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EFFECTS OF KALTONBORN JOINT MOBILIZATION ALONG WITH GRASTON TECHNIQUE ON PAIN AND GAIT IN PATIENTS WITH PLANTER FASCIITIS

Original Research

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ABSTRACT

Background: Plantar fasciitis is a common musculoskeletal condition causing persistent heel pain and functional limitations. Conservative management, including stretching and orthotic interventions, remains the first line of treatment; however, many patients continue to experience chronic symptoms. Manual therapy techniques such as the Graston Technique and Kaltenborn Joint Mobilization have been introduced as promising interventions for improving pain and mobility. This study investigates the combined effects of these techniques in enhancing range of motion (ROM), reducing pain, and improving gait in individuals with plantar fasciitis.

Objective: This study aimed to evaluate the effectiveness of the Graston Technique combined with Kaltenborn Joint Mobilization in reducing pain, improving ROM, and enhancing gait function in patients with plantar fasciitis.

Methods: A randomized clinical trial was conducted with 42 participants diagnosed with plantar fasciitis, assigned into two groups using a lottery method. Group A (n=21) received therapeutic ultrasound and the Graston Technique, while Group B (n=21) received the same baseline treatment along with Kaltenborn Joint Mobilization. Pain intensity was assessed using the Visual Analog Scale (VAS), ROM was measured with a goniometer, and gait function was evaluated using the Rivermead Visual Gait Analysis (RVGA). Baseline measurements were recorded before treatment, and post-treatment assessments were conducted after 12 therapy sessions over four weeks. Statistical analysis was performed using SPSS version 20.

Results: Significant improvements were observed in both groups, with Group B demonstrating superior post-treatment outcomes ($p<0.05$). Dorsiflexion improved from 15.26±1.43 to 31.71±1.75 in Group B, compared to 13.19±1.20 to 16.81±1.43 in Group A. Plantarflexion increased from 21.29±0.94 to 39.48±1.75 in Group B, while Group A improved from 30.76±0.94 to 30.76±1.20. Pain levels on the VAS decreased significantly in both groups, with a more pronounced reduction in Group B (pre: 21.38±0.57; post: 13.26±0.43). RVGA scores showed a marked improvement in Group B (pre: 22.00±0.57; post: 11.00±0.30), indicating better gait function.

Conclusion: Both the Graston Technique and Kaltenborn Joint Mobilization effectively reduced pain and improved ROM and gait in plantar fasciitis patients. However, the combined intervention demonstrated superior therapeutic benefits, suggesting that an integrated manual therapy approach may enhance clinical outcomes in plantar fasciitis management.

Keywords: Ankle joint, Fascial release, Foot pain, Gait rehabilitation, Joint mobilization, Manual therapy, Plantar fasciitis.

INTRODUCTION

Plantar fasciitis is one of the most common causes of heel pain, significantly affecting daily activities and overall quality of life. This condition is characterized by inflammation of the plantar fascia, a thick band of connective tissue that extends from the heel to the toes, playing a crucial role in maintaining foot stability and biomechanics (1). Despite the widespread use of conservative treatments such as rest, customized orthotics, and stretching exercises, many patients continue to experience persistent pain and functional limitations. Chronic plantar fasciitis can severely restrict mobility and interfere with routine activities, necessitating the exploration of alternative therapeutic interventions to enhance treatment outcomes (2). Recent advancements in manual therapy have introduced promising techniques for improving soft tissue flexibility and joint mobility. The Graston Technique and Kaltenborn Joint Mobilization are two notable approaches that have gained attention for their potential to alleviate plantar fasciitis symptoms. The Graston Technique employs specialized instruments to manipulate soft tissue, effectively breaking down fascial adhesions and scar tissue. This process stimulates localized healing, reduces inflammation, and enhances overall tissue flexibility, which is essential for restoring function and alleviating pain in individuals with chronic plantar fasciitis (3). In contrast, Kaltenborn Joint Mobilization focuses on restoring optimal joint function through graded traction and gliding movements. This technique specifically targets stiffness in the foot and ankle joints, improving joint alignment, reducing discomfort, and enhancing mobility (4). Given the distinct but complementary mechanisms of these two therapies, their combined application may offer a more comprehensive and effective solution than conventional treatment approaches alone (5).

Despite their individual benefits, limited research has explored the synergistic effects of the Graston Technique and Kaltenborn Joint Mobilization in the management of plantar fasciitis. Understanding the combined impact of these manual therapies on pain relief and gait function could provide valuable insights into optimizing treatment strategies for this prevalent musculoskeletal condition (5,6). This study aims to evaluate the effectiveness of integrating these two techniques in individuals with plantar fasciitis, with the objective of determining whether a combined manual therapy approach yields superior outcomes compared to standard treatments. By addressing this research gap, the study seeks to contribute to the growing body of evidence supporting the role of manual therapy in managing plantar fasciitis and improving patient outcomes (7).

METHODS

This randomized, single-blinded clinical trial was conducted over four months following ethical approval from the Institutional Review Board (IRB). A total of 42 patients diagnosed with plantar fasciitis were recruited using consecutive sampling from Faisal Hospital, Pro Health Rehab and Medical, and Physiofit IDC Faisalabad. Participants were randomly assigned to one of two intervention groups: Group A received therapeutic ultrasound in combination with the Graston Technique, while Group B received the same baseline treatment along with Kaltenborn Joint Mobilization. The study included individuals experiencing persistent heel pain for more than one month, discomfort during the first steps in the morning, pain after prolonged non-weight-bearing activities, tenderness at the medial tubercle of the calcaneus, and a positive Windlass test (5,6). Patients were excluded if they had a history of recent lower limb or spinal surgery, trauma, leg length discrepancies, corticosteroid use, pregnancy, or inability to complete prescribed exercises. Additionally, those diagnosed with tarsal tunnel syndrome, ankle sprains, heel spurs, Achilles tendinopathy, or neurological disorders were not eligible to participate (7,8).

The intervention consisted of 12 treatment sessions administered over four weeks. Therapeutic ultrasound was applied at an intensity of 1.5 W/cm² for 15 minutes per session. The Graston Technique involved the use of specialized instruments to apply soft tissue mobilization strokes for six minutes, targeting myofascial adhesions and restrictions. While six minutes is relatively short compared to conventional Graston protocols, this duration was selected based on clinical feasibility and patient tolerance. Kaltenborn Joint Mobilization was applied to the talocrural, subtalar, and navicular joints, using graded traction and gliding movements. Mobilization grades were adjusted progressively, starting with Grade I-II for pain modulation in the initial sessions and advancing to Grade III for joint mobility improvement in later sessions, ensuring a standardized and structured approach. Outcome measures included pain assessment using the Visual Analog Scale (VAS) (9), range of motion (ROM) evaluation with a goniometer, and gait assessment through

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the Rivermead Visual Gait Analysis (RVGA) (10). Baseline assessments were conducted prior to treatment initiation, and follow-up measurements were taken after the final session to determine the effectiveness of the interventions.

Ethical considerations were strictly adhered to throughout the study. Approval was obtained from the IRB, ensuring compliance with ethical research guidelines. Informed consent was obtained from all participants before enrollment, with detailed explanations provided regarding the study's objectives, potential risks, and expected benefits. Confidentiality and voluntary participation were ensured, with participants given the right to withdraw from the study at any time. Statistical analysis was conducted using SPSS version 20, with the Shapiro-Wilk test used to assess data normality. Between-group comparisons were analyzed using the Mann-Whitney U test, while within-group changes were assessed using the Wilcoxon signed-rank test (11).

RESULTS

The study demonstrated significant improvements in pain reduction and functional outcomes in both intervention groups. Post-treatment analysis revealed substantial enhancements in ankle range of motion (ROM), gait parameters, and pain scores. In Group A, dorsiflexion improved from a pre-treatment mean rank of 27.74 to a post-treatment mean rank of 11.29 ($P = 0.001$), while plantarflexion changed from 27.71 to 11.00 ($P = 0.902$). Inversion improved significantly from 16.62 to 11.00 ($P = 0.006$), whereas eversion showed a lesser degree of improvement with a pre-treatment mean rank of 20.19 and a post-treatment mean rank of 11.00 ($P = 0.473$). Visual Analog Scale (VAS) scores in Group A decreased post-treatment, with a mean rank shift from 21.62 to 29.74 ($P < 0.001$). Group B exhibited more pronounced improvements in several parameters. Dorsiflexion increased from a pre-treatment mean rank of 15.26 to a post-treatment mean rank of 31.71 ($P < 0.001$), and plantarflexion improved significantly from 21.29 to 32.00 ($P < 0.001$). Inversion showed a pre-treatment mean rank of 26.38, which increased to 32.00 post-treatment ($P < 0.001$). Eversion, which did not show a significant improvement in Group A, exhibited a considerable increase in Group B, with pre-treatment and post-treatment mean ranks of 22.81 and 32.00, respectively ($P < 0.001$). VAS scores in Group B decreased notably, with a pre-treatment mean rank of 21.38 shifting to 13.26 post-treatment ($P < 0.001$). Rivermead Visual Gait Analysis (RVGA) total scores also demonstrated greater improvements in Group B compared to Group A, with pre- and post-treatment mean ranks of 22.00 and 11.00, respectively ($P < 0.001$).

Within-group analysis further confirmed the efficacy of both treatment approaches. In Group A, dorsiflexion improved from 13.19 ± 1.20 to post-treatment values ($P = 0.001$), while plantarflexion increased from 30.76 ± 0.94 ($P = 0.004$). Inversion improved from 20.95 ± 0.97 ($P = 0.046$), whereas eversion showed no statistically significant change ($P = 0.317$). In Group B, dorsiflexion increased from 16.81 ± 1.43 ($P < 0.001$), and plantarflexion improved from 39.48 ± 1.75 ($P < 0.001$). Inversion improved significantly from 31.76 ± 0.76 ($P < 0.001$), and eversion showed a marked increase from 21.43 ± 0.92 ($P < 0.001$). Pain reduction was evident in both groups, but Group B demonstrated a more substantial decrease in VAS scores ($P < 0.001$). Between-group comparisons indicated that Group B had superior post-treatment outcomes in dorsiflexion, plantarflexion, inversion, eversion, and pain reduction. RVGA scores also reflected better functional improvements in Group B compared to Group A. The findings suggest that while both interventions were effective, the combination of the Graston Technique with Kaltenborn Joint Mobilization in Group B led to greater overall improvements in mobility, pain reduction, and gait function. These results emphasize the potential benefits of an integrated manual therapy approach for plantar fasciitis management.

Table 1: **Demographic of Variables**

Variable	Group A	Group B
Age	36.81 ± 7.52	37.29 ± 6.48
Gender	Male: 6 (28.57%)	Male: 14 (66.67%)
	Female: 15 (71.43%)	Female: 7 (33.33%)

Table 2: Between Group Difference of Variables

Between Group Difference of Variables			
	Group A (Pre vs. Post) Mean Rank (Sum of Ranks)	**Group A (Pre vs. Post) Mean Rank (Sum of Ranks)**	**P-VALUE (Pre vs. Post)**
Pre- post Treatment Dorsiflexion	Pre: 27.74 (582.5), Post: 11.29(237)	Pre: 15.26 (320.5), Post: 31.71(666)	Pre: .001 Post: .000
Pre-post Treatment Plantarflexion	Pre: 27.71 (456.0), Post: 11.00(231)	Pre: 21.29 (447), Post: 32.00(672)	Pre: 0.902 Post: .000
Pre-post Treatment Inversion	Pre: 16.62 (349.0), Post: 11.00(231.0)	Pre: 26.38 (554.0), Post: 32.00(672.0)	Pre: 0.006 Post: .000
Pre-post Treatment Eversion	Pre: 20.19 (424.0), Post: 11.00(231.0)	Pre: 22.81 (479.0), Post: 32.00(672.0)	Pre: .473 Post: .000
Pre-post Treatment Visual Analog Scale	Pre: 21.62 (454.0), Post: 29.74 (624.5)	Pre: 21.38 (449.0), Post: 13.26 (278.5)	Pre: .947 Post: .000
Pre-post Treatment RVGA Total Score	Pre: 21.00 (441.0), Post: 32.00 (672.0)	Pre: 22.00 (462.0), Post: 11.00 (231.0)	Pre: .750 Post: .000

Analysis of demographic data revealed that the mean age of participants in Group A was 36.81 ± 7.52 years, while Group B had a mean age of 37.29 ± 6.48 years, indicating a comparable age distribution between the two groups. Gender distribution varied notably, with Group A comprising a higher proportion of female participants (71.43%) compared to Group B (33.33%), while male participants constituted 28.57% in Group A and 66.67% in Group B. Despite this difference, the treatment outcomes did not show a clear correlation with gender, as both male and female participants demonstrated significant improvements in pain reduction and functional outcomes across both groups. However, the greater improvement observed in Group B may have been influenced by the higher proportion of male participants, who typically exhibit stronger musculoskeletal structure and greater baseline joint mobility, potentially enhancing their response to manual therapy interventions. Further subgroup analysis would be required to determine the precise impact of gender differences on treatment efficacy. The similarity in age distribution suggests that improvements in mobility, pain, and gait function were not age-dependent, reinforcing the effectiveness of both treatment approaches across different age groups.

Table 3: Within the Group Difference of Variables

VARIABLES	**Group**	**MEAN±SD**	**MEAN RANK**	**P-VALUE**
RVGA	Group A	21.0±.1.37	11.00	0.00
	Group B	7.33±.0.57	11.00	0.000
	Group B	1.24±.436	11.00	0.00

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VARIABLES	Group	MEAN±SD	MEAN	VARIABLES
DORSIFLEXION	Group A	13.19±1.20	0.00	0.001
	Group B	16.81±.1.43	0.00	0.00
PLANTARFLEXION	Group A	30.76 ± 0.94	0.00	0.004
	Group B	39.48±.1.75	0.00	0.00
INVERSION	Group A	20.95±0.97	0.00	0.046
	Group B	31.76±.0.76	0.00	0.00
EVERSION	Group A	11.90±1.41	5.00	0.317
	Group B	21.43±.0.92	0.00	0.00

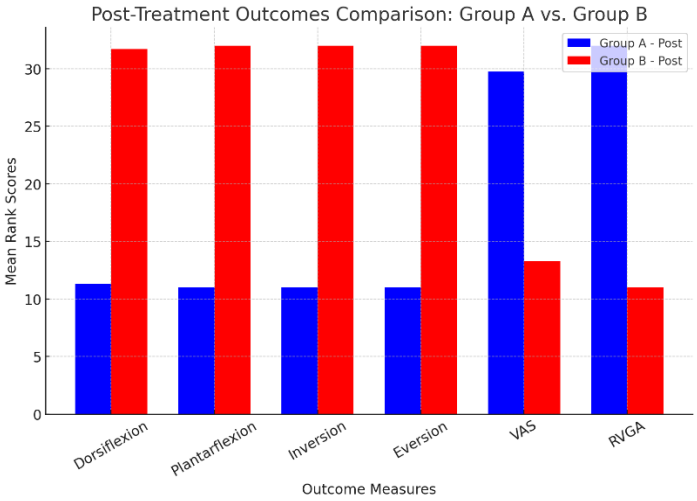

Figure 2 Post Treatment Outcomes Comparison: Group A vs Group B

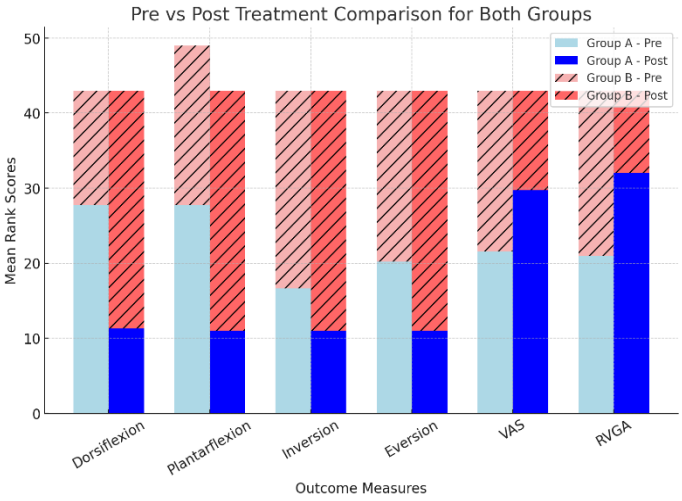

Figure 1 Pre vs Post Treatment Comparison for Both Group

DISCUSSION

The present study examined the effects of the Graston Technique and Kaltenborn Joint Mobilization on pain, range of motion (ROM), and gait in individuals with plantar fasciitis. The findings demonstrated significant improvements in all measured parameters, with the combined intervention group exhibiting superior outcomes compared to the group receiving only the Graston Technique. These results align with existing literature that emphasizes the effectiveness of manual therapy techniques in alleviating pain and enhancing functional mobility in plantar fasciitis patients. The plantar fascia, originating from the medial tubercle of the calcaneus and extending to the metatarsophalangeal joints, plays a fundamental role in foot stability and biomechanics (12). Dysfunction within this structure often leads to altered gait mechanics, primarily due to restricted ROM at the ankle and foot joints. Previous research has indicated that reduced flexibility in the plantar fascia contributes to biomechanical compensations, negatively affecting gait efficiency. The present findings reinforce this concept, as improvements in ROM observed in both intervention groups were directly associated with enhanced gait patterns. These results are consistent with prior studies that identified a direct correlation between ankle and foot mobility and the severity of gait disturbances in plantar fasciitis patients (13).

The observed improvements in pain, ROM, and gait following manual therapy interventions support the notion that targeted mobilization and instrument-assisted soft tissue techniques can effectively restore functional deficits in plantar fasciitis. Both treatment groups demonstrated statistically significant reductions in pain and improvements in mobility, with the combined intervention group exhibiting greater post-treatment gains. The results correspond with previous studies that reported the efficacy of joint mobilization and instrument-assisted techniques in reducing pain and increasing soft tissue flexibility, further supporting their role as beneficial conservative treatments for plantar fasciitis (14). The enhanced outcomes observed in the combined therapy group suggest that integrating joint mobilization with soft tissue mobilization optimizes therapeutic benefits, possibly due to the synergistic effects of improved tissue extensibility and joint mechanics. These findings contribute to the growing body of evidence that conservative interventions remain a primary approach for plantar fasciitis management. Contemporary studies have highlighted the effectiveness of manual therapy techniques over traditional methods, reinforcing their role in restoring function and mitigating symptoms in chronic cases (15). Additionally, recent investigations have shown that stretching and mobilization techniques not only alleviate pain but also improve static and dynamic balance, further supporting the mechanisms underlying the improvements noted in this study. The results align with research indicating that joint mobilization specifically enhances ankle ROM, which plays a pivotal role in gait restoration and weight-bearing function (16).

Despite these promising findings, the study has certain limitations that warrant consideration. The absence of long-term follow-up restricts the ability to determine the sustainability of the observed improvements over time. Additionally, variations in patient adherence to rehabilitation exercises outside the clinical setting could have influenced the outcomes, introducing potential variability (17). The gender distribution in the two groups was not balanced, which may have had an impact on the treatment response, as musculoskeletal differences between male and female participants could influence mobility and pain perception. Furthermore, the study did not assess

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potential biomechanical adaptations following treatment, which could provide further insights into the functional implications of these interventions (18). Future research should explore the long-term effects of combining soft tissue and joint mobilization techniques in plantar fasciitis management, incorporating objective gait analysis tools to assess biomechanical changes in response to treatment. Investigating additional patient subgroups, including varying age groups and activity levels, could further refine treatment recommendations. Addressing these factors could enhance the understanding of manual therapy applications in plantar fasciitis and contribute to the development of more comprehensive treatment protocols (19).

The findings of this study reaffirm the efficacy of the Graston Technique and Kaltenborn Joint Mobilization in improving pain, ROM, and gait function in plantar fasciitis patients. The superior outcomes observed in the combined therapy group suggest that integrating these techniques provides enhanced benefits compared to single-modality interventions. These results emphasize the importance of a tailored approach in conservative management strategies and underscore the need for further research to optimize long-term treatment outcomes (20). Despite its effectiveness, the research had certain limitations, including the absence of long-term follow-up and the potential for subjective symptom reporting. These factors should be considered when interpreting the results. Future studies should explore the durability of treatment effects and assess broader patient populations to refine clinical recommendations.

CONCLUSION

The findings of this study confirm that both the Graston Technique and Kaltenborn Joint Mobilization are effective in reducing pain and improving functional mobility in patients with plantar fasciitis. However, the combination of these interventions demonstrated superior outcomes, highlighting the potential benefits of integrating soft tissue and joint mobilization techniques for enhanced recovery. The study reinforces the importance of targeted manual therapy in addressing pain, range of motion deficits, and gait impairments associated with plantar fasciitis.

AUTHOR CONTRIBUTIONS

Author	Contribution
Sarwat Mehmood	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Sundas Farooq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Arslan Anwar	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Breera Zahid	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Tarfa Habib	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Zain Ali*	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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