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Original Article

Comparative Effects of ELDOA With and Without Muscle Energy Technique on Pain, Range of Motion and Functional Disability in Patients with Quadratus Lumborum Syndrome

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ABSTRACT

Background: Quadratus lumborum syndrome is associated with low back pain, restricted lumbar mobility, and functional limitation. ELDOA and Muscle Energy Technique (MET) are used in musculoskeletal rehabilitation, but evidence regarding their combined effects in this condition remains limited. Objective: To compare the effects of ELDOA combined with MET versus ELDOA combined with conventional physical therapy on pain, lumbar range of motion, and functional disability in patients with quadratus lumborum syndrome. Methods: A single-center randomized controlled trial was conducted at Islam Teaching Hospital, Sialkot. The manuscript reports 38 participants aged 18–45 years who received treatment three times weekly for six weeks. Group A received ELDOA plus MET, whereas Group B received ELDOA plus conventional physical therapy. Outcomes included the Numeric Pain Rating Scale (NPRS), Modified Oswestry Disability Index (MODI), lumbar range of motion, and quadratus lumborum test. Shapiro–Wilk testing demonstrated non-normal distributions; Mann–Whitney U and Wilcoxon signed-rank tests were applied with $p<0.05$. Results: Post-treatment differences favored Group A for NPRS (mean ranks 13.05 vs. 27.95, $p<0.001$), MODI (12.65 vs. 28.35, $p<0.001$), lumbar flexion (26.20 vs. 14.80, $p=0.002$), lateral rotation (24.23 vs. 16.78, $p=0.042$), and quadratus lumborum test scores (26.63 vs. 14.38, $p=0.001$). Lumbar extension also differed significantly from post-treatment ($p<0.001$), although a significant baseline difference was present ($p=0.011$). Conclusion: ELDOA combined with MET was associated with more favorable short-term pain, disability, and selected lumbar mobility outcomes than ELDOA combined with conventional physical therapy. Keywords: ELDOA; Muscle Energy Technique; Quadratus Lumborum Syndrome; Low Back Pain; Range of Motion; Functional Disability.

INTRODUCTION

Low back pain is a major musculoskeletal problem associated with pain, impaired mobility, activity limitation, and reduced functional performance. Among the muscular structures contributing to lumbar stability, the quadratus

lumborum (QL) has an important role in controlling the lumbar spine and pelvis during postural and trunk movements. Dysfunction of this muscle has been recognized as a potential contributor to chronic non-specific low back pain, particularly when altered muscle length, impaired recruitment, or myofascial involvement is present (1). Active myofascial trigger points within the QL may produce localized or referred pain and can contribute to restricted movement and impaired lumbar function, making identification and targeted management of QL dysfunction clinically relevant in patients presenting with mechanical low back symptoms (2).

Quadratus lumborum syndrome (QLS) is characterized clinically by pain and dysfunction associated with the QL muscle and may present with localized low back pain, muscular tenderness, active trigger points, restricted lumbar mobility, and difficulty performing activities requiring trunk movement. Myofascial involvement of the QL has been specifically investigated in patients with low back pain, and interventions directed toward QL trigger points have demonstrated measurable changes in pain-related outcomes (3,4). Because pain, muscle tightness, and restricted spinal movement may interact to limit daily activities, rehabilitation of QLS requires an approach that addresses both symptomatic pain and the associated impairments in mobility and function.

Conservative physical therapy interventions used for QL-related low back pain include stretching, manual therapy, exercise, myofascial techniques, and interventions intended to improve muscle extensibility and spinal movement. Stretching of a shortened QL has been investigated in patients with non-specific low back pain and has been associated with improvement in clinically relevant symptoms (5). Comparative research involving myofascial release, stretching, and Muscle Energy Technique (MET) has also demonstrated that directly targeting the QL can influence pain and musculoskeletal function in patients with non-specific low back pain (6). These findings support the clinical rationale for interventions specifically directed toward QL dysfunction rather than relying exclusively on generalized low back rehabilitation.

Muscle Energy Technique is an active manual therapy approach in which a patient performs a voluntary muscular contraction against controlled resistance provided by the therapist. Post-isometric relaxation is one form of MET commonly used to facilitate muscle relaxation and improve extensibility following an isometric contraction. Clinical investigations targeting QL-related myofascial pain have reported beneficial changes following MET, including studies comparing MET with dry needling, extracorporeal shock-wave therapy, and passive stretching or post-isometric relaxation approaches (3,4,7). Evidence from a broader systematic review of musculoskeletal disorders also suggests that MET may influence range of motion, flexibility, and physical function, although its relative advantage over other interventions is not consistent across all outcomes and clinical conditions (8). Consequently, MET may represent a useful component of multimodal rehabilitation, but its additional value should be evaluated within specific clinical populations and treatment combinations.

Longitudinal Osteo-Articular Decoaptation (ELDOA) is an exercise-based therapeutic approach involving specific postural positioning and active tension intended to influence segmental spinal loading and mobility. Available clinical research has evaluated ELDOA-based interventions in spinal musculoskeletal disorders, including cervical radiculopathy, lumbar disc protrusion, and non-specific low back pain (9–11). These studies provide preliminary clinical support for the use of ELDOA-oriented exercises for pain, disability, and spinal mobility outcomes; however, their populations and comparator interventions differ from patients specifically diagnosed with QLS. Therefore, findings from other spinal disorders cannot be assumed to establish the effectiveness of ELDOA for QLS without direct investigation.

The potential rationale for combining ELDOA and MET lies in their different therapeutic targets. An ELDOA-based program primarily emphasizes specific spinal positioning and active postural exercise, whereas MET directly addresses muscular extensibility and neuromuscular components of movement restriction. Since patients with QLS may present with both pain-related limitation and QL muscle dysfunction, incorporating MET into an ELDOA-based rehabilitation program could potentially provide additional clinical benefit. Nevertheless, evidence directly determining whether the addition of MET produces greater improvement than an ELDOA-based program with conventional physical therapy remains limited. Existing QL-focused studies have predominantly examined MET against other manual or physical therapy interventions, whereas available ELDOA research has largely involved other spinal conditions (3,6,7,9–11). This creates a clinically relevant evidence gap regarding the comparative effects of combining these approaches in patients with QLS.

Accordingly, the present randomized controlled trial aimed to compare the effects of ELDOA combined with Muscle Energy Technique and ELDOA combined with conventional physical therapy on pain intensity, lumbar range of motion, and functional disability in patients with quadratus lumborum syndrome. It was hypothesized that the two treatment approaches would differ in their effects on these clinical outcomes.

MATERIALS AND METHODS

A single-center, parallel-group randomized controlled trial was conducted at Islam Teaching Hospital, Sialkot, to compare the effects of ELDOA combined with Muscle Energy Technique (MET) with ELDOA combined with conventional physical therapy in patients with quadratus lumborum syndrome. The study was completed within six months following synopsis approval by the ethical committee of Riphah College of Rehabilitation and Allied Health Sciences. A non-probability convenience sampling technique was used for initial recruitment. After screening against the predefined eligibility criteria and obtaining informed consent, eligible participants were randomly allocated into two treatment groups using a computer-generated randomization procedure. The study was conducted as a single-blind trial in which the outcome assessor was kept unaware of treatment allocation; blinding of participants and treating clinicians was not feasible because of the visibly different intervention procedures.

The planned sample size was 38 participants after allowing for a 10% attrition rate. Participants were eligible if they were male, aged 18–45 years, had one or more trigger points with an active trigger point in the quadratus lumborum muscle, and reported pain greater than 5 on the Numeric Pain Rating Scale (NPRS). Participants were excluded if they had an acute muscular injury, localized or systemic infection, lumbar disc herniation, spinal abnormalities, anticoagulant use or a bleeding disorder, or a psychiatric condition that could interfere with their ability to provide informed consent. Following eligibility assessment, participants were allocated to Group A, which received ELDOA combined with MET using post-isometric relaxation, or Group B, which received ELDOA combined with conventional physical therapy.

Both groups received treatment three times per week for six weeks, providing a planned total of 18 treatment sessions. Before the intervention procedures, a hot pack was applied to the affected lumbar region for approximately 10–15 minutes in both groups as a common baseline treatment. In Group A, participants performed ELDOA exercises together with post-isometric relaxation MET. For the seated ELDOA procedure, participants sat upright on the floor with the lower limbs apart, knees semi-flexed, feet positioned outward and upward, the lumbar spine maintained in an upright position, the arms elevated with the palms facing upward, and the chin retracted. For the L5–S1 ELDOA position, participants lay supine with the lower limbs elevated and supported against a wall, the knees maintained in extension, and the upper limbs elevated and externally rotated with wrist extension while active axial tension was maintained. The ELDOA exercise was performed for two sets of four repetitions, with a 30-second hold and approximately 15 seconds of rest between repetitions, and the reported protocol was repeated during each treatment session throughout the six-week intervention period.

For the MET component in Group A, post-isometric relaxation was applied to the quadratus lumborum with the participant positioned in side-lying and the therapist standing posteriorly at waist level. The participant's upper arm was extended overhead to grasp the upper end of the treatment plinth. During inhalation, the uppermost lower limb was abducted until quadratus lumborum activity was detected, generally at approximately 30° of abduction. The participant then maintained an isometric contraction against resistance for approximately 10 seconds. Following relaxation and expiration, the therapist stabilized the pelvis and gently increased the stretch by directing the pelvis away from the lower ribs. The reported MET protocol consisted of two sets of four repetitions with a 30-second hold and approximately 15 seconds of rest between repetitions and was administered throughout the six-week treatment period. Group B received ELDOA in combination with the conventional physical therapy protocol specified for the comparator group, with the same six-week frequency and treatment schedule.

Outcome assessments were performed before the first treatment session and again after completion of the sixth week of intervention. Pain intensity was assessed using the 11-point Numeric Pain Rating Scale, ranging from 0, representing no pain, to 10, representing the worst possible pain (12). Lumbar range of motion was assessed using a universal goniometer, which was used to quantify the spinal movements evaluated in the study, including lumbar flexion, extension, and the reported lateral rotational movement (13). Functional disability related to low back pain was assessed using the Modified Oswestry Disability Index (MODI), a patient-reported measure of limitations in activities of daily living associated with low back pain (14).

Clinical assessment of quadratus lumborum dysfunction was also undertaken. For the quadratus lumborum test, the participant was positioned in side-lying with the upper arm placed overhead to expose the lateral lumbar region. The examiner palpated the lateral border of the quadratus lumborum while the participant abducted the uppermost lower limb and simultaneously monitored gluteus medius activity. Early or simultaneous activation of the quadratus lumborum relative to the gluteus medius was considered indicative of quadratus lumborum overactivity or shortening. Baseline and post-intervention assessments were obtained using the same clinical outcome framework to maintain consistency of measurement across the two treatment groups.

Potential measurement bias was reduced through assessor blinding, while treatment exposure was standardized by providing both groups with the same intervention frequency, overall treatment duration, and pretreatment hot-pack application. Eligibility criteria were applied before group allocation, and outcome measurements were obtained at equivalent pre-intervention and post-intervention time points for both groups. The use of the same outcome instruments throughout the trial was intended to maintain consistency of data collection.

Data were entered and analyzed using IBM SPSS Statistics for Windows, version 25. Statistical significance was set at $p<0.05$. Descriptive statistics were used to summarize participant characteristics and study outcomes. The distribution of continuous outcome variables was assessed using the Shapiro–Wilk test. Because the analyzed outcome data did not satisfy the assumption of normality, non-parametric statistical procedures were applied. Between-group differences in NPRS, MODI, lumbar range-of-motion variables, and the quadratus lumborum assessment at the measured time points were evaluated using the Mann–Whitney U test. Pre- to post-intervention changes were evaluated using the Wilcoxon signed-rank test. Statistical findings were interpreted in relation to the predefined level of significance.

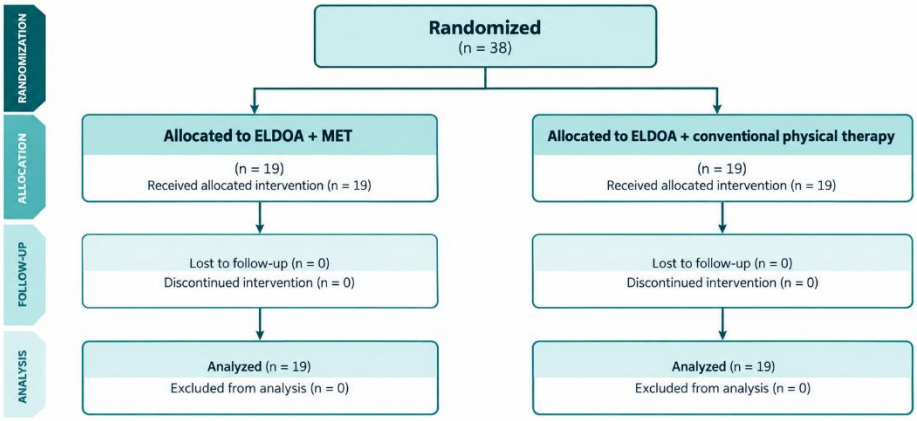

Figure 1 CONSORT Flowchart

All participants were informed about the study procedures before enrollment, and informed consent was obtained before data collection. The study was undertaken following approval of the research synopsis by the relevant ethical committee of Riphah College of Rehabilitation and Allied Health Sciences. Participant eligibility, treatment allocation, intervention delivery, and outcome assessment were conducted according to the predefined study protocol.

RESULTS

The study included 38 participants with a mean age of 33.65 ± 7.47 years. Participant age ranged from 18 to 45 years, indicating that the study population primarily consisted of young to middle-aged adults. Assessment of data distribution using the Shapiro–Wilk test demonstrated statistically significant departures from normality for all baseline clinical outcomes. The Numeric Pain Rating Scale showed a Shapiro–Wilk statistic of 0.866 ($p<0.001$), while lumbar flexion demonstrated a statistic of 0.922 ($p=0.009$). Lumbar extension was also non-normally distributed, with a statistic of 0.949 ($p=0.002$), whereas lumbar lateral rotation had a statistic of 0.955 ($p=0.001$). Similarly, the Modified Oswestry Disability Index showed a statistic of 0.939 ($p<0.001$), and the quadratus lumborum test demonstrated a statistic of 0.937 ($p=0.001$). As all p-values were below 0.05, non-parametric statistical procedures were used for subsequent comparisons.

At baseline, Numeric Pain Rating Scale scores were comparable between the two intervention groups, with mean ranks of 20.78 in Group A and 20.23 in Group B (Z=−0.157, p=0.875). Following treatment, a statistically significant between-group difference was observed, with mean ranks of 13.05 in Group A and 27.95 in Group B (Z=−4.135, p<0.001). Because lower NPRS scores indicate less pain, the direction of the post-treatment ranks was consistent with lower pain scores in the ELDOA plus Muscle Energy Technique group compared with the ELDOA plus conventional physical therapy group.

Table 1. Age Characteristics of the Study Participants

Variable	n	Mean ± SD	Minimum	Maximum
Age, years	38	33.65 ± 7.47	18	45

Table 2. Shapiro–Wilk Test of Normality for Baseline Outcome Measures

Outcome	Shapiro–Wilk Statistic	df	p-value
Numeric Pain Rating Scale	0.866	38	<0.001
Lumbar flexion	0.922	38	0.009
Lumbar extension	0.949	38	0.002
Lumbar lateral rotation	0.955	38	0.001
Modified Oswestry Disability Index	0.939	38	<0.001
Quadratus lumborum test	0.937	38	0.001

Note: p<0.05 indicates evidence of departure from normality.

Table 3. Between-Group Comparison of Clinical Outcomes Before and After Intervention

Outcome	Time Point	Group A Mean Rank	Group B Mean Rank	Z-value	p-value
Numeric Pain Rating Scale	Pre-treatment	20.78	20.23	−0.157	0.875
	Post-treatment	13.05	27.95	−4.135	<0.001
Modified Oswestry Disability Index	Pre-treatment	19.50	21.50	−0.543	0.587
	Post-treatment	12.65	28.35	−4.251	<0.001
Lumbar flexion	Pre-treatment	23.40	17.60	−1.575	0.115
	Post-treatment	26.20	14.80	−3.096	0.002
Lumbar extension	Pre-treatment	25.18	15.83	−2.538	0.011
	Post-treatment	28.78	12.23	−4.486	<0.001
Lumbar lateral rotation	Pre-treatment	20.15	20.85	−0.191	0.848
	Post-treatment	24.23	16.78	−2.029	0.042
Quadratus lumborum test	Pre-treatment	22.55	18.45	−1.111	0.267
	Post-treatment	26.63	14.38	−3.320	0.001

Statistical test: Mann–Whitney U test. Group A: ELDOA + Muscle Energy Technique. Group B: ELDOA + conventional physical therapy. Statistical significance: p<0.05.

Table 4. Reported Pre- to Post-Intervention Changes in Clinical Outcomes

Outcome	Pre-treatment, Mean ± SD	Post-treatment, Mean ± SD	Z-value	p-value
Numeric Pain Rating Scale	8.52 ± 0.96	2.40 ± 1.31	−5.614	<0.001
Modified Oswestry Disability Index	51.77 ± 5.88	31.62 ± 8.15	−5.597	<0.001
Lumbar flexion	40.62 ± 6.36	52.90 ± 8.43	−5.626	<0.001
Lumbar extension	18.52 ± 3.90	26.30 ± 5.32	−5.601	<0.001
Lumbar lateral rotation	14.45 ± 2.43	20.60 ± 2.93	−5.545	<0.001
Quadratus lumborum test	29.17 ± 5.87	41.32 ± 6.95	−5.598	<0.001

A similar pattern was observed for functional disability. Baseline Modified Oswestry Disability Index scores did not differ significantly between Group A and Group B, with mean ranks of 19.50 and 21.50, respectively (Z=−0.543, p=0.587). At the post-treatment assessment, the mean rank decreased to 12.65 in Group A compared with 28.35 in Group B, and the difference was statistically significant (Z=−4.251, p<0.001). The lower post-treatment ranking in Group A was consistent with lower disability scores following the combined ELDOA and MET intervention.

For lumbar flexion, no statistically significant difference was identified between the groups before treatment. Group A had a baseline mean rank of 23.40 compared with 17.60 in Group B (Z=−1.575, p=0.115). Following the six-week intervention, Group A demonstrated a higher mean rank of 26.20 compared with 14.80 in Group B, producing a statistically significant between-group difference (Z=−3.096, p=0.002). The post-treatment rank distribution therefore favored greater lumbar flexion values in Group A.

Lumbar extension differed from the other principal outcomes because a statistically significant between-group difference was already present at baseline. Before treatment, the mean rank was 25.18 in Group A and 15.83 in Group B (Z=−2.538, p=0.011). At the post-treatment assessment, the corresponding mean ranks were 28.78 and 12.23, respectively, with a significant between-group difference (Z=−4.486, p<0.001). Although the post-treatment

distribution showed higher lumbar extension values in Group A, interpretation of this finding requires caution because the groups were not comparable for lumbar extension at baseline.

No significant baseline difference was detected in lumbar lateral rotation, with mean ranks of 20.15 in Group A and 20.85 in Group B (Z=–0.191, p=0.848). After treatment, the mean rank increased to 24.23 in Group A compared with 16.78 in Group B. This post-treatment difference reached statistical significance (Z=–2.029, p=0.042), indicating higher reported lumbar lateral rotation values in Group A following the intervention.

For the quadratus lumborum test, baseline mean ranks were 22.55 for Group A and 18.45 for Group B, with no statistically significant difference between groups (Z=–1.111, p=0.267). Following treatment, Group A demonstrated a mean rank of 26.63 compared with 14.38 in Group B, resulting in a statistically significant between-group difference (Z=–3.320, p=0.001). The post-treatment rank distribution therefore indicated higher quadratus lumborum test values in Group A.

In the reported pre–post analysis, NPRS scores decreased from 8.52 ± 0.96 before treatment to 2.40 ± 1.31 after treatment, representing a mean numerical reduction of 6.12 points; the Wilcoxon signed-rank test was statistically significant (Z=–5.614, p<0.001). Functional disability also decreased, with MODI scores changing from 51.77 ± 5.88 to 31.62 ± 8.15, corresponding to a mean numerical reduction of 20.15 points (Z=–5.597, p<0.001).

The reported range-of-motion measures also increased between the pre- and post-treatment assessments. Lumbar flexion increased from 40.62 ± 6.36 to 52.90 ± 8.43, a numerical increase of 12.28 units (Z=–5.626, p<0.001), while lumbar extension increased from 18.52 ± 3.90 to 26.30 ± 5.32, representing an increase of 7.78 units (Z=–5.601, p<0.001). Lumbar lateral rotation increased from 14.45 ± 2.43 to 20.60 ± 2.93, corresponding to a numerical increase of 6.15 units (Z=–5.545, p<0.001). The quadratus lumborum test score increased from 29.17 ± 5.87 before treatment to 41.32 ± 6.95 after treatment, corresponding to a numerical increase of 12.15 units. This pre–post difference was statistically significant according to the reported Wilcoxon signed-rank analysis (Z=–5.598, p<0.001).

Overall, the reported between-group analyses demonstrated significant post-treatment differences in NPRS, MODI, lumbar flexion, lumbar extension, lumbar lateral rotation, and quadratus lumborum test outcomes. Baseline comparability was present for all of these outcomes except lumbar extension. The reported pooled pre–post analyses also showed statistically significant changes across all measured clinical outcomes; however, because the original manuscript does not present these Wilcoxon analyses separately for Group A and Group B, they should not be interpreted as evidence of group-specific treatment effects until the underlying statistical output is verified.

DISCUSSION

The present randomized controlled trial compared ELDOA combined with Muscle Energy Technique (MET) with ELDOA combined with conventional physical therapy in patients with quadratus lumborum syndrome. The reported findings demonstrated statistically significant post-treatment differences between the groups for pain intensity, functional disability, lumbar flexion, lumbar extension, lumbar lateral rotation, and the quadratus lumborum test. Group A showed a lower post-treatment rank for the Numeric Pain Rating Scale (13.05 vs. 27.95, p<0.001) and Modified Oswestry Disability Index (12.65 vs. 28.35, p<0.001), whereas higher post-treatment ranks were observed for lumbar flexion (26.20 vs. 14.80, p=0.002), lumbar extension (28.78 vs. 12.23, p<0.001), lumbar lateral rotation (24.23 vs. 16.78, p=0.042), and the quadratus lumborum test (26.63 vs. 14.38, p=0.001). These findings indicate that the six-week ELDOA plus MET program was associated with more favorable post-treatment distributions across the measured clinical outcomes than ELDOA combined with conventional physical therapy. Interpretation of lumbar extension, however, requires particular caution because a significant between-group difference was already present at baseline (p=0.011).

Pain reduction was one of the most prominent findings. NPRS values were comparable between the groups before treatment, with mean ranks of 20.78 and 20.23 (p=0.875), but differed markedly following the intervention, with a lower mean rank in the ELDOA plus MET group. This pattern is clinically plausible because QL dysfunction may involve painful muscular trigger points, increased muscular tension, and movement-related symptoms. Previous QL-focused research has investigated MET in comparison with interventions such as dry needling and other physical therapy approaches, supporting the relevance of MET as a therapeutic strategy for QL-associated

musculoskeletal pain (3,6,7). Nevertheless, the present findings should be interpreted as evidence of a difference between the tested treatment programs rather than proof that MET is universally superior to other interventions.

Functional disability showed a comparable pattern. The groups did not differ significantly in MODI at baseline ($p=0.587$), whereas a substantial post-treatment difference was observed ($p<0.001$), with lower ranks in Group A. Reduction in pain together with improvement in mobility may contribute to greater ease in performing everyday activities; however, the present study did not directly test the mechanisms responsible for changes in disability. Previous investigations have examined MET in relation to flexibility, range of motion, and functional outcomes across musculoskeletal disorders, indicating that functional change is an important outcome when assessing this form of manual therapy (8). QL-focused studies evaluating stretching, MET, and other manual interventions similarly provide a rationale for targeting muscular dysfunction as part of low back pain rehabilitation (5,6).

Lumbar mobility also differed between the interventions. Lumbar flexion was comparable before treatment ($p=0.115$) but showed a significant post-treatment difference ($p=0.002$), while lumbar lateral rotation changed from a non-significant baseline difference ($p=0.848$) to a statistically significant post-treatment difference ($p=0.042$). These findings are consistent with the therapeutic rationale of addressing both spinal mobility and QL muscle extensibility. Previous studies have investigated ELDOA-oriented interventions in cervical and lumbar musculoskeletal conditions, including cervical radiculopathy, lumbar disc protrusion, and non-specific low back pain (9–11). Although these populations are not directly equivalent to patients with quadratus lumborum syndrome, they demonstrate that ELDOA has been clinically evaluated in disorders characterized by pain, disability, and restricted spinal movement.

The findings for lumbar extension require a more restrained interpretation. Group A already demonstrated a higher mean rank for lumbar extension at baseline than Group B (25.18 vs. 15.83), and this difference was statistically significant ($p=0.011$). A larger post-treatment difference was subsequently observed (28.78 vs. 12.23, $p<0.001$), but a simple comparison of post-treatment ranks cannot determine how much of this difference was attributable specifically to the intervention because baseline equivalence was not present. A baseline-adjusted analysis or comparison of appropriately derived change scores would provide a more robust estimate of the treatment effect for this outcome. Therefore, lumbar extension should not be presented as unequivocal evidence of greater treatment efficacy until the underlying participant-level data have been reanalyzed.

The quadratus lumborum test also demonstrated a significant post-treatment difference, with the mean rank increasing from 22.55 to 26.63 in Group A and changing from 18.45 to 14.38 in Group B, with $p=0.001$ at the post-treatment assessment. This finding may indicate a change in the measured QL-related clinical characteristic following the intervention. However, interpretation is limited by the absence of a clearly reported numerical scale, unit, scoring range, and measurement properties for this test. Consequently, the direction and clinical magnitude of this outcome should be interpreted cautiously until the operational definition of the recorded quadratus lumborum test score is clarified.

The reported pooled pre- to post-treatment findings also showed substantial numerical change across all outcomes. NPRS decreased from 8.52 ± 0.96 to 2.40 ± 1.31, corresponding to a numerical reduction of 6.12 points, while MODI decreased from 51.77 ± 5.88 to 31.62 ± 8.15, a reduction of 20.15 points. Lumbar flexion increased by 12.28 units, lumbar extension by 7.78 units, lumbar lateral rotation by 6.15 units, and the quadratus lumborum test by 12.15 units, with all reported Wilcoxon tests reaching $p<0.001$. Although these changes demonstrate substantial improvement over the six-week treatment period in the analyzed sample, the original statistical output does not report these Wilcoxon analyses separately for the two intervention groups. These pooled changes therefore describe overall pre–post improvement and should not be used independently to establish the comparative effectiveness of Group A over Group B.

A possible explanation for the observed between-group pattern is that the two components of the Group A program addressed different aspects of the presenting musculoskeletal dysfunction. ELDOA was used as an active spinal exercise approach, whereas MET directly targeted muscular extensibility through post-isometric relaxation. Studies involving QL stretching, MET, and ELDOA-based rehabilitation provide a clinical rationale for each of these approaches (5–11). However, the present trial did not measure muscular activation, tissue extensibility, spinal loading, neuromuscular adaptation, or other mechanistic variables. Therefore, explanations involving muscle relaxation, altered proprioception, spinal decompression, or neuromuscular control should be considered plausible

therapeutic hypotheses rather than mechanisms demonstrated by the present data. Several features strengthen the study, including the randomized comparative design, use of an active treatment comparator, assessor blinding, a standardized six-week treatment period comprising three sessions per week, and assessment of pain, disability, and spinal mobility. Evaluating multiple clinical domains provides a broader representation of patient response than reliance on pain intensity alone. The use of baseline and post-treatment assessments also permits evaluation of changes occurring during the treatment period.

The findings should nevertheless be considered in light of important limitations. The sample was relatively small and was recruited from a single clinical setting using convenience sampling, which restricts generalizability. Eligibility was limited to males aged 18–45 years, further limiting applicability to women, older adults, and other clinical populations. No longer-term follow-up was reported, so persistence of treatment effects after six weeks cannot be determined. Baseline imbalance in lumbar extension complicates interpretation of that outcome, while effect sizes and confidence intervals were not reported. The manuscript also contains discrepancies in the reported participant numbers, and the reported Wilcoxon analyses do not distinguish the two treatment groups. In addition, adherence, treatment fidelity, adverse events, and the complete content of the conventional physical therapy comparator were not sufficiently reported. These issues should be addressed before firm conclusions about the magnitude of comparative treatment effects are made. Overall, the findings suggest that adding MET to an ELDOA-based rehabilitation program may be associated with greater short-term improvements in pain, disability, and selected lumbar mobility outcomes than the comparator program in the studied population. The results provide a basis for further investigation using adequately powered trials with clearly defined intervention protocols, consistent participant accounting, baseline-adjusted treatment-effect analyses, effect estimates with confidence intervals, and longer-term follow-up.

CONCLUSION

In patients with quadratus lumborum syndrome, ELDOA combined with Muscle Energy Technique was associated with more favorable short-term post-treatment outcomes for pain, functional disability, lumbar flexion, lumbar lateral rotation, and quadratus lumborum test measures compared with ELDOA combined with conventional physical therapy. Although lumbar extension also differed significantly after treatment, interpretation of this outcome is limited by the significant baseline difference between groups. Overall, the findings suggest that incorporating Muscle Energy Technique into an ELDOA-based rehabilitation program may provide additional short-term clinical benefit; however, the magnitude of the comparative effect should be interpreted cautiously until the reported participant-number and statistical inconsistencies are fully reconciled.

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