MMSx AUTHORITY · APPLIED BIOMECHANICS LAB

Lower Back Rehabilitation

50 Evidence-Based Biomechanics Analyses

50 titles · four analysis slides each · movement analysis, verified research data, decision pathways and APA 7 references

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BIOMECHANICS IS A FORCE-GOVERNED DECISION SYSTEM — NOT A POSTURE MODEL.

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WHY DOES MY LOWER BACK HURT? UNDERSTANDING COMMON CAUSES AND MOVEMENT SENSITIVITY

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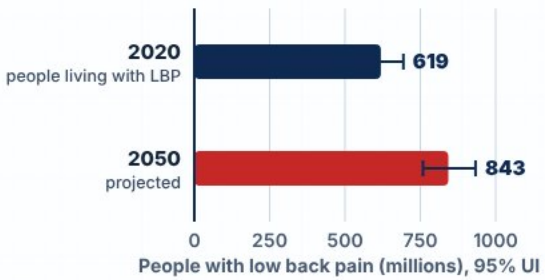
A · WHERE IT HURTS, REAR



Where "low back pain" lives

- Pain between the lower ribs and the buttock creases, with or without leg pain.
- In most people no single damaged structure can be identified: this is called **non-specific** low back pain and is managed by its features and impact.
- Standing at rest, the pelvis here sits **5°** off level: small asymmetries like this are normal and do not explain pain on their own.

A growing global burden



Global Burden of Disease 2021; age-standardised rate 832 years lived with disability per 100 000. Ferreira et al. (2023).

Key point: 38.8% of the global disability burden was attributed to three modifiable factors combined: occupational exposures, smoking and high body-mass index (Ferreira et al., 2023).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the rear view. Educational, not diagnostic.

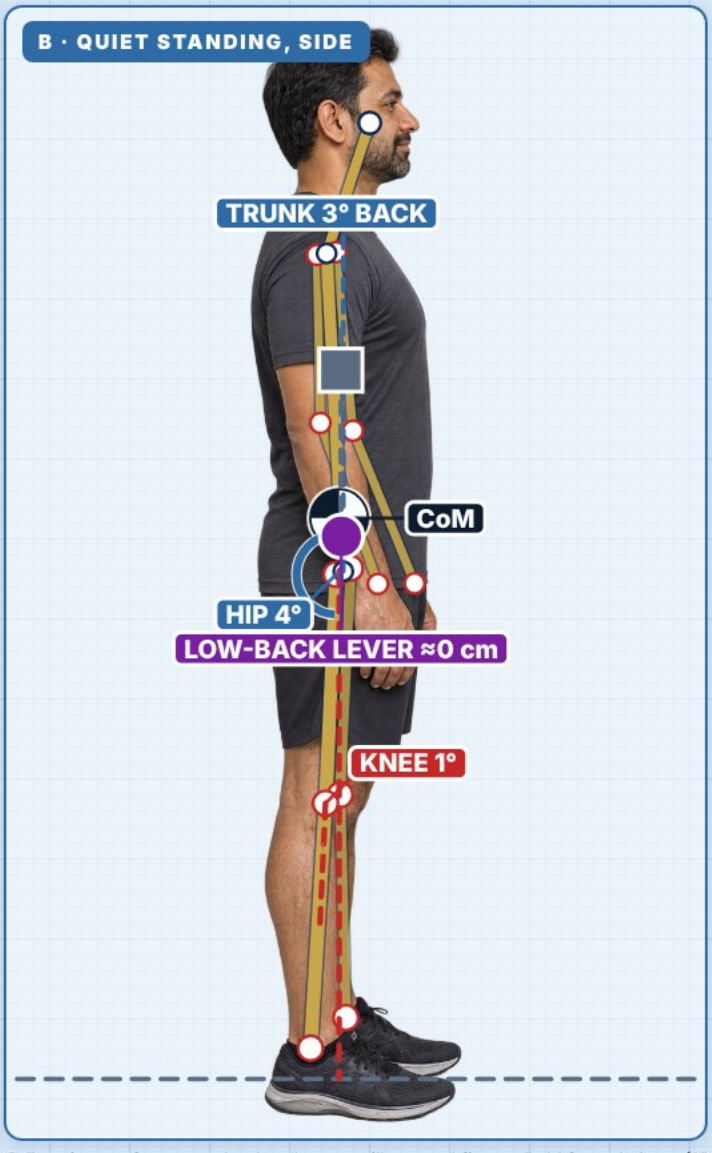
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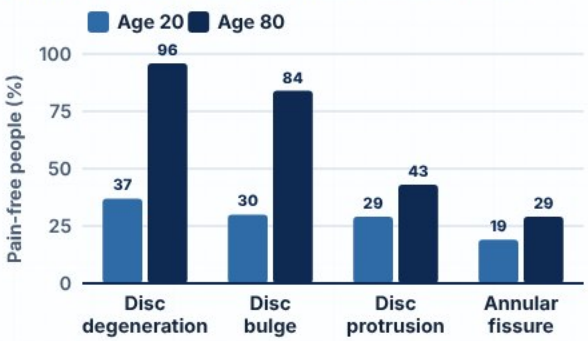
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Upright standing: the low-back lever is near zero

- Trunk **3°** behind vertical; the upper-body centre of mass sits almost directly over L5/S1 (lever **≈0 cm**), so back muscles need little effort to hold the posture.
- Scan findings are common in people with **no** pain and rise with age; a scan finding alone does not explain pain.

Spine scans of people without back pain



33 studies, 3,110 asymptomatic people (CT/MRI); age-specific prevalence. Brinjikji, Luetmer, et al. (2015).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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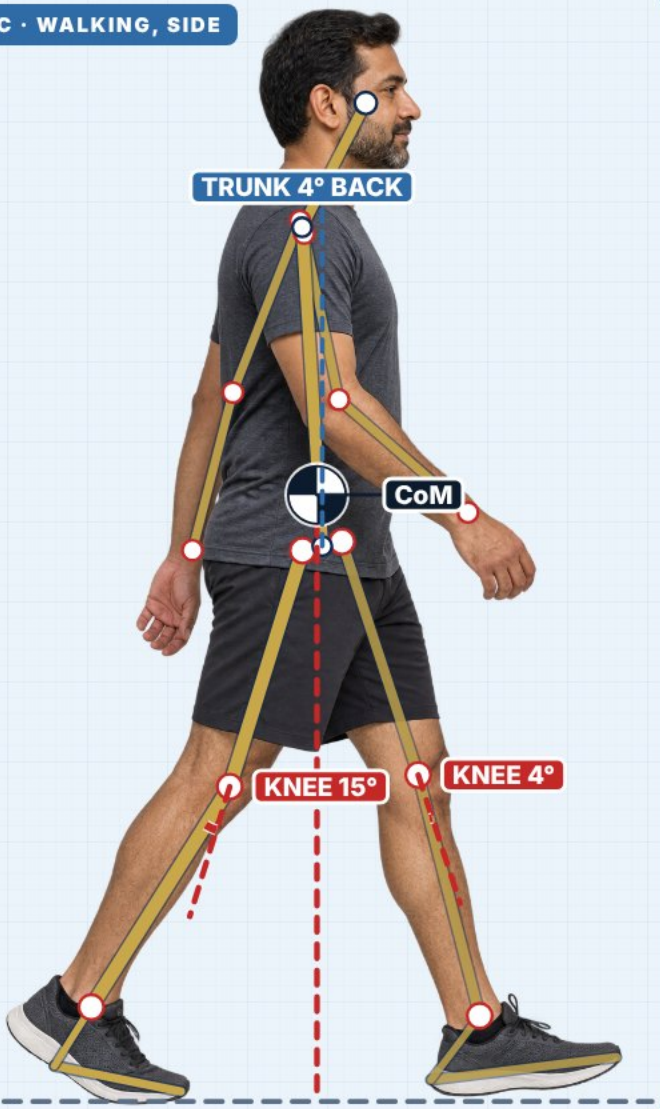
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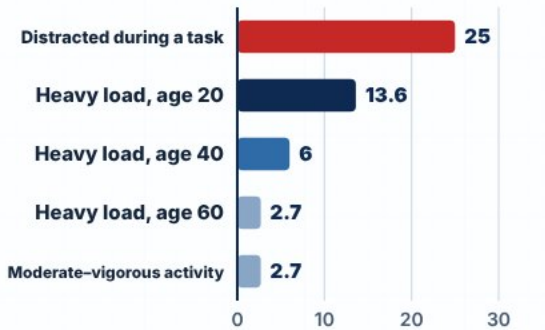
C · WALKING, SIDE



Movement sensitivity, not "damage"

- Walking: trunk **4°** behind vertical, lead knee **15°**; the trunk stays stacked over the pelvis, which is why many people tolerate walking early.
- New episodes were linked to short-term exposures such as unaccustomed heavy loads or being distracted mid-task: a moment of sensitivity, not proof of injury.

What happened just before an episode?



999 adults, case-crossover design; odds ratios (no CIs in the abstract). Associations, not causes. Steffens et al. (2015).

Key point: these short-term exposures guide how to grade activity; they are not a list of activities to avoid for ever.

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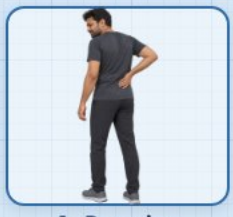
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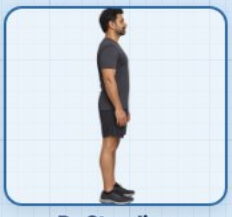
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A · Rear view
Where it hurts

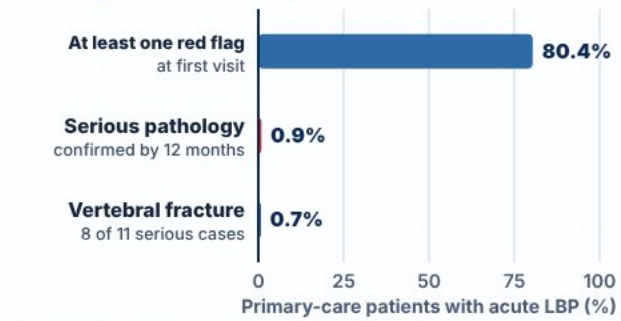


B · Standing
Lever ≈0 cm



C · Walking
Well tolerated early

Red flags are common; serious causes are rare



1,172 consecutive primary-care patients, Sydney. Henschke et al. (2009).

Decision pathway

1. **SCREEN**
   History and examination first: neurological signs, fracture risk, and how pain affects daily life.
2. **EXPLAIN**
   Most back pain is non-specific; scan findings are common in pain-free people; the outlook is usually good.
3. **STAY ACTIVE, REVIEW**
   Return to normal activities as tolerated; reassess if there is no improvement after about 4 weeks.

NOT RECOMMENDED

Routine imaging without a specific clinical question; bed rest.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, worsening leg weakness, significant trauma, or age over 70 with long-term corticosteroid use.

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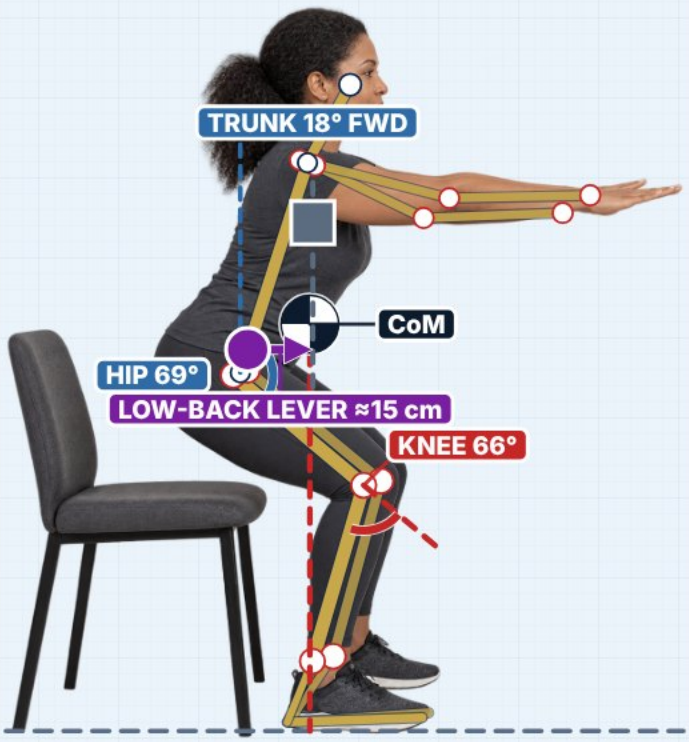
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BEST EXERCISES FOR LOWER BACK PAIN: HOW TO CHOOSE WHAT FITS YOUR SYMPTOMS

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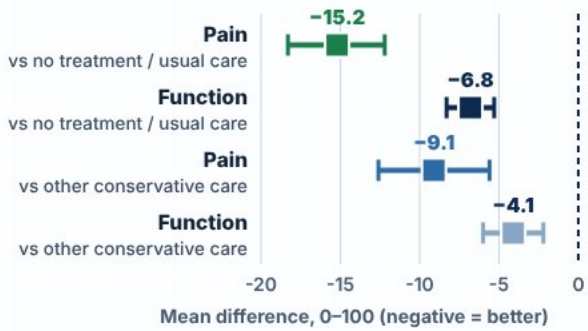
A · CHAIR RISE, SIDE



Chair rise: a task-based starting point

- Trunk **18°** forward, hip **69°**, knee **66°**; upper-body weight acts in front of L5/S1 (lever ≈**15 cm**, ≈**59 N·m**).
- Exercise for chronic LBP reduced pain by a clinically important amount compared with no treatment (moderate certainty).
- Effects on function were smaller; set goals for both.

Does exercise help chronic low back pain?



249 trials; mean difference (95% CI) at the earliest follow-up. Hayden et al. (2021).

Safety: adverse effects were reported in 33% of exercise groups and 29% of comparison groups, mostly minor (Hayden et al., 2021).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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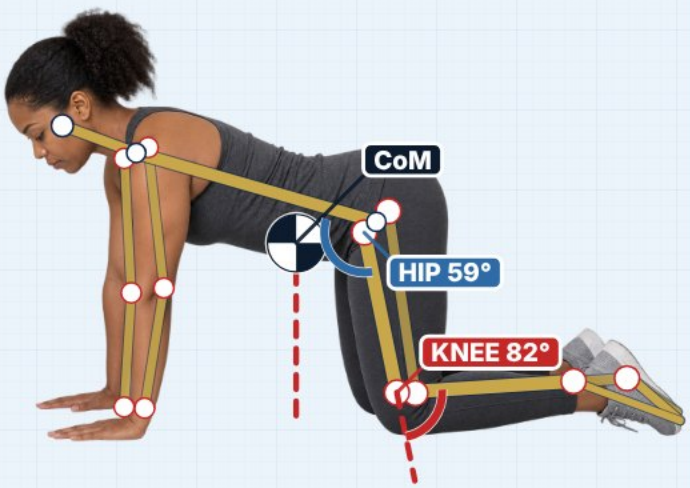
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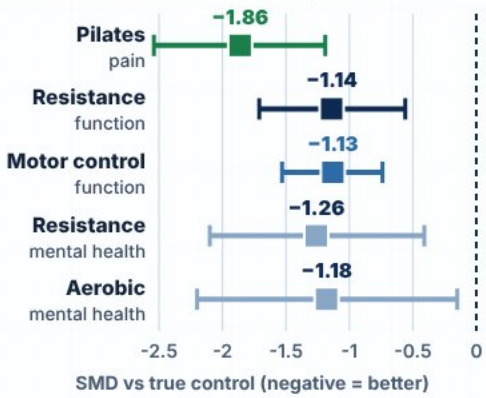
B · QUADRUPED, SIDE



Quadruped: low load, high control

- Hands and knees: hip **59°**, knee **82°**; the trunk is supported at both ends, so this is often tolerated early.
- Several types of exercise beat true control; the best type differed by outcome, and intervals overlapped widely.

Different modes, different strengths



Network meta-analysis of 89 trials (5,578 patients). Indirect comparisons: read as “several modes help”. Owen et al. (2020).

Key point: stretching alone and McKenzie exercise as a generic mode did not differ from true control in this analysis; that is not the same as directional-preference assessment in selected people.

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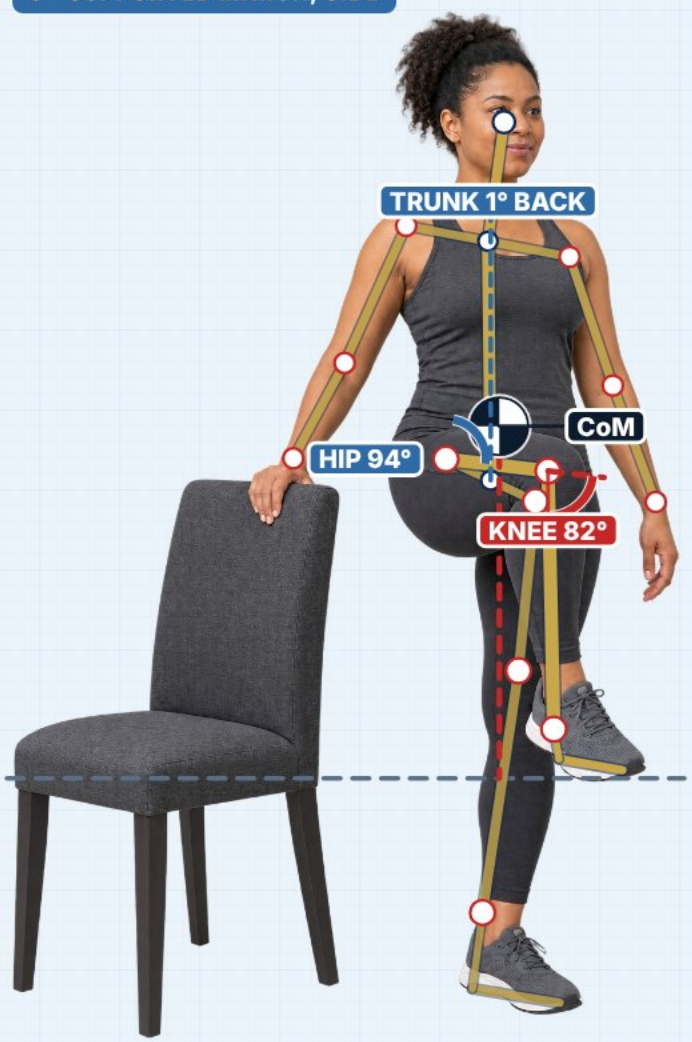
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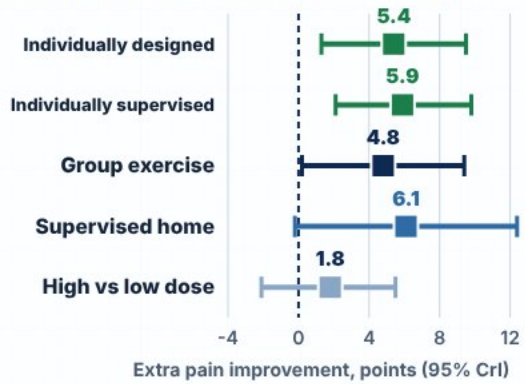
C · SUPPORTED MARCH, SIDE



Supported march: dose and delivery

- Standing knee lift with a hand on a chair: lifted hip **94°**, knee **82°**; support lets balance and confidence build together.
- How exercise is delivered mattered: individually designed and supervised programmes gained more than unsupervised home exercise alone.

Which programme features add benefit?



43 trials of chronic LBP; compared with home exercise alone (dose: high vs low). Hayden, van Tulder & Tomlinson (2005).

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A · Chair rise
Lever ≈15 cm

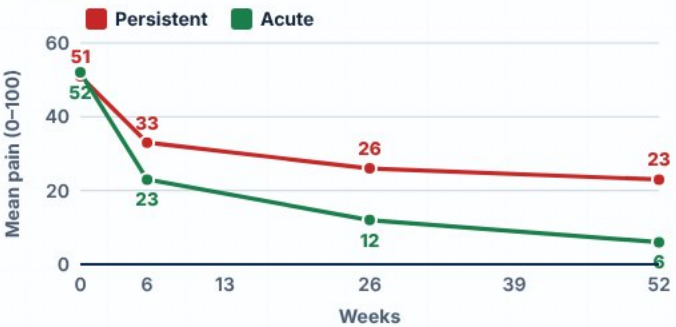


B · Quadruped
Supported trunk



C · Supported march
Balance + hip

Expected course: persistent pain changes more slowly



33 cohorts, 11,166 participants; variance-weighted mean pain. da C Menezes Costa et al. (2012).

Decision pathway

1. **MATCH THE GOAL**
   Pain, function, fitness or confidence: choose a mode the person can do and wants to do.
2. **START WHERE TOLERATED**
   Pick a starting level by symptom response during and the day after exercise.
3. **INDIVIDUALISE, SUPERVISE**
   Tailored, supervised programmes gained more; review progress over weeks to months.

NOT RECOMMENDED

Promising one "best" exercise for everyone; stretching alone as the whole programme.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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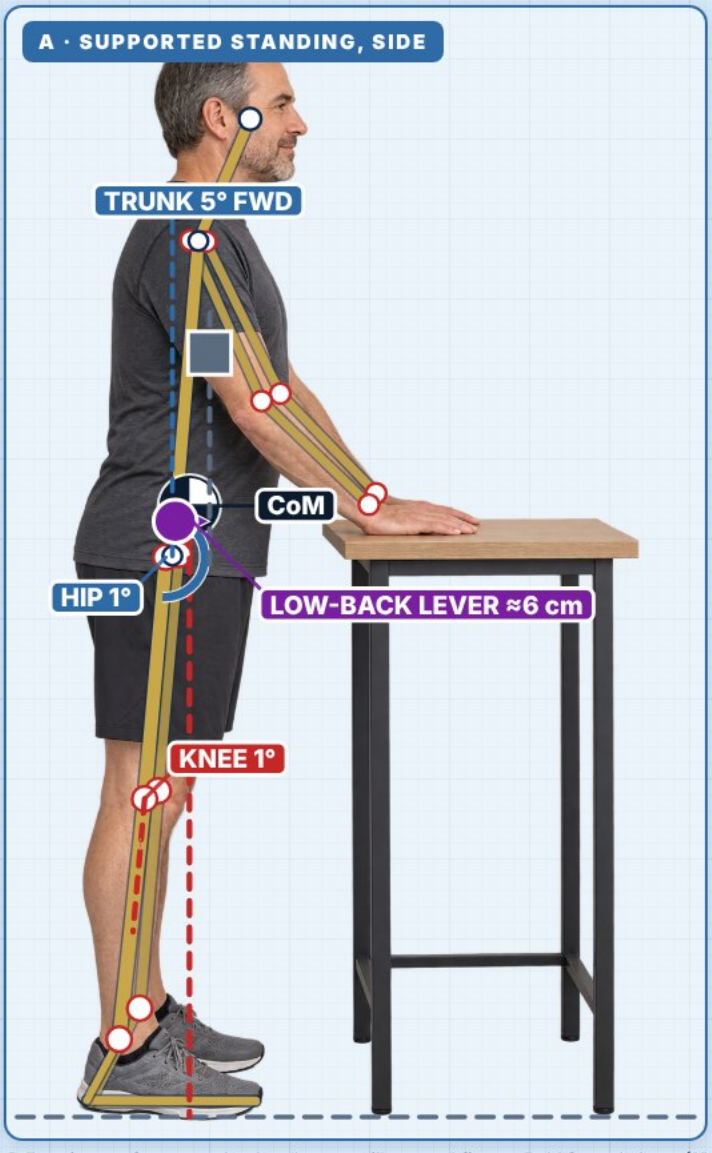
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SUDDEN LOWER BACK PAIN: WHAT TO DO IN THE FIRST FEW DAYS

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Supported standing: unloading through the arms

- Hands on a bench, trunk **5°** forward: the upper body sits close to L5/S1 (lever **≈6 cm**, **≈25 N·m**), and the arms share the load.
- Positions like this are comfort tools for the first days, not treatments in themselves.
- Most new episodes improve markedly within 6 weeks.

The usual course of a new episode



33 cohorts, 11,166 participants (acute-onset cohorts shown); variance-weighted mean. da C Menezes Costa et al. (2012).

Use the curve: progress clearly slower than this is a cue to reassess, not a reason for alarm.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

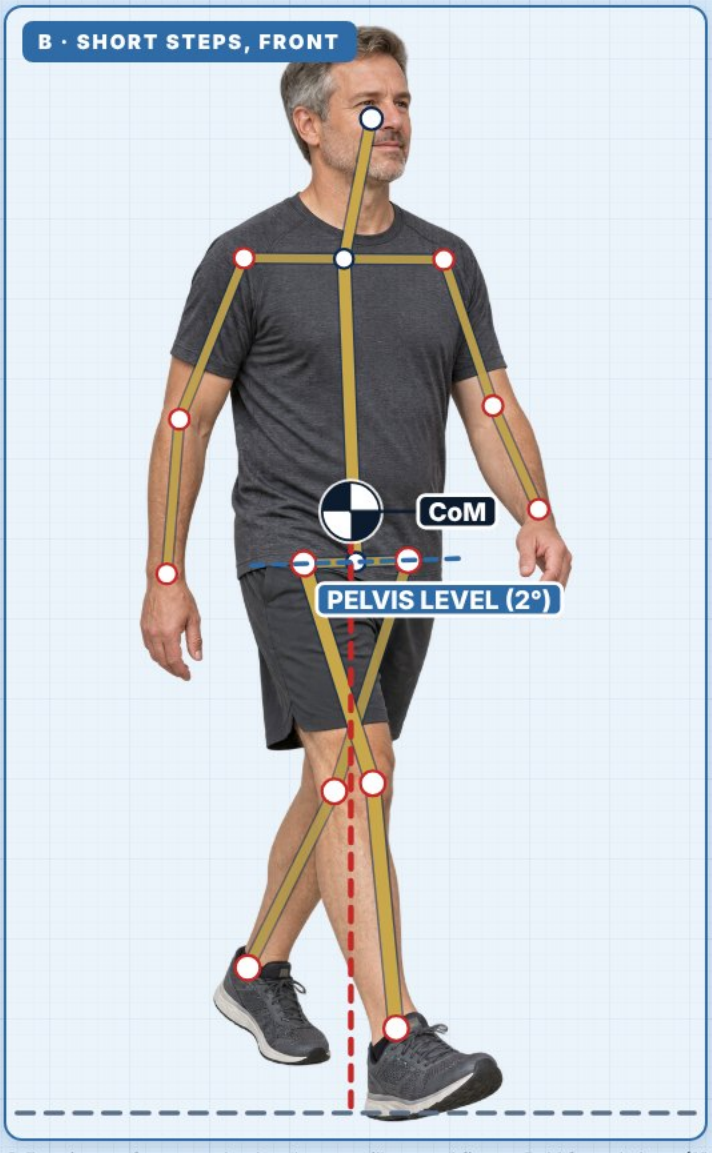
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BIOMECHANICS IS A FORCE-GOVERNED DECISION SYSTEM – NOT A POSTURE MODEL.

INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

SUDDEN LOWER BACK PAIN: WHAT TO DO IN THE FIRST FEW DAYS

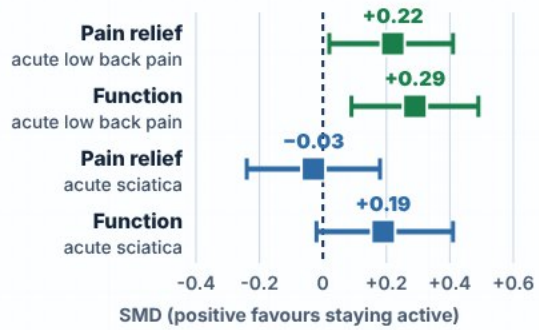
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Short steps: keep moving within comfort

- Front view, short stride: pelvis level (**2°**); short, frequent walks keep the trunk upright and the lever small.
- Advice to stay active gave small benefits over advice to rest in bed for acute LBP; for sciatica, bed rest gave no advantage.

Stay active or rest in bed?



10 trials; acute LBP 2 trials, n = 401. SMD (95% CI). Dahm et al. (2010).

Practical dose: several short bouts spread through the day, adjusted to how symptoms respond that evening and the next morning.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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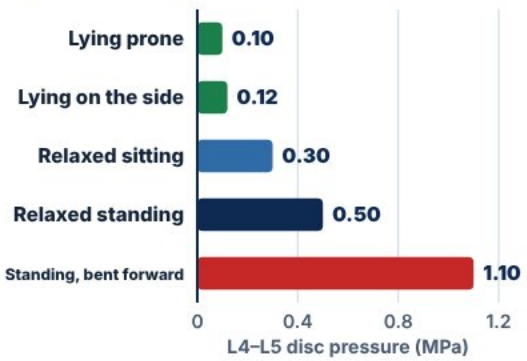
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C · HOOK LYING, SIDE



Disc pressure by position



One healthy 45-year-old man, in vivo telemetry: illustrative, not a safety threshold. Wilke et al. (1999).

Hook lying: a low-load rest position

- On the back with knees bent (hip **48°**): body weight is spread along the floor, so the low back carries the least load of any position.
- Short rests like this between bouts of activity are fine; days of bed rest are not recommended.
- Superficial heat gave small short-term relief (limited evidence).

Superficial heat (acute and subacute LBP)

Heat wrap vs oral placebo at day 5; 2 trials, 258 people. Limited evidence.

+1.06
pain relief, 0–5 scale (95% CI 0.68–1.45)

9 trials
1,117 people in the review

Rest, then move: a few minutes in a comfortable position, then a short walk. Repeat through the day.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Stats: French et al. (2006). Educational, not diagnostic.

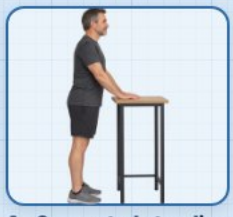
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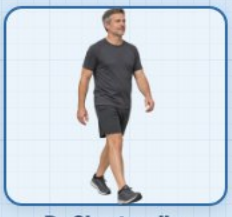
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A · Supported standing
Lever ≈6 cm

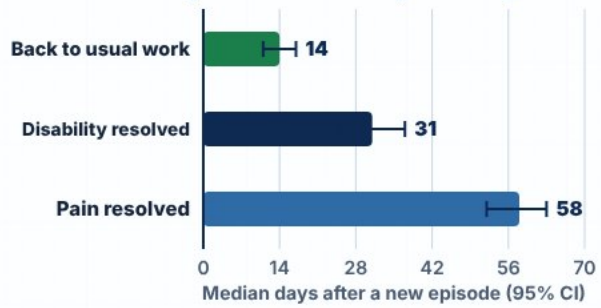


B · Short walks
Stay active



C · Hook lying
Lowest load

Function usually returns before pain fully settles



973 primary-care patients, pain under 2 weeks; 72% fully recovered by 12 months. Henschke et al. (2008).

Decision pathway

1. **SCREEN**
   Check for red flags and neurological signs; most new episodes have no serious cause (0.9% did).
2. **KEEP MOVING**
   Reassure, stay active, use positions and heat for comfort; continue work and daily tasks where possible.
3. **REASSESS**
   Review if not improving after about 4 weeks, sooner if symptoms spread or worsen.

NOT RECOMMENDED

Bed rest; routine imaging in the first days without red flags.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care. Also: significant trauma, fever, or a history of cancer.

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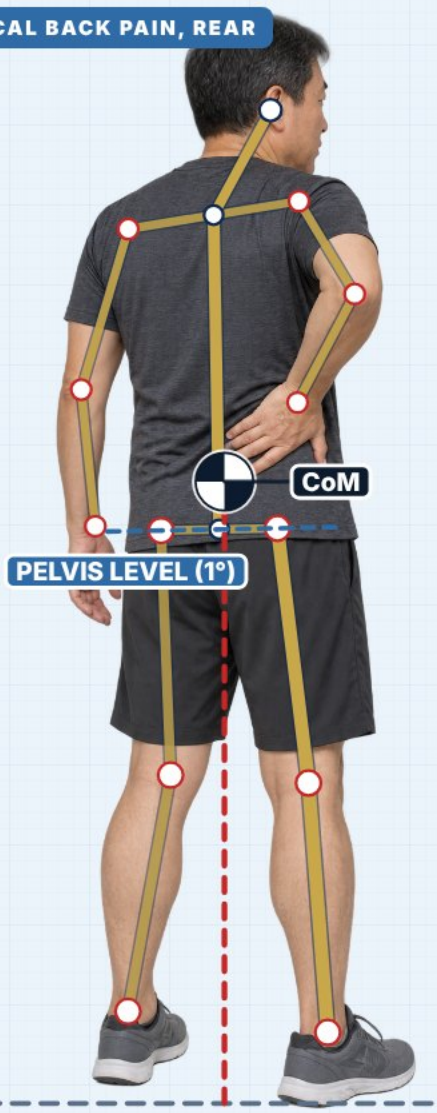
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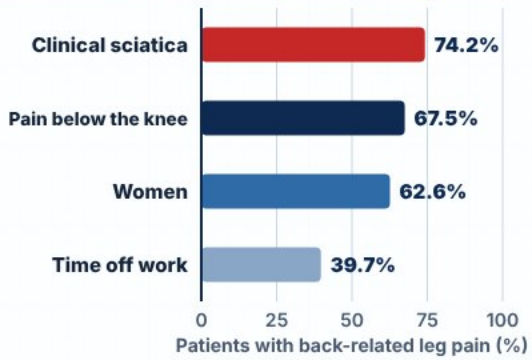
A · LOCAL BACK PAIN, REAR



Back pain: felt in the back

- Hand over the lower back; pelvis level within **1°**. Pain that stays in the back and buttock is the commonest pattern.
- **Referred leg pain** comes from lumbar tissues without nerve-root involvement: vaguer, usually above the knee.
- **Sciatica** (radicular pain) follows a nerve root, usually below the knee, sometimes with numbness, weakness or reflex change.

Who consults with back-related leg pain?



ATLAS cohort, 609 primary-care patients, mean age 50. Konstantinou et al. (2015).

Why it matters: the label changes what to examine and when to escalate, not whether to stay active.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the rear view. Educational, not diagnostic.

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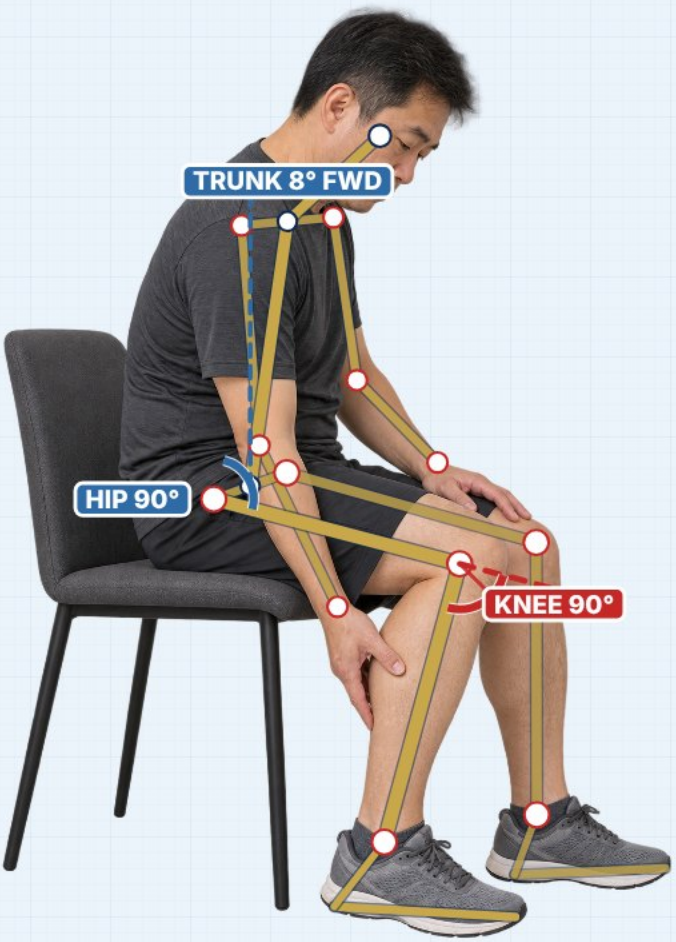
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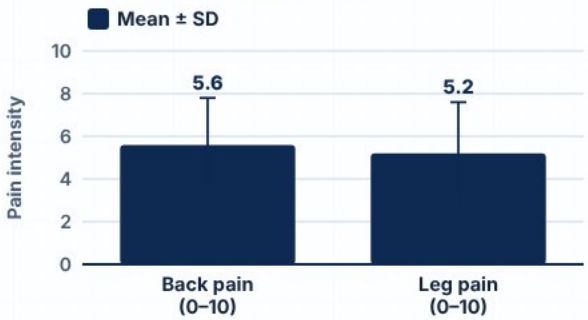
B · LEG SYMPTOMS, SIDE



Seated: tracing where the leg symptoms go

- Sitting with hip **90°** and knee **90°**, pointing down the leg: the map of symptoms is a key part of the assessment.
- Patients diagnosed with sciatica had more pain, more neuropathic features and more positive MRI findings than those with referred leg pain.
- Leg pain was as intense as back pain in this cohort.

Back and leg pain at first consultation



ATLAS cohort, n = 609; disability (RMDQ) 12.7 ± 5.7 of 24. Konstantinou et al. (2015).

Myth: "any pain in the leg is sciatica." Leg pain can be referred from the back without a nerve-root problem.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

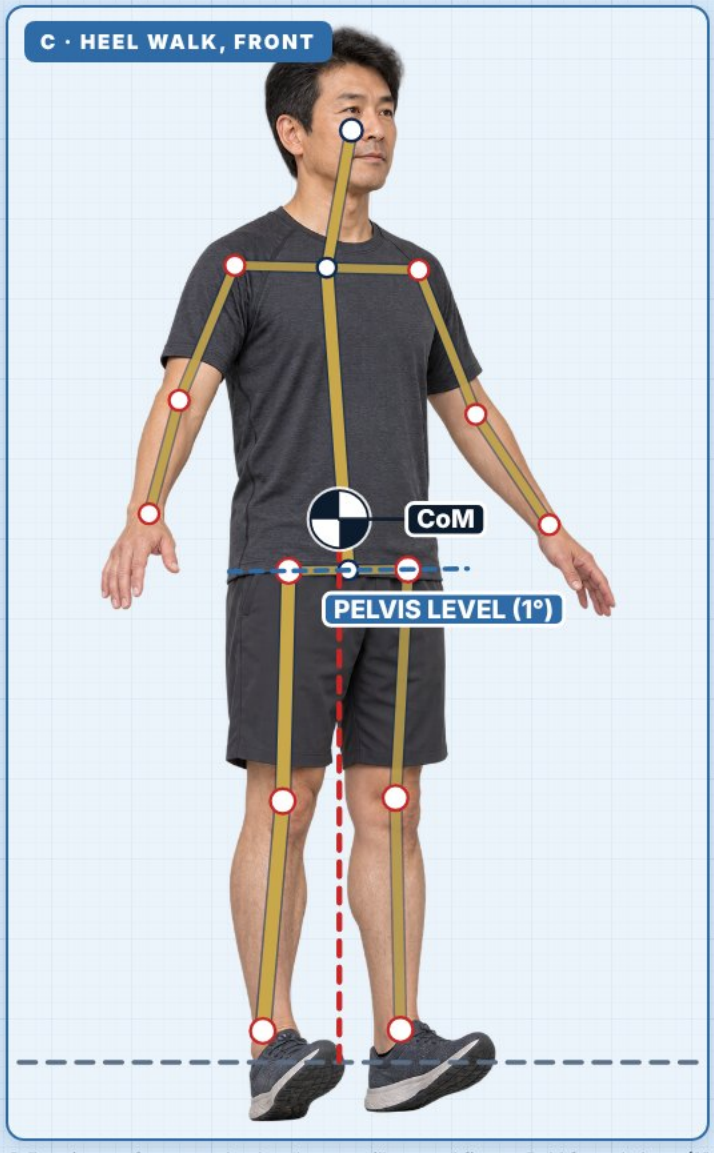
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Heel walk: a quick strength check

- Walking on the heels (knees near straight, **3°**) tests the ankle and toe lifters; difficulty on one side can point to L4–L5 nerve-root weakness.
- Examination (strength, sensation, reflexes, straight-leg raise) separates sciatica from referred pain better than symptoms alone.
- 55% of patients improved by 12 months, with or without the sciatica label; expectations mattered.

What predicted a poorer outcome?



ATLAS cohort, n = 609; OR < 1 = lower odds of improving. Konstantinou et al. (2018).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

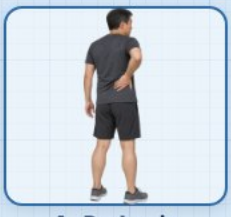
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A · Back pain
Stays in the back

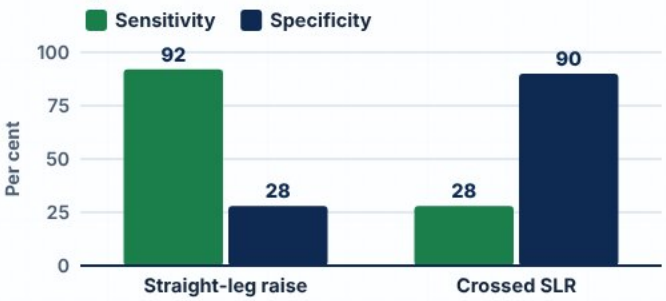


B · Leg symptoms
Map the pattern



C · Heel walk
Strength check

No single test confirms disc-related sciatica



Pooled accuracy for disc herniation, mostly surgical populations. van der Windt et al. (2010).

Decision pathway

1. **MAP THE SYMPTOMS**
   Back only, referred into the thigh, or below the knee in a nerve-root pattern?
2. **EXAMINE**
   Strength, sensation, reflexes and SLR: a negative SLR argues against, a positive crossed SLR for, disc-related radiculopathy.
3. **STAY ACTIVE, REVIEW**
   Bed rest is no better than staying active in sciatica; refer if deficits progress or no improvement by ~4 weeks.

NOT RECOMMENDED

Labelling all leg pain as sciatica; relying on one test.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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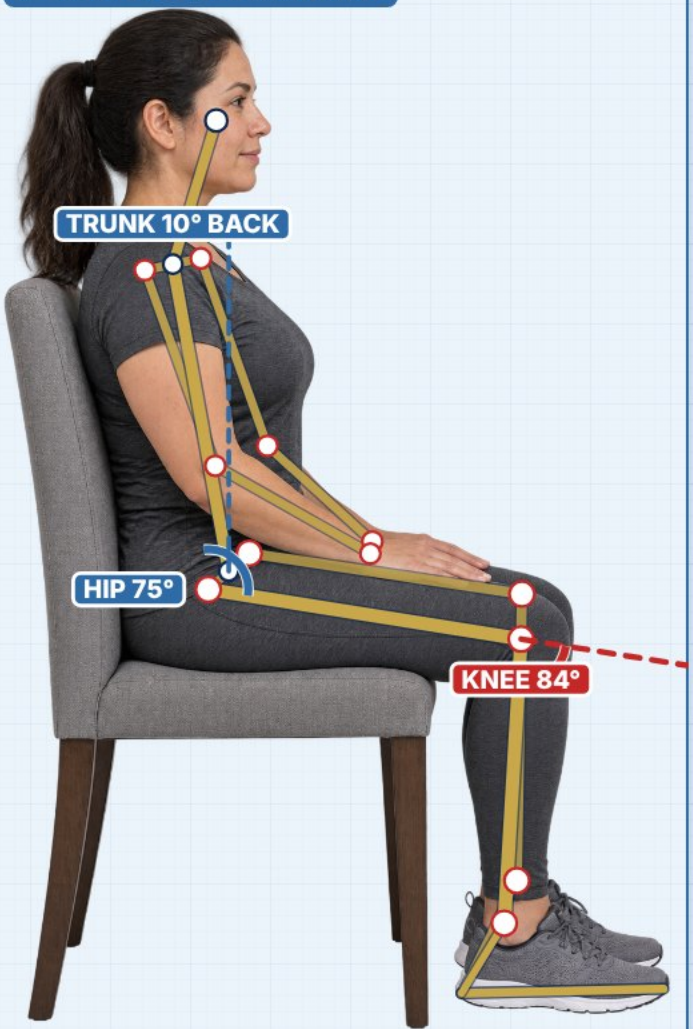
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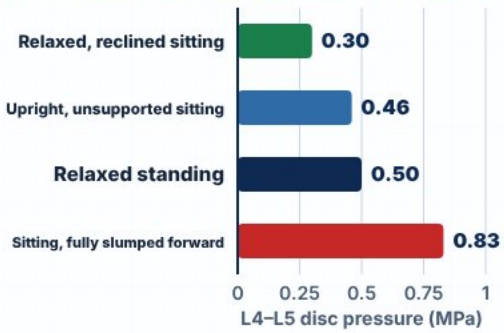
A · SUPPORTED SITTING, SIDE



Back-supported sitting

- Trunk **10°** behind vertical against the backrest; hip **75°**, knee **84°**. The backrest takes part of the upper-body weight.
- Relaxed sitting did not load the disc more than standing; slumping fully forward did.
- There is no single correct sitting posture: changing position is the lever.

Disc pressure in different sitting postures



One healthy 45-year-old man, in vivo telemetry: illustrative only. Wilke et al. (1999).

Myth: "sitting loads your discs far more than standing." Upright sitting (0.46 MPa) and relaxed standing (0.50 MPa) were similar.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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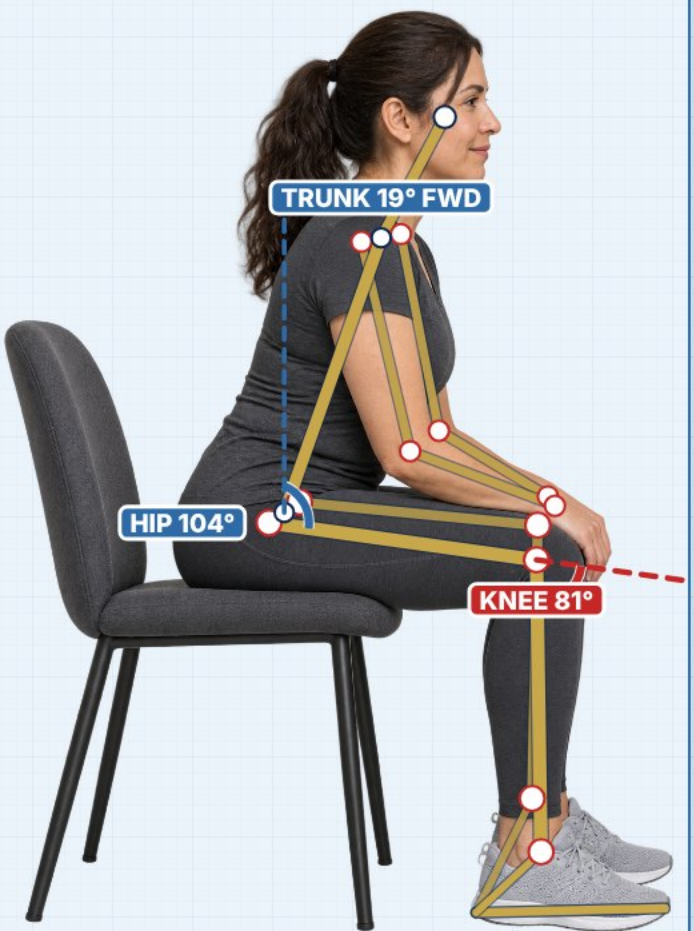
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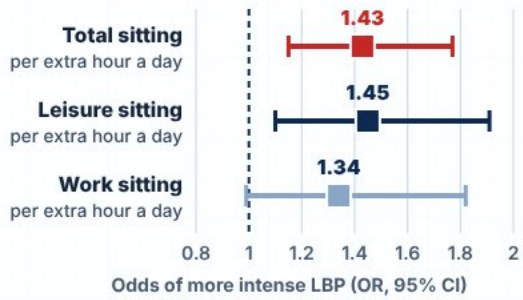
B · FORWARD SITTING, SIDE



Forward sitting: a different load, not a wrong one

- Perched forward: trunk **19°** forward, hip **104°**. Alternating between this and a supported posture spreads the load.
- In blue-collar workers, more measured sitting time went with more intense LBP, mainly leisure sitting.
- Cross-sectional data: sitting may be a marker of pain rather than its cause.

Daily sitting time and LBP intensity



201 workers, accelerometer-measured sitting; work sitting not significant. Gupta et al. (2015).

Takeaway: daily sitting time is modifiable: break it up and add activity rather than chasing a perfect spinal angle.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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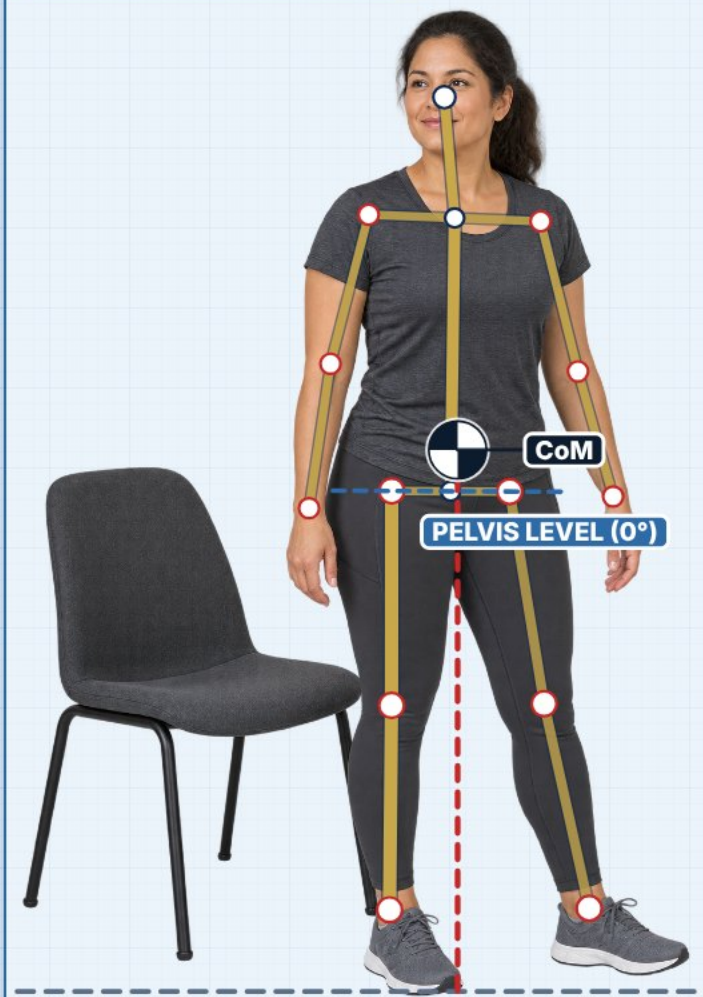
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C · MOVEMENT BREAK, FRONT



Movement break: stand up before symptoms build

- Standing beside the chair, pelvis level (**0°**): a short break changes disc and muscle loading and lets symptoms settle.
- Sitting tolerance = the time you can sit before symptoms limit the task. Find today's baseline, take a break just before it, then lengthen sitting bouts gradually.

Sit-stand workstations (pain-free workers)

Small reductions in low back discomfort; people already in pain were not studied, so the evidence is indirect.

8	−0.23	0.3–0.5
studies pooled	SMD, low back discomfort	points less on a 10-point scale

Graded exposure: if 20 minutes is comfortable today, plan breaks at 20 and add a few minutes each week as symptoms allow. Example dose, not a fixed rule.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Stats: Agarwal, Steinmaus & Harris-Adamson (2018). Educational, not diagnostic.

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A · Supported
Backrest takes load

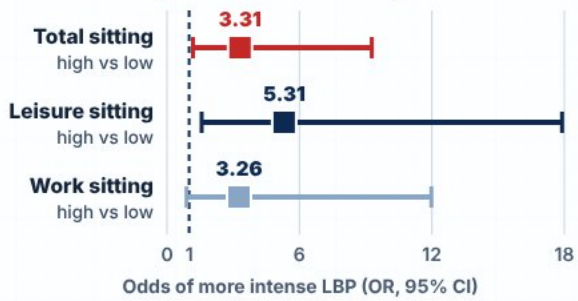


B · Forward
Vary the posture



C · Break
Stand before it builds

Most vs least sitting: wide uncertainty



Same 201 workers; wide intervals: associations only. Gupta et al. (2015).

Decision pathway

1. **FIND THE BASELINE**
   How long can you sit today before symptoms limit you? Start just below that.
2. **VARY AND BREAK**
   Alternate supported and forward postures; stand or walk briefly before symptoms build.
3. **EXTEND GRADUALLY**
   Lengthen sitting bouts week by week; add exercise for persistent pain.

NOT RECOMMENDED

Searching for one "perfect" chair posture; avoiding sitting altogether.

SEEK ASSESSMENT IF

Sitting brings on leg pain with numbness or weakness, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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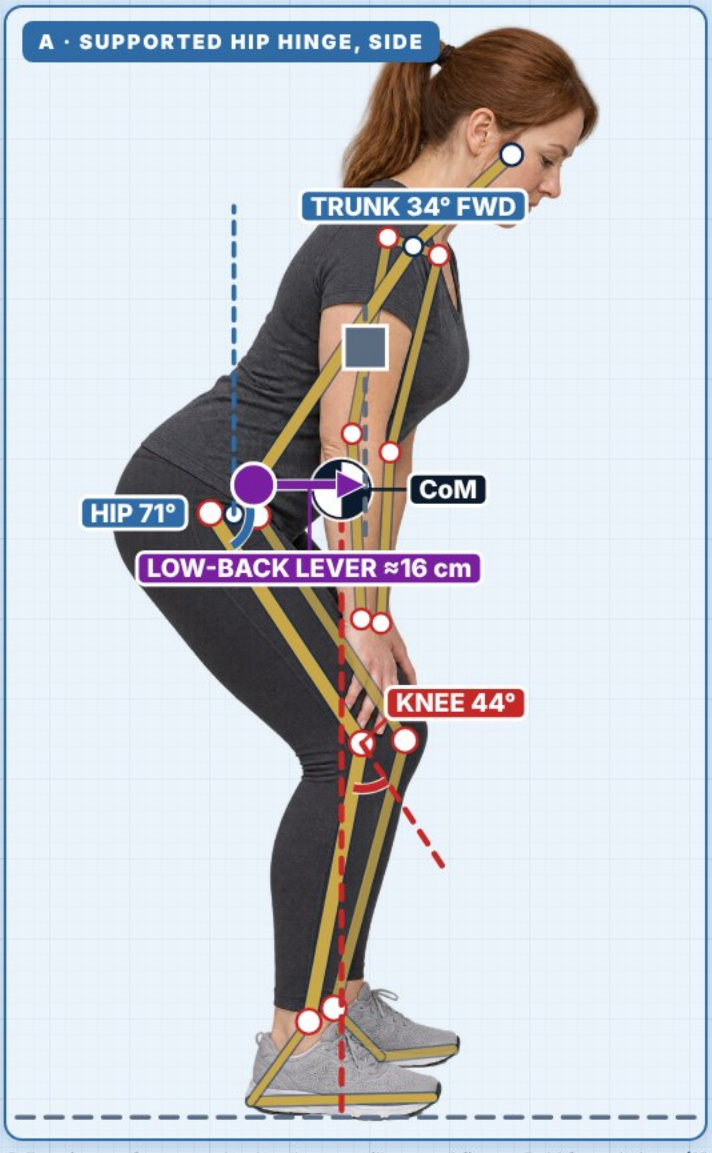
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BIOMECHANICS IS A FORCE-GOVERNED DECISION SYSTEM – NOT A POSTURE MODEL.

INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

LOWER BACK PAIN WHEN BENDING: HOW TO REBUILD MOVEMENT CONFIDENCE

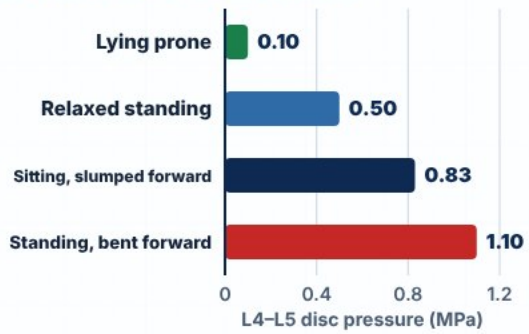
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Supported hip hinge: a gentle first range

- Hands on the thighs, trunk **34°** forward, hip **71°**, knee **44°**: lever ≈**16 cm**, ≈**66 N·m** about L5/S1, part of it carried through the arms.
- Bending roughly doubled disc pressure compared with standing: a normal load that healthy tissue tolerates daily.
- The task is to re-expose a sensitive back progressively, not to ban bending.

Disc pressure: upright vs bent



One healthy 45-year-old man, in vivo telemetry: illustrative only. Wilke et al. (1999).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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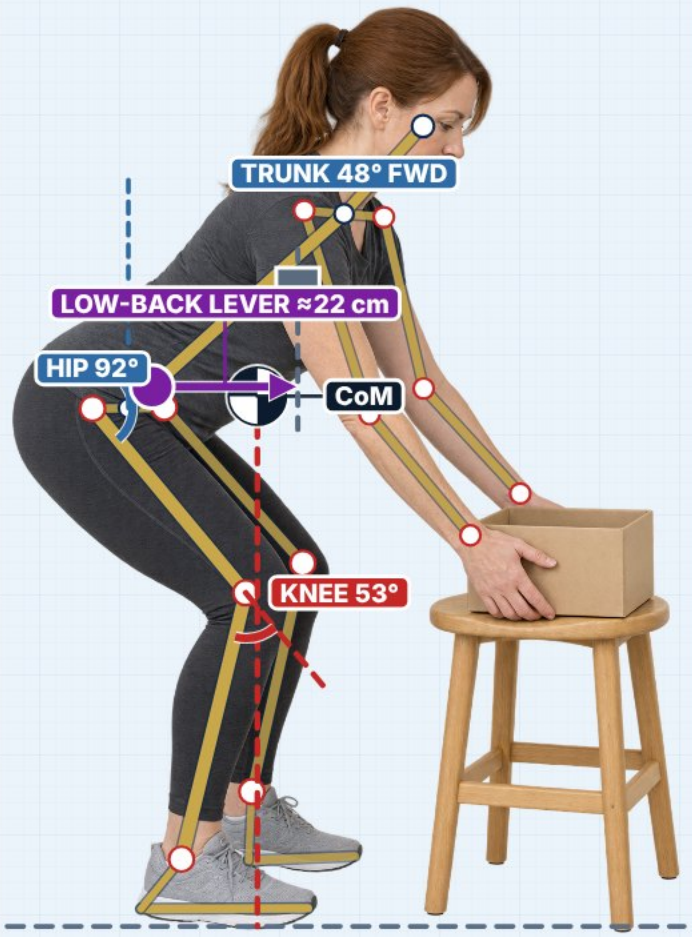
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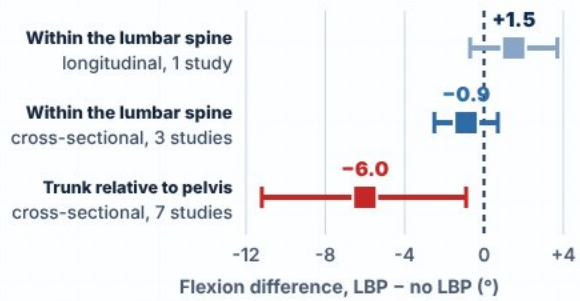
B · REACH TO A STOOL, SIDE



Reach to a stool: more range, longer lever

- Trunk **48°** forward, hip **92°**: lever **≈22 cm**, **≈89 N·m**, the largest of the three bends shown.
- People with LBP did not bend *more* when lifting; measured trunk-to-pelvis they bent about 6° *less*.
- Protective stiffening is common, so restoring confident, varied bending is often the goal.

Do people with back pain bend more?



Mean difference (95% CI) during lifting; low-quality evidence. Saraceni et al. (2020).

Confidence is trainable: repeated, successful exposure to a feared movement is part of the treatment, not a test to pass first.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

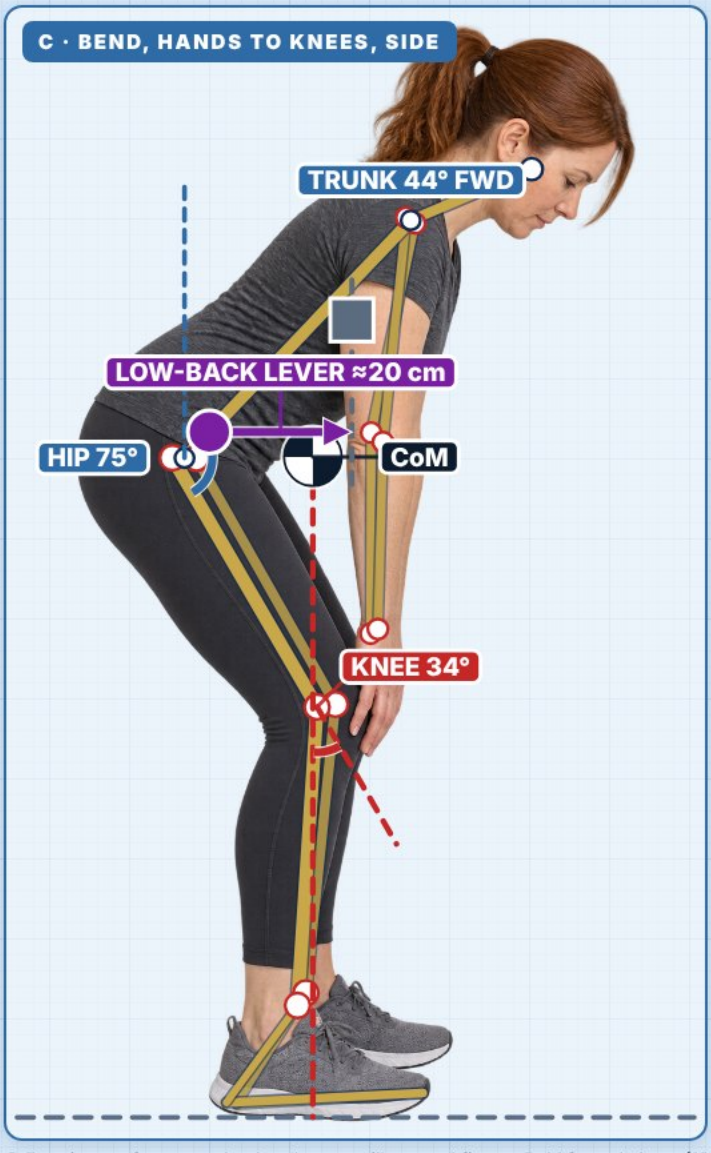
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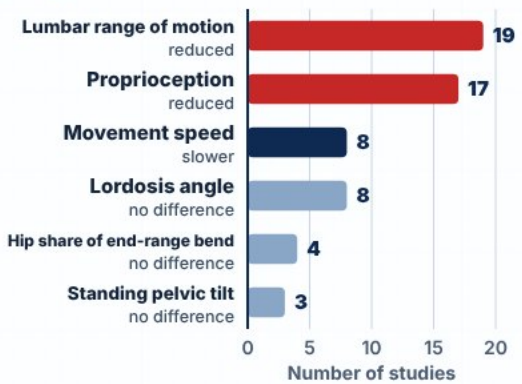
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Deeper bend: what actually differs

- Trunk **44°** forward with soft knees (**34°**): lever **≈20 cm**, **≈80 N·m**.
- People with LBP moved through less lumbar range and more slowly; lordosis and pelvic tilt did not differ from people without pain.

Back pain vs no back pain: movement findings



43 studies; bars show how many studies assessed each feature, with the direction found. Laird et al. (2014).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

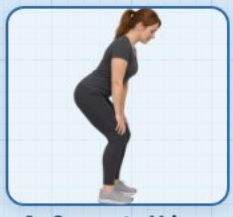
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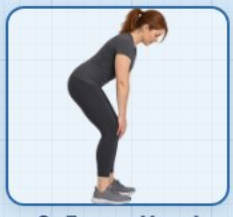
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A · Supported hinge
≈66 N·m

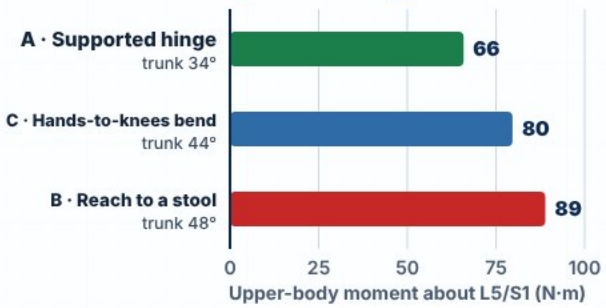


B · Reach to stool
≈89 N·m



C · Forward bend
≈80 N·m

A ladder for bending: same body, different demand



MMSx 2-D analysis of frames A–C; 70 kg adult, static, no hand load; arm support in A not subtracted.

Decision pathway

1. **RANGE**
   Start with supported, part-range bends that feel safe; add range as the response allows.
2. **REPETITION**
   Build the number of bends across the day before adding speed or weight.
3. **LOAD**
   Add light objects close to the body, then heavier or further away, guided by the next-day response.

NOT RECOMMENDED

Telling people to avoid bending as a rule; "keep your back straight at all times".

SEEK ASSESSMENT IF

Bending sends pain below the knee with numbness or weakness, pain after significant trauma, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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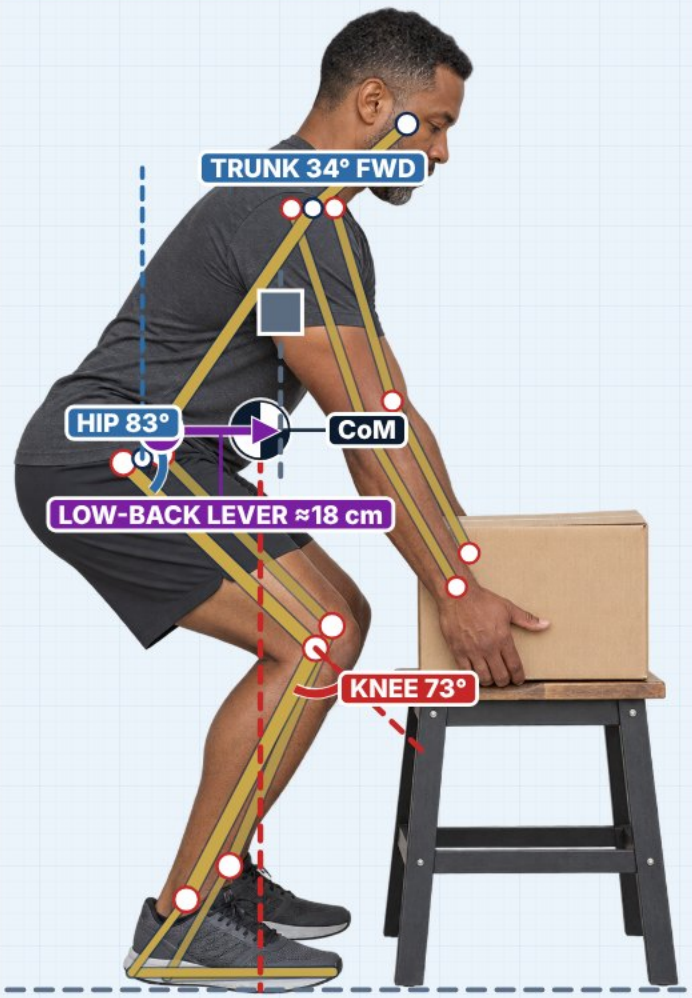
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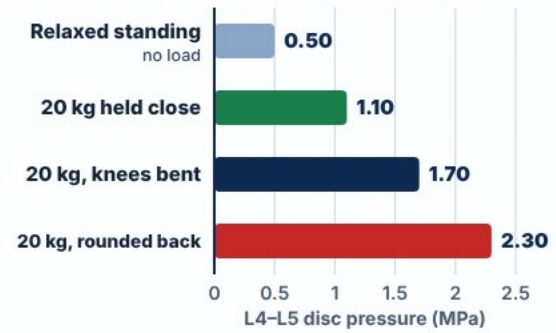
A · PICK-UP FROM A STOOL, SIDE



Pick-up from a raised surface

- Trunk **34°** forward, hip **83°**, knee **73°**: the upper body alone gives lever **≈18 cm**, **≈73 N·m** before the box is lifted.
- Raising the start height shortens the bend: an easy way to regress or progress a lift.
- In one person, the load's distance from the body changed disc pressure more than knee bend did.

Lifting 20 kg: what changes the load?



One healthy 45-year-old man, in vivo telemetry: illustrative, not a safety threshold. Wilke et al. (1999).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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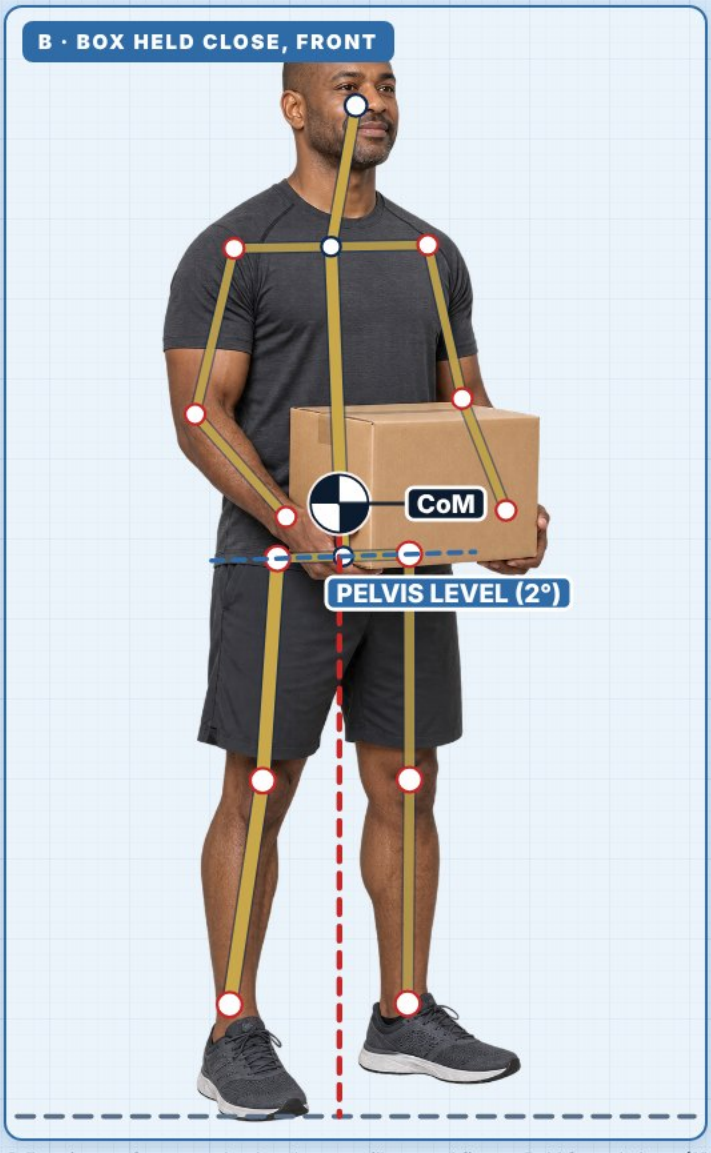
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B · BOX HELD CLOSE, FRONT



Box held close: the shortest load lever

- Upright, pelvis level (**2°**), box against the trunk: the load sits as close to the spine as it can.
- At work, LBP risk rose gradually with load and frequency: a dose to plan, not a reason to fear lifting.
- Loads over 25 kg raised annual LBP incidence by about 4 percentage points compared with no lifting.

Work lifting: a gradual dose–response



Meta-analysis of 8 longitudinal studies. Coenen et al. (2014).

Capacity view: the aim is to rebuild the capacity for the loads your day actually needs, not to avoid them.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

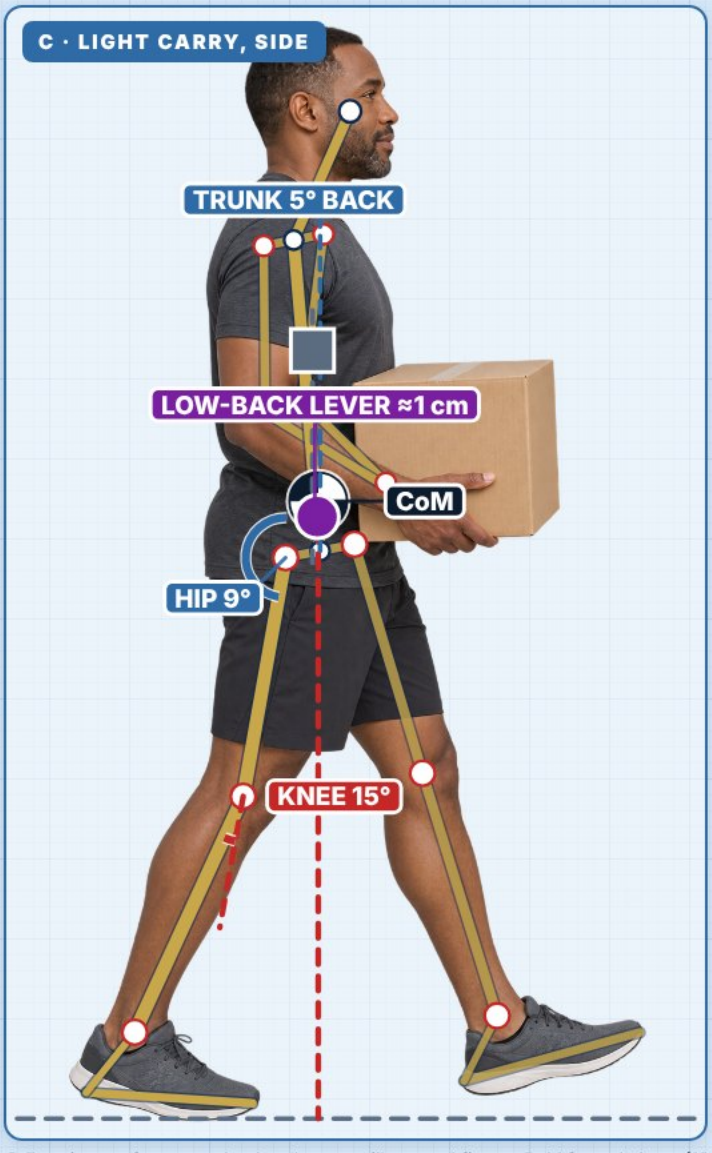
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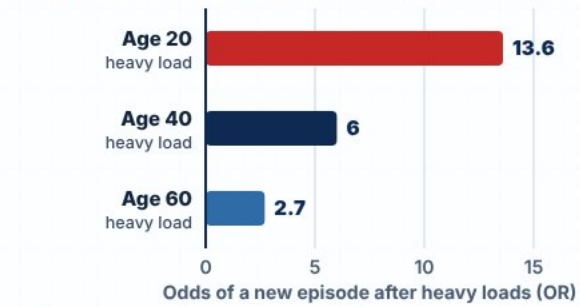
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Light carry: walking with the load

- Upright carry (trunk **5°** back): the upper-body lever is near zero (**≈1 cm**); the box adds its own small lever in front.
- Heavy loads in the preceding hours were associated with a new episode; the association weakened with age.

Heavy loads as a short-term trigger, by age



999 adults, case-crossover design; no CIs in the abstract. Steffens et al. (2015).

Myth: "never lift with a bent back." Lumbar flexion during lifting has not been shown to predict LBP (low-quality evidence; Saraceni et al., 2020).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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A · Raised pick-up
≈73 N·m, no box

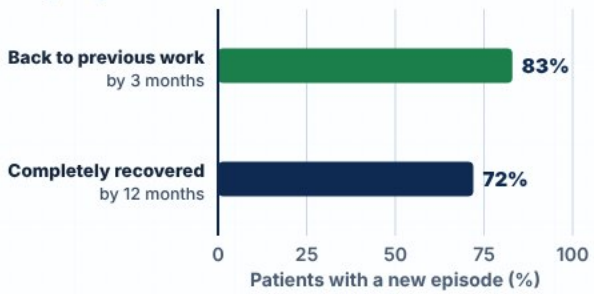


B · Held close
Shortest lever



C · Carry
Upright

Most people return to usual loads



973 primary-care patients; median return to work 14 days (11–17). Henschke et al. (2008).

Decision pathway

1. **ASSESS THE EPISODE**
   Check for red flags and nerve signs; most lifting-related episodes are non-specific.
2. **KEEP LOADS IN THE DAY**
   Stay active and keep working where possible; use raised start heights and close loads early.
3. **PROGRESS THE LIFT**
   Height lower → weight up → distance out, guided by symptoms that evening and the next day.

NOT RECOMMENDED

Banning lifting; teaching one "correct" technique for every task.

SEEK ASSESSMENT IF

Pain after significant trauma, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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MORNING LOWER BACK STIFFNESS: WHAT YOUR SYMPTOM PATTERN CAN TELL YOU

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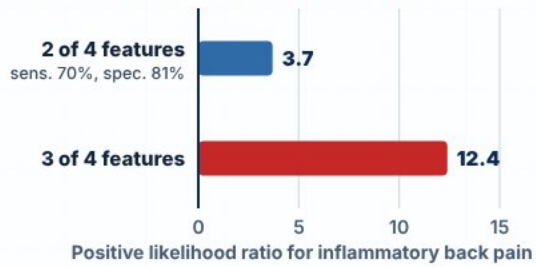
A · STIFF ON WAKING, SEATED



How long does the stiffness last?

- Mechanical back pain: stiffness for minutes that eases quickly once moving.
- Inflammatory pattern (Berlin criteria): ① morning stiffness **over 30 minutes**; ② better with exercise, not with rest; ③ waking in the **second half** of the night; ④ alternating buttock pain.

The more features, the more likely



213 patients under 50 with chronic back pain (101 ankylosing spondylitis); case–control, so real-world accuracy will be lower. Rudwaleit et al. (2006).

No single feature decides: it is the combination, the duration and the age at onset that change the probability.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: no joint angles reported for this view. Educational, not diagnostic.

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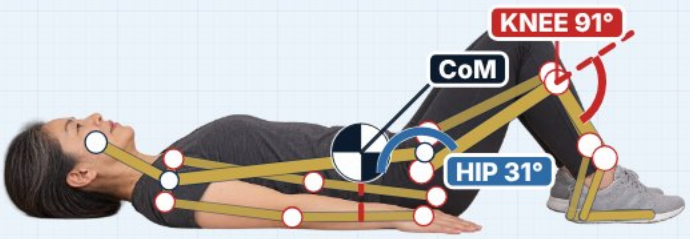
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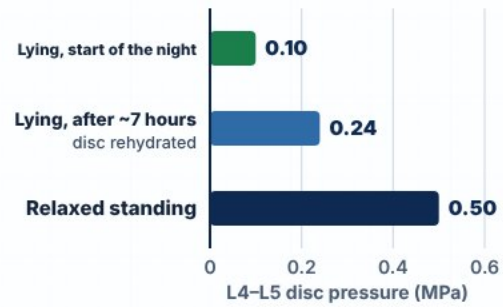
B · PELVIC TILTS, SIDE



Pelvic tilts in bed: easing into the day

- Lying on the back, knees bent (knee **91°**, hip **31°**): small, rhythmic tilts move the lumbar spine with almost no load.
- Overnight the disc takes up fluid and its pressure rises: one plausible contributor to brief stiffness on waking.
- Stiffness that settles within minutes of moving fits a mechanical pattern.

Disc pressure rises overnight



One healthy 45-year-old man, in vivo telemetry: a plausible mechanism, not a diagnostic test. Wilke et al. (1999).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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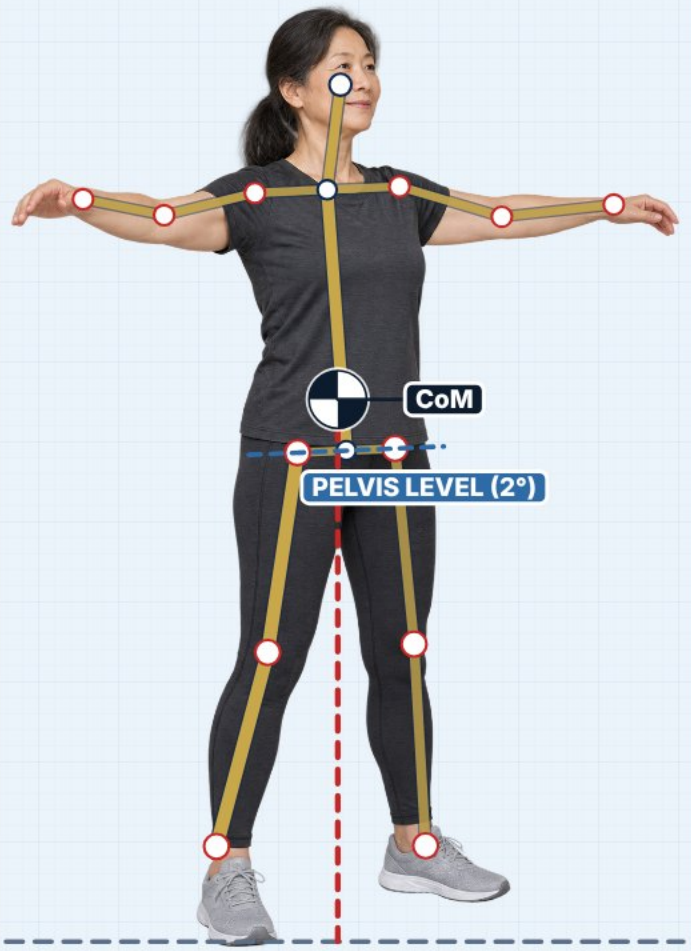
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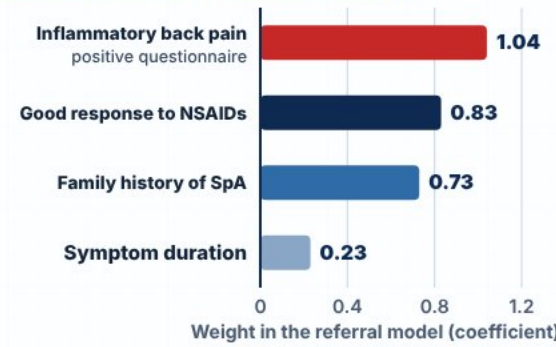
C · EASY STANDING REACH, FRONT



Easy reach: notice the response

- Arms out to the side, pelvis level (**2°**): gentle, whole-body movement soon after waking.
- Track two things: how long stiffness lasts and whether movement or rest eases it.
- In primary care, 24% of 20–45-year-olds with chronic LBP met axial spondyloarthritis (axSpA) criteria in one Dutch study.

Which features pointed to axSpA?



364 primary-care patients aged 20–45; model AUC 0.75. van Hoeven et al. (2014).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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BIOMECHANICS IS A FORCE-GOVERNED DECISION SYSTEM – NOT A POSTURE MODEL.

INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

MORNING LOWER BACK STIFFNESS: WHAT YOUR SYMPTOM PATTERN CAN TELL YOU

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A · On waking
How long? What eases it?

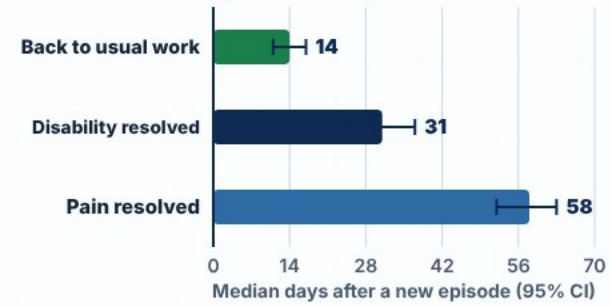


B · Pelvic tilts
Low-load start



C · Easy reach
Notice the response

Mechanical back pain usually settles



973 primary-care patients with a new episode. Henschke et al. (2008). Months of inflammatory-pattern stiffness do not fit this course.

Decision pathway

1. **TIME IT**
   Minutes and easing with movement fits a mechanical pattern; over 30 minutes is a cue to look further.
2. **LOOK FOR THE PATTERN**
   Under ~45 with pain over 3 months, better with exercise not rest, second-half-of-night waking: think inflammatory.
3. **REFER WHEN IT FITS**
   2–3 features, family history or a strong NSAID response: ask for rheumatology assessment.

NOT RECOMMENDED

Calling all morning stiffness "wear and tear"; years of delay before assessment.

SEEK ASSESSMENT IF

Stiffness over 30 minutes most mornings for 3+ months, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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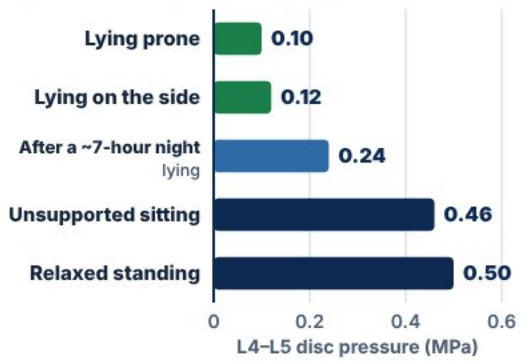
LOWER BACK PAIN AT NIGHT: SLEEP COMFORT AND SYMPTOMS WORTH CHECKING

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A · SIDE-LYING WITH PILLOW



Disc pressure: lying vs upright



One healthy 45-year-old man, in vivo telemetry: illustrative only. Wilke et al. (1999).

Side-lying with a pillow between the knees

- Hips and knees bent, a pillow keeping the top leg level: a common comfort set-up. No single sleeping position is proven best.
- Lying is the lowest-load position for the low back; night discomfort in mechanical LBP is more about sensitivity and lying still than about load.

Comfort strategies: change position, support the legs, stay active by day. These are low-risk suggestions, not graded treatments.

Turning over without a jolt

- Bend both knees, roll the shoulders and pelvis together, and use the arms to push up when getting out of bed.
- Stiffness that eases within minutes of moving in the morning fits a mechanical pattern (see Title 08).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Lying reference image: joint angles are not reported for this view. Educational, not diagnostic.

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B · ON THE BACK, KNEES SUPPORTED



On the back with the knees supported

- A cushion under the knees (knee **43°**, hip **22°**) lets the hip flexors and low back relax for many people.
- Sleep and pain travel together: in acute LBP, a worse night was followed by more pain the next day.
- This is an association; it does not prove that improving sleep will reduce pain.

Sleep quality and next-day pain

1,246 people with acute LBP; change in pain (0–10) for each 1-point worse sleep-quality rating (0–3).

+2.08
points of next-day pain (95% CI 1.99–2.16)

1,246
patients with acute LBP

Practical: treat poor sleep as a problem worth addressing in its own right, alongside pain.

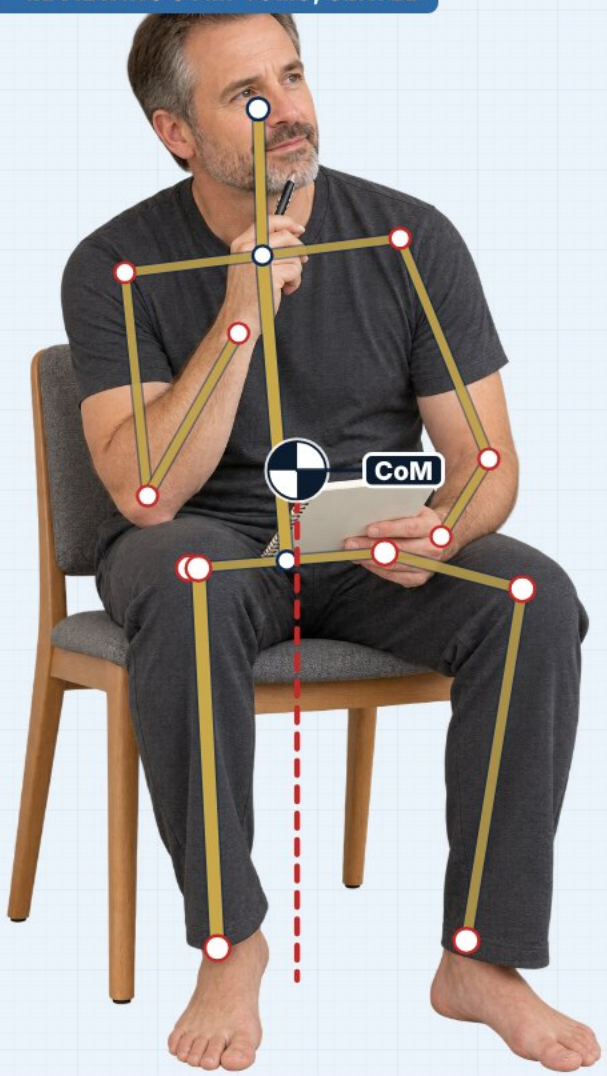
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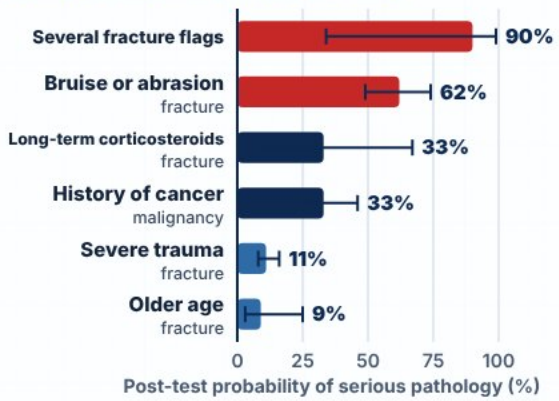
C · REVIEWING SYMPTOMS, SEATED



Which night symptoms are worth checking?

- Positional pain that eases when you turn over fits a mechanical pattern.
- **Constant** pain unrelieved by any position, with fever, unexplained weight loss or a history of cancer, needs prompt medical review.
- A past history of cancer was the strongest single flag for malignancy; night pain on its own was not among the most informative flags.

Red flags that raise the probability



14 studies, 53 red flags evaluated; 95% CI. Downie et al. (2013).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: no joint angles reported for this view. Educational, not diagnostic.

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A · Side-lying
Pillow between knees

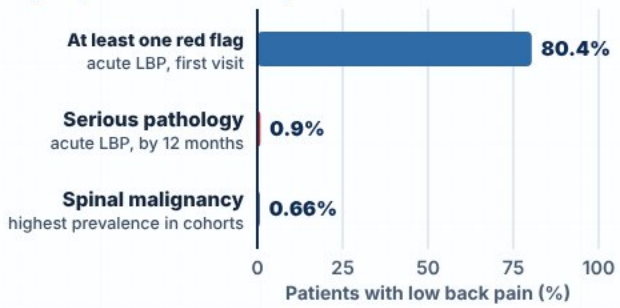


B · Knees supported
Relaxed hips



C · Review
Which pattern?

Night pain is common; serious causes are rare



Henschke et al. (2009): 1,172 primary-care patients; Henschke et al. (2013): 8 cohorts, malignancy 0–0.66%.

Decision pathway

1. **COMFORT FIRST**
   Experiment with supported positions and position changes; stay active by day; avoid bed rest.
2. **ADDRESS SLEEP**
   Poor sleep goes with more next-day pain: treat sleep as part of the plan.
3. **CHECK THE PATTERN**
   Constant, position-independent pain with other warning features needs prompt review.

NOT RECOMMENDED

Assuming night pain means cancer; ignoring it when other warning features are present.

SEEK ASSESSMENT IF

History of cancer, fever, unexplained weight loss, constant pain in any position, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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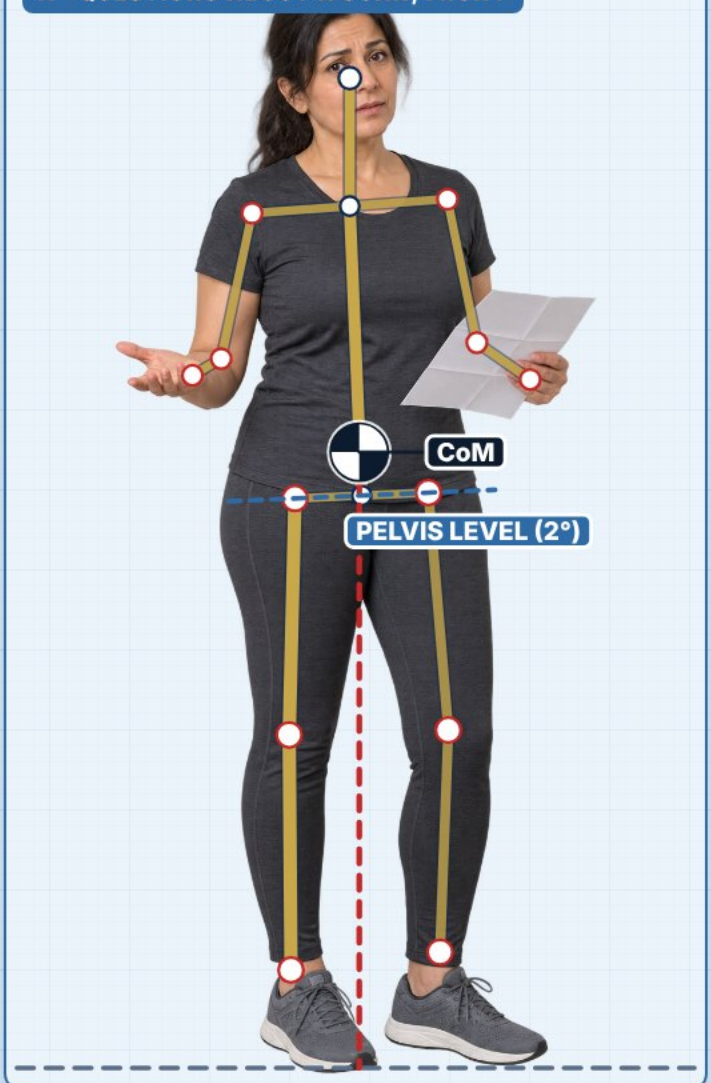
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DO YOU NEED AN MRI FOR LOWER BACK PAIN? WHEN IMAGING CHANGES CARE

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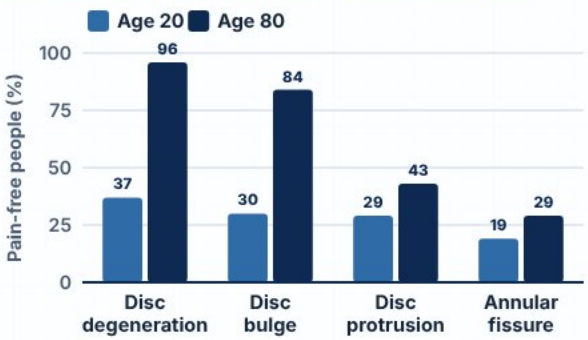
A · QUESTIONS ABOUT A SCAN, FRONT



"Will a scan show what is wrong?"

- Degenerative findings are common in people **without** pain and become the norm with age.
- So a finding on its own rarely identifies the source of pain. It has to be matched to symptoms and the examination.
- Guidelines advise imaging only when serious pathology is suspected, not routinely.

Scan findings in people without back pain



33 studies, 3,110 asymptomatic people (CT/MRI). Brinjikji, Luetmer, et al. (2015); guidance: Oliveira et al. (2018).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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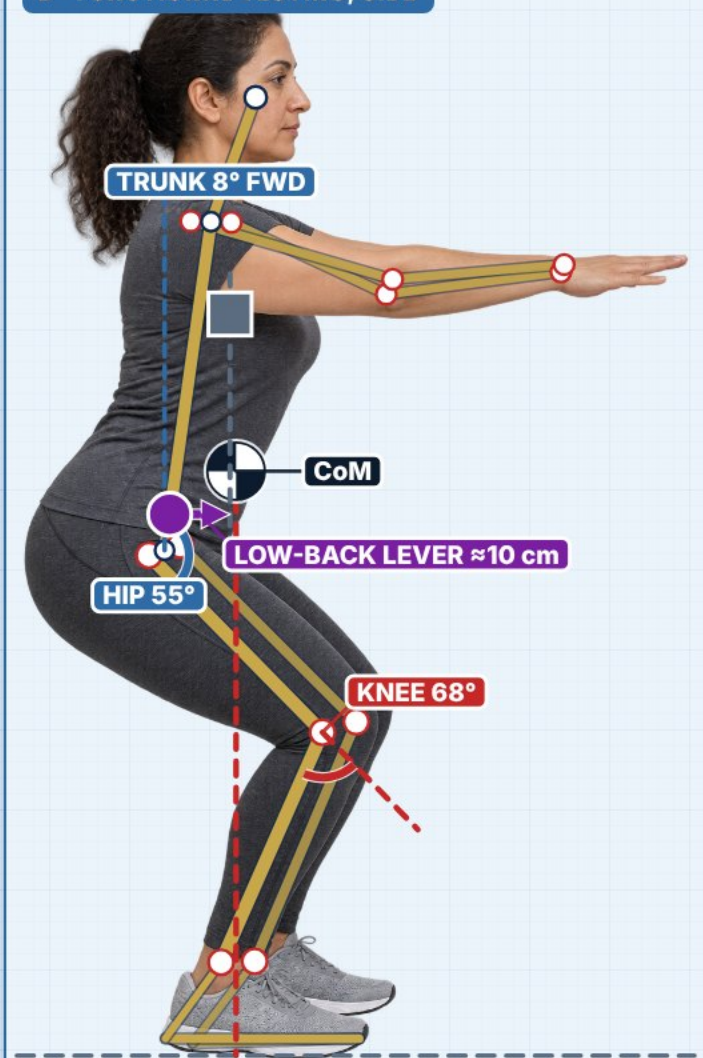
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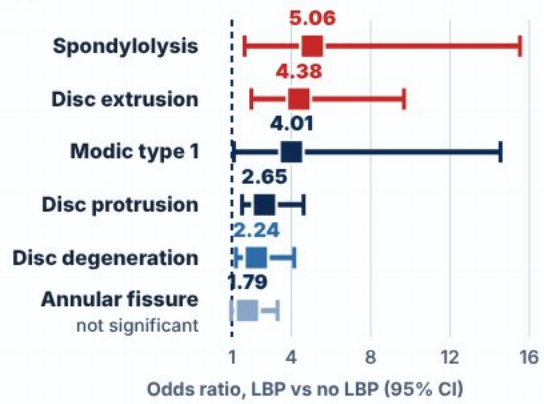
B · FUNCTIONAL TESTING, SIDE



Function first: what the scan cannot show

- Squat-type test: trunk **8°**, hip **55°**, knee **68°**, lever **≈10 cm**, **≈40 N·m**. Capacity, tolerance and confidence are measured here, not on a scan.
- Scans still carry information: in adults up to 50, some findings were more common in people with pain.

Findings more common with back pain (≤50 years)



14 studies, 3,097 adults. Disc bulge OR 7.54 (1.28–44.56) not drawn: interval too wide. Brinjikji, Diehn, et al. (2015).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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C · DISCUSSING THE PLAN



Shared decision: will the result change the plan?

- Imaging earns its place for suspected fracture, cancer, infection or cauda equina syndrome, and for persistent nerve-root pain when injection or surgery is being considered.
- Without these, an early scan rarely changes treatment and can add cost and worry.

Early MRI without an indication (US workers)

Acute, disabling work-related LBP; observational, so confounding is possible.

$12,948–13,816
extra medical cost per case

37%
of non-specific LBP had early MRI

Ask: "What would we do differently if the scan showed a bulge, and if it didn't?" If the answer is "nothing", the scan can wait.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Discussion reference image: no joint angles reported. Stats: Webster et al. (2013). Educational, not diagnostic.

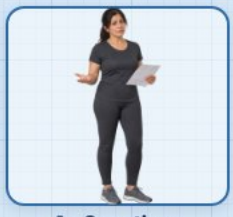
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A · Questions
What will it change?

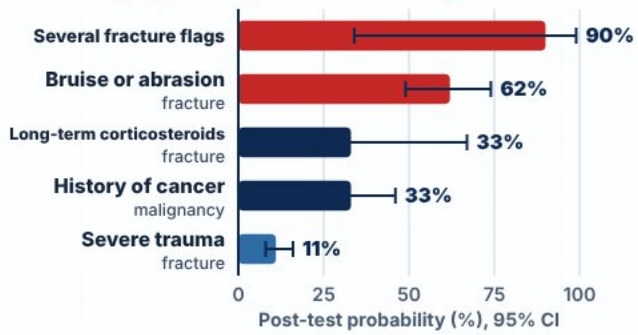


B · Function
Lever ≈10 cm



C · The plan
Shared decision

When imaging changes care: red flags



14 studies of red-flag accuracy. Base rate of serious pathology in primary care 0.9%. Downie et al. (2013); Henschke et al. (2009).

Decision pathway

1. **EXAMINE FIRST**
   History, neurological examination and function decide whether imaging could change care.
2. **IMAGE SELECTIVELY**
   Red flags, progressive deficit, or persistent radicular pain before injection or surgery.
3. **INTERPRET IN CONTEXT**
   Read findings against age-matched pain-free people and against the examination.

NOT RECOMMENDED

Routine early MRI for non-specific LBP; treating the report instead of the person.

SEEK ASSESSMENT IF

Suspected fracture, history of cancer, fever, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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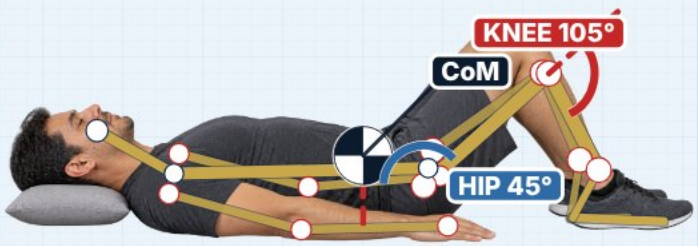
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HERNIATED LUMBAR DISC: WHAT RECOVERY WITHOUT SURGERY CAN INVOLVE

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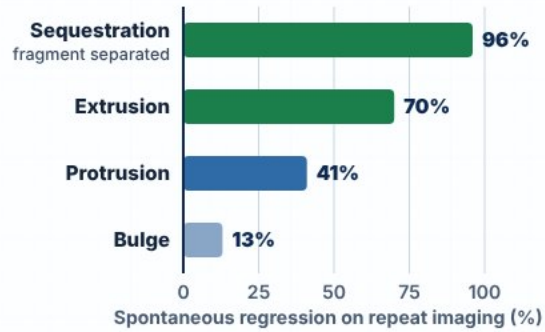
A · COMFORTABLE REST, SIDE



Herniations can shrink on their own

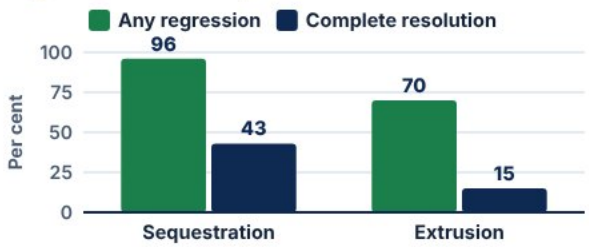
- Hook lying (hip **45°**, knees bent): a low-load position many people find comfortable in a flare.
- Disc material displaced beyond the disc margin can irritate a nerve root and cause leg pain.
- The larger, more "dramatic" herniations were the **most** likely to regress.

Regression by herniation type



Systematic review, 31 studies (9 pooled), conservatively treated patients. Chiu et al. (2015).

Regression vs complete resolution



Same review. Chiu et al. (2015).

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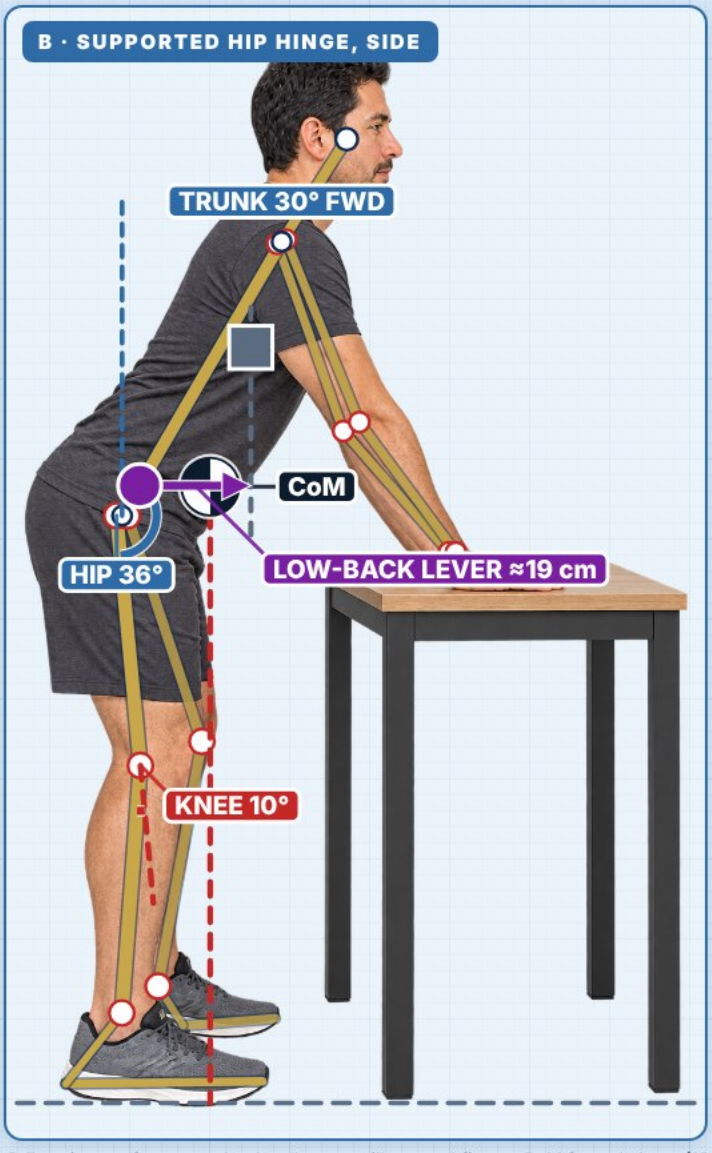
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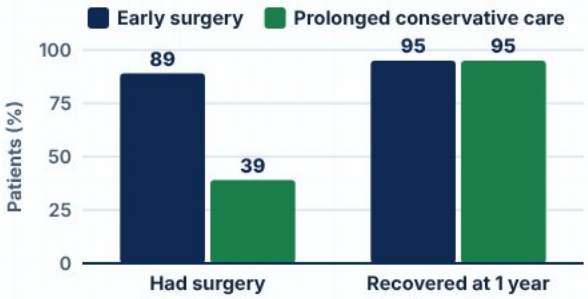
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Supported hinge: bending with the arms sharing load

- Hands on a table, trunk **30°** forward, hip **36°**: lever **≈19 cm**, **≈78 N·m**, part of it carried through the arms.
- In severe sciatica of 6–12 weeks, early surgery gave faster leg-pain relief, but 1-year recovery was the same; 61% of the conservative group never had surgery.

Early surgery or wait? Same destination



283 patients with severe sciatica for 6–12 weeks; faster recovery with surgery (HR 1.97). Peul et al. (2007).

Surgery buys speed: no significant difference in disability over the first year (P = .13). It is a choice, not a necessity, for most.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

HERNIATED LUMBAR DISC: WHAT RECOVERY WITHOUT SURGERY CAN INVOLVE

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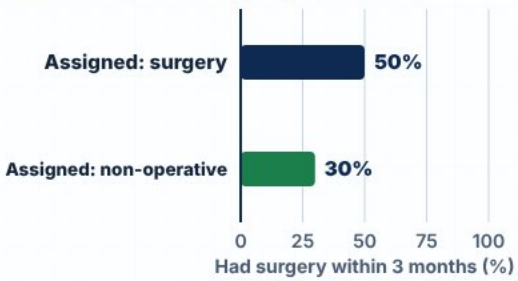
C · RETURN TO WALKING



Return to walking: activity within tolerance

- Short, frequent walks with an upright trunk keep the upper-body lever about L5/S1 small.
- In a US multicentre trial, both surgical and non-operative groups improved substantially over 2 years; many crossed over in both directions.

Who actually had surgery? (SPORT)



501 surgical candidates, radiculopathy ≥6 weeks; heavy crossover limits the comparison. Weinstein et al. (2006).

Escalate when: disabling leg pain persists after an adequate period of conservative care, or nerve function worsens.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Walking reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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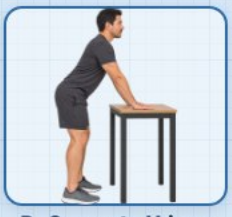
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A · Rest position
Low load

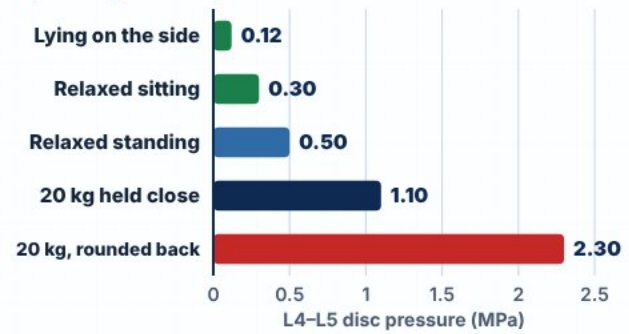


B · Supported hinge
≈78 N·m



C · Walking
Stay active

Adjusting activity: relative disc loads



One healthy volunteer: shows relative load, not thresholds or a cause of herniation. Wilke et al. (1999).

Decision pathway

1. **EXPLAIN**
   Many herniations regress; most people recover with or without surgery by one year.
2. **ADJUST, DON'T STOP**
   Stay active within tolerance; in flares, limit long flexed loading and heavy loads held away from the body.
3. **KNOW WHEN TO ESCALATE**
   Persistent disabling leg pain, progressive weakness or cauda equina signs: specialist review.

NOT RECOMMENDED

Promising a fixed recovery date; treating herniation size as a bad sign.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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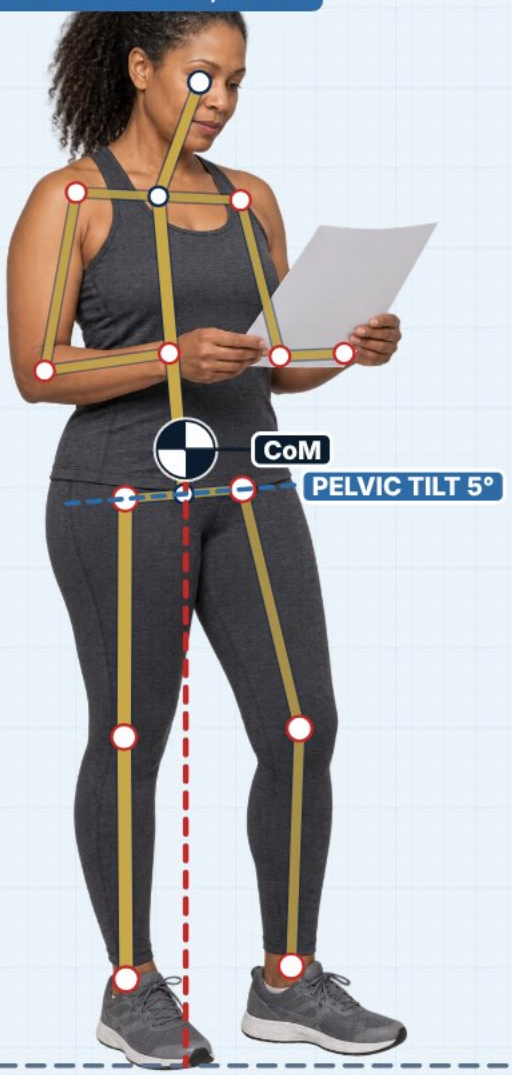
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DISC BULGE ON MRI: WHAT THE FINDING MEANS FOR YOUR MOVEMENT

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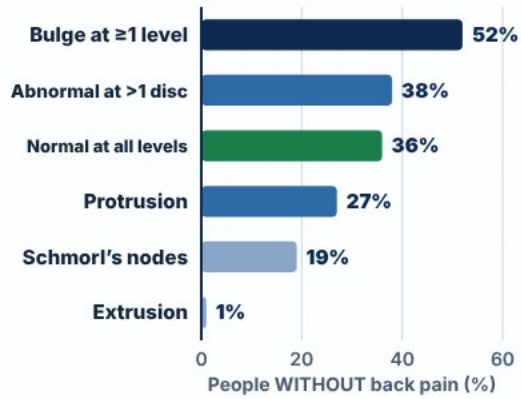
A · READING THE REPORT, FRONT



A bulge describes a shape, not a diagnosis

- A disc bulge is a broad, symmetrical extension of the disc margin beyond the vertebral edges.
- In a classic blinded MRI study, half of pain-free adults had a bulge, and only about a third had normal discs at every level.

MRI of 98 people without back pain



Blinded reading by two neuroradiologists. Jensen et al. (1994).

Words matter: "slipped" or "ruptured" are not accurate descriptions of a bulge and can increase fear of moving.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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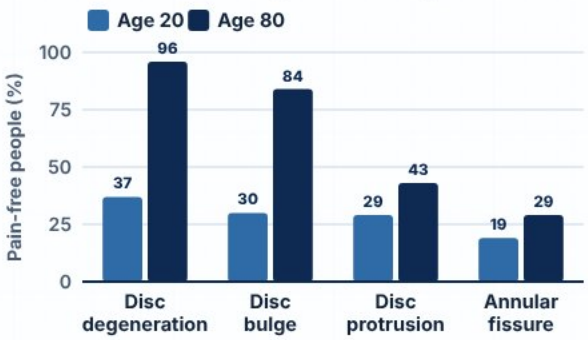
B · DAILY ACTIVITY, FRONT



Daily activity: the disc is built to take load

- Upright with a bag in one hand, pelvis level (**2°**): ordinary loading that discs handle all day and rehydrate from overnight.
- Bulges become more common with age in people without pain, so a bulge is expected, not alarming, in later life.

How common are bulges without pain?



33 studies, 3,110 asymptomatic people. Brinjikji, Luetmer, et al. (2015).

Movement is managed by symptoms and function, not by the report.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

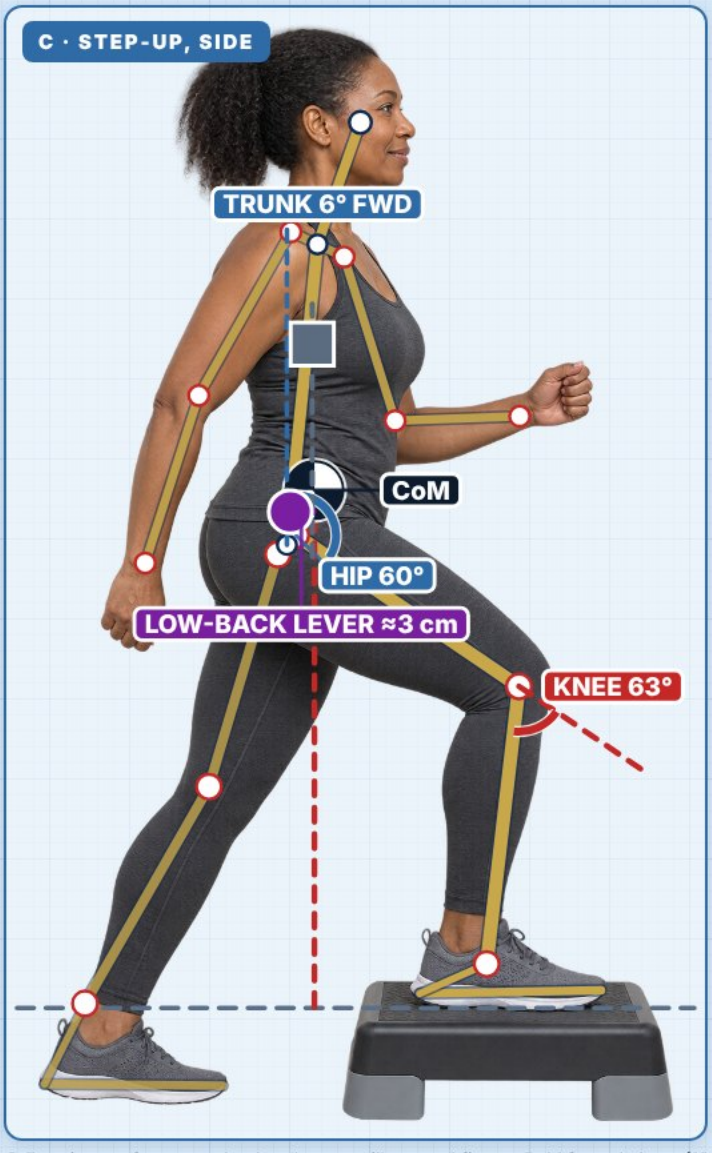
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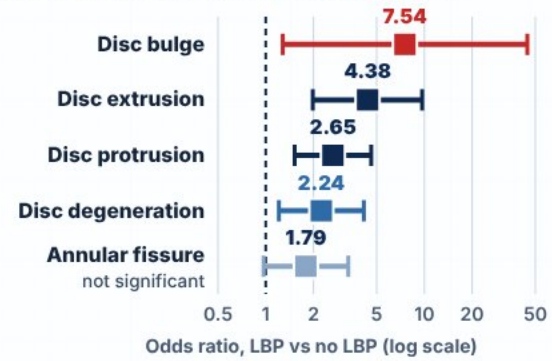
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Step-up: train function, not the image

- Lead hip **60°**, knee **63°**, trunk upright (lever **≈3 cm**): legs do the work while the trunk stays stacked.
- Bulges are not irrelevant: in adults up to 50 they were more common in people with pain, but with a very wide interval.
- A finding shifts probability; it does not identify the pain source in one person.

More common with pain, but uncertain



14 studies, 3,097 adults ≤50 years; case–control: association, not cause. Brinjikji, Diehn, et al. (2015).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

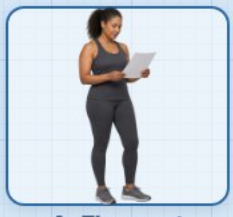
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A · The report
Shape, not diagnosis

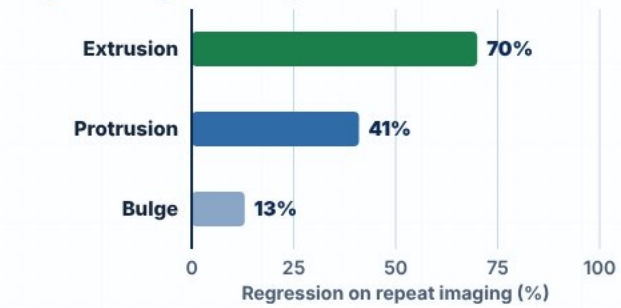


B · Daily load
Expected with age



C · Step-up
Train function

Bulges rarely "shrink", and do not need to



Conservatively treated herniations, repeat imaging. Chiu et al. (2015). Symptoms can improve while the image stays the same.

Decision pathway

1. **INTERPRET IN CONTEXT**
   Match any finding to symptoms and the examination; alone it does not explain pain.
2. **GRADE THE LOAD**
   Bending, lifting and exercise are progressed by response, not restricted by the report.
3. **KNOW WHEN IT MATTERS**
   Nerve-root signs that are not improving, progressive deficit or red flags make imaging relevant.

NOT RECOMMENDED

Repeat scans to track a bulge; banning bending because of a report.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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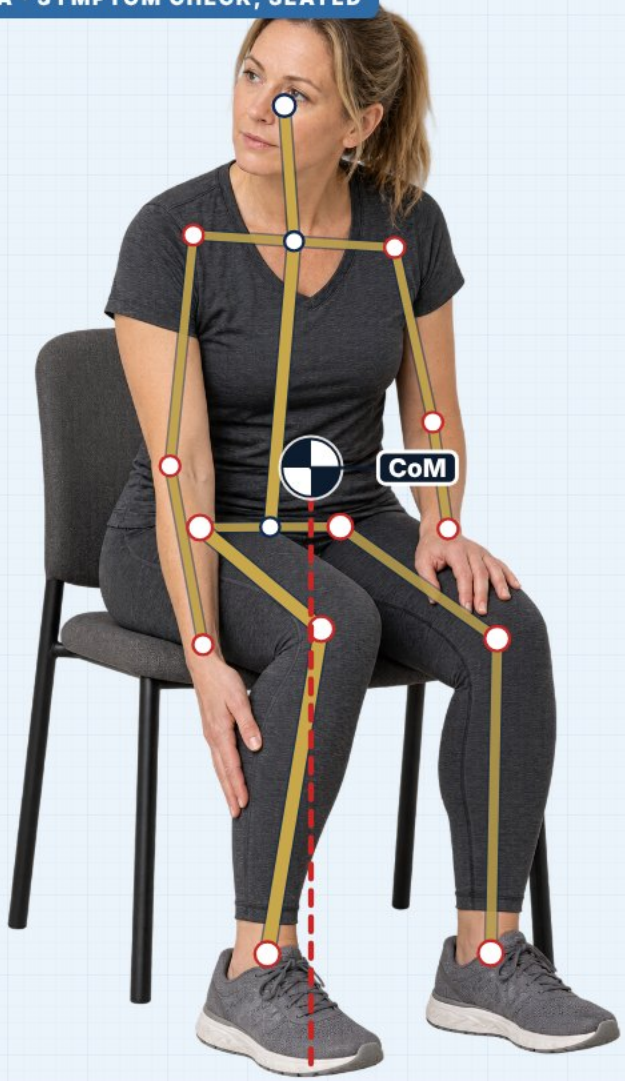
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SCIATICA EXERCISES: WHY YOUR SYMPTOM RESPONSE MATTERS

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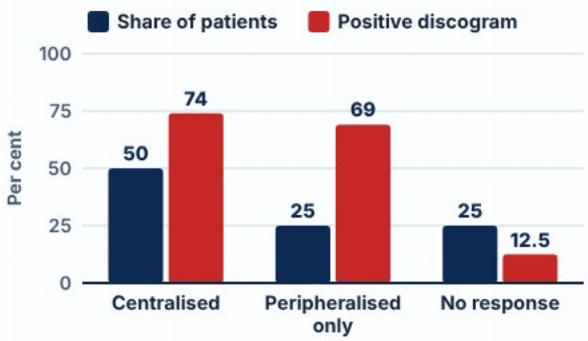
A · SYMPTOM CHECK, SEATED



Where is the leg pain now?

- **Centralisation:** leg symptoms retreat towards the spine with a movement. **Peripheralisation:** they spread further down the leg.
- During repeated-movement testing, half of patients centralised; a quarter only peripheralised; a quarter did not respond.
- Track it every session: how far down the leg, how intense, how long it lasts.

Symptom response carries information



Chronic low back and referred pain, McKenzie assessment then discography; diagnostic association, not a treatment trial. Donelson et al. (1997).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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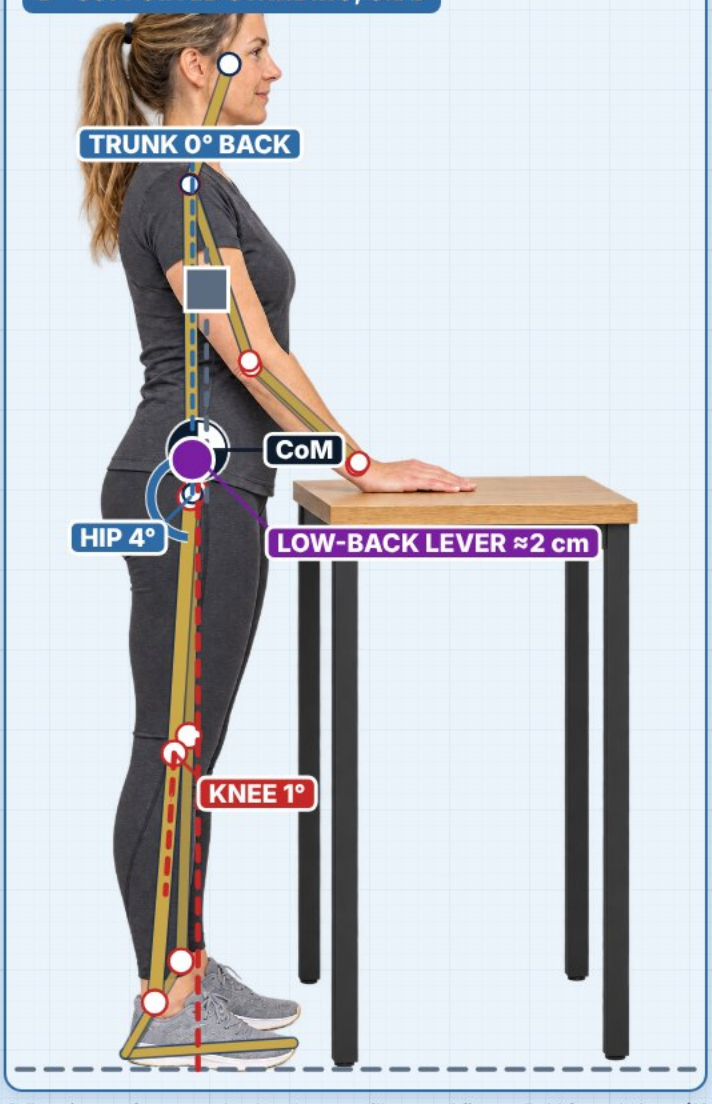
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B · SUPPORTED STANDING, SIDE



Supported standing: an easy starting load

- Hands on a bench, trunk upright (lever ≈**2 cm**): a position to test how standing and gentle movements change leg symptoms.
- Early physiotherapy (exercise + manual therapy) for recent sciatica improved disability, back pain and treatment success more than education alone.

Early physiotherapy for acute sciatica



220 adults, sciatica under 90 days, primary care; RR 1.6 (CI 1.1–2.4). Fritz et al. (2021).

Modest, real benefit: differences favoured physiotherapy from 4 weeks; health-care use and missed work did not differ.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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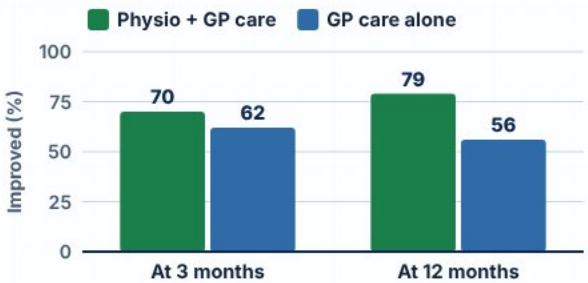
C · HEEL SLIDE, SIDE



Heel slide: a gentle, graded movement

- Lying on the back, one heel slides towards the buttock (knee **42°**, hip **21°**): it moves the hip and nerve bed with little spinal load.
- Continue movements that leave leg symptoms the same or more central; modify those that keep spreading them.

Physiotherapy added to GP care



135 patients with acute sciatica; only global perceived effect at 12 months differed (RR 1.4). Luijsterburg et al. (2008).

Bed rest does not help sciatica



183 people; adjusted OR 1.2 (95% CI 0.6–2.3). Vroomen et al. (1999).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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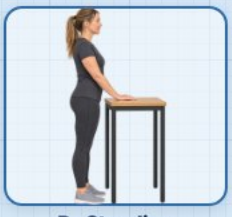
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A · Symptom check
Where is it now?

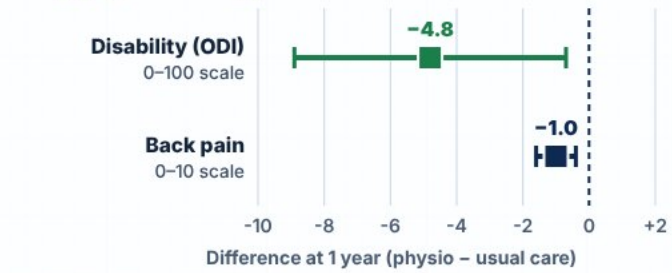


B · Standing
Easy load



C · Heel slide
Graded movement

Early physiotherapy: effect sizes



220 adults with recent sciatica; CIs as reported. Fritz et al. (2021).

Decision pathway

1. **MONITOR THREE THINGS**
   Leg-symptom distribution, function (walking, sitting tolerance) and neurological signs.
2. **KEEP WHAT CENTRALISES**
   Continue exercises that centralise or do not spread symptoms; modify those that peripheralise.
3. **ONE PERSON, ONE PLAN**
   Exercise is an option chosen for the individual, not one routine for everyone.

NOT RECOMMENDED

Bed rest; pushing through leg symptoms that keep spreading.

SEEK ASSESSMENT IF

Spreading numbness, symptoms in both legs, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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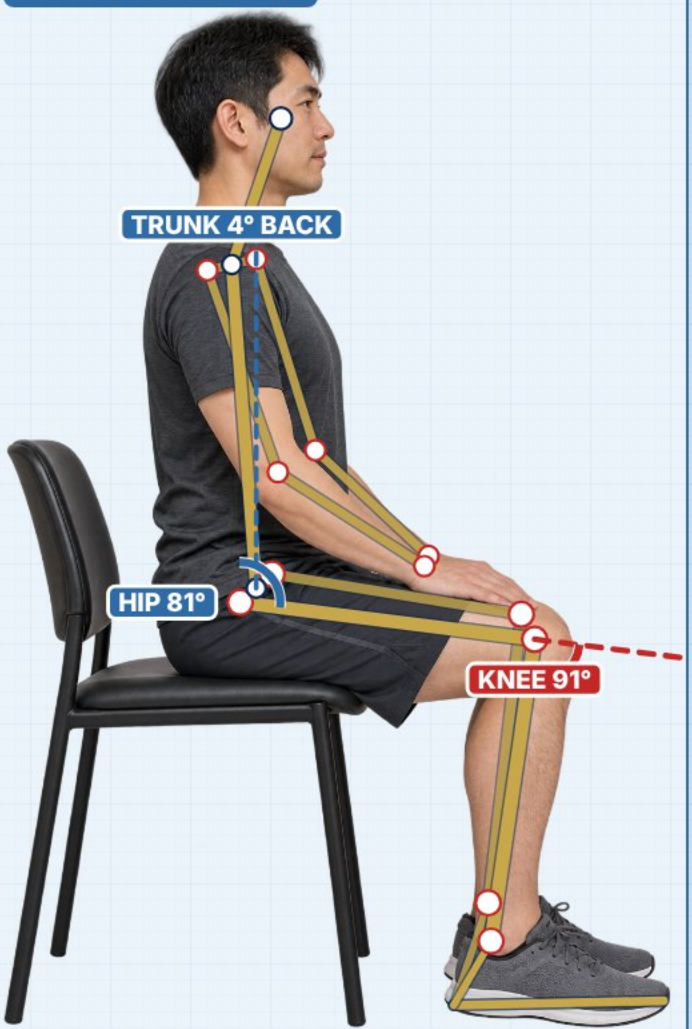
BIOMECHANICS IS A FORCE-GOVERNED DECISION SYSTEM – NOT A POSTURE MODEL.

INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

NERVE GLIDES FOR SCIATICA: WHEN THEY MAY HELP AND WHEN TO REASSESS

AN MMSX AUTHORITY | APPLIED BIOMECHANICS LAB EDUCATIONAL ANALYSIS

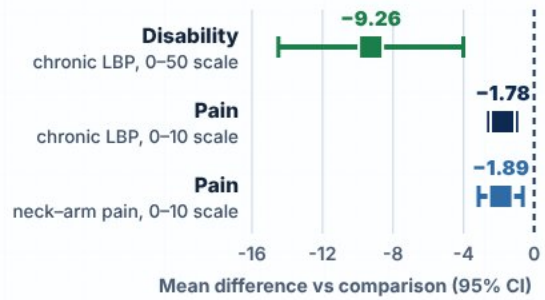
A · SLIDER START, SIDE



Seated slider: the starting position

- Sitting tall, hip **81°**, knee **91°**: the sciatic nerve bed is slack at the knee.
- Neural mobilisation ("nerve glides") moves or loads a nerve and its surrounding tissues through combined joint movements.
- Pooled trials showed moderate effects in chronic LBP, but those trials were not limited to people with leg pain.

Neural mobilisation: pooled effects



40 trials (17 at low risk of bias); carpal tunnel: not effective. Basson et al. (2017).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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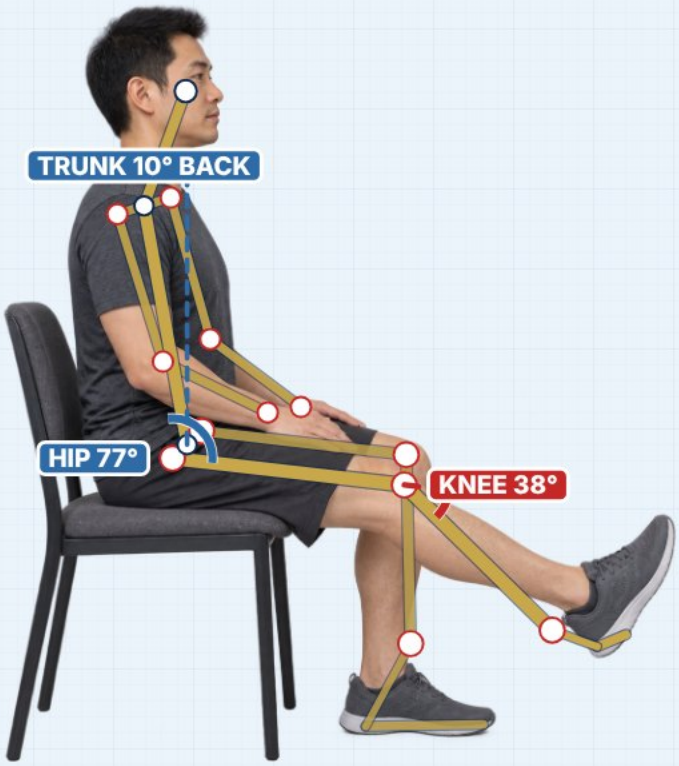
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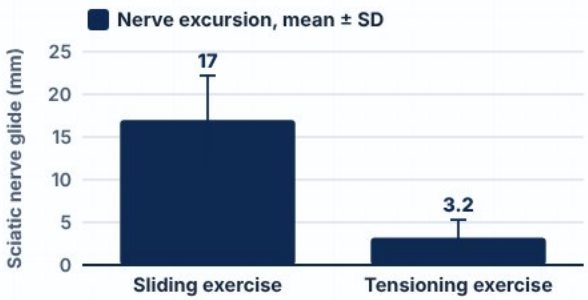
B · KNEE EXTENDS, SIDE



Knee extends: slider vs tensioner

- Knee straightens to **38°** short of full extension. In a **slider**, the head extends as the knee straightens, so the nerve moves with little tension.
- In a **tensioner**, both ends lengthen together: more tension, less movement.
- In healthy thighs, sliding moved the nerve about 5 times further.

How far does the sciatic nerve glide?



15 healthy adults, dynamic ultrasound of the thigh. Coppieters et al. (2015).

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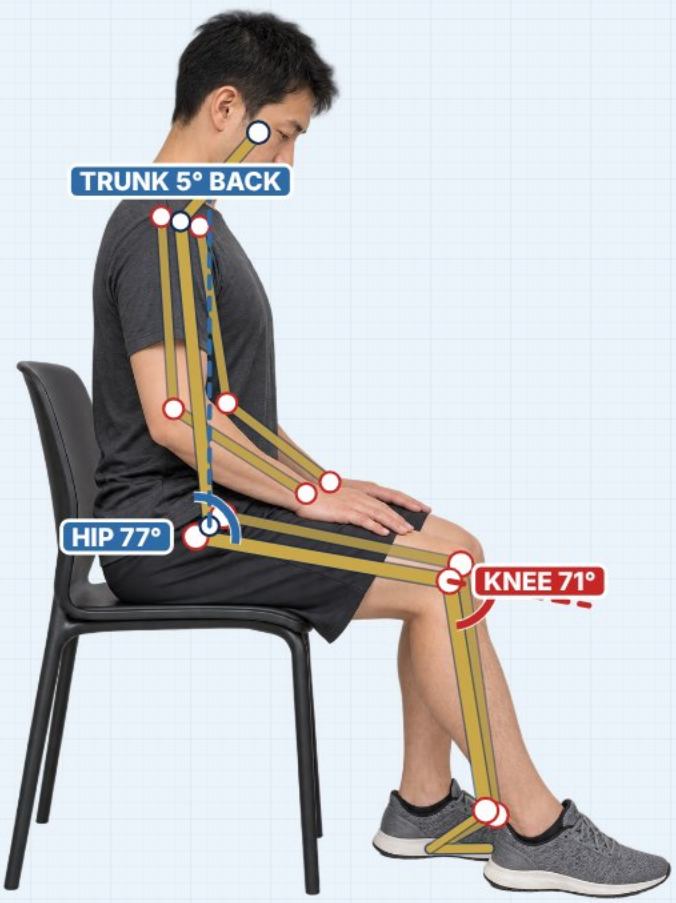
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C · RETURN, SIDE



Return: smooth, symptom-guided repetitions

- Knee back to **71°**, head neutral. Start with small ranges and slow, rhythmic repetitions.
- Expect at most mild, brief tingling that settles quickly; lasting increase or spread of leg symptoms means reduce or stop.

Combining joints changes nerve movement

31 healthy people, ultrasound at the posterior mid-thigh; neck flexion alone barely moved the nerve.

3.2 mm
slider: neck + knee extension

−0.1 mm
neck flexion alone

Myth: "glides stretch a trapped nerve free." Sliders are designed to *move* the nerve with little tension; the aim is movement, not stretch.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Stats: Ellis et al. (2012). Educational, not diagnostic.

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A · Start
Nerve bed slack

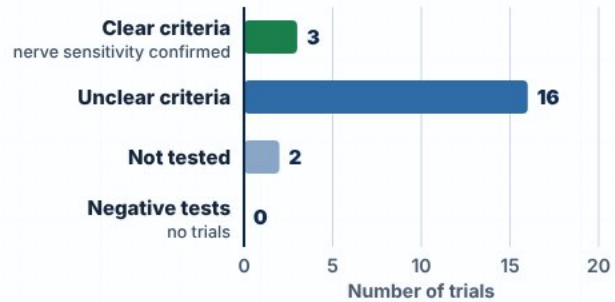


B · Knee extends
Knee 38° short



C · Return
Rhythmic reps

Who was studied? Selection is uncertain



21 trials, 914 patients with spinally referred leg pain; high risk of bias. Murape et al. (2022).

Decision pathway

1. **SELECT**
   Consider glides for leg symptoms that are sensitive to nerve-loading positions (e.g. slump or straight-leg raise).
2. **START WITH SLIDERS**
   Small, slow sliders when symptoms are irritable; progress to tensioners only if well tolerated.
3. **ADD, DON'T REPLACE**
   Use glides as an adjunct within an active programme; reassess if leg symptoms spread.

NOT RECOMMENDED

Pulling hard into nerve symptoms; glides as a stand-alone cure.

SEEK ASSESSMENT IF

Spreading numbness, symptoms in both legs, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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MCKENZIE EXERCISES FOR BACK PAIN: DOES EVERYONE NEED BACK EXTENSIONS?

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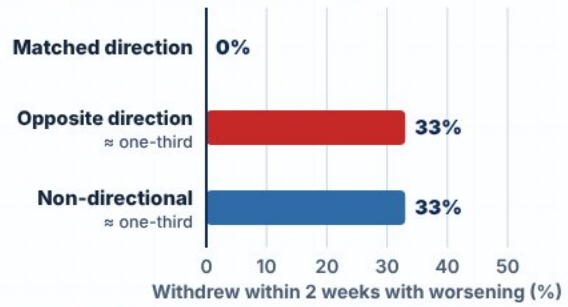
A · PRONE LYING, SIDE



Directional preference is individual

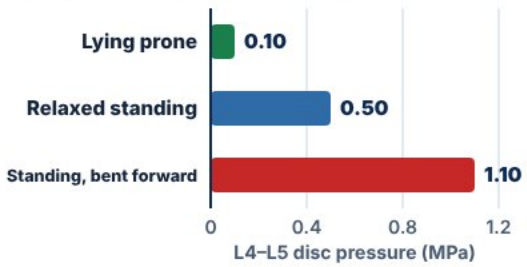
- The McKenzie method tests repeated movements and lets the **symptom response** choose the exercise.
- A directional preference was found in 74% of 312 people; their preferred direction varied.
- Exercise in the matched direction beat opposite or non-directional exercise on every outcome.

Does the direction matter? Yes



230 people with a directional preference, randomised; exact percentages beyond "one-third" not reported in the abstract. Long et al. (2004).

Prone lying is a low-pressure position



One healthy volunteer: illustrative only. Wilke et al. (1999).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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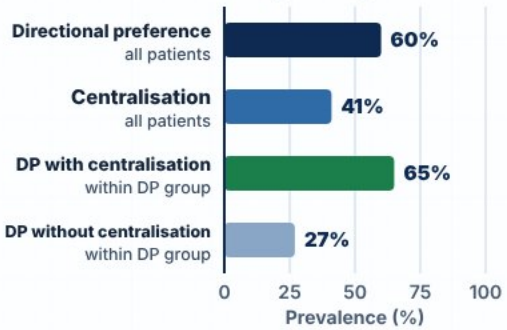
B · PRONE ON ELBOWS, SIDE



Prone on elbows: a first extension step

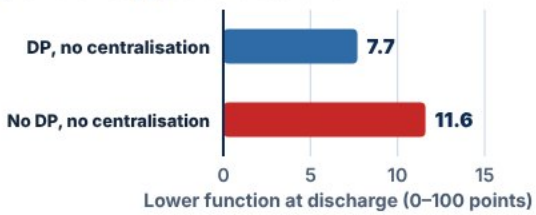
- Trunk raised about **25°** from the floor, supported on the forearms; for some people this eases or centralises symptoms, for others it does not.
- In a second cohort, a directional preference was found in 60% and centralisation in 41%.

How common are the response patterns?



Prospective outpatient cohort, 8 physiotherapists. Werneke et al. (2011).

No preference, poorer outcome



Compared with DP + centralisation (P < .001). Werneke et al. (2011).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Trunk elevation estimated from shoulder and hip points. Educational, not diagnostic.

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C · PARTIAL PRESS-UP, SIDE



Partial press-up: more range, same rule

- Arms push the trunk to about **40°** while the pelvis stays down: more lumbar extension than on the elbows.
- Progress only if leg and back symptoms stay the same or move towards the spine; stop if they spread.
- McKenzie care is one option, not a method superior to all others.

McKenzie (MDT) vs other care: meta-analysis

17 trials (11 pooled). Acute LBP: no difference in pain (P = .11) or disability (P = .61). Chronic LBP vs exercise alone: small advantage for disability. Vs manual therapy + exercise: no difference.

SMD −0.45
chronic LBP disability vs exercise alone

n.s.
acute LBP, pain and disability

Reading the response after a set

- **Centralising**: leg symptoms retreat towards the spine → continue and progress.
- **No change**: back pain may rise briefly but leg symptoms stay put → continue, recheck.
- **Peripheralising**: symptoms spread further down the leg → stop this direction.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Trunk elevation estimated from shoulder and hip points. Stats: Lam et al. (2018). Educational, not diagnostic.

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A · Prone
≈6°

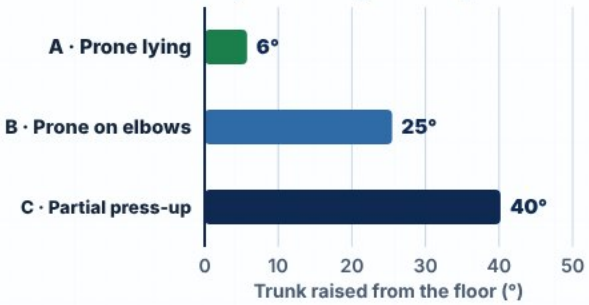


B · On elbows
≈25°



C · Press-up
≈40°

An extension ladder, used only if it helps



MMSx 2-D analysis of frames A–C; trunk angle from shoulder–hip line relative to the floor.

Decision pathway

1. **ASSESS THE RESPONSE**
   Test repeated movements in different directions; record where the symptoms go.
2. **MATCH THE DIRECTION**
   If a preference exists, use it; extension suits some people, flexion or side-shift others.
3. **NO PREFERENCE? CHANGE TACK**
   About 1 in 4 have none: use other active approaches and review progress closely.

NOT RECOMMENDED

Back extensions for everyone; pushing on when symptoms spread down the leg.

SEEK ASSESSMENT IF

Symptoms that spread further down the leg with every direction tested, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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LUMBAR SPINAL STENOSIS: WHY WALKING CAN HURT AND HOW REHABILITATION MAY HELP

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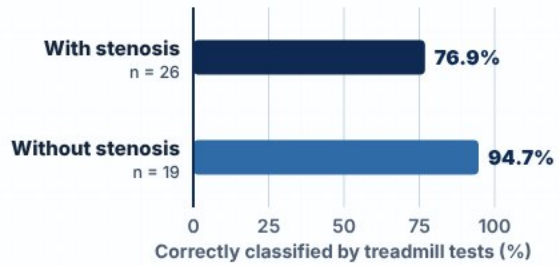
A · WALKING WITH A ROLLATOR, SIDE



Leaning on a rollator: flexion buys walking time

- Trunk **17°** forward over the handles: the lumbar spine flexes, which opens the canal and foramina a little.
- Neurogenic claudication: buttock or leg pain, heaviness or tingling brought on by standing and walking, eased by sitting or bending forward.
- On a treadmill, people with stenosis developed symptoms sooner on the level and walked longer uphill (trunk flexed).

Level vs uphill treadmill: a posture test



45 people; earlier onset when level (P = .0009), longer walking when inclined (P = .014). Fritz et al. (1997).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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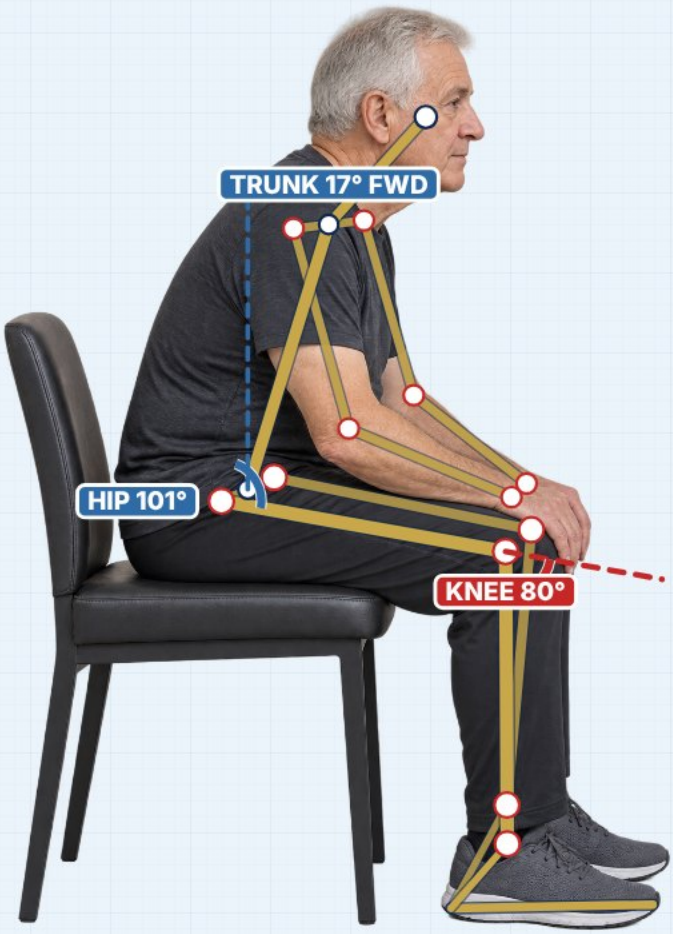
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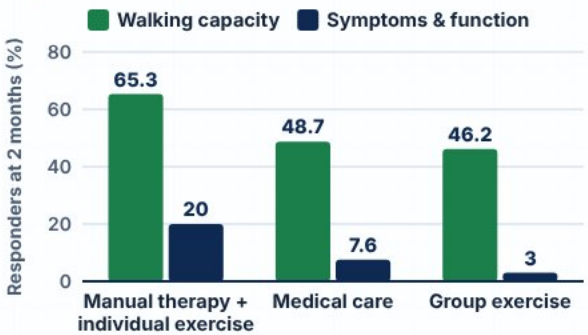
B · SEATED REST, SIDE



Seated rest: symptoms settle in flexion

- Sitting with the trunk **17°** forward, hip **101°**: flexion relieves neurogenic claudication within minutes for many people.
- Planned sitting breaks turn a symptom-limited walk into interval training.
- In adults over 60, every non-surgical approach produced walking-capacity responders; manual therapy plus individual exercise led at 2 months.

Which non-surgical approach? (≥30% improvement)



259 adults >60 years; no between-group differences by 6 months. Schneider et al. (2019).

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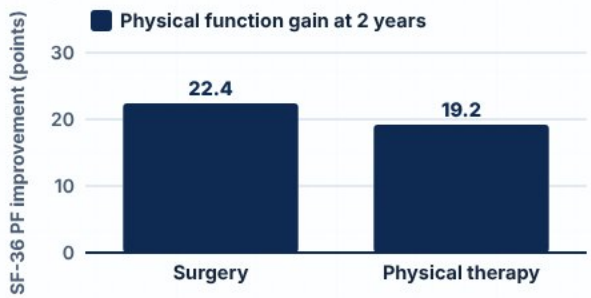
C · STATIONARY CYCLING, SIDE



Stationary cycling: fitness without standing

- Seated, trunk **5°** forward, hip **59°**, knee **60°**: sitting avoids the standing extension that provokes claudication, so cycling is often tolerated longer than walking.
- In surgical candidates, decompression and physical therapy gave similar 2-year gains in physical function (difference 0.9, 95% CI −7.9 to 9.6).

Surgery vs physical therapy: 2-year function



169 adults ≥50; intention to treat; 57% crossover. Delitto et al. (2015).

Shared decision: surgery remains an option for persistent, disabling symptoms; high crossover means neither path is wrong.

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A · Rollator
Trunk 17° forward

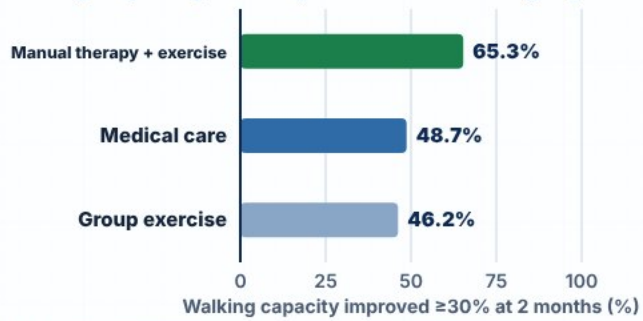


B · Seated rest
Flexion relieves



C · Cycling
Flexed fitness

Walking capacity can improve without surgery



259 adults with neurogenic claudication; 6-week programmes. Schneider et al. (2019).

Decision pathway

1. **USE POSTURE**
   Flexed options (rollator, poles, uphill, cycling) extend tolerance while capacity builds.
2. **INTERVAL WALKS**
   Walk to mild symptoms, sit to settle, repeat; lengthen bouts week by week.
3. **MULTIMODAL CARE**
   Education, individual exercise and manual therapy first; discuss surgery for persistent disability.

NOT RECOMMENDED

Advising rest or avoiding walking; treating MRI narrowing alone as the diagnosis.

SEEK ASSESSMENT IF

Leg pain eased by standing still rather than sitting (possible vascular cause), or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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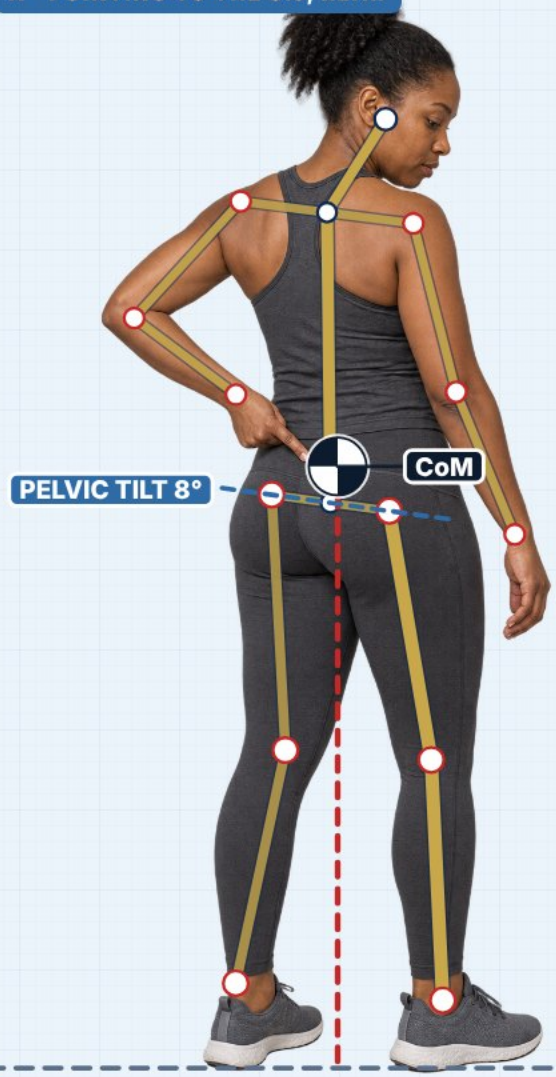
BIOMECHANICS IS A FORCE-GOVERNED DECISION SYSTEM – NOT A POSTURE MODEL.

INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

SACROILIAC JOINT PAIN: WHY PAIN LOCATION ALONE CANNOT CONFIRM THE DIAGNOSIS

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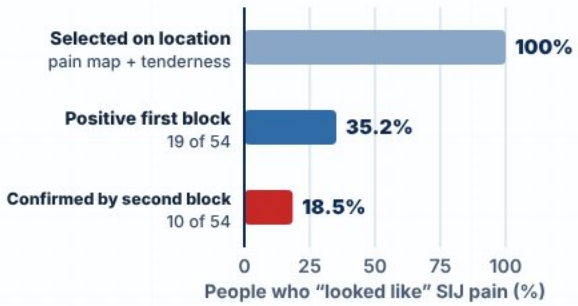
A · POINTING TO THE SIJ, REAR



Pointing to the dimple is not a diagnosis

- Hand over the sacroiliac region; pelvis **8°** off level in this rear view. Pain here can come from the SIJ, the lumbar spine or the hip.
- Research confirms SIJ pain with anaesthetic blocks of the joint. Of 54 people selected because their pain "looked sacroiliac", fewer than 1 in 5 were confirmed.

From "looks like SIJ" to confirmed SIJ pain



54 people with unilateral LBP; percentages calculated from the abstract counts. Maigne et al. (1996).

Myth: "pain in the dimple means it's your SIJ." Location raises the question; it does not answer it.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the rear view. Educational, not diagnostic.

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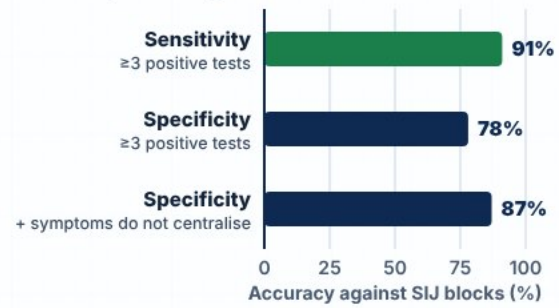
B · SINGLE-LEG STEP



Single-leg loading: one piece of the picture

- Stepping onto one leg loads the pelvic ring on that side; pain here is a clue, not a confirmation.
- A **cluster** of three or more positive pain-provocation tests did much better than any single test, especially when a lumbar source had been ruled out by repeated movements.

Clusters, not single tests



Review by the lead author of the original diagnostic studies; CIs not given in the abstract. Laslett (2008).

In 85 patients against an intra-articular block (45 positive, 40 negative), no history feature or single test had worthwhile diagnostic value (Dreyfuss et al., 1996).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Oblique reference image: joint angles not reported. Educational, not diagnostic.

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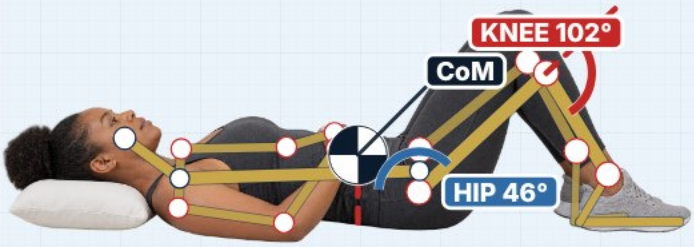
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C · SUPINE TESTING POSITION

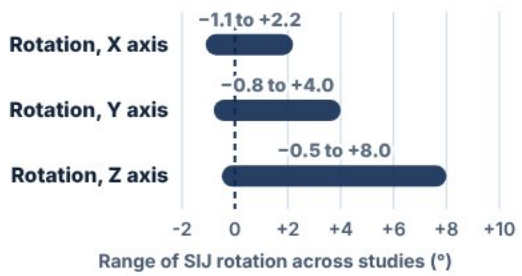


Supine testing: provocation, not palpation

- Lying on the back with knees bent (hip **46°**): the usual position for several pain-provocation tests.
- The joint moves only a few degrees, so "feeling" a stuck or rotated SIJ by hand is not reliable.
- Avoid telling people their pelvis is "out of place": it adds fear without adding accuracy.

Clinical picture: pain below L5 around the posterior pelvis, several positive provocation tests, no centralisation with repeated lumbar movements, and the hip examined: the diagnosis is a probability, built from several findings.

How much does the SIJ move?



7 three-dimensional motion studies; translations also only millimetres. Goode et al. (2008).

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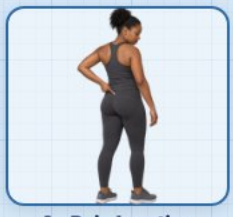
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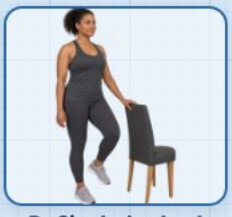
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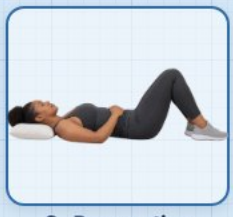
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A · Pain location
A clue only

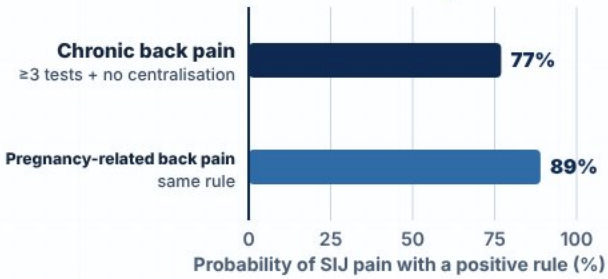


B · Single-leg load
One finding



C · Provocation
Cluster ≥3

Even the best rule leaves uncertainty



About 1 in 4 people with a positive rule in chronic back pain did not have SIJ pain by block. Laslett (2008).

Decision pathway

1. **RULE OUT THE SPINE**
   Test repeated lumbar movements first; centralising symptoms point away from the SIJ.
2. **CLUSTER THE TESTS**
   Use three or more provocation tests together; never pain location or palpation alone.
3. **TREAT THE PERSON**
   Graded, active loading of the lumbopelvic region guided by function; blocks only where they change care.

NOT RECOMMENDED

Telling people the pelvis is "out of place"; diagnosing from one test or a pain drawing.

SEEK ASSESSMENT IF

Buttock pain with long morning stiffness in a younger adult (Title 18), fever or recent infection, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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INFLAMMATORY BACK PAIN: WHEN STIFFNESS NEEDS A DIFFERENT ASSESSMENT

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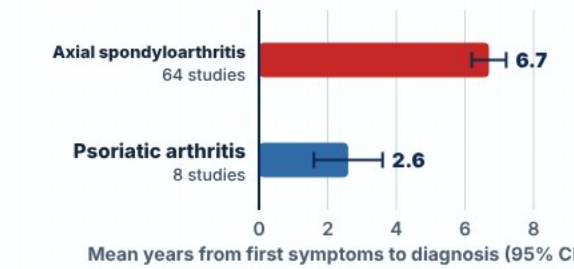
A · MORNING STIFFNESS, SEATED



A pattern, not a single symptom

- Inflammatory back pain: back pain for **3 months or more**, starting before middle age, with prolonged morning stiffness, better with exercise but not rest, and second-half-of-night waking.
- It is a screening pattern for axial spondyloarthritis (axSpA), not a diagnosis by itself.
- Missing it is costly: diagnosis took years on average, and the delay had not shortened over time.

How long until diagnosis?



Meta-analysis; longer delay with younger onset and no extra-articular features. Zhao et al. (2021).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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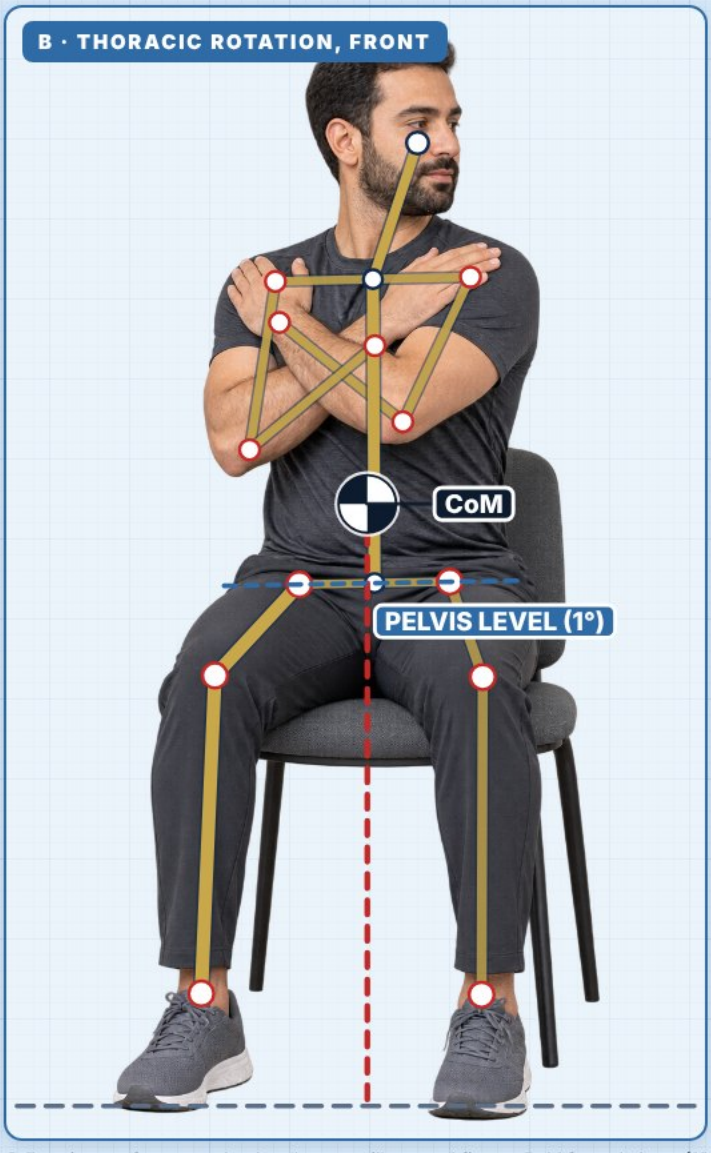
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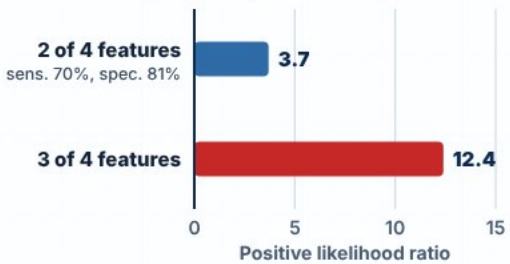
B · THORACIC ROTATION, FRONT



Seated rotation: does movement loosen it?

- Arms crossed, trunk turning while seated; pelvis level (**1°**). Exercise easing stiffness that rest does not is a key inflammatory feature.
- Four features (Berlin criteria): morning stiffness >30 min; better with exercise, not rest; second-half-of-night waking; alternating buttock pain.

More features, higher probability



213 patients under 50 (101 ankylosing spondylitis); case–control. Rudwaleit et al. (2006). Current reference set: ASAS criteria (Sieper et al., 2009).

Keep moving: exercise remains part of management alongside rheumatology treatment; stiffness is not a reason to rest.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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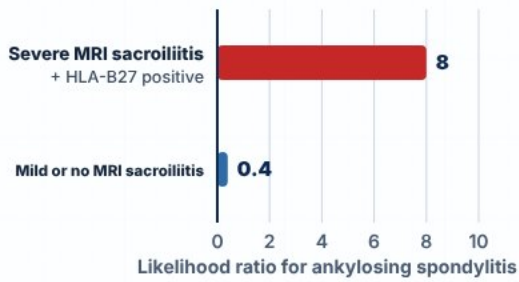
C · ARRANGING ASSESSMENT, FRONT



Arrange the right assessment

- Rheumatology assessment typically includes inflammatory blood markers, HLA-B27 and MRI of the sacroiliac joints.
- In early inflammatory back pain, one in three people met criteria for ankylosing spondylitis about 8 years later; MRI plus HLA-B27 shifted the probability strongly.

Early IBP: what predicted AS at ~8 years?



40 of 50 patients followed (mean 7.7 years); 13 of 39 (33%) met AS criteria; small cohort, no CIs. Bennett et al. (2008).

Strengthen the referral with associated features: psoriasis, inflammatory bowel disease, a painful red eye (uveitis) or a family history of spondyloarthritis.

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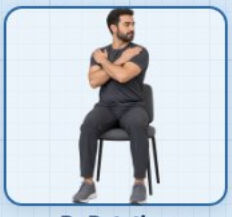
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A · Morning stiffness
Over 30 minutes?

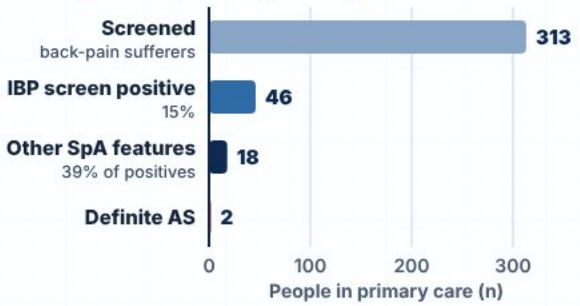


B · Rotation
Eases with exercise?



C · Assessment
Rheumatology

Screening back pain in primary care



313 back-pain sufferers screened with an inflammatory back pain questionnaire. Underwood & Dawes (1995).

Decision pathway

1. **RECOGNISE**
   Under ~45 at onset, pain ≥3 months, morning stiffness, better with exercise not rest, night waking.
2. **COUNT THE FEATURES**
   2 of 4 raises the probability; 3 of 4 raises it a lot. No single feature decides.
3. **REFER, KEEP MOVING**
   Rheumatology for markers, HLA-B27 and MRI; continue regular exercise meanwhile.

NOT RECOMMENDED

Labelling young-onset morning stiffness as "just mechanical" for years.

SEEK ASSESSMENT IF

A painful red eye, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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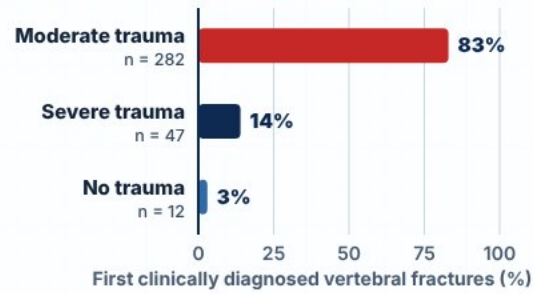
A · SUPPORTED BALANCE, FRONT



Balance training with support close by

- Standing with a hand on a chair as weight shifts, pelvis **4°** off level: balance training with support close by.
- Osteoporosis (DXA T-score ≤ −2.5) weakens bone, so vertebral fractures can follow everyday forces. Most did not need major trauma.
- Vertebral fractures may present as sudden back pain, height loss or increasing curvature, or be painless.

What preceded vertebral fractures?



341 residents, Rochester, Minnesota; incidence 145 (women) vs 73 (men) per 100 000 person-years. Cooper et al. (1992).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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Upright resistance: loading bone, sparing the spine

- Dumbbells at the sides, trunk upright (**4°**), hip **4°**: load travels down a stacked spine.
- In postmenopausal women with low bone mass, supervised high-intensity resistance and impact training raised spine bone density; one minor adverse event (back spasm).

LIFTMOR: high-intensity vs home exercise



101 women, T-score < −1.0, mean age 65; lumbar P < .001, femoral neck P = .004. Selected, supervised sample. Watson et al. (2018).

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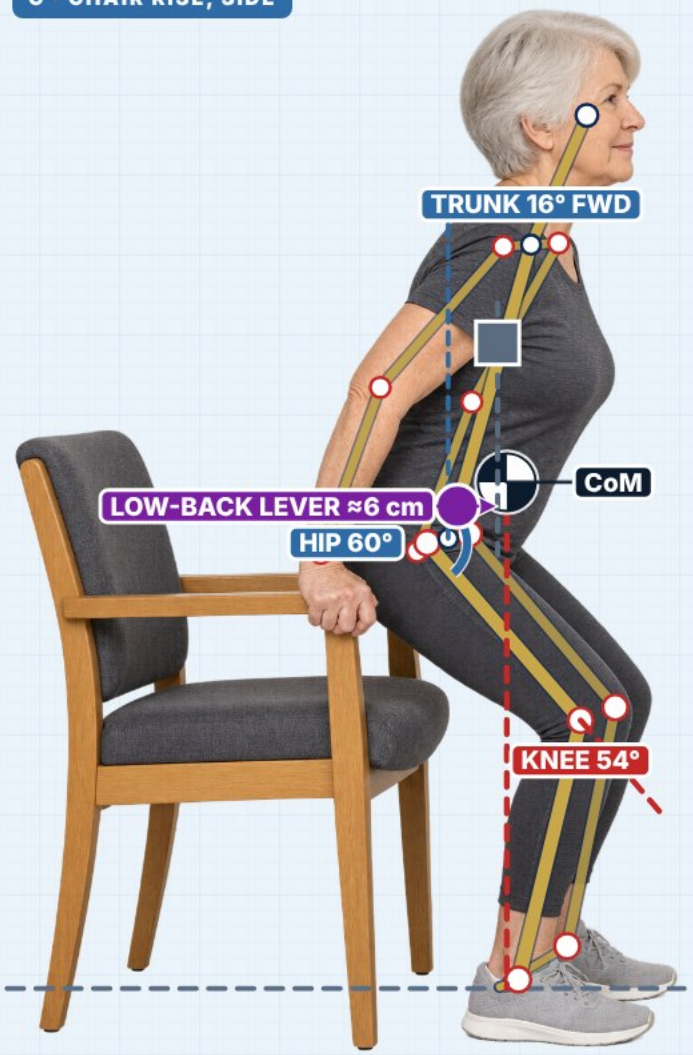
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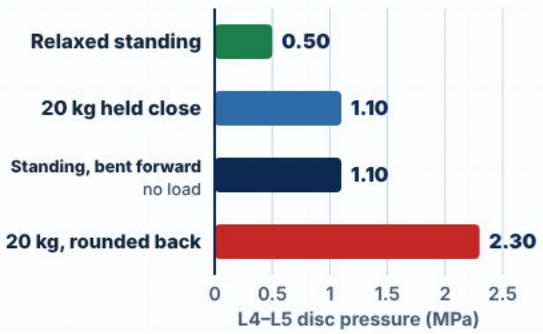
C · CHAIR RISE, SIDE



Chair rise: hinge at the hips

- Trunk **16°** forward, hip **60°**, knee **54°**: the hips flex while the spine stays long (lever ≈**6 cm**, ≈**25 N·m**).
- Flexed postures and loads held away from the body raise spinal load; with weak bone, hinge at the hips and keep loads close.

Flexion and load distance raise spinal load



One healthy volunteer: disc pressure is a proxy for compression, not a fracture threshold. Wilke et al. (1999).

Precautions, not prohibition: limit repeated or loaded end-range flexion and twisting; keep strength and balance training.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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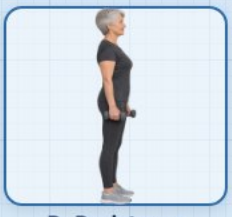
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A · Balance
Support close by

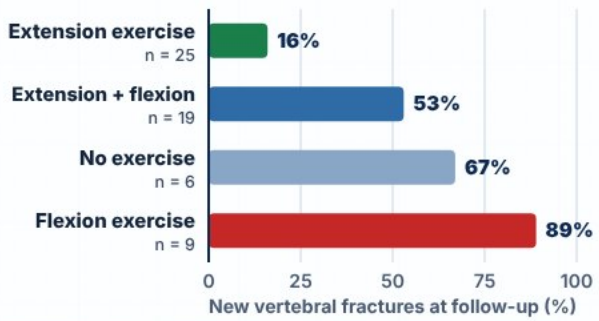


B · Resistance
Upright loading



C · Chair rise
Hip hinge

Exercise direction mattered in a classic cohort



59 women with spinal osteoporosis; small, non-randomised groups: hypothesis-generating. Sinaki & Mikkelsen (1984).

Decision pathway

1. **STAY STRONG**
   Progressive resistance and balance training are recommended, supervised where possible.
2. **PROTECT THE SPINE**
   Hip hinge, loads close, avoid repeated loaded sit-ups and toe-touches.
3. **KNOW THE SIGNS**
   Sudden pain after a minor bend, lift or fall needs a fracture check.

NOT RECOMMENDED

Complete rest; repeated loaded sit-ups or toe-touches with an osteoporotic spine.

SEEK ASSESSMENT IF

Sudden back pain after a minor fall, bend or lift; progressive height loss; long-term corticosteroid use with new pain.

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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

LOWER BACK PAIN RED FLAGS: WHEN TO SEEK URGENT MEDICAL CARE

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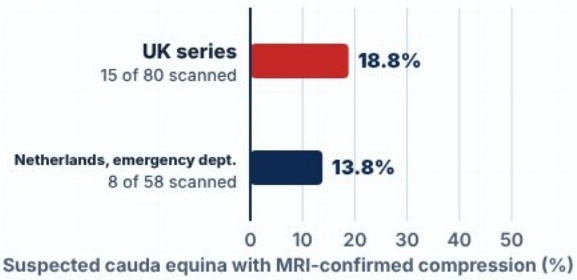
A · CALLING FOR HELP



Emergency: same-day assessment

- **Bladder:** new difficulty passing urine, reduced sensation, leakage.
- **Bowel:** new incontinence or loss of sensation.
- **Saddle numbness:** buttocks, genitals, inner thighs.
- **Legs:** sciatica in both legs, or rapidly worsening weakness or numbness.

Why scan quickly when cauda equina is suspected



Most scans are negative, but no symptom or sign had absolute predictive value. Balasubramanian et al. (2010); Domen et al. (2009, % calculated).

Do not wait for complete incontinence: early symptoms are the reason to act.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: no joint angles reported. Educational, not diagnostic.

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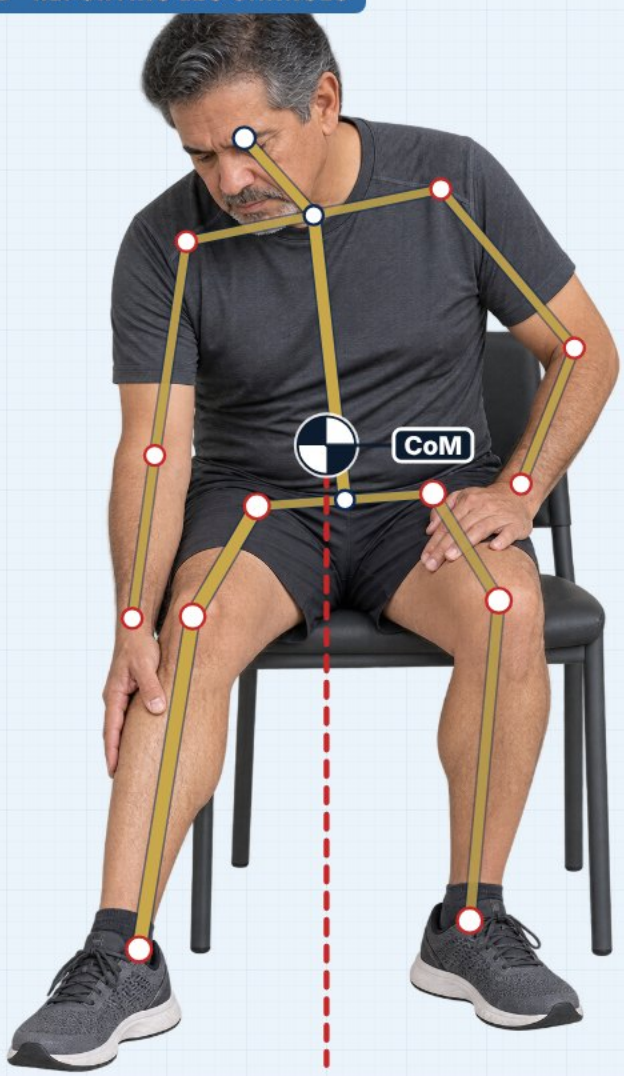
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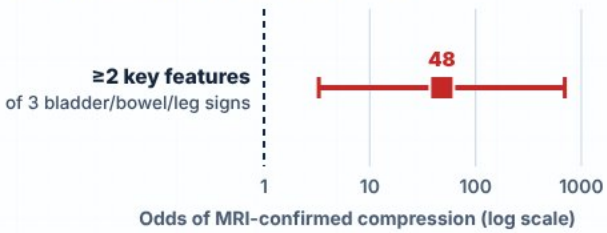
B · REPORTING LEG CHANGES



Report changes in the legs and saddle area

- Symptoms in **both** legs, plus bladder or bowel change, sharply raised the odds of nerve compression.
- Saddle sensory loss was the feature most associated with MRI-confirmed cauda equina syndrome in a UK series.
- Because no single sign is reliable, suspicion alone justifies urgent imaging.

Combinations of features matter



58 suspected-CES emergency presentations, 8 positive; very wide interval from a small study. Domen et al. (2009).

Key features in the study: sciatica in both legs, subjective urinary retention and rectal incontinence symptoms.

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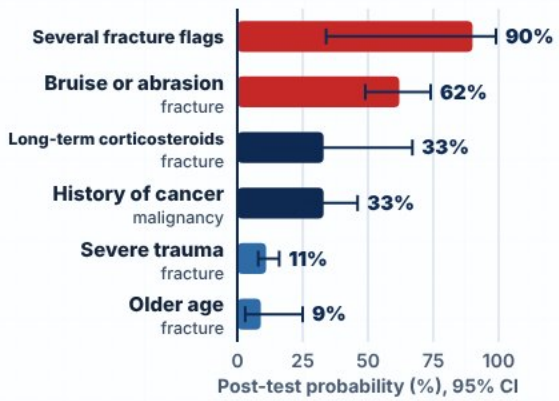
C · MEDICAL ASSESSMENT



Urgent: prompt medical review

- **Fracture:** significant trauma, or a minor fall in older people or those on long-term steroids.
- **Cancer:** previous cancer, unexplained weight loss, constant progressive night pain.
- **Infection:** fever, feeling unwell, recent infection, immunosuppression or injecting drug use.

Specific history matters most



14 studies, 53 red flags; not pooled. Downie et al. (2013).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Clinician reference image: no joint angles reported. Educational, not diagnostic.

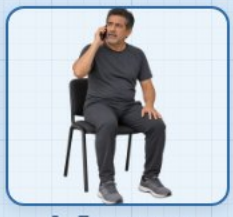
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A · Emergency
Same day

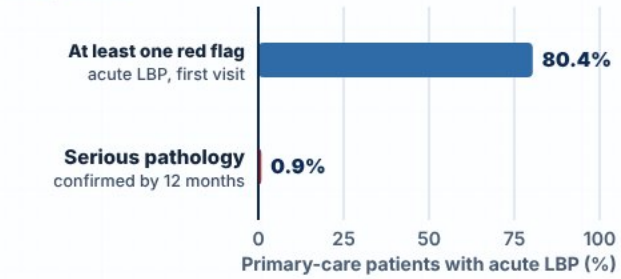


B · Leg changes
Report them



C · Assessment
Urgent review

Red flags guide assessment; they are not a diagnosis



1,172 consecutive patients; only steroids, age > 70 and trauma were informative. Henschke et al. (2009).

Decision pathway

1. **EMERGENCY**
   Bladder or bowel change, saddle numbness, both-leg symptoms, rapidly worsening weakness: emergency department now.
2. **URGENT**
   Trauma, cancer history, weight loss, fever, long-term steroids: prompt medical review.
3. **ROUTINE**
   No red flags: reassurance, stay active, review if not improving after about 4 weeks.

NOT RECOMMENDED

Dismissing a person because they have “only one” red flag; waiting for complete incontinence.

SEEK ASSESSMENT IF

Any emergency feature above: go to an emergency department today and say “I am worried about cauda equina syndrome”.

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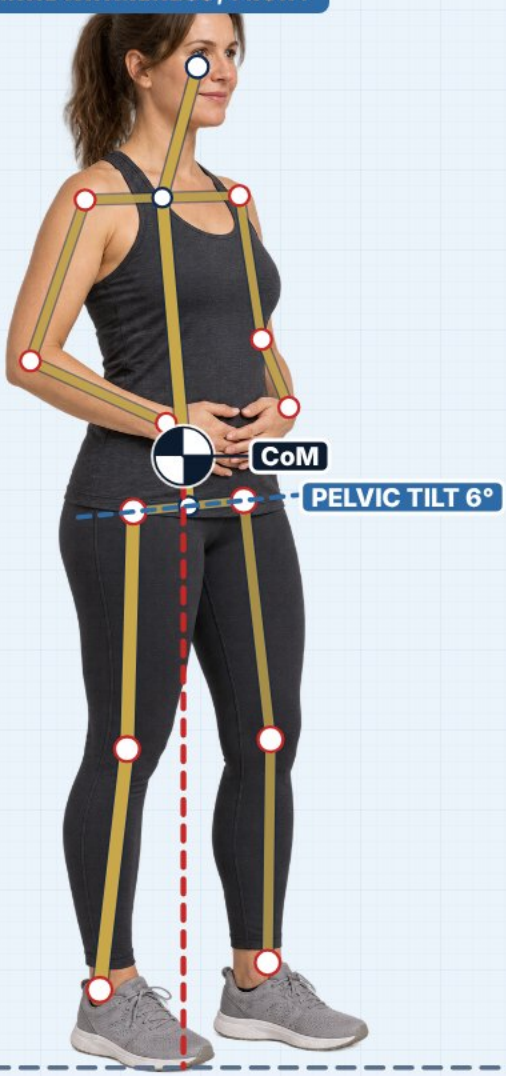
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DOES A WEAK CORE CAUSE LOWER BACK PAIN? WHAT THE EVIDENCE CAN TELL US

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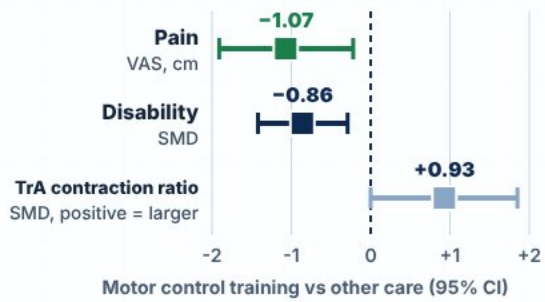
A · ABDOMINAL AWARENESS, FRONT



"Core": a training target, not a diagnosis

- Hands on the abdomen, pelvis **6°** off level: learning to feel trunk muscles can be a useful start, not a required test.
- Prospective studies found **strong evidence of no relationship** between trunk-muscle endurance and future LBP.
- Delayed deep-muscle timing in people with LBP is a cross-sectional finding: it cannot show which came first.

Symptoms changed; resting muscle size did not



15 studies (13 pooled); no pooled difference in resting thickness of TrA, obliques or multifidus. Shanbehzadeh et al. (2022).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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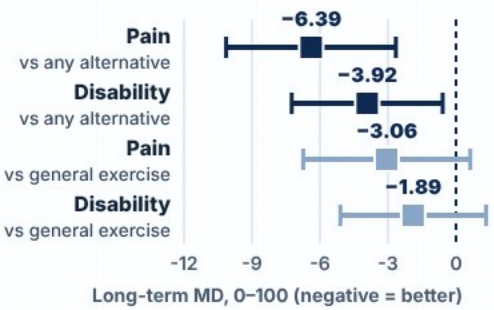
B · SUPINE MARCH, SIDE



Supine march: control under a moving leg

- Lying on the back, one hip lifts to **43°** with the knee bent: the trunk muscles resist the pelvis rotating with each leg lift.
- Stabilisation exercise beat "anything else" by a small margin, but its long-term advantage over general exercise was not significant.

Stabilisation exercise vs alternatives



29 trials; clinically important change is about 15 (pain) and 10 (function) points. Smith, Littlewood & May (2014); thresholds: Hayden et al. (2021).

Myth to correct

"Your back hurts because your core is weak; switch on the deep core first." Trunk endurance did not predict future LBP (Hamberg-van Reenen et al., 2007), and motor control training helped about as much as other exercise (Saragiotto et al., 2016).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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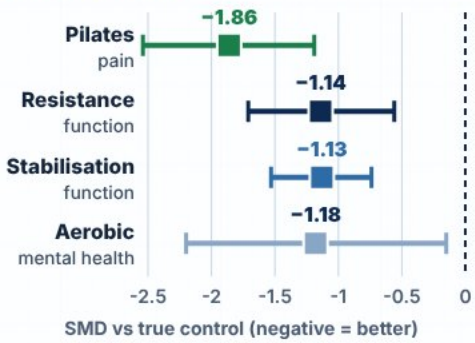
C · LOADED CARRY, FRONT



Loaded carry: the trunk working in real life

- A weight held in one hand, pelvis **3°** off level: the side muscles of the trunk resist the pull without any special instruction.
- Many exercise types helped; no single "core" method stood out across outcomes.

No single method wins



Network meta-analysis, 89 trials; low certainty. Owen et al. (2020).

Training the trunk is reasonable; blaming the pain on a "weak core" is not supported.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

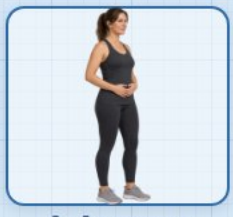
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A · Awareness
Optional start

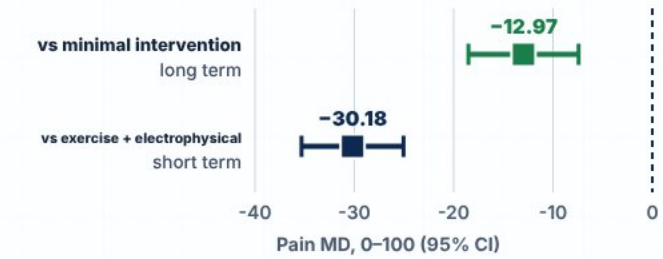


B · Supine march
Control



C · Carry
Real-life load

Motor control exercise: depends on the comparator



29 trials, 2,431 people; vs manual therapy or other exercise: similar outcomes. Low certainty. Saragiotto et al. (2016).

Decision pathway

1. **REFRAME**
   Explain the core as a trainable system, not a weak link that caused the pain.
2. **CHOOSE BY PREFERENCE**
   Motor control, Pilates, resistance or general exercise: pick what the person will do.
3. **PROGRESS TO TASKS**
   Move from awareness drills to lifting, carrying and the person's own activities.

NOT RECOMMENDED

Testing deep-muscle timing or thickness as a prerequisite to exercise.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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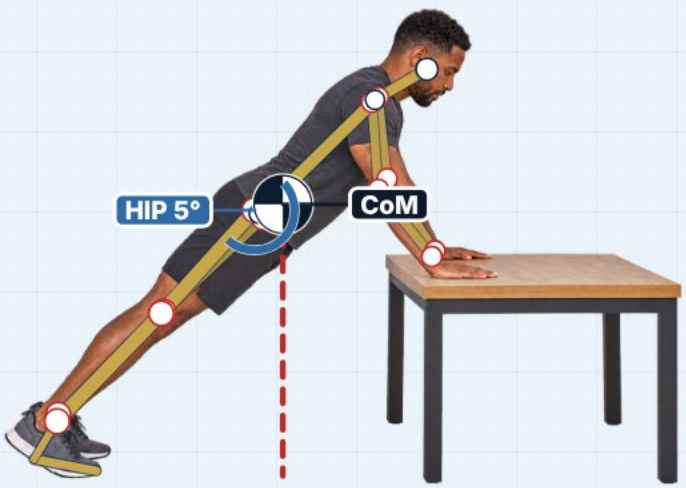
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PLANKS FOR LOWER BACK PAIN: FINDING THE RIGHT STARTING LEVEL

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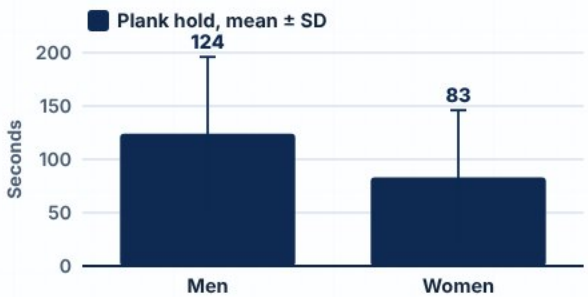
A · INCLINE PLANK, SIDE



Incline plank: hands raised, load reduced

- Body line about **44°** above the floor. Gravity's turning effect about the feet scales with the cosine of that angle: about **71%** of a full floor plank.
- Raising the hands is the simplest regression; lowering them is the simplest progression.
- Hold times vary widely even in healthy young adults, so a fixed "60 seconds" target does not fit everyone.

How long do healthy students hold a plank?



471 college students; forearm plank to failure. Healthy adults, not people with LBP. Strand et al. (2014).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Body-line angle from shoulder and hip points; relative moment = cos(incline), straight body, toes as pivot. Educational, not diagnostic.

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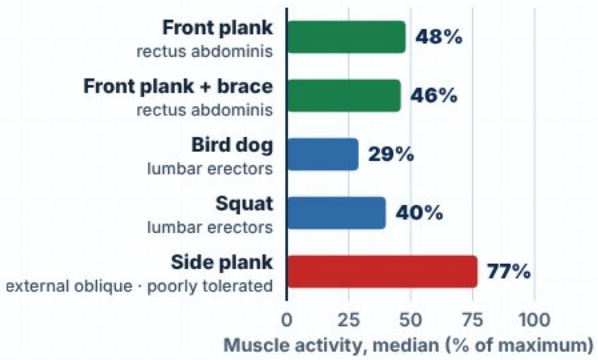
B · KNEELING PLANK, SIDE



Kneeling plank: a shorter lever

- Pivoting on the knees instead of the toes shortens the lever; body line ≈**7°** to the floor.
- In people with chronic LBP, front planks were well tolerated; the side plank was mostly **not** tolerated.

Demand and tolerance in chronic LBP



13 outpatients with chronic LBP, mean age 52; small sample. Calatayud et al. (2019).

Starting-level checklist

- **Support:** incline → knees → toes.
- **Lever:** elbows under shoulders before reaching forward.
- **Duration:** short holds repeated, then longer holds.
- **Response:** symptoms settled by the next day.

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C · FULL PLANK, SIDE



Full plank: longest lever, full body weight

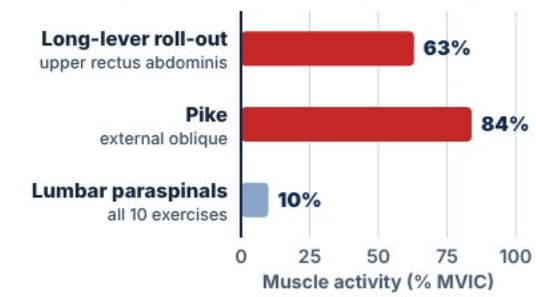
- On forearms and toes, body line ≈**3°** to the floor: the trunk resists close to the full turning effect of body weight.
- Moving the elbows further forward lengthens the lever and raised abdominal demand in healthy people: a later progression, not a start.

Lever length in a plank

- In 19 participants, a long-lever plank raised upper rectus abdominis and lower abdominal activity more than the traditional plank; a posterior-tilt plank raised external oblique activity (Schoenfeld et al., 2014).

Myth: "if you can't hold a plank for 2 minutes, your core is the problem." Trunk endurance did not predict future LBP (Hamberg-van Reenen et al., 2007).

Longer levers, higher demand (healthy)



18 healthy participants; paraspinals stayed below 10% MVIC in all exercises. Escamilla et al. (2010).

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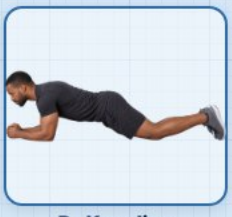
INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

PLANKS FOR LOWER BACK PAIN: FINDING THE RIGHT STARTING LEVEL

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A · Incline
≈71% of full

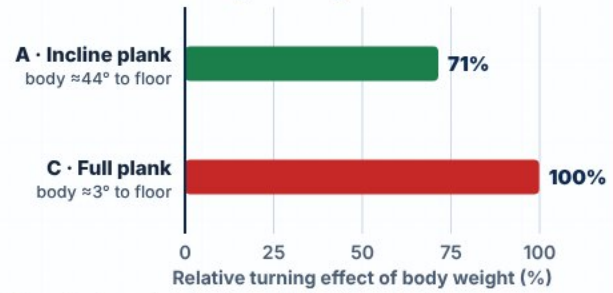


B · Kneeling
Shorter lever



C · Full plank
Longest lever

The incline does the regressing



MMSx 2-D analysis: straight-body model pivoting at the feet; moment ∝ cos(incline). Kneeling version not modelled (different pivot).

Decision pathway

1. **PICK THE SUPPORT**
   Start at the incline or knee level that feels controlled and symptom-steady.
2. **BUILD DURATION**
   Short holds repeated, then longer holds; ignore fixed targets from healthy norms.
3. **THEN LENGTHEN**
   Lower the incline, move to toes, then reach the elbows forward; add side planks last.

NOT RECOMMENDED

Universal hold targets; starting with long-lever or side planks.

SEEK ASSESSMENT IF

Holds that send pain into the leg with numbness or weakness, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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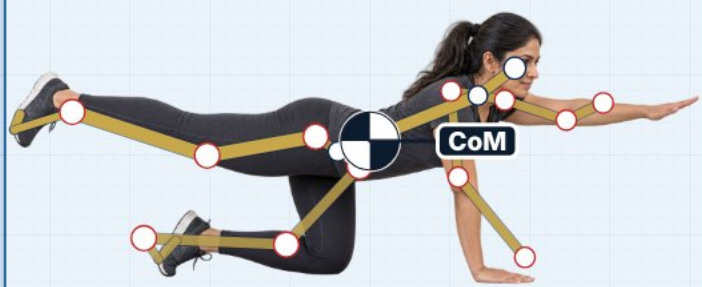
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

BIRD DOG, DEAD BUG, OR BRIDGE? CHOOSING AND PROGRESSING TRUNK EXERCISES

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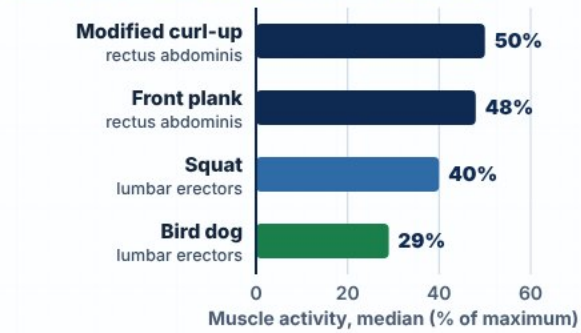
A · BIRD DOG, SIDE



Bird dog: back extensors at low load

- On hands and knees, opposite arm and leg reach out: the back extensors and hip extensors hold the trunk level against rotation.
- Each exercise shifts demand to different muscles; none is "the one safe exercise".
- In people with chronic LBP, bird dog was well tolerated at moderate erector activity.

Different exercises, different muscles



13 outpatients with chronic LBP; 15-RM intensity; small sample. Calatayud et al. (2019).

Progressing a bird dog

- Leg slide only → leg lift → arm and leg together → hold longer → add load.
- In healthy men, trunk-muscle activity rose with each of five graded levels (Kim et al., 2016).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Quadruped reference image: joint angles not reported for this pose. Educational, not diagnostic.

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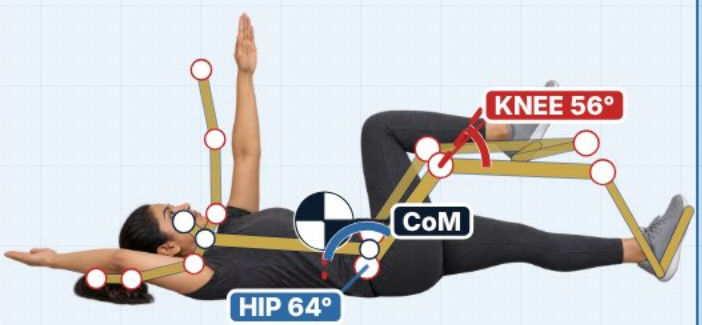
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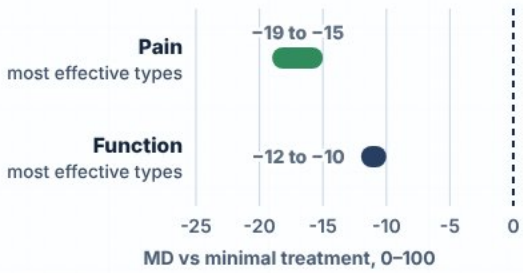
B · DEAD BUG, SIDE



Dead bug: abdominals against moving limbs

- On the back, arms and legs lifted (hip **64°**, knee **56°**); lowering an opposite arm and leg makes the abdominals resist the pelvis tipping.
- Shorter levers (bent knee, small range) make it easier; straighter limbs and lower reach make it harder.
- Across 217 trials, several exercise types reached clinically meaningful pain reductions.

Exercise vs minimal treatment (range of the best types)



217 trials, 20,969 adults with chronic LBP; Pilates, McKenzie, functional restoration among the most effective for pain. Hayden, Ellis, Ogilvie, Stewart, et al. (2021).

Symmetrical-looking is not symmetrical

In healthy men, 7 of 11 stabilisation exercises activated the two sides of the trunk unequally (Okubo et al., 2010). Watch for one side tiring first.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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C · BRIDGE, SIDE

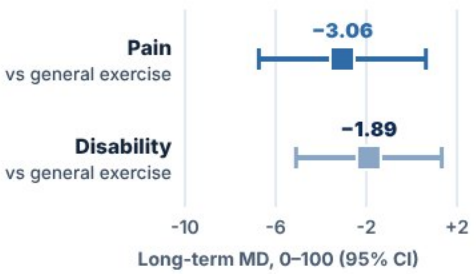


Bridge: hip extensors lift the pelvis

- Hips lifted until the thigh is near the trunk line (hip ≈**18°** from straight), knee **75°**: the gluteals and hamstrings do most of the work.
- On an unstable surface, planks increased all muscle activity but the back bridge did not (Imai et al., 2010).

Examples to adapt, not a compulsory sequence: there is no proven order such as "bird dog before bridge".

Specific stabilisation vs general exercise



Intervals cross zero: no clear long-term advantage. Smith, Littlewood & May (2014).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Bridge hip angle measured from the thigh to the trunk line. Educational, not diagnostic.

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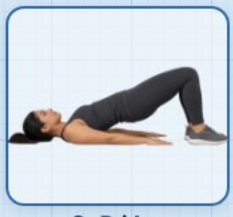
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A · Bird dog
Back extensors

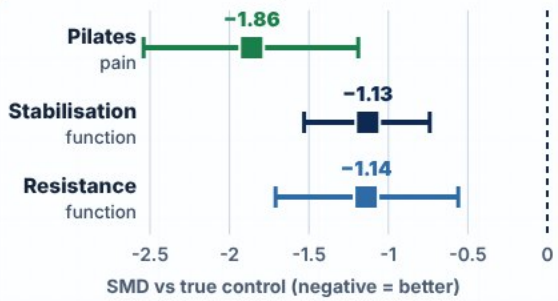


B · Dead bug
Abdominals



C · Bridge
Hip extensors

Rankings differ between analyses



Network meta-analysis, low certainty; choose by preference and tolerance. Owen et al. (2020).

Decision pathway

1. **PICK BY DEMAND**
   Bird dog for back extensors, dead bug for abdominals, bridge for hips; match to goals.
2. **PICK BY TOLERANCE**
   Start where symptoms stay steady during and the day after; swap if one aggravates.
3. **PROGRESS ONE THING**
   Lever, range, hold time or load: change one at a time.

NOT RECOMMENDED

Labelling one exercise “safe” and others “dangerous”; a fixed compulsory order.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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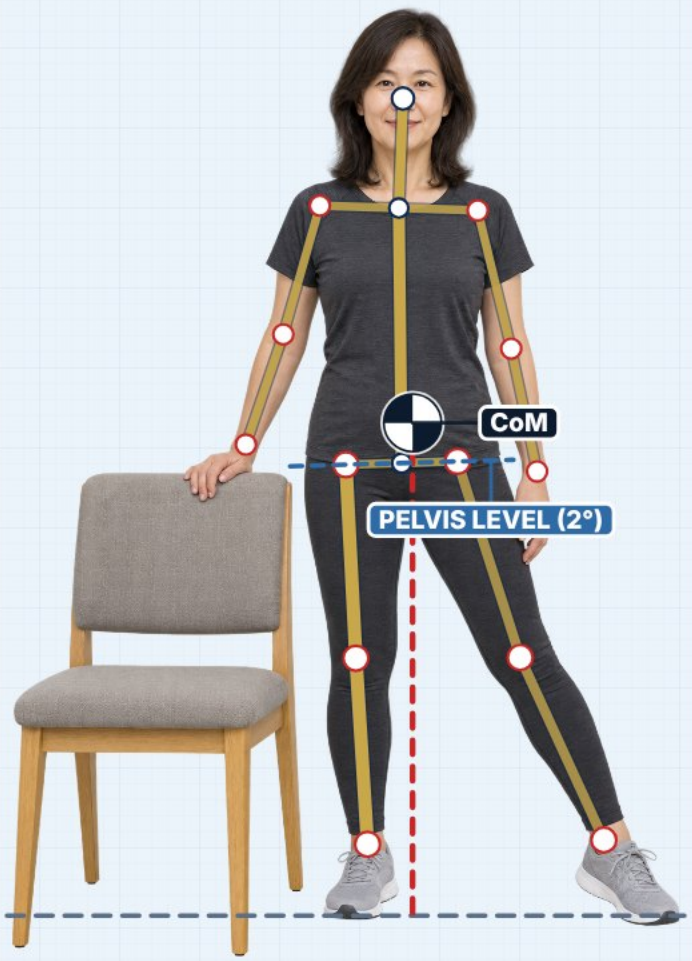
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

HIP STRENGTH AND LOWER BACK PAIN: WHO MIGHT BENEFIT FROM HIP-FOCUSED REHABILITATION?

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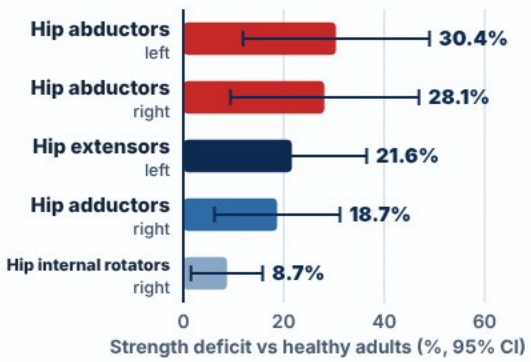
A · STANDING HIP ABDUCTION, FRONT



Standing abduction: the side-hip muscles

- Hand on a chair, one leg out to the side; pelvis level (**2°**), held by the standing-side abductors.
- Adults with chronic LBP were weaker at the hip than healthy adults, most of all in the abductors.
- Cross-sectional data: weakness may follow pain rather than cause it.

Hip strength gap in chronic LBP



40 adults with chronic non-specific LBP vs 40 healthy controls. Pizol et al. (2023).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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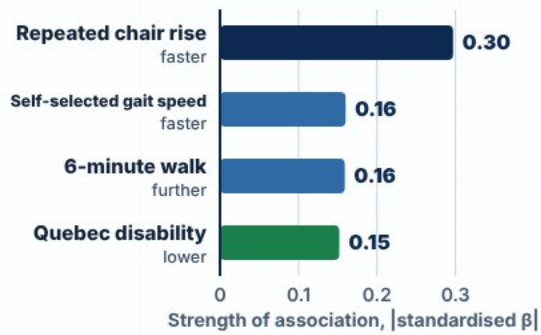
B · SIDE-LYING ABDUCTION



Hip abduction strength predicted function

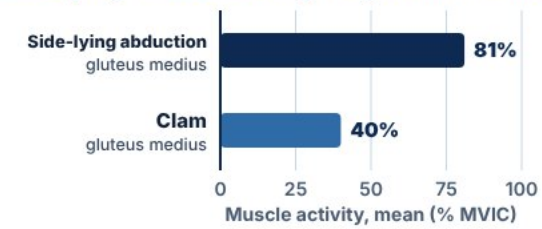
- In older adults with chronic LBP, stronger hip abductors at baseline went with better function 12 months later; hip osteoarthritis did not change these links.
- Associations: they do not prove that strengthening changes the outcome.

Baseline abductor strength vs 12-month function



Delaware Spine Studies, older adults with chronic LBP; all P ≤ .005. Coyle et al. (2021).

Side-lying abduction targets gluteus medius



Healthy adults; large SDs (81 ± 42, 40 ± 38). DiStefano et al. (2009).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Side-lying reference image: joint angles not reported. Educational, not diagnostic.

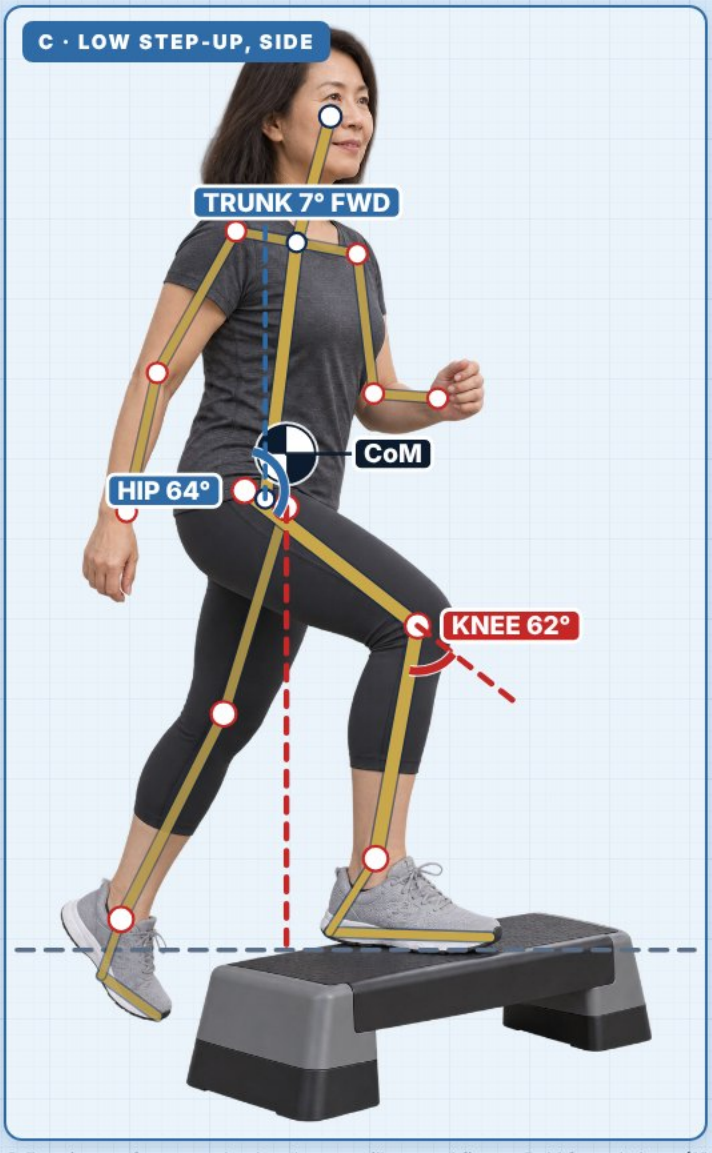
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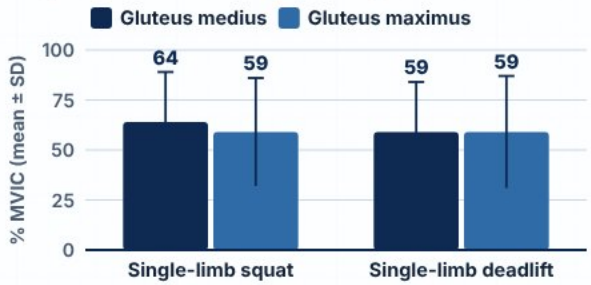
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Low step-up: hip strength in a real task

- Lead hip **64°**, knee **62°**, trunk **7°** forward: the lead-leg hip extensors and abductors lift and steady the body.
- Single-limb tasks recruited both gluteal muscles; choose by balance, tolerance and goals.

Single-limb tasks work both gluteals



Healthy adults, surface EMG. DiStefano et al. (2009).

Very low certainty: hip strengthening or stretching added to back exercise helped pain and disability in the short term only, with no medium- or long-term benefit (Ceballos-Laita et al., 2023).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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A · Standing abduction
Side-hip control

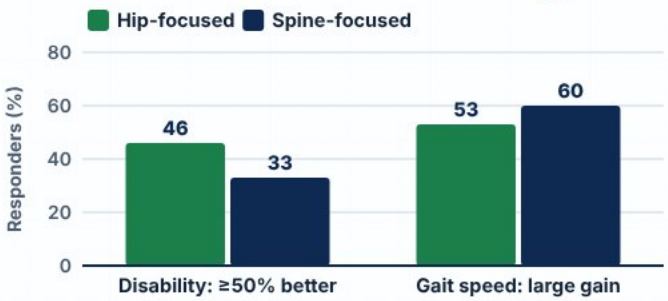


B · Side-lying
Gluteus medius



C · Step-up
Task strength

MASH trial: older adults with back AND hip pain



184 adults aged 60–85; greater disability reduction with hip focus at 8 weeks, no difference at 6 months; both improved. Hicks et al. (2024).

Decision pathway

1. **FIND THE SUBGROUP**
   Older adult with chronic LBP plus hip pain or hip weakness: the best-studied group.
2. **ASSESS THE HIP**
   Abductor and extensor strength, hip range and pain on hip movement.
3. **ADD, DON'T REPLACE**
   Hip work alongside back-focused exercise; not a universal fix for everyone.

NOT RECOMMENDED

Telling everyone with back pain that weak glutes are the cause.

SEEK ASSESSMENT IF

Groin pain with loss of hip rotation, inability to bear weight after a fall, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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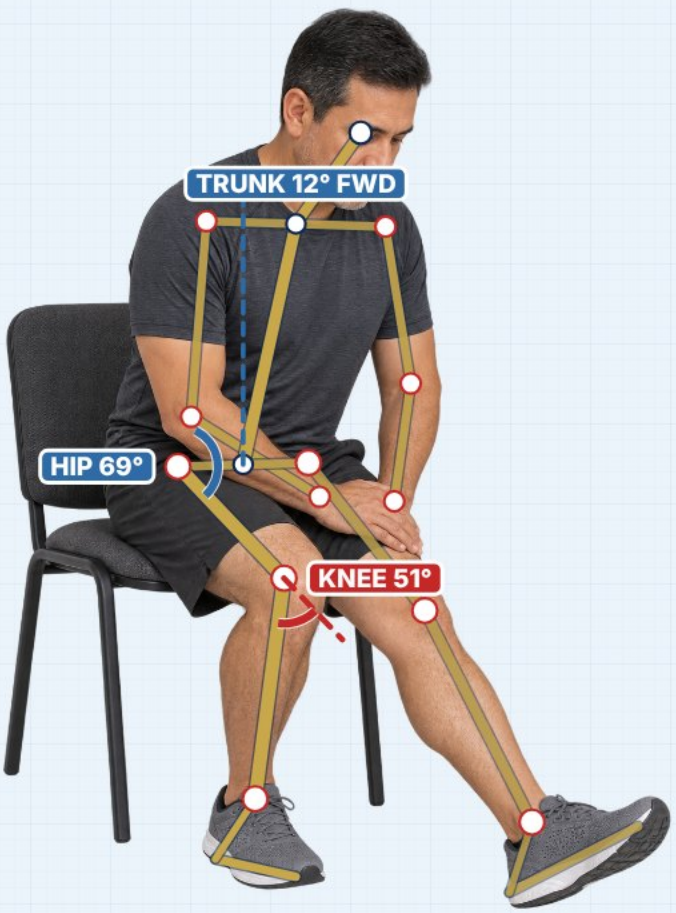
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TIGHT HAMSTRINGS OR SENSITIVE NERVES? WHY LEG SYMPTOMS NEED ASSESSMENT

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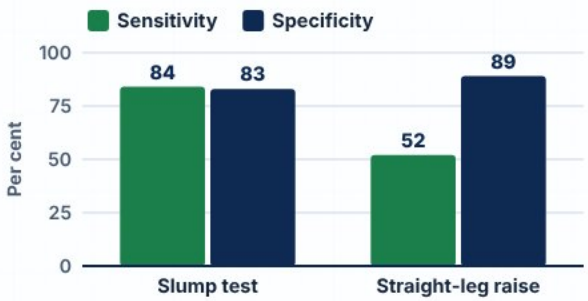
A · SEATED HAMSTRING POSITION



A "pull" behind the thigh: muscle or nerve?

- Seated with one knee extending (hip **69°**): this loads both the hamstrings and the sciatic nerve.
- The feeling alone cannot tell which. Clinicians change a body part that loads the nerve but not the hamstrings (ankle or neck) and watch the response.
- In suspected disc herniation, the seated slump test was more sensitive than the straight-leg raise.

Slump vs straight-leg raise



75 patients (38 with MRI-confirmed herniation); single study, no CIs. Majlesi et al. (2008).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Oblique seated view: hip angle approximate. Educational, not diagnostic.

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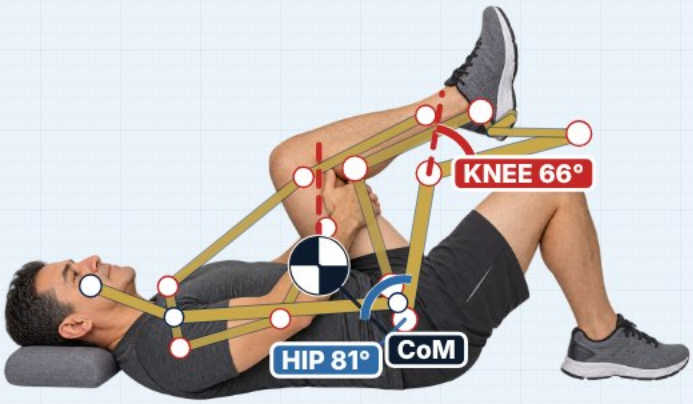
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

TIGHT HAMSTRINGS OR SENSITIVE NERVES? WHY LEG SYMPTOMS NEED ASSESSMENT

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B · LEG RAISE, KNEE BENT, SIDE



Change the ankle, not the hamstring

- On the back, hip lifted to **81°** with the knee bent (**66°**): straightening the knee from here is the straight-leg raise.
- Pulling the ankle up adds nerve load without lengthening the hamstrings; in healthy adults it cut SLR range by about 8°.
- If ankle or neck movement changes the symptom, nerve sensitivity becomes more likely.

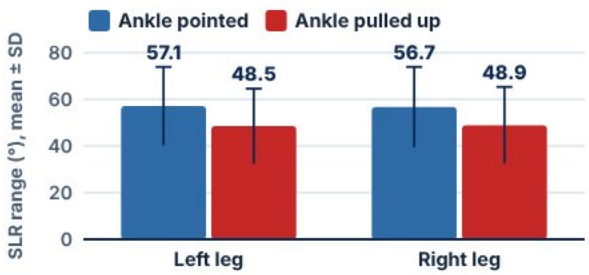
Compare sides, not "normal" angles

Healthy adults: the side-to-side difference was under 11° in 90% of people; absolute range varied widely (SD ≈ 16–17°).

5.0° mean left–right difference, ankle pointed

4.1° mean difference, ankle pulled up

Ankle position changes the straight-leg raise



40 healthy adults. Boyd & Villa (2012).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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C · SYMPTOM REVIEW



What to tell your clinician

- Where exactly the symptom travels (above or below the knee), whether there is tingling or numbness, and whether ankle or neck movement changes it.
- Stretching alone did not differ from true control for pain or function in a network meta-analysis (Owen et al., 2020).
- If symptoms behave like nerve sensitivity, hard hamstring stretching is not the logical first step.

Myth: "if the back of your thigh feels tight, stretch it harder." The same leg's range changed by about 8° when only the ankle moved, so the feeling cannot locate the source.

Guideline referral prompts

Neurological testing to identify radicular syndrome; refer when radiculopathy is suspected or there is no improvement after about 4 weeks (Oliveira et al., 2018).

~4 weeks
without improvement: review

Neuro exam
strength, sensation, reflexes

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: no joint angles reported. Educational, not diagnostic.

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A · Seated
Muscle or nerve?

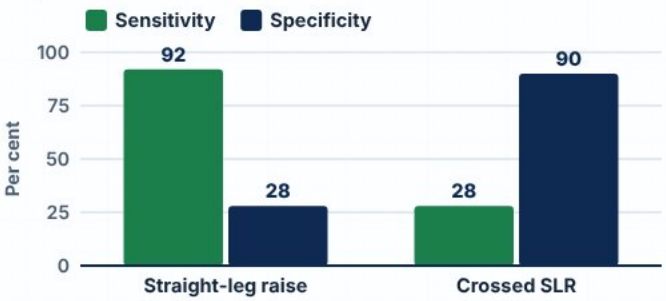


B · Leg raise
Add the ankle



C · Review
Map the symptom

A positive SLR alone is weak evidence



Pooled accuracy for disc-related radiculopathy, mostly surgical populations. van der Windt et al. (2010).

Decision pathway

1. **DIFFERENTIATE**
   Change ankle or neck position: if the symptom changes, the nerve is involved.
2. **EXAMINE**
   Neurological testing for strength, sensation and reflexes; the slump test adds information.
3. **MATCH THE CARE**
   Hamstring flexibility work for a muscle pattern; graded nerve-directed care for a nerve pattern.

NOT RECOMMENDED

Stretching harder into tingling; treating a tight feeling as a diagnosis.

SEEK ASSESSMENT IF

Foot drop, numbness spreading or in both legs, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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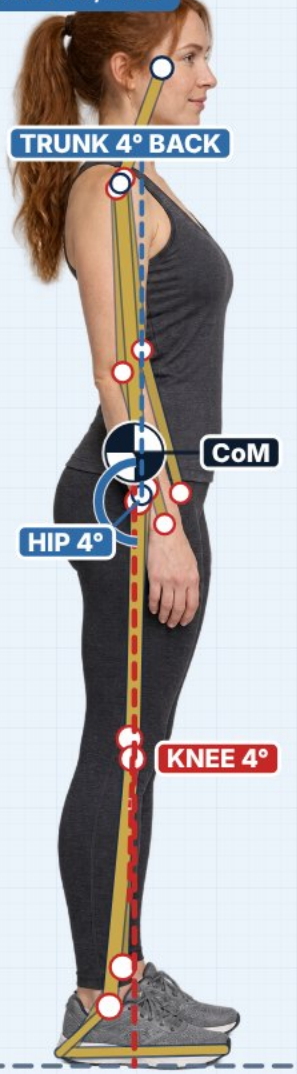
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

ANTERIOR PELVIC TILT AND BACK PAIN: DOES EVERYONE NEED "CORRECTION"?

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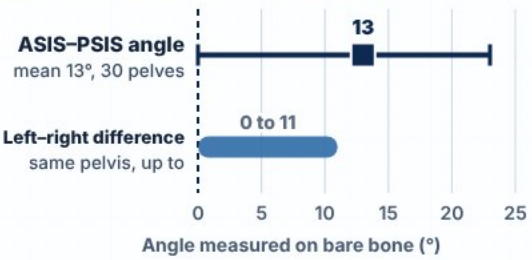
A · NATURAL STANDING, SIDE



A "tilt" reading can come from bone shape

- Relaxed standing, trunk **4°** behind vertical: a normal stacked posture.
- Pelvic tilt is usually estimated from the line between the front and back pelvic bony points (ASIS–PSIS).
- On bare cadaver pelves, that line already sloped 0–23°: the reading reflects anatomy, not only posture.

How much does bone shape vary?



30 cadaveric pelves; innominate height differed by up to 16 mm side to side. Preece et al. (2008).

So: "your pelvis is tilted" from palpation alone can mislead and adds worry without adding accuracy.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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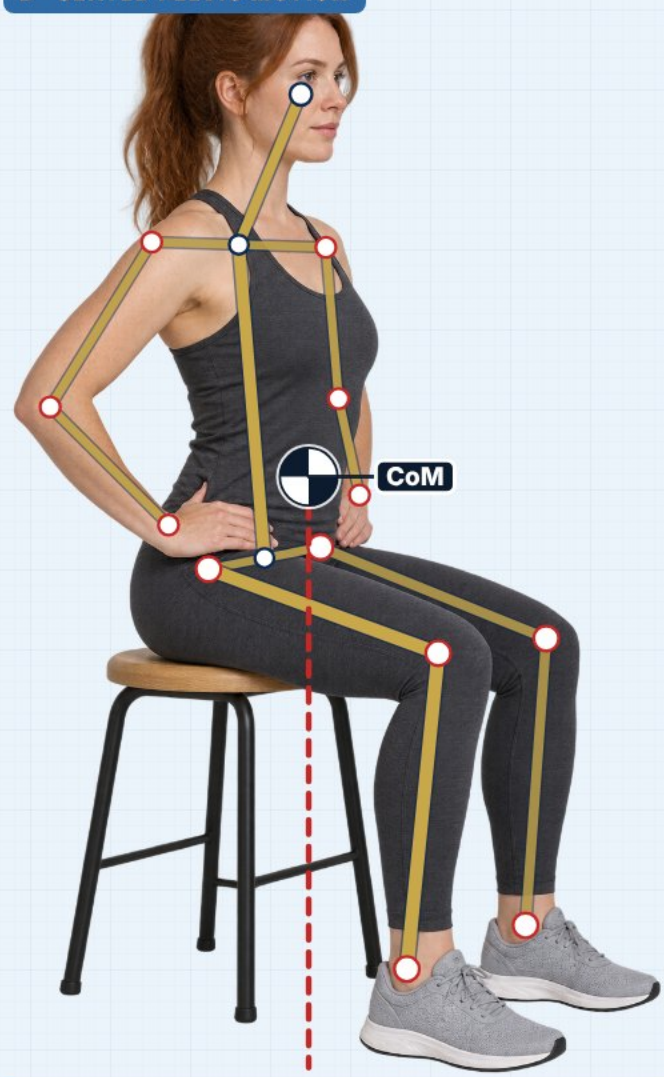
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B · SEATED PELVIC MOTION



Seated pelvic motion: movement, not a fixed shape

- Rocking the pelvis forward and back while seated is a mobility and awareness drill, not a correction.
- In 600 adults, pelvic tilt, lumbar lordosis and leg-length difference were **not** associated with LBP; back-extensor endurance was.

What was, and was not, linked to LBP

600 adults (150 per group, mean age ~43); 17 mechanical factors; cross-sectional associations.

Not linked
pelvic tilt, lordosis, leg length, hamstring length

Linked
back-extensor endurance (strongest), hip and abdominal strength

Muscle performance showed associations; static alignment did not.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Oblique seated view: joint angles not reported. Stats: Nourbakhsh & Arab (2002). Educational, not diagnostic.

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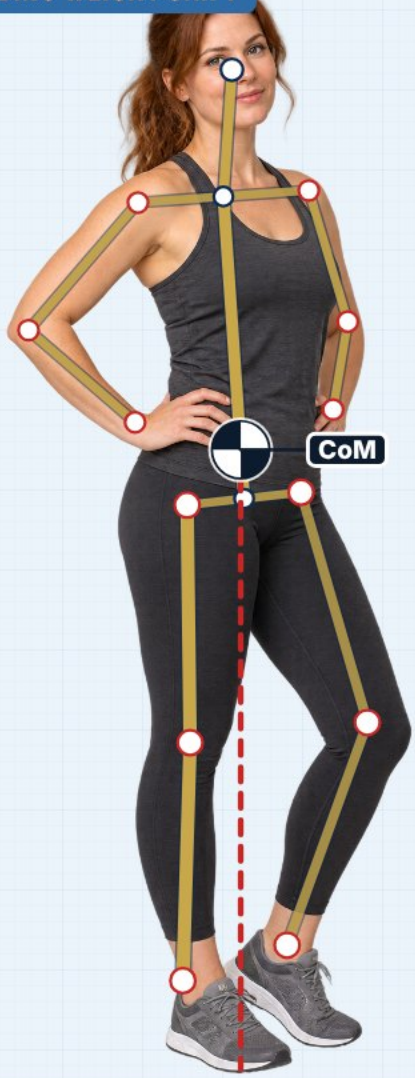
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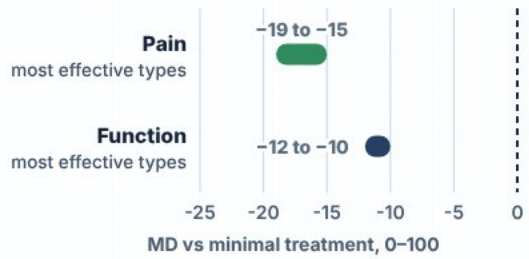
C · STANDING WEIGHT SHIFT



Weight shift: build capacity, not alignment

- Shifting weight between the legs trains load transfer through the pelvis in the position it is already in.
- Exercise improved chronic LBP across many types without any requirement to change pelvic alignment.

Exercise helps without "correcting" posture



217 trials, 20,969 adults with chronic LBP. Hayden, Ellis, Ogilvie, Stewart, et al. (2021).

Optional, individual: if a person finds a position change eases symptoms, use it; it is a tool, not a cure.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Oblique standing view: joint angles not reported. Educational, not diagnostic.

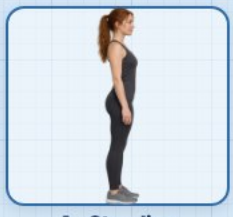
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A · Standing
Normal variation

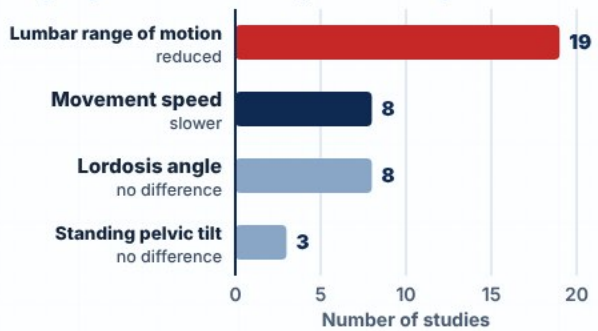


B · Seated motion
Movement drill



C · Weight shift
Capacity

How people move differs; static shape does not



43 studies of people with vs without back pain. Laird et al. (2014).

Decision pathway

1. **ASSESS IN CONTEXT**
   Posture is one observation; read it alongside symptoms, movement and function.
2. **DON'T LABEL**
   Avoid "your pelvis is out" or "tilted" as the cause of pain.
3. **TRAIN CAPACITY**
   Choose exercise for strength, endurance and tolerance; alignment change is optional.

NOT RECOMMENDED

Telling people a tilt reading causes their pain; correction as a prerequisite for exercise.

SEEK ASSESSMENT IF

A visibly increasing spinal deformity, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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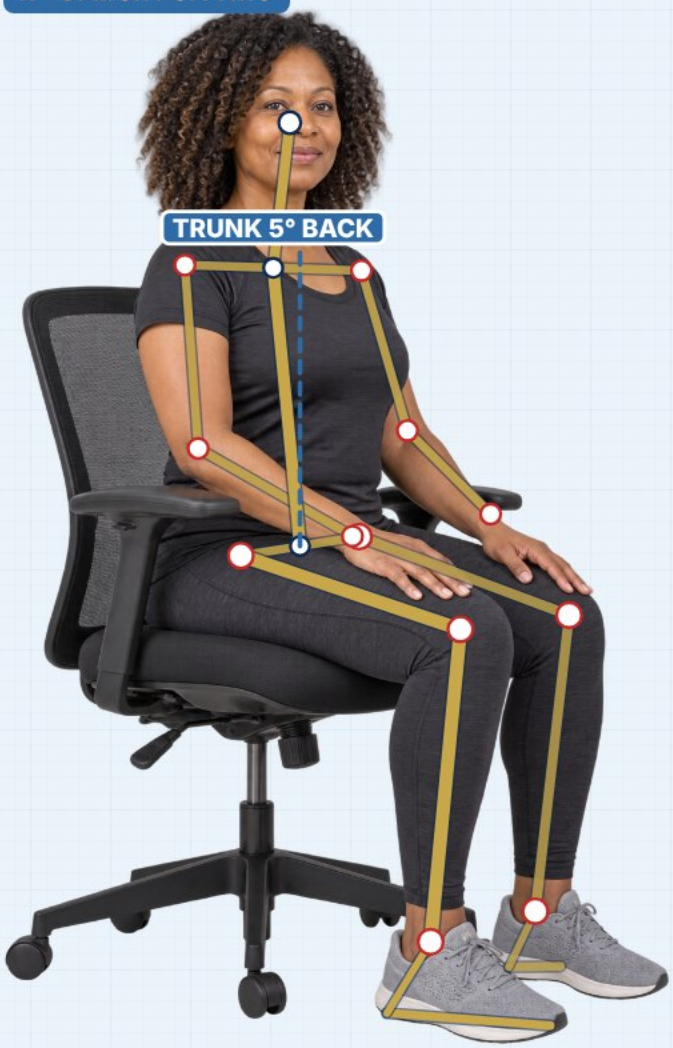
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IS THERE A PERFECT POSTURE FOR A PAIN-FREE LOWER BACK?

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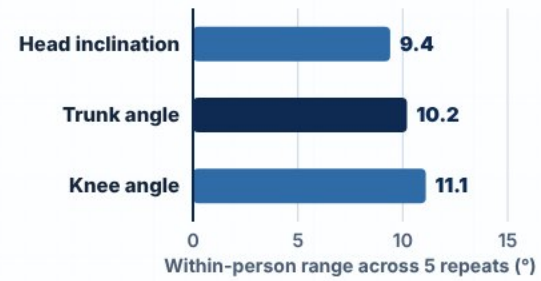
A · UPRIGHT SITTING



Upright sitting: one option among many

- Trunk about **5°** behind vertical against the backrest.
- Asked to sit in their "most comfortable" posture five times, healthy adults never sat the same way twice: about 10° of variation at each joint.
- People with and without back pain did not differ in lordosis or standing pelvic tilt (Laird et al., 2014).

Even your comfortable posture is not fixed



12 adults, 3 chair types; small preliminary study. Chen, Chan & Zhang (2021).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Trunk angle from shoulder and hip points; oblique view. Educational, not diagnostic.

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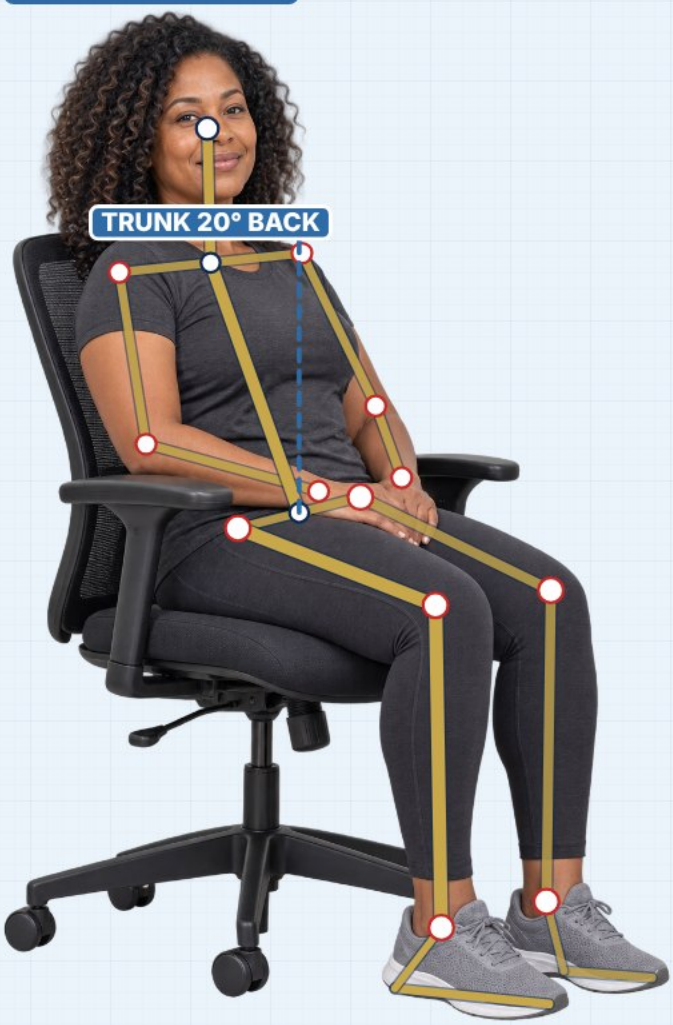
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B · RECLINED SITTING



Reclined sitting: different, not wrong

- Trunk about **20°** reclined: the backrest carries more of the upper body.
- People with chronic LBP showed **less ability to change** their posture when asked to slump than people without pain (Dankaerts et al., 2006).
- Total sedentary time, not one shape, showed modest associations with LBP.

Sedentary exposures: modest associations



27 cross-sectional studies pooled; association, not cause. Baradaran Mahdavi et al. (2021).

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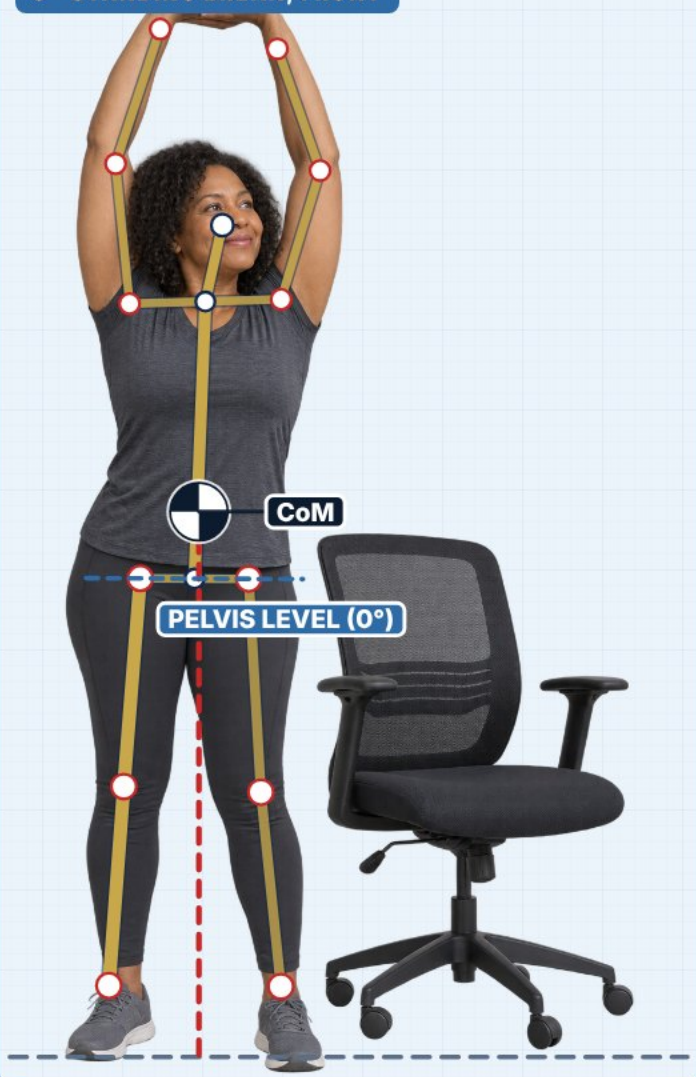
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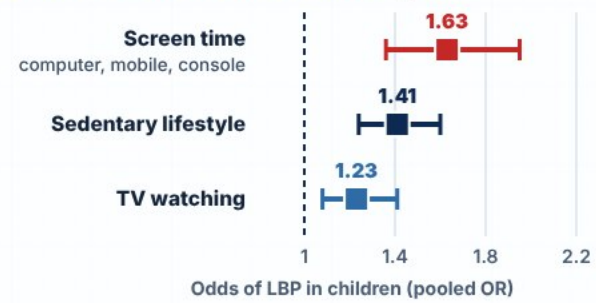
C · STANDING BREAK, FRONT



Standing break: the next posture is the best one

- Standing, arms overhead, pelvis level (**0°**): a short change of position after a sitting bout.
- Associations with sitting time appeared in children too, which points to total exposure and activity rather than spinal shape.

Children: screens and sedentary time



Same meta-analysis; cross-sectional data. Baradaran Mahdavi et al. (2021).

Myth: "slouching damages your spine; sit up straight to prevent back pain." Static shape did not separate people with and without LBP.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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A · Upright
One option

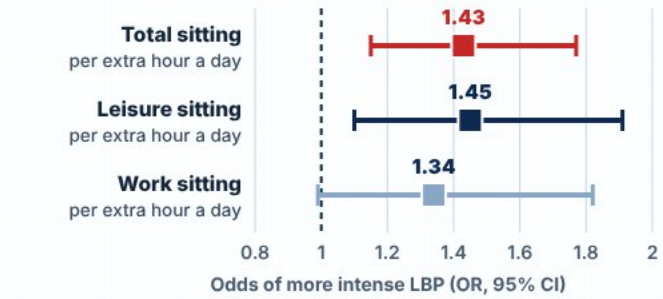


B · Reclined
Also fine



C · Break
Change it

Time in one position, not its shape



201 blue-collar workers, accelerometer-measured sitting; cross-sectional. Gupta et al. (2015).

Decision pathway

1. **COMFORT FIRST**
   Choose positions that feel comfortable for the task; there is no single correct shape.
2. **VARY OFTEN**
   Change position regularly; the ability to vary posture may matter more than any one posture.
3. **CUT TOTAL SITTING**
   Break up long sitting bouts and add activity across the day.

NOT RECOMMENDED

Prescribing one "perfect" sitting or standing posture as protective.

SEEK ASSESSMENT IF

Pain unrelieved by any position change or rest, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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BENDING WITH A ROUNDED BACK: WHAT LIFTING RESEARCH ACTUALLY SHOWS

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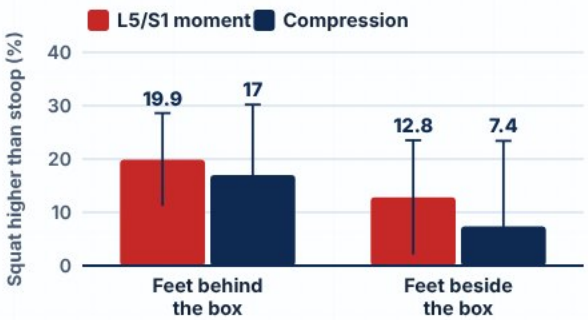
A · HIP-DOMINANT BEND, SIDE



Hip-dominant bend: a long upper-body lever

- Back held flatter, trunk **42°** forward, hip **65°**: lever **≈21 cm**, **≈85 N·m**. A "straight back" does not shorten the lever; trunk angle and load distance do.
- Lifting a box from near the floor, squatting raised the low-back moment over stooping when the box could not pass between the knees.

Squat vs stoop lift: which loads the back more?



10 participants, 10.5 kg box at 0.05 m; mean (SD); compression with feet beside the box not significant; no difference at 0.5 m. Kingma et al. (2004).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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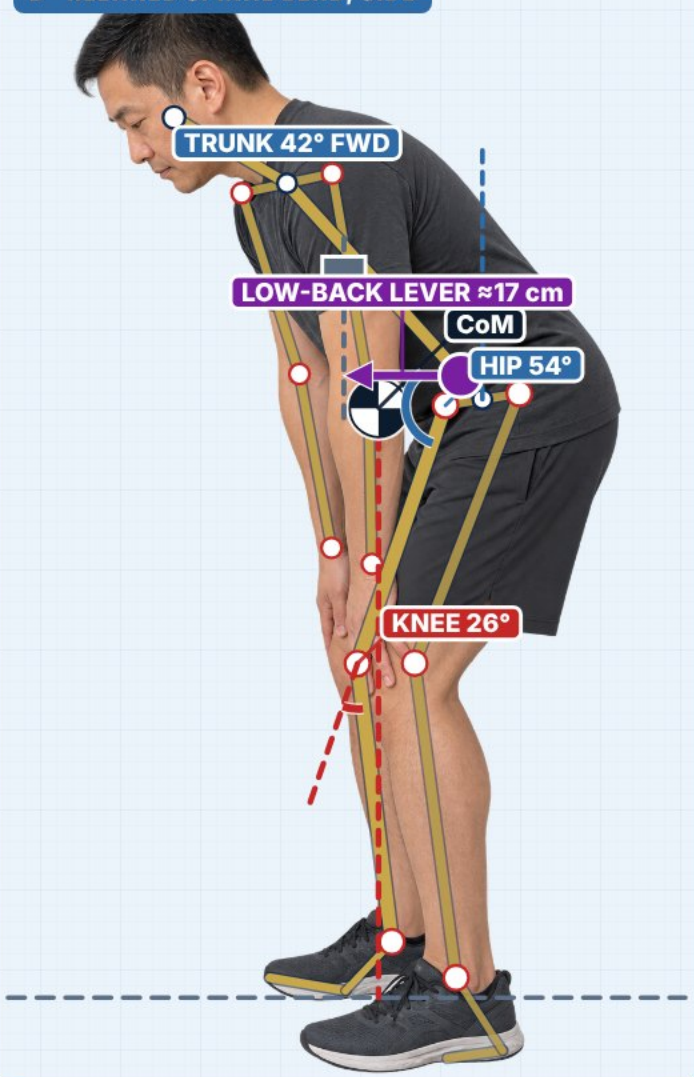
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

BENDING WITH A ROUNDED BACK: WHAT LIFTING RESEARCH ACTUALLY SHOWS

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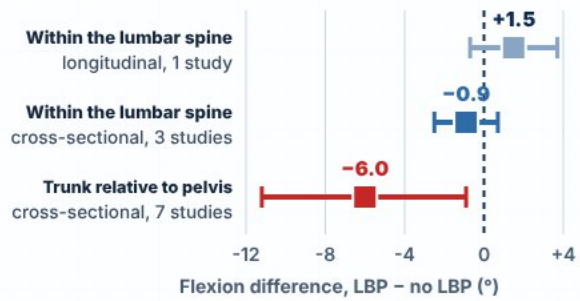
B · RELAXED SPINAL BEND, SIDE



Relaxed spinal bend: rounding is common

- Trunk **42°** forward with the spine allowed to round: lever **≈17 cm**, **≈72 N·m**, no larger than the flat-back bend in A.
- Low-quality evidence did not show lumbar flexion during lifting to be a risk factor for LBP; people with LBP flexed about 6° *less*.

Do people with back pain bend more?



Mean difference (95% CI); 9 of 11 studies found no difference. Saraceni et al. (2020).

Not a licence for any load: total load, distance from the body, repetition, fatigue and individual capacity still matter.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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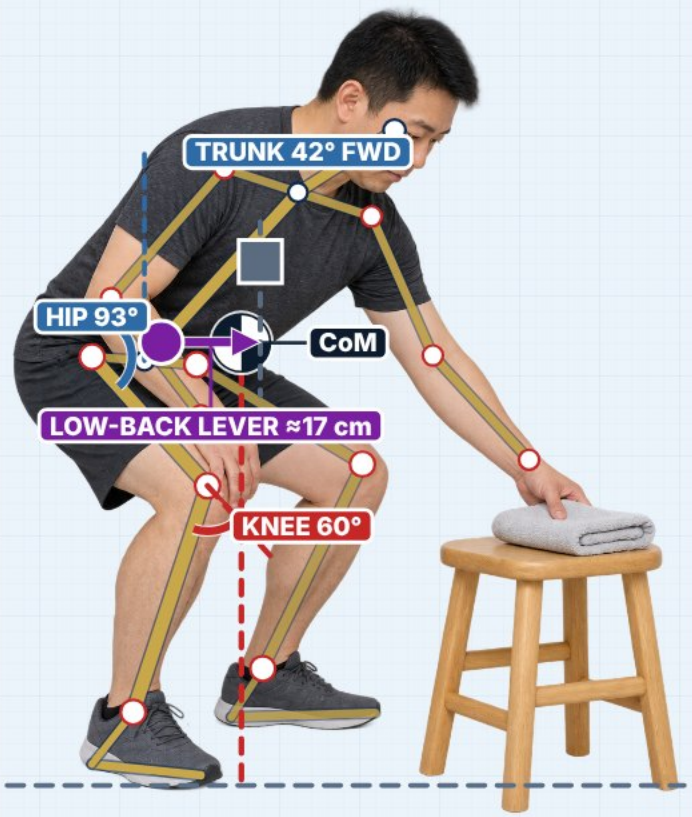
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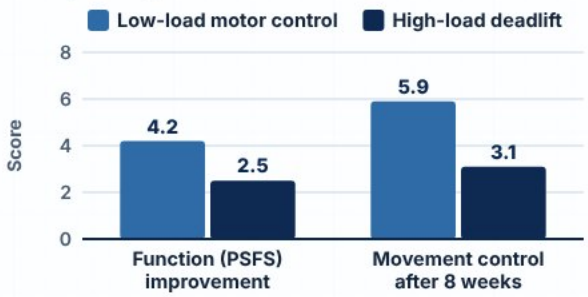
C · REACH TO A LOW STOOL, SIDE



Reach to a low stool: hips and knees share the bend

- Trunk **42°**, hip **93°**, knee **60°**: lever ≈**17 cm**, ≈**72 N·m**.
- In recurrent LBP, a progressive heavy-deadlift programme improved pain as much as low-load motor control; motor control did better on function.

Heavy lifting as rehabilitation



70 people with recurrent LBP, 8 weeks; pain improved in both groups (no difference, P = .505). Aasa et al. (2015).

Technique training for workers did not reduce back pain compared with no intervention: OR 1.17 (0.68–2.02); 7 trials, 19,317 employees (Verbeek et al., 2011).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

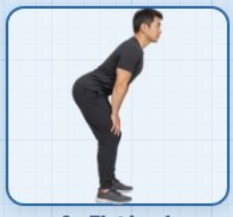
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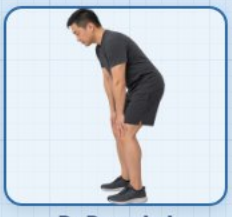
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A · Flat back
≈85 N·m

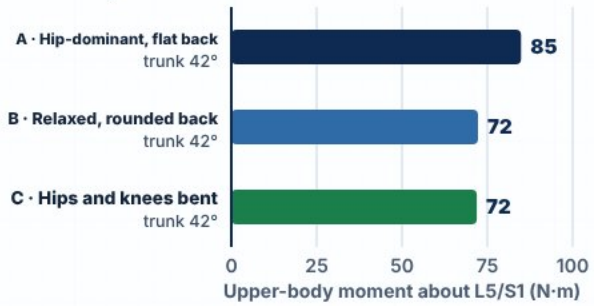


B · Rounded
≈72 N·m



C · Knees bent
≈72 N·m

Spinal shape alone did not set the load



MMSx 2-D analysis of frames A–C; 70 kg adult, static, no hand load. Trunk angle was similar (≈42°) in all three.

Decision pathway

1. **OFFER OPTIONS**
   Load close, feet placed to suit the object, a tolerable speed: choices, not one "correct" lift.
2. **BUILD CAPACITY**
   Progress lifting load by symptom response; heavy lifting can be part of rehab for selected people.
3. **RESPECT DOSE**
   Mass, distance, repetition and fatigue still decide demand: plan them.

NOT RECOMMENDED

Telling people that a bent back while lifting is inherently dangerous.

SEEK ASSESSMENT IF

Sudden pain after a minor lift in someone with osteoporosis, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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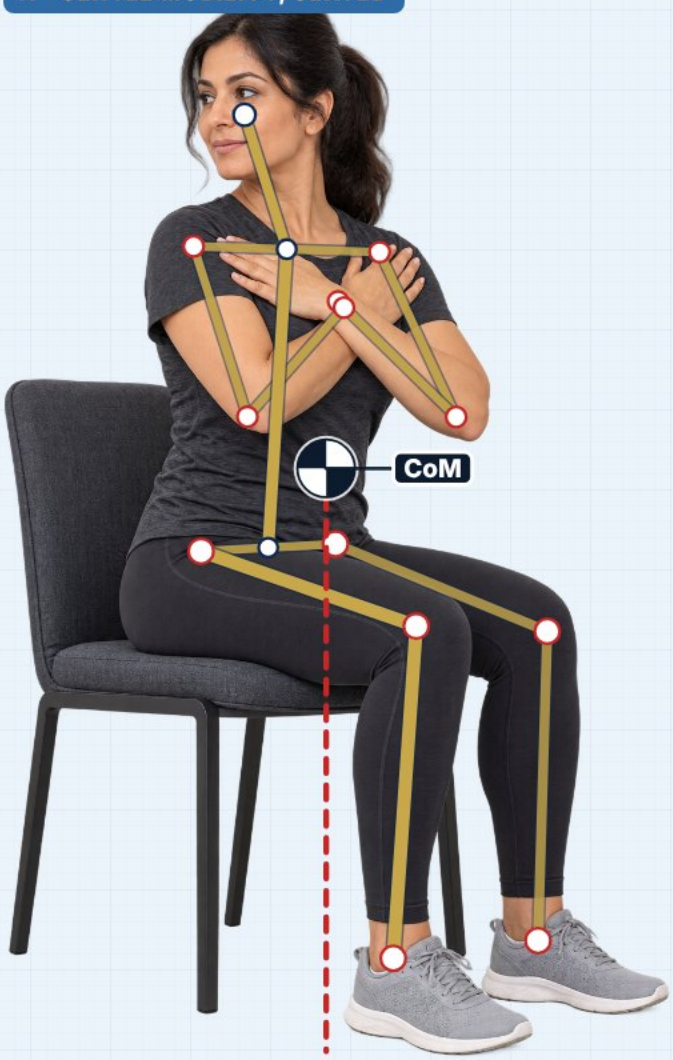
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STRETCHING OR STRENGTHENING FOR LOWER BACK PAIN: WHAT IS YOUR GOAL?

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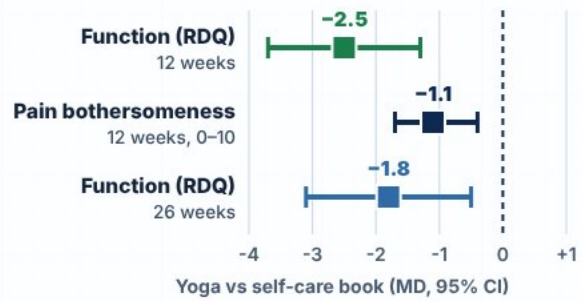
A · GENTLE MOBILITY, SEATED



Mobility: comfort at end range

- Seated rotation through a comfortable range: a mobility goal.
- Short-term gains in muscle extensibility come mainly from **stretch tolerance** (the sensation), not from muscles physically lengthening.
- In one trial, a structured 12-week stretching class matched yoga; both beat a self-care book.

Yoga vs self-care (stretching class: similar to yoga)



228 adults with chronic LBP; yoga not superior to stretching at any time point. Sherman et al. (2011); mechanism: Weppler & Magnusson (2010).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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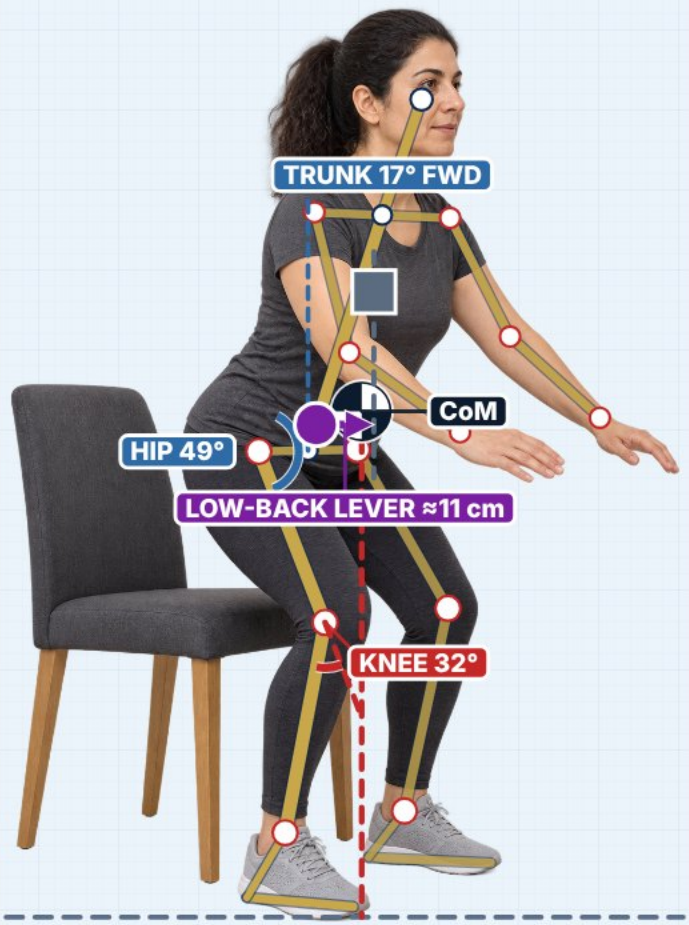
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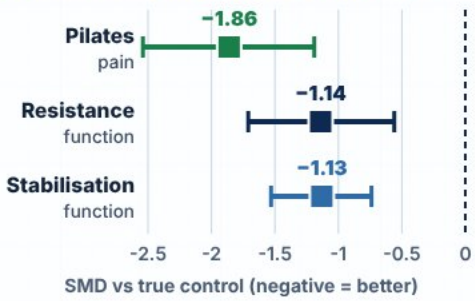
B · CHAIR RISE, SIDE



Strength: chair rise as a capacity task

- Trunk **17°** forward, hip **49°**, knee **32°**; lever **≈11 cm**, **≈45 N·m**. Slower lowering, a lower seat or added load build capacity.
- In one network analysis, resistance training ranked among the best for function; stretching did not differ from true control.

Different modes lead on different outcomes



89 trials; stretching and McKenzie not different from true control. Low certainty. Owen et al. (2020).

Analyses disagree: another network meta-analysis found flexibility exercise among the most effective for function (Hayden, Ellis, Ogilvie, Stewart, et al., 2021).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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C · LIGHT RESISTANCE, FRONT



Light resistance: building tolerance to load

- Dumbbells at the sides, pelvis level (**2°**): carries, deadlift patterns and rows train the trunk and hips together.
- Across 217 trials, most exercise types beat minimal treatment; the leaders differed for pain and for function.

The most effective types, by outcome



217 trials, 20,969 adults with chronic LBP. Hayden, Ellis, Ogilvie, Stewart, et al. (2021).

Re-test the goal (a lift, a walk, a bend), not range of motion alone.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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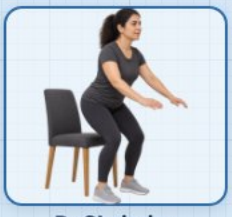
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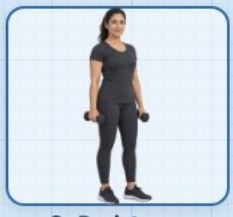
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A · Mobility
Comfort at range

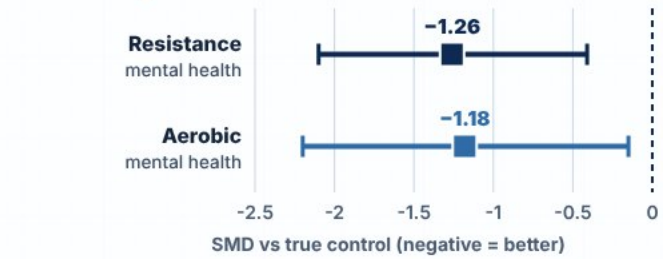


B · Chair rise
Capacity



C · Resistance
Load tolerance

Mood and general health: resistance and aerobic



Network meta-analysis; low certainty. Owen et al. (2020).

Decision pathway

1. **NAME THE GOAL**
   Comfort and range → mobility work; function and capacity → strength; mood → aerobic or resistance.
2. **COMBINE IF USEFUL**
   Most programmes mix modes; neither stretching nor strengthening is universally superior.
3. **KEEP WHAT LASTS**
   The mode a person enjoys and keeps doing usually wins in the long run.

NOT RECOMMENDED

"Back pain means tight muscles: stretch daily and it will go."

SEEK ASSESSMENT IF

Stretching that brings on leg numbness or weakness, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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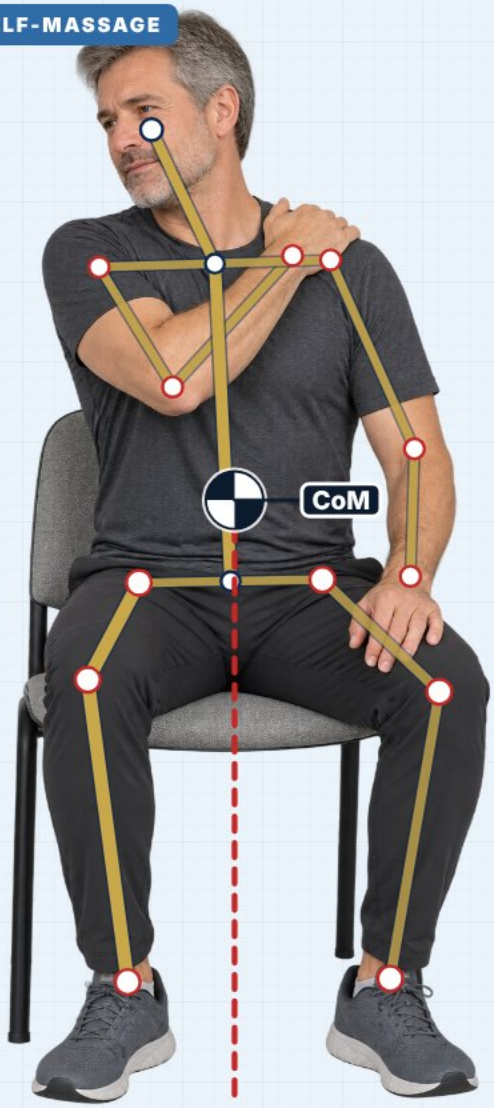
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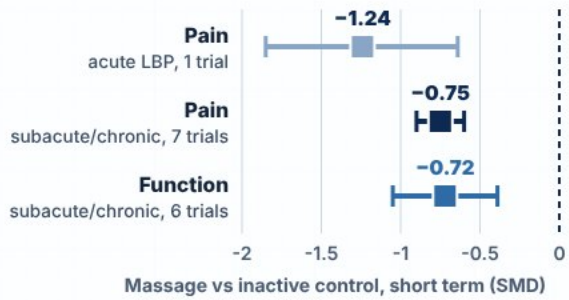
A · SELF-MASSAGE



Massage: short-term relief, low certainty

- Self-massage or massage can ease pain for a short time and help someone feel ready to move.
- Benefits were short term; evidence quality was low to very low, and the authors had little confidence in long-term effects.
- Adverse effects (mostly soreness) in 1.5–25% of participants.

Massage vs no treatment (short term)



25 trials, 3,096 participants. Furlan et al. (2015).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: no joint angles reported. Educational, not diagnostic.

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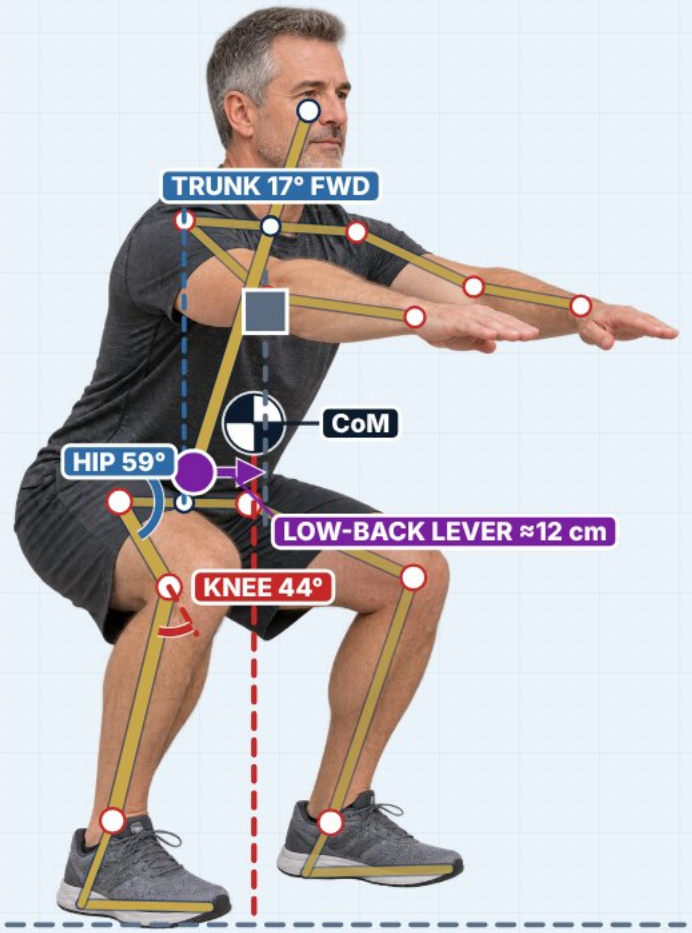
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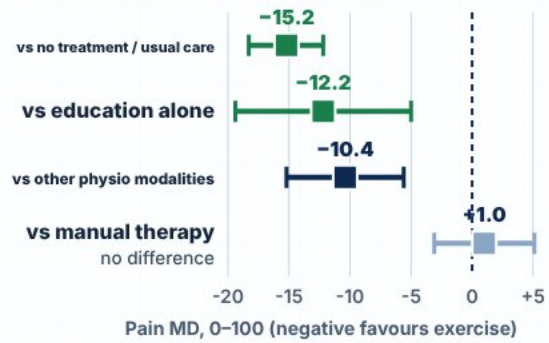
B · ACTIVE REHAB, SIDE



Active rehab: the backbone of chronic care

- Sit-to-stand pattern with arms forward: trunk **17°**, hip **59°**; lever **≈12 cm**, **≈52 N·m**.
- Exercise beat no treatment, education alone and passive physiotherapy modalities for pain, and matched manual therapy.

Exercise vs other options (pain)



249 trials of chronic LBP; important change ≈15 points. Hayden et al. (2021).

Hands-on care can help someone move; active care keeps them moving.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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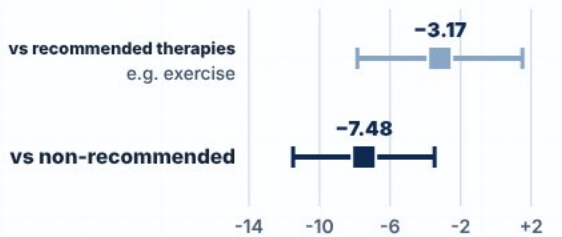
C · SHARED DECISION



Shared decision: where manipulation fits

- For chronic LBP, spinal manipulation gave short-term pain relief similar to other recommended therapies such as exercise.
- Guidelines list massage and manipulation as options (low-quality evidence), alongside staying active and exercise.
- Screening for serious pathology comes before any manipulation.

Spinal manipulation for chronic LBP



47 trials, 9,211 adults; function SMD −0.25 vs recommended therapies. Rubinstein et al. (2019); guideline: Qaseem et al. (2017).

Myth: manipulation "puts a bone back in place". Its effects are short-term symptom relief, similar to exercise.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: no joint angles reported. Educational, not diagnostic.

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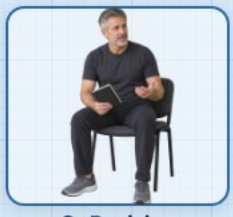
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A · Massage
Short-term relief

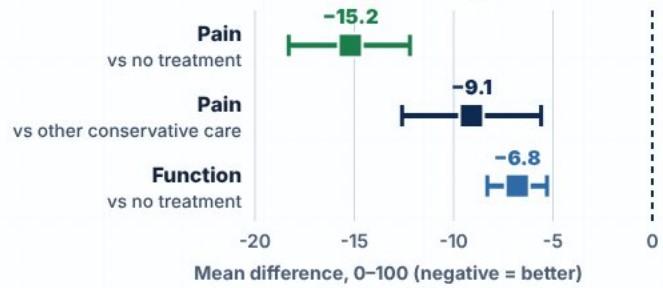


B · Exercise
The backbone



C · Decision
Combine wisely

Exercise: the consistent long-term option



249 trials of chronic LBP; moderate certainty vs no treatment. Hayden et al. (2021).

Decision pathway

1. **ACTIVE FIRST**
   Exercise and staying active form the plan for chronic LBP.
2. **ADD IF IT HELPS**
   Massage or manipulation as a short-term adjunct that makes movement easier.
3. **REVIEW AND TAPER**
   Move from passive to active care; avoid long courses of passive treatment alone.

NOT RECOMMENDED

Repeated passive treatment as the only intervention.

SEEK ASSESSMENT IF

Before manipulation: fracture risk, cancer history, progressive nerve signs, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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Analysis: MMSx Authority Applied Biomechanics Lab · Dr. Neeraj Mehta, PhD · Educational content, not a diagnosis.

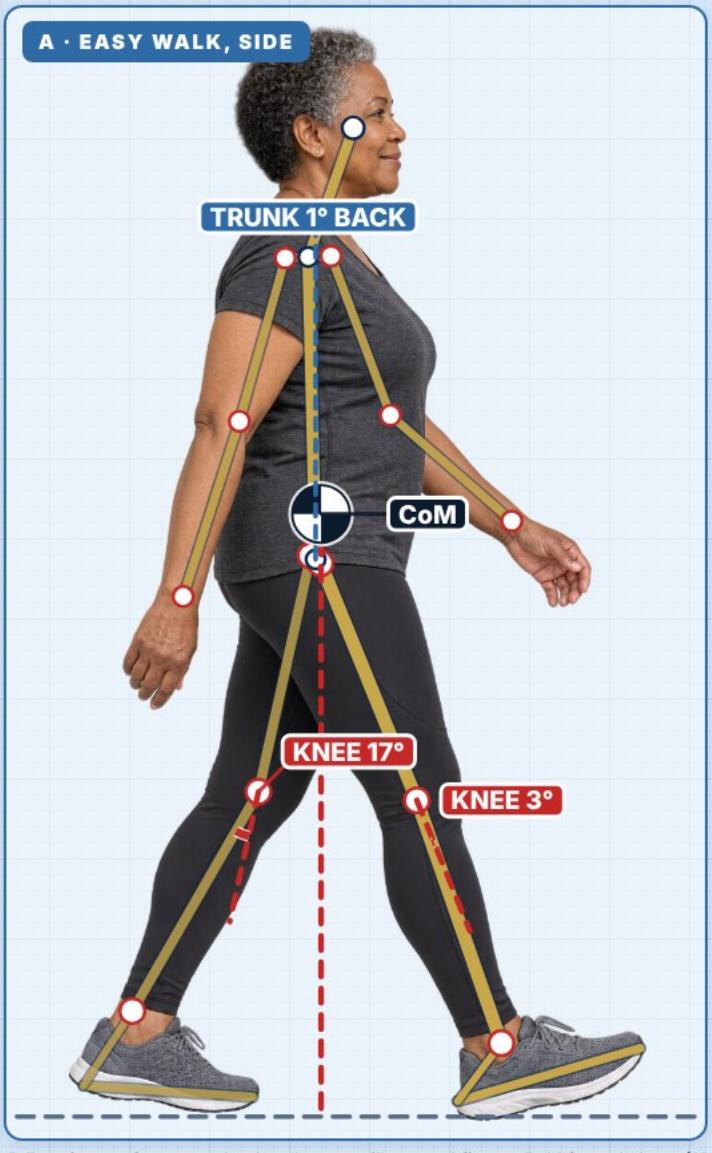
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

WALKING WITH LOWER BACK PAIN: HOW TO FIND A MANAGEABLE STARTING LEVEL

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Easy walk: start from your own baseline

- Upright trunk (**1°**), knees **17°** and **3°**: walking keeps the upper body stacked over the pelvis.
- In one programme, step targets were set from each person's own baseline, not a universal 10,000: steps rose by about 2,800 a day (+59%).
- Adherence to weekly targets averaged 70%; 13% had minor adverse events.

Baseline-based walking reduced disability



57 adults with chronic LBP in primary care; between-group d = 0.44. McDonough et al. (2013).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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Rest break: part of the plan, not a failure

- Standing pause with water, pelvis level (**2°**): planned breaks let a person walk further in total.
- Six weeks of walking matched specific back exercise: both improved disability, fear-avoidance and endurance, with no between-group difference.
- Walking can be an alternative to other exercise (meta-analysis of five trials; Vanti et al., 2019).

Walking vs back exercise: walking capacity



52 sedentary adults with chronic LBP, twice weekly for 6 weeks. Shnayderman & Katz-Leurer (2013).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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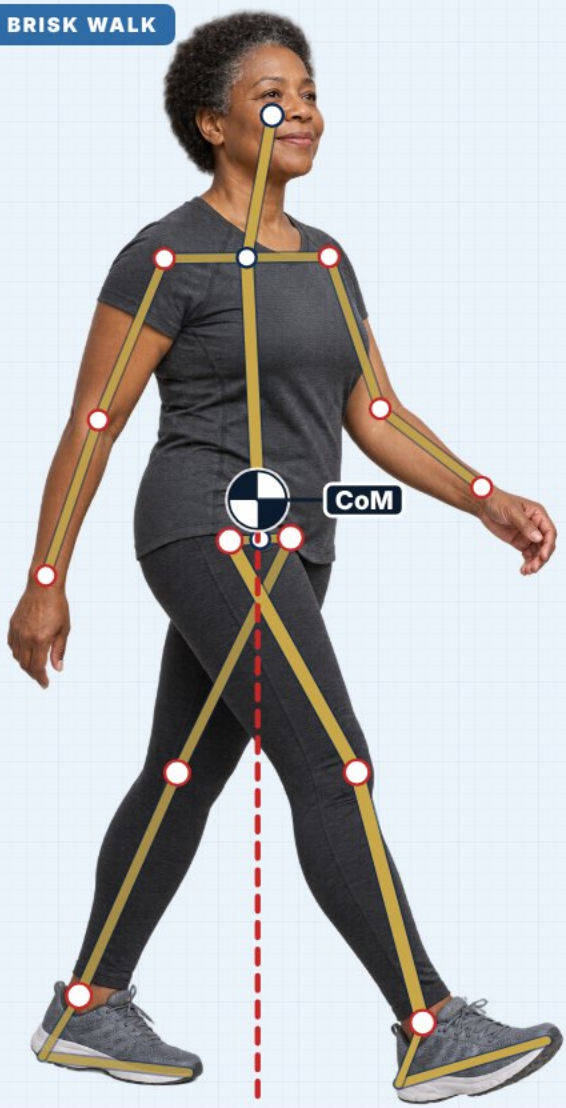
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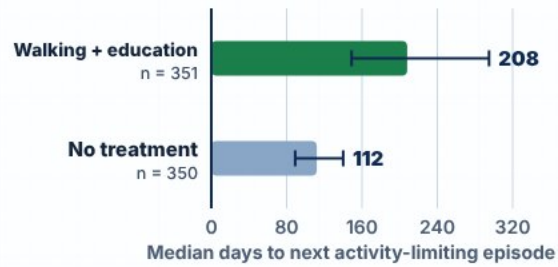
C · BRISK WALK



Brisk walk: progress one thing at a time

- Add duration first, then frequency, then pace or hills, checking the response over the next 24 hours.
- After recovery from an episode, a progressive walking and education programme nearly doubled the time to the next episode (HR 0.72).
- Lower-limb adverse events were more frequent with walking (100 vs 54), so build gradually.

WalkBack: walking delayed recurrence



701 adults recently recovered from LBP; not people in a current flare. Pocovi et al. (2024).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Oblique walking view: joint angles not reported. Educational, not diagnostic.

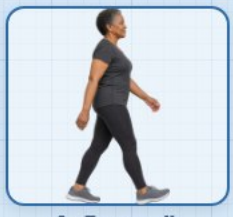
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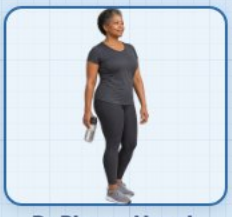
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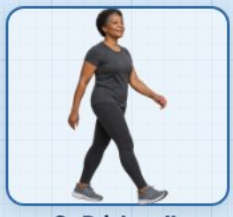
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A · Easy walk
Your baseline

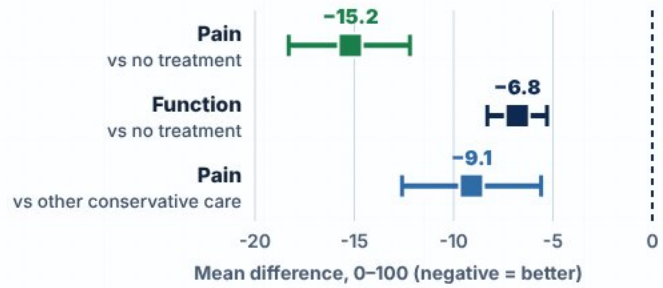


B · Planned break
Walk further in total



C · Brisk walk
Progress slowly

Exercise for chronic LBP: worthwhile but modest



249 trials; important change ≈15 (pain) and 10 (function) points. Hayden et al. (2021).

Decision pathway

1. **FIND THE BASELINE**
   Walk for a time or step count that does not cause a lasting flare; start just below it.
2. **CHECK 24 HOURS**
   Settled by the next day? Keep or progress. Worse for longer? Step back one level.
3. **PROGRESS ONE VARIABLE**
   Duration → frequency → pace or hills, in small steps each week.

NOT RECOMMENDED

Waiting for pain to vanish before walking; fixed step targets for everyone.

SEEK ASSESSMENT IF

Leg pain or numbness that builds with walking and eases with sitting (see Title 16), or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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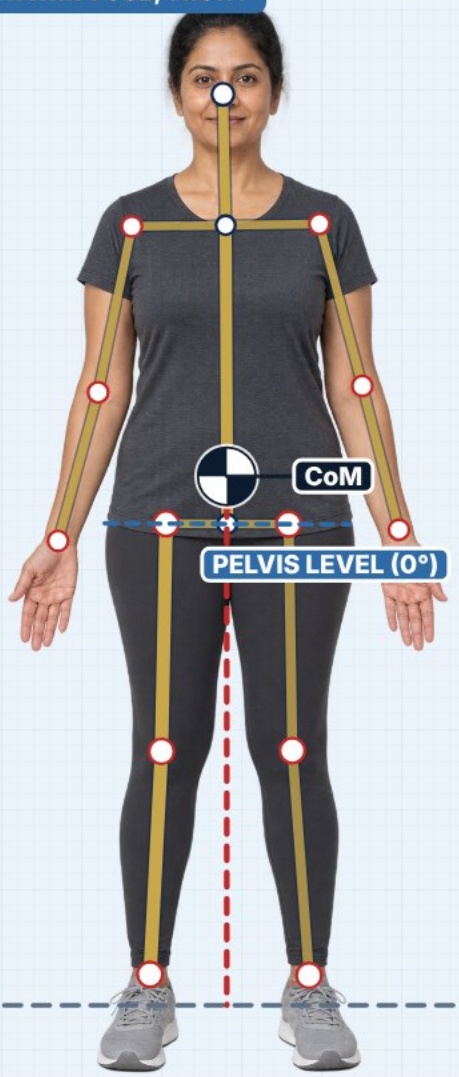
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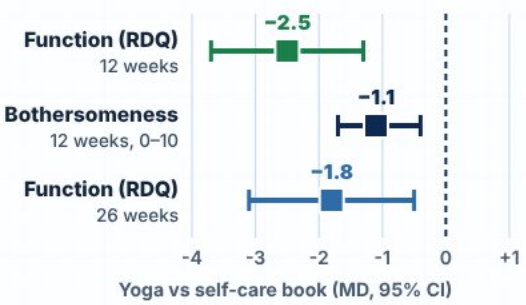
A · MOUNTAIN POSE, FRONT



Mountain pose: an easy, upright start

- Standing tall, pelvis level (**0°**): breathing and balance work with almost no spinal load.
- Yoga beat a self-care book for function and symptoms, but was **not** more effective than a conventional stretching class.
- Much of the benefit may come from regular, guided movement rather than something unique to yoga.

12 weekly classes vs a self-care book



228 adults with chronic LBP; yoga not superior to stretching. Sherman et al. (2011).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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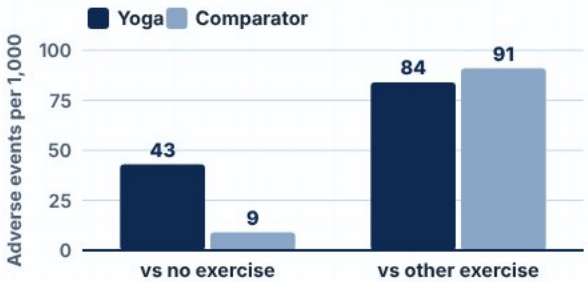
B · CHAIR-SUPPORTED HINGE, SIDE



Chair-supported hinge: adapt the pose

- Hands on a chair, trunk **27°** forward, hip **37°**: lever **≈18 cm**, **≈73 N·m**, part of it carried through the arms.
- Props, reduced range and shorter holds keep poses within tolerance; progress hold time before depth.
- Adverse events (mostly minor symptom increases) were more common than with no exercise, similar to other exercise.

Yoga is not risk-free, like any exercise



RR 4.76 (2.08–10.89) vs no exercise; 0.93 (0.56–1.53) vs other exercise; low certainty. Wieland et al. (2022).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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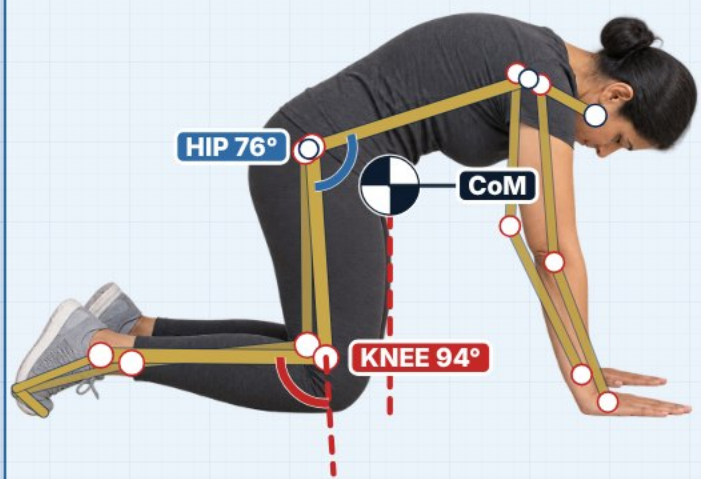
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C · QUADRUPED MOBILITY, SIDE



Quadruped mobility: small, symptom-steady ranges

- On hands and knees (hip **76°**, knee **94°**): gentle spinal rounding and arching within a comfortable range.
- Avoid sustained end-range flexion or extension that brings on leg symptoms.

Choosing between yoga and other exercise may depend on availability, cost and preference (Wieland et al., 2022). Guidelines list yoga among first-line non-drug options for chronic LBP (Qaseem et al., 2017).

Realistic expectations

Yoga vs no exercise, chronic LBP (Cochrane, 21 trials, 2,223 people).

−1.7
RMDQ points (0–24), low certainty

RR 2.33
rated improved at 3 months

Yoga vs physiotherapy

320 mostly low-income adults: 12 weekly yoga classes were **non-inferior** to 15 physiotherapy visits for function and pain; both groups were 21–22 percentage points less likely than an education group to use pain medication at 12 weeks, maintained at 1 year (Saper et al., 2017).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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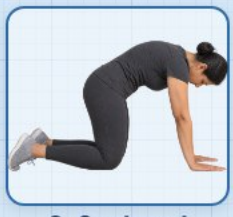
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A · Mountain pose
Upright start



B · Supported hinge
Adapt with props



C · Quadruped
Small ranges

Small average benefit: below the importance threshold



9 trials, 946 people; moderate certainty. Wieland et al. (2022); threshold from Hayden et al. (2021).

Decision pathway

1. **CHOOSE IF PREFERRED**
   Yoga is a reasonable first-line option for people who enjoy it and can access it.
2. **ADAPT THE POSES**
   Props, chair support, reduced range and shorter holds; progress hold time before depth.
3. **EXPECT MODEST GAINS**
   Similar to stretching or physiotherapy; reassess after 8–12 weeks.

NOT RECOMMENDED

Claiming yoga is uniquely healing or risk-free.

SEEK ASSESSMENT IF

Poses that bring on spreading leg pain, numbness or weakness, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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PILATES FOR LOWER BACK PAIN: HOW DOES IT COMPARE WITH OTHER EXERCISE?

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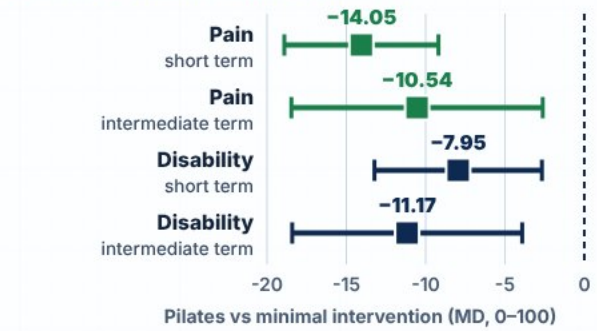
A · BREATHING SET-UP, SIDE



Breathing set-up: control before load

- Lying on the back, knees bent (knee **64°**): breathing and trunk awareness with the spine fully supported.
- Pilates reduced pain and disability compared with minimal intervention, with medium effects in the short term.

Pilates vs minimal intervention



10 trials, 510 participants. Yamato et al. (2015).

What Pilates is

Supervised mat or equipment exercise emphasising controlled movement, breathing, trunk and hip control, posture and flexibility, progressed in complexity and load. It is one form of therapeutic exercise, not a separate class of treatment.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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B · HEEL SLIDE, SIDE



Heel slide: one leg moves, the pelvis stays

- One heel slides away (knee **24°**, hip **12°**) while the trunk keeps the pelvis steady.
- In a dose trial, two sessions a week beat one for pain and disability; three added little more.
- The authors note attention and expectation may be part of the effect.

How many sessions a week?



296 adults with chronic LBP, 74 per group; instrument scales not named in the abstract. Miyamoto et al. (2018).

Efficient dose

Twice vs once weekly: pain −1.1 (−2.0 to −0.1), disability −2.8 (−4.5 to −1.1). Three sessions a week had a 0.78 probability of being cost-effective (Miyamoto et al., 2018).

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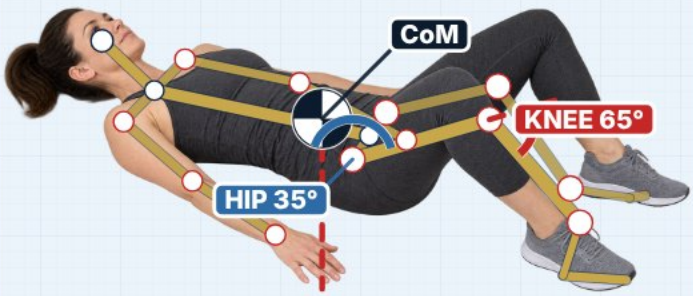
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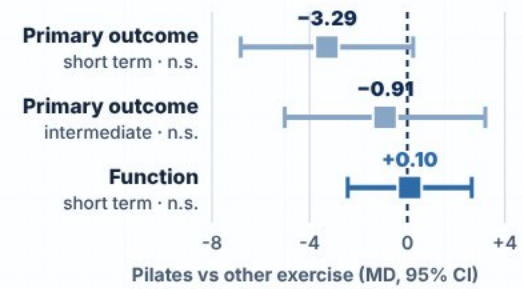
C · KNEE FALL-OUT, SIDE



Knee fall-out: controlled hip rotation

- One knee lowers out to the side (knee **65°**) while the pelvis resists rolling with it.
- Head to head, Pilates was **not clearly superior** to other exercise; network rankings place it high but do not show it is best for every person.

Pilates vs other exercise: no clear winner



4 trials; outcome name for the first two rows not recoverable from the abstract. Yamato et al. (2015).

Rankings vs head-to-head

A 118-trial network meta-analysis ranked Pilates first for pain (SUCRA 93%) and disability (98%), while most exercise types helped (Fernández-Rodríguez et al., 2022). A ranking is a probability of being "best", not proof of superiority.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

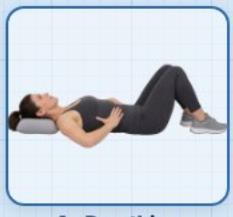
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A · Breathing
Control first



B · Heel slide
Steady pelvis



C · Knee fall-out
Hip rotation

Twice a week: an efficient dose



296 adults with chronic LBP; all groups received advice. Miyamoto et al. (2018).

Decision pathway

1. **A GOOD OPTION**
   Pilates helps compared with minimal care; choose it if the person prefers and can access it.
2. **ABOUT TWICE A WEEK**
   Two supervised sessions a week appeared efficient in one dose trial.
3. **NOT THE ONLY WAY**
   Other exercise types gave similar results head to head; adherence matters most.

NOT RECOMMENDED

Claiming Pilates is the best exercise for everyone, or that "core activation" is the mechanism.

SEEK ASSESSMENT IF

New bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

REFERENCES (APA 7)

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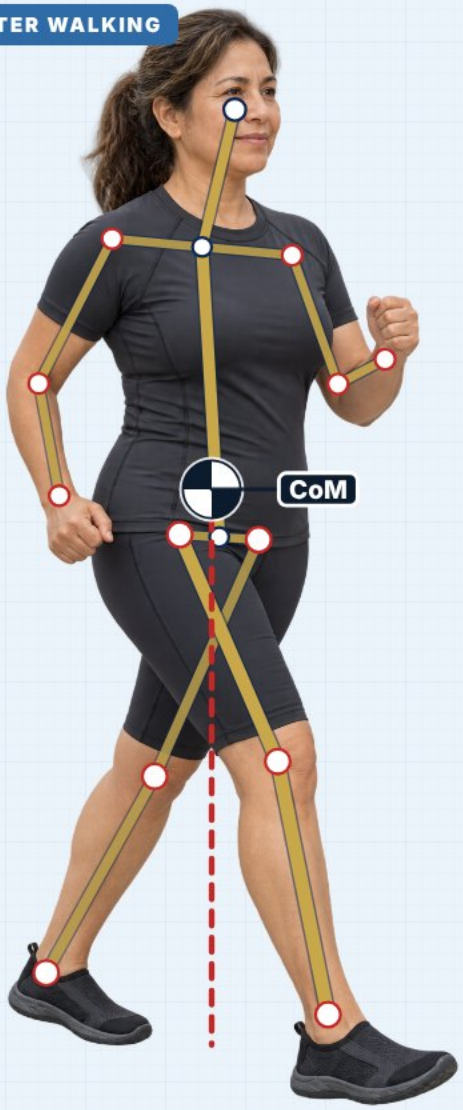
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

WATER-BASED EXERCISE FOR LOWER BACK PAIN: WHEN THE POOL MAY HELP

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A · WATER WALKING



Water walking: buoyancy lowers the load

- Buoyancy reduces effective body weight while water resistance still loads the muscles: useful when land exercise is hard to tolerate.
- Aquatic exercise reduced disability more than passive modalities (electrical stimulation and heat), and the gap widened over a year.

Pool exercise vs passive modalities



113 adults with chronic LBP, mean age 31; twice weekly for 3 months. Peng et al. (2022).

Limit: the comparator was passive care, so this shows pool exercise beats passive treatment, not that it beats land exercise.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Water reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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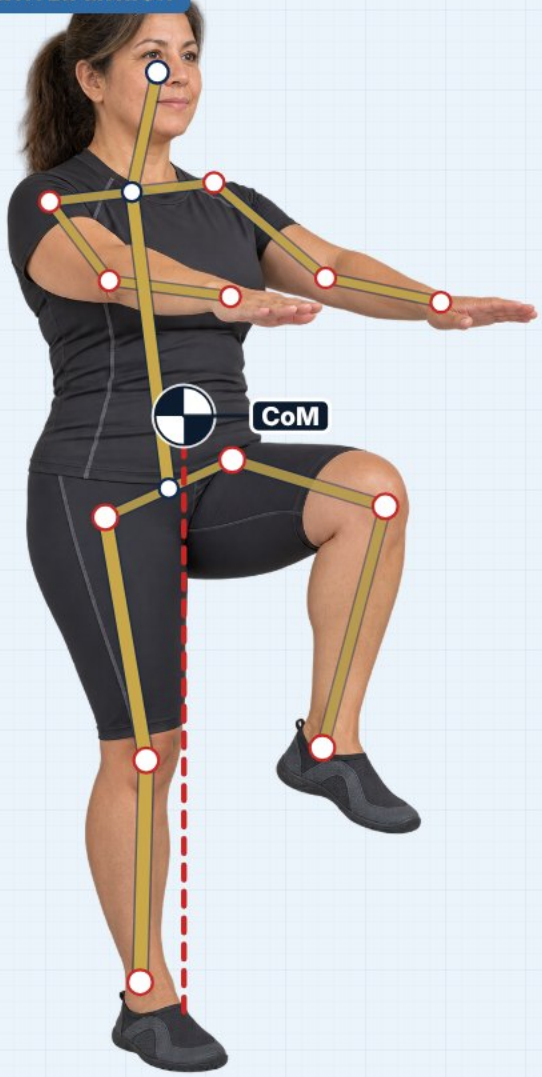
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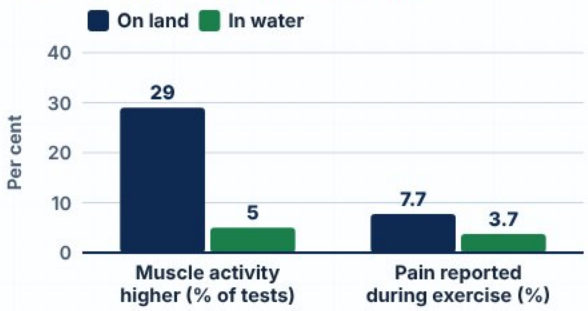
B · WATER MARCH



Water march: same exercise, lower demand

- Matched exercises on land and in water: heart rate was always higher on land, and muscle activity was higher on land in more comparisons.
- Pain was reported about half as often in water.
- Progress to land tasks when the goal is land-based function.

Water vs land: demand and pain



20 adults with chronic LBP and 20 healthy adults, 15 matched exercises. Psycharakis et al. (2019).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Water reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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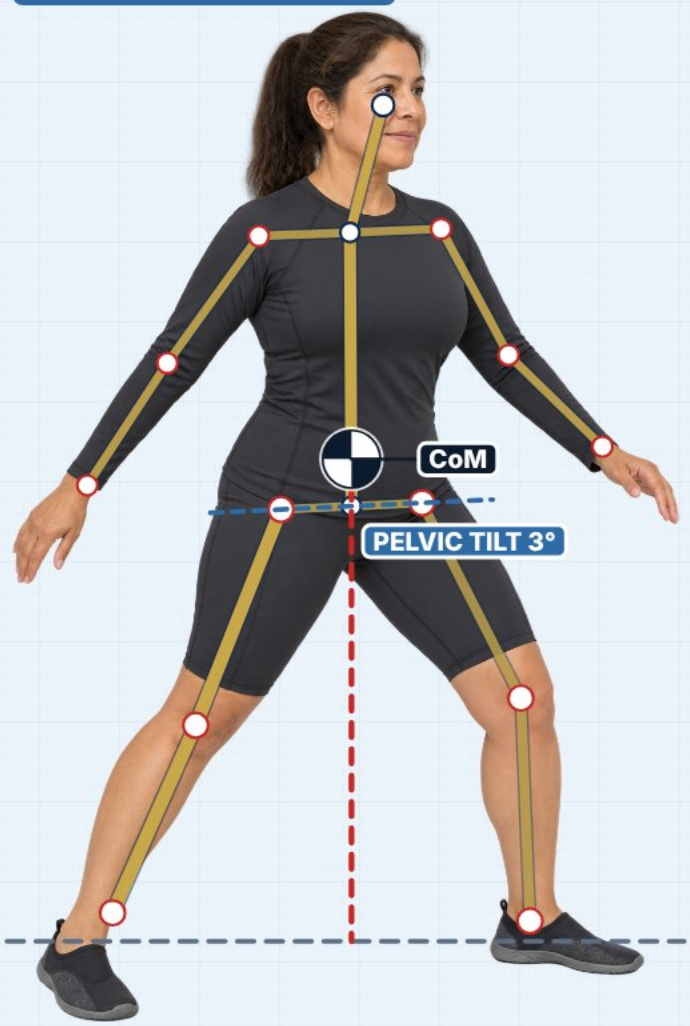
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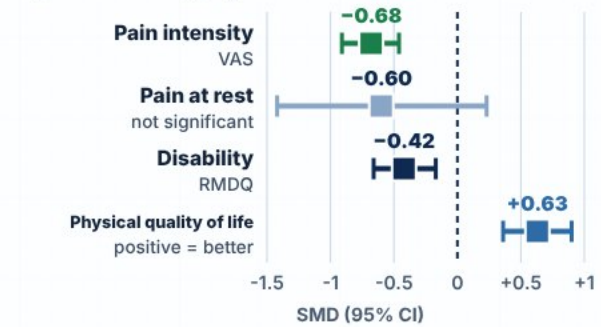
C · WATER SIDE STEP, FRONT



Side step: hips work against the water

- Stepping sideways, pelvis **3°** off level: the hip abductors push against water resistance with little impact.
- Pooled trials showed moderate improvements in pain and disability, with mixed comparators.

Aquatic therapy: pooled effects



13 trials, 597 patients with chronic LBP; comparators varied. Ma et al. (2022).

Who may benefit most: people with low tolerance to land loading, higher body mass or fear of movement, as a bridge back to land activity.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

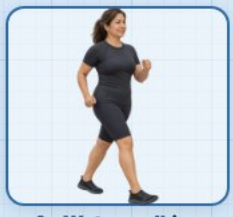
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A · Water walking
Less body weight

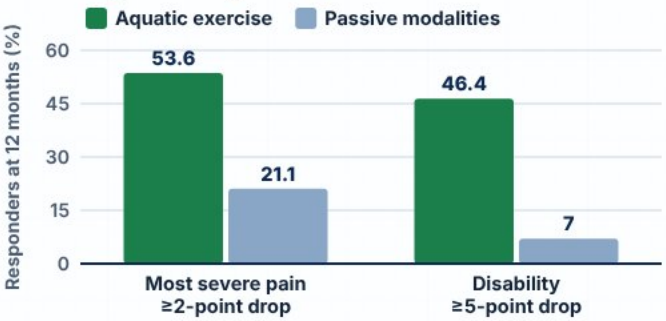


B · Water march
Lower demand



C · Side step
Hip work

Meaningful change at 12 months



113 adults; intervention-related pain events 1.8% vs 3.5%. Peng et al. (2022).

Decision pathway

1. **CONSIDER THE POOL**
When land exercise is poorly tolerated, or for higher body mass or fear of movement.

2. **KEEP IT ACTIVE**
Exercise in water, not passive soaking; it outperformed passive modalities.

3. **BRIDGE TO LAND**
Move to land-based tasks as tolerance grows if those are the person's goals.

NOT RECOMMENDED

Replacing active care with passive heat or electrical stimulation.

SEEK ASSESSMENT IF

Open wounds, uncontrolled heart disease or continence problems: get medical advice first. Also: new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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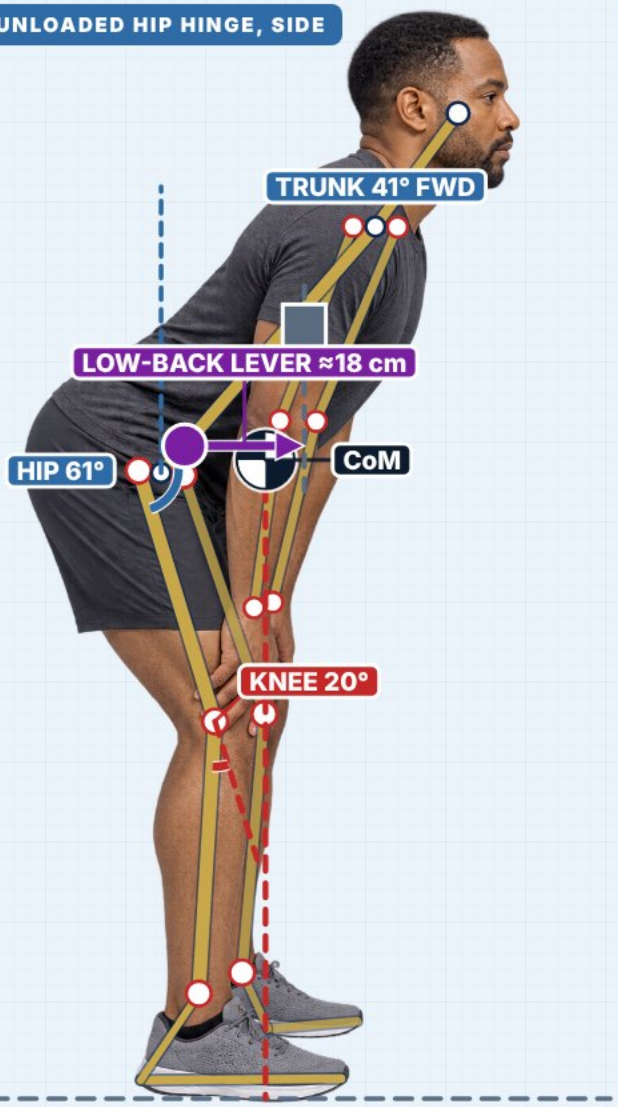
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DEADLIFTING WITH LOWER BACK PAIN: CAN IT BE PART OF REHABILITATION?

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A · UNLOADED HIP HINGE, SIDE



Unloaded hinge: learn the pattern first

- Hands to the thighs, trunk **41°**, hip **61°**, knee **20°**: the upper body alone gives lever **≈18 cm**, **≈76 N·m**.
- Posterior-chain resistance training (hip and back extensors, ≥6 weeks) helped disability and strength more than general exercise; adverse events did not differ.
- Longer programmes (12–16 weeks) did better than 6–8 weeks.

Posterior-chain strengthening: pooled effects



8 trials, 408 participants; pain interval reaches zero. Tataryn et al. (2021).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

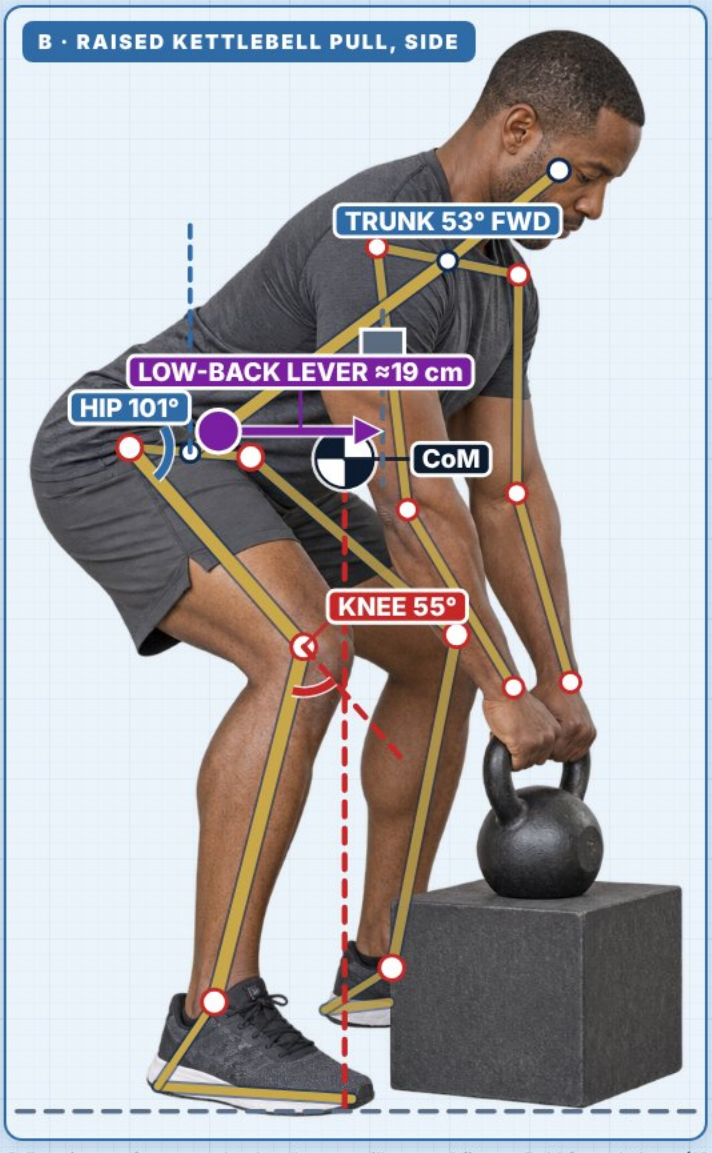
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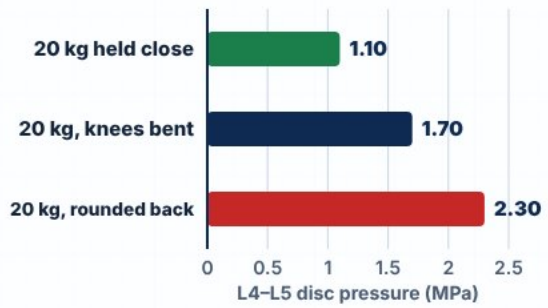
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Raised start: shorten the range, keep the pattern

- Kettlebell on a block: trunk **53°**, hip **101°**, knee **55°**; upper body lever ≈**19 cm**, ≈**78 N·m** before the bell is added.
- Raising the start height is the simplest regression; lowering it is a progression.
- Keeping the load close lowered measured disc pressure most in one volunteer.

Load distance and posture change spinal load



One healthy 45-year-old man, in vivo: illustrative only. Wilke et al. (1999).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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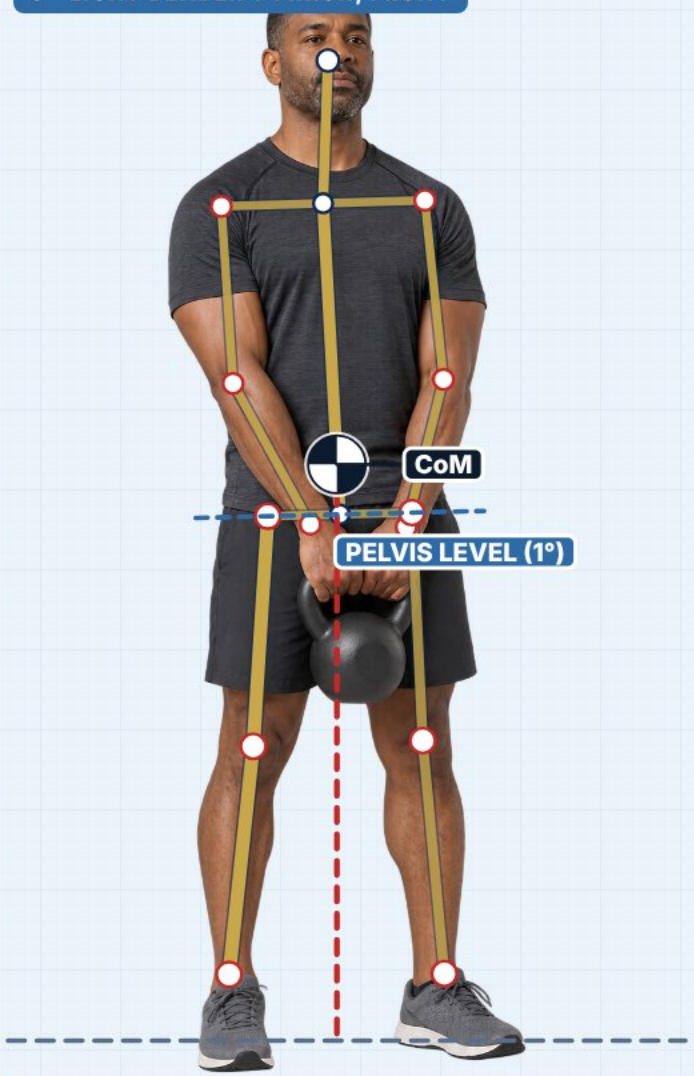
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C · LIGHT DEADLIFT FINISH, FRONT



Finish upright: who benefits most?

- Standing tall with the bell, pelvis level (**1°**): the load returns to a stacked spine at lockout.
- In 35 adults with mechanical LBP, those with **higher back-extensor endurance** and **lower pain** at baseline benefited most from 8 weeks of deadlift training (Berglund et al., 2015).
- Spinal tissues adapt to load over time; rehabilitation scales the load to the person.

What trained lifters tolerate

57 competitive powerlifters; modelled loads in competition. Sumo stance lowered the L4/L5 moment by 10% and shear by 8% vs conventional.

≈17,200 N
average L4/L5 compression, up to

988 N·m
highest average L4/L5 moment

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Stats: Cholewicki, McGill & Norman (1991). Educational, not diagnostic.

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A · Hinge pattern
≈76 N·m

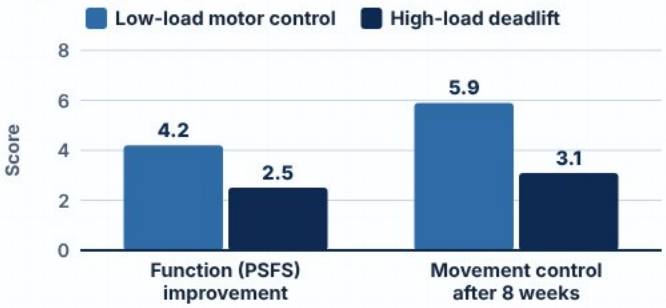


B · Raised start
Shorter range



C · Finish
Stacked spine

A good option, not the best for everyone



70 people with recurrent LBP; pain, strength and endurance improved equally in both groups. Aasa et al. (2015).

Decision pathway

1. **SELECT**
   Lower pain and reasonable back-extensor endurance predicted benefit; avoid maximal loads in a flare.
2. **COACH AND RAISE**
   Teach the hinge unloaded, start from a raised height, keep the load close.
3. **PROGRESS 12–16 WEEKS**
   Increase load, then lower the start height, guided by the next-day response.

NOT RECOMMENDED

Maximal or fast loading during a flare; the deadlift as compulsory for everyone.

SEEK ASSESSMENT IF

New leg pain, numbness or weakness after lifting; known osteoporosis (see Title 19); or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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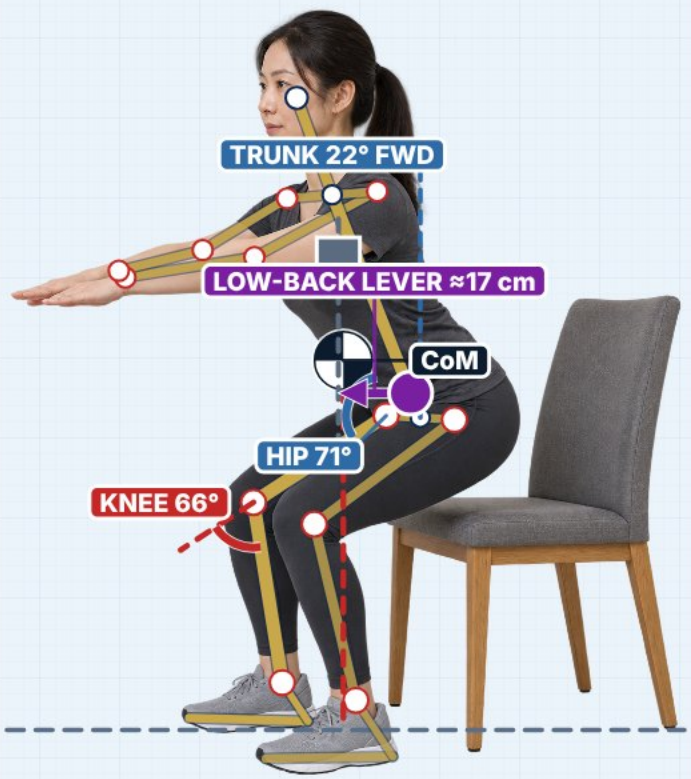
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SQUATS WITH LOWER BACK PAIN: ADJUSTING DEPTH, LOAD, AND SUPPORT

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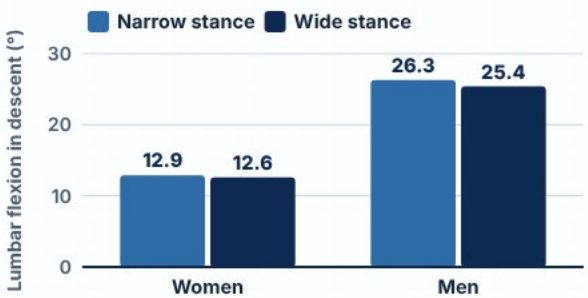
A · CHAIR SQUAT, SIDE



Chair squat: the seat sets the depth

- Trunk **22°** forward, hip **71°**, knee **66°**, arms forward: lever **≈17 cm**, **≈66 N·m**.
- A chair or box gives a consistent, adjustable depth; raise it to regress, lower it to progress.
- Some lumbar flexion is normal in a loaded squat and varies between people.

How much does the lumbar spine flex in a squat?



30 trained adults carrying 50% body weight; men flexed more than women ($P < .05$). McKean, Dunn & Burkett (2010).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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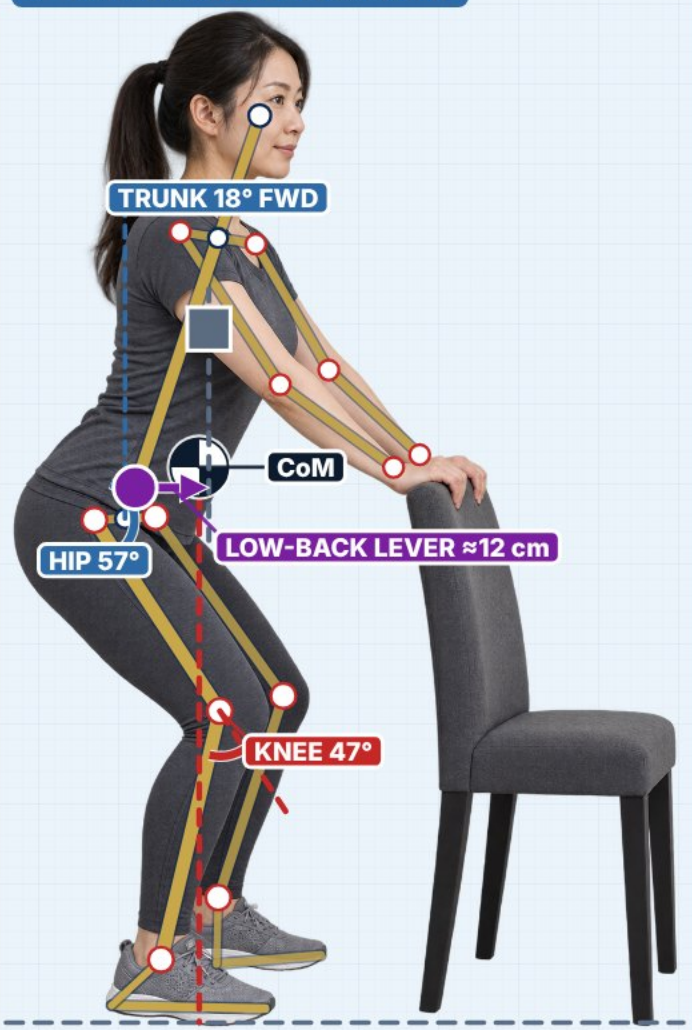
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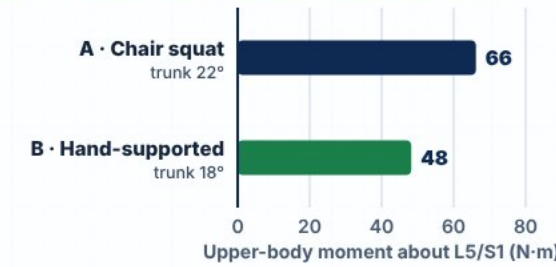
B · HAND-SUPPORTED SQUAT, SIDE



Hand support: a more upright squat

- Holding a chair back, trunk **18°**, hip **57°**, knee **47°**: lever **≈12 cm**, **≈48 N·m**.
- Support lets the trunk stay more upright and shares the load through the arms, a useful early option.
- Change one variable at a time: depth, load, load position, support, tempo or volume.

Support lowered the low-back moment



MMSx 2-D analysis of frames A and B; 70 kg adult, static, no hand load; arm support not subtracted.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

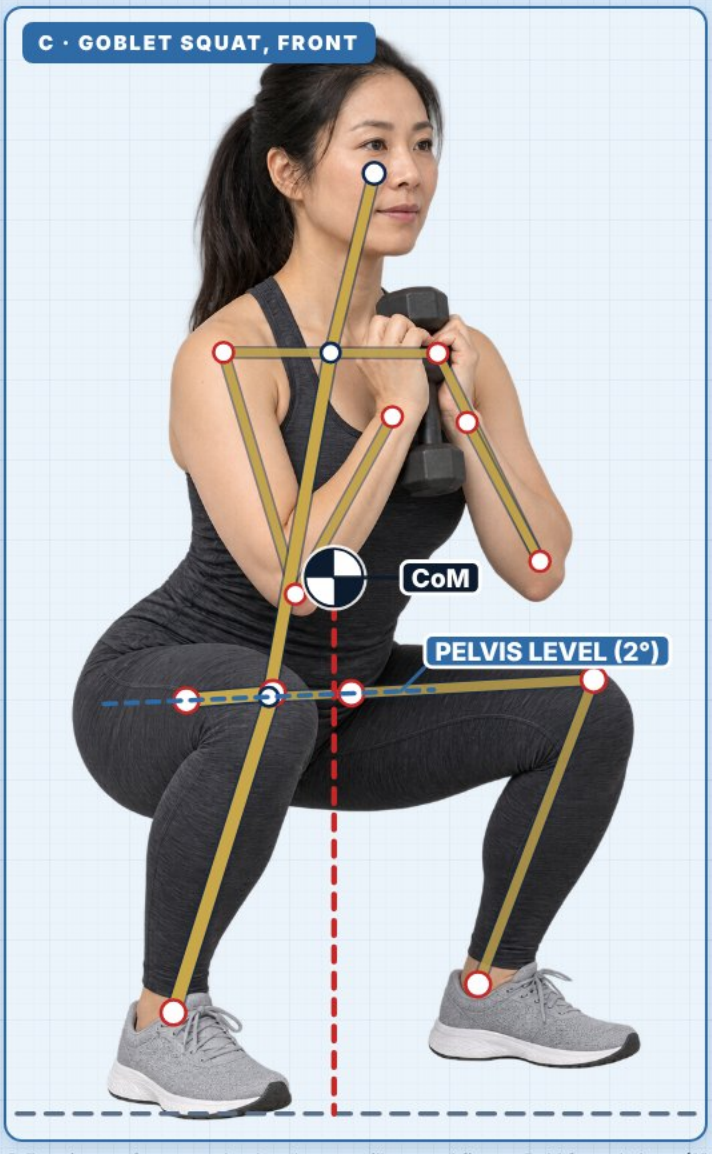
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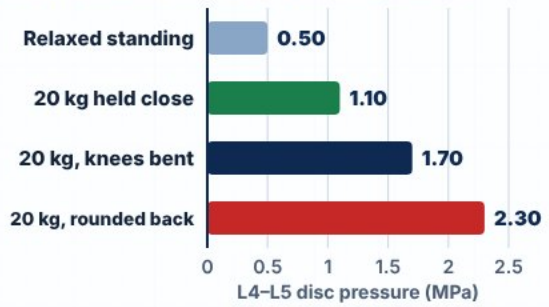
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Goblet squat: load held close

- Deep squat (knees ≈**112°**) with the weight held at the chest, pelvis level (**2°**): the load sits close to the spine.
- Keeping a load close lowered measured disc pressure in one volunteer.
- In healthy adults, heavy parallel squats changed lower-disc water signal more than half squats (Yanagisawa et al., 2021): depth is a dose lever under heavy load.

Load position changes spinal demand



One healthy volunteer: illustrative only. Wilke et al. (1999).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Front view: knee angle approximate. Pelvic tilt from left and right hip points. Educational, not diagnostic.

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A · Chair squat
≈66 N·m



B · Supported
≈48 N·m



C · Goblet
Load close

Progressive strength work: 12–16 weeks



8 trials, 408 participants; longer programmes did better. Tataryn et al. (2021). Single-group 16-week squat-based study: Welch et al. (2015).

Decision pathway

1. **PICK THE DEPTH**
   Use a box or chair; raise it to regress, lower it to progress.
2. **PICK THE SUPPORT**
   Hand support → free squat → goblet → barbell, as tolerance grows.
3. **ONE CHANGE AT A TIME**
   Depth, load, position, tempo or volume; review the next-day response.

NOT RECOMMENDED

Insisting on one "perfect" spinal position; fixed recovery dates.

SEEK ASSESSMENT IF

Leg pain, pins and needles or weakness brought on by squatting, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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Analysis: MMSx Authority Applied Biomechanics Lab · Dr. Neeraj Mehta, PhD · Educational content, not a diagnosis.

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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

RUNNING WITH CHRONIC LOWER BACK PAIN: WHAT THE ASTEROID TRIAL FOUND

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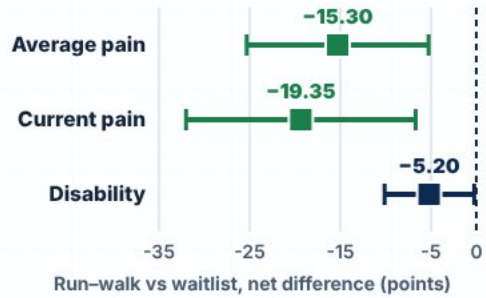
A · WALKING INTERVAL



Walk intervals: the starting point

- The programme alternated short running bouts with walking recovery, three 30-minute sessions a week for 12 weeks, supported remotely.
- Compared with a waitlist, run–walk training improved pain and disability; no one dropped out and adherence was 70%.
- **Who was studied:** 40 adults aged 18–45 with non-specific chronic LBP.

ASTEROID: 12-week run–walk vs waitlist



Scale ranges not stated in the abstract (reported as points). Neason et al. (2025a).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Walking reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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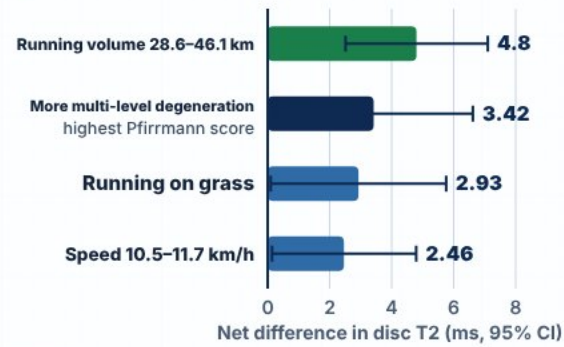
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Easy jog: what happened to the discs?

- MRI disc T2 (a marker of disc water and composition) was measured at 0, 6 and 12 weeks.
- Higher running volume, moderate speed and softer surfaces "may be associated with" more favourable T2 change: a secondary analysis, not proof of disc repair.
- Habitual loading around slow-running speeds (~2 m/s) was linked with better disc characteristics in a cross-sectional study (Belavý et al., 2017).

Which running factors went with better disc T2?



ASTEROID secondary analysis; moderator subgroups. Samanna et al. (2026).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Jogging reference image (oblique view): joint angles not reported. Educational, not diagnostic.

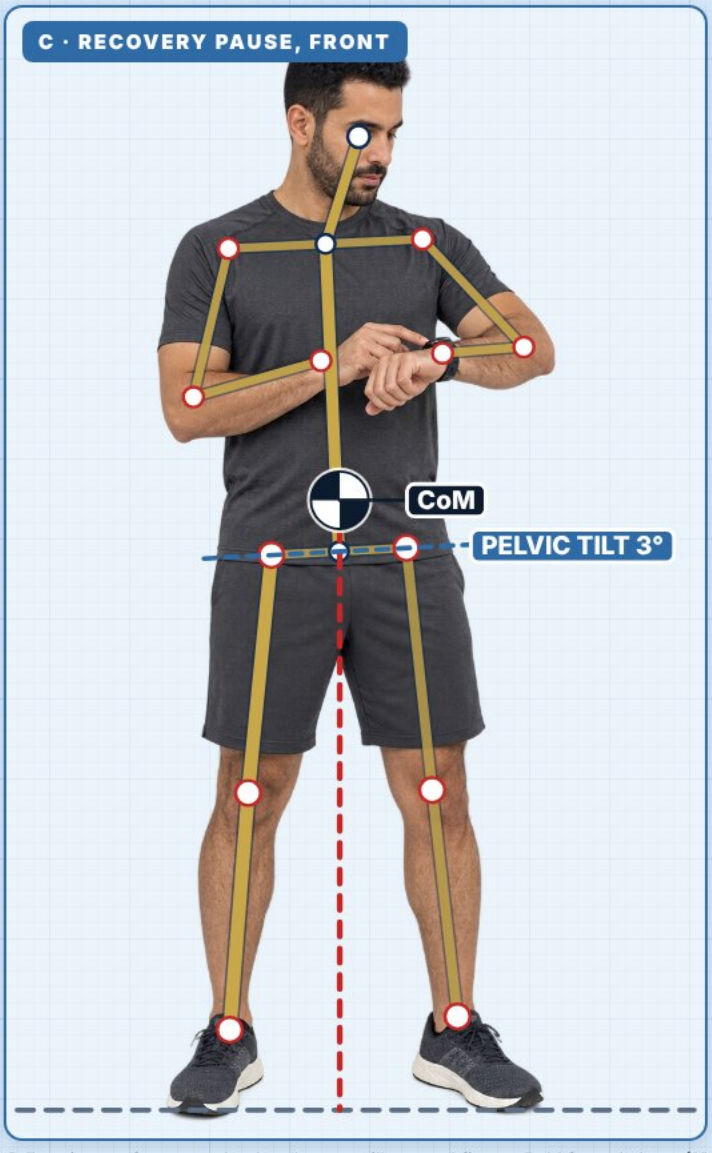
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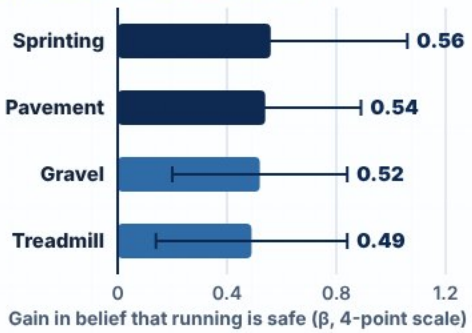
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Recovery pause: beliefs changed too

- Standing pause, pelvis **3°** off level: walking recovery between run bouts.
- At the start, 1 in 4 participants believed running was unsafe for their back.
- After 12 weeks, the running group believed running was safer than controls did, across surfaces and speeds.

Running beliefs after 12 weeks



Activity-specific beliefs questionnaire; between-group β (95% CI). Neason et al. (2025b).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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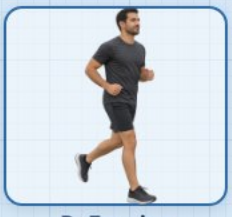
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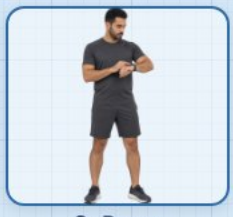
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A · Walk interval
Walk-dominant start

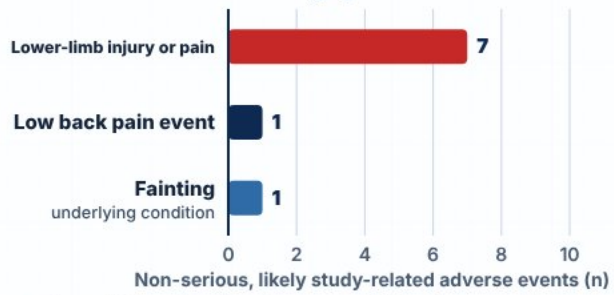


B · Easy jog
Add running time



C · Pause
Recovery built in

The main risk was to the legs, not the back



9 non-serious, likely study-related events over 12 weeks; no attrition.
Neason et al. (2025a).

Decision pathway

1. **SELECT**
   An option for adults with non-specific chronic LBP who want to run; not tested in older adults or radicular pain.
2. **START WALK-HEAVY**
   Short run bouts with longer walks, three times a week; add running time gradually.
3. **WATCH THE LEGS**
   Most adverse events were lower-limb: progress volume slowly and vary surfaces.

NOT RECOMMENDED

Telling everyone with back pain not to run; jumping straight to continuous running.

SEEK ASSESSMENT IF

Chest pain or fainting, new leg pain or nerve symptoms, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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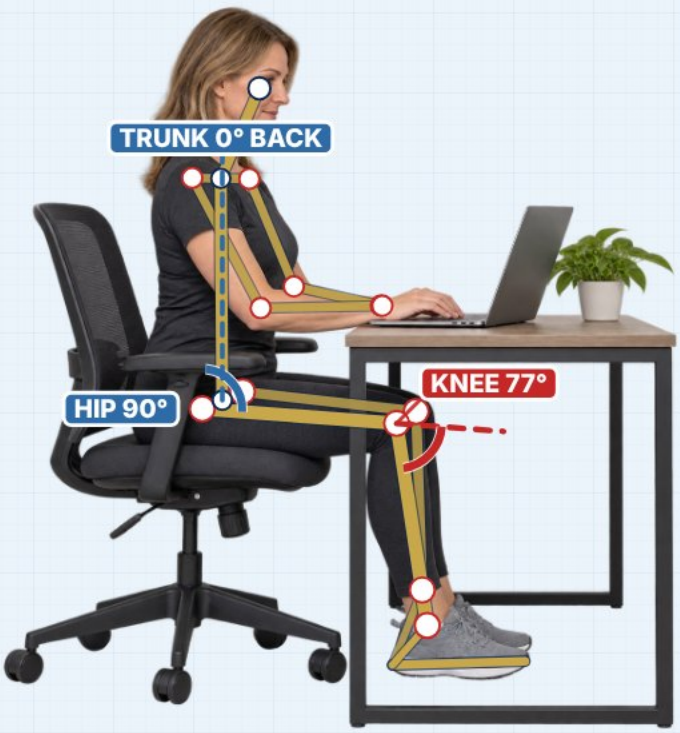
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DESK WORK AND LOWER BACK PAIN: BUILDING MOVEMENT INTO YOUR WORKDAY

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A · SEATED WORK, SIDE



Seated work: not the villain it is made out to be

- Upright at the desk: trunk **0°**, hip **90°**, knee **77°**.
- A systematic review found that all but one study failed to show a positive association between sitting at work and LBP.
- Discomfort with long, static positions is real: the answer is variation, not a perfect chair.

Is sitting at work linked with LBP?



35 reports, 1985–1997; 8 higher-quality studies. Hartvigsen et al. (2000).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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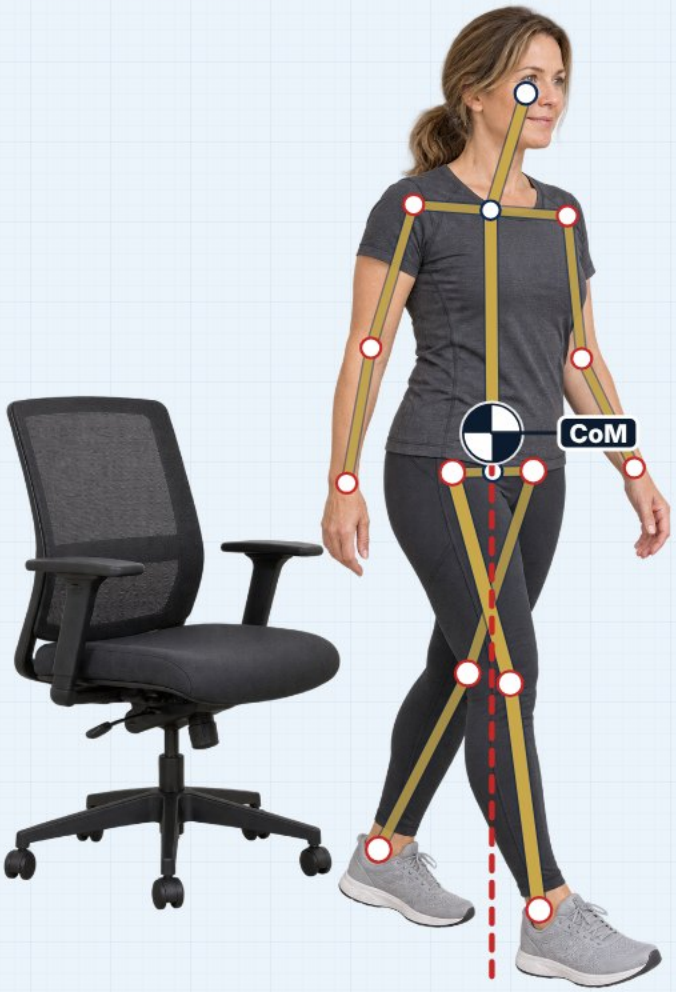
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B · STANDING BREAK



Standing break: easy to add, easy to repeat

- Workplace changes removed meaningful sitting time; frequent short breaks beat two long ones.
- The outcome here is sitting time, not pain; few studies followed people beyond 3 months.

How much sitting do workplace changes remove?



34 studies, 3,397 workers; low-certainty evidence. Shrestha et al. (2018).

Simple rule: stand, walk or change position every 30 minutes or so; set a reminder.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Standing reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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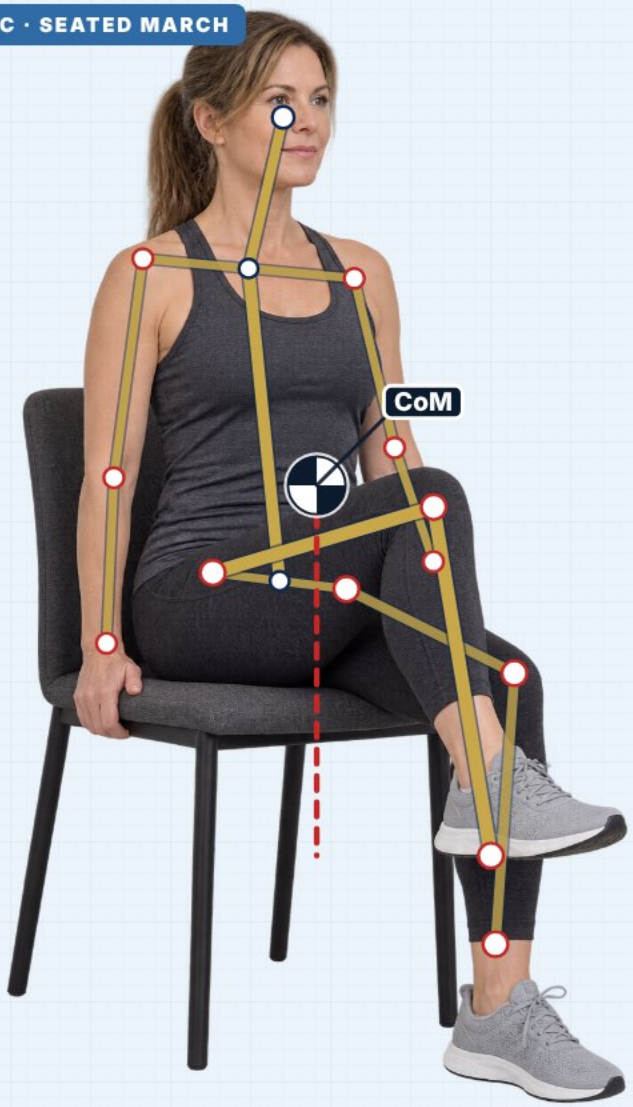
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C · SEATED MARCH



Seated march: movement without leaving the desk

- Alternate knee lifts while seated keep the hips moving between tasks.
- In 46 employees with chronic LBP, access to a sit-stand workstation was linked with lower current and worst back pain over 3 months (Ognibene et al., 2016).

Sit-stand workstations and low back discomfort

8 studies pooled, mainly office workers (including pain-free samples); no CIs in the abstract.

SMD −0.23
low back discomfort

0.3–0.5
points less on a 10-point scale

Myth: "sitting at a desk causes back pain." Studies largely did not find this; static posture is uncomfortable, so vary it.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Stats: Agarwal, Steinmaus & Harris-Adamson (2018). Educational, not diagnostic.

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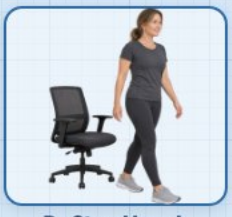
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A · Seated work
Fine, for a while

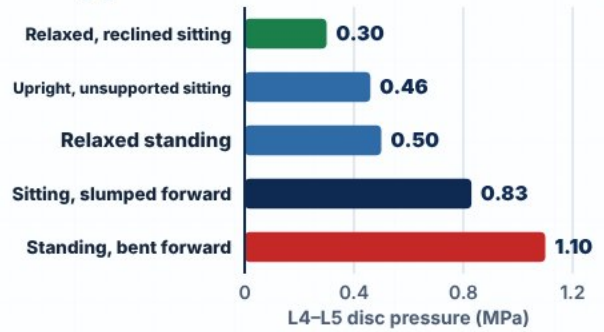


B · Stand break
Every ~30 min



C · Seated march
Move in place

Desk-day positions: each loads the disc differently



One healthy volunteer: changing position may help disc nutrition. Wilke et al. (1999).

Decision pathway

1. **VARY POSITION**
   Sit, stand and walk across the day; no single posture is protective.
2. **BREAK OFTEN**
   Short breaks every ~30 minutes beat two long breaks for cutting sitting time.
3. **KEEP ACTIVE**
   Exercise and general activity remain the core of care; the desk is a helper, not a cure.

NOT RECOMMENDED

Promising that a chair or desk will cure back pain; labelling sitting as damaging.

SEEK ASSESSMENT IF

Persistent leg symptoms, night pain with feeling unwell, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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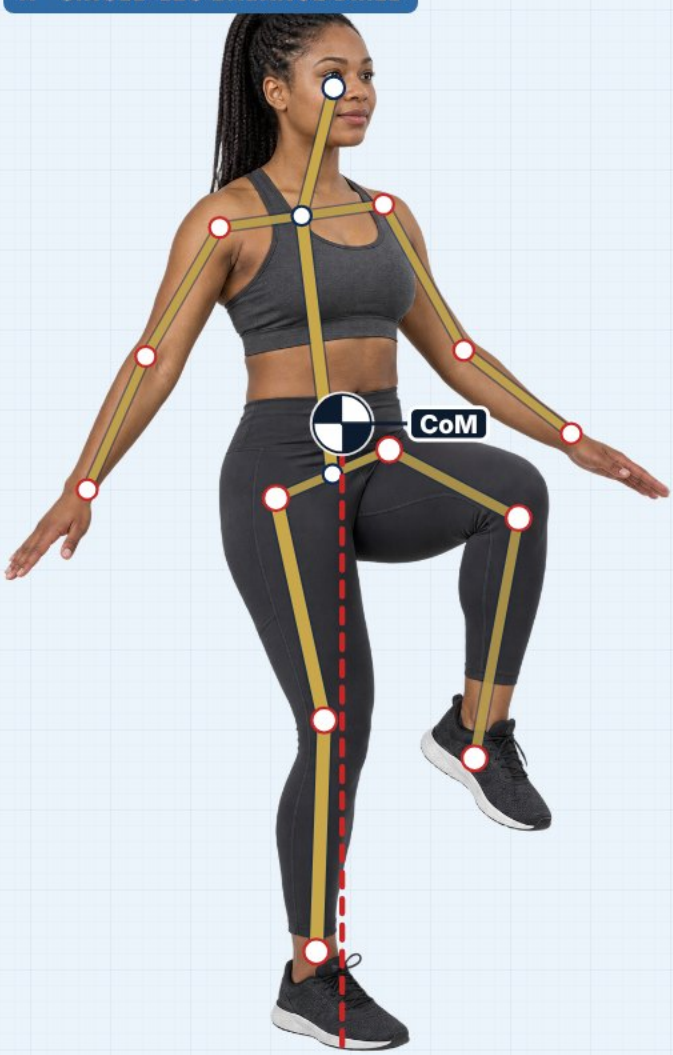
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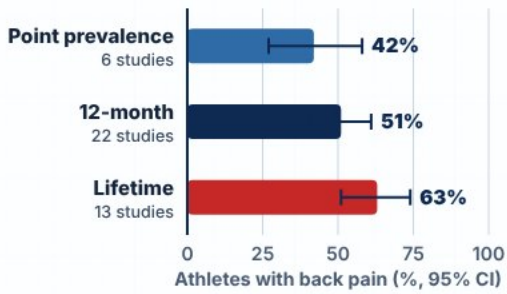
A · SINGLE-LEG BALANCE DRILL



Balance drill: control before speed

- Single-leg balance with arm and trunk movement: an early step towards sport-specific control.
- Back pain is common in athletes; heterogeneity between studies was very high, so treat these as broad estimates.
- Return to sport means rebuilding the specific demands of the game: running, jumping, twisting, lifting, contact.

How common is back pain in sport?



86 studies, 30,732 athletes; 17 studies gave no definition of back pain. Wilson et al. (2021).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Oblique reference image: joint angles not reported. Educational, not diagnostic.

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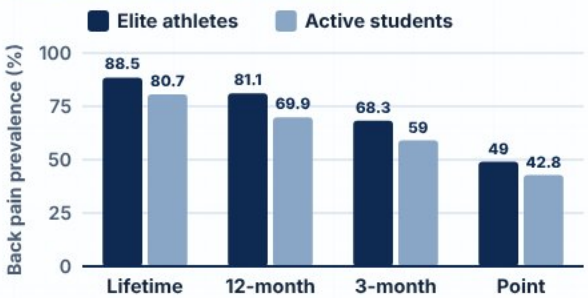
B · SHALLOW SPLIT SQUAT, SIDE



Split squat: load in a sport-like stance

- Front hip **51°**, knee **56°**, trunk upright (**3°**): single-leg strength in a staggered stance.
- Elite athletes reported more back pain than physically active students, consistent with higher training load.
- Build training volume (sessions, minutes, throws, jumps) before intensity and contact.

Elite athletes vs active students



1,114 German elite athletes vs 166 sports students; point-prevalence difference not reported as significant. Fett, Trompeter & Platen (2017).

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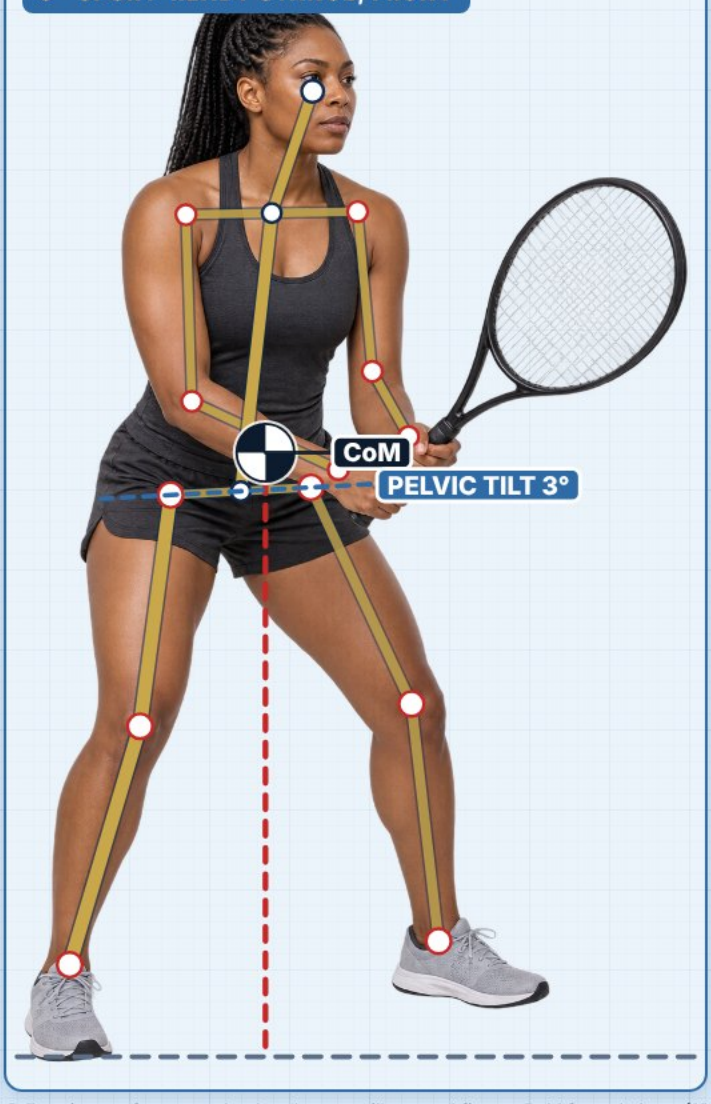
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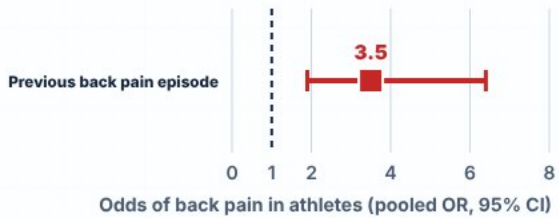
C · SPORT-READY STANCE, FRONT



Sport-ready: readiness is more than "no pain"

- Athletic stance with the racket, pelvis **3°** off level: the final stage rehearses the real movements of the sport.
- A previous episode was the main risk factor for back pain in athletes, so keep the conditioning going after symptoms settle.
- Exercise reduced pain and improved function in athletes, but no trial reported how it affected return to sport (Thornton et al., 2021).

The strongest risk factor



Pooled across studies; individual ORs 1.6–4.0. Wilson et al. (2021).

Young athlete with extension-related pain? Consider assessment for a pars stress injury (spondylolysis).

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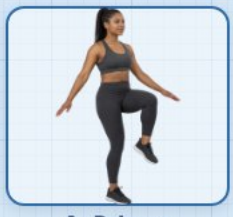
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RETURNING TO SPORT AFTER LOWER BACK PAIN: REBUILDING THE DEMANDS OF YOUR GAME

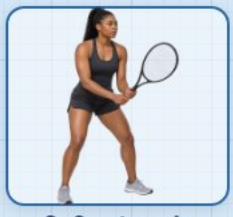
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A · Balance
Control first

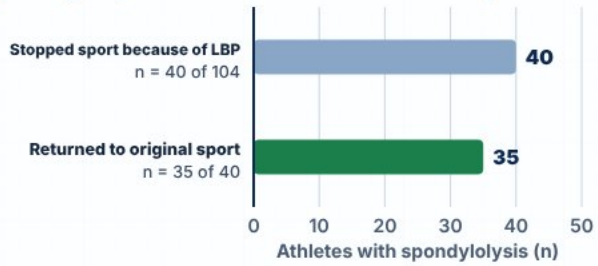


B · Split squat
Sport-like load



C · Sport-ready
Rehearse the game

Spondylolysis: most returned to their sport



Case series, conservative care with bracing; mean return 5.4 months (range 1.0–11.5). A specific diagnosis, not a template. Iwamoto, Takeda & Wakano (2004).

Decision pathway

1. **REBUILD THE DEMANDS**
   Progress the sport's own tasks (running, jumping, twisting, lifting, contact) as tolerated.
2. **VOLUME, THEN INTENSITY**
   Sessions and minutes first, then speed, load and contact; share decisions with coach and athlete.
3. **KEEP CONDITIONING**
   A previous episode raises the odds of another: continue capacity work after return.

NOT RECOMMENDED

Fixed return dates; passive treatment alone.

SEEK ASSESSMENT IF

Persistent extension-related pain in a young athlete, night pain, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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Analysis: MMSx Authority Applied Biomechanics Lab · Dr. Neeraj Mehta, PhD · Educational content, not a diagnosis.

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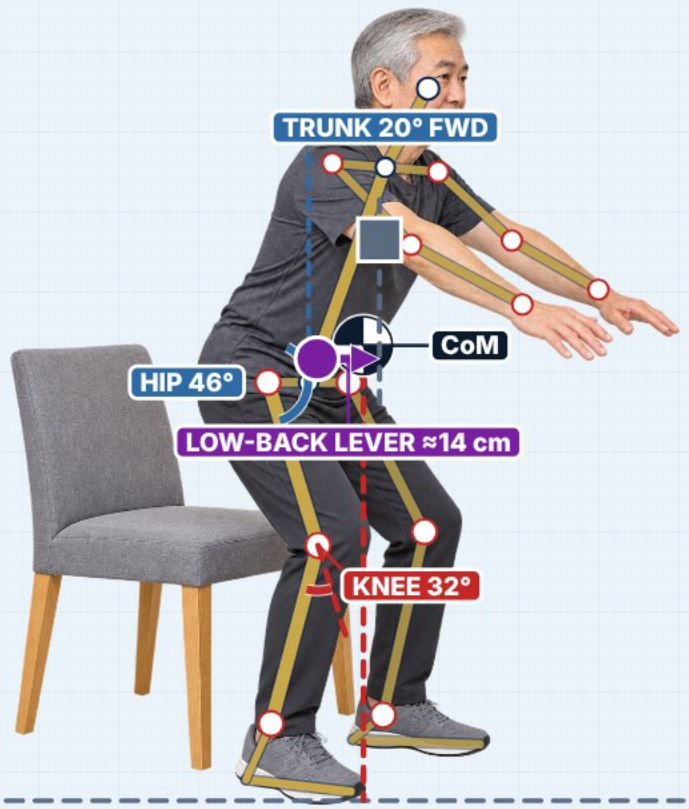
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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

LOWER BACK PAIN AFTER 60: BUILDING STRENGTH, WALKING CAPACITY, AND INDEPENDENCE

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A · CHAIR STRENGTH, SIDE



Chair strength: the foundation of independence

- Rising from a chair: trunk **20°** forward, hip **46°**, knee **32°**; lever **≈14 cm**, **≈59 N·m**.
- In adults aged 60 and over, exercise reduced pain and disability and improved quality of life.
- Programmes of 12 weeks or more, at least 3 times a week, appeared most effective.

Exercise works after 60



18 trials, 989 participants aged ≥60; SF-36 physical +7.07, mental +7.88. Zhang et al. (2023).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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B · DAILY WALK



Daily walk: capacity for the life you want

- Set goals around valued tasks: walking distance, stairs, carrying shopping, lifting grandchildren.
- In adults aged 70–79, back pain went with **perceived** difficulty in daily tasks more than with measured performance (Weiner et al., 2003): confidence is part of the target.
- In a trial of adults ≥65, a mind–body programme added a small early gain in function that faded by 6 months; both groups improved.

Mind–body vs health education (adults ≥65)



282 adults, mean age 74.5; extra difference −1.1 at 8 weeks. Morone et al. (2016).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Walking reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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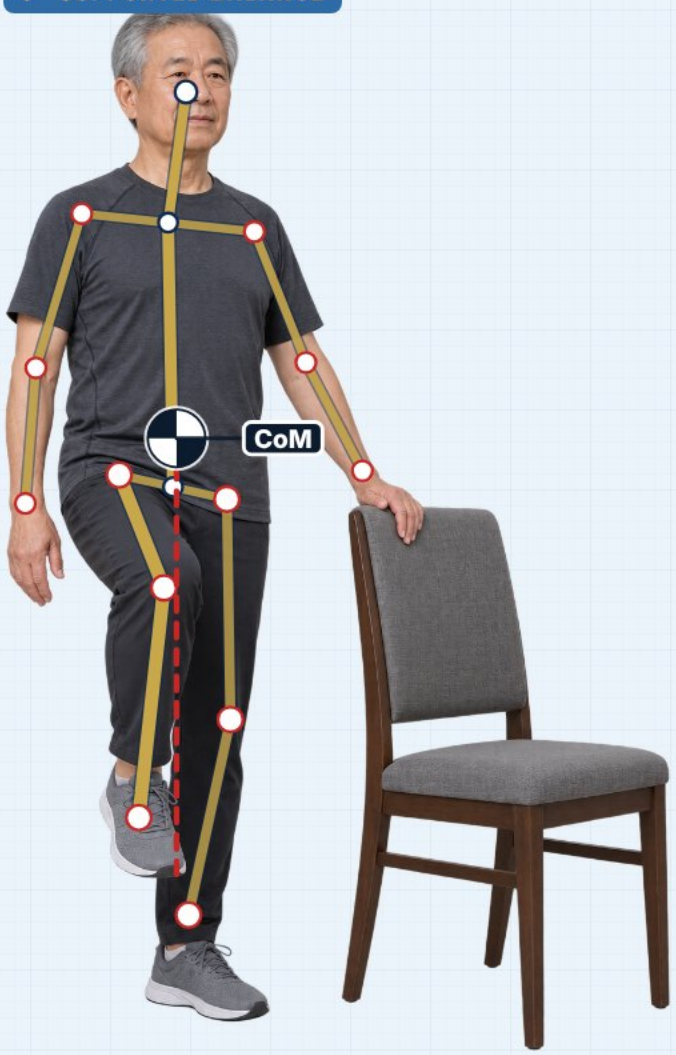
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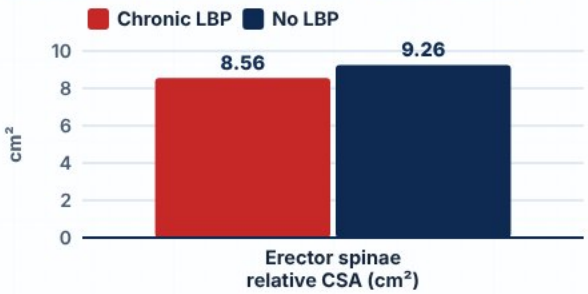
C · SUPPORTED BALANCE



Supported balance: train safely, with a hand nearby

- Single-leg balance beside a chair: falls prevention matters when bone or balance is a concern (see Title 19).
- Older adults with chronic LBP had smaller back-extensor muscle area; up to half of trunk-muscle area may be fat in later life.
- Muscle quality is a modifiable training target, not proof that weakness caused the pain.

Back-extensor muscle size (older adults)



102 older adults, MRI L2–L5, adjusted for age, sex and BMI; psoas and quadratus lumborum did not differ. Sions et al. (2017).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Oblique reference image: joint angles not reported. Educational, not diagnostic.

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A · Chair strength
≈59 N·m



B · Daily walk
Valued goals



C · Balance
Hand nearby

Older adults are under-represented in trials



274 RCTs, 1992–2010; pooled mean participant age 44.3 years; no change over two decades. Paeck et al. (2014).

Decision pathway

1. **SET PERSONAL GOALS**
   Stairs, walking distance, lifting, independence: build the programme around them.
2. **DOSE IT**
   ≥12 weeks, ≥3 sessions a week: strength, walking and balance, progressed gradually.
3. **ADAPT TO HEALTH**
   Osteoporosis, falls risk, heart disease and medicines shape the plan, not age alone.

NOT RECOMMENDED

Assuming age rules out strengthening; relying on scan findings that are common with age.

SEEK ASSESSMENT IF

New pain with a cancer history, weight loss, fever, a minor fall with osteoporosis, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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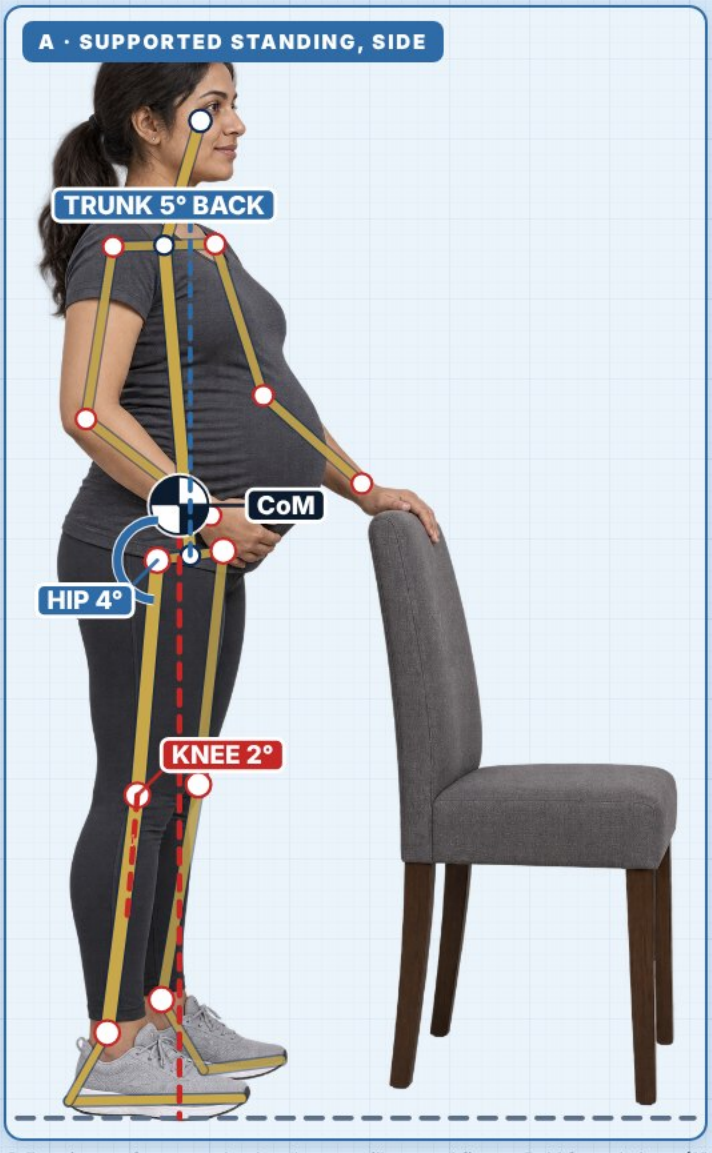
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LOWER BACK PAIN DURING PREGNANCY: MOVEMENT OPTIONS AND WHEN TO GET ASSESSED

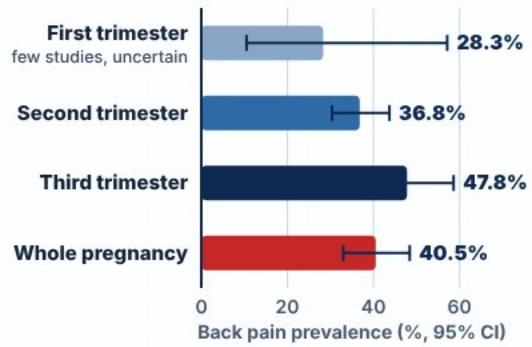
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Lumbar pain or pelvic girdle pain?

- Standing with a hand on a chair, trunk **5°** behind vertical: the growing front load is balanced by leaning back slightly.
- **Lumbar pain** sits above the sacrum; **pelvic girdle pain** sits between the back of the pelvis and the buttock crease, or at the pubic bone. They are assessed differently.
- Back pain became more common as pregnancy advanced.

Back pain across pregnancy



Global meta-analysis to 2023; association with advancing pregnancy, not proof of a purely mechanical cause. Salari et al. (2023).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Trunk angle from shoulder and hip points. Educational, not diagnostic.

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B · SIDE-LYING REST



Side-lying: rest and supported exercise

- Side-lying with pillows is a comfortable rest position and a base for adapted hip and trunk exercise.
- Prenatal exercise was linked with **less severe** pain (SMD −1.03) but did **not** reduce the odds of developing pain.

Prenatal exercise: what it changes

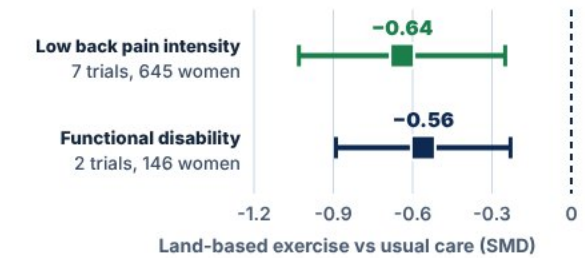
32 studies, 52,297 pregnant women; very low to moderate quality.

SMD −1.03
pain severity in pregnancy and early postpartum

No change
in the odds of getting back or pelvic pain

So: exercise helps manage symptoms and stay active; pain in pregnancy is not a sign of "failing" to exercise.

Land-based exercise in pregnancy (Cochrane)



Low-quality evidence. Liddle & Pennick (2015).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Stats: Davenport et al. (2019). Educational, not diagnostic.

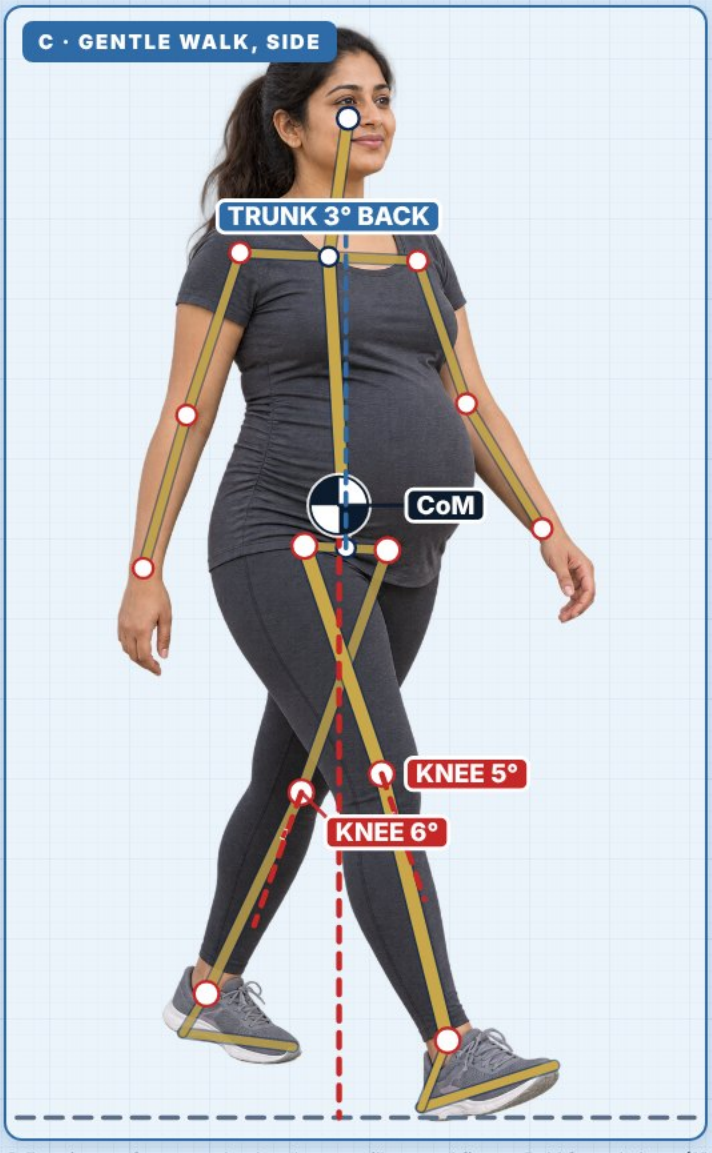
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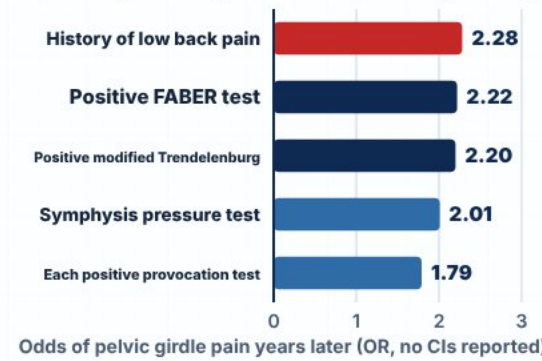
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Gentle walking: stay active, adapt the dose

- Walking, stationary cycling and water-based exercise are common options, adjusted to symptoms and obstetric advice.
- Pelvic pain-provocation findings in pregnancy helped flag women at risk of long-term pelvic girdle pain: 10% still had it up to 11 years later.

Pregnancy findings and long-term pelvic pain



371 women from three Swedish trials, followed up to 11 years. Elden et al. (2016).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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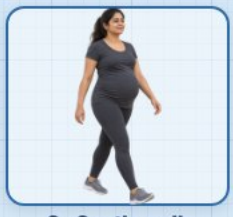
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A · Supported standing
Lumbar or pelvic?

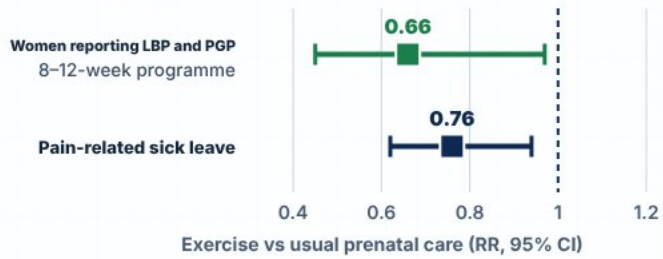


B · Side-lying
Rest and adapt



C · Gentle walk
Stay active

Exercise programmes reduced pain and sick leave



4 trials (1,176 women) and 2 trials (1,062); moderate-quality evidence.
Liddle & Pennick (2015).

Decision pathway

1. **LOCATE THE PAIN**
   Lumbar, pelvic girdle or both: pelvic provocation tests help tell them apart.
2. **STAY ACTIVE, ADAPTED**
   Supervised land-based exercise, walking, cycling or water work, guided by symptoms and obstetric advice.
3. **FOLLOW UP PGP**
   Several positive pelvic tests or earlier back pain: plan closer follow-up after birth.

NOT RECOMMENDED

Promising that exercise will prevent pregnancy back pain.

SEEK ASSESSMENT IF

Fever, vaginal bleeding or fluid loss, regular tightenings, urinary or flank pain, one-sided calf swelling, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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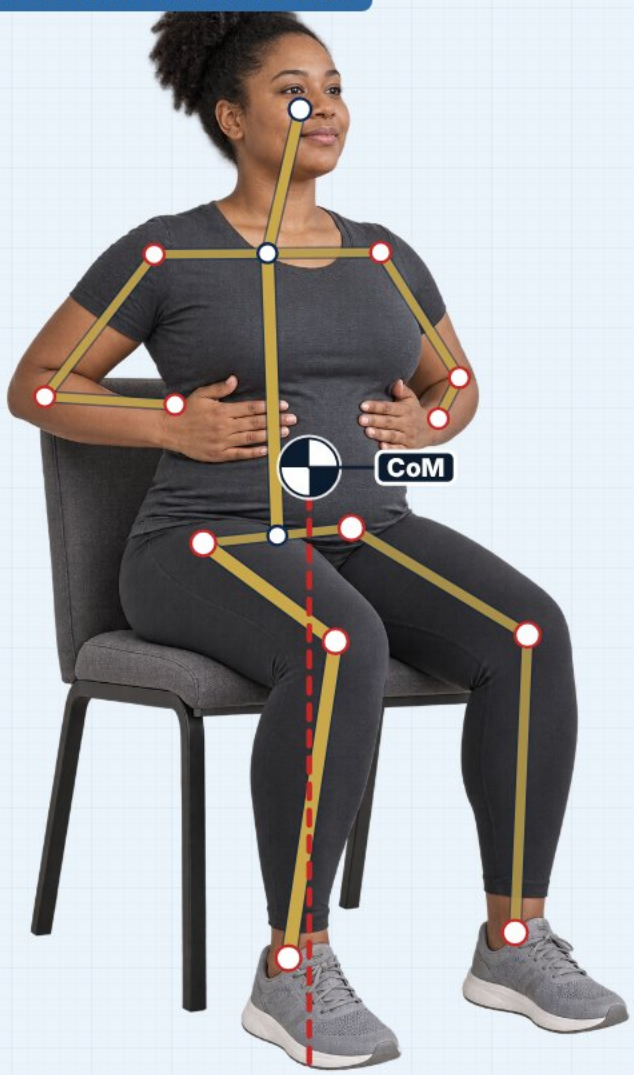
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POSTPARTUM LOWER BACK PAIN: REBUILDING CAPACITY FOR LIFTING AND DAILY CARE

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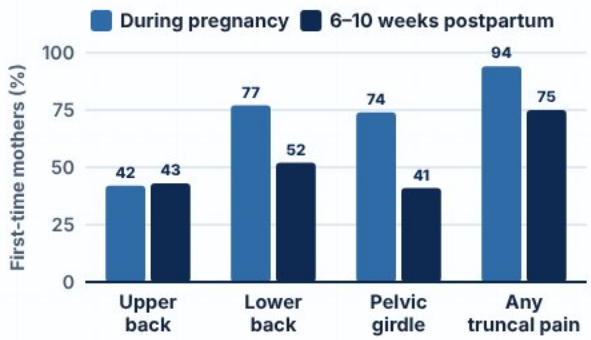
A · SUPPORTED SEATED REST



Where it hurts changes after birth

- Seated rest with back support: feeding and settling postures are sustained for long periods in the early weeks.
- Lower back and pelvic girdle pain usually fell after delivery; upper back pain did not, consistent with new feeding and carrying postures (association only).

Pain locations: pregnancy vs 6–10 weeks after



288 first-time mothers, US cohort. Dunn et al. (2019).

Most improve, but at 6–10 weeks half still reported lower back pain: persistent symptoms deserve assessment, not waiting.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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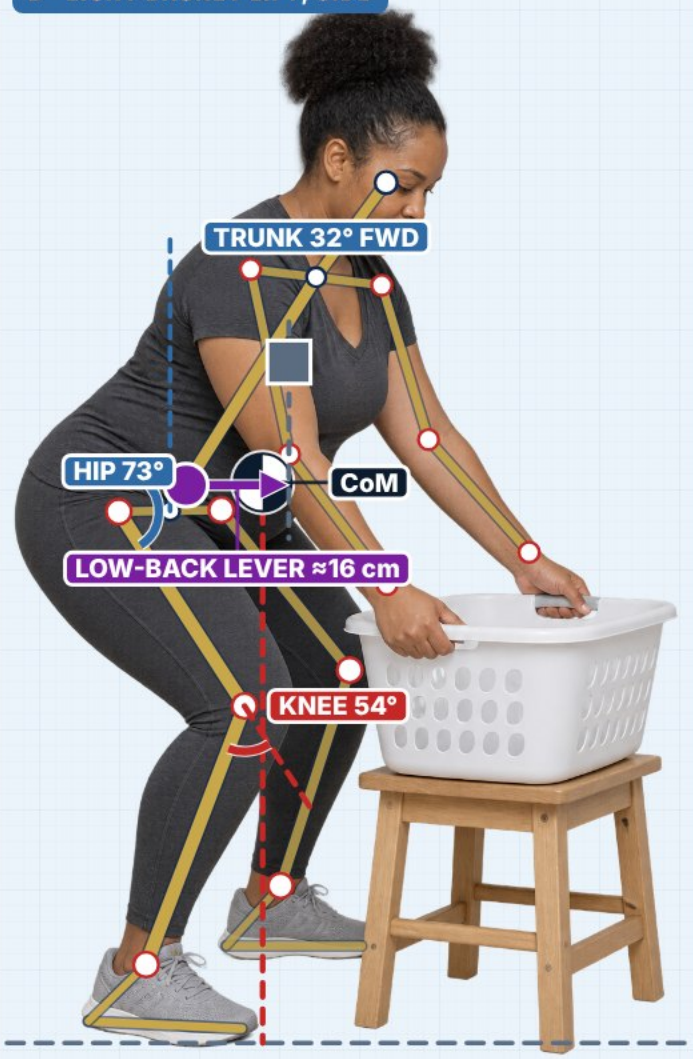
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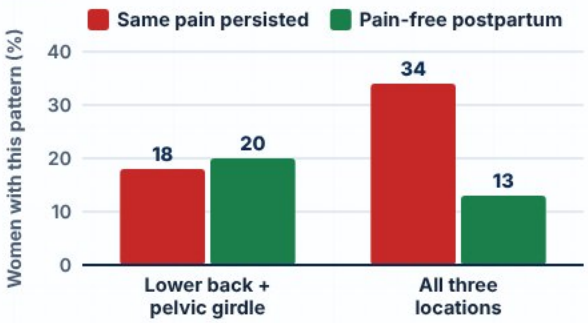
B · LIGHT BASKET LIFT, SIDE



Light basket lift: rehearsing daily care

- Lift from a stool: trunk **32°**, hip **73°**, knee **54°**; the upper body alone gives lever **≈16 cm**, **≈62 N·m**.
- Raised surfaces and close-to-body holds make cot, car-seat and floor lifts easier to rebuild.
- Women with pain in more locations in pregnancy were more likely to keep it after birth.

Pain pattern in pregnancy and what happened next



288 first-time mothers; postpartum = 6–10 weeks. Dunn et al. (2019).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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C · BASKET CARRY, FRONT



Basket carry: load close, body upright

- Carrying in front, pelvis **5°** off level: close loads keep the spinal lever short.
- In postpartum pelvic girdle pain, 20 weeks of physiotherapy with specific stabilising exercise beat individual physiotherapy without them.

Specific stabilising exercise after pregnancy

81 women with postpartum pelvic girdle pain; blinded assessor; results held at 1 year; no drop-outs.

30 mm
less evening pain (0–100 VAS, medians)

>50%
disability reduction vs negligible change

Graded daily-care tasks: lift from higher to lower surfaces, lighter to heavier, fewer to more repetitions, guided by the 24-hour response.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Stats: Stuge et al. (2004). Educational, not diagnostic.

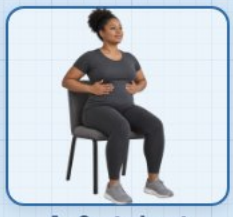
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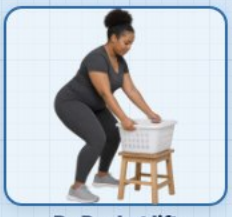
INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

POSTPARTUM LOWER BACK PAIN: REBUILDING CAPACITY FOR LIFTING AND DAILY CARE

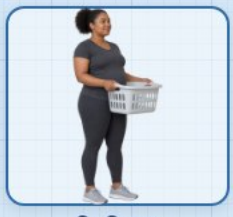
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A · Seated rest
Supported postures

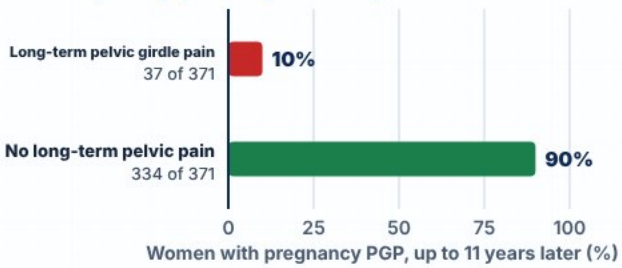


B · Basket lift
≈62 N·m



C · Carry
Load close

A minority keep pelvic pain for years



Those with long-term PGP reported lower quality of life and fewer working hours. Elden et al. (2016).

Decision pathway

1. **INDIVIDUALISE**
   Return is guided by symptoms, birth type and postnatal advice, not a fixed date.
2. **REHEARSE THE TASKS**
   Cot, car seat, pram and floor lifts as graded exercises: height, load, repetitions.
3. **TRAIN THE PELVIS**
   Supervised trunk and pelvic-girdle exercise for persistent pelvic girdle pain.

NOT RECOMMENDED

A fixed "return date"; assuming everyone recovers by a set time.

SEEK ASSESSMENT IF

Fever or wound signs after caesarean, one-sided leg swelling, breathlessness, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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POOR SLEEP AND LOWER BACK PAIN: WHY BOTH DESERVE ATTENTION

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A · SIDE-LYING WITH PILLOWS

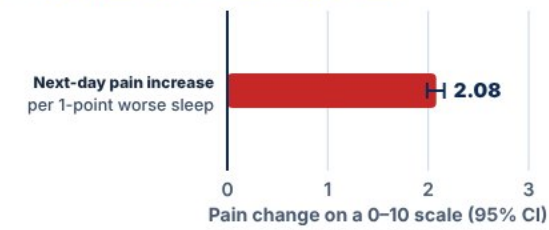


Sleep and pain travel together

- Side-lying with a pillow between the knees is a common comfort position; no single position is proven best.
- The link runs both ways: pain disturbs sleep, and poor sleep was followed by more pain.
- Over about 11 years, frequent sleeplessness went with a lower chance of recovering from chronic LBP.

Two-way street: people who often or always had sleeplessness were less likely to recover from chronic LBP over about 11 years (Skarpsno et al., 2020; see slide 4).

Sleep quality and next-day pain



1,246 people with acute LBP; adjusted for depression. Alsaadi et al. (2014).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Lying reference image: joint angles not reported. Educational, not diagnostic.

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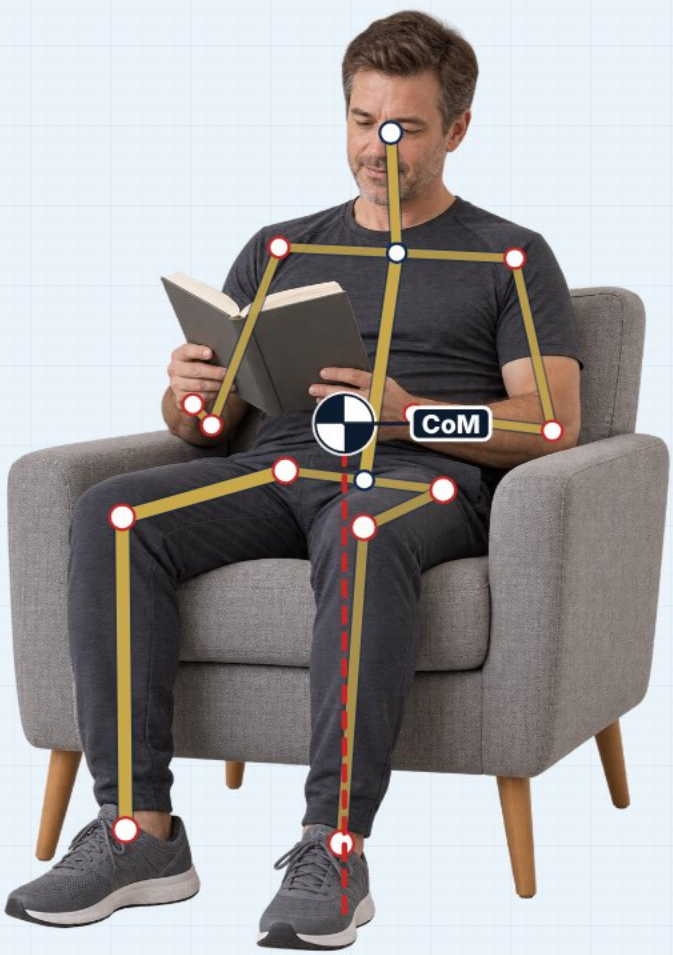
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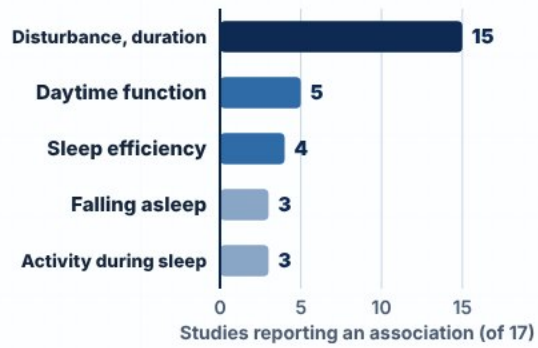
B · EVENING WIND-DOWN



Evening wind-down: sleep has several parts

- Reading in a supported chair: a regular, calm routine before bed is part of sleep care.
- Sleep disturbance and short sleep were the aspects most often linked with chronic LBP; daytime function was affected too.

Which aspects of sleep are linked with chronic LBP?



Systematic review of 17 studies; counts of studies, not effect sizes. Kelly et al. (2011).

Ask about sleep in every assessment: falling asleep, waking with pain, total hours, and how the next day feels.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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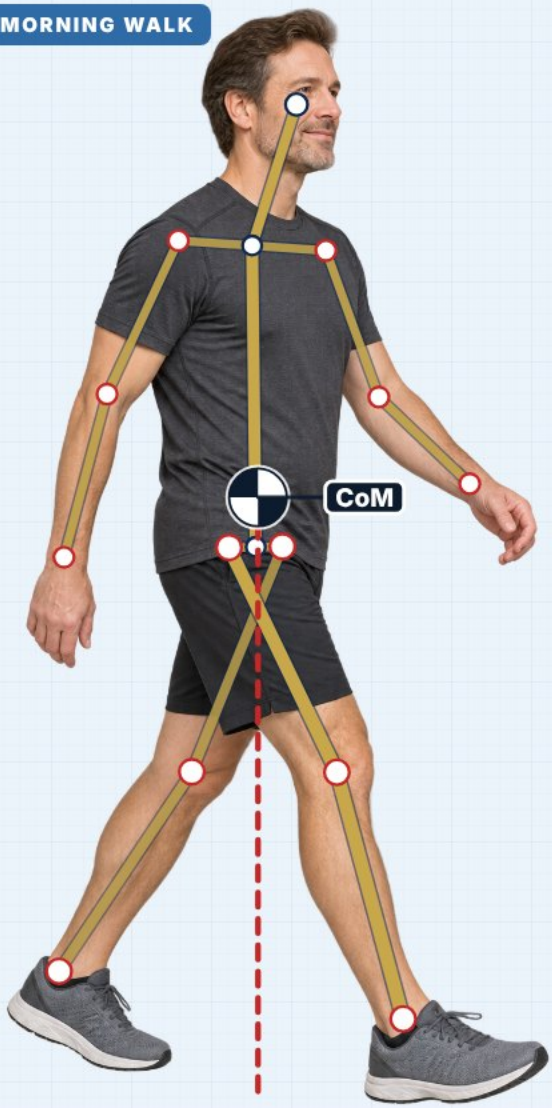
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C · MORNING WALK



Morning walk: daylight, movement, routine

- Gentle morning activity eases stiffness and supports a regular sleep–wake rhythm.
- Address both pain and sleep: comfortable positions, a regular routine, daytime activity, and a review of medicines that disturb sleep.
- For persistent insomnia, cognitive behavioural therapy for insomnia is the usual referral.

What the evidence shows, and does not

The studies here are observational: they show associations, not that fixing sleep will cure back pain.

+2.08
pain points after a worse night (acute LBP)

RR 0.65
chance of recovery, women with frequent sleeplessness

Myth: "bad sleep is just a side effect and will sort itself out." Poor sleep predicted more pain and slower recovery.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Walking reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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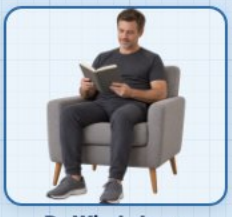
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A · Side-lying
Pillow support

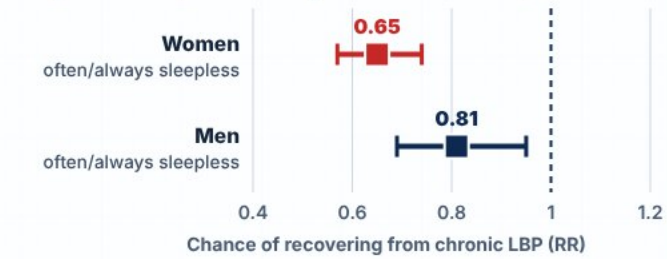


B · Wind-down
Regular routine



C · Morning walk
Daytime activity

Frequent sleeplessness, slower recovery



HUNT study, about 11 years of follow-up. Skarpsno et al. (2020).

Decision pathway

1. **ASK**
   Include sleep in the assessment of every person with back pain.
2. **TREAT BOTH**
   Comfort positions, routine, daytime activity; refer persistent insomnia for specific care.
3. **NO SLEEP CURE**
   Do not promise that a mattress or pillow alone will fix back pain.

NOT RECOMMENDED

Promising a sleep-based cure; ignoring sleep as "just a symptom".

SEEK ASSESSMENT IF

Constant night pain in any position, night sweats, fever, weight loss, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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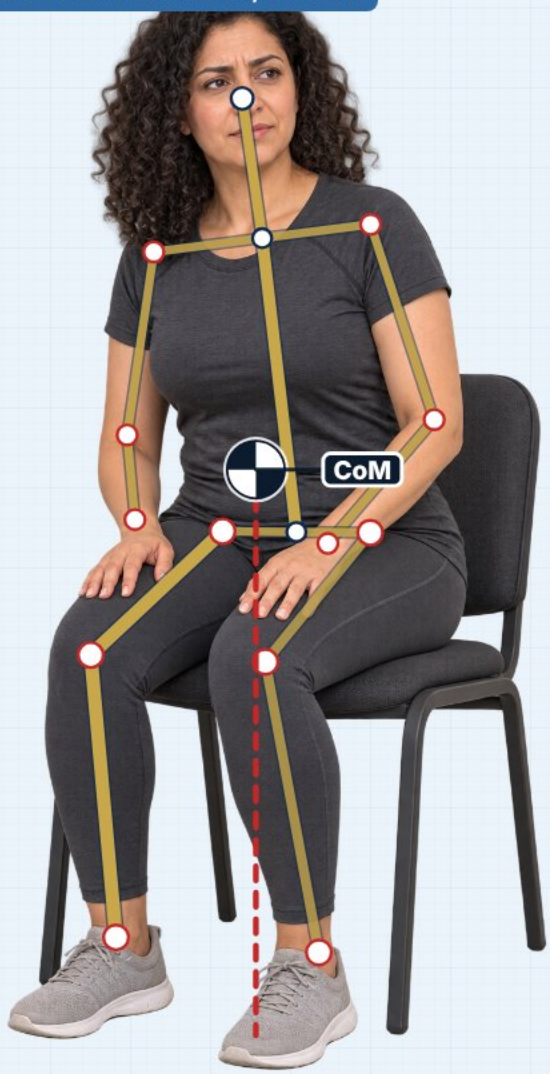
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STRESS AND PERSISTENT LOWER BACK PAIN: UNDERSTANDING THE CONNECTION

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A · STRESS AWARENESS, SEATED

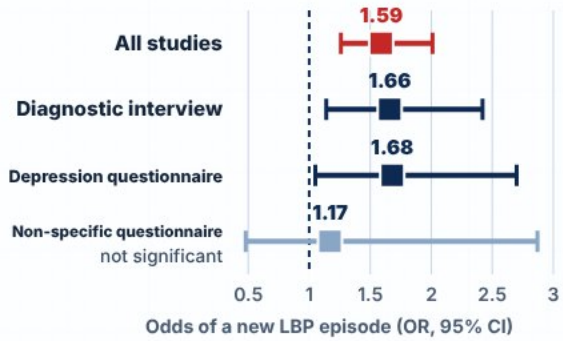


2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: joint angles not reported. Educational, not diagnostic.

Physical, psychological and social factors interact

- Persistent pain is shaped by tissue sensitivity, fitness and load, and by mood, stress, worry, work and support.
- People with depressive symptoms were more likely to develop a new episode of LBP.
- Saying stress contributes does **not** mean the pain is imagined.

Depressive symptoms and new back pain



19 cohort studies (11 pooled), people free of LBP at baseline. Pinheiro et al. (2015).

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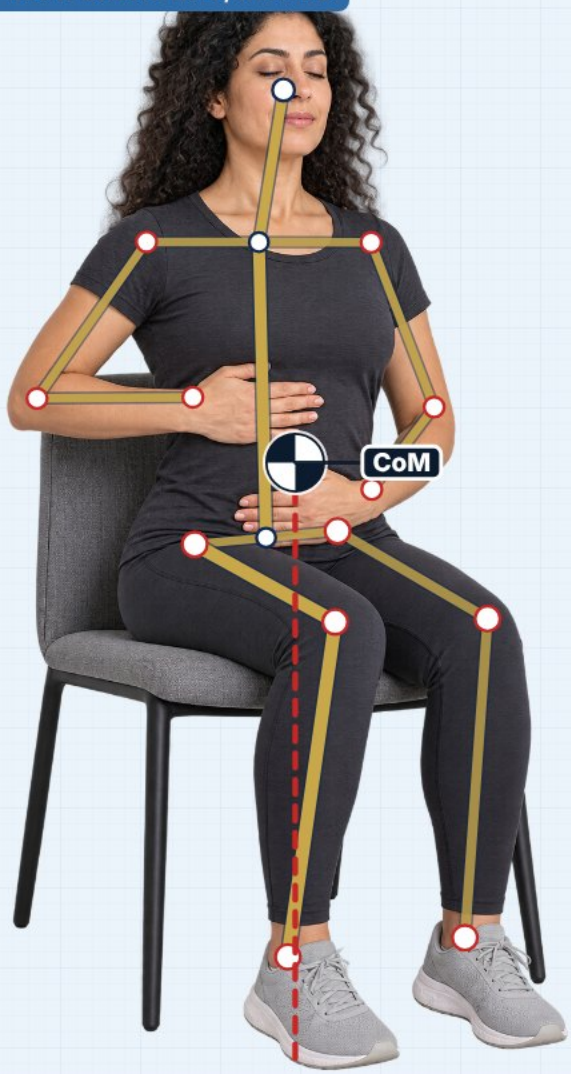
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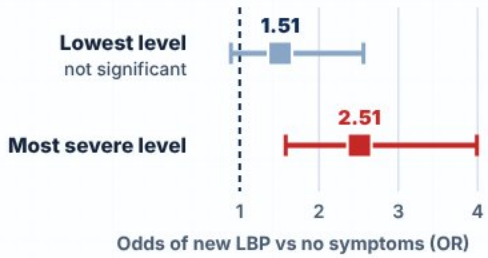
B · SLOW BREATHING, SEATED



Slow breathing: a tool for the stress response

- Hand on the abdomen, slow breaths: a simple way to down-regulate before activity or sleep.
- Risk rose with the severity of depressive symptoms, a gradient consistent with dose–response, but still an association.

More severe symptoms, higher risk



3 studies reporting graded categories. Pinheiro et al. (2015).

Yellow flags such as distress, fear or work problems are reasons to adapt care, not reasons to stop activity.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: joint angles not reported. Educational, not diagnostic.

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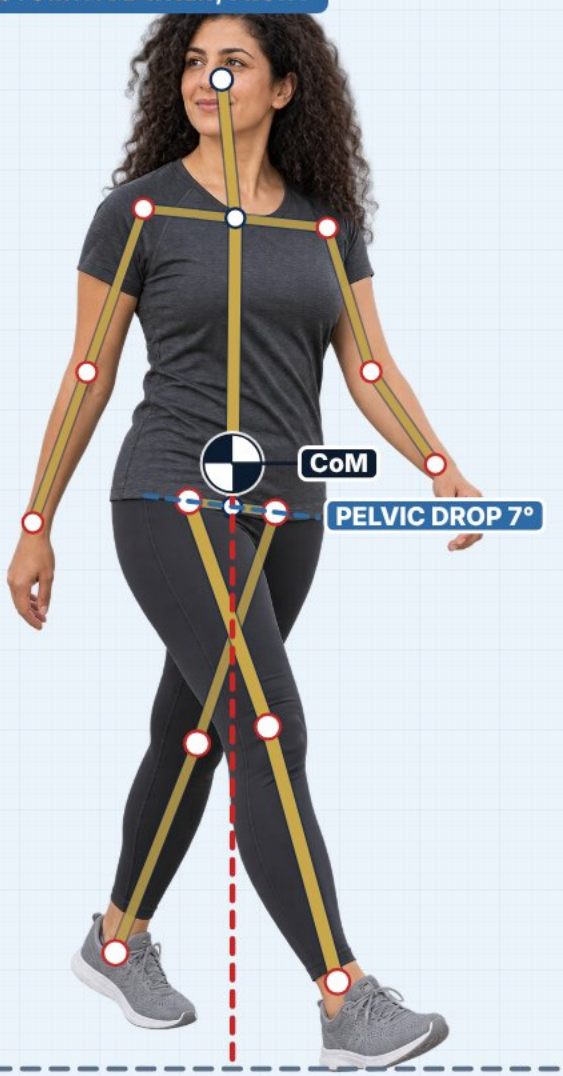
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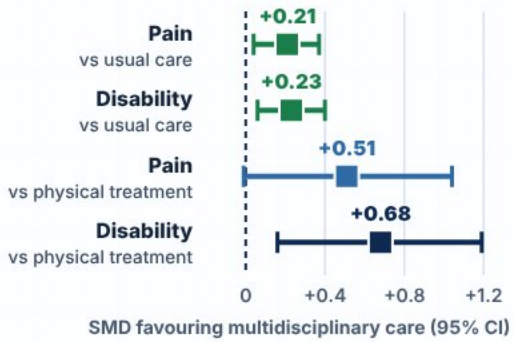
C · RESTORATIVE WALK, FRONT



Restorative walk: body and mind together

- Relaxed walking, pelvis **7°** off level: physical activity that also eases stress.
- Programmes combining physical and psychological or work-focused care reduced pain and disability more than usual care, with small effects (about 0.5 of 10 pain points; 1.5 of 24 RMDQ points).

Multidisciplinary biopsychosocial rehabilitation



41 trials, 6,858 adults with LBP for over 3 months; low-quality evidence vs physical treatment. Kamper et al. (2015).

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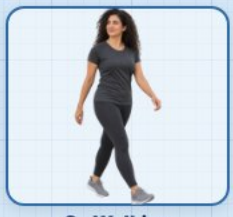
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A · Awareness
Name the stressors



B · Breathing
Down-regulate



C · Walking
Move and recover

Back at work a year later



Moderate-quality evidence. Kamper et al. (2015).

Decision pathway

1. **SCREEN**
   Ask about mood, stress, worry, sleep, work and support alongside the physical findings.
2. **COMBINE**
   For high-impact persistent pain, combine exercise with psychological or work-focused approaches.
3. **SET EXPECTATIONS**
   Average effects are modest and individual responses vary; review progress together.

NOT RECOMMENDED

Labelling the pain "psychological"; treating a screening score as a diagnosis.

SEEK ASSESSMENT IF

Persistent low mood, hopelessness or any thoughts of self-harm: contact a doctor or local crisis service promptly. Also: new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

REFERENCES (APA 7)

de Leva, P. (1996). Adjustments to Zatsiorsky-Seluyanov's segment inertia parameters. *Journal of Biomechanics, 29*(9), 1223–1230. https://doi.org/10.1016/0021-9290(95)00178-6

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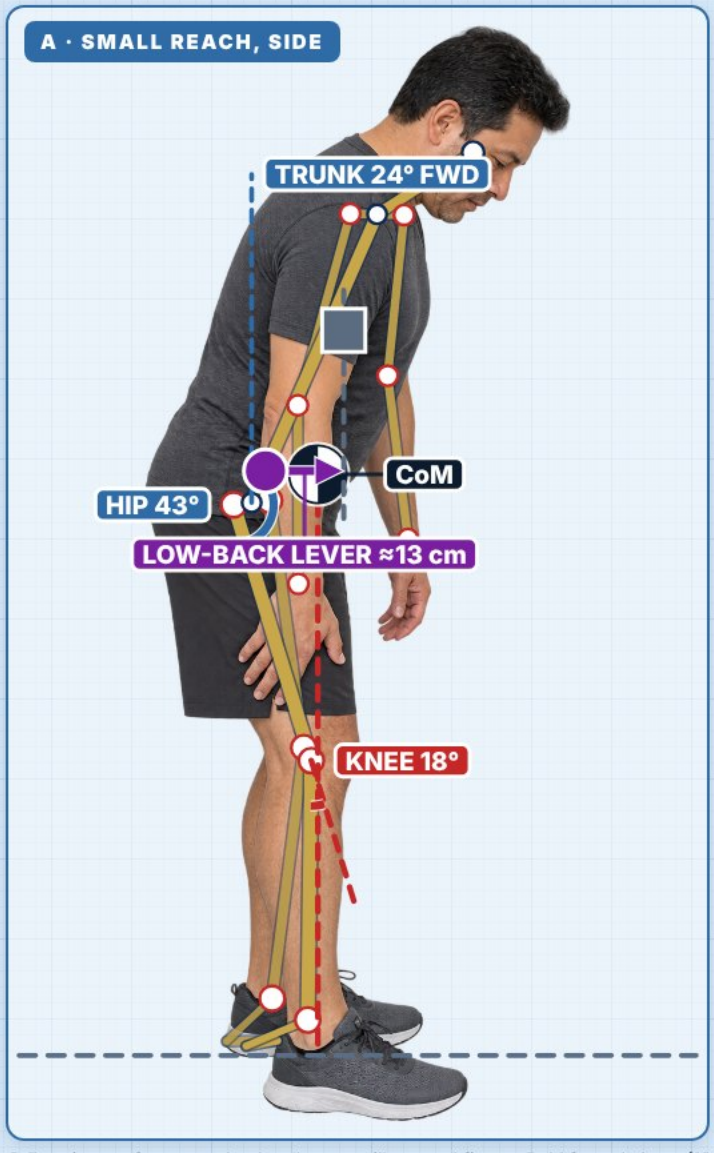
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AFRAID TO BEND? REBUILDING CONFIDENCE WHEN YOUR BACK HURTS

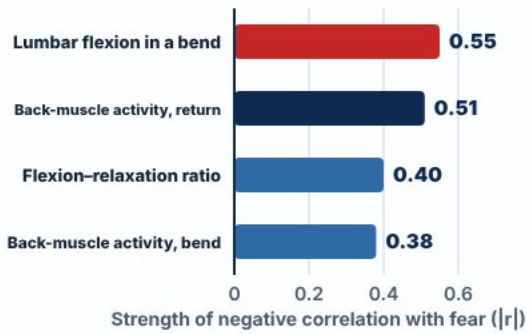
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Small reach: the first rung of the ladder

- Hands slide towards the knees, trunk **24°** forward: lever **≈13 cm**, **≈52 N·m**, a modest first step.
- Higher pain-related fear went with a stiffer, more guarded bend: less lumbar flexion and altered back-muscle activity.
- Cross-sectional data: fear and guarding travel together; neither proves the other.

Fear and the way people bend



76 adults with chronic LBP; all correlations negative and significant. Geisser et al. (2004).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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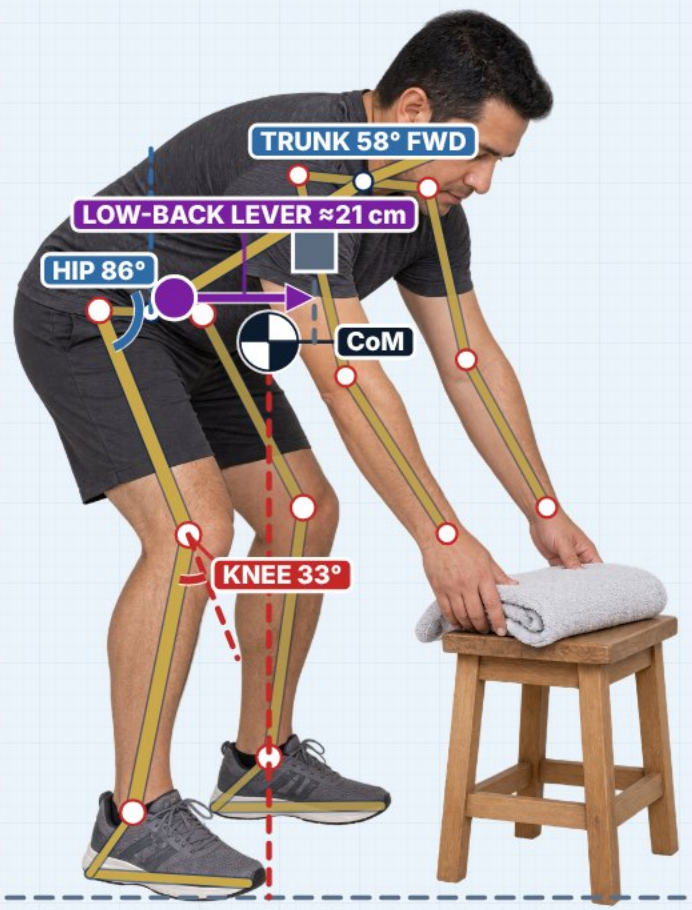
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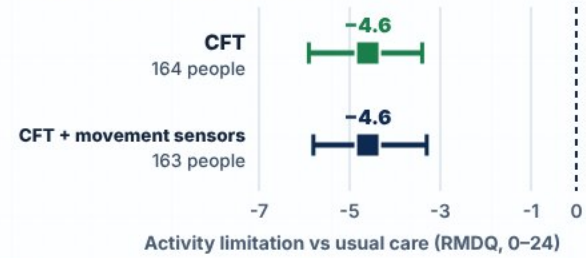
B · REACH TO A STOOL, SIDE



Reach to a stool: a meaningful, feared task

- Trunk **58°**, hip **86°**: lever **≈21 cm**, **≈86 N·m**. Practised relaxed, with breathing, not braced.
- Cognitive functional therapy (CFT) helps people make sense of pain and re-engage with feared movements step by step.
- In RESTORE, CFT reduced activity limitation by about 4.6 points more than usual care, sustained at 52 weeks.

RESTORE trial at 13 weeks



492 adults with chronic disabling LBP, 20 Australian clinics; up to 7 sessions plus a booster. Kent et al. (2023).

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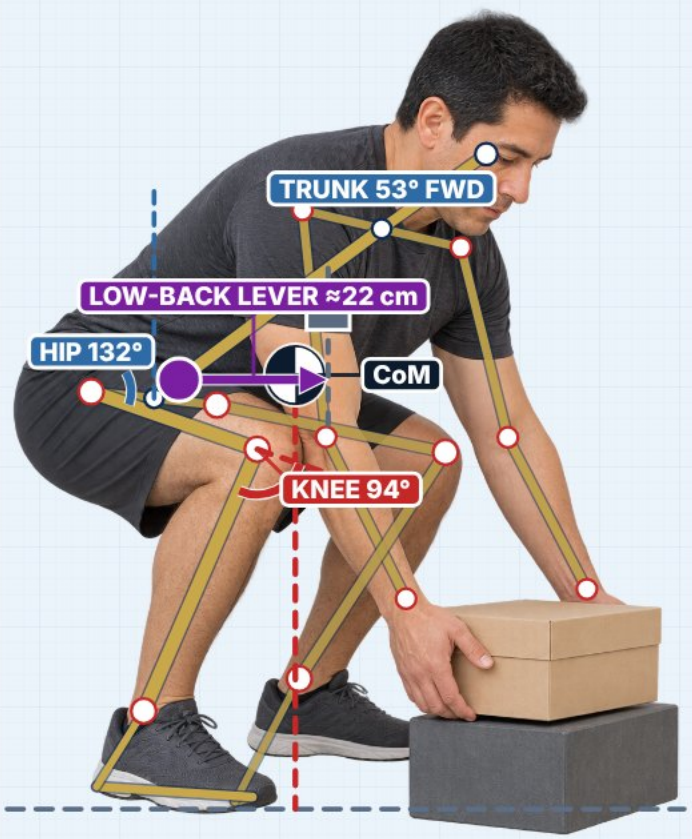
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AFRAID TO BEND? REBUILDING CONFIDENCE WHEN YOUR BACK HURTS

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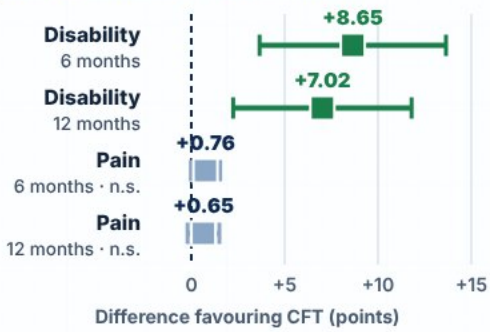
C · LOWER REACH, SIDE



Lower reach: range, then speed, then load

- Deep reach to a low box: hip **132°**, knee **94°**, lever **≈22 cm**, **≈90 N·m**: the top rung of this ladder.
- Individualised CFT improved disability more than a group exercise class; pain differences were not detected. Function can change even when pain changes less.

CFT vs group exercise and education



206 adults with chronic LBP, Ireland; disability scale not named in the abstract. O'Keeffe et al. (2020).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

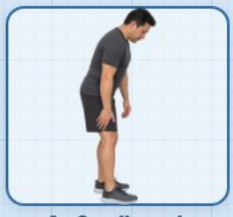
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BIOMECHANICS IS A FORCE-GOVERNED DECISION SYSTEM – NOT A POSTURE MODEL.

INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

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A · Small reach
≈52 N·m

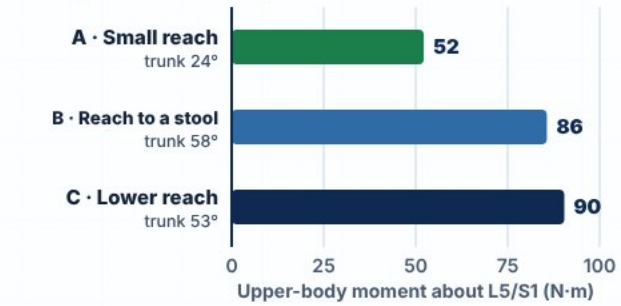


B · To a stool
≈86 N·m



C · Lower reach
≈90 N·m

An exposure ladder you can measure



MMSx 2-D analysis of frames A–C; 70 kg adult, static, no hand load. Rungs are chosen with the person, not imposed.

Decision pathway

1. **EXPLORE THE FEAR**
   What does the person expect will happen when they bend, and why?
2. **BUILD THE LADDER**
   List meaningful feared tasks (dishwasher, shoes, lifting a child) from easiest to hardest.
3. **PRACTISE RELAXED**
   Unguarded movement with breathing; progress range, then speed, then load, by confidence and the next-day response.

NOT RECOMMENDED

Telling people bending is dangerous; forcing exposure without agreement and understanding.

SEEK ASSESSMENT IF

Fear driven by new nerve symptoms, fever, weight loss, cancer history or suspected fracture: get assessed first. Also: new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

REFERENCES (APA 7)

de Leva, P. (1996). Adjustments to Zatsiorsky-Seluyanov's segment inertia parameters. *Journal of Biomechanics, 29*(9), 1223–1230. https://doi.org/10.1016/0021-9290(95)00178-6

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PAIN DURING BACK REHABILITATION: WHEN TO MODIFY, PAUSE, OR SEEK HELP

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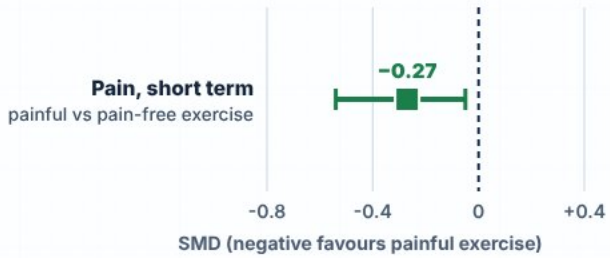
A · COMFORTABLE MOVEMENT, SIDE



Some discomfort is common, and usually safe

- Sit-to-stand pattern: trunk **11°**, hip **57°**; lever **≈12 cm**, **≈46 N·m**.
- Allowing tolerable pain during exercise did not lead to worse outcomes than pain-free exercise, and gave a small short-term benefit.
- Medium- and long-term pain and function: no difference.

Painful vs pain-free exercise



7 trials, 385 people with chronic musculoskeletal pain (not LBP only); moderate quality. Smith et al. (2017).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Low-back lever: upper-body CoM to an L5/S1 estimate; moment = upper-body weight × lever for a 70 kg adult, static, no hand load. Educational, not diagnostic.

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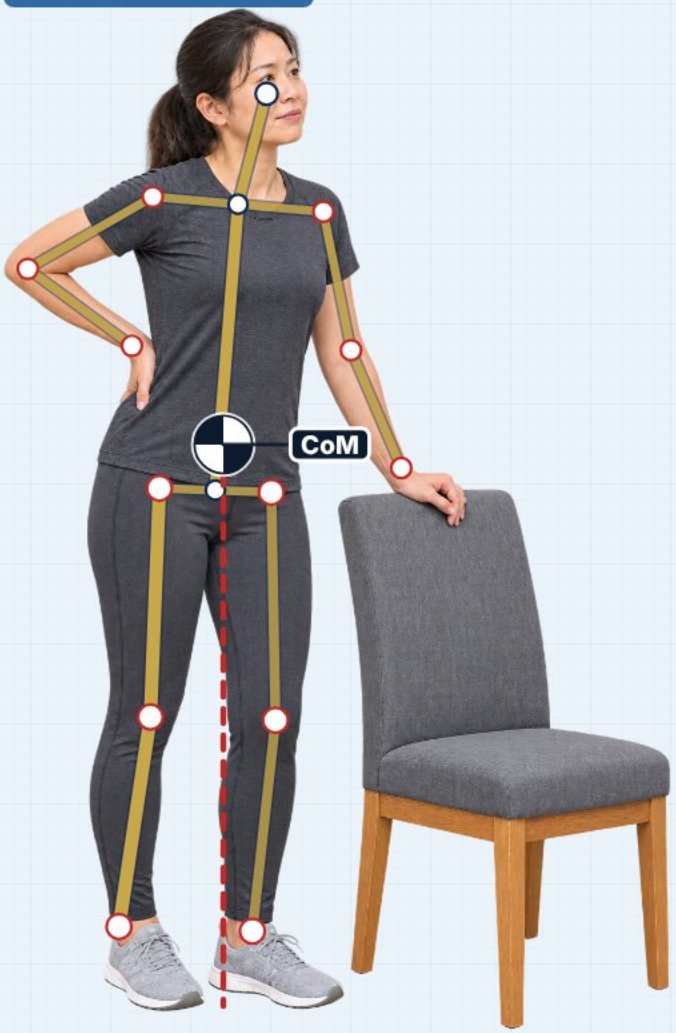
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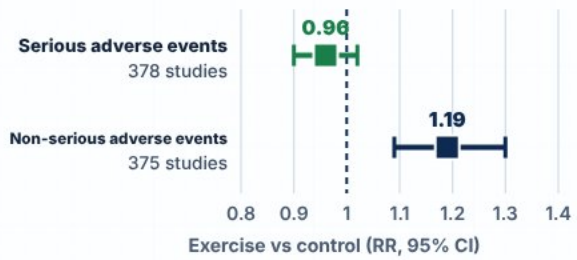
B · PAUSE AND REVIEW



Pause and review: a traffic-light guide

- **Green:** familiar, tolerable pain that settles to baseline within ~24 h → continue.
- **Amber:** not settled by the next day, or building over sessions → reduce load, range, volume or speed.
- **Red:** spreading leg symptoms, new weakness or numbness, bladder or bowel change → stop and seek help.

Exercise: minor events more common, serious ones not



180 Cochrane reviews, all conditions; one extra minor event for every 6 people treated. Niemeijer et al. (2020).

A clinical convention, not a validated rule: agree the acceptable level with your clinician beforehand.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Standing reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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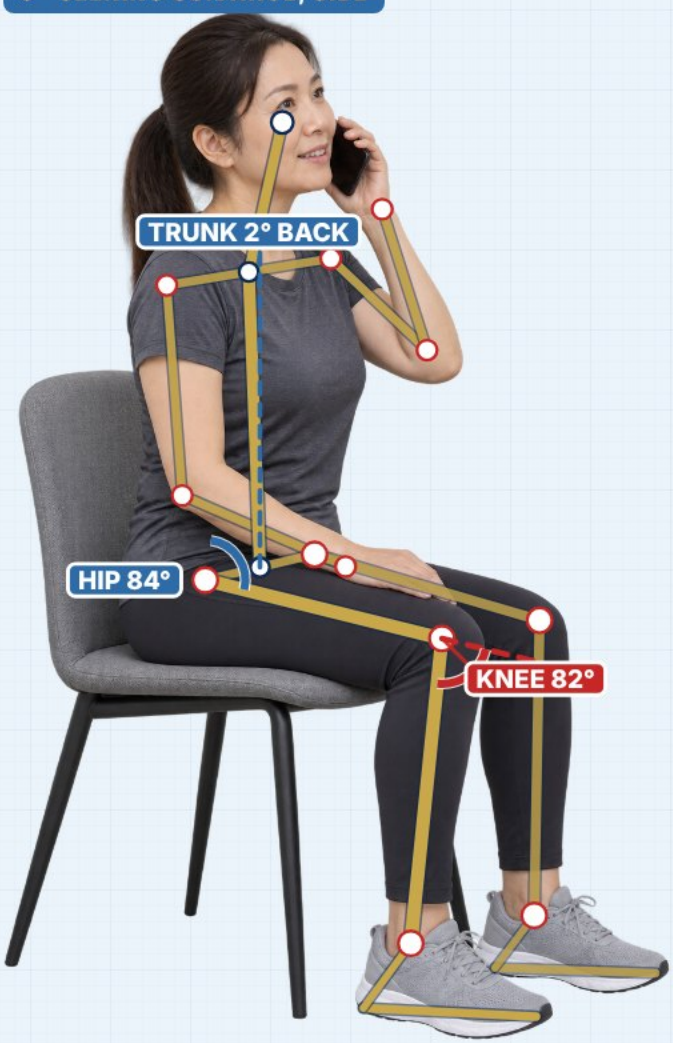
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C · SEEKING GUIDANCE, SIDE



When to seek guidance

- Pain that escalates from session to session, does not settle, or spreads further down the leg is a reason to review the plan.
- Track function (meaningful tasks) as well as pain: see Title 48.

Harms in exercise trials for chronic LBP

Groups reporting at least one adverse effect; harms were mostly minor, such as muscle soreness.

33% of exercise groups (37 of 112)

29% of comparison groups (12 of 42)

Myth: "any pain during rehab means I am damaging my back." Tolerable pain did not worsen outcomes.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image: joint angles not reported. Stats: Hayden et al. (2021). Educational, not diagnostic.

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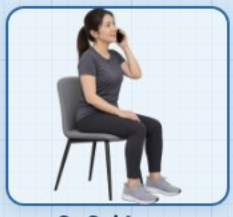
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A · Comfortable
Green: continue

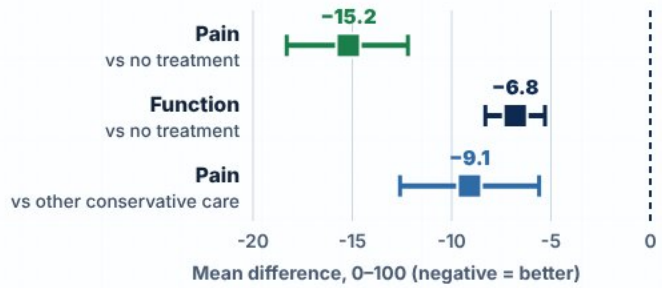


B · Pause
Amber: adjust



C · Guidance
Red: seek help

The benefit is worth the minor soreness



249 trials of exercise for chronic LBP. Hayden et al. (2021).

Decision pathway

1. **AGREE A LEVEL**
   Decide beforehand what pain is acceptable during and after exercise.
2. **MODIFY, DON'T QUIT**
   Not settled by the next day: reduce load, range, volume or speed, then rebuild.
3. **KNOW THE STOP SIGNS**
   Spreading or neurological symptoms, fever, chest pain: stop and get assessed.

NOT RECOMMENDED

Insisting exercise must be completely pain-free; pushing through spreading or nerve symptoms.

SEEK ASSESSMENT IF

Chest pain or breathlessness during exercise, fever, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

REFERENCES (APA 7)

de Leva, P. (1996). Adjustments to Zatsiorsky-Seluyanov's segment inertia parameters. *Journal of Biomechanics, 29*(9), 1223–1230. https://doi.org/10.1016/0021-9290(95)00178-6

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A LOWER BACK PAIN FLARE-UP: HOW TO ADJUST YOUR ACTIVITY PLAN

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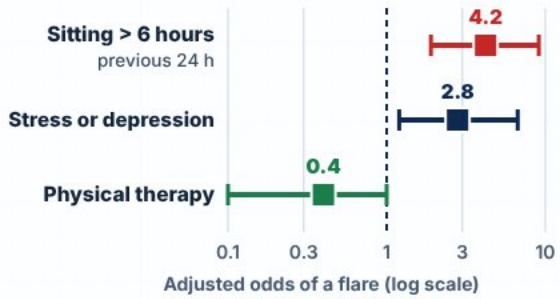
A · COMFORTABLE REST, SIDE



A flare is not new damage

- Hook lying (hip **45°**): a short rest position, not a day in bed.
- One research definition: at least 2 hours of pain distinctly worse than it has been recently.
- Review the past 1–3 days: long sitting and stress were linked with flares; most other physical activities were not.

What preceded flares in acute LBP?



Case-crossover, 48 people (81 flare periods); small sample, wide intervals. Suri et al. (2018).

Myth to correct

"A flare means I have re-injured my back." About half of people with chronic back pain report a flare in 6 months, and flares were linked with exposures such as long sitting and stress (Suri et al., 2012, 2018).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Educational, not diagnostic.

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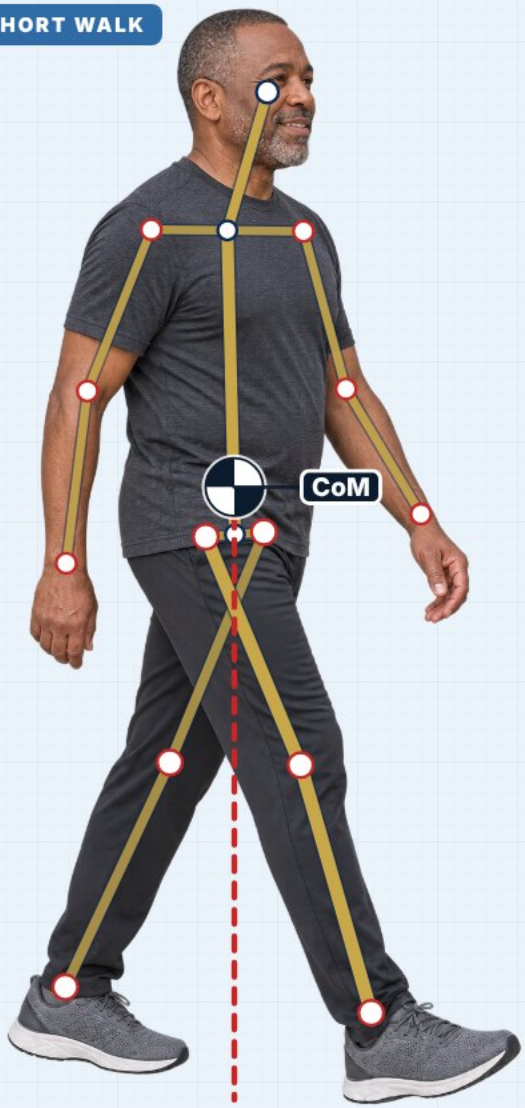
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B · SHORT WALK



Short walks: reduce, don't stop

- Shorter, more frequent walks and position changes every 20–30 minutes keep you moving at a lower dose.
- Use easier versions of your usual exercises, and comfort strategies such as heat or positions of ease.

Flare-ups in chronic back pain

634 primary-care patients, 2 years after a back-pain visit; flares in the last 6 months. Scale ranges not given in the abstract.

≈51%
reported a flare

4.2 vs 3.3
disability score, with vs without flares

Plan ahead: agree your flare plan when you feel well, so the next one is a routine, not an emergency.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Walking reference image (oblique view): joint angles not reported. Stats: Suri et al. (2012). Educational, not diagnostic.

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C · REDUCED-RANGE MOVEMENT



Reduced range: keep the pattern, shrink the dose

- Small, comfortable movements (trunk **12°**) keep the movement familiar while symptoms settle.
- Rebuild to your previous level over days as symptoms ease: range first, then repetitions, then load.

Unadjusted vs adjusted trigger estimates

Odds ratios (95% CI) for exposures in the previous 24 hours.

4.4 → 4.2
sitting > 6 h, unadjusted → adjusted

2.5 → 2.8
stress or depression

Not a typical flare? New leg weakness, numbness or bladder change, or a flare not easing after 1–2 weeks of adjusted activity: get assessed.

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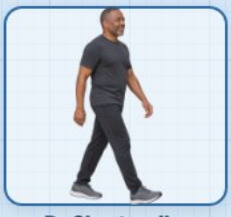
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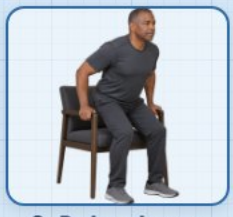
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A · Short rest
Not bed rest

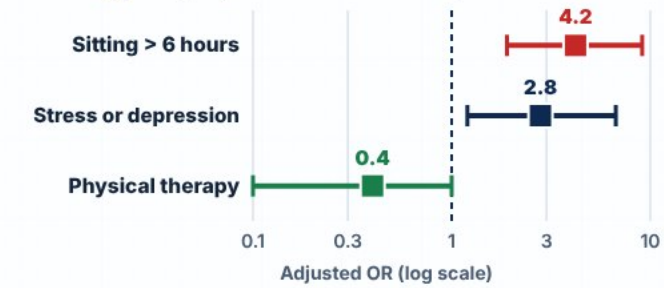


B · Short walks
Lower dose



C · Reduced range
Keep moving

Flare triggers (adjusted odds ratios)



48 people with acute LBP followed for 6 weeks. Suri et al. (2018).

Decision pathway

1. **CHECK, THEN REVIEW**
   Rule out red flags; look back at sitting, load, sleep and stress over 1–3 days.
2. **LOWER THE DOSE**
   Shorter walks, position changes every 20–30 min, easier exercise versions, comfort strategies.
3. **REBUILD STEADILY**
   Return to your previous level over days as symptoms ease; keep the plan for next time.

NOT RECOMMENDED

Bed rest or stopping all activity; treating one bad day as failure.

SEEK ASSESSMENT IF

Fever, weight loss, cancer history, significant trauma, a flare not easing in 1–2 weeks, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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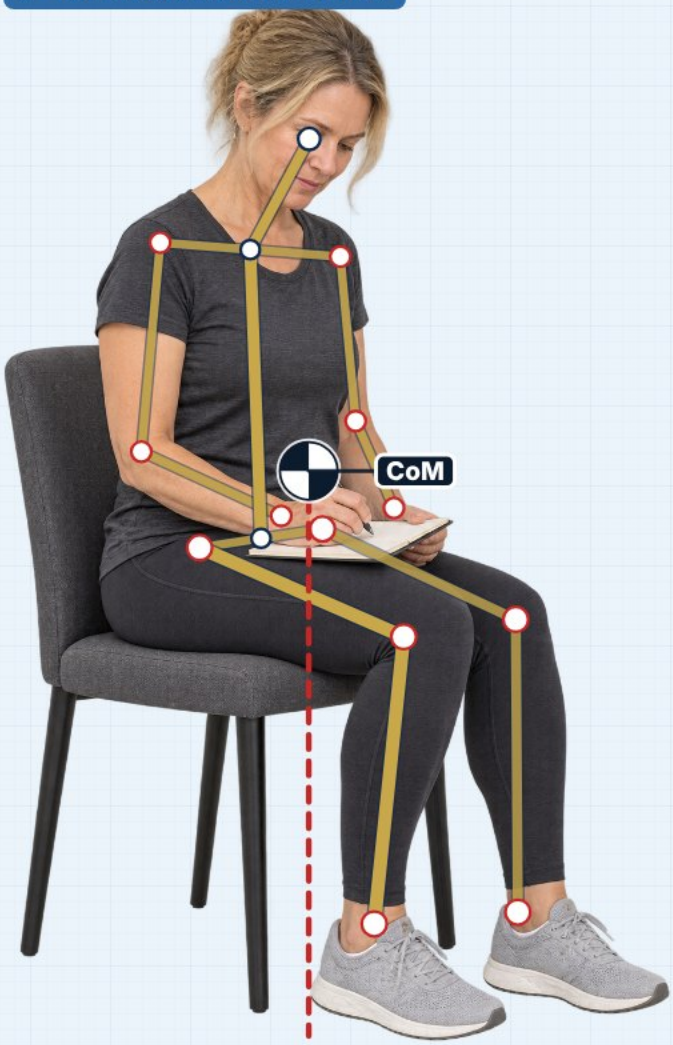
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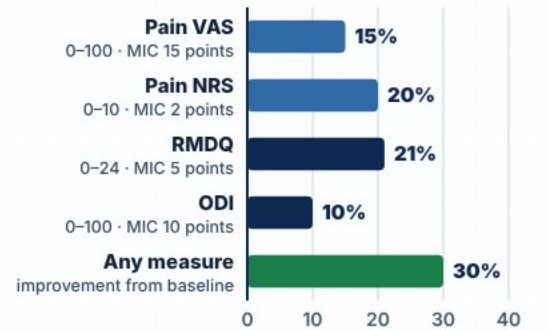
A · KEEPING AN ACTIVITY LOG



Measure more than pain

- Record a baseline, then re-measure every 2–4 weeks: one pain scale, one validated function questionnaire (RMDQ or ODI) and 2–3 tasks that matter to you.
- A change is meaningful when it exceeds the minimal important change (MIC); a 30% improvement is a useful general rule.

How much change matters?



International consensus. Percent-of-scale values are simple arithmetic (MIC ÷ scale range). Ostelo et al. (2008).

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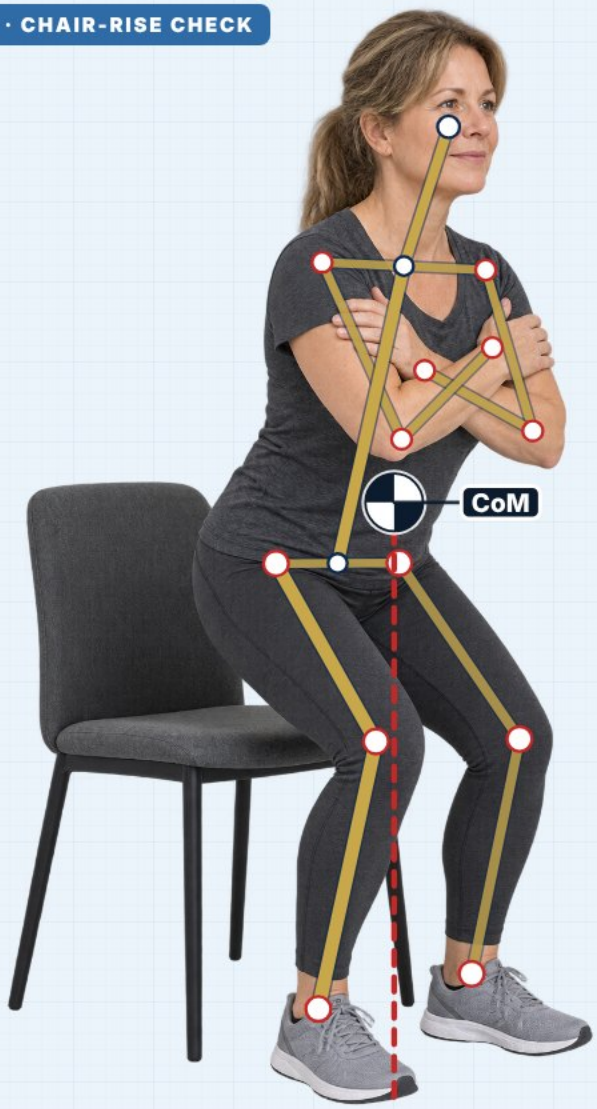
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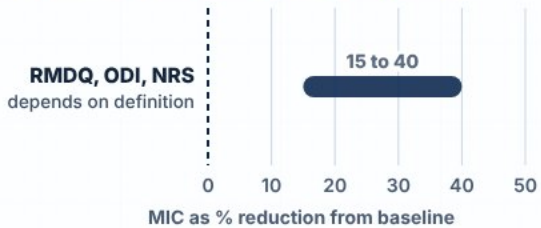
B · CHAIR-RISE CHECK



Chair-rise check: a task you can re-test

- Repeated chair rises (trunk **13°** forward at seat-off): count how many in 30 seconds, or time five.
- Simple task tests show change in function that a pain score can miss.
- Thresholds also depend on how "improved" is defined: estimates ranged from a 15% to a 40% reduction.

What counts as meaningful? It depends



Chronic LBP with Modic changes (AIM trial); all measures responsive (AUC > 0.7). Bråten et al. (2022).

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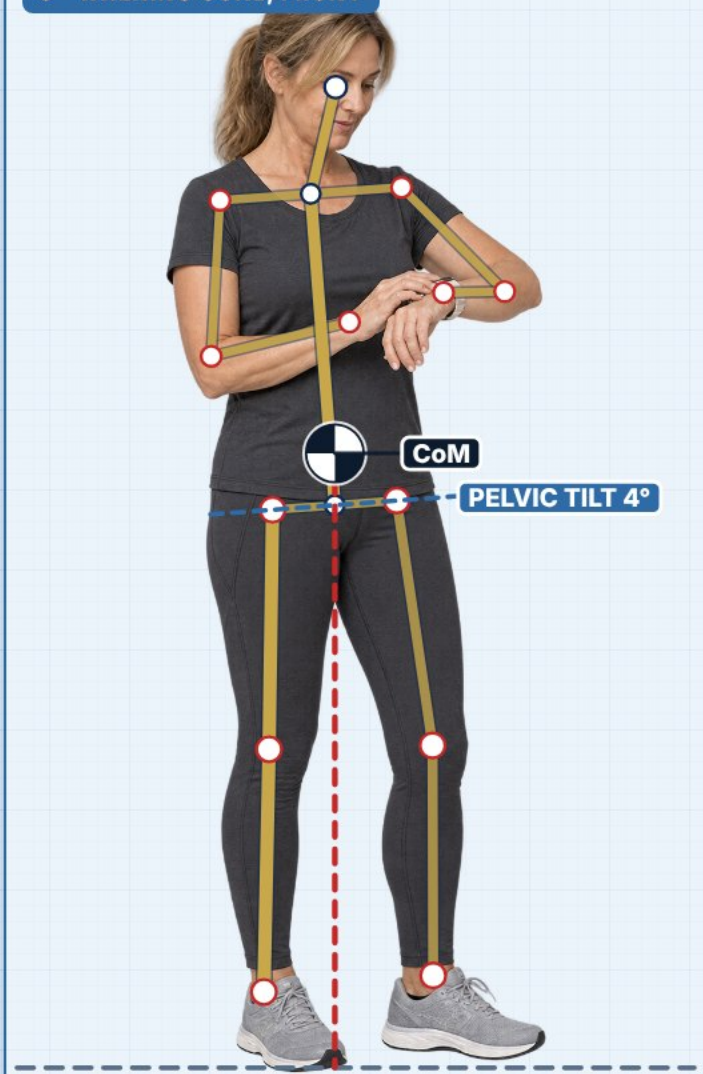
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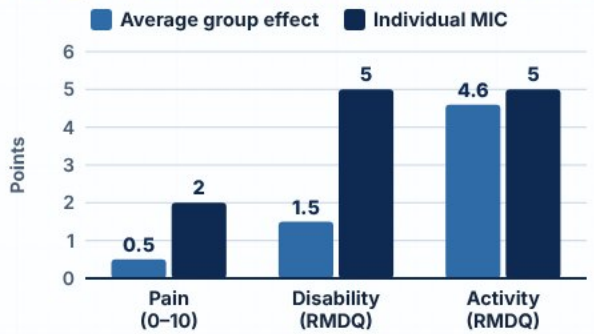
C · WALKING GOAL, FRONT



Walking goal: participation is the target

- Walking with a step counter, pelvis **4°** off level: minutes walked, sitting tolerance, lifting a child or returning to work are all measurable goals.
- Average differences between treatments are often smaller than what one person notices; individuals vary, so track your own change.

Average effects vs what an individual notices



Multidisciplinary care vs usual care: Kamper et al. (2015); cognitive functional therapy vs usual care: Kent et al. (2023); MIC: Ostelo et al. (2008).

Myth: "if my pain score hasn't dropped, rehab isn't working." Function can improve with little pain change (O'Keeffe et al., 2020).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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INTEGRATING PERFORMANCE & REHABILITATION HEALTHCARE PATHWAYS.

IS YOUR BACK REHABILITATION WORKING? TRACK FUNCTION ALONGSIDE PAIN

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A · Activity log
Baseline first

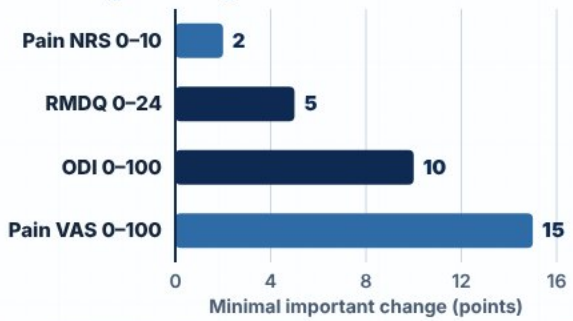


B · Chair rise
Re-testable task



C · Walking goal
Participation

The MIC targets at a glance



Or a 30% improvement from baseline on any of them. Ostelo et al. (2008).

Decision pathway

1. **SET A BASELINE**
   One pain scale, one function questionnaire, 2–3 meaningful tasks, before you start.
2. **RE-TEST REGULARLY**
   Every 2–4 weeks; ignore day-to-day swings and changes smaller than the MIC.
3. **JUDGE THE TREND**
   Function improving with little pain change is still real progress.

NOT RECOMMENDED

Judging progress on pain alone or on a single bad day.

SEEK ASSESSMENT IF

No meaningful change after 6–12 weeks of good adherence, steady worsening, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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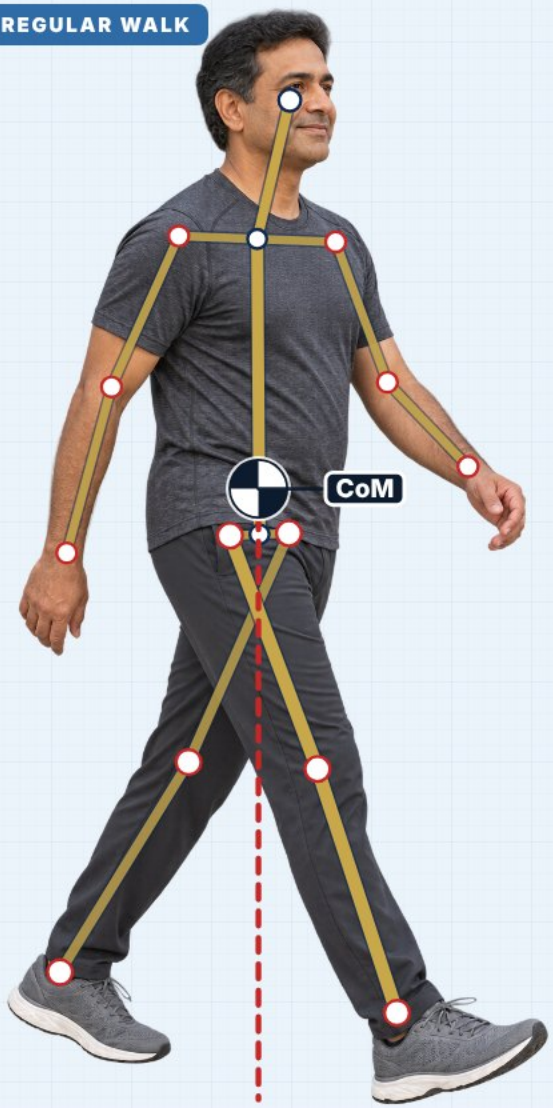
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CAN WALKING AND EDUCATION REDUCE LOWER BACK PAIN RECURRENCE? WHAT THE WALKBACK TRIAL FOUND

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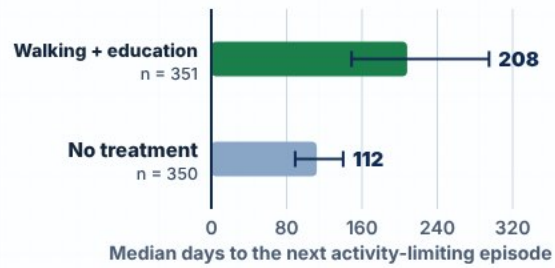
A · REGULAR WALK



An individualised, progressive walking plan

- Adults recently recovered from an episode of LBP followed a progressive walking programme plus education, with six physiotherapist sessions over 6 months.
- Time to the next activity-limiting episode nearly doubled (hazard ratio 0.72, 95% CI 0.60–0.85).
- It **delayed** recurrence; it did not abolish it.

WalkBack: time to recurrence



Follow-up 12–36 months; p = 0.0002. Pocovi et al. (2024).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Walking reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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B · EDUCATION REVIEW



Who was studied: read before applying

- Adults who had **recently recovered** from non-specific LBP lasting at least 24 hours: not people in a current severe episode or with sciatica or specific pathology.
- The comparison was no treatment, not a placebo or another exercise programme.

WalkBack in numbers

Australia, recruited September 2019 to June 2022; randomised 1:1.

701
randomised (of 3,206 screened)

81%
women; mean age 54 years

Safety and value: adverse events were similar (52% vs 54%), with more minor lower-limb aches in walkers; AU$7,802 per QALY gained, 94% likely cost-effective.

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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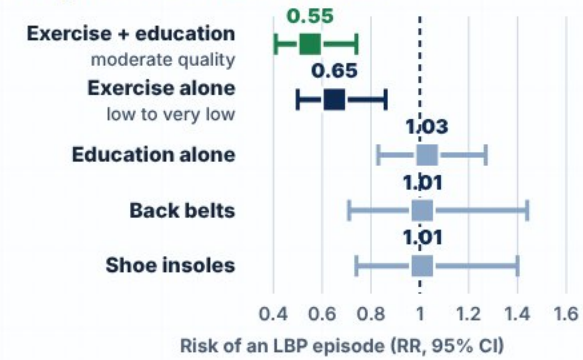
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Ongoing strength: exercise plus education

- Light dumbbell work, pelvis level (**1°**): regular exercise is the active part of prevention.
- Across 21 prevention trials, exercise combined with education reduced LBP episodes; education alone, belts and insoles did not.

What prevents an LBP episode?



21 trials, 30,850 participants. Steffens et al. (2016).

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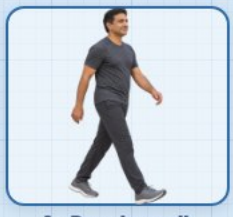
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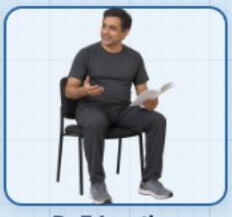
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A · Regular walk
Progressive plan



B · Education
Understand pain



C · Strength
Keep it going

WalkBack: a delay, not a cure



701 adults recently recovered from LBP. Pocovi et al. (2024).

Decision pathway

1. **AFTER RECOVERY**
   Start a progressive walking plan with education once the episode has settled.
2. **ADD SUPPORT**
   A few physiotherapist sessions helped individualise and progress the plan.
3. **SKIP THE GADGETS**
   Education alone, back belts and insoles did not prevent episodes.

NOT RECOMMENDED

Claiming walking cures back pain; relying on education alone.

SEEK ASSESSMENT IF

Leg symptoms that build with walking and ease with sitting, calf pain on walking, or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

REFERENCES (APA 7)

de Leva, P. (1996). Adjustments to Zatsiorsky-Seluyanov's segment inertia parameters. *Journal of Biomechanics, 29*(9), 1223–1230. https://doi.org/10.1016/0021-9290(95)00178-6

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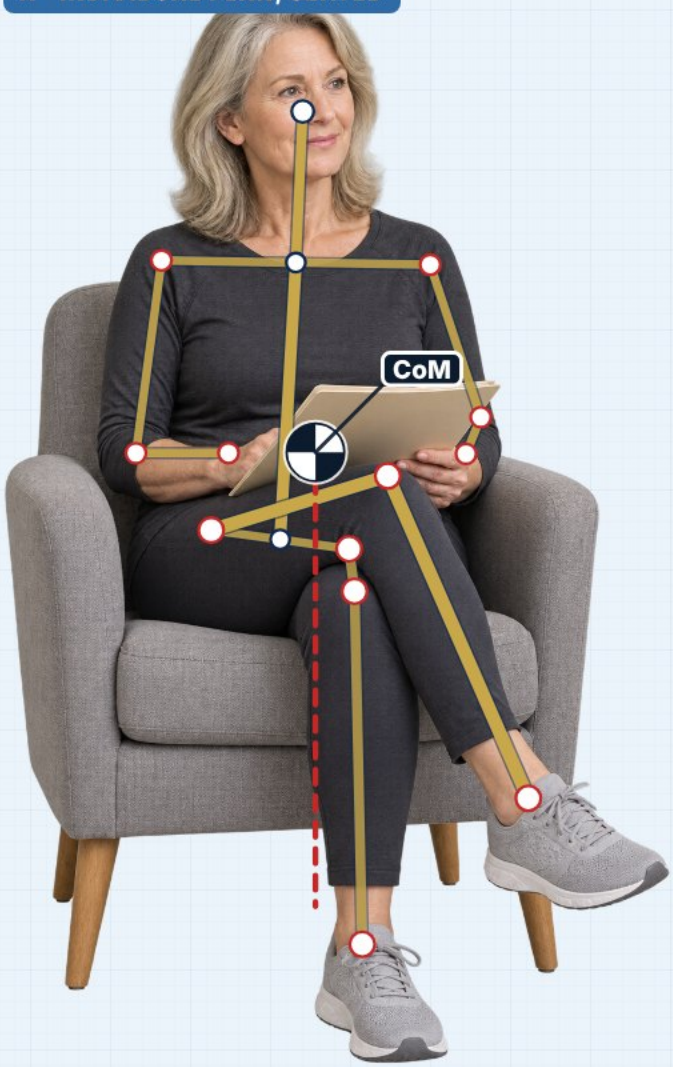
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EXERCISE AFTER LUMBAR DISC SURGERY: WHY PROGRESSION MUST BE INDIVIDUALISED

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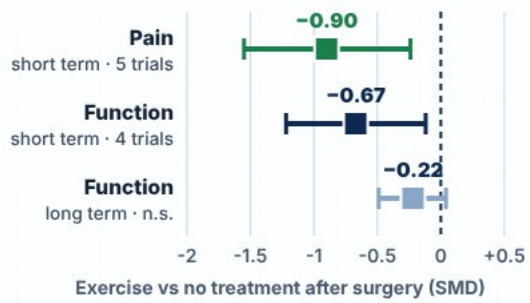
A · INDIVIDUAL PLAN, SEATED



Start with the surgeon's plan

- Rehabilitation is coordinated with the procedure, wound healing, remaining leg symptoms and the surgical team's advice.
- Exercise programmes starting about 4–6 weeks after surgery improved short-term pain and function more than no treatment.
- No included trial reported that exercise increased reoperation rates.

Exercise after lumbar disc surgery



22 trials, 2,503 participants, mean age 41; low to very low quality. Oosterhuis et al. (2014).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Seated reference image (oblique view): joint angles not reported. Educational, not diagnostic.

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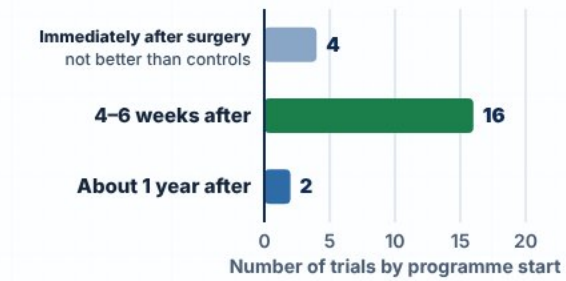
B · SUPPORTED WALK, FRONT



Supported walking: the early foundation

- Upright walking with support close by, pelvis level (**0°**): gentle walking and daily activity as advised by the surgical team.
- Most trials began structured exercise at 4–6 weeks; programmes started immediately were not more effective than their controls.
- Programmes lasted 12 weeks on average.

When did post-surgery programmes start?



Oosterhuis et al. (2014).

2-D estimates from pose landmarks on an illustrated figure; CoM from de Leva (1996) segment parameters; cm for a 1.70 m adult (Winter, 2009). Pelvic tilt from left and right hip points in the front view. Educational, not diagnostic.

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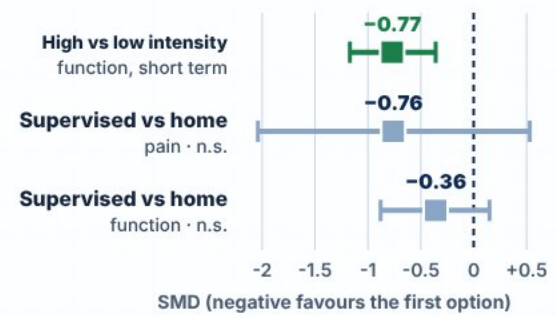
C · SUPPORTED TRANSFER



Supported transfer: progress intensity by response

- Rising with hand support (trunk **16°** forward): early transfers are progressed to unsupported sit-to-stand, then loaded tasks.
- Higher-intensity programmes beat lower-intensity ones in the short term (pain −10.7 points on 0–100); supervision alone showed no clear advantage over a well-designed home programme.

Intensity mattered; setting less so



Low to very low quality evidence. Oosterhuis et al. (2014).

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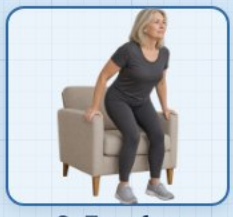
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A · The plan
Surgeon-led

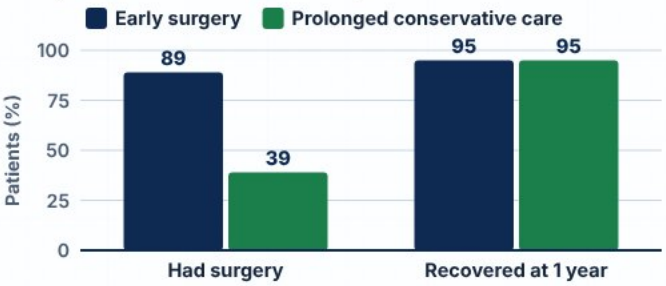


B · Walking
Early foundation



C · Transfers
Progress by response

People start from different points



283 patients with severe sciatica; surgery gave faster recovery (HR 1.97) but the same 1-year result. Peul et al. (2007).

Decision pathway

1. **COORDINATE**
   Follow the surgeon's advice on timing; agree the plan with the surgical team.
2. **START AT 4–6 WEEKS**
   Structured exercise usually begins then; walking and daily activity earlier as advised.
3. **PROGRESS INDIVIDUALLY**
   Increase intensity by symptoms and function; no one-size-fits-all timetable.

NOT RECOMMENDED

Avoiding all exercise "to protect the repair"; a fixed timetable for everyone.

SEEK ASSESSMENT IF

Wound redness, discharge or fever; returning severe sciatica; clear fluid from the wound; calf swelling; or new bladder or bowel change, saddle numbness, or worsening leg weakness or numbness: seek urgent care.

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