Journal of Bodywork & Movement Therapies 40 (2024) 1549–1554

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

The effect of different types of cupping therapy on acute changes in ankle dorsiflexion

Alexandria N. Schaub [a], Julie A. Rochester [a], Kari L. Getschow [b], Megan C. Nelson [a,*]

[a] Department of Health and Human Performance, Northern Michigan University, Marquette, MI, USA
[b] Elevate Athletic Training, Marquette, MI, USA

ARTICLE INFO

Keywords:
Cupping
Range of motion
Ankle dorsiflexion
Manual therapy

ABSTRACT

Introduction: Cupping therapy involves lifting and separating fascial tissue to facilitate stretching and promote blood flow. Although cupping is a common treatment modality for pain, various protocols exist and studies are inconsistent in regards to whether cupping improves outcomes such as range of motion. We aimed to determine the acute effect of different types of cupping therapy on ankle dorsiflexion.
Methods: Thirty-five generally healthy adults (mean ± SD; age: 22.1 ± 4.52 y; baseline ankle ROM: 34.68 ± 4.22°) were randomly assigned to one of four cupping therapy treatment groups: static, dynamic, static sham, or dynamic sham**.** Ankle ROM was measured using a digital inclinometer pre- and immediately post-intervention. ANCOVA was used to determine whether ROM differed between groups post-treatment when controlling for baseline ROM and the minimal detectable change (MDC) was used to determine clinical meaningfulness of the changes.
Results: Baseline ROM was significantly associated with post-intervention ROM (post-ROM: 38.41 ± 4.95°; $p < .001$), indicating an overall increase in ROM regardless of the intervention received. There was no difference in ROM between therapy groups post-intervention after controlling for baseline ROM. The dynamic cupping group experienced a change in ROM (baseline ROM: 34.11 ± 4.62°, post-ROM: 39.19 ± 6.44°) above the MDC (5.08°).
Conclusion: Our findings support cupping as a modality for improving ankle ROM in individuals with limited ROM. Dynamic cupping may be effective for improving ankle ROM due to the addition of functional movement. Clinicians may consider dynamic cupping as a potential intervention to address limited ankle ROM.

1. Introduction

Myofascial decompression therapy, also referred to as cupping, is a type of manual therapy often used as an alternative approach for reducing pain, inflammation, or improving range of motion (ROM) at specific areas of the human body (Warren et al., 2020). Dry cupping involves placing a dome-shaped cup over an area of skin and then creating a negative pressure within the cup, either through direct application of heat or through an air pump device (Lowe 2017). It is hypothesized that cupping grabs and lifts the fascia, allowing for lymphatic drainage of toxins and facilitating stretching of the tissue (Lowe 2017). This in turn, is thought to increase blood flow and ROM, promote cellular healing, and decrease inflammation and tension in the fascial and muscle tissue (Klecan 2018).

Cupping has taken off in popularity due to high profile athletes bearing circular-shaped cup markings/bruises on their backs (Lowe 2017). Applying cups to the skin is relatively easy and the equipment needed to perform cupping is affordable. Two types of dry cupping have been identified as the most commonly used techniques: static and dynamic cupping. Static cupping therapy involves cups being applied to a specific area of the body (e.g., back, hamstring, gastrocnemius) via negative pressure, for a period of time while a patient remains still and relaxed the entire time the cups are attached to the skin (Xie 2017). Dynamic cupping therapy involves a similar cup placement, but the patient is asked to move a particular body part through a full ROM while negative pressure persists in the cups, rather than lie still and relaxed (Warren et al., 2020). Static cupping is the most commonly used method of dry cupping and most research is conducted using this technique; limited research exists using dynamic cupping protocols (Lowe 2017).

There is low-quality evidence to suggest dry cupping is effective for reducing chronic neck and back pain acutely (Wood et al., 2020), however, it is unclear whether range of motion (ROM) is affected (Wood

* Corresponding author.
E-mail address: msuer@nmu.edu (M.C. Nelson).

https://doi.org/10.1016/j.jbmt.2024.08.012
Received 10 May 2024; Received in revised form 24 July 2024; Accepted 15 August 2024
Available online 22 August 2024

et al., 2020). Possessing a limited ROM at any particular joint is a common risk factor for musculoskeletal injuries such as strains and myofascial restrictions (Lowe 2017). Specifically, limited ankle ROM can be caused by tightness or lack of flexibility in the gastrocnemius muscle in the calf. Clinicians have reported that even in healthy subjects, the loss of ankle dorsiflexion ROM may result in compensatory hindfoot pronation with subsequent anterior knee joint pain due to altered patellofemoral tracking (Youdas et al., 2003), implying that a lack of ankle ROM can alter a patient's gait. Alteration of gait may lead to musculoskeletal injuries or limitations caused by poor walking or running mechanics (Konor et al., 2012). Identifying effective modalities, such as cupping, to improve ankle ROM may be one approach for decreasing injuries associated with poor flexibility and limited ROM. Thus, there is a need to understand whether cupping is a technique that can improve ankle ROM and how different types of cupping compare to each other in their ability to affect ankle ROM.

The aim of our study was to investigate the immediate effects of two different types of cupping protocols (i.e., static and dynamic) on ankle ROM, while including sham therapies to serve as active control groups and allow for blinding of participants to the therapy they received. We are unaware of any studies that compared the effects of both static and dynamic cupping on ankle ROM and also included a sham cupping therapy as a means to blind participants to assess the possibility of a placebo effect. We hypothesized that the dynamic cupping group would have the most improvements in ankle ROM measured via the modified lunge technique for weight bearing dorsiflexion, compared to all the other therapy groups, in adults with limited ankle dorsiflexion.

2. Methods

2.1. Participants

We recruited 35 adults aged 18 years and older with limited ankle ROM that did not have any previous history of cupping experience, lower extremity injury over the past 6 months, or any contraindications associated with cupping therapy (e.g., deep vein thrombosis, pregnancy, bone fracture, sunburn/rash). Limited ankle ROM was defined as <40 degrees of weight-bearing ankle dorsiflexion (Bagget and Young 1993). Therefore, inclusion criteria consisted of being a generally healthy adult with no injuries and possessing <40 degrees of weight-bearing ankle dorsiflexion. Participants were recruited by word of mouth and by putting up flyers around the university campus and surrounding community. This study was approved by the University Institutional Review Board (IRB) for ethical considerations. All participants signed a written informed consent form detailing all aspects of the study prior to taking part in any study procedures. The study was retroactively registered as a clinical trial on clinicaltrials.gov (NCT06513078).

2.2. Study design

A randomized, parallel group design with both within-subject (pre and post) and between-subject (treatment) factors was used to compare the acute effect of cupping therapy on ankle dorsiflexion. Participants received one of four cupping interventions, which they were blinded to. The four different intervention groups consisted of: two types of cupping therapy, static cupping and dynamic cupping, and two types of sham therapy, sham static cupping and sham dynamic cupping. The sham therapies were utilized in this study as an attempt to investigate the placebo effect from either static or dynamic cupping therapy, as the underlying mechanisms related to the effect of cupping therapy on ROM and other outcomes lack strong evidence.

2.3. Protocol

After completing a pre-screening questionnaire to ensure study inclusion criteria was met, participants were asked to come to the injury clinic on the university campus to participate in one 45-min laboratory visit. Participants were then randomly assigned to one of the four intervention groups and blinded to the intervention they were selected to receive. Survey information including basic demographics (e.g., age, sex, race/ethnicity) and health history was collected, followed by anthropometric measurements. Height was measured to the nearest 0.1 cm as the average of two measurements using a stadiometer. Weight was measured with a calibrated digital scale to the nearest 0.1 kg.

Weight bearing ankle dorsiflexion, the main outcome of the study, was measured pre-intervention and immediately post-intervention using a validated digital inclinometer (URPRO digital inclinometer) that records to the nearest degree, which has been shown to have high reliability when used to measure ankle ROM (Konor et al., 2012). Participants were placed into a modified lunge position and asked to bring their knee forward without allowing their heel to come off the ground with the digital inclinometer placed vertically over the tibial tuberosity (Krause et al., 2011). Measurements were taken three times and the average of the three measurements, recorded to the nearest degree, was reported as the ankle ROM. The same researcher measured ankle ROM for all of the participants.

Regardless of the therapy received (sham vs. cupping therapy), all participants had four cups placed on their left gastrocnemius totaling 10 min in duration. Specifically, all participants were asked to lie prone on an exam table while two cups were placed one-inch inferior to the medial and lateral heads of the gastrocnemius; and the remaining two placed four inches inferior to the initial cups, at approximately the middle of the muscle belly of the gastrocnemius. A trained researcher, who was a certified athletic trainer with 3 years of utilizing cupping in clinical practice, performed all cupping treatments in the study. The cups used in this study were plastic and measured two inches in diameter (Kangzhu, Beijing, China). Negative pressure was created inside all of the cups by drawing out air with two full pumps via a manual suction tool (Kangzhu, Beijing, China), similar to other cupping studies (Silva et al., 2019; Schafer et al., 2020). For participants randomized into a sham therapy group, a small pin-sized hole in the cups was created to provide the feeling of suction but relieve the cup of negative pressure throughout the 10-min intervention (Silva et al., 2019). Athletic pre-wrap was used to prevent the cups from detaching from the gastrocnemius for participants receiving sham therapy, however, the wrap was placed on all participants to ensure blinding was not revealed.

After the four cups were placed on the gastrocnemius, participants randomly assigned to the static cupping groups (i.e., sham or actual therapy) were asked to remain still in the prone position for a total of 10 min. For those randomly assigned to the dynamic cupping groups, participants remained still in the prone position for the first 5 min of the protocol. After 5 min passed, participants were asked to complete two sets of 10 full range ankle pumps with a rest period of 30 s between sets (approximately 2 min). For the remaining 3 min of the dynamic cupping protocol, the participants were asked again to lie still. Ankle ROM was measured again immediately post-intervention in all participants using the same procedure as the pre-intervention measurement.

2.4. Statistical analyses

Sample size was estimated *a priori* using G*Power (Erdfelder and Buchner 1996). To detect a difference in ankle ROM between the four treatment groups, we used an effect size of .49 that was calculated using the results from Schaefer et al. (2020). To reject the null hypothesis with a probability (power) of .08 and $\alpha = .05$, the calculation indicated $n = 35$ participants were required.

Descriptive statistics are reported as mean ± standard deviation (SD) or n(%) for continuous and categorical variables, respectively. Data were visually inspected for outliers and to determine whether parametric assumptions were met using residual plots and box-and-whisker plots. Differences in outcome variables between the treatment groups at baseline were tested using a one-way ANOVA and chi-squared test for continuous and categorical variables, respectively. Intrarater reliability was quantified by calculating the intraclass correlation coefficient ($ICC_{(3,1)}$) for the three ankle ROM measurements at baseline, using a two-way mixed effects model and absolute agreement (de Vet et al., 2006).

An analysis of covariance (ANCOVA) was used to determine whether there was a difference in ankle ROM immediately post treatment between the groups, while controlling for baseline ankle ROM. Additional considerations (i.e., independence of the covariate and treatment effect and homogeneity of regression slopes) that apply to the ANCOVA model were also checked using a one-way ANOVA and scatterplots. Statistical differences were defined as $p < .05$. Partial eta-squared (η^2) effect sizes were calculated and interpreted as: small effect = .01, medium effect = .06, and large effect = .14. All statistical analyses were conducted using IBM Statistical Package for the Social Sciences for Windows version 29.0 (SPSS Inc., Chicago, IL, USA).

Finally, the minimal detectable change (MDC) for ankle ROM, or smallest real change outside of measurement error, was calculated with the following formula: $MDC = 1.96 \cdot \sqrt{(2)} \cdot SEM$; where, SEM = standard error of the measurement ($SEM = SD \cdot \sqrt{(1\text{-}r)}$, and r is the ICC reliability parameter) (de Vet et al., 2006).

3. Results

3.1. Sample characteristics

In total, we recruited n = 49 volunteers, but n = 14 were deemed ineligible to participate due to possessing too great of ROM at the ankle (i.e., weight-bearing dorsiflexion ≥40°). A total of n = 35 participants were eligible and completed the study. The sample consisted of young (age: 22.1 ± 4.52 y), generally healthy adults (65.7% female, n = 23; height: 169.9 ± 7.71 cm, weight: 73.18 ± 18.66 kg) with an average ankle ROM below the criteria for a normal level of weight-bearing ankle dorsiflexion. Additionally, there were no differences between height, weight, and age between treatment groups ($p > .05$ for all, Table 1); however, the dynamic sham group included significantly more women compared to men. The participant characteristics for each of the treatment groups are displayed in Table 1.

3.2. Ankle range of motion

Reliability for baseline ankle ROM measurements was good $ICC_{(3,1)}$(absolute error) = .87, (95% confidence interval: .78-.93) (Koo and Li 2016). The assumption of independence of the covariate and treatment effect was met; average ankle ROM at baseline was not statistically different between the four treatment groups $F(3,31) = 1.31$, $p = .29$ (Table 1). Additionally, the assumption of homogeneity of regressions slopes was also met; the association between the outcome and covariate showed a similar trend for each of the treatment groups.

The covariate, baseline ankle ROM, was significantly related to the participant's post-intervention ankle ROM $F(1,30) = 24.5$, $p < .001$, partial $\eta^2 = .44$. Compared to baseline ankle ROM (34.68 ± 4.22°), all participants on average had increased their ankle ROM immediately post-intervention (38.41 ± 4.95°) regardless of therapy received (Table 1). However, there was no statistically significant difference in ankle ROM between the therapy groups post-intervention when controlling for baseline ankle ROM, $F(3,30) = .98$, $p = .42$, partial $\eta^2 = .09$ (Table 1).

The MDC for weight bearing ankle dorsiflexion was 4.96° when calculated using the ICC of .87. When comparing the change in ankle ROM for each of the groups to the MDC, the dynamic cupping group experienced a clinically significant change in ankle ROM above the MDC (5.08°). Participants in the static, static sham, and dynamic sham cupping groups did not experience changes above the MDC, on average (1.98°, 4.49°, 3.45°, respectively). Of the 35 participants in the study, n = 4(11.4%) experienced a decrease in ankle ROM whereas the remaining n = 31(88.6%) experienced an increase (Fig. 1a–d).

Table 1
Demographic, anthropometric, and ankle ROM variables by therapy group. Data is shown as mean ± SD for continuous variables and n(%) for categorical variables.

	Therapy				
	Static sham (n = 8)	Dynamic sham (n = 9)	Static (n = 9)	Dynamic (n = 9)	p-value
Age (y)	21.4 ± 2.3	21.2 ± 3.4	23.2 ± 7.1	22.6 ± 4.1	.77
Sex, male, n(%)	4(50.0)	4(44.4)	4 (44.4%)	0(0%)	.03[a]
Height (cm)	172.6 ± 5.9	173.7 ± 8.7	168.5 ± 8.6	165.2 ± 4.7	.07
Weight (kg)	81.4 ± 19.2	68.4 ± 11.7	71.9 ± 14.9	72.0 ± 26.5	.55
Baseline ankle ROM (°)	32.9 ± 5.1	36.8 ± 2.8	34.7 ± 3.9	34.1 ± 4.6	.29
Post-intervention ankle ROM (°)	37.4 ± 4.9	40.2 ± 3.3	36.7 ± 4.7	39.1 ± 6.4	–

[a] Statistically significant between therapy groups, $p < .05$.

4. Discussion

The purpose of our study was to examine the acute effect of different types of cupping protocols on ankle ROM, when compared to sham cupping. We found that on average, there was an improvement in ankle ROM immediately after treatment, regardless of whether participants were allocated to a sham or actual cupping treatment. However, there was no statistical difference in ankle ROM between the therapy groups post-intervention when controlling for baseline ROM. Notably, participants in the dynamic cupping therapy group experienced a change in ankle ROM above the MDC of 4.96° whereas participants in the static, static sham, and dynamic sham groups experienced changes in ankle ROM below the MDC. Although there were no statistical differences in ankle ROM post-intervention between the therapy groups, the change in ankle ROM above the MDC indicates the dynamic cupping group was the only group to experience a clinically significant change. Our novel findings suggest dynamic cupping therapy may result in acute changes to ankle ROM in generally healthy, young adults who have an ankle dorsiflexion range less than 40°.

Although there was no statistically significant difference of ankle ROM between therapy groups post-intervention, we found baseline ankle ROM was significantly associated with post-intervention ankle ROM, suggesting that participants who received any of the four interventions significantly improved their ankle ROM pre-to-post treatment. Our findings are somewhat consistent with other studies that examined the acute effect of dry cupping on ankle ROM (Hammons and McCullough, 2022; AlKhadhrawi and Alshami 2019). Hammons and McCullough (2022) investigated the effect of static cupping on muscle stiffness, active dorsiflexion and perceived pain after the completion of an exercise protocol designed to induce delayed-onset muscle soreness in the lower legs in n = 20 physically active, generally healthy men and women. Participants underwent a 5-min static cupping treatment where cups were placed on the medial gastrocnemius of the dominant leg. The non-dominant leg was used as a control and rested for the 5 min. All study outcomes were measured at baseline, pre-treatment, post-treatment, and 5 min post-treatment. It was found that active dorsiflexion was improved post-treatment (pre-ROM: 15.1° ± 4.5°, post-ROM: 16.8° ± 4.7°) and 5 min post treatment (17.4° ± 4.5°) in the dominant leg that received the cupping treatment, but not the non-dominant resting leg (pre-ROM: 14.1° ± 3.9°, post-ROM: 14.0° ± 4.3°, 5-min post-ROM: 15.0° ± 4.8°). Although Hammons and McCullough (2022) reported excellent reliability, along with statistically significant changes and

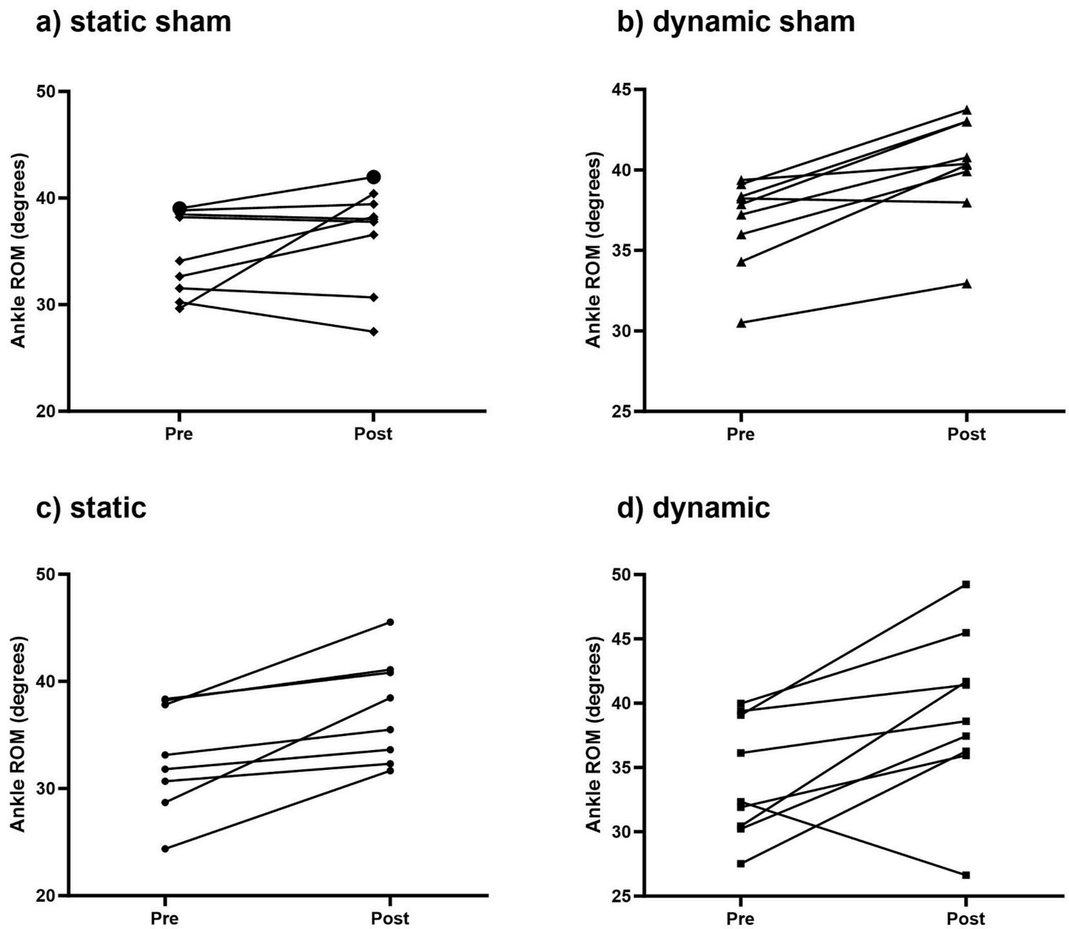

Fig. 1. Individual participant responses in ankle ROM (°) at baseline and post-intervention for a) static sham group, b) dynamic sham group, c) static group, and d) dynamic group.

large effect sizes for ankle ROM after the cupping intervention, the absolute change was small (range: 1.7–2.3°) which may not indicate a clinically significant change occurred. Hammons and McCullough (2022) also did not exclude participants with prior cupping experience, thus, the changes experienced in ankle ROM could have been influenced by previous perceptions of cupping. Additionally, using the resting leg as a control removes the ability of the researchers to employ blinding in the experiment (i.e., participants knew their dominant leg received real treatment while their non-dominant leg did not), which could have also impacted the findings. In our study, we found that although there was an improvement in participants who received the static cupping treatment, this improvement was not above the MDC threshold and thus, not likely clinically significant. AlKhadhrawi and Alshami (2019) used trigger points on the calf to place one cup on a tender area, and used a dynamic cupping technique after 5 min of static cupping, with the use of ankle pumps to reduce tenderness and to increase ankle dorsiflexion similar to our study, against an active control group of self-stretching, in participants with plantar fascia pain (n = 71). The main difference in the dynamic cupping protocol of AlKhadhrawi and Alshami, (2019) study compared to ours was the number of cups placed on the calf (one compared to four). The results of AlKhadhrawi and Alshami, (2019) study showed an increase in ROM in both the dynamic cupping group (n = 36, pre-ROM = 40°, post-ROM = 45°), as well as the active control group (n = 35, pre ROM = 41°, post ROM = 44°) (AlKhadhrawi and Alshami 2019). However, the increase in ROM in the intervention group was statistically significant, whereas, in the control group it was not. The magnitude of change in ankle ROM in this study is comparable to the change experienced by our dynamic cupping group. Additionally, in both AlKhadhrawi and Alshami, (2019) and our study, ankle ROM improved in the treatment and active control group, which both involved movement at the ankle, suggesting that the use of movement may have been important for participants' increase in ankle ROM regardless of the group.

The group that improved the most in our study was the dynamic cupping group, implying that the use of the functional movement of the gastrocnemius (i.e., the ankle pumps), may be a useful strategy to employ during a cupping treatment for improving weight bearing dorsiflexion. Participants in the dynamic cupping group in our study were the only ones, on average, to exceed the calculated MDC for ankle ROM of 4.96°, with a change of 5.08°. The MDC indicates the smallest amount change that is needed in order to see a clinical or functional change in the affected area, above the level of measurement error (de Vet et al., 2006). Although we found that the post intervention ankle ROM across the four cupping groups was not statistically different, the findings that the dynamic cupping group experienced the largest changes to ankle ROM exceeding the MDC suggest dynamic cupping may be relevant in a clinical setting (de Vet et al., 2006). Having participants actively move a muscle through a full ROM at the same time a negative pressure is applied to the muscle from the cups may produce a similar effect as proprioceptive neuromuscular facilitation (PNF) stretching. PNF stretching involves holding an isometric muscle contraction, followed by full relaxation of the same muscle, which results in an improvement to ROM at the targeted area. The PNF contraction-relaxation technique has been found to help individuals gain more neuromuscular control, which in turn increases ROM (Li et al., 2023). PNF stretching has been labeled as superior for improving ROM in the short term compared to other stretching techniques, which could be our participants experienced the greatest change in ROM when employing a dynamic cupping technique (Sharman et al., 2006). Having the participants actively contract and relax their ankle, while either the real or sham cups are placed on their calf, may in turn be increasing their neuromuscular control similarly to that of PNF stretching.

Dynamic cupping is also similar to Active Release Technique (ART). ART is performed by applying deep tension over tender tissues while the patient actively moves the tissue from a shortened to a lengthened position, thereby breaking up the fascial adhesions (Barnes and Rivera 2021). ART has been shown to decrease pain and dysfunction in low back patients, improving pelvic tilt and pelvic rotation, and hamstring ROM (Gaur et al., 2021). Dynamic cupping uses a similar technique, but instead of applying compressive forces over tender tissue, it uses decompressive tension with the use of a cup to complete a "pinning" effect. Since these techniques both involve the use of active movement with the use of a force over a tender area of the muscle, this may explain why the dynamic cupping group showed clinically significant improvements as well.

Participants who received sham cupping in our study also showed a slight increase in ankle ROM compared to baseline when measured immediately after their treatment. When compared to other studies that included a sham group, our findings were similar when ROM was the outcome (Silva et al., 2019). Silva et al. (2019) concluded that in participants with chronic low-back pain (n = 90), static cupping was not superior to sham cupping on trunk ROM. Trunk ROM was measured pre- and post-intervention after eight weeks of static cupping therapy (10-min per session, once per week). There was no between-group difference in the intervention and sham cupping groups, with a 1 cm difference in trunk ROM post-treatment, which was not statistically significant (Silva et al., 2019). Since there was no difference between static and sham cupping in either group regardless of whether the participant felt the negative pressure of the cups, is possible that improvements observed after static cupping are a consequence of the placebo effect (Silva et al., 2019). There may be reason to use dynamic cupping with movement in order to improve ROM, rather than static cupping, which is solely based on the physiological effects from the negative pressure in the cups and has been shown to have similar results to sham groups.

Although not reported in the present manuscript, we attempted to follow up with participants at the conclusion of data collection to ask whether they perceived the treatment they received to be beneficial using the following questions: "In this study, the participants were split up into either intervention groups or placebo groups. Based on your experience immediately after the cupping, do you believe you were in the placebo group or the intervention group? Why do you think you were in that group?" (Almeida Silva et al., 2022). Additionally, we asked participants to complete a Global Perceived Effect survey to measure the perceived effect cupping had on each subject (Kamper et al., 2010). We expected the surveys to reveal that regardless of the cupping treatment received, the blinding of participants was successful, and that participants would report high satisfaction with ankle ROM improvement. Since this questionnaire was added at the end of the participant recruitment and data collection and required follow up with the participants, the response rate was low (37%; n = 13 respondents). Of the 13 respondents, six participants stated they felt "much improvement", six stated "a little improvement", and one stated "a little deterioration". Overall, the majority of participants felt that the study intervention improved their ankle ROM, regardless of the intervention received. Almeida Silva et al. (2022) reported similar findings, with the majority of the participants stating positive feedback from their cupping experience, regardless of receiving the true intervention or sham group placement (Almeida Silva et al., 2022). Out of the 13 participants who completed the questionnaire, 10 believed they were in the intervention group (n = 7 in an intervention group, n = 3 in a placebo group), with three believing they were in one of the placebo groups. Of those three, only one was in the placebo group. Our findings indicate regardless of the physiological mechanism underlying the effects of cupping therapy, cupping therapy of any kind may provide beneficial outcomes to ankle ROM immediately after treatment in individuals that have a limited ROM.

4.1. Limitations

This study was accompanied by several limitations throughout the data collection process. Many more participants than anticipated were excluded from the study due to their ankle ROM being too high for inclusion in the study. Our criteria for ankle ROM was that participants must have less than 40 degrees of weight bearing dorsiflexion to qualify for the study, as normal dorsiflexion is defined as 40° and above (Krause et al., 2011). We would not expect to see many changes, if any, in ankle ROM in participants whom already possess an ankle ROM within the normative values for weight bearing dorsiflexion, as they would not have much to gain. Approximately 49 participants had entered the study and been assessed for ankle dorsiflexion, with only 35 participants meeting inclusion criteria for ankle dorsiflexion. Additionally, although we achieved our target sample size to detect a statistically significant difference, larger studies should be done to fully understand the effects of dynamic cupping on ankle ROM and its usefulness as a modality for improving ankle ROM, in a variety of different individuals.

Our study design itself also presents limitations. Although we believe our study design was strong to include two sham/placebo cupping treatments, we did not use a true control group of participants that received no form of cupping at all. The use of a true control group would have eliminated our ability to fully blind participants, as some participants would obviously know they were in a control group because they would have not received any cups placed on the skin. In addition, it should be noted that our results reflect acute changes to ankle ROM, therefore, we are unable to speculate on the long-term effects of different cupping therapies on ankle ROM. Future studies may want to consider including a true control group in addition to sham/placebo groups and measure ankle ROM on a more long-term scale.

The use of the weight bearing lunge position for ankle ROM measurements may also present limitations. Since our study involved observing the effects of cupping on the gastrocnemius, the use of the lunge position with the knee bent may have involved more of the soleus calf muscle, rather than just the gastrocnemius. Future research may want to consider a different weight bearing measurement position in order to prevent the involvement of the soleus muscle.

Finally, we attempted to collect data related to patient-reported outcomes, which was added a few months into the data collection process. Due to the late addition of patient-reported outcomes data to the study, the response rate was low and could be biased due to the time delay in survey administration. Participants may not have remembered exactly how the cupping intervention felt. We recommend that survey data related to patient-reported outcomes and blinding be collected earlier or immediately after receiving treatment in order to avoid this bias.

5. Conclusion

The findings of our study suggest that both static and dynamic cupping, as well as the sham cupping interventions, led to an improvement in ankle ROM immediately after treatment. However, the dynamic cupping group showed a clinically significant increase in ankle ROM above the MCD threshold, while the other groups did not reach this threshold. These findings suggest that dynamic cupping may be effective for improving ankle ROM in individuals with limited ankle dorsiflexion. Despite limitations, this study contributes to the understanding of the effects of cupping therapy on ankle ROM and provides valuable insights for the potential benefits of dynamic cupping. Further investigation is warranted to explore the long-term effects of cupping therapy, as well as the underlying mechanisms that contribute to its therapeutic effects, with the inclusion of sham groups to eliminate performance bias.

Clinical relevance

- Cupping therapy, regardless of type of cupping may lead to an improvement in ankle ROM immediately after treatment in patients with ROM less than 40°.
- Dynamic cupping may result in the most clinically significant difference in ankle ROM immediately after treatment in patients with ROM less than 40°.

CRediT authorship contribution statement

Alexandria N. Schaub: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Julie A. Rochester:** Writing – review & editing, Supervision, Resources, Methodology. **Kari L. Getschow:** Writing – review & editing, Supervision, Methodology. **Megan C. Nelson:** Writing – review & editing, Supervision, Methodology, Investigation, Formal analysis.

Declaration of competing interest

None.

This study was funded by an internal student research grant at Northern Michigan University.

Acknowledgements

This study was funded by an internal university student research grant. We would like to thank the participants for their time spent participating in the study.

References

AlKhadhrawi, N., Alshami, A., 2019. Effects of myofascial trigger point dry cupping on pain and function in patients with plantar heel pain: a randomized controlled trial. J. Bodyw. Mov. Ther. 23 (3), 532–538. https://doi.org/10.1016/j.jbmt.2019.05.016.

Almeida Silva, H.J., Avila, M.A., Castro, K.M.S., et al., 2022. Exploring patient experiences of participating in a real and sham dry cupping intervention for nonspecific low back pain: a qualitative study. PLoS One 17 (5), e0268656.

Baggett, B.D., Young, G., 1993. Ankle joint dorsiflexion. Establishment of a normal range. J. Am. Podiatr. Med. Assoc. 83 (5), 251–254. https://doi.org/10.7547/87507315-83-5-251.

Barnes, P., Rivera, M., 2021. The effect of active Release technique on clinician and patient-reported outcomes: a systematic review. J. Sport Rehabil. 1–6. https://doi.org/10.1123/jsr.2021-0106.

de Vet, H.C., Terwee, C.B., Ostelo, R.W., Beckerman, H., Knol, D.L., Bouter, L.M., 2006. Minimal changes in health status questionnaires: distinction between minimally detectable change and minimally important change. Health Qual. Life Outcome 4, 54. https://doi.org/10.1186/1477-7525-4-54.

Erdfelder, E., Faul, F., Buchner, A., 1996. GPOWER: a general power analysis program. Behav. Res. Methods Instrum. Comput. 28 (1), 1–11. https://doi.org/10.3758/BF03203630.

Gaur, V.V., Kapoor, A.A., Phansopkar, P.A., 2021. Short term effects of muscle energy technique vs. Active Release technique in improving hamstring flexibility and pain in patients with acute anterior cruciate ligament (ACL) tear - a randomized control trial. J. Evol. Med. Dent. Sci. 10 (3), 137–142. https://doi.org/10.14260/jemds/2021/29.

Hammons, D., McCullough, M., 2022. The effect of dry cupping on gastrocnemius muscle stiffness, range of motion and pain perception after delayed onset muscle soreness. Alternative Ther. Health Med. 28 (7), 80–87.

Kamper, S.J., Ostelo, R.W., Knol, D.L., Maher, C.G., de Vet, H.C., Hancock, M.J., 2010. Global Perceived Effect scales provided reliable assessments of health transition in people with musculoskeletal disorders, but ratings are strongly influenced by current status. J. Clin. Epidemiol. 63 (7), 760–766.e1. https://doi.org/10.1016/j.jclinepi.2009.09.009.

Klecan, K., 2018. The Use of Dry Cupping with Active Movement to Increase Functional Mobility and Decrease Pain in a Patient with Cervical Disc Disorder: A Case Report. University of Iowa.

Koo, T.K., Li, M.Y., 2016. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. J. Chiroprac. Med. 15 (2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012.

Krause, D.A., Cloud, B.A., Forster, L.A., Schrank, J.A., Hollman, J.H., 2011. Measurement of ankle dorsiflexion: a comparison of active and passive techniques in multiple positions. J. Sport Rehabil. 20 (3), 333–344. https://doi.org/10.1123/jsr.20.3.333.

Konor, M.M., Morton, S., Eckerson, J.M., Grindstaff, T.L., 2012. Reliability of three measures of ankle dorsiflexion range of motion, 7 (3), 279–287.

Li, L., Wei, Y., Xiang, S., 2023. Influences of PNF stretching on physical fitness in aerobic athletes. Rev. Bras. Med. do Esporte 29, e2023. https://doi.org/10.1590/1517-8692202329012023_0065.

Lowe, D.T., 2017. Cupping therapy: an analysis of the effects of suction on skin and the possible influence on human health. Compl. Ther. Clin. Pract. 29, 162–168. https://doi.org/10.1016/j.ctcp.2017.09.008.

Sharman, M.J., Cresswell, A.G., Riek, S., 2006. Proprioceptive neuromuscular facilitation stretching: mechanisms and clinical implications. Sports Med. 36 (11), 929–939. https://doi.org/10.2165/00007256-200636110-00002. PMID: 17052131.

Schafer, M.D., Tom, J.C., Girouard, T.J., Navalta, J.W., Turner, C.L., Radzak, K.N., 2020. Cupping therapy does not influence healthy adult's hamstring range of motion compared to control or sham conditions. Int. J. Exercise Sci. 13 (3), 216–224.

Silva, HJ. de A., Saragiotto, B.T., Silva, R.S., Lins, CA. de A., de Souza, M.C., 2019. Dry cupping in the treatment of individuals with non-specific chronic low back pain: a protocol for a placebo-controlled, randomised, double-blind study. BMJ Open 9 (12), e032416. https://doi.org/10.1136/bmjopen-2019-032416.

Warren, A.J., LaCross, Z., Volberding, J.L., O'Brien, M.S., 2020. Acute outcomes of myofascial decompression (cupping therapy) compared to self-myofascial Release on hamstring pathology after A single treatment. Int. J. Sports Phy. Thera. 15, 579–592. https://doi.org/10.26603/ijspt20200579.

Wood, S., Fryer, G., Tan, L.L.F., Cleary, C., 2020. Dry cupping for musculoskeletal pain and range of motion: a systematic review and meta-analysis. J. Bodyw. Mov. Ther. 24 (4), 503–518. https://doi.org/10.1016/j.jbmt.2020.06.024.

Xie, J., 2017. The Effects of Static versus Dynamic Myofascial Decompression on Hamstring Flexibility in A College-Aged Population: A Pilot Study. Thesis. California State University, Fresno.

Youdas, J.W., Krause, D.A., Egan, K.S., Therneau, T.M., Laskowski, E.R., 2003. The effect of static stretching of the calf muscle-tendon unit on active ankle dorsiflexion range of motion. J. Orthop. Sports Phys. Ther. 33 (7), 408–417. https://doi.org/10.2519/jospt.2003.33.7.408.