Baseline Range of Motion of the Lower Limb in Parkinsonian Gait is Consistent Among Treatment and Control Groups*

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INTRODUCTION

Parkinson's Disease (PD) is the second most common neurodegenerative disorder and significantly affects motor function. Individuals with PD experience bradykinesia, freezing, rigidity, and a decreased range of motion which has been associated with an increased risk of injury due to falls [1] [2]. This project will examine the efficacy of osteopathic manipulative treatment (OMT) and the addition of osteopathic cranial manipulative medicine (OCMM) in improving parkinsonian gait by increasing range of motion in the lower limb. With the addition of an OMT protocol incorporating OCMM techniques, we hope to examine the effects of treating the elevated frequency of cranial strain patterns seen in individuals with PD compared to a control group [3].

The purpose of this study was to:

1. **Serve as a preliminary analysis and comparison of baseline joint range of motion (ROM) across experimental PD groups**
2. **Compare pre-treatment and post-treatment joint range of motion within each experimental group**

METHODS

Participants

Participants were randomly assigned to receive one of three experimental protocols, each lasting 25-30 minutes:

- **Neck-Down OMT (OMT-ND)** – Bilateral myofascial release, articulatory, muscle energy, and balanced ligamentous tension techniques on regions below the head
- **Whole-Body OMT (OMT-WB)** – OMT-ND + OCMM which included occipitoatlantal and sphenobasilar synchondrosis decompression, occipitomastoid suture V-spread, temporal bone balancing, and venous sinus drainage
- **Sham OMT** – examination of active and passive ROM

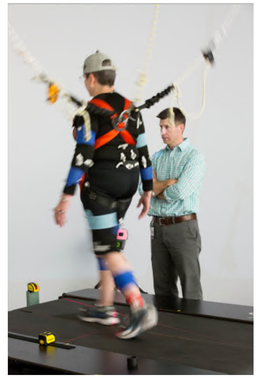
	OMT-ND (n = 9)	OMT-WB (n = 7)	Sham (n = 8)	p-value
Age (years)	70.7 ± 8.4	69.4 ± 7.8	65.0 ± 5.8	0.289
Height (cm)	167 ± 9.9	172 ± 11	174 ± 15	0.458
Mass (kg)	71.9 ± 13	78.6 ± 18	97.9 ± 21	0.246
Male/Female	2/7	4/3	7/1	---
Hoehn & Yahr	1.61 ± 0.7	2.07 ± 0.7	2.25 ± 0.7	0.613

All participants had neurologist-diagnosed idiopathic PD in Hoehn & Yahr stages 1.0 - 3.0. Those who had received OMT or PT in the 30 days prior to data collection were excluded.

METHODS CONT.

Protocol

Participants were instrumented with 54 reflective markers to gather full-body mechanics before performing a 30-second walking trial on the V-Gait CAREN dual-belted treadmill (DIH Technology Inc., USA) before and after application of the randomly-assigned OMT protocol. An 18-camera motion analysis system captured three-dimensional position data at 120 Hz. Walking speed was set to represent participants' habitual pace.



Parameters

The following parameters were assessed:

- Sagittal Ankle ROM
- Sagittal Knee ROM
- Sagittal Hip ROM

ROM was defined as maximum flexion of the joint subtracted by maximum extension, or minimum flexion, during one full gait cycle from heel contact. The participant's self-identified dominant limb used for calculation of ROM.

Data Processing

Visual3D (C-Motion, Germantown, MD) was used to create a three-dimensional model from the motion capture position data and calculated joint angles through inverse dynamics. Sagittal joint angles were normalized to 100% of the gait cycle in MATLAB (The Mathworks Inc., USA). Twenty gait cycles of each participant were identified from the middle of the walking trial. Outliers due to poor marker placement and cross-over steps onto the adjacent force plate were excluded, and of the remaining gait cycles, the first five were used for analysis of ROM to overcome normal stride-to-stride variability [3].

Statistics

To determine the validity of randomization and to verify that pre-treatment experimental groups were not significantly different, pre-treatment ROM of the hip, knee, and ankle joints were compared using one-way ANOVAs. To examine the effect of the OMT protocols on lower limb ROM, pre- and post-treatment ROMs were compared using paired t-tests. One-way ANOVAs were used to compare demographic and clinical measures. Statistical analysis was performed in MATLAB.

REFERENCES

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RESULTS

Table 1. *Mean and standard deviation joint range of motion before and after OMT-ND, OMT-WB, or Sham OMT protocol*

	Joint	Mean ROM (degrees)		
		Pre-Treatment	Post-Treatment	p-value
OMT-ND	Hip	30.8 ± 4.5	33.4 ± 5.3	0.117
	Knee	52.0 ± 6.4	55.0 ± 8.1	0.018*
	Ankle	24.1 ± 4.7	25.4 ± 6.7	0.256
OMT-WB	Hip	29.2 ± 9.6	31.6 ± 8.1	0.114
	Knee	45.9 ± 8.5	49.0 ± 7.5	0.032*
	Ankle	20.3 ± 3.1	22.1 ± 4.5	0.134
Sham	Hip	33.4 ± 7.3	33.2 ± 8.8	0.757
	Knee	56.9 ± 8.3	59.2 ± 8.4	0.196
	Ankle	27.6 ± 6.8	26.6 ± 5.8	0.469

** $p < 0.05$*

- There were no statistically significant differences in baseline mean ROMs between groups at the hip ($F(2,24) = 1.2$, $p = 0.318$), knee ($F(2,24) = 2.38$, $p = 0.114$), or ankle ($F(2,24) = 2.82$, $p = 0.079$).
- Knee ROM increased after receiving the OMT-ND protocol ($p = 0.018$), and after receiving the OMT-WB protocol ($p = 0.032$).
- No significant differences were found in the ankle or hip ROM for OMT-ND and OMT-WB. No significant differences were found within the SHAM group

Individuals with PD often experience decreased ROM at the hip, knee, and ankle compared to healthy controls [5]. However, it is possible that knee suffers greater deficits due to PD as compared to the hip and ankle [6] and would benefit more from targeted treatment. This may be why a statistically significant increase in ROM was only found at the knee joint. Increasing sagittal knee ROM in individuals with PD may have important implications for decreasing potential fall risk by increasing step clearance during normal gait [5]. Lack of statistical differences within the SHAM group strengthens the internal validity of the OMT-ND and OMT-WB protocols by controlling for potential placebo effects such as observation, therapeutic ritual, and a supportive patient-practitioner relationship [7].

Future studies will utilize statistical parametric mapping, a type of waveform analysis, rather than discrete point analysis to examine the gait cycle before and after OMT in more detail.

CONCLUSIONS

The results suggest adequate randomization of participants into experimental groups, and an acute increase in knee joint range of motion following application of OMT and OMT in conjunction with OCMM.

1. Hip, knee, and ankle joint range of motion is not significantly different between randomized experimental groups in the pre-treatment condition.

2. Individuals with Parkinson's disease who received neck-down or whole-body OMT experienced a significant increase in knee joint range of motion.