# Efficacy of Myofascial Release in Improving the Flexibility of Erector Spinae and Thoracolumbar Fascia in Subjects with Chronic Low Back Pain—A Sonoelastographic Analysis

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*Background:* Chronic low back pain (CLBP) is characterized by its diverse etiological factors. Scientific literature implies that fasciae might be crucial in the presentation of CLBP. Myofascial release (MFR) techniques are frequently employed within the realm of manual therapy and are found to reduce pain. However, studies investigating the structural and biomechanical effects of MFR findings remain limited.

*Purpose:* This study aimed to determine and compare the effect of MFR and simulated MFR on the flexibility of the erector spinae (ES) muscles and thoracolumbar fascia (TLF) utilizing sonoelastography in individuals with CLBP.

*Methods:* An experimental study was conducted with 40 individuals diagnosed with CLBP, who were recruited from the outpatient department of a tertiary-care hospital based on specified eligibility criteria. Participants were then randomly assigned to one of the study groups. Stiffness of the ES muscle and TLF were assessed through sonoelastography, while fascial thickness was evaluated via B-mode ultrasound. Pain intensity was quantified using the Numerical Pain Rating Scale, and lumbar mobility was assessed through the modified–modified Schober's test. The statistical analysis was performed using an independent *t*-test with statistical significance established at $p < 0.05$.

*Results:* The between-group analysis showed a significant reduction in bilateral ES muscle and TLF stiffness ($p = 0.00$). There was also a significant reduction in TLF thickness when compared to the simulated group ($p = 0.00$). Additionally, an immediate decrease in pain intensity ($p = 0.00$) and an increase in trunk mobility ($p = 0.00$) were found in the MFR group when compared to the simulated MFR group.

*Conclusion:* The MFR group demonstrated immediate tissue changes, reduced pain intensity, and improved trunk mobility in comparison with the simulated MFR group.

KEYWORDS: Low back pain; fascia; back muscles; manual therapy; myofascial release; flexibility; ultrasonography; elastography

## INTRODUCTION

Low back pain (LBP) represents the most prevalent condition among the spectrum of musculoskeletal conditions globally and is recognized as a primary contributor to disability.[1] A comprehensive global analysis on the prevalence of LBP in adult population has indicated a point prevalence of approximately 12%, alongside a 1-year prevalence of 38%.[2] A significant proportion (approximately 90%) of LBP presentations are non-specific, indicating that the underlying etiology remains undetermined, with the diagnosis being made established through the process of ruling

out specific pathologies. Non-specific LBP can be delineated based on the duration of symptoms into acute (<6 weeks), subacute (>6 weeks <3 months), and chronic (3 months) classifications.[3,4]

Only 10–20% of individuals experiencing LBP transition to chronic low back pain (CLBP), which, although it represents a minor segment, constitutes a significant portion of the global burden of LBP owing to episodes of severe pain, significant physical disability, and constraints on activity.[5,6] LBP prevalence was observed to be 19.6% in individuals aged between 20 and 59 years.[5]

The thoracolumbar fascia (TLF) is comprised of dense connective tissue strata interspersed with layers of loose connective tissue, which typically facilitate the gliding of dense layers over one another during movements of the trunk.[7]

A comprehensive review underscores that fascia functions not merely as a passive anatomical structure but rather as an integral contributor to kinetic activity. It has an essential role in maintaining structural integrity and functional efficiency throughout the body playing a pivotal role in the transmission of force, flexibility, and stability. This review elucidates that restrictions within the fascia may significantly foster various dysfunctions.[8]

A growing body of research has indicated that fascia may contribute to the etiology of chronic pain,[9–11] attributable to their abundant nociceptive innervation, which has been demonstrated to initiate a substantial and enduring sensitization process.[12–16]

Studies employing ultrasound imaging techniques have provided valuable insights into the mechanical and structural changes of peri-muscular connective tissues in individuals with CLBP. These studies have elucidated that the TLF shows a significant reduction in shear strain, indicating impaired elasticity and mobility.[17] This reduction, which reflects an abnormal stiffness of the fascia, is further evidenced by an increase in its thickness, suggesting the presence of fibrotic changes within the tissue.[10] This delineates that the structural integrity of the connective tissue was compromised with a reduction in the normal organization of the fascia. Additionally, research has found an increased stiffness in the ES muscle, compared to asymptomatic controls.[18]

Prior research has indicated that the integrated soft-tissue mobilization effectively reduced pain and improved lumbar spine mobility in patients with CLBP.[19]

Myofascial release (MFR) is a soft-tissue mobilization technique widely utilized in manual therapy. It is aimed at diminishing adhesions and restoring or optimizing fascial sliding mobility through application of sustained pressure in both acute and chronic pathological conditions.[20–22]

A limited number of studies have evaluated the impact of MFR on the structural and biomechanical properties of fasciae using advanced imaging methodologies.[23–25] These studies reported a decrease in the cervical fascia thickness[23] and decrease in stiffness of the posterior layer of the TLF,[24] while a recent study observed no notable change in the stiffness of the TLF.[25]

Other studies that evaluated the effects of MFR on muscle reported a decrease in stiffness of the iliocostalis[26] and ES muscles[25–27] and a decrease in the elastic modulus of the ES muscle.[28] While the results of these studies are noteworthy, they offer limited breadth of evidence.

An earlier study demonstrated reduction in stiffness of TLF post MFR in asymptomatic adults,[23] whereas another study focusing on individuals with CLBP reported no statistically significant alterations in TLF stiffness when compared with a simulated intervention.[25] In addition, four studies specifically evaluated the effects of MFR on lumbar ES muscle but used varying imaging modalities, and few studies had indirect stiffness index assessments.[25–28] Hence, the specific effects of MFR remain unclear, with limited conclusive evidence supporting their efficacy in CLBP.

In light of literature, the main objective of this study was to compare the effects of MFR and simulated MFR on the stiffness of ES muscle and TLF through sonoelastography analysis. The secondary objective is to compare the effects of MFR and simulated MFR on (i) the thickness of the TLF, (ii) pain intensity, and (iii) trunk mobility.

## METHODS

### Study Design and Setting

This experimental study was conducted at the outpatient department of a tertiary-care hospital in Chennai, Tamil Nadu,

India between February and April 2025. Ethical clearance was obtained from the Institutional Ethics Committee (CSP-III/25/JAN/15/09). The trial was pre-registered under the Clinical Trial Registry of India (REF/2025/01/098303).

Forty participants were recruited based on the eligibility criteria and were allocated to one of two groups by stratified randomization. The groups were stratified based on gender to account for sex-related differences in TLF properties.[10,29] The ultrasound assessments of tissue thickness and stiffness were conducted by an ultrasonographer who was blinded to group allocation. All the outcome measurements related to pain and mobility were documented by the treating physiotherapist without disclosure of group assignment to the participants.

## Participants

To all the participants, the investigator explained the purpose and procedures of the study. Informed consent was obtained from each participant, and confidentiality was ensured throughout the study. Participants included individuals aged between 20 and 59 years who had been diagnosed with CLBP persisting over 6 months and reported a pain intensity exceeding 3 on the Numerical Pain Rating Scale (NPRS). The exclusion criteria encompassed a history of spinal surgical interventions, recent receipt of manual therapy targeting the lumbosacral area within the preceding month or during the study, the presence of back pain attributable to a recognized pathology, and the administration of corticosteroids in the lumbar region through injections within the last 6 months.

## Procedure

Demographic and clinical information were gathered, encompassing body mass index (BMI), LBP duration, lumbar flexion range of motion (as measured by the modified–modified Schober's test), pain intensity (utilizing NPRS), and the impact of pain on functional abilities (assessed through the Oswestry Disability Scale).

Participants underwent a pre-treatment evaluation administered by an associate consultant in radiodiagnosis, who possessed expertise in musculoskeletal ultrasonography yet remained uninvolved in the therapeutic interventions and, consequently, was blinded to group assignment.

Subsequently, participants were instructed to lie in a prone position for pre-treatment evaluation using sonoelastography after determining the L2–L3 interspinous space and placing the linear probe 2 cm laterally to the interspinous ligament. This level was chosen because this is the level where the fascia runs parallel to the skin and optimal for image acquisition.[10]

Following these assessments, a physiotherapist applied the MFR or the simulated MFR based on group assignment. The post-treatment assessment, which included the sonoelastographic evaluation, was then carried out by a blinded assessor. Trunk mobility and pain levels were measured both before and immediately following treatment by the physiotherapist.

## Intervention

All participants underwent a single 8-min MFR treatment. The MFR techniques utilized in the present study were adapted from those described in earlier research.[25,27] The therapist stood on the treating side at the lower chest level. Crossed hands were applied to the patient's skin with the caudal hand resting on the ilium and the cephalad hand over the inferior thorax (Figure 1). Gentle, sustained pressure was exerted to specifically engage the TLF and ES musculatures. Subsequently, the thera-

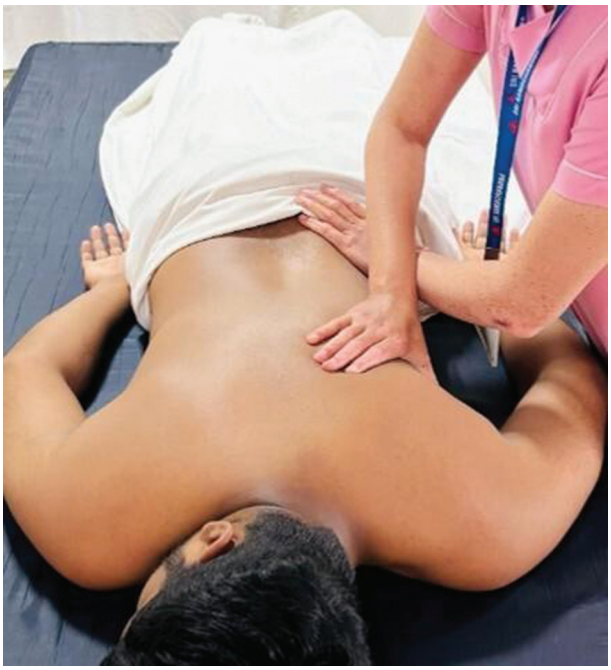

*Figure 1. Hand position for cross-hand release.*

pist stretched the tissue craniocaudally until the tissue depth barrier. Thereafter, the pressure was sustained inwards to the next depth barrier of tissue resistance. This technique was performed for 3 min on each side, followed by longitudinal deep strokes applied by having a loose fist (Figure 2). The strokes were performed three times in a cephalad direction for 60 s on each side, focusing on the ES muscle and TLF. During the simulated MFR, cross-hand release and longitudinal deep strokes were executed in a similar manner but involved superficial contact with the skin and no pressure applied between the hands.

## OUTCOMES

### Primary Outcome—Stiffness

The stiffness of the ES muscles and TLF was assessed using ultrasonography operating in the sonoelastography mode (LOGIQ P10; SL 12 MHz linear probe; GE Healthcare, Milwaukee, WI, USA).

An elasticity map, which is a sonoelastographic measurement box overlaid on the B-mode ultrasound image, is used in sonoelastographic analysis. To ensure comprehensive coverage of the tissue length within the elasticity map, four designated circles termed regions of interest (ROIs) were delineated. The stiffness was computed on the area indicated by the four circles placed over the elasticity map in the middle of the TLF (Figure 3A) and behind the epimysium for the ES muscle (Figure 3B). The ROIs' median stiffness was determined using the ultrasound machine's built-in software. For statistical analysis, the mean of three images was employed. The sonoelastographic measurements for the ES muscle[30] showed good reliability, and TLF[31] found an excellent intra-rater and inter-evaluator reliability.

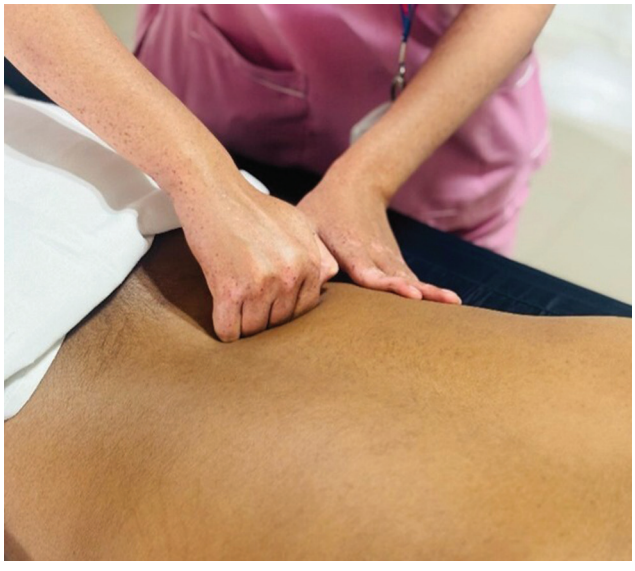

*Figure 2. Hand position for longitudinal deep strokes.*

### Secondary Outcomes

#### *Thickness*

The thickness of TLF was quantified using the B-mode ultrasound modality. Three images were acquired (Figure 4A and B), and the average of the measurements was computed for each side for the purposes of statistical analysis.

#### *Pain intensity*

The pain intensity was measured using NPRS, due to its extensive use in research contexts as it has shown good sensitivity to change.[32,33]

#### *Trunk mobility*

The modified–modified Schober's test which is a valid and reliable clinical tool was used to quantify lumbar flexion and detect changes following intervention.[34,35] Previous studies have shown that lumbar flexion range is significantly correlated with both functional disability and pain intensity in CLBP populations.[36]

#### *Sample size*

It was calculated using G-POWER 3.0.10 based on the results of previous research[26] and assumed a 95% study power and 95% confidence level, with an alpha error equal to 0.05. The sample size was estimated to be 40, with 20 samples in each group.

### Analysis

IBM SPSS Statistics (version 3.00, Armonk, NY) was used for all statistical analyses. Based on the variables (continuous or categorical) and normality of distribution, the independent *t*-test, chi-square test, and Mann–Whitney *U* test were utilized to evaluate the clinical and demographic data of the two groups prior to treatment. The independent *t*-test was employed for the analysis between groups, whereas the paired *t*-test was utilized for the analysis within groups. The significance level was

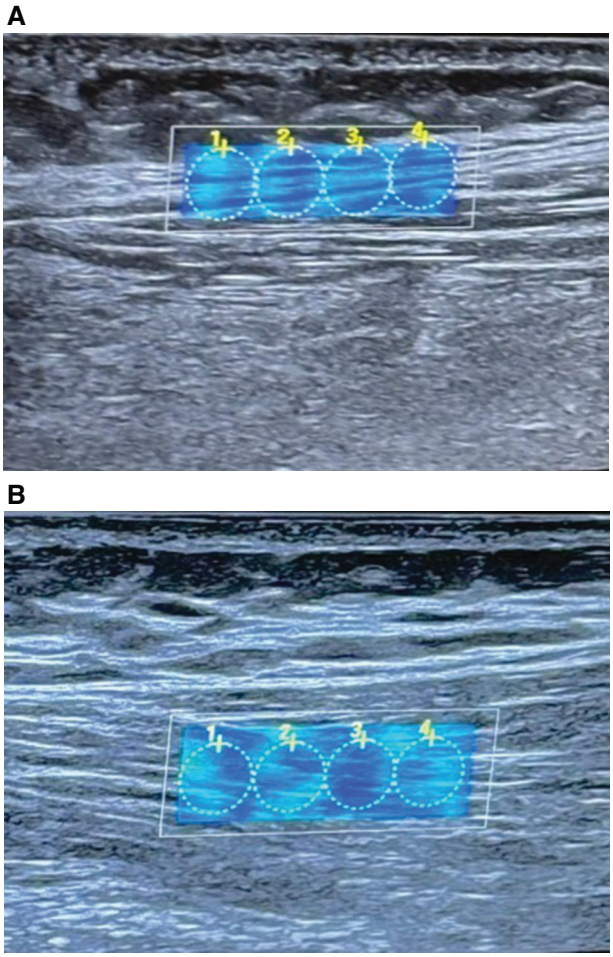


*Figure 3. Regions of interest in elastographic images. (A) TLF. (B) ES muscle. ES = erector spinae; TLF = thoracolumbar fascia.*

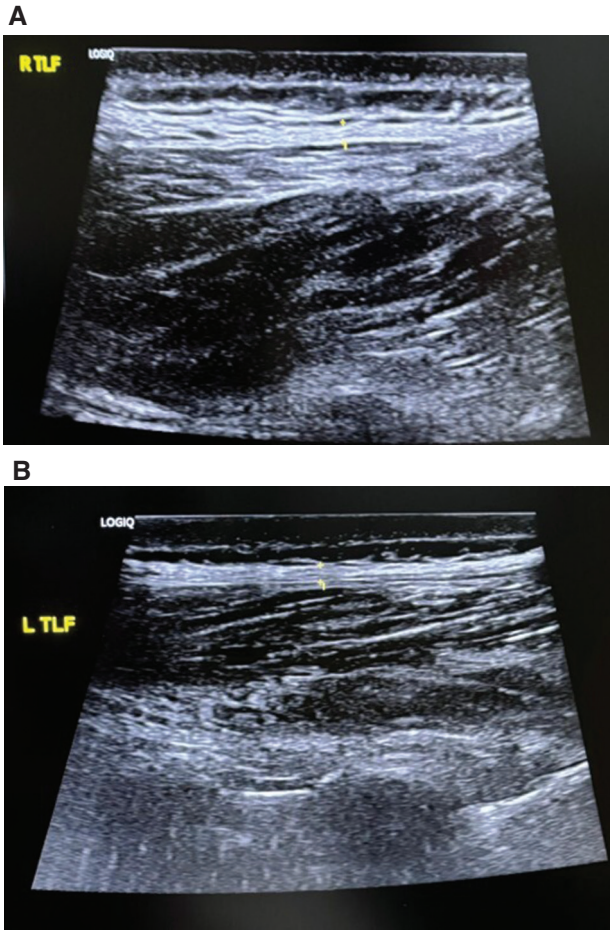


*Figure 4. Thickness of the TLF in ultrasound images: (A) Right TLF. (B) Left TLF. TLF = thoracolumbar fascia.*

established at p = 0.05. Cohen's suggested criteria, which state that a *d* = 0.96 implies a large effect and high clinical value, were used to compute the effect size.

## RESULTS

Forty participants who met the inclusion criteria were allocated randomly to either the MFR group or the simulated MFR group. The baseline characteristics including age, sex distribution, duration of pain, BMI, Schober's index, pain scores, disability index, stiffness, and thickness values between the two groups did not show a significant difference (Table 1), indicating that the groups were comparable at baseline.

Table 2 delineates the comparative analysis between groups at pre- and post-intervention. The stiffness metrics calculated using sonoelastography showed a statistically significant difference between groups in bilateral TLF (mean difference: −3.33 kPa; p = 0.04; mean difference: −4.92 kPa; p = 0.00). Furthermore, the between-group analysis of bilateral ES muscle stiffness showed a significant difference (mean difference: −6.76 kPa; p = 0.00; mean difference: −5.51 kPa; p = 0.00). The TLF thickness data assessed with B-mode ultrasound between groups for changes in the thickness of the TLF showed a significant difference (mean difference: −0.07 cm; p = 0.00; mean difference: −0.09 cm; p = 0.00). Immediately following treatment, the MFR cohort exhibited a substantial reduction in pain intensity (mean difference: 0.90; p = 0.00), alongside marked improvements in trunk mobility (mean difference: 0.00; p = 0.00).

Table 3 represents the within-group analysis of the MFR group, which shows statistically significant results in all the

TABLE 1. Characteristics of Participants in the MFR and the Simulated MFR Group

| *Parameter* | *MFR (n = 20)* | *Simulated MFR (n = 20)* | *p-Value* |
|---|---|---|---|
| Age (years), mean ± SD | 46.55 ± 7.28 | 44.55 ± 9.41 | 0.45[a] |
| Sex (male/female), n (%) | 10/10 (50%/50%) | 10/10 (50%/50%) | 1.00[b] |
| Duration of pain (months), mean ± SD | 8.95 ± 2.37 | 9.50 ± 2.28 | 0.49[c] |
| BMI (kg/m$^2$), mean ± SD | 24.68 ± 1.8 | 25.02 ± 1.49 | 0.45[c] |
| Schober index (cm), mean ± SD | 6.50 ± 1.28 | 6.05 ± 1.50 | 0.31[a] |
| Numeric Pain Rating Scale, mean ± SD | 6.83 ± 0.46 | 6.97 ± 0.45 | 0.33[a] |
| Oswestry Disability Index (%), mean ± SD | 18.90 ± 2.85 | 17.05 ± 3.39 | 0.06[a] |
| Right TLF stiffness, kPa, mean ± SD | 31.53 ± 5.41 | 30.09 ± 4.67 | 0.37[a] |
| Left TLF stiffness, kPa, mean ± SD | 30.25 ± 4.17 | 31.07 ± 5.21 | 0.58[a] |
| Right ES stiffness, kPa, mean ± SD | 22.77 ± 4.65 | 22.07 ± 3.82 | 0.61[a] |
| Left ES stiffness, kPa, mean ± SD | 22.56 ± 4.42 | 22.14 ± 4.36 | 0.76[a] |
| Right TLF thickness, cm, mean ± SD | 0.31 ± 0.09 | 0.29 ± 0.03 | 0.35[a] |
| Left TLF thickness, cm, mean ± SD | 0.30 ± 0.08 | 0.31 ± 0.04 | 0.62[a] |

[a]Independent *t*-test; [b]chi-squared test; [c]Mann–Whitney *U* test.

BMI = body mass index; ES = erector spinae; MFR = myofascial release; SD = standard deviation; TLF = thoracolumbar fascia.

parameters such as bilateral TLF and ES muscle stiffness and bilateral TLF thickness, pain intensity, and trunk mobility ($p < 0.05$). The MFR group demonstrated large to very large effect sizes ($d > 0.8$) across all outcomes, indicating substantial clinical impact.

Table 4 represents the within-group analysis of simulated MFR, which shows statistically significant results only in pain intensity ($p = 0.00$) and trunk mobility ($p = 0.00$), whereas the other parameters were not statistically significant ($p > 0.05$). The simulated MFR group showed negligible effect size on stiffness and thickness parameters. Only pain intensity ($d = 0.45$) and trunk mobility ($d = 0.49$) demonstrated small effect size, suggesting minimal physiological impact from the simulated intervention.

## DISCUSSION

The present study aimed to determine and compare the effect of MFR and simulated MFR on the flexibility of the ES muscles and TLF using sonoelastography and found a significant reduction in bilateral TLF stiffness in the MFR group in comparison to the simulated group. Previous studies have reported no significant changes in TLF stiffness in individuals with CLBP when compared to a simulated intervention.[25] Although the dosage and duration of the current study aligns with the previous study, this discrepancy may be attributable to ethnic, regional, and lifestyle differences that influence fascial loading patterns and baseline tissue characteristics.

Notably, in this study, the baseline TLF stiffness in our Indian cohort with CLBP was approximately 30 kPa, which contrasts with higher values reported in Western populations in the previous study.[25] The plausible explanation is that the ethnic variances in muscular composition, as elucidated in a previous study between Asians and Caucasian,[37] may possess considerable ramifications for the TLF, which exhibits biomechanical and functional interdependence with the underlying paraspinal musculature.[38] This underscores the need to consider demographic and biomechanical heterogeneity within fascia-related research.

The current study demonstrated a significant reduction in bilateral ES muscle stiffness in the MFR group in comparison

TABLE 2. Between-Group Comparison at Each Time Point and Differences Between the MFR and the Simulated MFR Groups

| *Structures* | *Time Points* | *MFR Mean ± SD (n = 20)* | *Simulated MFR Mean ± SD (n = 20)* | *Mean Difference* | *95% CI* | *p-Value* |
|---|---|---|---|---|---|---|
| Right TLF stiffness, kPa | Pre-treatment | 31.53 ± 5.41 | 30.09 ± 4.67 | | | |
| | Post-treatment | 26.61 ± 5.07 | 29.93 ± 5.13 | −3.33 | −6.59 to −0.06 | 0.04* |
| Left TLF stiffness, kPa | Pre-treatment | 30.25 ± 4.17 | 31.07 ± 5.21 | | | |
| | Post-treatment | 26.02 ± 3.67 | 30.94 ± 5.45 | −4.92 | −7.90 to −1.95 | 0.00* |
| Right ES stiffness, kPa | Pre-treatment | 22.77 ± 4.65 | 22.07 ± 3.82 | | | |
| | Post-treatment | 14.66 ± 3.02 | 21.42 ± 3.90 | −6.76 | −8.99 to −4.52 | 0.00* |
| Left ES stiffness, kPa | Pre-treatment | 22.56 ± 4.42 | 22.14 ± 4.36 | | | |
| | Post-treatment | 15.79 ± 4.12 | 21.30 ± 4.47 | −5.51 | −8.26 to −2.75 | 0.00* |
| Right TLF thickness, cm | Pre-treatment | 0.31 ± 0.09 | 0.29 ± 0.03 | | | |
| | Post-treatment | 0.22 ± 0.08 | 0.29 ± 0.04 | −0.07 | −0.11 to −0.02 | 0.00* |
| Left TLF thickness, cm | Pre-treatment | 0.30 ± 0.08 | 0.31 ± 0.04 | | | |
| | Post-treatment | 0.21 ± 0.08 | 0.30 ± 0.04 | −0.09 | −0.13 to −0.04 | 0.00* |
| Pain intensity | Pre-treatment | 6.83 ± 0.46 | 6.97 ± 0.45 | | | |
| | Post-treatment | 4.55 ± 1.15 | 5.45 ± 1.10 | −0.90 | −1.62 to −0.18 | 0.00* |
| Trunk mobility | Pre-treatment | 6.50 ± 1.28 | 6.05 ± 1.50 | | | |
| | Post-treatment | 8.14 ± 0.48 | 7.19 ± 0.44 | 0.94 | 0.64 to 1.24 | 0.00* |

*Significant value.

CI = confidence interval; ES = erector spinae; MFR = myofascial release; SD = standard deviation; TLF = thoracolumbar fascia.

TABLE 3. Within-Group Comparison of Pre-Test and Post-Test Results of the MFR Group

| *Structures* | *Pre-Test (Mean + SD)* | *Post-Test (Mean + SD)* | *Mean Difference* | *95% CI* | *p-Value* | *Effect Size (d)* |
|---|---|---|---|---|---|---|
| Right TLF stiffness, kPa | 31.53 ± 5.41 | 26.61 ± 5.07 | 4.930 | 1.57 to 8.29 | 0.00* | 0.93 |
| Left TLF stiffness, kPa | 30.25 ± 4.17 | 26.02 ± 3.67 | 4.23 | 3.61 to 4.85 | 0.00* | 1.07 |
| Right ES stiffness, kPa | 22.77 ± 4.65 | 14.66 ± 3.02 | 8.11 | 6.33 to 9.88 | 0.00* | 2.06 |
| Left ES stiffness, kPa | 22.56 ± 4.42 | 15.79 ± 4.12 | 6.77 | 5.34 to 8.19 | 0.00* | 1.58 |
| Right TLF thickness, cm | 0.31 ± 0.09 | 0.22 ± 0.08 | 0.08 | 0.06 to 0.11 | 0.00* | 1.05 |
| Left TLF thickness, cm | 0.30 ± 0.08 | 0.21 ± 0.08 | 0.08 | 0.05 to 0.11 | 0.00* | 1.12 |
| Pain intensity | 6.50 ± 1.28 | 4.55 ± 1.15 | 1.95 | 1.56 to 2.34 | 0.00* | 1.60 |
| Trunk mobility, cm | 6.83 ± 0.46 | 8.14 ± 0.48 | 1.31 | 1.46 to 1.14 | 0.00* | 2.78 |

*Significant value.

Cohen's *d* effect size shows that *d* = 0.2 be considered a small effect size, *d* = 0.5 represents a medium effect size, *d* = 0.8 represents a large effect size, and *d* = 1.3 represents a very large effect size.

CI = confidence interval; ES = erector spinae; MFR = myofascial release; SD = standard deviation; TLF = thoracolumbar fascia.

TABLE 4. Within-Group Comparison of Pre-Test and Post-Test Results of the Simulated MFR Group

| *Structures* | *Pre-Test (Mean + SD)* | *Post-Test (Mean + SD)* | *Mean Difference* | *95% CI* | *p-Value* | *Effect Size (d)* |
|---|---|---|---|---|---|---|
| Right TLF stiffness, kPa | 30.09 ± 4.67 | 29.93 ± 5.13 | 0.16 | −0.70 to 1.02 | 0.70 | 0.03 |
| Left TLF stiffness, kPa | 31.07 ± 5.21 | 30.94 ± 5.45 | 0.12 | −0.57 to 0.82 | 0.71 | 0.02 |
| Right ES stiffness, kPa | 22.07 ± 3.82 | 21.42 ± 3.90 | 0.65 | −0.19 to 1.4 | 0.12 | 0.16 |
| Left ES stiffness, kPa | 22.14 ± 4.36 | 21.30 ± 4.47 | 0.84 | 0.00 to 1.69 | 0.06 | 0.19 |
| Right TLF thickness, cm | 0.29 ± 0.03 | 0.29 ± 0.04 | 0.00 | 0.00 to 0.01 | 0.25 | 0.00 |
| Left TLF thickness, cm | 0.31 ± 0.04 | 0.30 ± 0.04 | 0.00 | 0.00 to 0.01 | 0.06 | 0.25 |
| Pain intensity | 6.05 ± 1.5 | 5.45 ± 1.1 | 0.60 | 0.22 to 0.98 | 0.00* | 0.45 |
| Trunk mobility, cm | 6.97 ± 0.45 | 7.19 ± 0.44 | 0.22 | −0.29 to 0.15 | 0.00* | 0.49 |

*Significant value.

Cohen's *d* effect size shows that *d* = 0.2 be considered a small effect size, *d* = 0.5 represents a medium effect size, *d* = 0.8 represents a large effect size, and *d* = 1.3 represents a very large effect size.

CI = confidence interval; ES = erector spinae; MFR = myofascial release; SD = standard deviation; TLF = thoracolumbar fascia.

with the simulated group, which is in line with the previous study results.[25]

While a previous study reported a statistically significant difference only in the left TLF thickness between groups, in which their simulated group showed a notable increase, the intervention group showed only a minor decrease.[25] The present study also found a significant reduction in the thickness of the bilateral TLF in the MFR group following intervention, whereas the simulated group did not have a corresponding increase. The most plausible rationale for this reduction in fascial thickness is the mechanical strain imposed during MFR, which may have induced interstitial fluid extrusion from the extracellular matrix within the fascial tissue. This hypothesis is supported by in vitro studies that demonstrate tissue deformation leading to measurable changes in fascial structure and hydration dynamics under mechanical loading.[39] The absence of a similar response in the simulated group further confirms the physiological specificity of MFR and suggests that superficial contact alone is insufficient to provoke changes in deep fascial layers.

Additionally, the present study indicates that a single session of MFR results in the reduction of pain intensity and improvement in trunk mobility among individuals with CLBP. The observed pain reduction may be explained by several physiological mechanisms. Firstly, the activation of mechanoreceptors embedded within fascial tissues are known to influence the central nervous system's processing of nociceptive input.[10] Secondly, the fascia is richly innervated and has been recognized as a significant contributor to pain modulation.[12,14] Thus, our findings regarding pain are consistent with the previous study results.[25]

The improvement in trunk mobility post-intervention in the MFR group may be attributed to improved gliding between the layers of the TLF. These findings are in line with the previous study, which found that myofascial interventions facilitate greater tissue deformation and mobility in asymptomatic subjects.[24] Similarly, another study by Geetha Hari Priya et al. (2020) demonstrated that fascial manipulation targeting the lateral thigh region significantly improved lumbar flexibility assessed using modified Schober's test in individuals with mechanical LBP. This parallel in outcomes, despite differences in anatomical treatment sites, underscores the systemic and interconnected nature of the fascial system.[40]

Although participants in the simulated MFR group reported some pain relief and improvements in trunk mobility, this effect is likely due to placebo and psychosocial factors. The larger effect size in the MFR group indicates that the standardized MFR had more substantial impact on pain relief and trunk mobility, beyond the psychological factors influencing the simulated group.

Future research should consider the inclusion of a healthy control group to establish baseline values for the stiffness of TLF. Additionally, incorporating a long-term follow-up would help assess the sustainability of the intervention's effects over time. Furthermore, future studies could benefit from integrating functional tests, such as the sit-and-reach test, to evaluate the practical impact of MFR on flexibility and mobility.

## CONCLUSION

Non-specific CLBP remains one of the most prevalent health issue globally. This clinical phenomenon is characterized by a complex interplay of various contributing factors, with the role of fasciae increasingly suspected to be involved. The intervention of CLBP via MFR plays a significant role in enhancing public health outcomes by diminishing rates of disability and elevating overall quality of life. This sonoelastographic analysis provided objective evidence of fascial response to MFR, revealing that a single session of MFR significantly reduced the stiffness of the TLF and ES muscles when compared to simulated MFR. Additionally, the MFR group found a reduction in the thickness of TLF and pain intensity, and an improvement in trunk mobility compared to the simulated group.

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## CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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## AUTHOR CONTRIBUTIONS

R. Angeline: conceptualized and analyzed the data, and interpreted the findings. J. Manisha: designed the study, collected data, and drafted the manuscript. Rajeev Pulimi: acquired and formally analyzed the study data. Sharath Raj Mohan Doss: acquired the data for this study. P. Antony Leo Aseer: provided a critical review and intellectual input for the study. K. Subbiah: reviewed and edited the manuscript.



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