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Research Article

Does conjunctive tissue massage increase range of movement in parkinsonian rigidity?

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HIGHLIGHTS
- The effects of connective tissue massage on hypertonic muscles are not yet known.
- A connective tissue massage session did not increase range of motion in older people.
- Cervical rotation was reduced in people with Parkinson's disease after massage.

ABBREVIATIONS

CG	neurologically healthy older people
CTM	Connective tissue massage
M1	before
M2	immediately after
M3	one hour after
PD	Parkinson's disease
PDG	people with PD
ROM	range of motion

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BACKGROUND: Plastic hypertonia (rigidity), presented by individuals with Parkinson's disease (PD), leads to reduced range of motion (ROM), impairing daily activities and balance reactions. Connective tissue massage (CTM) promotes increased ROM in normotonic muscles, however its effects on hypertonic muscles are not yet known.
AIM: To verify the immediate and acute (1 hour after) effects of CTM on cervical ROM in individuals with PD.
METHOD: Cervical ROM during anterior flexion, extension, lateral flexion, and rotation was evaluated using a fleximeter at three moments: before (M1), immediately after (M2), and one hour after (M3) CTM in 14 older people with PD (PDG) and 13 neurologically healthy older people (CG).
RESULTS: The CG presented a higher ROM than the PDG for the cervical rotation movement. In addition, there was interaction between group*intervention time. The cervical rotation movement was higher for the CG than PDG at M2 and M3. On the other hand, there was no main effect of intervention time.
CONCLUSION: It was concluded that a single session of CTM was not sufficient to promote an increase in ROM in either normotonic or hypertonic muscles in older people, but the higher ROM for cervical rotation in the CG versus PDG was evident after CTM.

KEYWORDS: Muscle Hypertonia | Parkinson's Disease | Musculoskeletal Manipulations | Range of motion | Motor control

INTRODUCTION

Parkinson's disease (PD) is a chronic and progressive central nervous system disease. PD results from the death of dopaminergic neurons in the compact part of the substantia nigra, which damages the motor circuit of the base nuclei and its communication with the cerebral cortex[1]. The classical signs and symptoms of the disease, such as rigidity, bradykinesia, tremor, and postural instability emerge when approximately 50% to 75% of these cells have already been lost[1]. Among these symptoms, rigidity, defined as increased resistance to the passive movement of a joint independent of direction and velocity of movement[2], is considered a principal symptom of PD, affecting 78.2% of cases[3].

Parkinsonian rigidity is characterized by a continuous and uniform increase in muscle tone, which causes constant resistance throughout passive movement[4]. Parkinsonian rigidity progresses faster than other motor signs in PD[2] and generally responds well to dopaminergic medication and surgical intervention[2,5]. Muscle rigidity is constant, independent of the task and amplitude or speed at which the limb is moved and is usually asymmetrical in the early stages of PD, primarily affecting the proximal muscles, especially the trunk, shoulders, and neck and progressing to the muscles of the face and limbs[1,6]. Although the causes of neuromotor muscle rigidity have not yet been fully elucidated, it has been attributed to increased simultaneous contraction of muscle pairs of agonists and antagonists, or co-contraction[7]. People with PD present a significant increase in co-contraction of antagonistic muscle pairs compared to their neurologically healthy peers[8]. In addition, rigidity is attributed to both exaggerated neural reflex and altered muscle mechanical properties[2]. With disease progression, rigidity becomes more severe and decreases the ability to move and range of motion (ROM), which causes secondary complications, such as contractures, and may contribute to abnormal axial postures such as anterocollis and scoliosis[6].

Although rigidity is responsive to drug[9,10] and surgical[11] treatments, it is possible that morphological alterations in the muscles that occur in elastic hypertonia[12] also occur in plastic hypertonia, which limits the effects of these therapeutic forms over time. Physical therapy is used as an adjunct treatment to the medications used in PD and is intended to improve and maintain the ease and safety of performing activities of daily living and prevent secondary complications[13]. Massage is one of the most commonly used forms of alternative therapies for PD[14]; however, it remains one of the least studied practices. Manual therapy, which for some authors also involves the techniques of myofascial release and massage of connective tissue, has been used as a way to treat pain and increase ROM in several pathological conditions, particularly those of musculoskeletal origin[14]. However, the effects of the technique on muscles with tonus changes have not yet been established.

The purpose of this study was to investigate the immediate and acute effects of connective tissue massage (CTM) on cervical ROM in older people with PD and neurologically healthy individuals. We hypothesized that both muscles with plastic hypertonia and without tone changes would be responsive to CTM techniques, increasing the ROM. In addition, we expected that cervical ROM would be higher in neurologically healthy older individuals compared to older people with PD, especially after CTM.

METHODS

Participants

Twenty-seven volunteers (14 people with PD and 13 neurologically healthy individuals) ranging in age from 52 to 89 years were recruited from the local community. Participants were excluded if they exhibited musculoskeletal conditions that contraindicated the performance of massage, such as a history of neck trauma, herniated disk, cervical protrusion, or solution of skin continuity. In addition, individuals presenting other neurological diseases associated with PD or the presence of dyskinesias, making it difficult to register the ROM using the fleximeter, were excluded. The people with PD (PDG) were recruited from the Ativa Parkinson Project (São Paulo State University - UNESP), which is a university community project that provides systematic multimodal physical activity twice a week for people with PD. All participants of the PDG were required to present a minimum rigidity of 1 in item 22 of the UPDRS III (motor), which allowed comparison of the effect in muscles with and without hypertonia (PDG and CG respectively).

Experimental procedures

All subjects completed the same tests before and after the CTM. For descriptive purposes, demographic and clinical characterization data were collected: age and sex in both groups; severity of motor symptoms, stage and time of disease, in PDG. Participants in the PDG were evaluated at the time "*on*", that is, approximately one hour after the ingestion of antiparkinson medication. The study was approved by the local Human Research Ethics Committee (#1.691.221), and all participants signed an informed consent form before joining the experiments.

Cervical ROM evaluations were performed at three moments: before (M1), immediately after (M2), and one hour after (M3) the CTM by different examiners at M1 (pre-intervention) and M2/M3 (post-intervention). Cervical ROM was evaluated one-hour after the CTM to analyze the long-lasting (follow-up) effect of the CTM techniques. As a means of avoiding influence, the M2/M3 evaluator did not have access to the M1 measurements. Both examiners underwent previous training to standardize the positioning of the equipment for each movement and use the same command voice. In addition, the evaluators alternated the participants with whom they performed the M1 evaluation and M2/M3 evaluations.

Outcome measure

A fleximeter was used to measure the active range of motion of the cervical spine. The fleximeter was placed on the participant's head, as shown in Figure 1. The subject was seated comfortably on a chair (Figures 1A and 1B) or lying in a dorsal decubitus position on a stretcher (Figure 1C). The instruction given to participants was to move his/her head as far as possible in each movement. In order to assess ROM, the mobile pointer on the fleximeter started in the neutral position where the zero degree coincides with 360°, and the position of the instrument was parallel to the joint, with the zero facing upwards. The participant then performed a slow movement, maintaining the position for three seconds to measure the ROM, according to the user manual[15]. Three measures were performed for each movement, at the three moments of evaluation, and the average of the three measures at each moment was calculated[15]. The measurements were performed in three planes of movement, flexion-extension (sagittal plane), lateral flexion (frontal plane), and rotation (horizontal plane) on the most affected/non-dominant side (identified from items 23 to 25 of the UPDRS). Fleximetry has shown high reliability to assess cervical ROM, with levels of intrarater ICC values from 0.69 to 0.80 and interrater ICC values from 0.66 to 0.88[16].

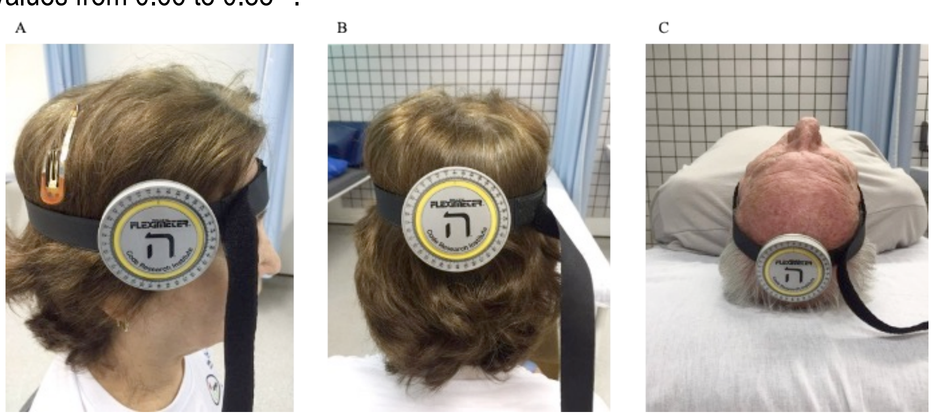

Figure 1. Fleximeter in neutral position with the patient seated to perform anterior flexion and extension (A), lateral flexion (B) and in dorsal decubitus position to perform the rotational movements (C).

Connective tissue massage

The CTM techniques were always applied by the same researcher. All individuals in the CG and PDG received the techniques in a single session of approximately twenty minutes. The massage was performed initially with the patient lying supine, upper limbs placed at their side, and later in the sitting position, with the spine erect and lower limbs well supported. The following techniques were part of the intervention protocol:

- Classic therapeutic: superficial and deep gliding, kneading, friction, and compression (Figure 2).

- Myofascial release: tissue compression was performed with sufficient force to wrap the lining layer of the deep fascia (or more deeply), and then a mild to moderate horizontal traction or drag in opposite directions was exerted. This movement lengthens the tissues between the hands in a direction parallel to the line of muscle fibers[17].

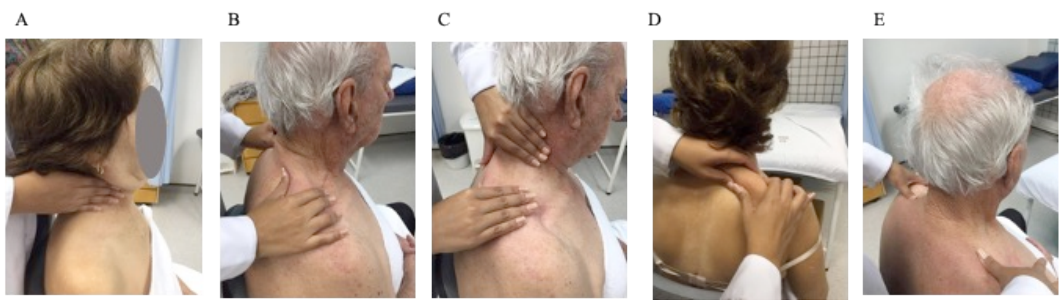

Figure 2. Classic techniques of connective tissue massage: superficial (A) and deep gliding (B), kneading (C), compression (D), and friction (E).

Statistical analysis

The significance level was set at 0.05 for all analyzes and SPSS 18.0 (SPSS, Inc.) was used for statistical analysis. The Shapiro-Wilk and Levene's tests were employed to check the normal distribution of data and homogeneity of variances, respectively. The average of the cervical ROM in anterior flexion, extension, lateral flexion, and rotation at M1, M2, and M3 was calculated. The cervical ROM and intervention time (M1, M2, or M3) were analyzed by two-way ANOVA with repeated measures for intervention time.

RESULTS

Characteristics of the participants

Data regarding the age, sex, side considered for evaluation (non-dominant/most affected) of both groups, and clinical characteristics of the PDG are presented in Table 1. No significant differences between groups were observed for age (p>0.05).

Table 1 –Demographic and clinical variables.

	CG (n=13)		PD (n=14)	
Demographic characteristics				
Sample (n)	Men 7	Women 6	Men 7	Women 7
Age (years)	72±9		68±7	
Non-dominant/Most-affected side (n)	Right 2	Left 12	Right 3	Left 11
Clinical characteristics				
UPDRS motor score (pts)	----		28.35±13.6	
Rigidity (pts)	----		2 (1 – 3)	
H&Y (stage)	----		2 (2 – 4)	
Duration of disease (years)	----		6.64±3.3	

Cervical range of motion

The values of the four cervical movements performed by the CG and PDG at M1, M2, and M3 are shown in Figure 3. The ANOVA indicated a group main effect, in which the CG presented a higher ROM than the PDG for the cervical rotation movement ($F_{(1,25)}$= 5.235, p = 0.03). In addition, there was an interaction between group*intervention time. The cervical rotation movement was higher for the CG than PDG at M2 and M3 ($F_{(1,25)}$=4.320; p=0.04 and $F_{(1,25)}$=5.815; p=0.02, respectively). On the other hand, there was no main effect of intervention time (p> 0.05).

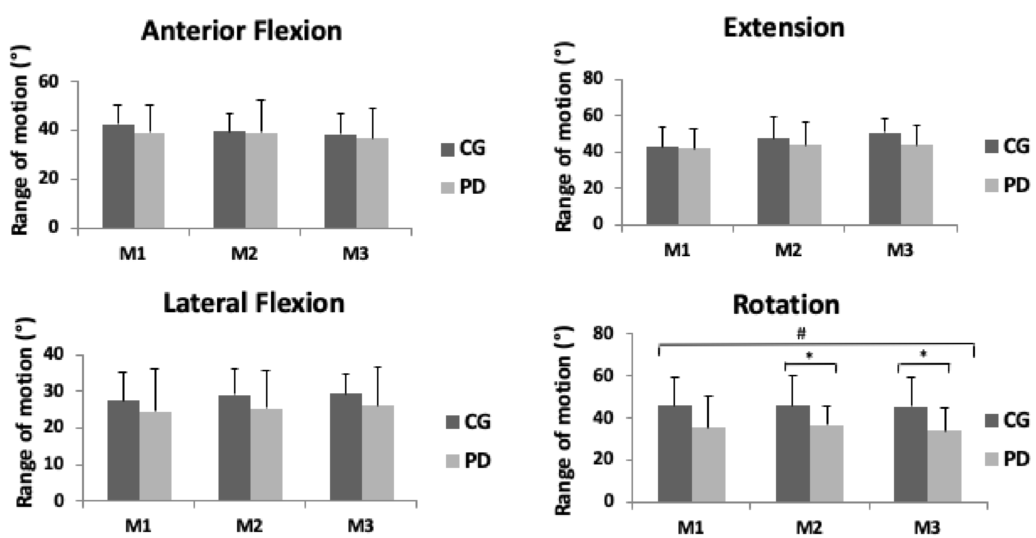

Figure 3. Means and standard deviation of cervical range of motion (degrees) of control group (CG) and Parkinson's disease group (PD) at the intervention moments (M1, M2, and M3). # main effect of group. * interaction of group and intervention time.

DISCUSSION

The purpose of this study was to compare the immediate and acute effects of CTM on cervical ROM between older people with PD (PDG) and neurologically healthy older individuals (CG). The main finding of this study was that CTM had no effect on cervical ROM in either participant group, which was contradictory to our hypothesis. However, although neither of the two groups presented increased ROM at M2 or M3, for all movements analyzed after CTM, the difference in ROM of cervical rotation between the CG and PDG was significant after the massage, which partially confirmed our hypothesis. Therefore, it is possible to state that the CTM presented a positive immediate response for neurologically healthy individuals (albeit a discrete effect). Each of these findings will be discussed below.

CTM presented no effects on cervical ROM (immediate or acute). This finding could be explained by the intervention time, which may not have been sufficient for significant results after CTM. An immediate effect was more expected after CTM than an acute effect. As an immediate effect was not observed, no effect was expected after one-hour (acute effect) either. The literature is not clear about the time of CTM, which is variable in studies[18]. Immediate positive results with a single session have been observed in previous studies[19], however the subjects of these studies did not present neuromotor alterations. Results from one study[20] using EMG found that the evoked stretch response in rigid limbs decreased significantly 1 and 11 minutes after Trager therapy. After a single 40-minute massage session involving upper and lower limb exercises in outpatients with PD, visual analogue scale scores were significantly lower for muscle rigidity, movement difficulties, pain, and fatigue, added to improvement in qualitative aspects of gait[21]. In the same study[21], after a longer period of treatment (seven weeks), increased flexion and abduction of the shoulder were also observed. In addition, other researchers[22] used a longer period of intervention (ranging from 4 to 8 weeks, 1 or 2 times a week) to observe positive effects on distinct motor and non-motor aspects of PD using various massage techniques. Thus, it can be seen that the intervention time used in studies for this type of intervention is quite variable, as well as the therapeutic and evaluation protocols used, making comparisons and consistent conclusions difficult.

Another possible explanation for the lack of effects on cervical ROM is the age of the participants. Previous studies have demonstrated that passive viscoelastic properties are increased in older people[23], which could require a longer intervention time or the association of other techniques to increase ROM. In addition, older people with neuromotor alterations, specifically rigidity, may be less responsive to CTM. This is justified as; besides the typical morphological alterations of connective tissue caused by aging, the intrinsic component of rigidity includes viscoelastic (i.e., mechanical) properties of muscle fibers and passive connective tissues[2] and increased rigidity is associated with increased values of viscoelastic stiffness[24].

Finally, a difference was observed only in the cervical rotation movement. Rotation movements are reduced in PD[25], resulting in movements that are basically uniplanar (in one plane of movement)[6]. While the values obtained for this movement in the CG are within the normal values expected for healthy individuals, they are reduced in PDG. One of the main features of PD that justifies such a finding is its asymmetrical impairment[9], including with regard to the installation of rigidity in the proximal muscles from the earliest stages of the disease[9].

This study presents some limitations, such as the reduced number of individuals, which did not allow segmentation according to degree of stiffness and/or disease stage (unilateral or bilateral impairment of motor symptoms). It is suggested that further studies be performed with a larger number of subjects, manipulating variables such as degree of stiffness and disease stage and comparing the effects of a single session with a care protocol. In addition, the physical activity level and cognitive function were not measured in this study. Physical activity seems to bring benefits to flexibility and ROM[26], mainly for rigidity in PD. However, although rigidity patients are more likely to show decreased cognitive functions, rigidity is not associated with cognitive assessment[27]. Even though the effects of these aspects may not affect the effects of massage therapy, they should be measured to avoid random effects in the therapy.

CONCLUSION

We can conclude that a single CTM session was not sufficient to promote an increase in ROM in either normotonic muscles in older neurologically healthy individuals or hypertonic muscles in older people with PD; however, higher ROM for cervical rotation was evidenced after CTM in the CG versus PDG.

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