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CASE REPORT

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Influences of Neuromuscular Facilitation in the hamstrings and quadriceps muscles of Parkinsonian elderly.

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ABSTRACT

Introduction: Parkinson's disease (PD) is a type of neurodegenerative disease that affects between 4.1 and 4.6 million people in the 10 most populous nations of the world, worldwide approximately 7 million people are affected by PD, both affected with age or more than 50 years, this problem affects the independent subjects of sex and its most important pathological finding is the injury of the black substance, which is located in the basal ganglia **Objective:** to evaluate and quantify the effects of PNF technique on individuals Parkinsonian residents in Coari-AM city, being evaluated areas of strength and flexibility of the hamstrings and quadriceps muscles. **Methods:** five elderly diagnosed with PD and mean age 82.5 ± 10.33 were performed, anamnesis, screening and evaluation of the strength and flexibility of the quadriceps and hamstring muscles bilaterally. The treatment protocol consisted of 10 sessions, often at least 3 times a week and estimated treatment time 50 minutes. **Results:** It was observed that all the muscles tested positive at the beginning of treatment, for flexibility and power of them, however, after the application of any treatment, the quadriceps muscles did not show statistically significant improvement since the hamstring muscles presented significant improvements in both strength and flexibility, when analyzed belatedly. The results were adopted with significance values $p < 0.05$. **Conclusion:** The PNF technique was positive for the immediate gains of flexibility and strength, however, after 10 sessions program, the results showed little variation, there were no significant differences in the strength of the quadriceps after the treatment program.

Keywords: Parkinson's disease; Elderly; Physiotherapy; Muscle strength; Chronic diseases

INTRODUCTION

Parkinson's disease (PD) is a type of chronic neurodegenerative disease that affects[1-4] between 4.1 and 4.6 million people in the 10 most populous nations of the world, worldwide approximately 7 million people are affected by PD, both affected with aged[2,4] to 50 years or more, this problem affects individuals regardless of sex and its most important pathological finding is the injury of the black substance, which is located in the basal ganglia[1-3].

The patients have a progressive depression of dopaminergic neurons which are in the region of black substance, this results in reduced levels of dopamine in the basal ganglia generating instability in electrogenic engine performance circuits of that region[5,] another important finding is the induction of Lewy neurite by the formation of Lewy bodies in myelinated neurons in the midbrain, a phenomenon that prevents the smooth conduct of the action potential through the motor circuit, which is closely related to motor changes, in which PD patients exhibit[4-5].

Progressive clinical findings include: Tremor at rest, muscle stiffness, reduced strength, proprioceptive deficits, fatigue, deterioration of cardiovascular conditioning, sleep disturbances, bradykinesia, and major changes in the gait cycle, in more severe cases of this pathology is possible to observe cognitive and autonomic disturbances[2-3,6-7], as a result of engines and cardiorespiratory problems, the PD patients commonly are sedentary and have very high risk of developing depression[2-7].

There are therapies that reduce the clinical signs of PD, such treatments influencing positively in the functional deficits of the Parkinsonian patient[2-3,6]. One of the treatments is the pharmacological, which comprises administering drugs which reduce the activity of the enzyme monoamine oxidase (L-Deprenyl), or added dopamine exogenously by administration of the dihydroxyphenylalanine levorotatory isomer, L-Dopa[2,8]. As the non-pharmacological treatments, the treatment is mainly based on patient motion induction, in which the patient receives the proprioceptive stimulation needed for the reestablishment of the functionality of the body kinetic[2,4,9-10].

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Some studies with electrical stimulation of the central nervous system have shown some positive results, attempt electrical neurostimulation presents promising, however, still presents conflicting results and they need more scientific confirmations[3,7].

Treatments based on cinesioterapia have been quite explored and clearly demonstrated in the scientific community, the basis for this type of treatment is to keep the motor qualities still preserved in the patients, assuming as progression the search of neurofunctional adaptations to the reacquisition of lost musculoskeletal functions[2,4,6,9].

Studies with manual therapy have been developed to observe its possible positive effects to improve the clinical state of patients with PD, including the use of the Proprioceptive Neuromuscular Facilitation (PNF) technique, which has shown optimistic results for the treatment of motor disorders of DP, positive progressions are suggested in the continuous treatment of the patient, since it receives a very high load of proprioceptive stimuli which added up, causing the patient to have a neurofunctional and musculoskeletal readaptation due to the execution of a series of functional diagonals that the technique has[10-11].

The present study aims to evaluate and quantify the effects of the PNF technique on Parkinsonian individuals living in Coari-AM, evaluating domains such as strength and flexibility of the hamstring and quadriceps muscles, as can be seen in Annexes I and II..

METHOD

Sample Characterization

The sample consisted of 10 patients with Parkinson's disease aged 50 or older of both genders, however, only 5 presented a closed medical diagnosis for the disease. The attending were performed at the outpatient clinic of Physiotherapy of ISB-UFAM.

The patients were submitted to a screening interview that included anamnesis, physical examination and application of the inclusion and exclusion criteria, performed by a Physiotherapy student. From this, the subjects were informed of the nature of the study and invited to participate. The volunteers had to sign the Informed Consent Form at the time of their admission, authorizing the publication of the results obtained (Figure 1).

The flexibility assessment was performed by a collaborator student, the method[12-13] was applied to the lower limbs through the analog fleximeter $_{TM}$ device patent ICP nºREG. UM.8320-3RJ, the assessment procedure was to maintain the patient in dorsal decubitus on litter, being executed passive hip flexion with knee extension (hamstrings muscles), then it was placed in ventral recumbence, being executed passively the hip extension with semiflexion of the ipsilateral knee (quadriceps muscles).

For the evaluation of muscle strength, it was used the analog dynamometer unit AR 200 Cronw® and leg extensor chair for the lower limbs[13-14]. The evaluation procedure consisted in maintaining the patient in a sitting position in the leg extensor chair and a soft and light ankle band was attached to his ankle and attached to a cable, in which, it was attached to the dynamometer, then the patient actively performed the knee flexion movement for strength analysis of the hamstrings and extension of the knees to analyze the strength of the femoral quadriceps muscles.

Evaluations were performed one day before the first session in all patients, with the purpose of they were not overwhelmed for the beginning of the treatment. The PNF exercise protocol was applied during 10 sessions, three times a week, on alternate days, during approximately 70 minutes. It was consisted by: (Figure 2)

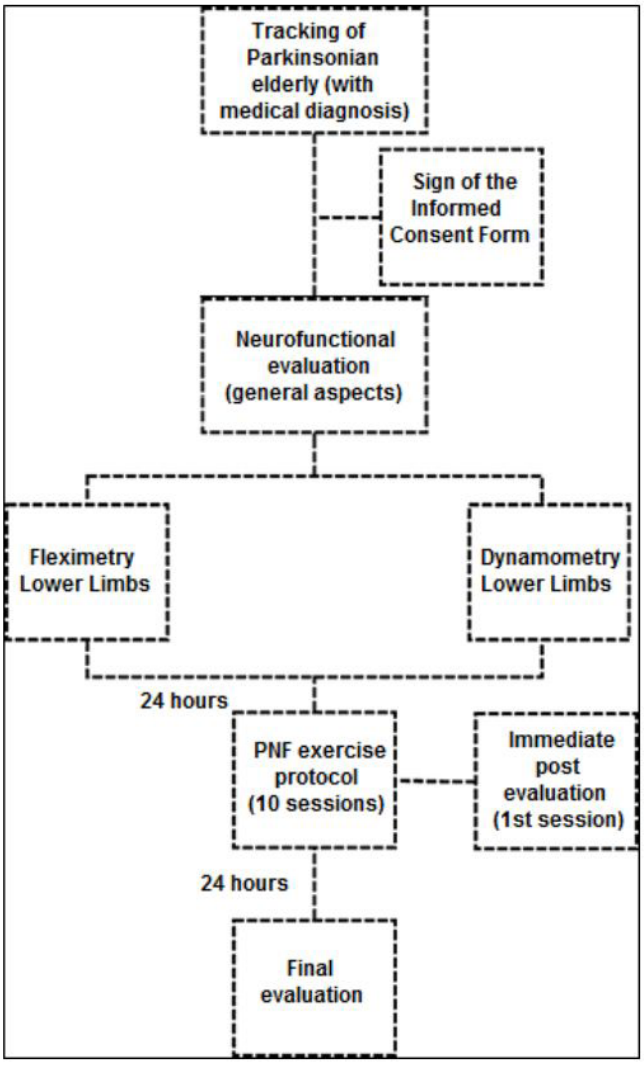

Figure 1: Organization chart of the methodological procedures performed in the research.

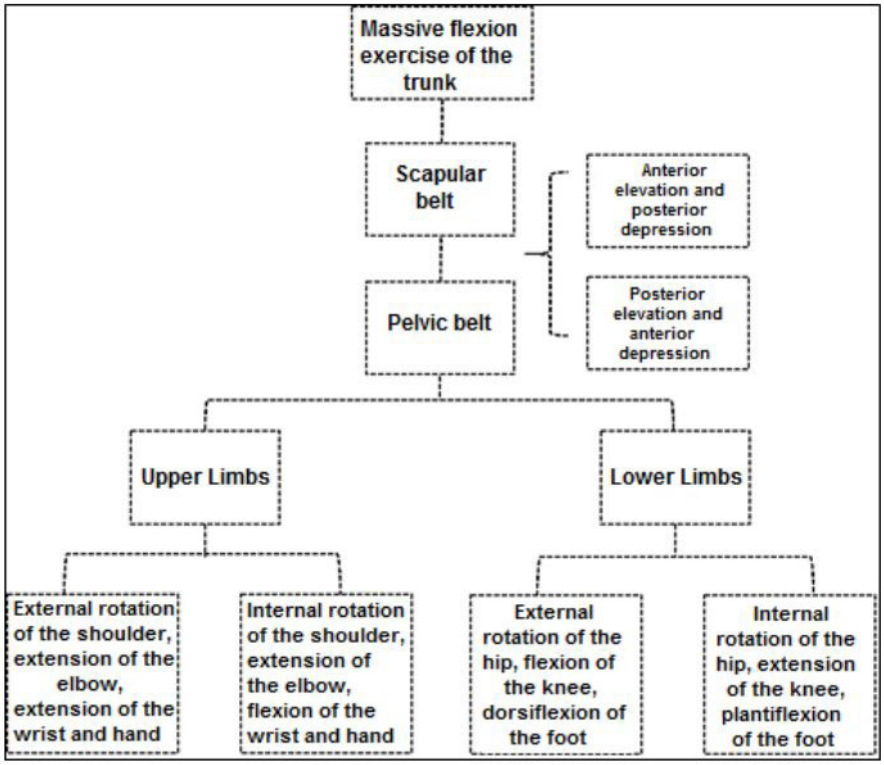

Figure 2. Flowchart of the treatment protocol followed in the study. NOTE: Treatment was initiated by the rhythmic initiation technique with progression to the antagonist reversal technique.

Ethical aspects

The study was carried out obeying the Guidelines and Norms Regulating Human Involvement Research (Resolution 196/1996, National Health Council), it was submitted to the Human Research Ethics Committee of the Federal University of Amazonas (UFAM), being approved with the CAAE opinion: 12641813.4.0000.5020.

Statistical analysis

The descriptive appreciation of the data was expressed as mean ± standard deviation. Initially, the analysis of the normality of the data was performed using the *Kolmogorov-Smirnov* test, followed by the application of the t test and Wilcoxon test for nonparametric paired data, through the GraphPad Prism© software version 5.0 trial version for Microsoft Windows 7. The values were accepted with a significance level of $p<0.05$ to $p<0.01$.

RESULTS

The individuals participating in the study had a mean age of 82.5±10.33 years, all older than 2 years of PD diagnosis, the Annexes I presents the results collected for the strength of the hamstring and quadriceps muscles bilaterally, in the phases, before the beginning of the treatment, after the first session based on PNF and after the treatment program.

In figure 3 it is possible to observe that only the strength of the hamstring muscles presented statistically significant differences ($p<0.05$ and $p<0.01$) at the end of the treatment program, when compared with the initial strength of the same musculature. It is also possible to observe that the hamstring muscles in relation to the quadriceps muscles, initially presented with a lower level of strength (6.53±3.67 - 5.87±3.55kgF Hamstrings, 12.53±5.57 - 10.60±5.49kgF Quadriceps), this characteristic is confirmed when we compare the differences between the groups when we also analyzed the flexibility of the muscles, which present with a level of flexibility greater than the level of flexibility of the quadriceps, which results are demonstrated in the figure 4.

Figure 4 shows the results obtained in the assessment of the flexibility of the muscular groups bilaterally, during the three phases of patient evaluation, it was accepted only the results with statistical difference with significance value $p<0.05$. It's shown that the quadriceps muscles had a greater stiffness than the hamstrings (28,80 °±24,02 - 28,40°±21,51 quadriceps, 63,14°±34,57 - 65.73°±21.77).

Figure 4 shows that the hamstrings D showed little statistical improvement when compared to the other groups, this difference may have been due to the high compensation of the movement that these muscles performed, it was possible to observe that the elderly did not flex satisfactorily the right knees during the walk and trailing most this side of the lower limb, even after the treatment sessions.

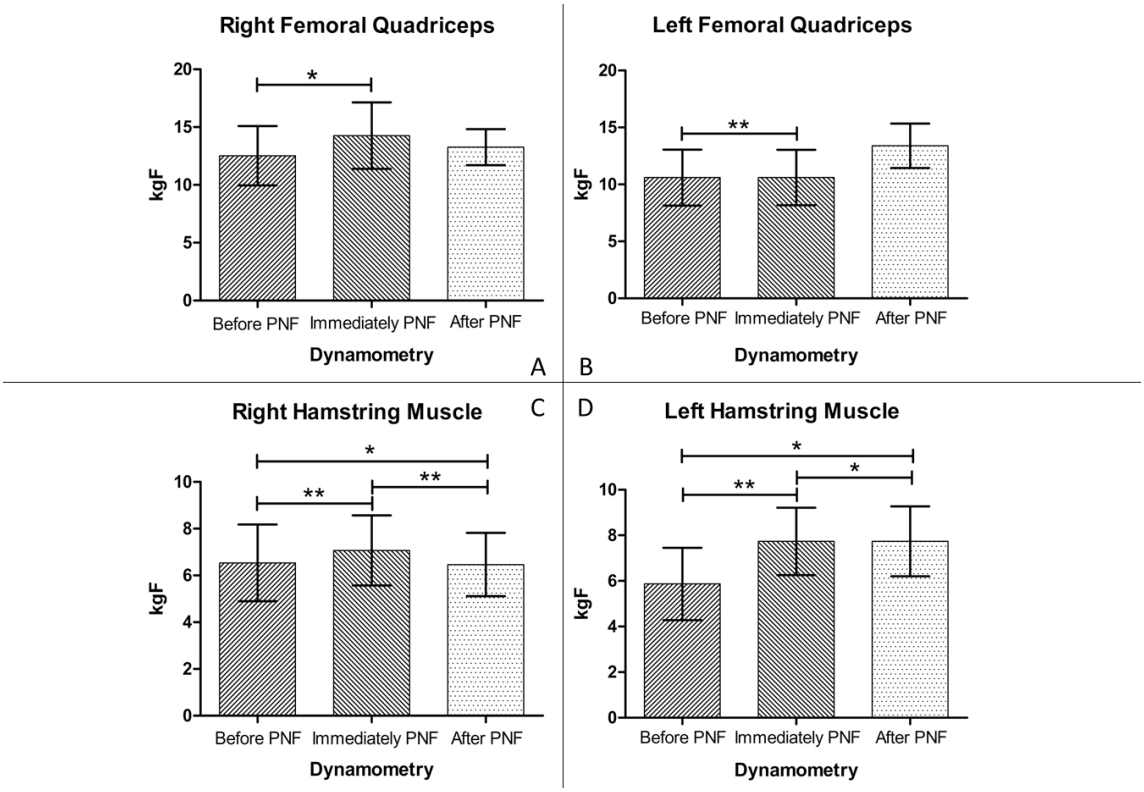

Figure 3 - Dynamometry of the muscles evaluated in the three phases of the treatment program, data were expressed as mean and standard deviation. Legend: *=p<0.05; **=p<0.01; PNF = Proprioceptive Neuromuscular Facilitation; kgF = kilogram force; R = right; L = left.

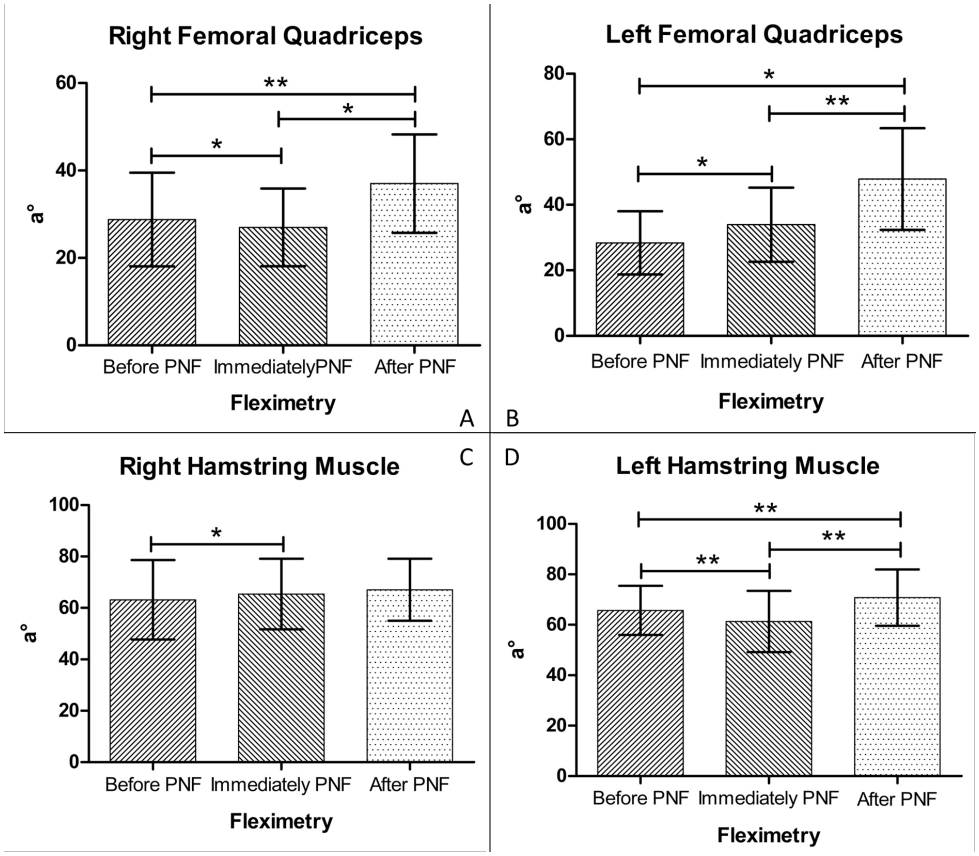

Figure 4 - Fleximetry of the muscles evaluated in the three phases of the treatment program, data were expressed as mean and standard deviation. Legend: *=p<0.05; **=p<0.01; PNF=Proprioceptive Neuromuscular Facilitation; a°=degrees of radians.

DISCUSSION

The effects of PNF in patients with PD have been studied and evaluated mainly in the final phase of treatment, and it is possible to observe that PNF is able to improve the PD patients response at the end of treatment, obtaining the same functional gains, Santos et al. (2012) observed that after the submission of a PNF-based treatment program, elderly parkinsonians presented a good response to the program, obtaining beneficial variations in the kinetic-functional characteristics in which they presented before the treatment program.

In this study, we observed more significant immediate results, suggesting a greater efficacy in the acquisition of strength and immediate flexibility of the worked musculature, obtaining the same response as analyzed by Mortari et al. (2009) who, when evaluating patients from different groups, observed that both groups presented an increase in strength in the thigh muscles after a session of PNF application.

Nogueira et al. (2009) observed that the effects of PNF were not satisfactory for the study thereupon the first application session in healthy individuals, however, the current study observed results contrary to the author, observing a greater influence of PNF at the beginning of the treatment, nevertheless, the results may be taken into consideration independently for each study, due to the different characteristics of the treated groups, and it is possible to speculate that in PD groups the PNF may be beneficial to prevent damage to the current situation of the patient, possibly avoiding the evolution of the pathology.

In the study carried out by Carvalho et al. (2015), there were optimistic results regarding the positive effects of PNF on the functional independence level of parkinsonian elderly, and these possible effects were attributed to the treatment program. The current study also found optimistic results for patients with PD at the end of a PNF-based treatment program, although the results were statistically accentuated in the immediate results of the addition of the PNF-based treatment program.

Other studies show positive chronic results of PNF in other clinical cases of neuromuscular disease or induced physical performance states[15-19], comprehending people beyond PD patients. Noting the suggested efficacy of the technique in the positive acute adaptations of the treatment program on the neuromuscular complex.

Because it is a neurological problem with strong functional repercussions[2,4-6,11,21], it is important to functional stimulation constantly, neuromuscular problems can be reversed when the muscle function is required and mechanically, many authors were able to observe the positive results when the PD patients were encouraged to perform some functional activity, including information collected on improving the quality of life of individuals[6,9-10,20].

In the review by Sharp and Hewitt (2014) it was observed that the functional movements of the dance have significant effects to improve the functional status of the PD patient, Dreu et al. (2014) argued in their work that there was a great deal of literary divergence regarding the possible beneficial effects of music and dance on the motor control of PD patients.

In theory, the stimulation of functional movements and muscle training may be effective for improving parkinsonian muscle control, Lima & Rodrigues de Paula et al. (2012), present the muscular training as a good therapeutic acquisition to manage the muscular disorders that the PD entails for the individual, which could be observed in the current study.

Despite the results obtained for strength, they present a chronic adaptation not very important for the quadriceps muscles, and a positive adaptation in the quality of the strength of this musculature could be noticed, although it does not have statistical significance (Figure 3), this difficulty of adaptation of the musculature may be related to the hugely exacerbated muscular rigidity of this musculature when compared to the stiffness of the hamstring muscles (Figure 4).

However, Santos et al. (2012) and Carvalho et al. (2015) show optimistic results which suggest a positive influence of the technique on the elderly functionality which can be related to control of improved muscle function, which ends degraded as the disease progress[4,8].

The difficulty in adapting and improving muscle strength of patients is also related to the characteristics of the disease itself, given that individuals end up reducing the endurance of the muscles and physical ability as well as its rapid contraction capacity when required[2,20-21], and the PNF itself has its restrictions on the adaptation and muscular power improvement of the individuals, being important for the improvement of the functional status of patient, as suggested by Santos et al. (2012), Lacerda et al. (2013) and Carvalho et al. (2015) is not necessarily important to the increase in muscular power[20].

CONCLUSION

The present study demonstrated that after the submission of a treatment protocol based on PNF, individuals with PD present effective results in improving the strength and flexibility of the quadriceps and hamstring muscle groups, especially at the beginning of treatment, happening a possible late adjustment in muscle control at the end of the treatment program.

AUTHOR'S CONTRIBUTION

ELC: participated in all stages of the article; KLTC: participated in the collection of data; IPQ: participated in the collection of data; FSSC: participated in the collection of data; TSM: participated coordinating the stages of work, statistical analysis, interpretation of results and writing of the article; FZSA: participated in the methodological planning of the article.

CONFLICTS OF INTEREST

I inform that this article does not present any conflicts of interest.

AUTHOR DETAILS

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Annex I – Data collection of the Fleximetry.

Volunteer: nº:

Date:

FLEXIMETRY				
Pre				
Evaluation	**Quadriceps L**	**Hamstrings L**	**Quadriceps R**	**Hamstrings R**
1°				
2°				
3°				
Immediate Post				
1°				
2°				
3°				
Late Post				
1°				
2°				
3°				

Annex II - Data collection of the Dynamometry.

Volunteer: nº:

Date:

Dynamomety				
Pre				
Evaluation	**Quadriceps L**	**Hamstrings L**	**Quadriceps R**	**Hamstrings R**
1°				
2°				
3°				
Immediate Post				
Evaluation	**Quadriceps L**	**Hamstrings L**	**Quadriceps R**	**Hamstrings R**
1°				
2°				
3°				
Late Post				
Evaluation	**Quadriceps L**	**Hamstrings L**	**Quadriceps R**	**Hamstrings R**
1°				
2°				
3°				