prior to carrying out the task. It is known that individuals with PD with cognitive impairments have greater postural instability and increased risk of falls.[19]

From the results we observed that participants who had tremor as the first noticeable symptom of PD obtained the largest proprioceptive errors. To date, no studies linking the first motor symptom of PD with proprioceptive changes caused by the disease were found. Although bradykinesia and postural instability are motor symptoms most often cited in studies as having a close relationship with deficits in proprioception.[7,10,11,20] .

One possibility of the absence of correlation between results of COP and the pull test with angular errors of proprioception could possibly be explained by the compensation of the visual system in realization of assessment of postural stability tests. The fact that with the aid of the visual system proprioceptive deficits and postural reactions are minimized is known, because the vision compensates the instabilities preventing falls. Thus, probably the results of the evaluation of postural instability would be different if the tests were conducted without the influence of vision, then maybe there was a relationship of this symptom with proprioceptive alteration of parkinsonian participants.

The motor ability of participants PG, tested by UPDRS-III scale correlated significantly with higher angular errors in proprioceptive assessment of the dominant side of individuals. This relationship between the worsening of motor symptoms and higher deficits in proprioception were also found in previous studies.[4,12,20]

Despite the severity of the disease have influenced the proprioceptive aspects in the sample, the time of diagnosis was not significantly associated with these aspects. This finding is probably explained by the fact that the sensory deficit's increases with duration of disease.[21]

From the findings of this study and based on previous studies, we note that there was a proprioceptive deficit in PD and therefore in the joint position sense. However it is still controversial what is the real origin of this alteration, since it is known that the functioning of muscle spindles, especially the receiver of joint position

sense, appear to be normal in PD and that there is no evidence about the existence of some alteration in ascending somatosensory pathways in this disease.

Some authors argue that proprioception deficits in PD may be associated with dysfunction of sensory integration signs to guide the movements, within the basal nucleus (BN), because BN intact circuitry is essential for perception of the joint position and movement and any damage to this circuit can result in kinesthetic deficits. Therefore, the BN would be responsible for alterations in proprioception in individuals with PD, but should not exist disagreement among studies that evaluated the effect of dopaminergic medication on these deficits, because it is expected that this shows similar results for all patients, regardless of disease severity. Thus, some authors[11,12,22] suggest that dopaminergic dysfunction within the BN is not primarily responsible for the dysfunction of the proprioceptive system.

To corroborate this hypothesis in the study by Jacobs and Horak (2006)[15] was presupposition that the disturbances of proprioception in PD may occur primarily due to a dysfunction in the supplementary motor area (SMA), because this is one of the main places of exit of BN, it is sensitive to dopamine and contributes significantly in the planning and direction of movement[23]. Furthermore, the cells of the SMA showed a loss of selectivity in the responses to passive joint movement in parkinsonian monkeys, demonstrating the important contribution of SMA in the proper processing of proprioceptive inputs[24].

Comparisons of proprioceptive errors with the larger motor involvement side, disease duration, presence of dyskinesias and motor fluctuations, oscillations of COP, pull test showed no statistical significance. It is believed that significant results should arise from samples with larger numbers of participants.

Conclusions

The present study identified the prevalence of higher angular proprioceptive errors in participants with PD, supporting the hypothesis that the disease affects the proprioceptive system of this population. Comparisons between individuals with PD and healthy also showed statistical significance when evaluated fluctuations of the center of pressure indicating that individuals with PD tend to have greater postural instability than healthy.

Analyzing the factors that have a relationship with proprioception, it was found that low cognitive ability and tremor as the dominant symptom are factors that significantly influence the presence of proprioceptive alteration in parkinsonian individuals. A close relationship between the deterioration of motor skills with the presence of larger deficits in proprioception was found as well.

Due to postural instability in individuals with PD in this study and the relationship between proprioceptive deficits with the motor skills and severity of the disease, therefore highlights the importance of an approach focused on these aspects in the rehabilitation process. From the results of this study we suggest that physiotherapy should include proprioceptive and balance exercises for this population, favoring an improvement in motor skills and therefore in the functionality, factors that will influence the improvement of the quality of life of these individuals.

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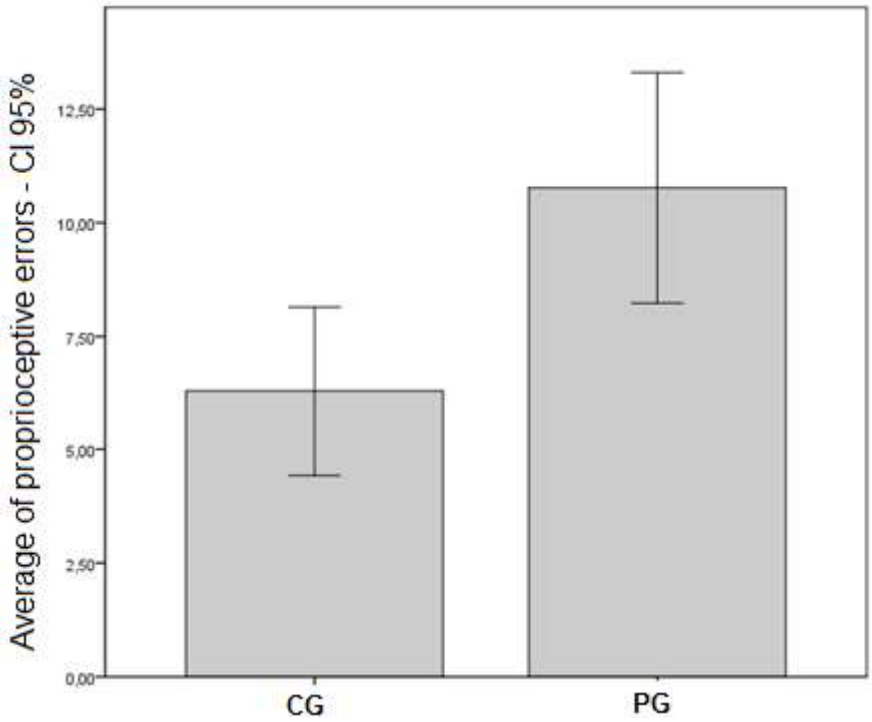
Figure 1- Positioning of the individual to the proprioceptive assessment.

Table 1 - Sample characterization

Variables	PG (n=20)	CG (n=20)
Gender - n (%)		
Female	14 (70%)	14 (70%)
Male	6 (30%)	6 (30%)
Age - mean (SD)	61.60 (9,21)	61.35 (9,48)
Education level - n (%)		
Until 9 years	3 (15%)	7 (35%)
8 to 12 years	6 (30%)	7 (35%)
More than 12 years	11 (55%)	6 (30%)
Duration of disease - mean (SD)	6,10 (4,15)	-----
Predominant motor symptom - n (%)		
Tremor	9 (45%)	-----
Rigidity or bradykinesia	11 (55%)	-----

* PG = Parkinson Group, CG = Control Group, n = sample size, SD = standard deviation, % = percentage.

Figure 2 - Average of bilateral proprioceptive errors



* CI 95%= Confidence interval of 95%, PG= Parkinson Group, CG= Control Group.

Table 2 – Comparison between groups

Variables - Median (P25 – P75)	**PG (n=20)**	**CG (n=20)**	**p**
Bilateral Proprioception	9.70 (6.77-13.63)	4.60 (3.26-7.79)	0.002*
Right Proprioception	9.30 (6.77-12.38)	4.80 (3.43-9.63)	0.050*
Left Proprioception	10.22 (7.27-14.58)	4.50 (3.42-6.87)	0.004*
COP	3.46 (2.04-6.64)	1.32 (0.60-1.93)	0.002*

*With statistical significance, PG= Parkinson Group, CG= Control Group, COP= Oscillations of the center of pressure, P25= Percentile 25, P75= Percentile 75.

Table 3 – Comparison of proprioception with other variables **in PG (n=20)**

	Right Proprioception		Left Proprioception		Bilateral Proprioception	
Variables	**Median (IQR) or r[1]**	**p**	**Median (IQR) or r[1]**	**p**	**Median (IQR) or r[1]**	**p**
Education level		0.155		0.147		0.082
Until 9 years	12.50 (9.25-18.45)		14.75 (9.35-18.70)		13.90 (10.25-17.92)	
8 to 12 years	8.25 (4.25-10.75)		8.85 (8.10-13.80)		8.25 (4.87-12.82)	
More than 12 years	9.30 (4.31-11.60)		8.82 (3.03-12.60)		7.63 (5.90-11.81)	
Duration of disease	0.083	0.727	- 0.170	0.475	-0.076	0.749
Predominant motor symptom		0.023*		0.102		0.017*
Tremor	12.05 (8.87-22.87)		12.10 (9.57-16.22)		12.82 (9.70-18.02)	
Rigidity or bradykinesia	8.25 (4.25-9.55)		8.25 (3.10-14.10)		7.75 (4.87-11.72)	
COP	0.073	0.760	-0.146	0.539	-0.054	0.821
Presence of *On/Off* moment		0.114		0.143		0.064
Yes	8.87 (4.42-11.27)		9.10 (4.07-13.23)		7.93 (5.28-12.55)	
No	10.80 (8.50-23.60)		12.95 (9.00-16.85)		12.11 (8.75-19.52)	
Presence of dyskinesias		0.232		0.217		0.143
Yes	8.87 (4.42-12.23)		9.10 (4.07-13.83)		7.93 (5.28-13.63)	
No	9.45 (8.50-23.48)		12.95 (9.00-14.58)		11.90 (8.75-18.80)	
Disease staging	-0.392	0.087	-0.461	0.041*	-0.554	0.011*
Cognition	-0.502	0.024*	-0.528	0.017*	-0.627	0.003*
Instability (Pull test)	0.238	0.311	0.091	0.701	0.167	0.483
Motor Function (UPDRS)	0.539	0.014*	0.253	0.281	0.394	0.085

[1]For qualitative variables is presented median and interquartile range (IQR). For quantitative variables is presented the Spearman correlation coefficient (r). *With Statistical difference

5 CONCLUSÃO GERAL

O presente trabalho identificou a existência de uma alteração proprioceptiva nos indivíduos com doença de Parkinson. Verificou-se, também, que estes indivíduos apresentam maior instabilidade postural e presença de quedas do que indivíduos saudáveis, e que a gravidade da doença e a capacidade motora são aspectos que estão relacionados com os déficits proprioceptivos existentes nesta população.

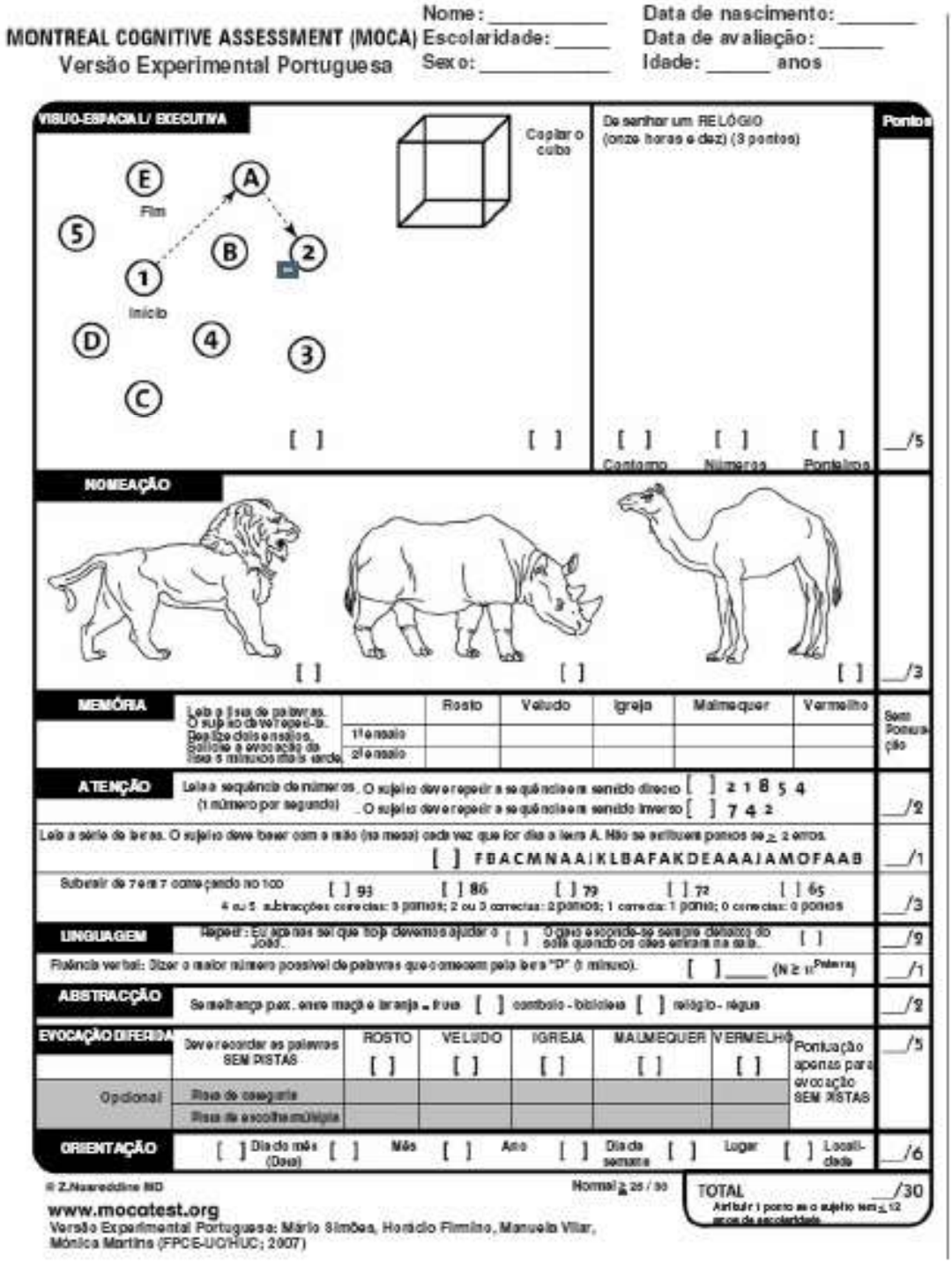
A partir destes achados sugerimos uma abordagem fisioterapêutica focada nos distúrbios motores decorrentes da doença, incluindo no processo de reabilitação exercícios de treino proprioceptivo e de equilíbrio. Através de uma abordagem adequada durante as sessões de fisioterapia, acreditamos que pode-se evitar episódios de quedas e melhorar a funcionalidade destes indivíduos, colaborando para uma maior expectativa de vida destes.

Entre as limitações do trabalho, destaca-se o pequeno número de indivíduos participantes, prejudicando a evidência e a comparação dos achados encontrados, assim como influenciando a grande gama de sintomas motores sem relação significativa com a propriocepção. Sugere-se estudos futuros com maior número de participantes e, também, estudos que verifiquem a influencia da medicação dopaminérgica sobre os aspectos proprioceptivos dos membros inferiores dos indivíduos com DP.

ANEXOS

ANEXO A

Avaliação Cognitiva de Montreal (MoCA)



MONTREAL COGNITIVE ASSESSMENT (MOCA)
Versão Experimental Portuguesa

Nome: _____ Data de nascimento: _____
Escolaridade: _____ Data de avaliação: _____
Sexo: _____ Idade: _____ anos

VISUO-ESPACIAL/ EXECUTIVA — Pontos

Copiar o cubo

Desenhar um RELÓGIO (onze horas e dez) (3 pontos)

Contorno Números Ponteiros

/5

NOMEAÇÃO

/3

MEMÓRIA

Leia a lista de palavras. O sujeito deve repeti-la. Realize dois ensaios. Solicite a evocação da lista 5 minutos mais tarde.

	Rosto	Veludo	Igreja	Malmequer	Vermelho
1º ensaio					
2º ensaio					

Sem Pontuação

ATENÇÃO

Leia a sequência de números (1 número por segundo). O sujeito deve repetir a sequência em sentido direto [ ] 2 1 8 5 4
O sujeito deve repetir a sequência em sentido inverso [ ] 7 4 2

/2

Leia a série de letras. O sujeito deve bater com a mão (na mesa) cada vez que for dito a letra A. Não se atribuem pontos se ≥ 2 erros.

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

/1

Subtrair de 7 em 7 começando no 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 ou 5 subtracções correctas: 3 pontos; 2 ou 3 correctas: 2 pontos; 1 correcta: 1 ponto; 0 correctas: 0 pontos

/3

LINGUAGEM

Repetir: Eu apenas sei que hoje devemos ajudar o João. [ ]
O gato esconde-se sempre debaixo do sofá quando os cães entram na sala. [ ]

/2

Fluência verbal: Dizer o maior número possível de palavras que comecem pela letra "P" (1 minuto). [ ] ____ (N ≥ 11 Palavras)

/1

ABSTRACÇÃO

Semelhança par. ex. maçã e laranja → fruta [ ] comboio - bicicleta [ ] relógio - régua

/2

EVOCAÇÃO DIFERIDA

	Deve recordar as palavras SEM PISTAS	ROSTO	VELUDO	IGREJA	MALMEQUER	VERMELHO
		[ ]	[ ]	[ ]	[ ]	[ ]
Opcional	Pista de categoria					
	Pista de escolha múltipla					

Pontuação apenas para evocação SEM PISTAS

/5

ORIENTAÇÃO

[ ] Dia do mês (Data) [ ] Mês [ ] Ano [ ] Dia da semana [ ] Lugar [ ] Localidade

/6

© Z.Nasreddine MD

Normal ≥ 26 / 30

TOTAL /30

Atribuir 1 ponto se o sujeito tem ≤ 12 anos de escolaridade

www.mocatest.org

Versão Experimental Portuguesa: Mário Simões, Horácio Firmino, Manuela Vilar, Mónica Martins (FPCE-UC/HUC; 2007)

ANEXO B

Exame Motor UPDRS III

1. Fala:

a) normal.

b) perda discreta da expressão, volume ou dicção.

c) comprometimento moderado. Arrastado, monótono, mas compreensível.

d) comprometimento grave, difícil de ser entendido.

e) incompreensível.

2. Expressão facial:

a) normal.

b) hipomimia mínima.

c) diminuição pequena, mas anormal, da expressão facial.

d) hipomimia moderada, lábios caídos/afastados por algum tempo.

e) fácies em máscara ou fixa, com pedra grave ou total da expressão facial. Lábios afastados ¼ de polegada ou mais.

3. Tremor de repouso:

a) ausente.

b) presente mas infrequente ou leve.

c) persistente mas de pouca amplitude, ou moderado em amplitude mas presente de maneira intermitente.

d) moderado em amplitude mas presente a maior parte do tempo.

e) com grande amplitude e presente a maior parte do tempo.

4. Tremor postural ou de ação nas mãos:

a) ausente

b) leve, presente com a ação.

c) moderado em amplitude, presente com a ação.

d) moderado em amplitude tanto na ação quanto mantendo a postura.

e) grande amplitude, interferindo com a alimentação.

5. Rigidez (movimento passivo das grandes articulações, com paciente sentado e relaxado):

a) ausente

b) pequena ou detectável somente quando ativado por movimentos em espelho de outros.

c) leve e moderado.

d) marcante, mas pode realizar o movimento completo da articulação.

e) grave e o movimento completo da articulação só ocorre com grande dificuldade.

6. Bater dedos continuamente – polegar no indicador em seqüências rápidas com a maior amplitude possível, uma mão de cada vez.

a) normal

b) leve lentidão e/ou redução da amplitude.

c) comprometimento moderado. Fadiga precoce e bem clara. Pode apresentar parada ocasional durante o movimento.

d) comprometimento grave. Hesitação freqüente para iniciar o movimento ou paradas durante o movimento que está realizando.

e) realiza o teste com grande dificuldade, quase não conseguindo.

7. Movimentos das mãos (abrir e fechar as mãos em movimentos rápidos e sucessivos e com a maior amplitude possível, uma mão de cada vez).

a) normal

b) leve lentidão e/ou redução da amplitude.

c) comprometimento moderado. Fadiga precoce e bem clara. Pode apresentar parada ocasional durante o movimento.

d) comprometimento grave. Hesitação freqüente para iniciar o movimento ou paradas durante o movimento que está realizando.

e) realiza o teste com grande dificuldade, quase não conseguindo.

8. Movimentos rápidos alternados das mãos (palma da mão pra coma e pra baixo', horizontal ou verticalmente, com a maior amplitude possível, as duas mãos simultaneamente).

a) normal

b) leve lentidão e/ou redução da amplitude.

c) comprometimento moderado. Fadiga precoce e bem clara. Pode apresentar parada ocasional durante o movimento.
d) comprometimento grave. Hesitação freqüente para iniciar o movimento ou paradas durante o movimento que está realizando.
e) realiza o teste com grande dificuldade, quase não conseguindo.

9. Agilidade da perna (bater o calcanhar no chão em sucessões rápidas, levantando toda a perna, a amplitude do movimento deve ser de cerca de 3 polegadas/ ±7,5 cm).
a) normal
b) leve lentidão e/ou redução da amplitude.
c) comprometimento moderado. Fadiga precoce e bem clara. Pode apresentar parada ocasional durante o movimento.
d) comprometimento grave. Hesitação freqüente para iniciar o movimento ou paradas durante o movimento que está realizando.
e) realiza o teste com grande dificuldade, quase não conseguindo.

10. Levantar da cadeira (reto, com braços cruzados em frente ao peito).
a) normal
b) lento ou pode precisar de mais de uma tentativa
c) levanta-se apoiando nos braços da cadeira.
d) tende a cair para trás, pode tentar se levantar mais de uma vez, mas consegue levantar
e) incapaz de levantar-se sem ajuda.

11. Postura
a) normal em posição ereta.
b) não bem ereto, levemente curvado para frente, pode ser normal para pessoas mais velhas.
c) moderadamente curvado para frente, definitivamente anormal, pode inclinar-se um pouco para os lados.
d) acentuadamente curvado para frente com cifose, inclinação moderada para um dos lados.
e) bem fletido com anormalidade acentuada da postura.

12. Marcha

a) 0= normal

b) 1= anda lentamente, pode arrastar os pés com pequenas passadas, mas não há festinação ou propulsão.

c) 2= anda com dificuldade, mas precisa de pouca ajuda ou nenhuma, pode apresentar alguma festinação, passos curtos, ou propulsão.

d) 3= comprometimento grave da marcha, necessitando de ajuda.

e) 4= não consegue andar sozinho, mesmo com ajuda.

13. Estabilidade postural (respostas ao deslocamento súbito para trás, puxando os ombros, com paciente ereto, de olhos abertos, pés separados, informado a respeito do teste)

a) 0= normal

b) 1= retropulsão, mas se recupera sem ajuda.

c) 2= ausência de respostas posturais, cairia se não fosse auxiliado pelo examinador.

d) 3= muito instável, perde o equilíbrio espontaneamente.

e) 4= incapaz de ficar ereto sem ajuda.

14. Bradicinesia e hipocinesia corporal (combinação de hesitação, diminuição do balançar dos braços, pobreza e pequena amplitude de movimentos em geral).

a) 0= nenhum.

b) 1= lentidão mínima. Podia ser normal em algumas pessoas. Possível redução na amplitude.

c) 2= movimento definitivamente anormal. Pobreza de movimento e certo grau de lentidão.

d) 3= lentidão moderada. Pobreza de movimento ou com pequena amplitude.

e) 4= lentidão acentuada. Pobreza de movimento ou com pequena amplitude.

ANEXO C

Escala de estadiamento de Hoehn & Yahr Modificada

ESTÁGIO 0: Nenhum sinal da doença.

ESTÁGIO 1: Doença unilateral.

ESTÁGIO 1,5: Envolvimento unilateral e axial.

ESTÁGIO 2: Doença bilateral sem déficit de equilíbrio.

ESTÁGIO 2,5: Doença bilateral leve com recuperação no “teste do empurrão”.

ESTÁGIO 3: Doença bilateral leve a moderada; alguma instabilidade postural; capacidade para viver independente.

ESTÁGIO 4: Incapacidade grave, ainda capaz de caminhar e permanecer de pé sem ajuda.

ESTÁGIO 5: Confinado à cama ou cadeira de rodas a não ser que receba ajuda.

Estágio em que se encontra o paciente: _____

ANEXO D

Normas de submissão do periódico *Gait and Posture*

GAIT & POSTURE

Official Journal of: Gait and Clinical Movement Analysis Society (GCMAS), European Society of Movement Analysis in Adults and Children (ESMAC), Società Italiana di Analisi del Movimento in Clinica (SIAMOC), and the International Society for Posture and Gait Research (ISPGR).

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ANEXO E

Parecer de aceite do Comitê de Ética em pesquisa – UFCSPA

Parecer Consubstanciado de Projeto de Pesquisa

Título do Projeto: Propriocepção cinético-postural na doença de Parkinson: influência do estado funcional e da levodopa

Pesquisador Responsável Carlos Roberto de Mello Rieder

Data da Versão 25/04/2012 | **Cadastro** 988/12 | **Data do Parecer** 16/05/2012

Grupo e Área Temática III - Projeto fora das áreas temáticas especiais

Objetivos do Projeto
Avaliar a propriocepção cinético-postural dos indivíduos com doença de Parkinson, avaliando o efeito da levodopa nessa situação.

Sumário do Projeto
Ensaio clínico controlado com análise quantitativa dos dados, para dissertação de mestrado.

Itens Metodológicos e Éticos	Situação
Título	Adequado
Autores	Adequados
Local de Origem na Instituição	Adequado
Projeto elaborado por patrocinador	Não
Aprovação no país de origem	Não necessita
Local de Realização	Própria instituição
Outras instituições envolvidas	Não
Condições para realização	Adequadas

Comentários sobre os itens de Identificação

Introdução	Adequada

Comentários sobre a Introdução

Objetivos	Adequados

Comentários sobre os Objetivos

Pacientes e Métodos	
Delineamento	Adequado
Tamanho de amostra	Total 56 Local
Cálculo do tamanho da amostra	Adequado
Participantes pertencentes a grupos especiais	Não
Seleção eqüitativa dos indivíduos participantes	Adequada
Critérios de inclusão e exclusão	Adequados
Relação risco- benefício	Não se aplica
Uso de placebo	Não utiliza
Período de suspensão de uso de drogas (wash out)	Nâo utiliza
Monitoramento da segurança e dados	Não necessário
Avaliação dos dados	Adequada - quantitativa
Privacidade e confidencialidade	Adequada
Termo de Consentimento	Adequado
Adequação às Normas e Diretrizes	Sim

Comentários sobre os itens de Pacientes e Métodos

Cronograma	Adequado
Data de início prevista	06/2012
Data de término prevista	08/2013
Orçamento	Adequado
Fonte de financiamento externa	Não

Comentários sobre o Cronograma e o Orçamento

Referências Bibliográficas	Comentário

Comentários sobre as Referências Bibliográficas

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Recomendação

Aprovar

Comentários Gerais sobre o Projeto

O projeto vai aprovado mas sendo muito recomendada a uniformização das referências.I