Development and Evaluation of a Portable Wedge Device for Calf Stretching to Alleviate Strain and Spasms: A Randomized Controlled Trial

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ABSTRACT

Background: Calf strain and spasms are prevalent issues that impair mobility and quality of life. Innovative devices that facilitate effective stretching can help manage these symptoms, improve muscle elasticity, and enhance overall musculoskeletal health.

Objective: To evaluate the effectiveness of a portable wedge device in reducing calf strain and spasms compared to conventional physiotherapy.

Methods: A randomized controlled trial was conducted involving 26 participants diagnosed with calf strain and spasms. Participants were divided into two groups: Group A received conventional physiotherapy, while Group B utilized a portable wedge device along with conventional therapy. The intervention lasted for four weeks, with outcomes measured using the Visual Analog Scale (VAS) for pain and the Functional Disability Index (FDI) for ankle function.

Results: Group B demonstrated significant improvements with a decrease in VAS scores (p=0.000) and enhanced FDI scores (p=0.031), indicating a reduction in pain and functional disability compared to Group A.

Conclusion: The portable wedge device significantly reduced symptoms of calf strain and spasms, showing its potential as an effective tool for enhancing calf flexibility and preventing musculoskeletal injuries.

INTRODUCTIO

Calf strain (CS) and spasms represent prevalent musculoskeletal disorders that significantly impair daily activities and overall quality of life by inducing pain and limiting mobility (1). The muscles of the calf, including the gastrocnemius and soleus, are critical for normal lower limb function, providing stability during weight-bearing activities and facilitating movements such as walking (2). When these muscles become overly tight, the risk of pain, reduced range of motion, and subsequent injuries increases, highlighting the need for innovative interventions to enhance muscle stretching and alleviate strain (3). Among various interventions, the utilization of devices designed for targeted muscle stretching has garnered attention for their potential to improve flexibility and prevent injuries. The Slant Board, a specific device engineered to stretch the tibialis, ankles, and calves, allows users to achieve a comprehensive stretch by standing on the platform and promoting full extension and contraction of the calf muscles (4).

This study explores the effectiveness of a novel portable wedge device aimed at relieving calf tension and reducing spasms by focusing on the impact on pain, muscle elasticity, and overall musculoskeletal health. Calf pain, often resulting from overuse and soft tissue damage, poses significant challenges, particularly in mid-portion calf strains and spasms that are notably prevalent among active populations (5). For instance, runners face a heightened risk, with a lifetime prevalence of such ailments reaching up to 52% among elite competitors, underscoring the critical need for effective preventative and therapeutic strategies (6). The gastrocnemius and soleus muscles, crucial for lower leg movement, connect to the Achilles tendon and are predominantly composed of type I fibers in the soleus, making them essential for endurance activities (7). However, these muscles are also prone to injuries at the myotendinous junction during rapid movements like the transition from dorsiflexion to plantar flexion, particularly the medial gastrocnemius head which is more susceptible to injuries than the lateral head (8). The severity of a calf strain can vary, with symptoms ranging from mild stiffness and discomfort to more severe manifestations including pain, discoloration, and swelling, necessitating effective treatment modalities (9).

In addressing these challenges, the portable wedge device was developed as an ergonomic, cost-effective, and user-friendly solution to enhance calf flexibility and reduce the likelihood of spasms and strain. The objective of this randomized controlled trial was to assess the device's effectiveness in a clinical setting, comparing its outcomes with conventional physiotherapy techniques in improving musculoskeletal health indicators such as pain and functional disability. Through structured intervention and detailed analysis, this study aimed to provide empirical evidence supporting the device's utility in musculoskeletal prevention and rehabilitation, potentially revolutionizing the

approach to managing calf strain and enhancing patient outcomes in clinical practice (10).

MATERIAL AND METHODS

The randomized controlled trial was conducted to evaluate the efficacy of a portable wedge device for alleviating calf strain and spasms compared to conventional physiotherapy methods. The study received approval from the Research Ethics Committee (REC), adhering to the ethical standards set forth in the Declaration of Helsinki. Recruitment and data collection occurred at two locations: Faqraj Sharif Hospital and Ramay Clinic, both renowned for their Physiotherapy and Orthopedic Departments.

Participants included male and female individuals aged 18 and above who were diagnosed with calf strain and spasms. Inclusion criteria required that participants voluntarily consent to the study while experiencing leg pain or functional disability. Exclusion criteria included unconscious patients, individuals with sensory impairments, or a history of significant neurological or psychiatric disorders such as stroke, multiple sclerosis, Parkinsonism, or Alzheimer's disease. Patients with severe mobility impairments, systemic infections such as liver failure or active cancer, and those with recent fractures or certain arthritic conditions were also excluded.

Upon meeting the inclusion criteria, participants provided informed consent and were subsequently randomized into two groups. Group A received conventional treatment consisting of deep friction massage applied to the calf muscles using fingertip pressure. Group B participants underwent a combination of traditional physiotherapy and calf stretching exercises using the portable wedge device. The treatment period spanned 12 weeks with sessions held three times per week. Each session for Group B involved ten minutes of stretching using the wedge device followed by a series of calf muscle exercises including bilateral stretches and heel raises on steps.

Data were collected using two primary instruments: the Functional Disability Index (FDI) for the ankle to assess physical impairment, and the Visual Analogue Scale (VAS) for pain measurement. These tools were administered at baseline and after four weeks of intervention to evaluate changes in pain intensity and functional disability.

The statistical analysis was conducted using SPSS version 25. Descriptive statistics including means, standard deviations, and percentages provided a comprehensive overview of the demographic and baseline characteristics of the participants. The Wilcoxon Signed Ranks Test was utilized to compare pre- and post-intervention scores within each group, while the Mann-Whitney U Test was applied to assess differences between the two groups at the end of the study period, ensuring a robust analysis of the treatment outcomes.

RESULTS

The results of the study are presented in a structured manner to clearly delineate the effectiveness of the portable wedge device in comparison to conventional physiotherapy treatments. Statistical analysis was utilized to interpret the data, revealing significant differences between the two groups in terms of pain reduction and functional improvement.

Table 1: Demographic and Baseline Characteristics

Variable	Group A (Conventional Therapy)	Group B (Wedge Device)
Mean Age (years)	42.23 ± 13.097	43.08 ± 14.991
Gender	Male: 30.8%, Female: 69.2%	Male: 38.5%, Female: 61.5%
BMI	Underweight: 23.1%,	

The results section provides a detailed comparison between the outcomes for the two study groups, highlighting the effectiveness of the portable wedge device in alleviating calf strain and spasms as compared to conventional therapy. Statistical analysis demonstrates significant improvements in pain reduction and functional disability for participants using the wedge device.

Table 1: Demographic and Baseline Characteristics

Variable	Group A (Conventional Therapy)	Group B (Wedge Device)
Mean Age (years)	42.23 (SD = 13.097)	43.08 (SD = 14.991)
Gender - Male	30.8%	38.5%
Gender - Female	69.2%	61.5%
BMI - Underweight	23.1%	38.5%
BMI - Healthy	23.1%	7.7%
BMI - Overweight	53.8%	53.8%

Table 2: Frequency and Percentage of Qualitative Demographic Variables

Variable	Construct	Group A	%	Group B	%
BMI	Underweight	3	23.1	5	38.5
	Healthy	3	23.1	1	7.7
	Overweight	7	53.8	7	53.8
Gender	Male	4	30.8	5	38.5
	Female	9	69.2	8	61.5

Variable	Construct	Group A	%	Group B	%
Education Level	Primary	2	15.4	2	15.4
	Secondary	3	23.1	2	15.4
	Matric	3	23.1	4	30.8
	Intermediate	2	15.4	2	15.4
	Bachelors	3	23.1	3	23.1
Stage of Calf Strain	Grade-I	4	30.8	3	23.1
	Grade-II	7	53.8	5	38.5
	Grade-III	2	15.4	5	38.5
Marital Status	Single	2	15.4	3	23.1
	Married	9	69.2	8	61.5
	Divorced	1	7.7	2	15.4
	Widow	1	7.7	3	23.1

Table 3: Wilcoxon Signed Rank Test (Within Group Analysis)

Variables	Mean Rank	z value	p-value
VAS (baseline - 4th weeks) - Group A	12.50	-4.56	0.000
FADI (baseline - 4th weeks) - Group A	10.00	-2.29	0.000

Table 4: Mann Whitney U Test (Between Group Analysis)

Variables	Treatment Groups	Mean Rank	Mann Whitney U test value	P Value
VAS - Baseline	Group A	32.43	457.50	0.867
	Group B	34.57		
VAS - 4th Week	Group A	48.21	137.00	0.000
	Group B	22.79		
FADI - Baseline	Group A	35.96	458.50	0.658
	Group B	35.04		
FADI - 4th Week	Group A	30.34	311.50	0.031
	Group B	40.66		

The results clearly indicate significant improvements in pain intensity (VAS scores) and functional disability (FADI scores) in Group B using the portable wedge device compared to Group A receiving conventional therapy. These findings underscore the device's potential in enhancing calf flexibility and reducing musculoskeletal strain and spasms.

DISCUSSION

The results of this randomized controlled trial suggest that the portable wedge device significantly enhances the treatment outcomes for individuals with calf strain and spasms when compared to traditional physiotherapy methods alone. The device not only improved pain management but also facilitated better functional recovery as evidenced by the changes in Visual Analog Scale (VAS) and Functional Disability Index (FDI) scores between baseline and the study's conclusion (1). This finding aligns with previous studies that have emphasized the importance of specific, targeted stretching devices in rehabilitating musculoskeletal injuries and preventing their recurrence (2).

Myofascial release, a component of the therapy administered to Group B, has been documented to reorganize collagen fibers and enhance the sliding of actin and myosin during muscle contractions (3). The incorporation of the portable wedge device appears to augment this effect, facilitating easier and more effective stretching of the calf muscles. This could be a crucial factor in the device's efficacy, as stretching has been shown to improve range of motion and reduce the risk of further injury, particularly in muscles that are susceptible to spasms and strains (4). However, while the study presents promising results, there are inherent limitations that must be considered. The sample size was relatively small and the study duration was limited to 12 weeks, which may affect the generalizability of the findings. Moreover, the study focused only on participants with specific conditions of calf strain and spasms, and thus the results may not be applicable to other populations or to those with different musculoskeletal conditions.

The strength of this study lies in its rigorous methodology, including the randomized control design and the use of validated instruments for measuring outcomes. Nonetheless, future research should look to include a larger sample size and longer follow-up periods to better understand the long-term efficacy of the portable wedge device. Comparing the wedge device against other therapeutic interventions could also provide deeper insights into its relative effectiveness.

Furthermore, additional studies should consider including a broader range of participants, including those with varying degrees of severity of calf muscle issues and different demographic characteristics, to enhance the external validity of the findings. It would also be beneficial to explore the impact of the device in conjunction with other treatment modalities, such as medication or different physical therapy techniques, to ascertain the most effective comprehensive treatment strategy for calf strain and spasms.

CONCLUSION

In conclusion, the use of a portable wedge device in the treatment of calf strain and spasms holds significant promise. The current study supports its effectiveness in reducing pain and improving functional abilities, which are key outcomes for patients suffering from these conditions. Recommendations for future research include expanding the scope of the investigations to validate these findings further and to optimize the use of the device in clinical practice (5).

REFERENCES

1. Abushkadim MD, Amro A, Ahmad MS. Physical Activity and Health-Related Quality of Life Among Physiotherapists in Hebron/West Bank. J Novel Physiother Rehabil. 2020;4(2):22-7.
2. Ragab B, Al Balah OF, Osama A, Mohamed M. Effect of Low-Level Laser Therapy on Hamstring Muscle Tightness and Calf Muscle Spasticity in Children With Cerebral Palsy. Turk J Physiother Rehabil. 2020;32(3).
3. Nakayama Y, Abo M. Physical Therapy Combined With Transcranial Magnetic Stimulation Therapy: Treatment Practice Considering the Effect of Reducing Upper Limb Spasticity on Gait. Phys Ther Res. 2023;26(2):44-9.
4. Lohrer H, Malliaropoulos N, Korakakis V, Padhiar N. Exercise-Induced Leg Pain in Athletes: Diagnostic, Assessment, and Management Strategies. Phys Sportsmed. 2019;47(1):47-59.
5. Schoenfeld BJ, Vigotsky AD, Grgic J, Haun C, Contreras B, Delcastillo K, et al. Do the Anatomical and Physiological Properties of a Muscle Determine Its Adaptive Response to Different Loading Protocols? Physiol Rep. 2020;8(9).
6. Meek WM, Kucharik MP, Eberlin CT, Naessig SA, Rudisill SS, Martin SD. Calf Strain in Athletes. JBJS Rev. 2022;10(3).
7. Beer B. How to Rehab Calf Strains in Runners. 2021.
8. Park S-H, Oh S-M, Jo Y-J, Lee D-Y, Yu J-H, Kim J-S, et al. A Study on Change of Pennation Angle Based on Gastrocnemius Stretching and Additional Muscle Exercise. Indian J Public Health Res Dev. 2019;10(11).
9. Anderson SI, Brown MD. Inhibition of Prostaglandin Synthesis Does Not Alter the Decrease in Pre-Capillary Resistance in the Human Calf in Response to Small Cumulative Increases in Venous Congestion. Clin Sci (Lond). 2005;109(3):303-9.
10. Fonta M, Tsepis E, Fousekis K, Mandalidis D. Acute Effects of Static Self-Stretching Exercises and Foam Roller Self-Massaging on the Trunk Range of Motions and Strength of the Trunk Extensors. Sports. 2021;9(12):159.
11. Guillot A, Kerautret Y, Queyrel F, Schobb W, Di Rienzo F. Foam Rolling and Joint Distraction With Elastic Band Training Performed for 5-7 Weeks Respectively Improve Lower Limb Flexibility. J Sports Sci Med. 2019;18(1):160.
12. Ahmad M, Arab A. Ability of MRI Diagnostic Value to Detect the Evidence of Physiotherapy Outcome Measurements in Dealing with Calf Muscles Tearing. J Med-Clin Res Rev. 2022;6(10):1-6.
13. Tyler TF, Schmitt BM, Nicholas SJ, McHugh MP. Rehabilitation After Hamstring-Strain Injury Emphasizing Eccentric Strengthening at Long Muscle Lengths: Results of Long-Term Follow-Up. J Sport Rehabil. 2017;26(2):131-40.
14. Vijayakumar M, Jaideep A, Khankal R, Gazbare P, Abraham B. Effectiveness of Compressive Myofascial Release Vs Instrument Assisted Soft Tissue Mobilization in Subjects With Active Trigger Points of the Calf Muscle Limiting Ankle Dorsiflexion. Int J Health Sci Res. 2019;9(4):98-106.
15. Waterworth G, Wein S, Gorelik A, Rotstein AH. MRI Assessment of Calf Injuries in Australian Football League Players: Findings That Influence Return to Play. Skeletal Radiol. 2017;46:343-50.
16. Wilke J, Vogt L, Banzer W. Immediate Effects of Self-Myofascial Release on Latent Trigger Point Sensitivity: A Randomized, Placebo-Controlled Trial. Biol Sport. 2018;35(4):349-54.
17. Wong V, Spitz RW, Bell ZW, Viana RB, Chatakondi RN, Abe T, et al. Exercise Induced Changes in Echo Intensity Within the Muscle: A Brief Review. J Ultrasound. 2020;23:457-72.
18. Yue D, Ho J, Al-Hadithy N. A Case of Sudden Ankle Pain. BMJ. 2012;345.
19. Rabusin CL, Menz HB, McClelland JA, Evans AM, Landorf KB, Malliaras P, et al. Efficacy of Heel Lifts Versus Calf Muscle Eccentric Exercise for Mid-Portion Achilles Tendinopathy (The HEALTHY Trial): Study Protocol for a Randomised Trial. J Foot Ankle Res. 2019;12:1-12.
20. Ramezani S. Optimizing Biomechanical Models: Estimation of Muscle Tendon Parameters and Ankle Foot Orthosis Stiffness. 2023.