



COMPARISON OF DEEP FRICTION MASSAGE AND POST-ISOMETRIC RELAXATION TECHNIQUE IN COMBINATION WITH LONG WAVE DIATHERMY FOR THE MANAGEMENT OF ACHILLES TENDINOPATHY

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ABSTRACT

Background: Achilles tendinopathy is a load-related musculoskeletal condition associated with pain, restricted ankle movement and reduced physical function. Manual therapy techniques may be used as adjuncts to physiotherapy management. This study compared Deep Friction Massage (DFM) and Post-Isometric Relaxation (PIR), both combined with Long Wave Diathermy (LWD), in individuals with midportion Achilles tendinopathy.

Objective: To compare the effects of DFM combined with LWD and PIR combined with LWD on pain, ankle range of motion (ROM) and Achilles-specific functional status.

Methods: A quantitative randomized comparative controlled trial was conducted in 40 participants with clinically diagnosed midportion Achilles tendinopathy. Participants were randomly allocated in a 1:1 ratio to Group A (LWD + DFM; n=20) or Group B (LWD + PIR; n=20). Treatment was administered six sessions per week for four weeks (24 sessions). Outcomes were assessed at baseline, two weeks and four weeks using the Numeric Pain Rating Scale (NPRS), universal goniometry for ankle ROM, and the Victorian Institute of Sport Assessment–Achilles (VISA-A). Within-group changes were assessed using the Friedman test followed by Wilcoxon signed-rank pairwise testing with Bonferroni adjustment when appropriate. Between-group comparisons were performed using the Mann–Whitney U test.

Results: Both groups demonstrated improvement over four weeks. NPRS decreased from 5.70 ± 1.13 to 2.00 ± 0.86 in Group A and from 5.70 ± 0.98 to 1.35 ± 0.75 in Group B. VISA-A increased from 60.05 ± 8.17 to 80.65 ± 6.84 in Group A and from 62.35 ± 6.59 to 86.25 ± 4.38 in Group B. Ankle ROM increased in both groups. The study analysis reported statistically significant between-group differences at four weeks for NPRS, eversion ROM and VISA-A; the four-week change in dorsiflexion was also significantly greater in Group B, whereas plantarflexion and inversion did not show significant between-group differences.

Conclusion: Both treatment combinations were associated with improvement in pain, ankle ROM and Achilles-specific functional status over four weeks. The reported between-group differences occurred for selected outcomes. Larger controlled studies with longer follow-up and appropriate rehabilitation control conditions are needed to clarify the comparative effects of DFM and PIR when used with LWD

Keywords: Achilles tendinopathy; Deep Friction Massage; Post-Isometric Relaxation; Long Wave Diathermy; Numeric Pain Rating Scale; VISA-A; ankle range of motion



1. Introduction

Achilles tendinopathy is a load-related disorder of the Achilles tendon that commonly presents with pain, stiffness and impaired physical function. The condition may occur in active populations as well as in individuals outside sport. Midportion Achilles tendinopathy refers to symptoms arising in the non-insertional portion of the tendon and is clinically distinct from insertional disease. Contemporary descriptions emphasize the relationship between tendon loading, symptoms and changes in tendon structure rather than viewing tendinopathy as a simple inflammatory disorder [1–4].

Clinical management generally includes education, load modification and progressive tendon-loading rehabilitation. Exercise-based loading has substantial relevance in contemporary management, while adjunctive interventions may be used to address pain, mobility and short-term tolerance to rehabilitation [5–7]. Current clinical guidance for midportion Achilles tendinopathy emphasizes progressive rehabilitation and individualized management [8].

Manual therapy has been investigated as an adjunct in Achilles tendinopathy. Deep Friction Massage is intended to apply controlled mechanical stimulation to the symptomatic tendon region. Previous clinical work has reported improvements in pain and functional outcomes following pressure or friction-based massage, although treatment protocols and treatment sites vary [9,10].

Post-Isometric Relaxation is a muscle-energy-based technique in which a submaximal isometric contraction is followed by relaxation and movement toward the available range. Evidence concerning muscle-energy approaches in Achilles tendinopathy is comparatively limited. A pilot randomized study comparing muscle energy technique with eccentric loading reported improvement in Achilles tendinitis outcomes, providing a rationale for further investigation of this approach [11].

Long Wave Diathermy was used as the common adjunct intervention in both groups in the present study. Research on deep heating modalities has examined effects on the mechanical properties of the non-insertional Achilles tendon, although direct evidence for clinical effectiveness remains limited [12].

The present study therefore compared two manual therapy approaches, DFM and PIR, when both were combined with the same LWD intervention. Pain was assessed using NPRS, ankle mobility using universal goniometry, and Achilles-specific functional status using VISA-A. Repeated assessment at baseline, two weeks and four weeks was used to document changes during the treatment period.

2. Materials and Methods

2.1 Study design and setting

The study used a quantitative, experimental/comparative randomized controlled design with two intervention groups and repeated assessments over four weeks. The study was conducted in the Department of Physiotherapy, National Heart Institute, East of Kailash, New Delhi.

2.2 Participants and sample

Forty participants with clinically diagnosed midportion Achilles tendinopathy were included and randomly allocated into two equal groups of 20 participants each. Participants were aged 20–50 years and fulfilled the study eligibility criteria. The Royal London Hospital Test was used as one of the clinical assessment procedures during screening.

2.3 Ethical approval and trial registration

The study received ethical approval from the Institutional Ethical Committee of Prakash Institute of Physiotherapy, Rehabilitation and Allied Medical Sciences, Greater Noida. The uploaded ethics approval letter states that the study was reviewed and discussed in the Institutional Ethical Committee meeting held on 15 March 2025 and that the approval letter was dated 1 April 2025. The study was registered with the Clinical Trials Registry–India before participant recruitment (CTRI/2026/01/101292; trial reference REF/2026/01/121368). Written informed consent was obtained from all participants before participation.



No IEC approval number is reported here because it was not visible in the ethics approval document supplied for manuscript preparation.

2.4 Randomization and intervention groups

Following baseline assessment, participants were randomly allocated in a 1:1 ratio. Group A received Long Wave Diathermy followed by Deep Friction Massage. Group B received Long Wave Diathermy followed by Post-Isometric Relaxation Technique.

2.5 Intervention protocol

Long Wave Diathermy (LWD): LWD was administered to the affected Achilles tendon region with the participant in prone lying. The protocol documented in the thesis consisted of 15 minutes per session, 1 mHz, 20 mA, continuous application, six sessions per week for four weeks, giving 24 sessions.

Deep Friction Massage (DFM): In Group A, DFM was applied transversely/perpendicular to the longitudinal direction of the Achilles tendon fibres over the symptomatic/tender region. The documented duration was 10 minutes per session. Pressure was adjusted according to participant tolerance.

Post-Isometric Relaxation (PIR): In Group B, PIR was performed for dorsiflexion, plantarflexion, inversion and eversion. The documented protocol consisted of a submaximal isometric contraction for 10 seconds, a 5-second relaxation period and five repetitions for each movement. The PIR component was administered for 10 minutes per session, six sessions per week for four weeks, for a total of 24 sessions.

2.6 Outcome measures

Pain intensity was assessed using the Numeric Pain Rating Scale (NPRS). Ankle ROM was measured with a universal goniometer for dorsiflexion, plantarflexion, inversion and eversion. Achilles-specific pain and functional status were assessed using the Victorian Institute of Sport Assessment–Achilles (VISA-A) questionnaire. Measurements were obtained at baseline, after two weeks (12 sessions) and after four weeks (24 sessions).

2.7 Statistical analysis

Descriptive data were summarized as mean $\pm$ standard deviation. The Shapiro–Wilk assessment indicated non-normality for relevant outcome distributions; therefore, non-parametric procedures were used. Within-group changes across baseline, two weeks and four weeks were assessed using the Friedman test. Where the overall test was significant, pairwise comparisons were performed using the Wilcoxon signed-rank test with Bonferroni adjustment. Between-group differences at two and four weeks and baseline-to-four-week change scores were assessed using the Mann–Whitney U test. Categorical baseline variables were compared using the chi-square test. A p value <0.05 was considered statistically significant.

3. Results

Forty participants completed the study, with 20 participants in each treatment group. The mean age was 33.20 ± 8.56 years in Group A and 33.75 ± 9.48 years in Group B. Each group included 13 males and 7 females. Sex distribution did not differ significantly between groups ($\chi^2=0.00$, $p=1.000$), and affected-side distribution also did not differ significantly ($\chi^2=2.60$, $p=0.273$).

Table 1. Baseline comparison of principal continuous outcomes.

Outcome	Group A	Group B	p value
NPRS	5.70 ± 1.13	5.70 ± 0.98	1.000
Dorsiflexion ROM	13.15 ± 2.76	13.62 ± 2.46	0.569
Plantarflexion ROM	39.98 ± 3.17	41.40 ± 3.56	0.189



Outcome	Group A	Group B	p value
Inversion ROM	27.10 ± 3.30	27.20 ± 3.24	0.923
Eversion ROM	11.97 ± 1.80	12.32 ± 2.10	0.575
VISA-A	60.05 ± 8.17	62.35 ± 6.59	0.333

Values are mean ± SD. No statistically significant baseline differences were reported for the measured outcomes (all $p > 0.05$).

Table 2. Mean ± SD values for NPRS, ankle ROM and VISA-A at baseline, two weeks and four weeks

Outcome	Group	Baseline	2 weeks	4 weeks
NPRS	A	5.70 ± 1.13	3.50 ± 1.00	2.00 ± 0.86
NPRS	B	5.70 ± 0.98	3.50 ± 0.89	1.35 ± 0.75
Dorsiflexion ROM	A	13.15 ± 2.76	15.22 ± 2.20	16.20 ± 1.79
Dorsiflexion ROM	B	13.62 ± 2.46	15.65 ± 2.18	17.27 ± 1.93
Plantarflexion ROM	A	39.98 ± 3.17	42.23 ± 2.72	43.83 ± 2.12
Plantarflexion ROM	B	41.40 ± 3.56	43.02 ± 3.05	44.67 ± 3.03
Inversion ROM	A	27.10 ± 3.30	28.43 ± 3.56	29.27 ± 3.69
Inversion ROM	B	27.20 ± 3.24	28.50 ± 3.38	29.52 ± 3.49
Eversion ROM	A	11.97 ± 1.80	13.18 ± 1.76	13.70 ± 1.84
Eversion ROM	B	12.32 ± 2.10	13.22 ± 1.75	14.32 ± 1.66
VISA-A	A	60.05 ± 8.17	71.45 ± 7.45	80.65 ± 6.84
VISA-A	B	62.35 ± 6.59	73.00 ± 5.87	86.25 ± 4.38

Pain decreased progressively in both groups. At four weeks, the mean NPRS was 2.00 ± 0.86 in Group A and 1.35 ± 0.75 in Group B. The thesis analysis reported a statistically significant between-group difference at four weeks ($p = 0.015$).

Ankle ROM increased across the intervention period in both groups. Dorsiflexion increased from $13.15 \pm 2.76^\circ$ to $16.20 \pm 1.79^\circ$ in Group A and from $13.62 \pm 2.46^\circ$ to $17.27 \pm 1.93^\circ$ in Group B. Plantarflexion and inversion also increased in both groups, without a reported significant between-group difference at four weeks. Eversion increased from $11.97 \pm 1.80^\circ$ to $13.70 \pm 1.84^\circ$ in Group A and from $12.32 \pm 2.10^\circ$ to $14.32 \pm 1.66^\circ$ in Group B; the four-week between-group difference was reported as significant ($p = 0.032$).

VISA-A scores increased in both groups. Group A increased from 60.05 ± 8.17 at baseline to 80.65 ± 6.84 at four weeks, while Group B increased from 62.35 ± 6.59 to 86.25 ± 4.38 . The four-week between-group difference was reported as statistically significant ($p = 0.004$).

Table 3. Baseline-to-four-week change scores between groups.

Outcome	Group A change	Group B change	p value
NPRS	-3.70 ± 0.66	-4.35 ± 0.67	0.005
Dorsiflexion	3.05 ± 2.04	3.65 ± 1.09	0.036
Plantarflexion	4.85 ± 4.66	3.27 ± 1.29	0.288
Inversion	2.17 ± 0.88	2.33 ± 1.36	0.737
Eversion	1.73 ± 1.16	2.00 ± 1.08	0.235
VISA-A	20.60 ± 3.65	23.90 ± 4.12	0.012

Negative values indicate reduction in NPRS; positive values indicate increased ROM or VISA-A.

Table 4. Between-group comparisons at two and four weeks using the Mann–Whitney U test.

Outcome	2-week p value	4-week p value
NPRS	0.989	0.015



Outcome	2-week p value	4-week p value
Dorsiflexion ROM	0.405	0.052
Plantarflexion ROM	0.142	0.053
Inversion ROM	1.000	0.967
Eversion ROM	0.853	0.032
VISA-A	0.569	0.004

Within-group analysis showed statistically significant change across the repeated assessment points for the measured outcomes. Pairwise testing was performed using the Wilcoxon signed-rank test with Bonferroni adjustment. The reported baseline-to-four-week within-group comparisons were significant ($p < 0.001$).

4. Discussion

The present study compared DFM and PIR when each was combined with LWD in participants with midportion Achilles tendinopathy. The principal findings were improvements in pain, ankle ROM and VISA-A in both groups over the four-week treatment period. The groups were comparable at baseline for the principal measured outcomes, supporting subsequent between-group comparisons.

The reduction in NPRS observed in both groups is consistent with the broader literature describing improvement following conservative management of Achilles tendinopathy. Pressure- or friction-based massage has previously been studied as an adjunctive intervention, with reported improvements in patient-reported outcomes [9,10]. The present findings add a comparison with a PIR-based approach while maintaining LWD as a common adjunct.

The improvement in VISA-A in both groups indicates an increase in Achilles-specific functional status during the intervention period. Previous research using VISA-A in midportion Achilles tendinopathy supports its use as a condition-specific patient-reported outcome for monitoring clinical change [6,13]. The larger numerical increase in Group B was accompanied by the statistically significant between-group finding reported in the study analysis.

Ankle ROM increased in both groups. Dorsiflexion showed a significantly greater four-week change in Group B according to the change-score analysis ($p = 0.036$), although the four-week final value itself did not reach statistical significance between groups ($p = 0.052$). This distinction is important because statistical significance of a change score and statistical significance of the final value answer different questions.

Plantarflexion and inversion did not show significant between-group differences at four weeks. This indicates that the observed changes for these movements were not statistically distinguishable between the groups over the study period. Eversion showed a significant four-week between-group difference ($p = 0.032$).

PIR incorporates an isometric contraction followed by relaxation and movement toward the available range. The findings are compatible with previous work investigating muscle-energy approaches in Achilles tendinitis, although the evidence base remains smaller than that for progressive loading rehabilitation [11]. The present intervention should therefore be interpreted as an adjunctive manual technique rather than as a replacement for comprehensive tendon-loading rehabilitation.

LWD was provided to both groups, meaning that the independent contribution of LWD cannot be separated from the effects of DFM or PIR. Research on deep heating and Achilles tendon properties provides physiological context for its use, but the present trial does not establish the independent clinical efficacy of LWD [12].

Overall, the findings provide comparative clinical data on two manual therapy approaches used with the same adjunctive modality. However, the sample was small, the intervention period was four weeks, and there was no long-term follow-up. Larger controlled studies with longer follow-up and an appropriate rehabilitation control are required.

5. Limitations



- The sample size was relatively small (40 participants), which may limit generalizability.
- The intervention period was limited to four weeks and no longer-term follow-up was performed.
- Both groups received LWD, so the independent contribution of LWD, DFM and PIR could not be determined.
- The assessed outcomes were limited to pain, ankle ROM and Achilles-specific functional status.
- The study was conducted in a single physiotherapy setting, which may limit representativeness.
- The study focused on midportion Achilles tendinopathy; the findings may not be directly applicable to insertional Achilles tendinopathy.

6. Clinical Implications

The findings indicate that both DFM + LWD and PIR + LWD were associated with improvements in pain, ankle ROM and Achilles-specific functional status over four weeks. These approaches may be considered as adjunctive manual therapy components within a broader physiotherapy program. The reported between-group differences for selected outcomes should be interpreted in the context of the study design, sample size, treatment duration and absence of long-term follow-up.

7. Conclusion

Four weeks of treatment was associated with improvement in pain, ankle ROM and Achilles-specific functional status in both groups. The study analysis reported statistically significant between-group differences at four weeks for NPRS, eversion ROM and VISA-A, while the baseline-to-four-week change in dorsiflexion was also significantly different between groups. Plantarflexion and inversion did not demonstrate significant between-group differences. Further adequately powered studies with longer follow-up and appropriate rehabilitation control conditions are needed to clarify the comparative effects of DFM and PIR when used with LWD.

8. Declarations

Ethical approval: The study received ethical approval from the Institutional Ethical Committee of Prakash Institute of Physiotherapy, Rehabilitation and Allied Medical Sciences, Greater Noida. The approval documentation supplied for manuscript preparation records review at the meeting held on 15 March 2025 and an approval letter dated 1 April 2025.

Trial registration: Clinical Trials Registry–India (CTRI/2026/01/101292); trial reference REF/2026/01/121368.

Informed consent: Written informed consent was obtained from all participants before participation.

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Data availability: The underlying participant-level dataset is available from the corresponding author on reasonable request, subject to applicable ethical and institutional requirements.

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