INTERNATIONAL JOURNAL OF RESEARCH CULTURE SOCIETY
Monthly Peer-Reviewed, Refereed, Indexed Journal
Volume - 10, Issue - 8, August - 2026
ISSN(O): 2456-6683
[Impact Factor: 9.241]
IJRCS

DOIs:10.2017/IJRCS/202608008 --:-- Research Paper / Article / Review

"Comparative Efficacy of Integrated Foam Rolling and Self-Stretching and strengthening on calf muscle versus plantar fascia on pain and Ankle Range of motion in Occupational Drivers with plantar fasciitis."

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Background: *Plantar fasciitis is one of the most common causes of heel pain among both athletes and non-athletes, and professional drivers are particularly vulnerable due to repetitive ankle dorsiflexion–plantarflexion during pedal control. Reduced ankle dorsiflexion, tight calf musculature, and increased strain on the plantar fascia are major biomechanical contributors. Although foam rolling, stretching, and strengthening exercises have shown benefits individually, limited evidence exists comparing their effects on the calf versus plantar fascia specifically in drivers.*
Aim: *To compare the effectiveness of foam rolling combined with self-stretching and strengthening of the calf muscle versus the plantar fascia on pain and ankle range of motion (ROM) among professional drivers with plantar fasciitis.*
Methodology: *A comparative study was conducted on 34 male professional drivers aged 24–60 years, randomly divided into two groups (n=17 each).*
Group A: Foam rolling + self-stretching + strengthening of the calf muscles
Group B: Foam rolling + self-stretching + strengthening of the plantar fascia
Interventions were administered for 3 weeks. Outcome measures included Numeric Pain Rating Scale (NPRS), Foot and Ankle Ability Measure (FAAM), Knee-to-Wall Test (KFT), and Ankle Dorsiflexion ROM. Pre- and post-intervention values were analyzed using appropriate statistical tests.
Results*: Both groups showed significant improvement in pain and function post-treatment. However, Group A demonstrated superior improvements across most parameters.Pain reduction (NPRS): Group A > Group B Functional ability (FAAM): Greater improvement in Group A Ankle dorsiflexion ROM: Group A ,KFT showed significant change only in Group A.*

Key words : *NPRS (Numeric Pain Rating Scale),ROM (Range of motion), SMFR(self-myofascial release) MSDs (musculoskeletal disorders)*

1. INTRODUCTION:

Plantar fascia is a connective tissue, an aponeurosis that attaches from the calcaneal tuberosity to the proximal phalanges. 1 The function of plantar fascia is to provide a longitudinal arch that supports statically and absorbs shock dynamically.[2] The most commonly known cause of heel pain is plantar fasciitis which is seen around 10% of non athletic and athletic population .[3] plantar fascitis is an inflammatory condition of plantar fascia usually caused due to repetitive micro trauma .[4] calf muscles plays role in development of plantar fascitis as it become tight and reduce Dorsiflexion movement at ankle joint. [5] Gastronemius and soleus muscles are connected to the plantar fascia and pain in plantar fascia could be

cause due to reduced extensibility and trigger point present in posterior leg mucsles [6] clincian assess presence of limited ankle dorsiflexion range of motion work related weight bearing activities particularly under conditions with poor shock absorption are risk for development of plantar fascitis. [7] Professional drivers are defined as workers whose main task is to operate a motor vehicle, such as bus, truck, trolley, taxi driver, and ambulance drivers.[8] Professional drivers have shown 60% of symptoms of MSDs(musculoskeletal disorders).[8] MSDs are the result of repetitive, forceful movements and misalignment of posture. Drivers require one foot to control the accelerator and brake pedals to increase speed, with repetitive dorsi flexion plantar flexion movements in the ankle. In stop-and-go traffic, drivers alternate between the accelerator and brake pedal by pivoting the ankle on the heel.[8] The activity of ankle dorsiflexion increases the stretch reflex of ankle plantar flexors, which is strongly suppressed during rapid dorsiflexion movement. It is found that Achilles tendon stretching, along with plantar fascia stretching, had almost double the effect on pain reduction and improvement in dorsiflexion range of movement of the ankle joint. [9] As well, self-myofascial release (SMFR) alternate treatment option available for increasing flexibility and reducing pain.[9] SMR methods, like using a foam roller, significantly increase flexibility and improve arterial functions.[10]

MFR, in principle, stimulates the muscle fascia and loads the soft tissues [11]. However, it requires application of pressure by the individual using self-body weight. The movement between the foam roller and tissue structure causes sweeping pressure as well as direct pressure on the soft tissues. [12] . This increases lubricity of the fascial layer and causes an increase in tissue extensibility by breaking adhesions.[13]

Hence, this study was undertaken to assess the effect of foam rolling with self-stretching on the calf muscle or plantar fascia on pain and range of motion in plantar fasciitis patients.

2. LITERATURE REVIEW:

1 . **Thomas A., et .al (2023)** clinical practice guidlines linked to international classification of functioning, disability and health from the academy of orthopaedic physical therapy and American academy of sports physical therapy of American physical therapy Associations, HEEL PAIN –PLANTAR FASCITIS;REVISION 2023. Recommendation that the presence of limited ankle dorsiflexion range of motion, work-related, weight-bearing activities- particularly under conditions with poor shock absorption –as risk factor for the development of heel pain /plantar fasciitis.

2. **Ischita Rambhia et .al(2018)** conducted a study, “immediate effect of foam rolling on pain and weight distribution in patients with plantar fasciitis "; a comparative study was done on
patient under age group 45 to 65 year with plantar fasciitis which control group include conventional physiotherapy and experimental group include foam rolling with flexor bar and after intervention result were compare and show affected affected foot had significant changes in average pressure and thrust and as a result study conclude that foam rolling is effective for pain reduction and conventional treatment given was effective for changes in weight distribution .

3. **Sunny Yadav, et .al (2021)** Conducted study on “ to evaluate effect of foam rolling with self-stretching on pain and range of motion in plantar fasciitis patients – A Quasi – experimental study” comparative study among 30 participant with group A receive self stretching on calf and where as foam rolling with sel- stretching on plantar fascia recording at baseline by the end of 3 week and result within group analysis shoen that significant difference were found study proved that both stretching and foam rolling with self stretching showed significant improvement on pain and increasing ROM in plantar fasciitis however, statistically significant difference was found for WBLT (P=0.003).

4 . **Thomas christroph seevr et .al**, Conducted study “ To evaluate chronic and residual effect of 2 week foam rolling intervention on ankle flexibility and dynamic balance it is an 2 week foam roller massage intervention on ankle dorsiflexon and balance 42 participant were randomly assign to roller massage or control group with no intervention ankle ROM assesd with WBLT and dynamic balance with y balance test for both limb Result show using roller massage for 2 weeks period chronically increase ROM and dynamic balance 7 day post intervention emphasizing the sustainability of foam rolling effect t(heir were no acute but chronic ($p<0.05$)

5 . **Kwangsun Doa, et .al (2018)** Study to evaluate “Acute effect of self-myofascial release using a foam roller on the plantar fascia on hamstring and lumbar spine superficial back line flexibility” The purpose of this study was to investigate the immediate effect of applying self-myofascial release (SMR) to the plantar fascia. Conclusions: The results of this study showed that SMR on the plantar fascia was immediately effective for improving the flexibility of the SBL of the lumbar spine and hamstring.

6 . **Kazuki Fujata, .et .al** Study aim to clarify kinemetic and electrophysiological characterestic of pedal switching associated with emergency breaking in case of elderly drivers and result show that they took longer to switch break pedal the participant in this study consisted of 11 young drivers and elderly drivers and experimental pedal was used and muscle activity and kinematic data during breaking action were analyse using the light from light emmiting diode. The results showed that elderly drivers took the same time from viewing the visual stimulus to releasing the accelerator pedal as young drivers. ($p =0.007$;95%).Difference in release phase.

7. **Sun–Young Kang et al (2014).** Study conducted on characteristics of leg and ankle in taxi drivers significant less AROM in dorsiflexion and greater AROM in external tibial rotation. For the results, taxi drivers had significantly less AROM in dorsiflexion and greater AROM in external tibial rotation compared to the control group. Also, dorsiflexor strength and PPT of TA in taxi drivers were significantly lower than in the control group. This study indicates that the repetitive ankle movements associated with driving have an effect on ankle AROM, dorsiflexor strength, and PPT of TA and may lead to work-related musculoskeletal disorders of the ankle.

2. AIMS:

• To evaluate the effectiveness of foam rolling with self-stretching, strengthening of the calf & plantar fascia.

OBJECTIVE

- Assessment of pain & decrease in ankle dorsiflexion range in the ankle in pre & post training.
- To find the effectiveness of foam roller, self-stretching & strengthening on plantar fascia to reduce pain.
- To find the effectiveness of foam roller, self-stretching & strengthening on calf muscle to reduce pain.

3. METHODOLOGY :

• Type of study - comparative study
• Duration of study – 6 months
• Duration of intervention - 3 weeks
• Sample setting - Chh. Sambhajinagar
• Sample size - 17 in each group (total 34)
• The sample size is calculated using the following Formula :

$$n = \frac{2Z1^2S^2}{d^2}$$

The present study sample size will be 17 in each group.

INCLUSION CRITERIA:-

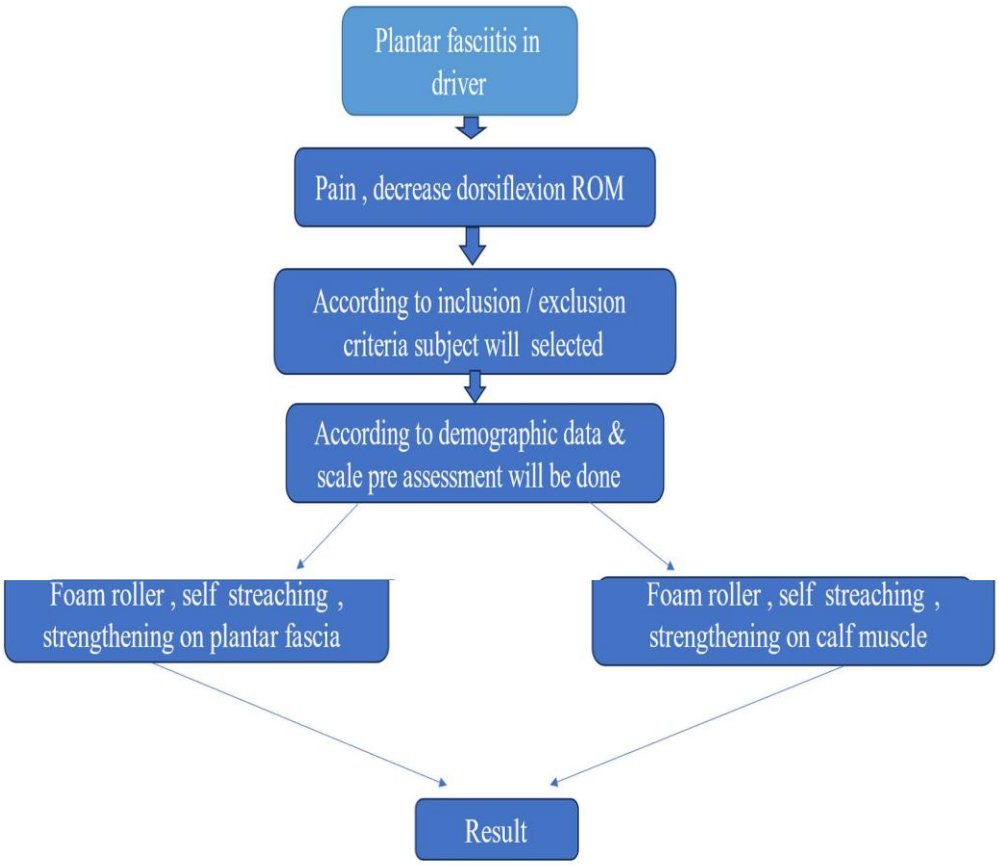
- Males
- Age group – 28 to 60
- At least 10 yr driving experience
- Patients with more than 30 km of driving/day
- Patients were willing to participate
- Patients with a positive windlass test

EXCLUSION CRITERIA :

- Any other musculoskeletal disorder of the ankle, knee, or hip in the previous 6
- month
- Inflammatory joint stiffness
- Diabetes mellitus
- Patient having heel pain.
- Non-plantar fasciitis disorder, e. Heel spur

MATERIALS USED

- Pen
- Data collection sheet
- Yoga mat
- Foam roller
- Consent form
- Scales
- Goniometer
- Measuring tape
- Napkin
- Marbles



5. PROCEDURE

GROUP A :

- Fill the consent form.

- Foam rolling with self-stretching and strengthening
- For the calf muscle in the standing position, the affected foot is placed away from the wall; the subject should lean forward & make sure not to lift the heel from the floor
- Here, focused on stretching the soleus muscle, the affected leg was placed backward with the knee bent
- For the gastrocnemius muscle, keep the affected leg backward with knee in full extension
- Ask the subject to maintain the position for 30 sec, until they feel a stretch
- Now the subject should be in a long sitting position with the affected leg extended on the foam roller and foot relaxed
- The non-affected leg should be used for support purposes, with the knee flexed in a comfortable position
- Instruction should be given to use their hand & non-affected leg, opposite side leg, to roll the foam roller from popliteal fossa to Achilles tendon.
- Strengthening:
- Heel raised - instruct patient to stand and raise both heels off the ground until you are on the tips of your toes, then slowly lower them back down, and hold the position for a couple of seconds

walking on tiptoes –

Once the patient gets comfortable with the heel raised, try to walk on tiptoes

Duration – foam rolling – 45 sec. And 15 sec rest with 5 repetitions

= 2 min

- stretching for 5 min.
- strengthening = 15 min

for 3 weeks

GROUP B:

- Foam rolling with stretching and strengthening
- For plantar fascia - stretching should be performed in a sitting position with the affected foot placed over the other side of the thigh
- Subjects were asked to place one hand over the base of the toes and the other at the heel and pull toes toward shin slowly until they feel a stretch on plantar fascia
- The intensity of the stretch should increase as tolerable, and indivisual subject maintain stretch for 30 sec.
- Perform 3 sets for 30 sec. and 2 times a day
- Next, foam rolling – subject should be in a standing position with affected leg on foam roller and non-affected on floor
- Subject instructed to do a back-and-forth motion from heel to toe of foot on foam roller, while exerting pressure on foam roller
- Duration – foam rolling – 45 sec. And 15 sec rest with 5 repetitions
    - = 2 min
        - Stretching for 5 min.
        - Strengthening = 15 min for 3 weeks
- Plantar fascia strengthening – marble pick-up activity. Towel crumple activity

OUTCOME MEASURES

- FAAM foot and ankle ability measure
- Knee to wall test

5. RESULTS :

Table 1: Distribution of cases in the study groups according to age group

The demographic table shows that a total of 34 participants were included in the study. All participants were male, with ages ranging from early adulthood to late middle age. The driving experience of participants varied widely, ranging from 10 to 26 years, indicating prolonged exposure to occupational driving stress. This variation helped in understanding the impact of long-term driving on ankle mobility and pain. The sample represents a homogeneous gender group with diverse age and experience levels.

Age-Group [In year]	**Group A**		**Group B**	
	No	**Percentage**	**No**	**Percentage**
≤20	**00**	**00**	**01**	**5.9**
21-30	01	5.9	00	**00**
31-40	10	58.8	05	**29.4**
41-50	03	17.6	06	**35.3**
51-60	03	17.6	05	**29.4**
Total	**17**	**100%**	**17**	**100%**
Mean±SD	**40.29±8.03**		**43.41±10.06**	
t-value	**0.997**			
P-value	**P=0.325 NS**			

NS = Not Significant

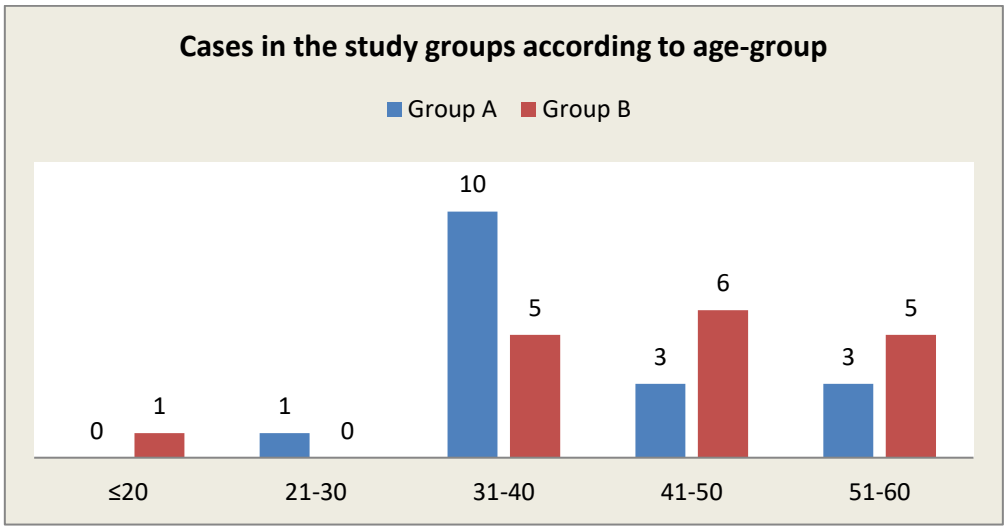


Table 2: Comparison of mean NPRS pre- **and post-treatment in study Groups**

Pre and Post Knee-to-Floor Test (KFT) Measurements

The Knee-to-Floor Test values increased from pre to post intervention in most participants. This improvement indicates enhanced ankle dorsiflexion and weight-bearing capacity. The increase in KFT measurements suggests improved flexibility and functional ankle mobility. These changes are clinically relevant, as KFT is closely associated with gait and lower limb function. The intervention effectively enhanced ankle joint mechanics**.**

NPRS	Group A Mean±SD	Group B Mean±SD	t-value	P-value
Pre-treatment	5.82±1.51	5.29±1.10	1.16	P=0.252 NS
Post-treatment	1.17±1.18	2.59±1.27	3.34	P=0.002 S

NS = Not Significant, S = Significant

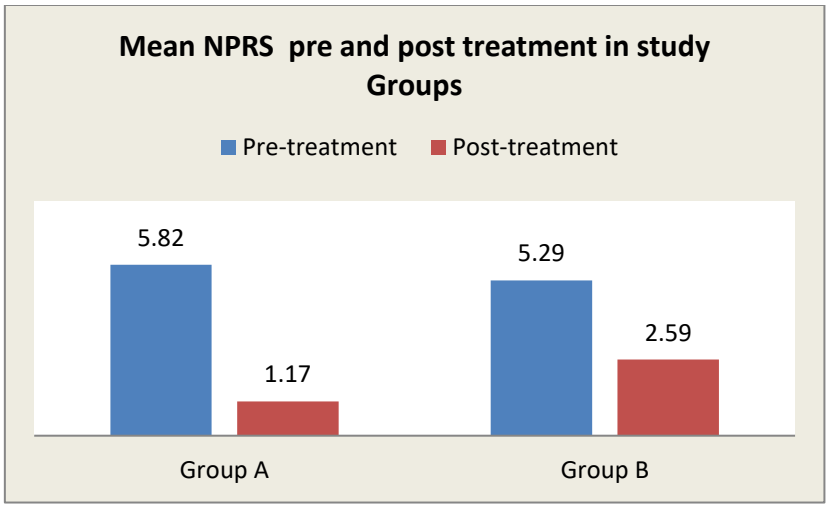


Table 3: Comparison of mean difference in NPRS in pre and post-treatment study Groups

Windlass Test and Group Distribution

The Windlass test results showed positive findings across both Group A and Group B participants. Group A demonstrated comparatively greater improvements in FAAM scores and KFT values than Group B. This suggests a better functional response in Group A following the intervention. The consistent positivity of the Windlass test indicates

the involvement of plantar fascia mechanics. Group-wise analysis highlights differential functional outcomes between the two intervention groups.

NPRS	Mean Difference	t-value	P-value
Pre Vs Post Treatment in Group A	4.65	7.59	P<0.0001 S
Pre Vs Post Treatment in Group B	2.70	3.17	P=0.002 S

NS = Not Significant, S = Significant

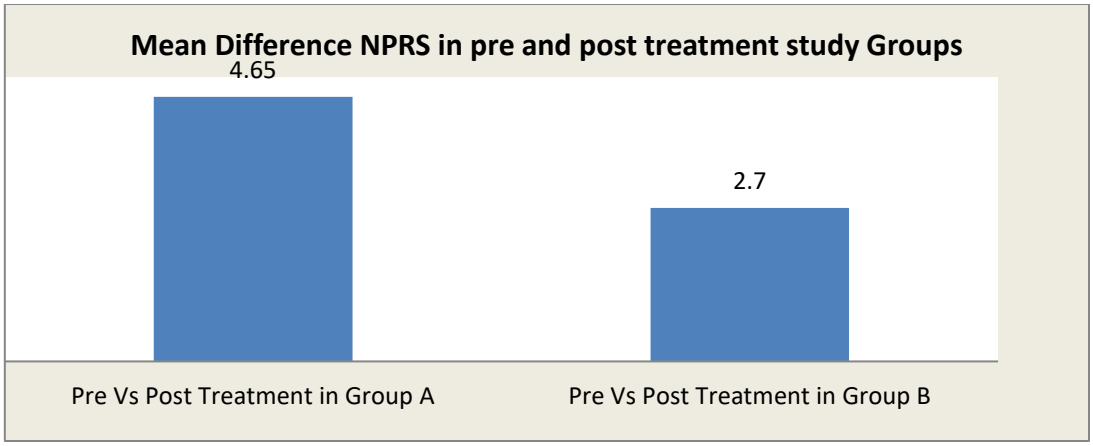


Table 4: Comparison of mean FAAM in study Groups at pre- and post-treatment

Pre and Post-FAAM Scores: The table compares pre- and post-intervention Foot and Ankle Ability Measure (FAAM) scores. Pre-treatment scores indicated reduced functional ability in daily activities. Post-treatment scores showed a consistent increase across participants. This improvement reflects enhanced foot and ankle function. The results confirm functional recovery following the intervention.

FAAM	Group A Mean±SD	Group B Mean±SD	t-value	P-value
Pre-treatment	62.56±6.11	63.48±3.91	0.562	P=0.603 NS
Post-treatment	74.22±5.66	68.93±3.96	3.15	P=0.003 S

NS = Not Significant, S = Significant

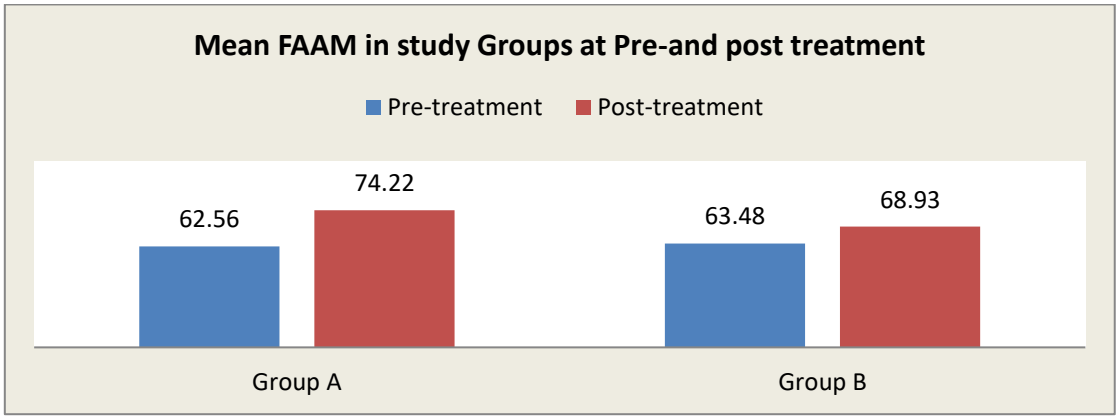


Table 5: Comparison of mean difference at pre and post-treatment FAAM **in study Groups**

This table reports the mean FAAM improvement within each group. Both groups showed statistically significant functional improvement, with Group A achieving a greater mean change than Group B. This indicates enhanced recovery in Group A.

FAAM	**Mean Difference**	**t-value**	**P-value**
Pre Vs Post Treatment in Group A	**11.66**	**7.83**	**P<0.0001 S**
Pre Vs Post Treatment in Group B	**5.45**	**4.62**	**P=0.0001 S**

NS = Not Significant, S = Significant

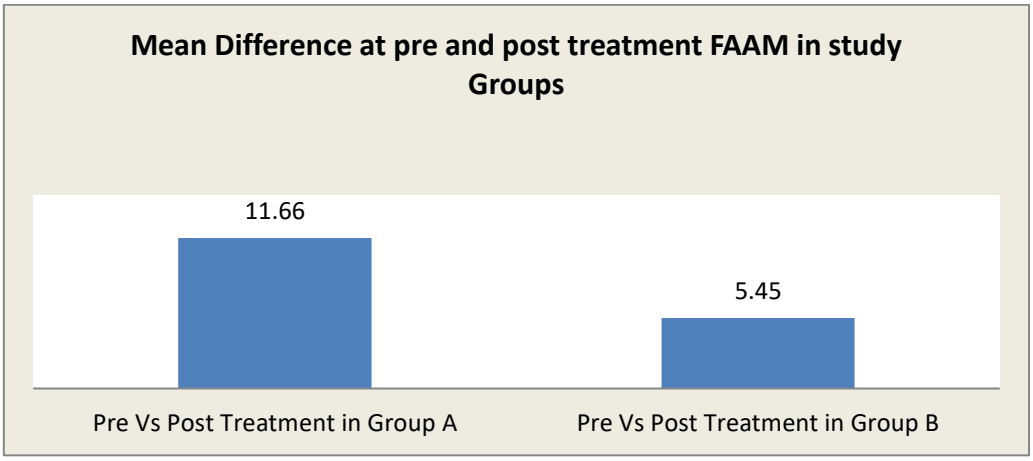


Table 6: Comparison of mean KFT in study Groups at pre- and post-treatment

This table compares pre- and post-treatment KFT values between groups. Pre-treatment values were not significantly different. Post-treatment results showed that Group A improved significantly more than Group B.

KFT	**Group A Mean±SD**	**Group B Mean±SD**	**t-value**	**P-value**
Pre-treatment	**9.07±0.49**	**8.88±0.31**	**0.562**	**P=0.603 NS**
Post-treatment	**9.74±0.60**	**9.18±0.30**	**3.15**	**P=0.003 S**

NS = Not Significant, S = Significant

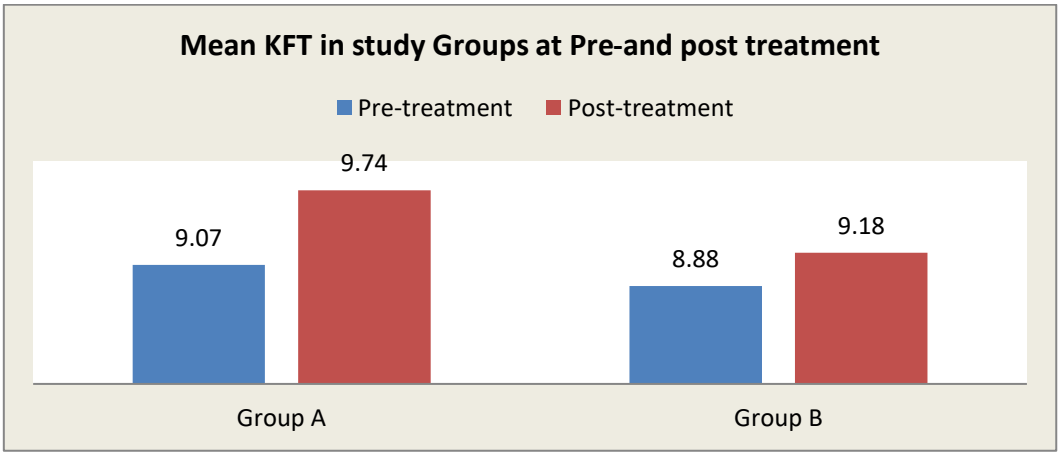


Table 7: Comparison of mean difference in pre and post-treatment KFT in study Groups
This table shows the mean change in KFT within each group. Group A showed significant improvement, while Group B's improvement was not statistically significant. This reflects better treatment efficacy in Group A.

KFT	Mean Difference	t-value	P-value
Pre Vs Post Treatment in Group A	0.67	2.93	P=0.021 S
Pre Vs Post Treatment in Group B	0.30	1.62	P=0.103 NS

NS = Not Significant, S = Significant

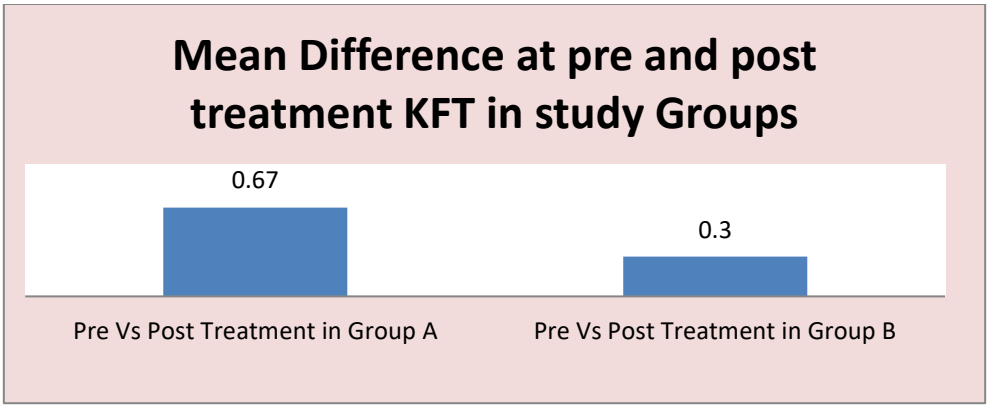


Table 8: Comparison of mean Ankle Dorsiflexion in study Groups at pre- and post-treatment
This table compares ankle dorsiflexion before and after treatment. Pre-treatment values were similar in both groups. After treatment, Group A exhibited significantly greater dorsiflexion improvement than Group B.

Ankle Dorsiflexion	Group A Mean±SD	Group B Mean±SD	t-value	P-value
Pre-treatment	13.64±2.21	13.82±1.70	0.261	P=0.796 NS
Post-treatment	18.94±1.14	16.41±1.62	5.52	P<0.0001 S

NS = Not Significant, S = Significant

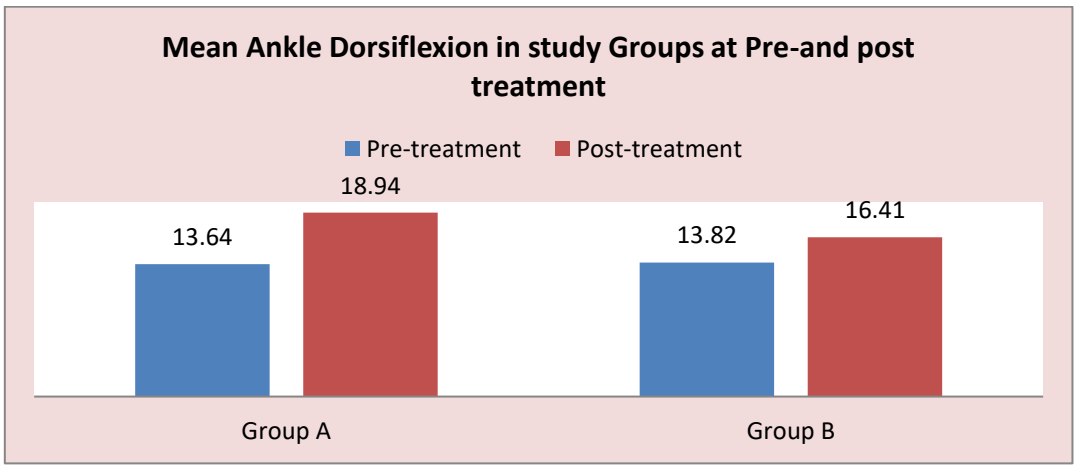
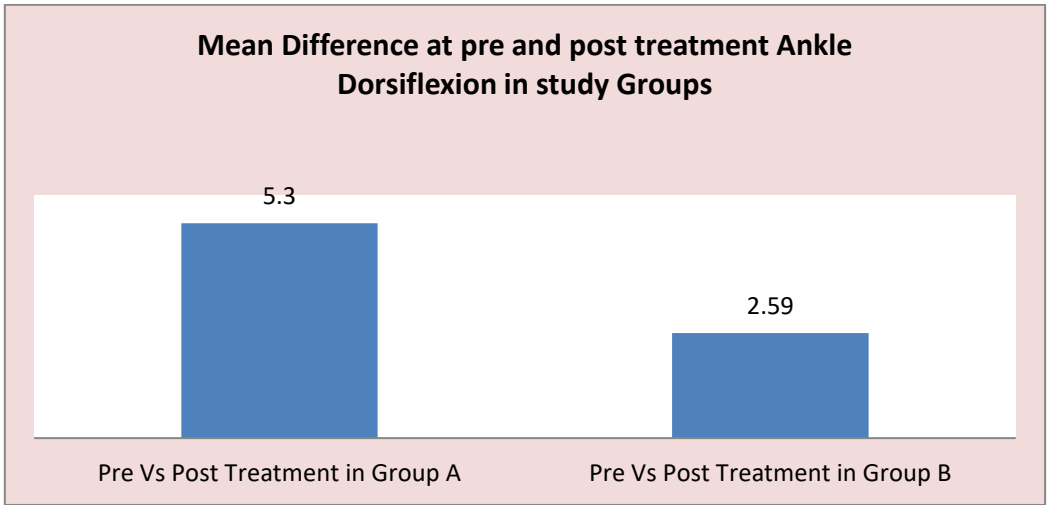


Table 9: Comparison of mean difference in ankle dorsiflexion at pre and post treatment Ankle Dorsiflexion in study Groups

This table shows the change in ankle dorsiflexion within groups. Both groups improved significantly, but the mean increase was higher in Group A. This suggests superior treatment outcomes in Group A.

Ankle Dorsiflexion	Mean Difference	t-value	P-value
Pre vs. Post-Treatment in Group A	5.30	4.95	P<0.0001 S
Pre Vs Post Treatment in Group B	2.59	2.92	P=0.004 S

NS = Not Significant, S = Significant



6. DISCUSSION :

The present study aimed to compare the effectiveness of foam rolling combined with self-stretching and strengthening on the calf muscles versus the plantar fascia on pain reduction and improvement in ankle dorsiflexion ROM among professional drivers diagnosed with plantar fasciitis. This study is one of the few that specifically focuses on professional drivers, a population at increased risk for plantar fasciitis due to repetitive occupational biomechanics. A total of 34 subjects were divided equally into Group A (calf intervention) and Group B (plantar fascia intervention). After a 3-week intervention, outcomes were measured using NPRS, FAAM, KFT, and ankle dorsiflexion ROM. The findings demonstrated that although both treatment approaches were beneficial, Group A exhibited significantly greater improvements across nearly all parameters. Interpretation of Study Findings: Pain Reduction (NPRS) - Both groups showed significant decreases in pain, but the reduction was more pronounced in Group A compared to Group B. Reason for Greater Improvement in Group A: Calf muscle tightness is strongly associated with plantar fascia overload due to the shared Achilles–plantar fascia continuum. Tight gastrocnemius–soleus muscles increase ground reaction forces and strain on the plantar fascia during weight-bearing. The study of Thomas et al. (2023) reported that reduced ankle dorsiflexion is a major risk factor for plantar fasciitis, and Young et al. (2001) emphasized treating the calf to relieve plantar fascia stress. Foam rolling reduces myofascial adhesions and improves blood flow, leading to a more effective decrease in posterior chain tension. Functional Ability Scale (FAAM)-Group A demonstrated significantly greater improvement in FAAM scores compared to Group B . Interpretation: Improved FAAM scores reflect enhanced ability to stand, walk, climb stairs, and perform daily and occupational tasks. Similar improvements were noted in studies by Kamonseki et al. (2016) and Sunny Yadav et al. (2021), who found that incorporating calf stretching yields superior functional outcomes in plantar fasciitis rehabilitation. Calf muscle stretching restores normal gait mechanics. Strengthening improves ankle stability and reduces compensatory overloading of the plantar fascia. Foam rolling enhances tissue pliability, allowing smoother movement and better shock absorption. Next, the Knee-to-Wall Test (KFT) – Functional Dorsiflexion. KFT results showed significant improvement only in Group A; Group B did not show significant improvement. KFT reflects functional ankle dorsiflexion during tasks like squatting, walking, and stepping. Improvement in Group A is due to: Decreased calf muscle stiffness after foam rolling. Increased tibial mobility relative to the foot. Reduced tension in the posterior chain (superficial back line). This aligns with Kwangsun Doa et al. (2018),

who showed that self-myofascial release improves posterior chain flexibility. Group B's minimal improvement is expected because plantar fascia treatment alone is insufficient to improve tibial-talus mobility. According to the assessment in Ankle Dorsiflexion ROM, both groups showed significant increases; however, Group A experienced nearly double the improvement: Group A Improved More, as Gastrocnemius and soleus tightness directly restricts dorsiflexion. Foam rolling decreases muscle tone and stiffness, increasing extensibility. The findings correspond with: Thomas Christophe et al., who showed chronic improvements in ankle ROM after foam rolling. Rambhia et al. (2018), who found ROM gains after plantar fascia foam rolling but less than calf interventions. Calf stretching lengthens the Achilles tendon, reducing passive resistance. Strengthening stabilizes the ankle, improving neuromuscular control. These results strongly support the Achilles–Plantar Fascia Connection Theory, where increased calf tension translates to increased plantar fascia strain. Comparison With Existing Literature Consistencies: The study supports the findings of Yadav et al. (2022) that foam rolling combined with stretching significantly improves pain and ROM. The result agrees with Kang et al. (2014), showing that drivers have reduced dorsiflexion due to repetitive pedal use. The study strengthens evidence that treating the calf muscle is crucial in plantar fasciitis rehabilitation.

7. CONCLUSION:

The present study was conducted to compare the effectiveness of integrated foam rolling combined with self-stretching and strengthening of the calf muscles versus the plantar fascia on pain intensity, functional ability, and ankle dorsiflexion range of motion in occupational drivers diagnosed with plantar fasciitis. Professional drivers are particularly prone to plantar fasciitis due to prolonged sitting, repetitive ankle movements, and sustained loading during pedal operation.

The findings of this study clearly demonstrate that both intervention protocols were effective in reducing pain and improving functional outcomes over 3 weeks. Significant improvements were observed within both groups in terms of Numeric Pain Rating Scale (NPRS), Foot and Ankle Ability Measure (FAAM), and ankle dorsiflexion range of motion, indicating that foam rolling combined with stretching and strengthening is beneficial in the management of plantar fasciitis.

However, when the two groups were compared, Group A (calf muscle foam rolling, stretching, and strengthening) showed significantly greater improvements than Group B across most outcome measures. Group A exhibited superior pain reduction, greater enhancement in functional ability, and a more pronounced increase in ankle dorsiflexion ROM. Additionally, improvement in the Knee-to-Floor Test (KFT), which reflects functional weight-bearing dorsiflexion, was statistically significant only in Group A.

These results suggest that addressing calf muscle tightness plays a crucial role in reducing plantar fascia stress due to the anatomical and biomechanical linkage between the gastrocnemius-soleus complex, Achilles tendon, and plantar fascia. Improving calf muscle flexibility and strength appears to restore ankle mechanics, reduce abnormal loading on the plantar fascia, and enhance overall lower-limb function, particularly in individuals exposed to repetitive occupational ankle movements such as drivers.

In conclusion, while both treatment approaches are effective, foam rolling combined with stretching and strengthening of the calf muscles is more effective than plantar fascia-focused intervention alone for reducing pain, improving ankle dorsiflexion, and enhancing functional performance in occupational drivers with plantar fasciitis. These findings support the inclusion of calf-focused interventions as a primary component of physiotherapy rehabilitation programs for plantar fasciitis, especially in work-related populations.

8. LIMITATIONS:

Small sample size (n = 34) limits wider generalizability.
Short intervention duration (3 weeks); long-term effects not assessed.
Only male professional drivers were included, limiting applicability to females.
No follow-up to check recurrence or sustainability of improvement.
No imaging (ultrasound) used to confirm plantar fascia thickness changes.

9. RECOMMENDATIONS

Larger sample size with equal gender distribution.
Long-term follow-up (3–12 months).
Comparative studies including: eccentric loading, manual therapy, orthotics, combined kinetic chain interventions
Investigate effects on occupational performance (e.g., driving fatigue, pedal reaction time).

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