



POSNA

The Core Curriculum

Leg length discrepancy: assessment and natural history

Objectives

1. Describe physical exam methods useful for assessment of leg length discrepancy, including potential causes of error with each method.
2. List imaging studies available for quantifying leg length discrepancy. Discuss accuracy and radiation dose for each method.
3. Describe the functional effects of smaller amounts of leg length discrepancy (< 2.5 cms) on posture, incidence of back pain, development of scoliosis, and functional capability.
4. Discuss methods used for predicting leg length discrepancy at skeletal maturity, including possible causes of error.

Discussion points

1. What is a reasonable goal (amount of residual discrepancy at maturity) for a child with leg length discrepancy? Would your goals be different for a child with discrepancy following fracture and a child with a congenital short femur?
2. Describe the data base used for the Green-Anderson and Moseley methods of determining timing of epiphyseodesis. Is this information still reliable?
3. How accurate is bone age assessment? What was the data base for our present method of determining bone age?
4. What factors contribute to error when trying to quantitate orthoroentgenograms and teleoroentgenograms?
5. Are the methods used to assess functional effects of leg length discrepancy valid?

Discussion

Assessment of leg length discrepancy may seem straightforward, but both the clinical and imaging are anything but. For some time, clinicians have recognized a difference between "real" and "apparent" discrepancy. Apparent discrepancies are basically a result of joint contractures; hip abduction results in apparent lengthening of the limb, adduction in shortening. Flexion contractures at the hip or knee can also produce apparent shortening; equinus contracture of the ankle, apparent lengthening. These conditions can also alter the effect of tape measurements, even when made from the anterior superior iliac spine (the so called true leg length measurement). Angular deviations such as genu valgum can alter the path of the tape to further invalidate the measurement. An alternate method is to sit behind the standing patient and palpate the iliac crests, using blocks to bring the examiner's fingers resting on the iliac crests to equal heights. This method also will include discrepancies of foot or pelvis, and a more functional test of the effect of the discrepancy on posture.

Imaging studies also are subject to error. The classic orthoroentgenogram, made with separate exposures of the hip, knee, and ankle joints, does not include effects of the pelvis or foot on discrepancy, and is dependant on careful positioning during the study and the lack of motion by the patient between exposures. Flexion contracture will produce apparent shortening.

Teleoroentgenograms, standing roentgenograms of the entire lower limbs, include the foot and pelvis, but are subject to error from improper positioning and contracture. Increased attention has been directed toward digital imaging, which drastically reduces the amount of radiation exposure. The practical considerations of scheduling and access have resulted in this modality still awaiting widespread use. Interpretation of wrist radiographs for boneage have essentially a one-year variation in accuracy.

Data on leg lengths, expected growth remaining, and bone age are now 3 generations removed from the present, when children were smaller. Reasonable accuracy in predicting timing of epiphyseodesis is still possible if serial data is collected. The advantage of the Moseley chart over the Green-Anderson (both are derived from the same data) is that collection of essential data is required for the Moseley chart completion.

Smaller amounts of leg length discrepancy (less than 2-2.5 cms) do not seem to result in functional complaints by patients. The question of the effect of leg length discrepancy on back pain is still unsettled, but there is little data to implicate lesser amounts of leg length discrepancy as a predictor of back pain.

References

1. Aitken AG, Flodmark O, Newman DE, Kilcoyne RF, Shuman WP, Mack LA. Leg length determination by CT digital radiography. *AJR. American Journal of Roentgenology* 1985;144(3):613-5.
2. Cleveland RH, Kushner DC, Ogden MC, Herman TE, Kermond W, Correia JA. Determination of leg length discrepancy. A comparison of weight-bearing and supine imaging. *Investigative Radiology* 1988;23(4):301-4.
3. Cundy P, Paterson D, Morris L, Foster B. Skeletal age estimation in leg length discrepancy. *Journal of Pediatric Orthopedics* 1988;8(5):513-5.
4. Eastwood DM, Cole WG. A graphic method for timing the correction of leg-length discrepancy. *Journal of Bone & Joint Surgery - British Volume* 1995;77(5):743-7.
5. Gross RH. Leg length discrepancy: how much is too much? *Orthopedics (Thorofare, NJ)* 1978;1(4):307-10.
6. Helms CA, McCarthy S. CT scanograms for measuring leg length discrepancy. *Radiology* 1984;151(3):802.
7. Krettek C, Koch T, Henzler D, Blauth M, Hoffmann R. [A new procedure for determining leg length and leg length inequality using ultrasound. II: Comparison of ultrasound, telerradiography and 2 clinical procedures in 50 patients]. *Unfallchirurg* 1996;99(1):43-51.
8. Liu XC, Fabry G, Molenaers G, Lammens J, Moens P. Kinematic and kinetic asymmetry in patients with leg-length discrepancy. *Journal of Pediatric Orthopedics* 1998;18(2):187-9.

9. Moseley CF. Assessment and prediction in leg-length discrepancy. *Instructional Course Lectures* 1989;38:325-30.
10. Nadler SF, Wu KD, Galski T, Feinberg JH. Low back pain in college athletes. A prospective study correlating lower extremity overuse or acquired ligamentous laxity with low back pain. *Spine* 1998;23(7):828-33.