

Chiropractic and Sports: Treatment and Biomechanics of the Lower Extremity and Effects on the Spine

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Conflicts of interest: none. The phone inclinometer used in this session is the presenter's own free tool; no commercial interest. The presenter is President of the Chiropractic Outcomes Research Institute (CORI), a 501(c)(3) nonprofit, with no financial interest in this content. All photographs are the presenter's own.

Learning objectives

By the completion of this workshop, attendees will be able to:

1. Describe the mechanical pathways by which restricted ankle dorsiflexion and restricted hip rotation alter loading at the knee, pelvis, and lumbar spine in athletes and active patients.
2. Perform a four-item lower-extremity screen — weight-bearing ankle dorsiflexion, seated hip internal rotation, single-leg stance control, and single-leg mini-squat quality — and interpret the findings against published reference values.
3. Use the immediate retest to distinguish articular restriction from tissue-capacity restriction in a lower-extremity sports case, select a management approach matched to that finding and its timescale — within-session manual intervention or a dosed loading program — and state the certainty of the evidence and the contraindications for the chosen approach.

1 · Session map

The case of Marta: a 34-year-old recreational footballer with three months of anterior-medial knee pain and a normal knee MRI. Her history adds an S1 radiculopathy two years ago, a hamstring strain eight months ago with no structured rehab, and new lateral hip pain when lying on that side.

The loop: Screen → Commit → Intervene → Retest.

Two timescales at the table: articular restrictions change within the session, and the immediate retest demonstrates it. Tissue-capacity problems change over weeks; there the immediate retest is a differential — an unchanged number after joint treatment localizes the problem to tissue and redirects care to dosed loading.

Why look above the knee — and at the spine

- Abnormal hip mechanics are a recognized contributor to knee injury (Powers 2010).
- In athletes, lower total hip rotation is associated with hip and groin pain (Tak 2017, systematic review).
- In professional golfers, loss of lead-hip internal rotation tracked a history of low back pain; the non-lead hip did not (Vad 2004; cross-sectional, n = 42 — an association, not a cause).
- Greater trochanteric pain syndrome was present in 20.2% (51 of 252) of patients referred to orthopedic spine specialists for low back pain; 28 of those 51 had already had an MRI, and one had undergone two lumbar decompressions (Tortolani 2002). Palpate the trochanter in every “sciatica.”

2 · Screen first: three things that break

- **Femoral neck stress fracture** — runner with thigh, knee, or groin pain; pain with hop or fulcrum load → image before you load or mobilize.
- **Hip osteoarthritis in the older athlete** — groin pain, capsular-pattern restriction; internal rotation under 15° with hip pain is an ACR classification criterion (Altman 1991) → assess and image as indicated.
- **True radicular recurrence** — progressive neurological deficit, dermatomal signs → neurological work-up before manual care.

Upstream reasoning never replaces the screen for conditions that need imaging, referral, or a surgeon. This list is also the contraindication list for the manual techniques in Sections 5 and 7.

3 • The four-item screen (no plinth, no disrobing)

Test	How	What the number means
1 • Weight-bearing ankle dorsiflexion	Lunge with the back leg straight, heel down; phone flat on the front of the shin; read degrees.	Under 30° = restricted in a young athlete (Baumbach 2016; Searle 2018). Healthy young adults average ≈33° knee-extended, weight-bearing (Baumbach 2016). Older adults commonly read lower — compare sides. Physiological side-to-side asymmetry is under 6° (Baumbach 2016) and an inclinometer's minimal detectable change in the lunge is ≈4° (Konor 2012), so a difference of 6° or more is a real finding.
2 • Seated hip internal rotation	Seated, hip and knee at 90°; rotate the lower leg outward; phone flat on the shin.	No validated “normal” cutoff exists. Healthy young adults average 33 ± 7° seated (Simoneau 1998); age changes it only 3–5° up to age 74 (Roach & Miles 1991). Under ~20° (about 2 SD below average) warrants attention; under 15° with hip pain, consider hip OA (Altman 1991). Compare sides, and expect more side-to-side measurement noise at the hip than at the ankle.
3 • Single-leg stance, 30 s	Stand on the painful side up to 30 s, one finger on a chair or wall for balance only.	Positive = her familiar lateral hip pain. A positive rules in gluteal tendinopathy (specificity 100%, LR+ ≈12 against MRI; Grimaldi 2017, n = 65); sensitivity is low, so a negative does not rule it out. Test origin: Lequesne 2008 (17 patients with refractory symptoms).
4 • Single-leg mini-squat quality	Five slow squats on one leg. Watch: overall balance · trunk lean · pelvic drop or shift · thigh drifting inward · knee inside the foot.	Good = 4 of 5 criteria clean on every squat (Crossley 2011; “pass/fail” is the presenter’s simplification of their good/fair/poor grading). On video, knee valgus during a single-leg squat averaged ≈8° in healthy women and ≈17° in women with patellofemoral pain — group averages, not a cutoff (Herrington 2014).

The phone inclinometer. Free, runs in any phone browser, no data leaves the phone, and works on any long bone: jarmichaeldc.github.io/shin-inclinometer. Tap Start, lay the phone flat along the segment, Zero in the start position, read at end range, Hold to show your partner. It shows a number only; interpretation is yours.

How much hip rotation does the activity ask for?

Peak active hip rotation during activity, in degrees (highest average peak across studies; 3-D motion capture, mostly young healthy adults, referenced from standing neutral — a sport demand, not a clinical cutoff, and not directly comparable to a seated measurement).

Activity	Internal rotation	External rotation	Demand*
Stair ascent	6	9	Low
Stair descent	6	20	High
Running	11	18	Moderate
Walking	15	12	Moderate
Squatting	19	32	Extreme
Landing	22	14	High

Activity	Internal rotation	External rotation	Demand*
Soccer	22	—	High
Side-step cutting	22	7	High
Picking up an object	32	3	Extreme
Taekwondo	35	18	Extreme
Golf swing	35	30	Extreme
Ballet	38	42	Extreme
Ice hockey	42	28	Extreme

*Demand grade as assigned by the source. Data re-tabulated from Han S, Kim RS, Harris JD, Noble PC. *Gait Posture* 2019;71:227–233.

4 • The hamstring: the finding the traditional exam missed

The H-test (Askling 2010)

Supine, uninjured leg flat and fixed. The patient performs a maximal-speed active straight-leg raise (“as fast and as high as safely possible”), three trials, best of three. Record (a) the highest range of motion and (b) the patient’s sense of insecurity on a 0–100 scale. In 11 athletes with MRI-verified hamstring strain whose standard exam was already clean (no palpation pain, normal manual strength, symmetric passive straight-leg raise), the injured leg still showed 8% less active flexibility, with mean insecurity of 52 (range 28–98) vs 0 on the uninjured side. Test–retest reliability was high (ICC 0.94–0.99). Use it before the return-to-sport decision.

The L-protocol (Askling 2014)

Return to full training: mean 49 days with the lengthening (L) protocol vs 86 days with the conventional protocol (43% shorter); both reinjuries in the 12-month follow-up occurred in the conventional group. Studied in 56 elite sprinters and jumpers. Progression in all three exercises is steered by pain avoidance.

Exercise	Method	Dose
L1 — The Extender	Supine; hold and stabilize the thigh of the injured leg at about 90° hip flexion; slow knee extensions to a point just before pain.	Twice daily, 3 × 12
L2 — The Diver	Simulated dive: from an upright trunk, hip flexion over the standing injured leg (knee 10–20°), arms reaching forward, lifted leg driving toward maximal hip extension with its knee at 90°, pelvis kept level; very slow at first.	Every other day, 3 × 6
L3 — The Glider	Upright trunk, one hand on a support, legs slightly split; all weight on the heel of the injured leg, knee 10–20°; glide the other leg backward on a low-friction surface and stop before pain; return using the arms, not the injured leg. Progress distance, then speed.	Every third day, 3 × 4

5 • The hip: belt-assisted mobilization and the retest

Technique. Supine, hip flexed toward 90° without pain. A treatment belt around the patient’s proximal thigh and the clinician’s pelvis; the clinician stabilizes the ilium and applies a lateral glide through the belt (with slight distraction), repeated; then the same glide with the hip positioned in flexion and internal rotation. Grade to comfort.

Evidence. In a sham-controlled trial of this belt-assisted lateral glide (mobilization with movement), pain fell by 2 points, hip flexion rose 12.2° and internal rotation 4.4°, with no change after sham (Beselga 2016). The technique is the trial’s own; only the population is borrowed — the patients had hip OA and a mean age of 78, and there is no trial in athletes. The retest is how you check whether the result transfers to your patient.

Retest. Same seated position, same phone, same leg. If the number moves, the restriction was articular. If it doesn't, suspect tissue and move to the weeks timescale.

Contraindications. Suspected fracture or stress fracture, active infection or malignancy in the region, significant osteoporosis, acute inflammatory arthropathy, post-surgical precautions, and any red flag in Section 2.

6 · Gluteal tendinopathy: education and exercise before injection

Trial evidence. Education plus exercise produced better global improvement than corticosteroid injection at 8 and 52 weeks; pain was equal by 52 weeks (Mellor 2018). Participants were aged 35–70 with MRI-confirmed tendinopathy. Tissue timescale: weeks — tell the patient on day one.

What the LEAP trial prescribed (Mellor 2016 protocol)

- **Home:** 4–6 exercises daily, no more than 15–20 minutes — deliberately limited to support adherence.
- **Progression over 8 weeks:** static abduction (low-load activation) → bridging, then offset bridging → double-leg squats, then offset squats → side-stepping, then band side-slides, at a “somewhat hard” to “hard” effort.
- **Supervised:** 14 clinic sessions (weekly for 2 weeks, then twice weekly for 6), including heavier slow loading on a spring-resisted sliding platform.
- **Pain rules:** no increase in lateral hip pain during functional retraining; up to 5/10 during heavy slow strengthening, provided it settles and is not worse that night or the next morning.
- **Load modification:** avoid compressive positions — no ITB or piriformis stretches, limited adduction in every exercise. Daily-life advice: avoid crossing the legs, hanging on one hip, and side-lying without a pillow between the knees.

Presenter's low-cost adaptation of the sliding-platform work (not trial-tested): band resistance plus floor sliding — a paper plate under the foot on carpet, or a microfibre cloth on a wooden floor.

7 · The ankle: when dorsiflexion is restricted

Marta's ankle measured clear, so it was not treated in the session. If yours isn't, the sequence is the same loop: measure, mobilize, re-measure.

Technique card: talocrural (posterior talar glide) mobilization

Element	Detail
Purpose	Restore posterior glide of the talus in the mortise, the accessory motion that dorsiflexion requires. Target the joint, not the calf; the knee-extended lunge already told you the calf's contribution.
Setup — supine	Patient supine, heel just over the edge of the plinth, knee extended or on a small bolster. Clinician at the foot. Stabilizing hand cups the calcaneus and holds the foot in a comfortable, slightly dorsiflexed position. Mobilizing hand: web space over the anterior talar neck, just distal to the joint line — not on the tibia.
Direction	Posterior (anterior-to-posterior) glide of the talus on the tibia, force perpendicular to the plane of the mortise. Keep the foot in slight dorsiflexion so the glide occurs with the joint near its restriction; do not let the force drift into plantarflexion.
Grading and dose	Grade III–IV oscillations at the end of available range, or a sustained hold at end range; 3 bouts of 30–60 s with a brief rest. Weight-bearing option (mobilization with movement): patient lunges with the knee toward the wall while a belt or the clinician's hands apply a sustained posterior glide to the talus; 3 sets of 6–10 pain-free lunges.
Retest	Knee-extended lunge, phone on the anterior tibia, same leg, same placement. A change of about 4° or more exceeds the inclinometer's minimal detectable change (Konor 2012). No change → the restriction is not articular; look at the calf, the foot, or load tolerance, and move to the weeks timescale.

Element	Detail
Contraindications	Fracture or suspected fracture, acute ligament injury or joint instability, active infection or inflammatory flare, deep-vein thrombosis, hypermobility of the ankle, and any red flag in Section 2. Grade to comfort in the presence of pain.

Calf stretch with the heel lowered off a step. No stretching dose has been shown superior: sustained 3-minute holds (three times daily) and repeated short holds (5 × 20 s, twice daily) performed the same for pain and flexibility in painful heel syndrome (Porter 2002; no no-stretch control group, and the stretch was not a stair heel-drop). The best protocol is the one your patient will keep doing. Retest with the knee-extended lunge.

8 • Arthrogenic muscle inhibition (AMI)

Afferent input from an injured, swollen, or inflamed joint — largely effusion-driven mechanoreceptor input, which can occur without pain — reflexively inhibits quadriceps activation below voluntary control. “Do your quad sets” cannot fix a muscle the nervous system has switched off.

Switching it back on. These options were held for the handout rather than the session. Disinhibition approaches with mechanistic support include cryotherapy, TENS, and NMES, alongside treating the source of the afferent barrage — the effusion or joint irritation itself (Rice & McNair 2010, narrative review).

Evidence honesty: the AMI literature is built on knee-joint models; extending it to hip- and spine-driven presentations is clinical inference, one rung down the ladder.

Diagram shown in the session: open access under CC BY-NC 4.0 from Lee Z et al., Ann Med 2026 (reference 14).

9 • Quick taping: medial-glide patellar tape (McConnell-style)

A window to load, not the diagnosis.

1. Skin prep; apply Cover-Roll underwrap first (Leukotape directly on skin risks shear injury).
2. Anchor Leukotape at the lateral patellar border.
3. Glide the patella medially with the thumb; lay the tape under tension toward the medial femoral condyle.
4. Test a pain-provoking movement (step-down) before and after — the tape should change it now.

Evidence: medially directed tape reduced chronic knee pain by 16.1 mm on a 100-mm scale vs no tape and 10.9 mm vs sham tape (Warden 2008; 16 trials, 13 in anterior knee pain, with high heterogeneity and publication bias). Tape so that loading is tolerable today, then load through the window. Remove if itching or burning; caution with fragile skin and adhesive allergy.

10 • Fascial points: VMO and gracilis (Stecco method)

Not demonstrated in the session — deliberately. Point locations and parameters: Stecco & Stecco 2009 (Fascial Manipulation – Practical Part, pp. 105–106). Evidence position, stated plainly: a 2026 meta-analysis of 15 randomized trials favored fascial manipulation over active controls for musculoskeletal pain (ES –0.80, 95% CI –1.30 to –0.29) but rated certainty very low by GRADE (small samples, no blinding, $I^2 = 85\%$) (Trybulski 2026). Stage time was proportional to that certainty: zero.

11 • How sure are we? The evidence ladder for Marta’s care

Rung	Intervention	Source and its limit
RCT • similar patients	Tendon loading program; hamstring lengthening rehab	Mellor 2018 (ages 35–70); Askling 2014 (elite sprinters and jumpers)
RCT • borrowed population	Hip mobilization changes range acutely	Beselga 2016 — hip OA, mean age 78; no athlete trial

Rung	Intervention	Source and its limit
Pooled trials · lower certainty	Patellar taping; fascial manipulation	Warden 2008; Trybulski 2026 (very low certainty)
Association, not cause	Hip rotation loss ↔ groin pain; lead-hip IR ↔ low back pain	Tak 2017; Vad 2004 (golfers, cross-sectional)
Mechanism and experience	Quadriceps switch-on after AMI; restoring hip external rotation	Rice & McNair 2010 (mechanism); the presenter's own observation

Design sets the ceiling. Certainty and fit set the rung. Stage time proportional to the rung — and every rung still gets a retest.

12 · For educators: running this as a lab

- **Test–treat–retest is a complete lab station:** student pairs measure with the phone inclinometer, intervene, re-measure, and grade themselves on the number. “Your retest didn’t change — what does that tell you, and what next?” is a ready-made OSCE question. One station, one phone, one examiner, fifteen minutes.
- **Commitment before correction:** have students vote on the driver before revealing evidence (Slido or hands). Committed learners remember being wrong.
- **Certainty-proportional teaching time:** allocate minutes to techniques in proportion to evidence certainty, and tell students you are doing it. This is how emerging manual methods get taught honestly.
- **Measure your own teaching effect:** one Slido event, polls pre-loaded, the anchor question rerun at the end — the before/after shift is generated live by the class.
- **Zero-cost measurement:** the phone inclinometer gives any program, at any budget, a number to teach and assess against — and every recorded retest is a data point a practice-based research network can use.

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Every question left in the Slido queue receives a written reply if you signed in with a name and email address.

Questions about the phone inclinometer, the screen, or running this as a lab in your own program are welcome.