Comparative Sustained Effects of Stretching and Dry Needling on Ankle Dorsiflexion Range of Motion

Direct Original Research

Jeffrey R. Doeringer Ph.D. ATC, LAT[1], Philip Van Dyke PT, DPT[1], Christina Deltoro[1], Luis Valdes[1], E. Joanna Soles DHSc, ATC, LAT[1]

[1]*University of the Incarnate Word, San Antonio, Texas/United States*

Open Access

Published: *January 7, 2025*

Research Directs in Therapeutic Sciences: *2025, Volume 4 (Issue 1): 1*

ISSN 2837-5033

Abstract

Introduction: This study compared the effects of static stretching and trigger point dry needling on weight-bearing ankle dorsiflexion range of motion (ROM) in individuals with limited dorsiflexion and determined whether changes in ROM persisted up to 60 minutes post-treatment.

Methods: Thirty participants underwent one of two separate treatment sessions: static stretching of the triceps surae or dry needling of the same muscles. Weight-bearing ankle dorsiflexion ROM was measured pre-treatment, immediately post-treatment, and 60 minutes post-treatment. Repeated measures analysis of variance was used to assess ROM changes over time for each intervention.

Results: Static stretching resulted in significant improvements in ankle dorsiflexion ROM both immediately and 60 minutes post-treatment ($p < 0.05$). In contrast, dry needling of the triceps surae showed no significant change in ROM at any time point ($p > 0.05$). There was no interaction between treatment type and time on dorsiflexion ROM.

Conclusions: Static stretching of the triceps surae leads to short-term improvements in ankle dorsiflexion ROM, which may reduce compensatory movement patterns during physical activity. However, dry needling of the triceps surae does not appear to affect dorsiflexion ROM in individuals with limited range of motion.

Key Words: static stretching, dry needling, ankle mobility

Corresponding author: Jeffrey R. Doeringer, doeringe@uiwtx.edu

Introduction

Limited dorsiflexion range of motion (ROM) can be a risk factor to various impairments in the lower limb. This limitation could be a result from tightness in the gastrocnemius and soleus.[1–3] Previous research has shown that healthy individuals with limited dorsiflexion range of motion (ROM) may use compensatory movements and patterns throughout the lower extremity.[4] Compensations can include decreased knee flexion with step down and landing tasks, decreased hip flexion with landing tasks, increased knee valgus, and a greater medial collapse of the lower extremity.[5–8] Physical impairments that have been associated with a limited dorsiflexion ROM include Achilles tendinopathy, plantar fasciitis, patellofemoral pain, and anterior cruciate ligament tears.[5,7,9,10] Restricted dorsiflexion ROM can also hinder dynamic balance and gait, which may increase the risk of falls.[4, 10-12]

Stretching has been reported to show an increase in range of motion which will stand as a reliable indicator to compare results to the dry needling intervention.[13] Although there is reliable evidence that shows that stretching is an effective treatment, there is limited research on the effects over a sustained period.[13,14] To address these gaps, the purpose of this study compares the effects of static stretching and dry needling on ankle dorsiflexion ROM, and whether these effects persist over time.

Scientific Methods

Participants

A sample of 32 subjects was included in the study, with 16 subjects assigned to the Dry Needling intervention group (average age = 22.8 years old) and 16 subjects to the Stretching intervention group (average age = 24 years old). All subjects reported experiencing tight or limited dorsiflexion in an ankle. Exclusion criteria were based on common contraindications and cautions for Dry Needling. Prior to commencing the study, approval was obtained from the Institutional Review Board of the University of the Incarnate Word. Participants completed a pre-participation survey to confirm the absence of current or past injuries and to ascertain their perception of the upcoming intervention.

Protocol

Subjects were recruited based on self-reported tightness or limitation with dorsiflexion of the ankle. The dependent variables were assessed before and after the intervention at five time points, including immediate and 15-minute increments. Dorsiflexion measurements were obtained during a modified knee-to-wall assessment, utilizing a digital leveling application positioned just inferior to the tibial tuberosity of the front leg under evaluation. During the assessment, participants assumed a weightbearing lunge position, with the forward leg tested for the angle of dorsiflexion in degrees, while the rear leg was supported on a towel. Both legs were measured to establish a baseline for the control leg, ensuring that no changes occurred in that leg during the intervention. The modified knee-to-wall assessment method has been previously validated.[15] All interventions were administered by one of the investigators, either a physical therapist or an athletic trainer.

For the Dry Needling Intervention, participants were positioned prone on the intervention table. The gastrocnemius muscle on the treated leg was sterilized using an alcohol swab. The clinician conducted palpation to locate trigger points on both the lateral and medial heads of the gastrocnemius as well as the soleus muscle. A single sterile monofilament needle (0.30mm x 50mm) was inserted into each identified trigger point or intervention area in the medial and lateral heads of the gastrocnemius, as well as the soleus (totaling three needles), utilizing the fast-in and fast-out technique. The needle was then rapidly pistoned into the tissue without complete withdrawal. If a localized twitch response was elicited, the needle was repeatedly pistoned until the twitch response ceased. If the twitch response persisted after 10 repetitions, the pistoning was halted. In cases where a localized twitch response was not elicited, the needle was pistoned 10 times. Subsequently, the needle was removed, and immediate manual pressure was applied over the intervention area using a cotton swab for 15 seconds. This procedure was repeated for each of the three locations by the same physical therapist for each subject.

The stretching intervention focused on the triceps surae muscle group, consisting of the gastrocnemius and soleus muscles. Participants were instructed to statically stretch one leg on a 45-degree slant board. They were asked to step onto the slant board with the treated leg and lean forward until they experienced a stretch in the targeted muscles. Participants were directed to maintain knee extension throughout the stretching exercise. Each participant completed three sets of stretching, with each set lasting 45 seconds with a 60-second break between sets. After completing the interventions, ankle dorsiflexion ROM was measured using the modified knee-to-wall test pre-and post-treatment, and at 15-minute increments, to assess the effects of the treatments.

Statistical Analysis

All statistical analyses were conducted using SPSS (version 29; IBM Corp, Armonk, NY). A 2 (Dry Needling and Stretching) x 6 (pre- and post-intervention at immediate, 15-minute, 30-minute, 45-minute, and 60-minute intervals) repeated measures analysis of variance (ANOVA) was employed to compare the dependent variable with a Bonferroni correction. The dependent variable assessed was the knee-to-wall test measurement. Pairwise comparisons between the different time intervals were performed. The alpha level was predetermined at $P < .05$.

Results

A detailed analysis was conducted to assess the effects of dry needling and stretching on ankle dorsiflexion ROM across all time intervals. The means and standard deviations for all dependent variables are reported in Table 1. A 2 (intervention) x 6 (time) repeated measures ANOVA revealed statistically significant main effect difference between interventions (Dry Needling vs Stretching) for knee-to-wall measurement ($P < .001$). There were statistically significant differences for stretching when comparing pre-intervention to each post-intervention measurement ($P < 0.05$). The control leg displayed no differences for either intervention or between any time interval ($P > 0.05$). There were no other statistically significant differences ($P > 0.05$).

Table 1: Means and Standard Deviations for intervention by time.

Time	Dry Needling	Stretching	Non-Intervention Leg
Pre	39.19±4.61	37.63±9.9*	39.56±7.83
Post 0	39.63±5.43	43.13±7.31*	40.56±7.90
Post 15-min	40.44±5.57	42.43±6.15*	40.16±7.02
Post 30-min	40.94±5.26	43.13±6.23*	40.81±6.33
Post 45-min	40.56±5.62	43.00±6.85*	41.69±6.74
Post 60-min	40.75±5.13	42.94±7.94*	41.84±7.69

Stretching Intervention was statistically significant when compared from pre-intervention compared to each post-intervention, p<0.05 and identified with "*". "Pre" - pre-intervention; "Post 0" - post-intervention immediately after treatment; "Post 15-min" - 15 minutes post-interventions; ""Post 30-min" - 30 minutes post-interventions; "Post 45-min" - 45 minutes post-interventions; "Post 60-min" - 60 minutes post-interventions; Dry Needling - treated leg; Stretching - Treated leg; 0.00±0.00 - Mean±Standard Deviation.

Discussion

Although this current study only assessed short-term effects, the observed improvements in dorsiflexion ROM may have practical implications. Short-term gains in ROM could help reduce lower extremity compensatory patterns during exercises or other activities, such as sporting competitions. However, the decision to stretch should be weighed against the known transient effects of static stretching, such as reduced maximal and explosive muscle performance.[16] These detrimental effects can be minimized by limiting static stretching to bouts of less than 45 seconds.[16]

There is conflicting evidence on the immediate effects of dry needling on ankle dorsiflexion ROM. Two previous studies found no significant change in dorsiflexion ROM after dry needling of the triceps surae in triathletes[17] and in adults from the general population.[18] In contrast to the findings of the current study, Cruz-Montecinos et al. found significant differences in ankle dorsiflexion ROM immediately following dry needling in adult males. However, Cruz-Montecinos et al. stated that local twitch responses were achieved for all participants with greater ROM improvements observed in participants who had larger local twitch responses.[12] The methods of the current study called for performing the dry needling treatment regardless of whether of a local twitch response was achieved. The necessity of achieving local twitch responses with dry needling has previously been advocated.[19] However, current evidence does not support achieving a local twitch response producing superior outcomes to dry needling without a local twitch response.[20] The mixed results across studies reflect broader inconsistencies in the literature regarding the effects of dry needling on ROM in various body regions.[21,22]

The present study had several limitations. First, the study was performed on young, non-pathological volunteers and relied on self-reported feelings of tightness or lack dorsiflexion of the ankle. Additionally, conclusions cannot be made about medium or long-term effects of either intervention on dorsiflexion ROM since measurements were limited to 60 minutes post-intervention.

Based on the findings of the current study, static stretching of the triceps surae is effective for short-term improvements in closed-chain ankle dorsiflexion in individuals with limited motion. In contrast, dry needling of the triceps surae did not result in improvements in ankle dorsiflexion ROM in these individuals. Based on these findings, conclusions can be drawn regarding the clinical application of static stretching and dry needling in improving ankle dorsiflexion ROM. Future studies warrant for longitudinal studies to assess long term effects.

Conclusions

The findings indicate that static stretching of the triceps surae significantly improved dorsiflexion ROM up to 60 minutes post-treatment, while dry needling had no effect on ROM.

Acknowledgements: No Acknowledgement

References

1. Kang MH, Lee DK, Kim SY, Kim JS, Oh JS. The influence of gastrocnemius stretching combined with joint mobilization on weight-bearing ankle dorsiflexion passive range of motion. *J Phys Ther Sci*. 2015;27(5):1317-1318. doi:10.1589/jpts.27.1317
2. Etnyre BR, Abraham LD. Gains in range of ankle dorsiflexion using three popular stretching techniques. *Am J Phys Med Rehabil*. 1986;65(4):189.
3. Medeiros DM, Martini TF. Chronic effect of different types of stretching on ankle dorsiflexion range of motion: Systematic review and meta-analysis. *The Foot*. 2018;34:28-35. doi:10.1016/j.foot.2017.09.006
4. Young R, Nix S, Wholohan A, Bradhurst R, Reed L. Interventions for increasing ankle joint dorsiflexion: a systematic review and meta-analysis. *J Foot Ankle Res*. 2013;6(1):46. doi:10.1186/1757-1146-6-46
5. Rabin A, Portnoy S, Kozol Z. The association of ankle dorsiflexion range of motion with hip and knee kinematics during the lateral step-down test. *J Orthop Sports Phys Ther*. 2016;46(11):1002-1009. doi:10.2519/jospt.2016.6621
6. Taylor JB, Wright ES, Waxman JP, Schmitz RJ, Groves JD, Shultz SJ. Ankle dorsiflexion affects hip and knee biomechanics during landing. *Sports Health*. 2022;14(3):328-335. doi:10.1177/19417381211019683
7. Hassan KA, Youssef RSEE, Mahmoud NF, Eltagy H, El-Desouky MA. The relationship between ankle dorsiflexion range of motion, frontal plane projection angle, and patellofemoral pain syndrome. *Foot Ankle Surg*. 2022;28(8):1427-1432. doi:10.1016/j.fas.2022.08.003
8. Lima YL, Ferreira VMLM, de Paula Lima PO, Bezerra MA, de Oliveira RR, Almeida GPL. The association of ankle dorsiflexion and dynamic knee valgus: A systematic review and meta-analysis. *Phys Ther Sport*. 2018;29:61-69. doi:10.1016/j.ptsp.2017.07.003
9. Radford JA, Burns J, Buchbinder R, Landorf KB, Cook C. Does stretching increase ankle dorsiflexion range of motion? A systematic review. *Br J Sports Med*. 2006;40(10):870-875. doi:10.1136/bjsm.2006.029348
10. Abassi M, Whiteley R. Serial within-session improvements in ankle dorsiflexion during clinical interventions including Mobilization-With-Movement and a novel manipulation intervention – A Case Series. *Int J Sports Phys Ther*. 16(4):1158-1168. doi:10.26603/001c.25544
11. Basnett CR, Hanish MJ, Wheeler TJ, et al. Ankle dorsiflexion range of motion influences dynamic balance in individuals with chronic ankle instability. *Int J Sports Phys Ther*. 2013;8(2):121-128.
12. Cruz-Montecinos C, Cerda M, Becerra P, et al. Qualitative ultrasonography scale of the intensity of local twitch response during dry needling and its association with modified joint range of motion: a cross-sectional study. *BMC Musculoskelet Disord*. 2021;22(1):790. doi:10.1186/s12891-021-04592-z
13. Nakamura M, Ikezoe T, Umegaki H, Kobayashi T, Nishishita S, Ichihashi N. Changes in passive properties of the gastrocnemius muscle–tendon unit during a 4-week routine static-stretching program. *J Sport Rehabil*. 2017;26(4):263-268. doi:10.1123/jsr.2015-0198
14. Kim H, Moon S. Effect of joint mobilization in individuals with chronic ankle instability: A systematic review and meta-analysis. *J Funct Morphol Kinesiol*. 2022;7(3):66. doi:10.3390/jfmk7030066
15. Konor MM, Morton S, Eckerson JM, Grindstaff TL. Reliability of three measures of ankle dorsiflexion range of motion. *Int J Sports Phys Ther*. 2012;7(3):279-287.
16. Simic L, Sarabon N, Markovic G. Does pre-exercise static stretching inhibit maximal muscular performance? A meta-analytical review. *Scand J Med Sci Sports*. 2013;23(2):131-148. doi:10.1111/j.1600-0838.2012.01444.x
17. Benito-de-Pedro M, Becerro-de-Bengoa-Vallejo R, Elena Losa-Iglesias M, et al. Effectiveness of deep dry needling vs ischemic compression in the latent myofascial trigger points of the shortened triceps surae from triathletes on ankle dorsiflexion, dynamic, and static plantar pressure distribution: A clinical trial. *Pain Med*. 2020;21(2):e172-e181. doi:10.1093/pm/pnz222
18. Pérez-Bellmunt A, Casasayas-Cos O, López-de-Celis C, et al. Effects of dry needling of latent trigger points on viscoelastic and muscular contractile properties: Preliminary results of a randomized within-participant clinical trial. *J Clin Med*. 2021;10(17):3848. doi:10.3390/jcm10173848
19. Hong CZ. Lidocaine injection versus dry needling to myofascial trigger point. The importance of the local twitch response. *Am J Phys Med Rehabil*. 1994;73(4):256-263. doi:10.1097/00002060-199407000-00006
20. Perreault T, Dunning J, Butts R. The local twitch response during trigger point dry needling: Is it necessary for successful outcomes? *J Bodyw Mov Ther*. 2017;21(4):940-947. doi:10.1016/j.jbmt.2017.03.008
21. Espejo-Antúnez L, Tejeda JFH, Albornoz-Cabello M, et al. Dry needling in the management of myofascial trigger points: A systematic review of randomized controlled trials. *Complement Ther Med*. 2017;33:46-57. doi:10.1016/j.ctim.2017.06.003
22. Chys M, De Meulemeester K, De Greef I, et al. Clinical effectiveness of dry needling in patients with musculoskeletal pain—An umbrella review. *J Clin Med*. 2023;12(3):1205. doi:10.3390/jcm12031205