LEG LENGTH INEQUALITY: Sports Medicine Perspective

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18 Year Old Experienced Cross Country Runner: Sept Sr Year

- Pain in left lower leg with running
- Pain now prevents all running
- Spent summer in Costa Rica
- Ran on local terrain
- PE -> suspected LLI
- Standing AP pelvis x-ray confirmed ¾” (20mm) LLI–left long
- X-ray tibia normal, presumed tibial periostitis (medial tibial stress syndrome)
16 Year Old Female Soccer Midfielder: Oct of Club Season

- Pain in left mid-medial thigh
- First season back after fracturing tibia while skiing—healed uneventfully
- Pain with impact and kicking
- Deep tenderness over medial thigh, pain with Fulcrum Test (bending pressure on femur over edge exam table)
- Standing PE suggests LLI

Club Soccer Player

- Weakness and pain when testing core and hip musculature
- AP pelvis confirms LLI of 15mm (5/8")
- AP femur shows early callus over mid medial cortex (healing stress fx)

Leg Length Inequality

- Topic is rich in controversy
- Anatomic vs Functional
- Clinically significant vs insignificant
- Accurate measurement
- Treatment implications
- To “lift” or not to “lift”
- Impact athletes vs regular mortals
Leg Length Inequality

• 90% of population has some anatomic leg length inequality
• Mean LLI is 5.21 mm (3/16”)
• Left leg is longer 53–75% of the time
• No differences between genders
• 15% have LLI > 10mm
• 2.4% > 15mm

Anatomic (Structural) Limb Length Inequality

Functional leg length inequality due to scoliosis

• Leg is of equal length to opposite side but pelvic obliquity resulting from spinal curvature makes it appear short
Magnitude of Inequality

- Evidence suggests that for most people, anatomic leg-length inequality is not clinically significant until ~20mm
- LLI prior to skeletal maturity, body makes adaptive changes which become permanent in spine and pelvis
- LLI acquired after maturity (fracture, hip replacement), body does not make compensatory changes

How to Diagnosis LLI

- Mixed data on significance in military recruits and athletes
- Increased LLI associated with back pain, patellar tendinitis, patellofemoral pain, stress fractures, arthritis of hip & knee, balance deficits and decreased trunk (core) strength

- Best method initially is standing AP x-ray of pelvis centered on femoral heads done with computed digital radiography (PACS = Picture Archiving & Communication System) - less radiation & greater enhancement capabilities
- Level iliac crests first with block or book, then take x-ray (gives measure of LLI)
How to Diagnosis LLI

- Scanogram only if necessary (standing x-ray from top hip down to ankle containing with a ruler present on the film for accurate measurement – requires more radiation and more time to interpret results
- Palpation and tape measure least accurate

Body’s Adaptation to LLI

- In order to keep both feet flat on the ground and to stand upright, body compensates for LLI as follows:
  - LLI < 20mm: passive structural changes of pelvic torsion, mild lumbar scoliosis, facet angulation and change in muscle length
  - LLI > 20 mm: in addition, active muscular compensatory occurs which if prolonged becomes painful

Treatment:
Distinguish true anatomic LLI from “Functional” LLI
**Functional LLI**

- Pelvic obliquity (scoliosis)
- Adduction or flexion contracture of hip
- Genuvalgum/varum/recurvatum
- Foot deformities: Calcaneovalgus/Equinovarus
- Over pronation
- “Spasm” above the pelvis (erector spiniae/quadratuslumborum
- Roadway crown, banked running surface
- Asymmetric shoe wear

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**Structural LLI**

**Long Side**
- ASIS high, knee flexion, foot pronation
- Flank pain
- Hip & knee pain
- Psoas tendinitis
- Patellar tendinitis
- Plantar fasciitis
- Medial tibial stress syndrome
- Metatarsalgia

**Short Side**
- ITB tendinitis with lateral knee pain
- Trochanteric bursitis
- SI joint pain
- Achilles tendinitis
- Cuboid syndrome
- Early heel off during walking or running

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**To Lift or Not to Lift**

- LLI > ¾” requires muscle compensation that over time becomes painful—proven that lift can assist with relieving pain
- With lesser LLI, best to allow therapist to work on soft tissue elements first to improve flexibility, alignment and strength, then add lift if symptoms don’t resolve
Damned if you don’t & Damned if you do

Sports

- For impact athlete, if a lift is necessary, gradually correct up to 50% of LLI using an adjustable lift.
- If > 20 mm (3/4") correction is necessary, must be added to outside sole of shoe.
- Remember to consider running surface/shoes.
- Gradual return to running program.
- Change directions on track while training, esp if banked track.
- Replace shoes after 400-500 miles of wear.
- Gradual return to running program.

Treatment????????

18 year old high school senior cross country runner with lifelong anatomic LLI of 20mm (3/4")
18 Year Old HS Senior CC Runner

**Etiology**
- Reason for symptoms: change from Illinois "flatland" running to mountainous terrain
- Worn out shoes
- Inflexibility and weakness
- LLI

**Treatment**
- Cross trained
- Replaced shoes
- PT for stretching and strengthening work—especially core
- Videotaped running eval
- Progressive lift (began @1/8") due to video showing he was unbalanced
- Missed CC but made Indoor & Outdoor Track
- Eventually d/c’ed lift

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Treatment????????

16 year old club soccer midfielder with newly acquired anatomic LLI of 15mm (5/8")

**Etiology**
- Reason for symptoms was newly acquired LLI due to inevitable shortening of her high energy (skiing) tibial fx
- Core and hip region weakness
- Intensity of practice & play 1st season back after injury

**Treatment**
- Corrected LLI, started at ~ 1/4"
- Began with adjustable lift—once sure that she was tolerant of lift and symptoms improved, she was provided with permanent orthotics for sports
- Corrected core weakness
- Gradually returned to spring practice with permanent lift in place

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16 Year Old Club (& HS) Soccer Player

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**Additional Reference**

Knutson, GA. Anatomic and functional leg length inequality: A review and recommendation for clinical decision-making, Parts I & II. ChiroprOsteopat 2005; 13 (12).

**Thank you**