The Effects of Therapeutic Exercise With and Without Mobilization in Participants With Chronic Ankle Instability: A Randomized Controlled Trial

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Context: Manual therapy (MT) is reported to increase range of motion (ROM), improve balance, and decrease pain in individuals with chronic ankle instability (CAI). Additional literature is needed to examine the effectiveness of the addition of MT to a therapeutic exercise regimen in individuals with CAI. **Objective:** To examine the combined effects of thrust joint manipulation (TJM) and exercise on function in participants reporting CAI. **Design:** Randomized controlled trial. **Setting:** Research laboratory. **Participants:** A convenience sample of 30 participants (mean age 23.7 [3.65] y; mean height 169.50 [9.50] cm; mean mass 66.48 [10.64] kg). **Intervention:** Participants were randomly allocated to the exercise (n = 15) or exercise + TJM group (n = 20) and completed an exercise program. The exercise + TJM group also received MT at the talocrural, proximal, and distal tibiofibular joints in the first 3 sessions. **Main Outcome Measures:** Self-reported outcomes were recorded at baseline and follow-up using the Foot and Ankle Ability Measure (FAAM), the FAAM-Sport (FAAM-S) subscale, and the Ankle Joint Functional Assessment Tool (AJFAT). The side-hop test, figure-of-8 hop test, 3 directions of the Star Excursion Balance Test, and dorsiflexion ROM were also assessed at baseline and follow-up. **Results:** Only the exercise + TJM group demonstrated an improvement in weight-bearing dorsiflexion with the knee flexed following treatment ($P = .02$). For all outcome measures, except ROM, subjects improved significantly at follow-up regardless of group assignment ($P \leq .01$). **Conclusions:** Our data suggest that rehabilitation of patients with CAI is related to improved ROM, function, and self-reported outcomes. This provides evidence that the addition of MT to exercise may enhance improvements in ROM as compared with exercise alone. Additional research is needed to identify optimal parameters to maximize therapeutic benefit.

Keywords: functional performance, discipline area(s), manual therapy, physical therapy, ankle sprain, rehabilitation

Ankle sprains are among the most common musculoskeletal injury in the general population^{1,2} and up to 70% of individuals who sustain an acute ankle sprain may develop chronic ankle instability (CAI).² CAI is a condition characterized by repetitive giving way of the ankle, diminished self-reported function, and persistent symptoms that may impede both mechanical and functional systems of the lower-extremity.³ It has been suggested that individuals who sustain an ankle sprain may develop residual physical disabilities that impact function from activities of daily living to sport-specific tasks.^{1,2,4} The economic burden of ankle sprains is estimated up to \$4 billion annually,⁴ and the sequelae of persistent disability suggests a public health concern.^{2,5} The complex sequela to CAI necessitates a multimodal, comprehensive treatment approach to address the many facets that lead to dysfunction in those with CAI.

Manual therapy directed at the ankle joint is an intervention that is part of a comprehensive treatment approach for those with CAI⁶⁻⁹ given that alterations in joint structure and function are likely to occur following an ankle sprain.¹⁰⁻¹² Authors have reported an anterior displacement of the talus¹⁰ and distal fibula,^{11,12} a posterior displacement of the proximal fibula,¹³ and a loss of dorsiflexion range of motion (DFROM) following an ankle sprain.¹⁴ Manual therapy directed at the ankle joint, including

mobilization and high-velocity low-amplitude (HVLA) thrust manipulation techniques, has been shown to improve DFROM, reduce pain, and improve dynamic balance in individuals with CAI.¹⁵

Although the exact mechanism of manual therapy is complex and remains uncertain, it is hypothesized that manual therapy may target a centrally mediated mechanism found in those with CAI.¹⁶ Literature demonstrates the use of manual therapy as a neurophysiological agent that may affect sensory-perceptual (eg, pain); motor-behavioral (eg, balance); and pathoanatomical impairments (eg, range of motion) in those with CAI.^{3,15} Described in a model by Bialosky et al,¹⁷ by acting as a mechanical stimulus at the peripheral nervous system, manual therapy may affect tissue and neuromuscular responses as well as pain modulation in an individual with CAI.

There is currently a lack of literature to support 1 type of manual therapy technique, nonthrust mobilization versus thrust joint manipulation (TJM), at the ankle joint to improve outcomes in those with CAI. However, manual therapy research of the spine suggests a greater effect is seen in outcomes related to pain and disability with the addition of TJM over other forms of manual therapy.^{18,19} A limited number of studies have explored the combination of manual therapy and exercise compared with exercise alone on outcomes in individuals with CAI,⁶⁻⁹ and even fewer that have explored the addition of TJM to an exercise regimen.⁷ Although these studies reported improvement in outcomes for those with CAI, there is lack of literature examining the effects of the addition of TJM to a therapeutic exercise regimen on functional performance.

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Therefore, the purpose of our study is to examine the effects of TJM directed at the talocrural joint and the proximal and distal tibiofibular joints in conjunction with an exercise program as compared with an exercise program alone on self-reported function, range of motion, and functional performance in those with CAI. We hypothesize that completing an exercise program in conjunction with TJM will optimize functional performance in those with CAI.

Methods

Study Design

This study was a single-blinded, randomized controlled trial (NCT03428620), which included individuals who reported CAI. Participants were recruited through a convenience sample from Shenandoah University and the surrounding community by recruitment flyers, email, and word of mouth. Participants were randomly assigned to either an exercise group ($n = 15$) or exercise + TJM group ($n = 20$). Both groups underwent 12 supervised exercise sessions across a 6-week period; the exercise + TJM group also received high-velocity low-amplitude (HVLA) thrust manipulations at the start of each of the first 3 sessions.²⁰

Randomization

Research coordinators at the university laboratory randomly assigned eligible participants into exercise or exercise + TJM groups by simple randomization. Following group assignment, a research coordinator then counterbalanced the order in which the 3 high-velocity, low-amplitude TJMs would be administered by utilizing a Latin square. This system of counterbalancing was administered for participants in the exercise + TJM group for each of the first 3 sessions. After randomization, neither the participant nor the research coordinators were blind to group allocation; however, the examiner performing baseline and follow-up testing remained blinded to group assignment.

Participants

A convenience sample of 30 (9 males and 21 females) participants (mean age 23.7 [3.65] y; mean height 169.50 [9.50] cm; mean mass 66.48 [10.64] kg) completed the study (Table 1). For inclusion, we utilized a modified version of the International Ankle Consortium selection criteria for patients with CAI.²¹ Participants were required to be between the ages of 16 and 35 years, with a self-reported history of an ankle sprain resulting in reports of “giving way” or a “loose” ankle within the past 6 months and/or a decrease in functional status, as compared with the uninvolved ankle. Participants were excluded from the study if they had any lower-extremity

injury within the past 3 months, a history of a lower-extremity fracture within 10 years, a history of vestibular dysfunction, self-reported neuromuscular diagnosis and/or mental illness, or if the participant was currently participating in another supervised rehabilitation program for the involved ankle. If the participant reported bilateral ankle sprains, the limb with the greatest self-reported dysfunction was used for analysis and treatment for both groups.²² This was verified using the Ankle Joint Functional Assessment Tool (AJFAT) in which the participants could not rate the “better ankle” as worse on any item of the AJFAT. The consort diagram is reflected in Figure 1. Before participation, all participants completed an informed consent form approved by Shenandoah University’s Institutional Review Board, and the rights of the participants were protected. This study’s estimated sample size was calculated using DFROM data from Cruz-Díaz et al.²³ We chose this outcome to be conservative, as it was the least responsive outcome measure. A sample size of $n = 12$ per group was formed with this data and equated to 80% power to detect differences in the means at the level of 0.05.

Procedure

Baseline data including functional-performance tests (figure-of-8 hop test, side-hop test, and the Star Excursion Balance Test [SEBT]); weight-bearing DFROM with the knee extended and with the knee flexed; and self-reported function (Foot and Ankle Disability Index [FAAM], FAAM-Sport, and AJFAT) were collected prior to beginning the 6-week exercise program. The same examiner administered the functional-performance tests for each participant; the examiner was blinded to both the involved limb and the group assignment. The order of limb testing and functional measures performed in the initial and final assessment was counterbalanced to ensure order had no effect on the results. Follow-up testing was completed within 1 week of completing the 6-week exercise program and was identical to baseline testing and administered by the same examiner.

Functional-Performance Testing. The figure-of-8 hop test has been shown to have excellent reliability intraclass correlation coefficient ($ICC = .95$), to be able to detect differences between stable and unstable limbs, and to correlate with subjective reports of CAI.^{24,25} The participant began the test on either side of a demarcated 5-m distance. While standing on the involved ankle, the participant was instructed to “hop on 1 foot as fast as you can,” twice around the figure-8. About 2 trials were performed with the fastest time being recorded. If the participant put the contralateral foot down, fell, or did not complete the course as outlined, they were asked to perform the trial again.

The side-hop test has been shown to have good reliability ($ICC = .84$), is capable of detecting differences between the stable and unstable limbs, and has been shown to correlate with subjective reports of CAI.^{24,25} For this test, the participant stood on the involved limb on either side of 2 lines that are 30-cm apart. They were then instructed to “hop on 1 foot as fast as you can,” laterally and then back to the starting position. This was counted as 2 repetitions, and 10 repetitions were performed. If the participant landed on or between the lines, this repetition was not counted, and they continued until 10 successful repetitions were completed. Participants performed 2 trials, and the fastest time was recorded.

The SEBT has been shown to have high interrater reliability ($ICC = .86-.92$), is responsive to change, and suggested to be valid for detecting deficits in individuals with CAI.²⁶⁻²⁹ As outlined by

Table 1 Participant Demographic Characteristics

Descriptor	Exercise Mean (SD)	Exercise + TJM Mean (SD)
Age, y	23.71 (2.67)	23.63 (4.43)
Height, cm	Male: 184.15 (1.80) Female: 166.16 (6.72)	Male: 171.99 (12.42) Female: 168.77 (8.53)
Mass, kg	Male: 74.55 (3.86) Female: 60.15 (5.20)	Male: 77.93 (10.89) Female: 64.21 (9.28)

Abbreviation: TJM, thrust joint manipulation.

Figure 1 — CONSORT flow diagram.

Gribble et al.²⁸ participants were asked to maintain single-limb stance, with hands on their hips, while reaching in anterior, posteromedial, and posterolateral directions. When reaching in the anterior direction, participants were positioned with the great toe just posterior to the center of the grid. When reaching in the posteromedial and posterolateral directions, participants were positioned with the heel placed just anterior to the center of the grid. A total of 6 practice reaches in each direction were allowed before recording 3 trials.²⁹ Each participant was instructed to reach as far as possible and lightly tap their uninvolved foot on the line, then bring the foot back to the center of the grid.²⁹ Trials were discarded and repeated if (1) the hands were removed from the hips, (2) the reaching limb was used for weight bearing, (3) the stance limb was displaced, or (4) there was a loss of balance.³⁰ If this occurred, the participant was asked to repeat the trial. The mean of the 3-recorded trials was calculated for analysis. The distance that each participant reached was also normalized to the corresponding stance leg length.³⁰ Leg-length measurements were taken with the participant positioned in supine. The examiner measured from the inferior margin of the anterior superior iliac spine to the inferior aspect of the medial malleolus and recorded this measurement in centimeters.

Subjective Reports of Function. Measures of self-reported ankle function were completed at the start of the study and upon completion of the study. The FAAM is a 21-item tool that has been found to be valid and reliable and is able to identify self-reported functional deficits in those with CAI.^{31,32} Each item is scored from 4 (no difficulty) to 0 (unable to do) and has a total point value of 84 and transformed to a percentage score.³¹ The FAAM-S is an 8-item tool that is a subscale of the FAAM, and has been found to detect functional deficits related to CAI in an athletic population.³² Each item is scored in the same manner as the FAAM, with a total point value of 32 points and then converted to a percentage score.³¹

The AJFAT is a 12-item tool that rates the participant's overall perceived level of function (eg, pain, stability, and strength) when comparing the involved limb to the uninvolved limb.³³ Each item is assigned a point value from 0 (much less than other ankle) to 4 (much more than other ankle) with a possible total value of 48 points. The AJFAT has been found to be an excellent assessment tool for discriminating between stable and unstable ankles and has excellent test-retest reliability (ICC = .94).³³ The AJFAT has also been shown to be responsive to changes in function following intervention.³⁴

Range of Motion. Standing DFROM with the knee extended and with the knee flexed were measured with a fluid-filled bubble inclinometer (Fabrication Enterprises, White Plains, NY) using the methods described by Denegar et al.³⁵ The use of an inclinometer has been found reliable and superior to a standard goniometer to measure ankle DFROM.³⁶

Intervention

Exercise Protocol. Both the exercise and exercise + TJM groups performed the same exercise protocol. This exercise regimen is a modified version of the balance training program described by McKeon et al.²⁷ Participants completed this protocol twice a week, for 6 weeks, with at least 1 day in between consecutive exercise sessions. One-on-one, supervised, exercise sessions lasted approximately 30 minutes. During each exercise session, participants were challenged to maintain a single-limb stance while performing balance activities. Participants were individually progressed on particular exercises if zero errors were observed as defined in the protocol. In addition, all participants were given a home exercise program to complete everyday of the week excluding treatment days. The participants were asked to document each time they performed the home exercise program on a log. According to the logs, participants completed the home exercise program an average of 3.0 times a week.

Manual Therapy. Participants allocated to the exercise + TJM group also received HVLA thrusts at the proximal tibiofibular, the distal tibiofibular, and talocrural joints. These HVLA TJMs were performed one time at each joint, prior to completing the exercise protocol during the first 3 treatment sessions. The order of the joints to be manipulated was randomized prior to administering. For the proximal tibiofibular joint, the participant was positioned in supine on a treatment table (Figure 2). The clinician placed a fist posterior to the fibular head and maximally flexed and externally rotated the tibia. The opposite hand applied HVLA thrust technique through the distal tibia, in an anterior to posterior direction, thus allowing the proximal fibula to translate anteriorly. For the distal tibiofibular joint, the participant was positioned in supine on a treatment table (Figure 3). A towel roll was placed parallel to the leg, under the Achilles tendon of the side to be mobilized. The distal tibia was stabilized with 1 hand while the opposite hand

applied a HVLA thrust technique, using the thenar eminence, in an anterior to posterior direction, through the distal fibula. For the talocrural joint, the participant was positioned in supine on a treatment table (Figure 4). The limb to be manipulated was placed slightly off the end of the table. Using overlapped hands, a firm grip was applied to the ankle to be mobilized, with the medial surfaces of the fifth phalanges contacting the neck of the talus. A HVLA thrust technique was then applied in a caudal direction.

Statistical Analysis

All data analysis was performed using the IBM SPSS (version 22; IBM Corp, Armonk, NY). The alpha level was set a priori at $P < .05$. The independent variables were group (exercise + TJM, exercise) and time (baseline, follow-up). Separate 2×2 repeated-measures analyses of variance were used to assess changes in the FAAM, FAAM-Sport, weight-bearing DFROM with knee extended, weight-bearing DFROM with knee flexed, side-hop

Figure 3 — Positioning for the distal tibiofibular thrust joint manipulation.

Figure 2 — Positioning for the proximal tibiofibular thrust joint manipulation.

Figure 4 — Positioning for the talocrural thrust joint manipulation.

test, and figure-of-8 hop test, and each direction of the SEBT for each group. When a significant interaction was identified, pairwise comparisons with Sidak adjustment were used.

Results

Initially, 35 participants were randomly allocated to the exercise ($n = 15$) or exercise + TJM ($n = 20$) groups. A total of 5 participants did not complete the study. Of these, 4 were allocated to the exercise + TJM group, and 1 was in the exercise group. Of those in

the exercise + TJM group, 3 withdrew due to reinjury of the involved ankle, which occurred outside of the study. The other participant withdrew due to medical conditions unrelated to the study. The participant in the exercise group withdrew due to family issues. Data from the remaining 30 participants were analyzed. Baseline and follow-up scores for each group are reflected in Tables 2 and 3.

For all of the self-reports of function and functional-performance measures, only a significant main effect of time was identified (AJFAT: $F_{1,25} = 47.363$, $P = .000$; FAAM: $F_{1,23} = 7.269$, $P = .01$; FAAM-S: $F_{1,23} = 67.319$, $P = .000$; SEBT_{anterior}:

Table 2 Baseline and Follow-Up Measures of AJFAT, FAAM, FAAM-Sport, Side-Hop Test, Figure-of-8 Hop Test, and All 3 Directions of the SEBT Among Exercise and Exercise + TJM Groups

Measure	Group								
	Exercise			Exercise + TJM			Combined		
	Baseline Mean (SD)	Follow-up Mean (SD)	Change score ^a (95% CI)	Baseline Mean (SD)	Follow-up Mean (SD)	Change score ^a (95% CI)	Baseline Mean (SD)	Follow-up Mean (SD)	Change score ^a (95% CI)
AJFAT	20.15 (2.97)	27.61 (4.37)	7.46 (4.27 to 10.65)	19.57 (4.20)	26.14 (4.80)	6.57 (3.51 to 9.63)	19.85 (3.60)	26.86 (4.57)*	7.00 (4.94 to 9.06)
FAAM, %	93.48 (7.65)	98.02 (2.50)	4.54 (0.65 to 9.73)	94.17 (6.41)	97.28 (2.94)	3.06 (0.23 to 6.35)	93.84 (6.89)	97.63 (2.71)*	3.74 (0.98 to 6.51)
FAAM-Sport, %	82.34 (10.03)	93.15 (9.32)	10.81 (7.22 to 14.40)	77.47 (11.51)	89.96 (8.83)	12.48 (7.53 to 17.43)	79.81 (10.89)	91.49 (9.03)*	11.70 (8.79 to 14.57)
Side-hop test, s	6.29 (1.41)	5.40 (0.84)	0.89 (0.30 to 1.47)	6.75 (2.61)	6.00 (2.16)	0.75 (0.05 to 1.46)	6.54 (2.12)	5.72 (1.68)*	0.82 (0.38 to 1.25)
Figure-of-8 hop test, s	14.21 (1.47)	13.43 (1.31)	0.78 (0.17 to 1.39)	14.89 (3.55)	13.21 (2.76)	1.68 (0.58 to 2.76)	14.57 (2.76)	13.31 (2.17)*	1.26 (0.62 to 1.89)
SEBT-A, %LL	75.87 (9.23)	80.01 (8.20)	4.13 (0.33 to 7.93)	70.91 (7.91)	74.84 (6.74)	3.94 (2.32 to 5.55)	73.22 (8.77)	77.25 (7.78)*	4.03 (2.19 to 5.87)
SEBT-PM, %LL	88.81 (8.73)	94.34 (8.91)	5.53 (3.61 to 7.46)	85.51 (8.94)	88.34 (7.38)	2.84 (0.63 to 5.04)	87.05 (8.85)	91.14 (8.55)*	4.10 (2.62 to 5.58)
SEBT-PL, %LL	80.87 (11.15)	87.35 (9.12)	6.49 (2.60 to 10.38)	78.52 (9.31)	82.99 (8.03)	4.47 (1.62 to 7.33)	79.61 (10.10)	85.03 (8.69)*	5.41 (3.17 to 7.66)

Abbreviations: %LL, percent of leg length; A, anterior; AJFAT, ankle joint functional assessment tool; CI, confidence interval; FAAM, foot and ankle ability measure; FAAM-Sport, foot and ankle ability measure sport subscale; PL, posterolateral; PM, posteromedial; SEBT, star excursion balance test; TJM, thrust joint manipulation.

^aChange scores represented as a positive reflect an improvement. A negative change score reflects a decline in function.

*Statistically significant difference between baseline and follow-up ($P < .05$).

Table 3 Baseline and Follow-Up Passive Weight-Bearing Dorsiflexion Range of Motion Measurements Among Exercise and Exercise + TJM Groups

Measure	Group								
	Exercise			Exercise + TJM			Combined		
	Baseline Mean (SD)	Follow-up Mean (SD)	Change Score ^a (95% CI)	Baseline Mean (SD)	Follow-up Mean (SD)	Change Score ^a (95% CI)	Baseline Mean (SD)	Follow-up Mean (SD)	Change Score ^a (95% CI)
DFROM knee extended	19.07 (5.36)	20.36 (4.48)	1.29 (−2.38 to 4.95)	18.13 (7.11)	19.25 (6.25)	1.13 (−2.79 to 5.04)	18.57 (6.26)	19.77 (5.43)	1.20 (−1.33 to 3.73)
DFROM knee flexion	26.29 (2.97)	24.57 (3.80)	−1.71 (−3.95 to 0.52)	19.81 (5.91)	23.50 (5.91)*	3.69 (−0.15 to 7.53)	22.83 (6.13)	24.00 (4.98)	1.17 (−1.23 to 3.56)

Abbreviations: CI, confidence interval; DFROM, dorsiflexion range of motion; TJM, thrust joint manipulation.

^aChange scores represented as a positive reflect an improvement. A negative change score reflects a decline in function.

*Statistically significant difference between baseline and follow-up ($P < .05$).

$F_{1,28} = 19.420$, $P < .0005$; SEBT_{posteromedial}: $F_{1,28} = 36.440$, $P < .0005$; SEBT_{posterolateral}: $F_{1,28} = 24.599$, $P < .0005$; side-hop test: $F_{1,28} = 14.197$, $P = .001$; figure-of-8 hop test: $F_{1,28} = 16.184$, $P < .0005$). For each of these measures, participants reported and demonstrated improvements at follow-up, when compared with baseline, regardless of treatment group (see Table 2 for a summary of change in each group).

There was a significant interaction between group and time for DFROM with the knee flexed ($F_{1,28} = 6.261$, $P = .02$), suggesting the effect of time depended on group assignment. Post hoc testing was unable to identify the significant difference. However, the significant interaction and the point estimates of the mean difference for each group suggest that only the exercise + TJM group demonstrated improvements across time (see Table 3 for summary of change in each group). When analyzing measurements of DFROM with the knee extended, we did not identify any significant main effects (time: $F_{1,28} = 0.910$, $P = .35$; group: $F_{1,28} = 0.337$, $P = .56$) nor a significant interaction between time and group ($F_{1,28} = 0.004$, $P = .95$). This suggests that neither time nor group had an effect on DFROM with the knee extended (see Table 3 for summary of change in each group).

Discussion

The purpose of this study was to compare the combined effects of TJM and therapeutic exercise on function to the effects of therapeutic exercise alone in participants reporting CAI. Our results suggest that the addition of TJM improves DFROM in those with CAI compared with therapeutic exercise alone. Although statistically significant improvements were measured in self-reported function and functional, no group differences were noted.

The statistically significant improvements we identified likely have clinical significance as well. Specifically, our participants' baseline scores for the AJFAT, FAAM-S, SEBT-PM, and side-hop test were suggestive of CAI given cut-off scores published in the literature (AJFAT: ≥ 26 ; FAAM-S: 80%; SEBT-PM: 91%; side-hop test: 12.88 s).^{21,33,37} Upon follow-up testing, participants' self-reported function and performance exceeded these cut-off scores and therefore suggest the resolution of CAI. To compare cut-off scores on the side-hop test, the cut-off score provided by Linens et al³⁷ was reduced by 50%; this is due to a difference in the operational definition of a repetition for the side-hop test. Changes in function and functional performance in our study may be attributed to the therapeutic exercise regimen given that the regimen was common to both groups, both groups improved, and previous literature reflects that a therapeutic exercise regimen is associated with improvements in self-reported function and functional performance.^{22,27,38,39}

Although therapeutic exercise is shown to be effective in improving self-reported function and functional performance in those with CAI, the effects of adding manual therapy to an exercise program is less clear. Studies that examined the combined effects of manual therapy with therapeutic exercise have mixed findings.⁶⁻⁹ Burcal et al⁹ demonstrated that therapeutic exercise combined with sensory-targeted-rehabilitation strategies, including ankle mobilizations, was no more effective than balance training alone. While Burcal et al⁹ report results favored the multimodal approach, no significant differences were identified between groups. In contrast, some studies report that the addition of manual therapy, including TJM, leads to improved outcomes in those with CAI compared with exercise alone.⁶⁻⁸

Although the addition of TJM did not appear to result in greater improvement in self-reported function and functional performance compared with exercise alone in our study, we did find that the addition of TJM led to greater improvements in DFROM. With the knee flexed, the TJM group demonstrated 3.69° increase in DFROM following the 6-week intervention. To our knowledge, there is no reported minimal clinically important difference in weight-bearing DFROM with the knee flexed using the methods described by Denegar et al.³⁵ To compare our findings, Denegar et al³⁵ reported a difference of 2.9° in the standing bent knee DFROM measurement between injured and uninjured limbs.³⁵ We may deduce from the findings by Denegar et al³⁵ that the difference of 3.69° found in our study may be clinically relevant.

The effects of TJM on DFROM in those with CAI reported in the literature are inconsistent. Similar to our study, Marrón-Gómez et al⁴⁰ found significant improvement in weight-bearing DFROM with the knee flexed following manual therapy interventions. But, Beazell et al⁴¹ found no significant changes to DFROM following TJM. It is difficult to compare findings due to the variability in parameters across studies. The variability in manual therapy techniques and dosage in the literature supports the need to determine ideal parameters that will lead to improvements in DFROM. Although we cannot state the exact reason as to why TJM improved DFROM, a model by Bialosky et al⁴² suggests there may be either biomechanical or neurophysiological effects of manual therapy including TJM. Although our study found improvements in DFROM with the addition of TJM and improvements in self-reported function and functional performance in both groups, we must discuss the potential limitations that may impacted our findings. The small sample size of the study, the lack of a short-term reassessment, and the manual therapy parameters we selected may have influenced our findings. A larger sample size may have yielded group differences that were statistically significant. In addition, the TJM was performed at the first 3 sessions out of a total of 12 sessions, and the outcomes were assessed after the 12th visit. It is possible that the investigators did not capture a short-term benefit of the addition of TJM earlier in the 6-week intervention that has been seen in the literature.⁴⁰ Finally, there is still a lack of literature to support optimal parameters and dosage for manual therapy. Thus, the addition of TJM at the first 3 sessions may not have been the optimal parameter for benefit. This idea is outside the scope of this study, however, and warrants further research to determine ideal parameters of manual therapy at the ankle joint.

Conclusions

To our knowledge, this study is the first of its kind to demonstrate the benefits of combining TJM and therapeutic exercises on range of motion, self-reported function, and functional performance. These findings reflect current practice that therapeutic exercise improves self-reported function and functional performance. In addition, it highlights the importance of a multimodal approach to the treatment of CAI, specifically that the addition of TJM to a therapeutic exercise regimen has the greatest benefit on weight-bearing DFROM in those with CAI.

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