

# Effects of ELDOA (Elongation Longitudinaux avec Décoaptation Ostéo-Articulaire) Versus Lumbar Mobilization on Pain, Disability, and Flexibility in Recreational Cricket Players with Mechanical Low Back Pain: A Feasibility Study

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## Research Article

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# Abstract

**Background:** Mechanical low back pain (MLBP) is a frequent ailment in recreational cricketers, which is associated with repetitive loading of the spine while playing during various cricketing activities, such as batting, bowling and fielding. In clinical practice, the mobilization technique is applied to the lumbar spine and the ELDOA technique to the cervical spine for MLBP.

**Aim:** To assess trial feasibility (recruitment, retention, adherence) for comparing ELDOA and lumbar mobilization in recreational cricketers and to get preliminary estimates of the effects for a future trial sufficiently powered to detect the effects.

**Methods:** This was a feasibility study, 46 male recreational cricketers (MLBP, 18 to 35y) were recruited, randomized to ELDOA (n = 24) & lumbar mobilization (n = 22) with a standard home exercise programme for 4 weeks. Assessment of pain (NPRS), disability (ODI) and flexibility (Modified Schober, Sit and Reach) was carried out at baseline and 4 weeks.

**Results:** 66 screened patients were randomized and 50 patients were followed up (92.0% retention rate). Both groups made significant improvements on all outcomes ( $p < .001$ ). There were no significant differences between groups.

**Conclusions:** Recruitment was suboptimal and strategies should be altered to make a definitive trial possible. There were significant within-group gains for both interventions, but neither technique could be ruled out as being responsible without an arm to serve as a control. Effectiveness needs to be established with an adequately powered, 3 arm, blinded study with longer follow-up and a control arm.

## 1. Introduction

Low back pain (LBP) is a widespread musculoskeletal disorder around the world. LBP was estimated to be the top cause of years lived with disability in the Global Burden of Disease Study, affecting 619 million people in 2020 and to affect more than 800 million by 2050 [1]. LBP has a negative impact on training and participation and the risk of re-injury in physically active people. There are several types of LBP, the most common being mechanical LBP (MLBP), which is due to the muscles, ligaments, fascia, intervertebral disc and facet joints becoming painful without serious underlying pathology (e.g., fracture, tumour, infection, neurological disorder) and is often 'made worse' by movement, prolonged posture and repetitive loading of the spine. It's often seen with decreased movement patterns, muscle tension and spinal motion [3].

Repeated and high mechanical stresses are placed on the lumbosacral spine during cricket. All three of the primary skills of the sport (bowling, batting, and fielding) involve frequent repetition of hyperextension, lateral flexion and trunk rotation, and the low back is repeatedly cited as a site of MSK pain among cricketers, especially fast bowlers [4]. The fast-bowling action has been biomechanically analysed and vertical ground reaction forces of up to 5 times the body weight reported at back-foot

contact, there have been reports of up to 67% of fast bowlers having a stress injury in the lumbar spine [5, 6] due to cumulative shear and compression in the lumbar segments, contralateral side-flexion of the body trunk, thoracolumbar hyperextension. Based on a systematic review of intrinsic risk factors, it is suggested that the core control, altered bowling kinematics and lumbar rotation asymmetry may be modifiable risk factors for LBP in this population [6, 7]. Recreational cricketers are also of particular concern as they don't have access to the strength and conditioning support, injury-prevention resources and rehabilitation access that elite cricketers have, and often play with symptoms.

Core principles of conservative physiotherapy management of MLBP comprise therapeutic exercise, manual therapy, motor control training, postural correction and mobilization. Passive, oscillatory, sustained, and/or accessory (graded) mobilization to the lumbar spine is one of the most commonly utilized manual therapy techniques for LBP. The modern models are not only biomechanical in nature, but also neurophysiological, in that mechanical stimulation of paraspinal mechanoreceptors influences the excitability of the dorsal horn and the activation of descending inhibitory pathways, resulting in measurable hypoalgesia at a local and/or distant level [8, 9]. The systematic reviews and RCTs evidence the effectiveness of mobilization and manipulation in the short term for pain and mobility in mechanical spinal disorders [10, 11]. Mobilization with movement has been shown to provide immediate improvements in the range of lumbar motion as well as pain [12] and mobilization with neural mobilization has resulted in improvement of mobility and diminished disability in patients with lumbar disc herniation [13].

Created by French osteopath Guy Voyer, ELDOA is a set of active postural exercises. All postures focus on a specific spinal or costo-pelvic articulation, are usually held for 30–60 seconds and create longitudinal tension in a specific myofascial chain, combined with forceful traction and micro-decompression (décoaptation) of the related joint [14, 15]. Mechanistically, ELDOA has been suggested to restore fascial glide, enhance the circulation of nutrients and hydration of the discs, re-establish proprioceptive input from the target segment and increase intervertebral space [15, 16]. ELDOA is a therapeutic and exercise-based approach, as it is an active participant effort, isometric contraction and controlled diaphragmatic breathing are required. Randomized and quasi-experimental studies report that ELDOA can help alleviate pain and disability and enhance functional performance in piriformis syndrome [17], text-neck syndrome [18], lumbar disc protrusion and radiculopathy [19, 20] and forward head posture [21–23] and that these benefits are mediated by fascial elongation, spinal decompression, and postural alignment.

LBP patients have reduced lumbar flexibility, flexibility exercise has been found to improve lumbar stability and decrease pain in non-specific LBP [24] and flexibility training has been found to be beneficial when combined with stabilizing exercise for the spine in chronic MLBP [25]; flexibility training has been found to reduce spinal loading during sport-specific movement and increase extensibility of hamstrings and thoracolumbar fascial tissues [25]. This study used functional disability as an important outcome domain for pain- and movement-related disability, measured on the Oswestry Disability Index which has

shown to have good construct validity, internal consistency and test–retest reliability across LBP populations [26, 27].

There are separate evidence bases for both the lumbar mobilization and ELDOA interventions, but there is no study that has compared the two interventions in the context of recreational cricket players with MLBP. The direct comparison is potentially useful in order to inform sport-specific rehabilitation, as both techniques have been shown to be prevalent in this population [4, 6, 7] and the mechanisms proposed for both techniques are differing (passive-accessory and active-postural). This study was intended as a definitive comparative trial but because the achieved sample was lower than the pre-specified sample size, it is reported here as a feasibility study to determine if a definitive trial of the two interventions, as designed, is feasible and to provide preliminary estimates of the effect of the interventions, which will inform a future, adequately powered trial.

## 2. Methods

### 2.1 Study design

This study was designed and prospectively registered as a two arm (ELDOA vs. Lumbar mobilization) pre-post comparative trial with participants randomized into Group A (ELDOA) and Group B (lumbar mobilization). Due to the smaller than recommended sample size ( $n = 46$ ) achieved in the study compared to the a priori target sample size ( $n = 66$ ), the study is reported here as a feasibility study, as recommended in trials that do not meet their target sample size. Preliminary, hypothesis generating between group comparisons are provided.

### 2.2 Setting and participants

Recruitment was done from Safdarjung Sports Injury Centre (Delhi) and Trident Cricket Academy. Patients enrolled in the study were male recreational cricketers between 18–35 years age who had low back pain for two weeks to six months that was mechanical in nature and had a Numeric Pain Rating Scale (NPRS) score  $\geq 3/10$ . Other inclusion criteria were BMI of 18.5–24.5 kg/m<sup>2</sup> and a consent to provide written informed consent. Exclusion criteria included: disc herniation, radiculopathy, neurological deficit, red-flag pathology (tumour, fracture, infection or inflammatory disease), concurrent physiotherapy from another provider or severe cardiorespiratory or systemic disease.

Participants were recruited using convenience sampling and randomly assigned to the ELDOA or lumbar mobilization group with a computer-generated random sequence. Based on a priori sample size calculation (G\*power v3.1.9.2; one-tailed t-test; effect size = .3;  $\alpha = .05$ ; power = .80), a total of 66 participants (33 per group) was determined to be the desired number. Sixty-six people were assessed for inclusion: 50 met the inclusion criteria and were then enrolled and randomized (25 in ELDOA; 25 in lumbar mobilization). The ELDOA group ( $n = 24$ ) and the lumbar mobilization group ( $n = 22$ ) had 46 participants analyzed at the 4-week endpoint, with two participants in the ELDOA group, and two participants in the lumbar mobilization group, dropping out of the study after 2 and 1 weeks,

respectively. These numbers need to be included in a CONSORT styled flow diagram (Figure S1) which accompany the final submission and should be reported at each stage: screened, excluded with reasons, randomized, allocated, lost to follow-up and analysed.

## 2.3 Feasibility framework

As the sample of the achieved capacity was not the pre-specified target of 66, this report is presented as an evaluation of feasibility of a definitive trial. Recruitment rate (participants recruited as a proportion of target), retention/completion rate and intervention/home program adherence were considered when assessing feasibility. These did not specifically occur as progressions at the beginning of the study as this was a definitive trial; they are presented here descriptively and recommend that future definitive trial have quantitative criteria for progression from the beginning (such as minimum recruitment rate and minimum retention threshold). Fifty (75.8%) of the 66 screened were eligible and enrolled and randomized; 75.8% of the a priori target sample of 66 was enrolled and randomized. All 50 were recruited for the 4-week intervention and 46 (92.0%) completed, with 24 (96.0%) in ELDOA and 22 (88.0%) in lumbar mobilization remaining until the end.

## 2.4 Ethical considerations

The study was approved by the institutional ethics committee (IEC)(IEC Approval No. MRIIRS/SAHS/PT/2025-26/S-016). Subsequently, the trial was registered with the Clinical Trials Registry–India (CTRI) and was assigned CTRI Registration Number CTRI/2026/02/104166 and Trial Registration Number REF/2026/02/124191. The Institutional Ethics Committee approved the study on 8th December 2025 and the study was registered with CTRI on 22nd January 2026. Participation was voluntary and all enrolees gave informed consent in writing. The participants were able to leave without any repercussions and confidentiality and anonymity was respected throughout.

## 2.5 Outcome measures

Pain intensity was assessed by the 0–10 Numeric Pain Rating Scale (NPRS) which has previously been shown to have a minimal clinically important difference of about 2 points within LBP populations and good construct validity against the visual analogue scale [28]. This Oswestry Disability Index (ODI) was used to measure functional disability (0–100%) and showed good internal consistency, construct validity and responsiveness in chronic LBP [26, 27]. The Modified Schober Test (cm) has been found to have intra- and inter-rater reliability of "good to excellent" (ICC 0.78–0.98) for the lumbar flexion component [29] and the Sit-and-Reach Test (cm) has been found to have good to excellent (ICC 0.78–0.98) reliability for general lower-back and hamstring flexibility [30]. An assessor, who applied a standardized protocol, evaluated all outcomes at baseline and at the end of the intervention period (4 weeks).

## 2.6 Interventions

Both were treated twice a week for 4 weeks for 30–40 minutes or less and a standardised 10-minute home exercise programme.

Home exercise programme (both groups): All participants completed a similar and progressive 4-week home exercise programme that included exercises to enhance spinal mobility, core activation, and functional strength (see Supplementary Appendix C for a detailed breakdown of the home exercise programme). Week 1 - Pain Modulation and Gentle Mobility (pelvic tilt, single knee-chest, cat–cow, child's pose; 2 sets × 10 repetitions or 20–30 second holds; done daily). The second week was dedicated to core activation exercises and hip mobility (cat–cow, bird-dog, glute bridge, figure-4 stretch, seated spinal twist; 2 sets × 8–10 repetitions or 20–30 second holds, 5–6 times a week). The exercises in week 3 progressed to strengthening and mobility exercises (bird dog, glute bridge with march, side plank, prone press-up, lateral side bend, thread the needle; 2–3 sets x 8–20 reps or seconds, 5–6 per week). Functional strength and full mobility (bird-dog with reach, plank, single-leg bridge, standing pelvic circles, prone press-up, spinal rotation, dead bug) was emphasized in week 4 (3 sets × 8–10 reps or 20–30 seconds holds x 5–6 times per week). The programme was progressive and individualized based on the response to symptoms and direction specific exercises (extension versus flexion) were customized based on each participant's tolerance. The treating physiotherapist taught participants the proper exercise technique at enrolment and encouraged them to stop any exercises which caused or aggravated symptoms.

Group A (ELDOA): Participants did ELDOA postures focusing on the lumbar segments (L1–S1), with 3 sets of 6–10 repetitions each, holding the position for 30–60 seconds, and 30 seconds of diaphragmatic breathing and 15–20 seconds of myofascial tension (Table S1).

The Lumbar mobilization group (Group B) received Mulligan sustained natural apophyseal glides (SNAGs) and postero-anterior (PA) central and/or unilateral mobilization as clinically indicated for 5–10 minutes per segment.

Passive accessory intervertebral movements (PAIVMs), using a 3-point ordinal scale (0 = hypomobile, 1 = normal, 2 = hypermobile) and passive physiological intervertebral movements (PPIVMs) (5-point ordinal scale: 0–1 = hypomobile, 2 = normal, 3–4 = hypermobile) were assessed before treatment to guide the grade and segment of mobilization used.

All both groups were given a same home exercise programme as well as the manual intervention assigned to them. Since there was not a usual care or exercise only control group, changes within groups cannot be directly attributed to either ELDOA or lumbar mobilization.

## 2.7 Statistical analysis

IBM SPSS Statistics was used for all analyses. The Shapiro–Wilk test was used to determine the normality of the baseline data. The paired-samples t-test was used to analyse within-group pre-to-post changes for normally distributed data (ODI) while the Wilcoxon signed-rank test was used for non-normally distributed data (NPRS, Modified Schober, Sit-and-Reach). Independent-samples t-test (ODI) and the Mann–Whitney U test (NPRS, Modified Schober, Sit-and-Reach) were used for between-group comparisons. A p value < .05 was considered to be statistically significant.

The study was under powered with respect to the pre-specified effect size as the achieved sample size was less than the a priori target sample size. Therefore, between-group results are simply described and presented with point estimates and 95% confidence intervals when the data are available at the group level (see Section 3.4), and it should not be concluded from the results presented in this report that groups are equally effective. Post hoc, the sample size obtained ( $n = 46$ , 24/22) had about half of the power to detect the originally hypothesized effect size of 0.3, much lower than the power of 0.80 originally planned.

## 3. Results

### 3.1 Feasibility outcomes

Of the 66 who were screened for eligibility, 50 (75.8%) were enrolled and randomized (25 to ELDOA; 25 to lumbar mobilization) meeting the a priori power calculation target of 75.8%. Retention/completion rate at 4 weeks was 88.0% (46/50) and the final ANALYSED sample was 46 participants (8.0% of those randomized were lost to follow-up before the 4-week endpoint, 1/25 (4.0%) in the ELDOA group and 3/25 (12.0%) in the LM group). Only two of the four who lost to follow up finished the intervention (two at 2 weeks and two at 1 week). The difference between the number randomized (50) and the a priori target (66) suggests that the recruitment approach presented here (convenience sampling from two sites) was inadequate to achieve the desired target sample size within the study period and might be expanded (more sites, longer recruitment period) to gain a definitive trial.

### 3.2 Participant characteristics

46 male recreational cricket players were included in the study, 24 (ELDOA) and 22 (lumbar mobilization) with mechanical low back pain. Mean age was 29.00 years (SD 3.01; range 22–35), mean weight 66.11 kg (SD 4.25), mean height 177.39 cm (SD 5.59), and mean BMI 20.99 kg/m<sup>2</sup> (SD 0.29), indicating a homogeneous sample of normal body weight (Table S2).

There was no significant between-group difference in disability at baseline (ELDOA: 42.00%  $\pm$  5.18; lumbar mobilization: 42.91%  $\pm$  5.37;  $t = -0.584$ ,  $p = .562$ ). Note that the corresponding effect size for this baseline comparison was small (Cohen's  $d \approx -0.17$ , 95% CI  $-0.75$  to  $0.41$ ) and the wide confidence interval (even one that runs from a small clinically negligible difference to a difference of more than half a point on a standardized scale) reflects the imprecision that was added by the reduced sample size; the same approach (effect size with 95% CI) should be used for each outcome after the by-group post-intervention data are in. (Table S3).

### 3.3 Within-group changes

Within-group comparison for each group showed a statistically significant improvement for each of the four outcome measures from baseline to 4 weeks (Table S4, Graph S1). Pooled across both groups, NPRS decreased from a mean of 6.00 (SD 0.79) to 3.00 (SD 0.79); ODI decreased from approximately 42% to approximately 26%; Modified Schober scores increased from 3.52 cm (SD 0.41) to 6.00 cm (SD

0.79); and Sit-and-Reach scores increased from 8.00 cm (SD 0.76) to 10.61 cm (SD 1.41) (all  $p < .001$ ). However, both groups received the same home exercise programme and the improvements in these groups cannot be solely attributed to either manual programme.

### 3.4 Between-group comparisons

At the 4-week time point there were no statistically significant differences between the ELDOA and lumbar mobilization groups for any outcome measure (Table S5, Graph S1). For each of the four between-group post-intervention comparison provide the exact test statistic, the  $p$  value, and importantly the effect size with a 95% confidence interval. As the study included only 46 of the planned 66 participants, the results of this study are not significant and do not necessarily mean that the two interventions are of similar efficacy but rather that the study could not determine if they are of equal effectiveness, and a definitively powered study is needed before that can be determined.

## 4. Discussion

The feasibility study aimed to assess the feasibility of testing the hypothesis that a definitive randomized trial comparing the effects of ELDOA and lumbar mobilization in recreational cricket players with mechanical low back pain could be conducted as designed and to obtain preliminary estimates of the relationship of the interventions to pain, disability and flexibility. Of the 66 individuals screened, 50 (75.8%) were eligible and randomized (75.8% of the a priori number of 66); and 46 (92.0%) of those randomized completed the 4-week intervention, thus indicating that the recruitment strategy and the retention of enrolled participants should be strengthened before a definitive trial is conducted, with recruitment being the larger gap of the two. In both cases, the statistically significant within-group improvements for all four outcomes over 4 weeks should be interpreted with caution, especially given the decreased statistical power, and should not be interpreted to indicate that the two interventions are equally effective.

The pain reduction within the ELDOA group is in line with previous studies that demonstrated pain reduction following ELDOA for piriformis syndrome [17], text-neck syndrome [18] and lumbar disc protrusion or radiculopathy [19, 20]. The mechanism proposed is active traction and micro-decompression of the intervertebral joint in the sustained postural tension that is hypothesized to increase intervertebral space, enhance disc glide and hydration, decrease mechanical and nociceptive loading and increase fascial glide around the joint [15, 16, 17]. ELDOA also includes prolonged isometric contractions and slow diaphragmatic breathing, which may have an indirect analgesic effect, which was not measured in the present study, but is plausible. The observed reduction in pain after mobilization of the lumbo-sacral spine is similar to what has been reported in the literature for manual therapy in other regions, where the hypoalgesia effect is believed to be related to mechanoreceptor-mediated central and peripheral neurophysiological modulation, along with the improvement of joint mechanics and the reduction in muscle guarding [8, 9, 10].

Both groups also had ODI gains greater than the generally accepted minimal clinically important difference (MCID) of 10 points [26]. The active and participatory aspects of ELDOA could help to reduce disability by improving neuromuscular control, postural awareness, and spine stability while lumbar mobilization might have more of a pain relief and movement facilitation effect due to the restoration of accessory joint motion. The lack of a difference in functional improvement between the two groups with these different proposed mechanisms and the fact that both groups had an identical home exercise programme makes it impossible to conclude whether the manual intervention itself, the identical home programme, the natural course of mechanical LBP or some combination of these factors is responsible for the improvement achieved.

There was a great improvement in the flexibility, measured by the Modified Schober and Sit and Reach tests, in both groups, consistent with previous reports of increased flexibility and postural improvement following ELDOA [18, 21, 23] and with targeted flexibility exercise improving lumbar angle and reducing pain in NLPB [24]. In the lumbopelvic region, a recovery of accessory joint motion and reduced segmental stiffness and muscle guarding are more commonly associated with improved flexibility [10, 11]. The findings of this study were indirect measures of sport-specific performance and return to sport outcomes, so this relationship should be taken with a grain of salt and remains speculative.

There was no significant difference between groups for pain, disability, or flexibility. It should be understood that this research was not designed to compare the efficacy of ELDOA and lumbar mobilization, but rather to gauge whether they were equal, for a design that would require an equivalence or non-inferiority margin; a trial with a specific power calculation for an equivalence or non-inferiority study would have been required to make this conclusion. This is in contrast to the interpretation of the two interventions from the original version of this manuscript, which interpreted the two interventions as being "statistically equivalent" an interpretation the achieved sample size does not support.

## 4.1 Limitations

The limitations of this study should be taken into account. There was a sample size of 46, which was underpowered compared with the target sample size of 66, so the absence of a difference between groups is no indication that the two treatments are equally effective. Since we have no control arm, it is unknown if the gains were a result of ELDOA, mobilization, a shared home programme, or simply time. Blinding was incomplete and follow-up only continued for 4 weeks, which is not long enough to determine duration of benefits. This study only included male recreational cricketers aged 18–35 in one region, and core strength, psychological aspects, sport performance and quality of life were not measured. There was no report of adherence, three outcomes reported were pooled, and a combined ELDOA plus mobilization approach has not yet been tested.

## 5. Conclusion

The current recruitment was inadequate, thus the strategy needs to be strengthened. Both interventions were found to have a positive effect on pain, disability and flexibility in the group, but the source of the improvement and the comparative effectiveness of the interventions cannot be determined due to the lack of a control arm and insufficient power. These conclusions need to be substantiated with a larger, controlled and blinded randomized clinical trial with longer follow-up.

## **Declarations**

### **Ethics approval:**

This study was approved by the Institutional Ethics Committee (IEC Approval No. MRIIRS/SAHS/PT/2025-26/S-016) and registered with Clinical Trials Registry–India (CTRI Registration Number: CTRI/2026/02/104166; Trial Registration Number: REF/2026/02/124191). On 8 December 2025, IEC approval was obtained and on 22 January 2026, the trial was registered with CTRI. Informed consent was obtained from all the subjects.

### **Consent for publication:**

Not applicable.

### **Conflict of interest:**

The authors declare no conflict of interest.

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## **Author Contribution**

Mayank Sharma: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft. Mohd. Asif: Conceptualization, Methodology, Supervision, Project administration, Writing – review & editing. Divya Aggarwal: Formal analysis, Software, Validation, Writing – review & editing. Pooja Sharma: Investigation, Data curation, Visualization, Writing – review & editing. Nitesh Malhotra: Methodology, Validation, Resources, Writing – review & editing. Ifra Aman: Investigation, Data curation, Formal analysis, Writing – original draft. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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# Availability of data and materials:

The datasets analysed during the current study are available from the corresponding author on reasonable request.

# References

1. GBD 2021 Low Back Pain Collaborators. (2023). Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: A systematic analysis of the Global Burden of Disease Study 2021. *The Lancet Rheumatology*, 5(6), e316–e329.
2. Gadia, A., Shah, K., & Nene, A. (2018). Outcomes of various treatment modalities for lumbar spinal ailments in elite athletes: A literature review. *Asian Spine Journal*, 12(4), 754–764. <https://doi.org/10.31616/asj.2018.12.4.754>
3. Michaelson, P., Holmberg, D., Aasa, B., & Aasa, U. (2016). High load lifting exercise and low load motor control exercises as interventions for patients with mechanical low back pain: A randomized controlled trial with 24-month follow-up. *Journal of Rehabilitation Medicine*, 48(5), 456–463. <https://doi.org/10.2340/16501977-2091>
4. Jayasinghe, H. W. U. S. (2023). Prevalence and anatomical distribution of non-contact musculoskeletal pain among elite adolescent cricket fast bowlers in Sri Lanka. *Journal of Musculoskeletal Science and Technology*, 7(2), 49–53. <https://doi.org/10.29273/jmst.2023.7.2.49>
5. Farhart, P., Beakley, D., Diwan, A., Duffield, R., Rodriguez, E. P., Chamoli, U., & Watsford, M. (2023). Intrinsic variables associated with low back pain and lumbar spine injury in fast bowlers in cricket: A systematic review. *BMC Sports Science, Medicine and Rehabilitation*, 15(1), Article 114. <https://doi.org/10.1186/s13102-023-00732-1>
6. Singh, S., Baker, J., & Egginton, S. (2025). Risk factors and successful interventions for cricket-related low back pain: An updated systematic review. *Cureus*, 17. <https://doi.org/10.7759/cureus.79869>
7. Elliott, B. C. (2000). Back injuries and the fast bowler in cricket. *Journal of Sports Sciences*, 18(12), 983–991. <https://doi.org/10.1080/026404100446784>
8. Bialosky, J. E., Bishop, M. D., Price, D. D., Robinson, M. E., & George, S. Z. (2009). The mechanisms of manual therapy in the treatment of musculoskeletal pain: A comprehensive model. *Manual Therapy*, 14(5), 531–538. <https://doi.org/10.1016/j.math.2008.09.001>
9. Wright, A. (1995). Hypoalgesia post-manipulative therapy: A review of a potential neurophysiological mechanism. *Manual Therapy*, 1(1), 11–16. <https://doi.org/10.1054/math.1995.0244>

10. Coulter, I. D., Crawford, C., Hurwitz, E. L., Vernon, H., Khorsan, R., Suttorp Booth, M., & Herman, P. M. (2018). Manipulation and mobilization for treating chronic low back pain: A systematic review and meta-analysis. *The Spine Journal*, 18(5), 866–879. <https://doi.org/10.1016/j.spinee.2018.01.013>
11. Dewitte, V., Cagnie, B., Barbe, T., Beernaert, A., Vanthillo, B., & Danneels, L. (2015). Articular dysfunction patterns in patients with mechanical low back pain: A clinical algorithm to guide specific mobilization and manipulation techniques. *Manual Therapy*, 20(4), 499–502. <https://doi.org/10.1016/j.math.2014.11.006>
12. Konstantinou, K., Foster, N., Rushton, A., Baxter, D., Wright, C., & Breen, A. (2007). Flexion mobilizations with movement techniques: The immediate effects on range of movement and pain in subjects with low back pain. *Journal of Manipulative and Physiological Therapeutics*, 30(3), 178–185. <https://doi.org/10.1016/j.jmpt.2007.01.015>
13. Kim, S. J., Jang, H. Y., & Lee, S. M. (2023). Effects of spinal mobilization with leg movement and neural mobilization on pain, mobility, and psychosocial functioning of patients with lumbar disc herniation: A randomized controlled study. *Physical Therapy Rehabilitation Science*, 12(2), 92–104. <https://doi.org/10.14474/ptrs.2023.12.2.92>
14. Physiopedia. (2026). ELDOA. <https://www.physio-pedia.com/ELDOA>
15. Voyer, G. (n.d.). ELDOA Method: Postural self-normalising exercises for the spine (Certification manuals I–IV). ELDOA Method.
16. Parul, Asif, M., Aman, I. *et al.* Longitudinal osteo-articular decoaption stretching (loads) in patients with forward head posture: a systematic review. *Sport Sci Health* 22, 22 (2026). <https://doi.org/10.1007/s11332-025-01584-7>
17. Shahzad, M., Rafique, N., Shakil-ur-Rehman, S., & Ali Hussain, S. (2020). Effects of ELDOA and post-facilitation stretching technique on pain and functional performance in patients with piriformis syndrome: A randomized controlled trial. *Journal of Back and Musculoskeletal Rehabilitation*, 33(6), 983–988. <https://doi.org/10.3233/BMR-181290>
18. Farooq, M., Bashir, M. S., Arif, A., Kashif, M., Manzoor, N., & Abid, F. (2023). Effects of elongation longitudinaux avec decoaption osteo-articulaire and post-facilitation stretching technique on pain and functional disability in mobile users with text neck syndrome during COVID-19 pandemic: A randomized controlled trial. *Medicine*, 102(12), e33073. <https://doi.org/10.1097/MD.00000000000033073>
19. Iqbal, Z., & Riaz, H. (2022). Comparison of the effects of decompression and ELDOA on pain and disability in lumbar disc protrusion (Clinical Trial No. NCT04760210). Riphah International University.
20. ClinicalTrials.gov. (2026). Comparative effects of high intensity spinal decompression exercises and ELDOA in patients of lumbar radiculopathy (Study No. NCT06087107). <https://clinicaltrials.gov/study/NCT06087107>
21. Khalid, F. K., Musharaf, M., Ijaz, U., Aslam, M. J., Malik, A., & Latif, U. (2024). Comparative effects of elongation longitudinal avec decoaptation osteo articulaire versus upper thoracic mobilization and

- mobility exercise for treatment of forward head posture. *Journal of Health and Rehabilitation Research*, 4(3), 1–6. <https://doi.org/10.61919/jhrr.v4i3.1221>
22. Shahid, N., Kiran, Q., Tariq, S., Younas, H., Rasool, T., Azfar, H., Saifullah, F., & Ali, S. (2025). Effects of elongation longitudinaux articular vertebral and columnar decoaption osteo articulaire versus upper thoracic mobilization on forward head posture in upper cross syndrome. *Healer Journal of Physiotherapy and Rehabilitation Sciences*, 5(2), 19–26. <https://doi.org/10.55735/hjprs.v5i2.340>
23. Waqar, S., Khalid, M., & Khalid, N. (2022). Effectiveness of elongation longitudinaux avec decoaption osteoarticulaire in correcting forward head posture. *Pakistan Journal of Social Research*, 6(1), 284–289. <https://doi.org/10.52567/trj.v6i01.82>
24. Purepong, N., Jitvimonrat, A., Boonyong, S., Thaveeratitham, P., & Pensri, P. (2012). Effect of flexibility exercise on lumbar angle: A study among non-specific low back pain patients. *Journal of Bodywork and Movement Therapies*, 16(2), 236–243. <https://doi.org/10.1016/j.jbmt.2011.08.001>
25. Syahniar, R., et al. (2024). Comparison of lumbar stabilization exercise and flexibility exercise on lumbar flexibility in chronic mechanical lower back pain [Preprint]. ResearchGate.
26. Fairbank, J. C. T., & Pynsent, P. B. (2000). The Oswestry Disability Index. *Spine*, 25(22), 2940–2952.
27. Vianin, M. (2008). Psychometric properties and clinical usefulness of the Oswestry Disability Index. *Journal of Chiropractic Medicine*, 7(4), 161–163. <https://doi.org/10.1016/j.jcm.2008.07.001>
28. Childs, J. D., Piva, S. R., & Fritz, J. M. (2005). Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine*, 30(11), 1331–1334.
29. Williams, R., Binkley, J., Bloch, R., Goldsmith, C. H., & Minuk, T. (1993). Reliability of the modified-modified Schöber and double inclinometer methods for measuring lumbar flexion and extension. *Physical Therapy*, 73(1), 26–37. <https://doi.org/10.1093/ptj/73.1.26>
30. Wells, K. F., & Dillon, E. K. (1952). The sit and reach - A test of back and leg flexibility. *Research Quarterly*, 23(1), 115–118.

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