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Clinical Efficacy of Dynamic Sustained Versus Static Intermittent Lumbar Traction for Lumbar Spinal Stenosis: A Systematic Review

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Abstract

Background: Lumbar spinal stenosis (LSS) commonly causes neurogenic claudication, and lumbar traction remains widely used despite guideline uncertainty. Two traction philosophies — dynamic sustained traction (DST, continuous/slowly cycling force) and static intermittent traction (SIT, fixed load cycled on/off) — are applied clinically, but their comparative effectiveness specifically in LSS has not been systematically reviewed.

Objective: To systematically synthesize 2015–2025 evidence on DST versus SIT in conservative LSS management.

Methods: PRISMA 2020-guided search of PubMed/MEDLINE, PMC, Embase-indexed sources, ScienceDirect, JOSPT, CINAHL, Cochrane Library, and PEDro, supplemented by guideline and registry hand-searching. Adults with LSS (or closely related nerve-root-compression cohorts where LSS-specific data were unavailable) receiving a traction or traction-adjacent intervention with an extractable outcome were eligible. Risk of bias in RCTs was appraised using a Cochrane RoB2-informed approach; narrative synthesis was used given clinical/methodological heterogeneity.

Results: Of 859 records identified, 14 studies (8 RCTs, 3 prospective cohort/pilot, 2 retrospective cohort, 1 contextual guideline) met eligibility. No study directly compared DST against SIT within an LSS-diagnosed population — the review's principal finding. The closest evidence, from nerve-root-compression and flexion-distraction literature, showed no consistent superiority of either modality; one well-powered RCT found no added benefit of intermittent traction over extension exercise alone. Flexion-biased, dynamically applied distraction in LSS-specific cohorts showed modest, generally short-term functional gains, but was confounded by concurrent manual therapy/exercise. Adverse events were infrequent, mostly transient symptom aggravation.

Conclusion: Evidence is insufficient to recommend DST over SIT, or vice versa, for LSS. This reaffirms existing guideline positions and highlights a clear research gap: an adequately powered RCT directly randomizing LSS patients to DST versus SIT, with walking capacity as a primary outcome, is needed.

Keywords: lumbar spinal stenosis; neurogenic claudication; lumbar traction; dynamic sustained traction; static intermittent traction.

1. Introduction

Lumbar spinal stenosis (LSS) is a degenerative narrowing of the central canal, lateral recess, or neural foramen that most often affects adults over 60 and produces neurogenic claudication — posture-dependent leg/back pain worsened by extension/standing and relieved by flexion/sitting. Non-surgical care, including exercise, manual therapy, and traction, is recommended first-line [1], yet the North American Spine Society [2] and a 2021 GRADE-based guideline [3] both state there is insufficient evidence to recommend for or against traction in LSS.

Traction is classified by force-delivery pattern: static/sustained (continuous force) versus intermittent (cycled force), with modern motorized units enabling dynamic sustained traction (DST, a continuous or slowly ramping, adjustable force) as distinct from static intermittent traction (SIT, a fixed load mechanically cycled). Given the extension-sensitive, flexion-relieved pathophysiology of LSS, these approaches may plausibly differ in suitability, yet — to our knowledge — no dedicated systematic review has compared them specifically in LSS. This review synthesizes 2015–2025 evidence to address that gap and to determine whether current 'insufficient evidence' guidance remains accurate.

Research Questions

RQ1: In adults with lumbar spinal stenosis, does dynamic sustained traction (DST) differ from static intermittent traction (SIT) in effects on pain, disability, and walking capacity?

RQ2: Among adjacent nerve-root-compression and radiculopathy populations, does either a sustained/static or an intermittent traction delivery pattern show consistent superiority over the other?

RQ3: In LSS-diagnosed cohorts specifically, does flexion-biased, dynamically applied distraction improve pain, disability, and walking tolerance relative to comparator or baseline care?

2. Methods

This review followed PRISMA 2020 reporting standards.

Eligibility and Search

Element	Criterion
Population	Adults with clinically/radiologically confirmed LSS (nerve-root-compression cohorts used were LSS-specific data absent)
Intervention	Dynamic sustained traction (DST), static intermittent traction (SIT), and flexion-distraction
Comparator	Alternate traction type, sham/no traction, or usual conservative care
Outcomes	Pain, disability, walking capacity, imaging, adverse events
Design/Timeframe	RCTs, cohort/pilot studies, guidelines; 2015–2025 (pre-2015 cited as background only)

Sources indexed in PubMed/MEDLINE, PMC, Embase-indexed publisher platforms, ScienceDirect, JOSPT, CINAHL, Cochrane Library, and PEDro were searched for January 2015–2025, combining terms for (i) LSS/neurogenic claudication, (ii) traction/DST/SIT/flexion-distraction, and (iii) conservative management, supplemented by guideline reference-list and ClinicalTrials.gov hand-searching. Given the

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anticipated scarcity of LSS-specific direct comparative trials (confirmed on screening), eligibility was pragmatically broadened during full-text review to include closely related nerve-root-compression and flexion-distraction studies, transparently reported as a limitation.

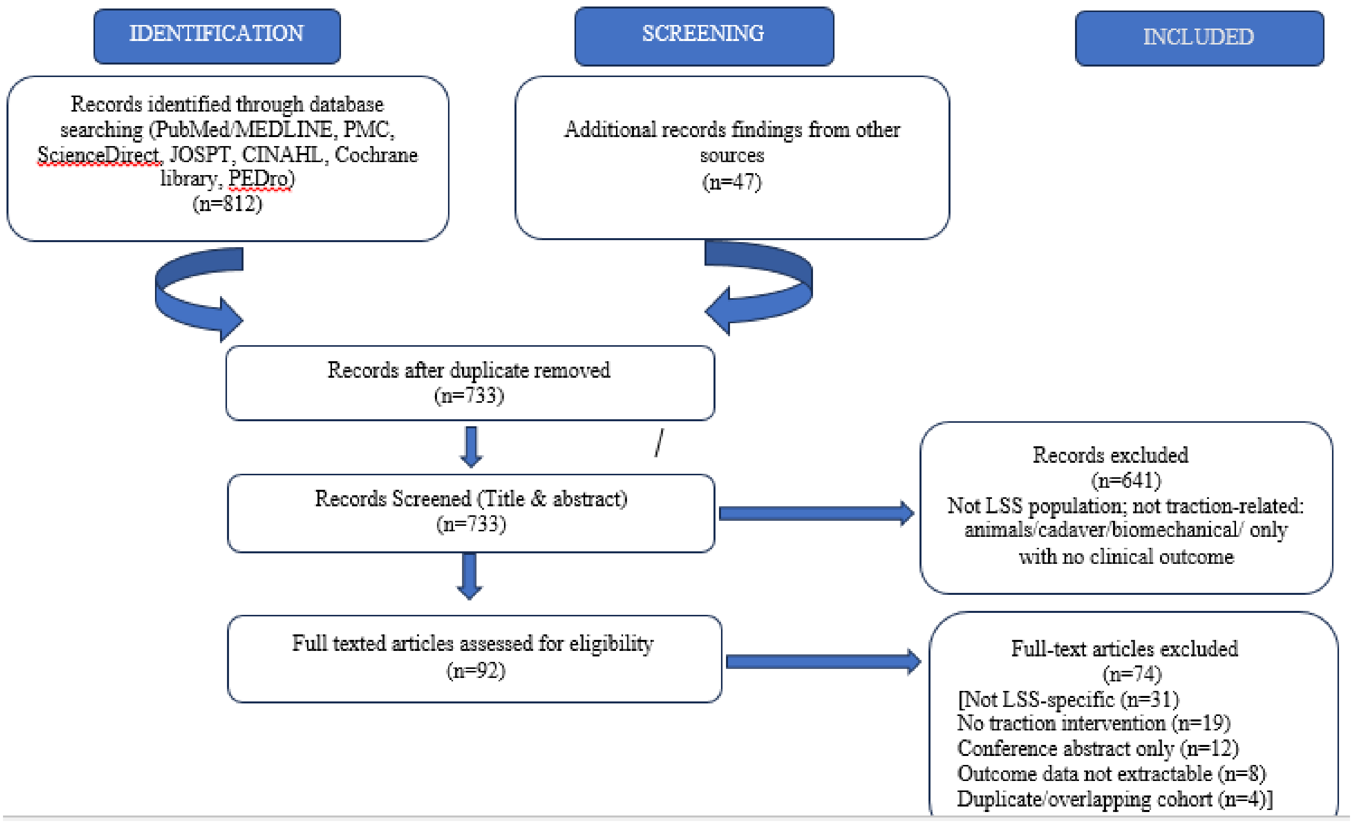
2.2 Selection, Extraction, and Appraisal

Records were screened by title/abstract then full text against PICOS criteria. Extracted data included design, sample, population, intervention/comparator, outcomes, and adverse events. RCTs were appraised using a Cochrane RoB2-informed framework across standard domains plus an 'other bias' domain for traction-dosage reporting adequacy. Non-randomized studies were appraised narratively. Given clinical and methodological heterogeneity — and the absence of any direct DST-vs-SIT LSS trial — findings were synthesized narratively rather than pooled quantitatively.

3. Results

Study Selection

859 records were identified (812 database, 47 other sources); 733 remained after de-duplication. Following title/abstract and full-text screening, 14 studies (2015–2025) met eligibility for synthesis (Figure 1). No study directly compared DST against SIT within an LSS-diagnosed population.



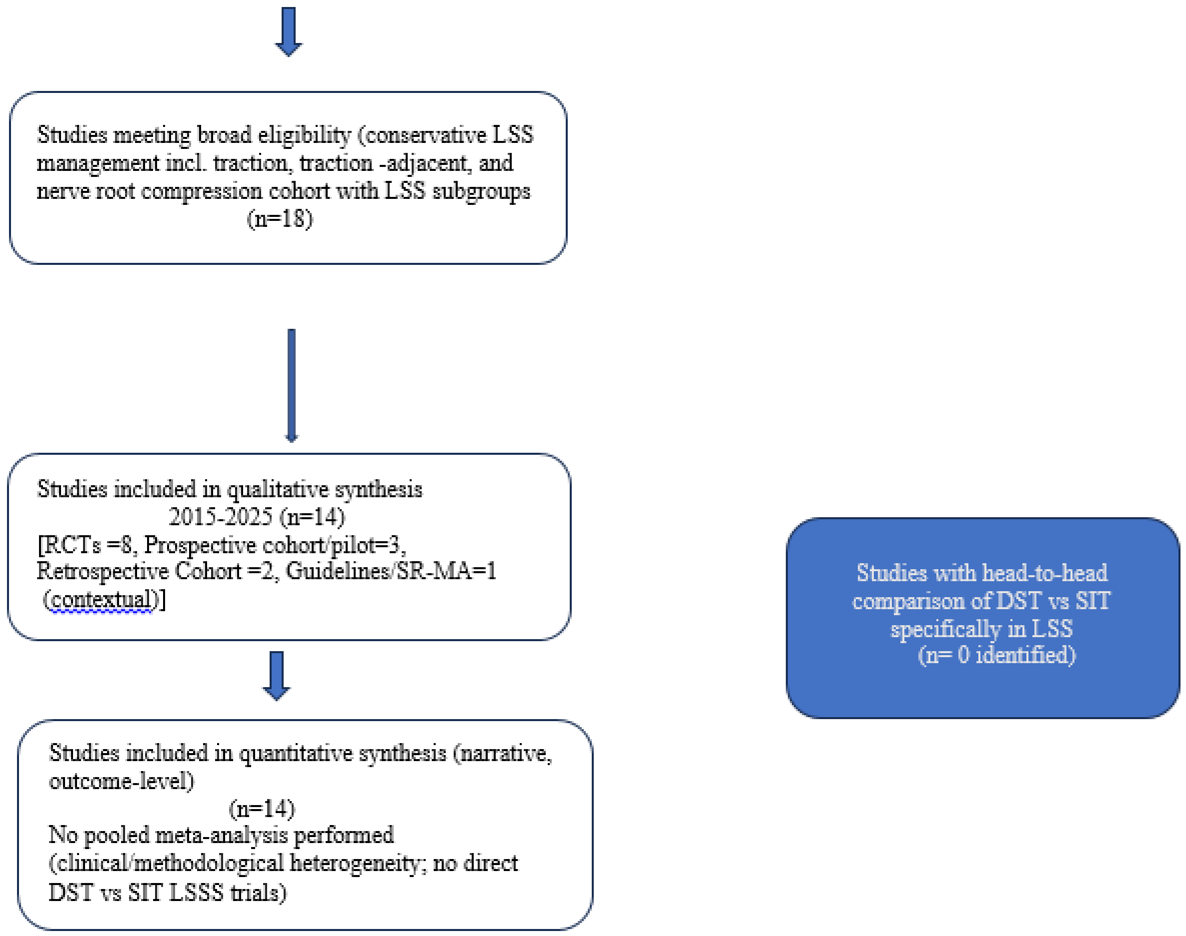


Figure 1- PRISMA flow diagram of the study identification, screening, eligibility assessment and inclusion.

Study Characteristics

Designs comprised 8 RCTs, 3 prospective cohort/pilot studies, 2 retrospective cohorts, and 1 contextual guideline (Table 1, Figure 2A). Pain and disability were the most-reported outcomes (13 and 11 of 14 studies); walking capacity — the most LSS-relevant outcome — was reported in only 6, and imaging outcomes in 3 (Figure 2B).

Author, Year	Design (N)	Population	Traction-Related Intervention	Key Finding
Choi et al., 2015 [4]	Pre–post (small n)	LSS, neurogenic claudication	Flexion-distraction manipulation	Significant pain/disability improvement after treatment course.
Ammendolia et al., 2015 [5]	Retrospective (49)	Older adults, LSS claudication	6-wk multimodal incl. flexion-distraction	Clinically meaningful gains in disability, walking, pain.

Author, Year	Design (N)	Population	Traction-Related Intervention	Key Finding
Thackeray et al., 2016 [6]	RCT (120)	LBP with nerve-root compression	Intermittent traction + extension exercise vs. exercise alone	No added benefit of traction; short-term aggravation in some patients.
Bilgilisoy Filiz et al., 2018 [7]	RCT (58)	Lumbar radicular pain (not LSS)	Supine vs. prone static traction	Supine positioning superior for short-term pain/SLR.
Ammendolia et al., 2018 [8]	RCT (180)	LSS, neurogenic claudication	Comprehensive program incl. flexion-distraction vs. self-directed care	Small, statistically significant but not clearly clinically important gain in walking ability.
Ammendolia et al., 2019 (follow-up) [9]	Cohort (49)	LSS, neurogenic claudication	Multimodal incl. flexion-distraction	Gains largely maintained at long-term follow-up.
Vanti et al., 2021 (SR/MA) [10]	SR + MA (16 RCTs)	Lumbar radiculopathy (mixed)	Supine/prone static, intermittent, autotraction	Short-term benefit of supine traction + PT; no clear difference between traction sub-types.
Bagley et al., 2022 [11]	Pilot, single-arm	LSS	Flexion-distraction manipulation	Preliminary improvement in pain, disability, mobility measures; uncontrolled.
Seeger & Müller, 2025 [12]	RCT (101)	Lumbar spondylosis (LSS excluded)	Intermittent traction-bed device	Favorable outcomes in non-stenosis population; LSS explicitly excluded.
Bernhard et al., 2025 [13]	RCT (424)	Disc-herniation radicular pain (not LSS)	Protocolized traction vs. usual care	Large contemporary trial; not generalizable to canal/foraminal stenosis.

Author, Year	Design (N)	Population	Traction-Related Intervention	Key Finding
Elgendy et al., 2025 [14]	RCT	Chronic nonspecific LBP	Core stability exercise vs. intermittent traction	Contextual comparator evidence for intermittent traction vs. active exercise.

Table 1. Included studies, 2015–2025

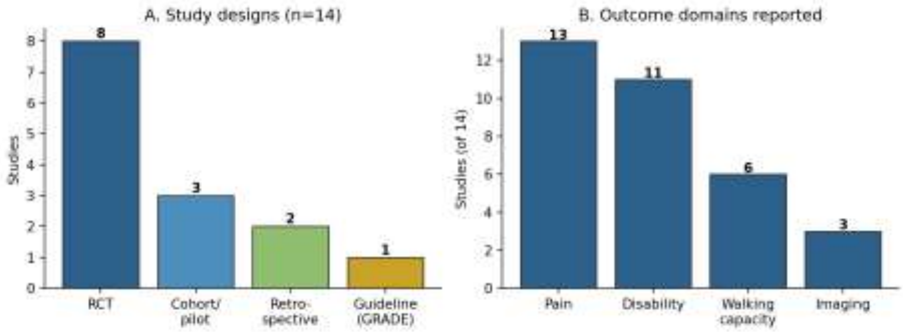


Figure 2. (A) Study designs; (B) outcome domains reported.

Risk of Bias

Among the 8 RCTs, random sequence generation and selective reporting were generally low risk; blinding of participants was consistently the weakest domain (high risk in half the trials), reflecting the inherent difficulty of blinding traction versus comparator modalities. Traction-dosage reporting (force, duration, cycle parameters) was often incomplete.

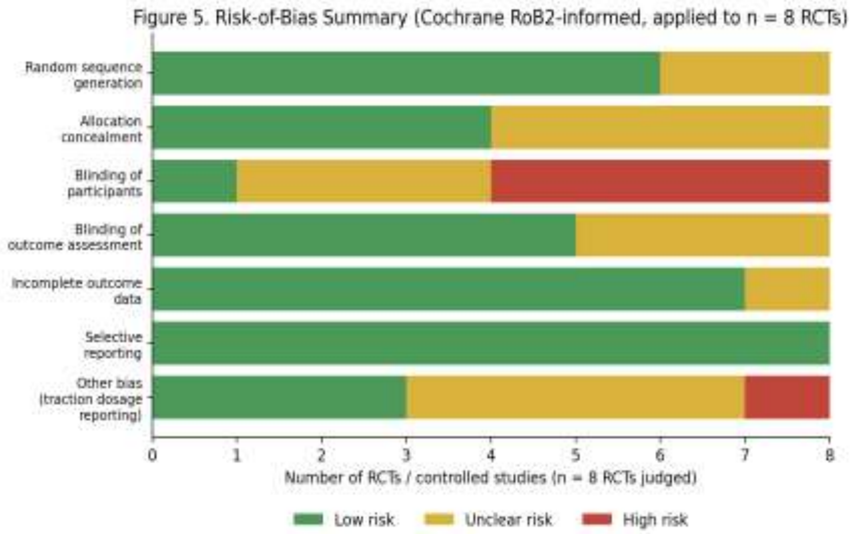


Figure 3. Risk-of-bias summary (Cochrane RoB2-informed, n = 8 RCTs).

Synthesis of Findings

Thackeray et al. (2016, n=120) [6] found no added benefit of intermittent traction over extension-oriented exercise alone in nerve-root-compression patients, with short-term aggravation in a minority — though its extension-based protocol limits direct applicability to flexion-relieved LSS. Vanti et al.'s 2021 meta-analysis (16 RCTs, 5 pooled, mixed radiculopathy) [10] found short-term benefit of supine static traction plus physical therapy but no significant difference between traction sub-types, including position or delivery pattern. Bilgilisoy Filiz et al. (2018) [7] found supine static traction superior to prone for short-term pain/SLR in radicular pain (not LSS).

The most LSS-relevant signal came from flexion-biased, dynamically applied distraction: Choi et al. (2015) [4], Ammendolia and colleagues' program studies (2015 [5], 2018 [8], 2019 [9]), and Bagley et al.'s 2022 pilot [11] all reported modest, generally short-term improvements in pain, disability, and walking tolerance after flexion-distraction-based multimodal care in LSS cohorts — but concurrent manual therapy/exercise prevents isolating the traction-specific effect, and no arm isolated DST against SIT.

Two large 2025 RCTs (Seeger & Müller [12]; Bernhard et al. [13]) confirm continued traction research activity but notably did not enrol LSS-confirmed populations — one explicitly excluded LSS patients — illustrating that the field continues to study traction while largely avoiding direct stenosis-population comparisons. Adverse events, reported in 7 of 14 studies, were predominantly transient symptom aggravation; no serious traction-attributable event was reported.

4. Discussion

The central finding of this review is an evidentiary gap: despite a decade of traction research, no study has directly compared DST against SIT within an LSS-diagnosed population. This is consistent with, and helps explain, the persistent 'insufficient evidence' position held by the North American Spine Society [2] and the 2021 GRADE-based LSS guideline [3]. Indirect evidence from adjacent radiculopathy populations shows no consistent advantage of either sustained/static or intermittent delivery, while flexion-biased dynamic distraction shows the most consistent (if modest and confounded) LSS-specific signal — plausible given the flexion-relieved, extension-aggravated nature of neurogenic claudication, but not yet demonstrated through an isolated, randomized comparison.

Clinically, neither modality should be assumed superior for LSS pending direct trial evidence; flexion-biased protocols appear better aligned with LSS pathophysiology than extension-oriented, intermittent-traction protocols studied in some radiculopathy trials, though this remains inferential. Shared decision-making should weigh the modest expected effect, possible transient aggravation, and patient tolerance, particularly in older, comorbid patients.

Limitations

- Single-reviewer, web-based bibliographic search rather than direct Ovid/Embase/CENTRAL access with full controlled vocabulary; not dual-screened or PROSPERO-registered.
- Eligibility was broadened to mechanistically adjacent nerve-root-compression/flexion-distraction studies once the near-total absence of direct LSS traction-comparison trials became apparent.
- Underlying evidence: no RCT randomizes LSS patients directly to DST vs. SIT; traction dosage is inconsistently reported; traction is frequently bundled with concurrent manual therapy/exercise; walking capacity is under-reported relative to generic pain/disability scores; and blinding participants to traction type is inherently difficult.

5. Conclusion

No 2015–2025 study directly compares dynamic sustained and static intermittent lumbar traction in a confirmed LSS population. Available adjacent evidence does not support the superiority of either modality, while flexion-biased dynamic distraction offers a plausible, unproven signal worth testing directly. Current guideline positions of insufficient evidence remain accurate. An adequately powered, dosage-standardized RCT directly randomizing LSS patients to DST versus SIT, with walking capacity as a primary outcome, is the highest-priority research need identified by this review.

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