BIOMECHANICAL EXAMINATION OF THE PEDIATRIC LOWER EXTREMITY

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ARCH HEIGHT OFF WEIGHTBEARING

• Evaluate arch height by placing a ruler from the heel to the first metatarsal head

• Compare arch height of one foot to the other

• Any digital deformities?

  Metatarsus Adductus
  Bleck’s Test

• Bisect the plantar heel

• Where does the ruler bisect the forefoot? (normal 2nd digit or second interspace)

HALLUX RANGE OF MOTION OFF WEIGHT BEARING

• Hallux range of motion off weight bearing

• Grasp the proximal phalanx and dorsiflex at 1st MPJ

  First Ray Range of Motion

• Grasp forefoot so that thumb is under the metatarsal heads

• With your other hand grasp 1st metatarsal head

  First ray range of motion-dorsiflexion
  First Ray Motion- Plantarflexion

Midtarsal Joint Range of Motion- oblique axis
• Supinate STJ

• Grasp foot just distal to the MTJ and put it through a range of motion

• (dorsiflex-abduct, plantarflex adduct)

Ankle Joint Range of Motion

• Bisect the lower lateral 1/3 of the leg and the lateral plantar aspect of the rearfoot

• Dorsiflex the ankle, keeping the STJ neutral and MTJ supinated/ if you mistakenly pronate the stj as you evaluate ankle dorsiflexion, you will get a false impression that the patient has adequate ankle range of motion

Leg Length Evaluation

• Patient is supine

• Place hands on ASIS to make sure that pelvis is level

• Compare the level of one malleolus to the other

• Flex both hips and knees so that both heels are parallel with each other

• Compare knee heights

Anatomic (structural) discrepancy – measure from anterior superior iliac spine to medial malleolus

Apparent (functional) discrepancy- measure from umbilicus to medial malleolus of left and right leg

CHECK FOR SCOLIOSIS

Adam’s Forward Bend Test

Lumbosacral Area
Patient had an underlying spinal tumor and unilateral cavus foot deformity

Netter’s Method of Assessing Femoral Anteversion Ruwe et al JBJS 1992 74

• Patient is prone with knee flexed 90 degrees and hip extended
• Palpate greater trochanter with one hand while opposite hand internally rotates hip
• At the point of maximum greater trochanter prominence, neck is parallel to the table
• Angle formed between the tibia and true vertical represents the femoral anteversion

HIP ROTATIONS

• GRASP SOFT TISSUE FIRMLY BEHIND KNEE AND INWARDLY (MEDially) & OUTWARDLY (LATERALLY) ROTATE LEG AT HIP JOINT

HIP Rotation

• Infants -60 degrees lateral; 0-30 degrees medial

• 6 months of age- 50 degrees lateral; 30 degrees medial

• 1-4 years of age-40-45 degrees lateral; 35-45 degrees medial

HIP ABDUCTION
  (hip extended)
HIP ABDUCTION
  (hip flexed)

If asymmetry in hip abduction, think possible hip pathology

TIBIAL TORSION
osseous twist in the bone

• Birth – 0 degrees
• 18 months – 9 degrees
• 3 years- 12 degrees
• 6 years- 18-23 degrees (adult value)

  Tibial Torsion patient is supine with hip and knee extended

• Place knee on the frontal plane

• Compare the medial malleolus to the lateral malleolus

  Hamstring Flexibility

• Hip and knee are extended
• Leg is raised to resistance
• 70 degrees of hip flexion should be obtained

  POPLITEAL ANGLE- also tests for hamstring tightness

• With hip flexed 90 degrees, extend knee until firm resistance is met, acute angle between lower leg & imaginary line extending from a bisection of the lateral aspect of thigh
• Birth- 2 yrs. 0-6 degrees
• 5 and older 0-25 degrees full ROM

  Subtalar Joint Neutral Position

• Bisect lower 1/3 of leg
• Bisect posterior calcaneus
• Place STJ in neutral position

  Observe relationship between heel and lower leg- subtalar varus?
Subtalar Joint Range of Motion

- Patient is prone/place stj in neutral
- Rotate heel into maximum supination
- Rotate heel into maximum pronation
- There should be a 2:1 relationship between supination and pronation. A young child may have a 3:1 or 4:1 ratio/restricted motion, suspect tarsal coalition

Forefoot to Rearfoot Relationship

- Place STJ in neutral position
- Place thumb on 4th and 5th metatarsal heads and dorsiflex to resistance
- Compare plane of metatarsals to heel bisection
- The plane of the metatarsals should be perpendicular to the heel bisection

Forefoot Varus

- Loading 4th & 5th metatarsal heads
- Note low arch contour

Stance Measurements
Genu Varum or Valgum

- Place patient’s feet so that ankles are as close together as possible

Genu Varum

- If ankles touch and knees can’t, a genu varum

Normal Ranges
• Birth – 1 ½ genu varum
• 1 ½ - 3 straight
• 3 –6 genu valgum
• 6 – 12 straight

Ligamentous Laxity

Beighton Scale
4 or > out of 9
2 pts. dorsiflexion of 5th MCP joint > or equal to 90 degrees
2 pts. Opposition of thumb to volar surface of forearm
2 pts. Hyperextension of elbows > or equal to 10 degrees
2 pts. Hyperextension of knee > or equal to 10 degrees
1 pt. Place hands flat on floor without bending knees

Lumbar Lordosis

Arch Height On Weight Bearing
Tell patient to take a few steps in place and then stop.
• This is their angle and base of stance
• Compare arch height of one foot to the other
  Arch Height
  Wide Base of Stance

Hallux Range of Motion On Weight Bearing
• Place patient in angle and base of gait
• Dorsiflex hallux
• 15- 20 degrees dorsiflexion

Relaxed Calcaneal Stance Position
• Have the patient take a few steps in place and then stop
• Compare the heel bisection to an imaginary perpendicular to the ground
  Relaxed Calcaneal Stance Position - Valgus
  Relaxed Calcaneal Stance Position – Varus

  MIDTARSAL JOINT SUBLUXATION- forefoot abducted to rearfoot

  Neutral Calcaneal Stance Position

  • Patient is placed in angle and base of stance
  • Place patient in neutral
  • Compare heel bisection to imaginary perpendicular line

  Tibial Varum or Valgum

  • Place subtalar joint in neutral
  • Compare lower leg bisection to an imaginary perpendicular to the ground

  Malleolar Heights

  • Have the patient take a few steps in place and then stop
  • Compare the level of one malleolus to the other. If the left medial malleolus is lower (closer to the ground), then the left foot is more pronated than the right side.