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The Effect of Manual Therapy on Muscle Stiffness in Healthy Individuals

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Background

Dry needling (DN) is an intervention used to address impairments in neuromusculoskeletal function related to pain, stiffness, and loss of motion. DN incorporates a thin filiform needle which penetrates the skin and stimulates underlying myofascial trigger points, muscular, and connective tissues for the management of neuromusculoskeletal pain and movement impairments.[1]

Trigger points (TP) are exquisitely tender spots in discrete taut bands of hardened muscle that produce local and referred pain. These areas of intense focal sarcomere contraction[2] are often found in postural muscles;[3] creating pain, stiffness, and muscle dysfunction and interfering with activities such as walking.

DN is associated with decreased pain and improvements in flexibility, strength, and performance of activities (such as walking) in individuals with trigger points.[4] It's possible that DN modifies the mechanical properties of muscle; and thereby reduces pain and improves efficiency of muscle.[5,6]

Purpose

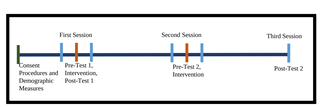
The purpose of this study was to evaluate the immediate and delayed changes in muscle stiffness (in a resting and contracted state) related to DN of the gastrocnemius compared to a sham DN condition. To further investigate this relationship, we investigated these changes at the site of the TP, as well as at a standard site (medial head of the gastrocnemius). We hypothesize that gastrocnemius DN reduces muscle stiffness in individuals with TP.

Methods

This RCT investigated the immediate and delayed impact of gastrocnemius DN or sham DN on muscle stiffness in a resting and contracted state. Stiffness was measured at the TP and standard site on the medial gastrocnemius.

- 1st visit: demographics were collected, participants completed initial measures, received randomly assigned intervention (DN or sham), and completed post-test measurements.
- 2nd visit (7-10 days later): participants completed a second post-test of the measures, received their second dose of their randomly assigned intervention (DN or sham), and completed post-test measurements.
- 3rd visit (7-10 days later): participants completed final post-test measurements.

Figure 1 (Right): Participant timeline. The x axis represents time, green bar represents consent process and collection of demographic data, blue bars represent performance of outcome measures, and orange bars represent receiving intervention.



Results

Figure 2 (Left): Photograph of dry needling intervention of a trigger point. Note the demarcation of the trigger point with a marker on the medial gastrocnemius.

54 individuals were recruited and randomized into either the DN or sham group. Baseline characteristics were similar between the two groups. No significant adverse events were reported.

A significant group by time interaction was found for resting muscle stiffness at the intervention site (TP) [13.9 N/m (95% CI: -12.1, 40), P=.03]; but not at the standard site (medial head of the gastrocnemius muscle). No other significant group by time interactions were found for any other outcome variables.

For the DN group, a significant decrease in resting muscle stiffness immediately after each DN session was found [-14.8 N/m (95% CI: -28.7, -.9), P=.04], [-21.1 N/m (95% CI: -36.0, -6.2), P<.01]. These changes were not maintained at the final visit [-14.6 N/m (95% CI: -27.2, -1.9), P=.03].

No differences between groups were found for muscle stiffness under the contracted condition.

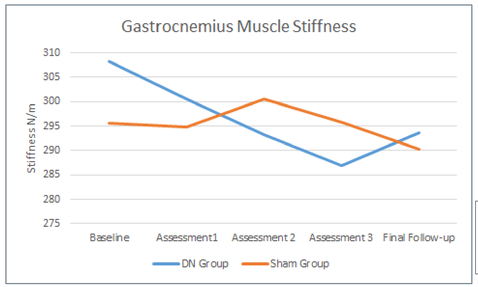
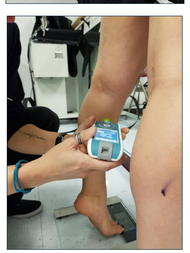


Figure 3 (Left): Post-Testing Trials for Resting Muscle Stiffness at the Trigger point. The x-axis represent post-test trial number, y-axis represents stiffness at the trigger point. The orange line represent changes between post-test trials for the participants receiving DN and the blue line represents changes between post-test trials for the sham group. Note the decrease in muscle stiffness for the DN group at post-test trial 2 and 3.

Table 1 (Left): Outcomes of Muscle Stiffness (MyotonPRO). Top values represent the control site (medial head of the gastrocnemius) in the resting state. Top/middle values represent the testing site (trigger point in the gastrocnemius) in resting state. Bottom/middle values represent the control site (medial head of the gastrocnemius) in a contracted state. Bottom values represent the testing site (trigger point in the gastrocnemius) in a contracted state. Note the significant decrease in resting muscle stiffness immediately after each DN session at the trigger point site.

Figure 4 (Below): Photographs of the measurement of resting muscle stiffness (top) and contracted muscle stiffness (bottom). Note demonstration of the myotome measuring the standard site.



Outcome	Visit	SHAM GROUP		DN GROUP		GROUP DIFF	
		Mean Score ± SD	Mean Change From Baseline (95% CI)	Mean Score ± SD	Mean Change From Baseline (95% CI)	Mean Difference Between Groups in Change From Baseline[a] (95% CI)	P Value
Medial Head: Resting Muscle Stiffness of Gastrocnemius (N/m)							
	Baseline (Day 1 Pre)	295.6 ± 57.7		308.2 ± 69.9			
	Assessment 1 (Day 1 Post)	294.9 ± 60.9	.7 (-5.8, 7.2)	300.6 ± 59.1	7.6 (-6.0, 21.2)	-5.7 (-38.4, 27.1)	0.73
	Assessment 2 (7-10 days pre)	300.5 ± 60.4	-4.9 (-14.9, 5.1)	293.3 ± 61.8	14.8 (.9, 28.7)*	7.1 (-26.2, 40.5)	0.67
	Assessment 3 (7-10 days post)	295.8 ± 66.2	-.2 (-12.2, 11.8)	287.0 ± 52.8	21.1 (6.2, 36.0)*	8.7 (-24.0, 41.4)	0.59
	Assessment 4 (2 Weeks)	290.2 ± 53.6	5.4 (-7.9, 18.7)	293.6 ± 64.6	14.6 (1.9, 27.2)*	-3.4 (-35.8, 29.1)	0.84
Trigger Point: Resting Muscle Stiffness of Gastrocnemius (N/m)							
	Baseline (Day 1 Pre)	281.4 ± 28.6		283.3 ± 52.9			
	Assessment 1 (Day 1 Post)	275.5 ± 51.8	5.9 (-6.4, 18.2)	276.7 ± 51.1	6.6 (-.8, 14.0)	-1.3 (-29.4, 26.9)	0.93
	Assessment 2 (7-10 days post)	290.5 ± 63.2	-9.1 (-29.6, 11.4)	270.4 ± 49.7	12.9 (1.4, 24.2)*	20.0 (-11.0, 51.1)	0.2
	Assessment 3 (7-10 days post)	282.6 ± 56.1	-1.2 (-18.8, 16.5)	268.0 ± 36.1	15.4 (3.9, 26.8)*	14.6 (-11.1, 40.4)	0.26
	Assessment 4 (2 Weeks)	276.3 ± 42.8	5.1 (-15.0, 25.2)	290.2 ± 52.2	-6.9 (-22.1, 8.3)	-13.9 (-40.0, 12.1)	0.29
Medial Head: Contracted Muscle Stiffness of Gastrocnemius (N/m)							
	Baseline (Day 1 Pre)	507.3 ± 208.2		479.1 ± 174.9			
	Assessment 1 (Day 1 Post)	504.6 ± 211.5	2.8 (-13.6, 19.1)	469.7 ± 173.5	9.4 (-16.8, 35.6)	34.9 (-70.8, 140.5)	0.51
	Assessment 2 (7-10 days post)	527.4.5 ± 237.2	-20.0 (-59.8, 19.7)	471.1 ± 166.1	8.0 (-31.0, 46.9)	56.3 (-55.6, 168.1)	0.32
	Assessment 3 (7-10 days post)	531.6 ± 233.6	-24.3 (-57.6, 9.1)	453.5 ± 156.0	25.6 (-19.6, 70.8)	78.1 (-30.4, 186.6)	0.16
	Assessment 4 (2 Weeks)	485.9 ± 207.4	21.4 (-23.4, 66.3)	451.8 ± 165.5	27.3 (-7.9, 62.5)	34.1 (-68.3, 136.6)	0.51
Trigger Point: Contracted Muscle Stiffness of Gastrocnemius (N/m)							
	Baseline (Day 1 Pre)	502.3 ± 189.5		465.1 ± 141.0			
	Assessment 1 (Day 1 Post)	493.9 ± 175.9	8.4 (-13.7, 30.5)	445.2 ± 146.6	20.0 (1.1, 38.8)*	48.7 (-39.7, 137.1)	0.27
	Assessment 2 (7-10 days post)	551.3 ± 228.3	-49.1 (-97.7, -.5)*	463.1 ± 130.8	2.0 (-34.7, 38.8)	88.2 (-13.4, 189.8)	0.09
	Assessment 3 (7-10 days post)	526.5 ± 215.2	-7.7 (-68.8, 53.4)	473.2 ± 118.5	-.1 (-51.7, 51.6)	53.3 (-41.5, 148.2)	0.26
	Assessment 4 (2 Weeks)	482.9 ± 179.9	19.4 (-28.6, 67.4)	463.0 ± 115.1	2.1 (-32.9, 37.2)	41.1 (-62.6, 102.4)	0.63

Discussion

These results suggest that the DN intervention is associated with a reduction in resting muscle stiffness when measured at an active trigger point compared to a sham condition. Further, this effect is limited to the site of intervention, and not to a standard location within the same muscle receiving the intervention.

The increase in resting muscle stiffness at assessment 4 (3rd visit) is interesting. It is possible that the overall neuromusculoskeletal system is responding to the multiple interventions and recalibrating to the changes in muscle stiffness.

Conclusion

Preliminary findings suggest that DN is associated with a reduction in resting muscle stiffness at the trigger point compared to a sham condition.

Further data collection (to a sample size of n=102) will further elucidate these findings.

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