SPINE

SCOLIOSIS
- CONGENITAL
- INFANTILE (0-3)
- JUVENILE (3-10)
- ADOLESCENT (>10)
INFANTILE SCOLIOSIS
- AGE 0 - 3
- MALE >>> FEMALES
- NO FAMILY HISTORY
- PAINLESS
- NON OPERATIVE TREATMENT VERY SUCCESSFUL

JUVENILE SCOLIOSIS
- AGE 3 - 10
- FEMALE >>> MALE
- NO FAMILY HISTORY
- PAINLESS
- BRACING FOLLOWED BY SURGERY MOST COMMON TREATMENT

adolescent scoliosis
- AGE > 10
- FEMALE > MALE (7:1)
- FAMILY HISTORY
- PAINLESS
- NON OPERATIVE TREATMENT VERY SUCCESSFUL
A child presents for her 2-week evaluation after being delivered by a midwife at home. The parents say that they have never seen her turn her head, making it difficult for her to breastfeed. They also note that her back does not appear normal. On physical examination, her hairline appears low posteriorly. You confirm that she does not turn her head, and when placed prone, does not turn her head to the side. Her right scapula appears to be higher than the left, and you note that the spine does not appear to be perfectly straight, suggesting congenital scoliosis. You obtain an AP radiograph of the cervical spine, which shows multilevel segmentation anomalies in the mid to lower cervical spine.

Of the following, the condition that is MOST consistent with these findings is:

A. Cleidocranial dysostosis
B. Klippel-Feil syndrome
C. Noonan syndrome
D. Sandifer syndrome
E. Turner syndrome

---

**PRESENTATION**

- **ASYMMETRY OF:**
  - SHOULDER
  - BREAST
  - CHEST
  - WAIST
  - TRUNK
  - LIMB LENGTHS
SCOLIOSIS EXAM
SCAPULA & WAIST ASYMMETRY

SCOLIOSIS EXAM
LIMB LENGTH ASYMMETRY

Apparent Scoliosis from limb length inequality

ASSESS MATURITY
- Risser Sign
- 0 – 1 High Risk
- 4 – 5 Low Risk
**ADOLESCENT SCOLIOSIS TREATMENT**

- <25° → OBSERVE
- 25°–30° WITH 5° PROGRESSION → BRACE
- 30° – 40° → BRACE
- > 40° & RISER 0, 1, 2 → FUSE

**DIASTOMATOMYELIA**

- CAVUS FOOT

**SYRINGOMYELIA**

- HIGH LEFT THORACIC
- HAND PAIN
- MRI
NEUROFIBROMATOSIS

- CAFÉ – AU LAIT SPOTS
- SHARP CURVES
- VERY AGGRESSIVE

Muscular Dystrophy

- Gowers
- Calf Hypertrophy
- Lumbar Lordosis

SCHEUERMANN’S THORACIC / LUMBAR

- MALES = FEMALES
- 12 – 15 Y.O.
- + FAMILY HISTORY
- PAINLESS / PAINFUL
THORACIC SCHEUERMANS

PIKE

3 WEDGED VERTEBRAE

SKELETALLY IMMATURE

40–90 DEGREES

SURGERY

SKELETALLY MATURE

>90 DEGREES

>60 AND PROGRESSIVE

THORACIC SCHEUERMANS

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SPONDYLO
LYSIS VS LISTHESIS

Lysis

Listhesis

Grade 3 Slippage

SPONDYLO
HISTORY

• ANY AGE
• PAIN WITH EXERCISE
• HIP AND THIGH
• GYMNASTICS / FOOTBALL

EXAM - TIGHT HAMSTRINGS
XRAY - STRESS FRACTURE
Bone Scan or MRI

SPONDYLO

Lumbar Flexion

Decreased Lordosis

NYU Langone
KLIPPEL-FEIL

- CONGENITAL CERVICAL FUSION
  - EMBRYOLOGIC

- TRIAD
  - LOW POSTERIOR HAIRLINE
  - SHORT NECK
  - LIMITED NECK MOTION

- INSTABILITY

ASSOCIATIONS
- SPRENGEL DEFORMITY
- CARDIAC
- RENAL

CONGENITAL SPINA BIFIDA OCCULTA

INFECTION SPINE

HISTORY
- URI
- DENTAL WORK
- FEVER
- INCREASING PAIN
INFECTION

MRI IS BEST STUDY

SPINE NEOPLASM

- OSTEOID OSTEOMA
- OSTEOBLASTOMA
- ABC
- E.G.
- SPINAL CORD TUMOR

OSTEOID OSTEOMA

- NIGHTTIME PAIN
- NSAIDs
- SCOLIOSIS
EOSINOPHILIC GRANULOMA
• VERTEBRA PLANA

DISC HERNIATION DIAGNOSIS
HISTORY
• TWISTING, LIFTING
• RADICULAR PAIN
MRI

REFERRED PAIN:
3Gs
• GYN
• GU
• GI
You are examining a newborn boy in the nursery. Findings are normal except for asymmetric thigh folds and a questionable “clunk” on Barlow maneuver. While you wait for results from hip ultrasonography, you review his records.

Of the following, the indicator MOST likely to increase your suspicion of hip subluxation is

A. first-born child
B. male sex
C. meconium staining
D. polyhydramnios
E. vertex positioning

An 18-month-old girl who has been adopted from Russia presents to your office for an initial health supervision visit. The mother notes that the girl limps, and she thinks one leg is longer than the other. There is no history of medical attention for this problem in the adoption documentation. Review of available medical history and the current physical examination reveal no signs of illness. The child appears to be otherwise growing and developing normally. On physical examination, you measure a leg-length discrepancy of 2 cm, and the girl has a “waddling” type limp and difficulty in abducting her right thigh at the hip.

Of the following, the MOST likely diagnosis is

A. developmental dysplasia of the hip
B. femoral anteversion (internal femoral torsion)
C. Legg-Calvé-Perthes disease
D. slipped capital femoral epiphysis
E. vitamin D-dependent rickets
DISLOCATIONS

• DEVELOPMENTAL
• NEUROMUSCULAR
• TERATOGENIC

DDH

FIRST FEMALE BREECH 70%
• LEFT HIP 60%
• RIGHT HIP 20%
• BILATERAL 20%
• TORTICOLLIS 20%
• METARSUS ADDUCTUS 10%
• INCIDENCE 1/1000

ASSOCIATED DISORDERS

TIGHT LEFT SCM

TORTICOLLIS
ASSOCIATED DISORDERS
METATARSUS ADDUCTUS

ETIOLOGY
- GENETIC - 10X
- HORMONAL
- MECHANICAL - BREECH

DIAGNOSIS
- PHYSICAL EXAM - BIRTH
- ULTRASOUND - < 6 MONTHS
- XRAY > 6 MONTHS
PHYSICAL EXAM
ORTOLANI SIGN
- ABDUCTION
- ANTERIOR PRESSURE
- RELOCATE HIP

PHYSICAL EXAM
BARLOW SIGN
- ADDUCTION
- POSTERIOR PRESSURE
- DISLOCATE HIP

LIMITED ABDUCTION
3 MONTHS
- BILATERAL
- UNILATERAL

LIMITED ADDUCTION
3 MONTHS
- BILATERAL
- UNILATERAL
**GALEAZZI SIGN**
6 MONTHS

- Painless limp
- Galeazzi sign
- LLD
- Abduction
- Internal Rotation
- X-Ray
LLD

TRENDELENBERG LIMP
- DDH – 1 YEAR OF AGE
- Legg – Calve – Perthes
- 4 – 8 YEARS OF AGE

HIP ULTRASOUND
HIP ULTRASOUND

NOT A ROUTINE NEWBORN SCREENING EXAM

RADIOGRAPHS

X-Rays useful after 6 Months of age

PAVLIK HARNESS

FLEXION STRAPS - LIMIT EXTENSION

ABDUCTION STRAPS - LIMIT ADDUCTION
SEPTIC ARTHRITIS
- Surgical emergency
- Sequelae
  - Sepsis
  - Joint damage
    - Cartilage destruction
- Prompt diagnosis & treatment

JOINT INFECTION
- HIP
- KNEE
- SHOULDER
- ANKLE
- ELBOW

PATHOPHYSIOLOGY
- Hematogenous seeding
- Contiguous infection
- Primary seeding
  - Surgery/Trauma
**CLINICAL PRESENTATION**
- Acute onset
- Irritable hip
- Limp to NWB
- Fever
- Limited motion/severe pain
- FABER position
  - Flexed
  - Abducted
  - Ext Rotation

**INDEPENDENT MULTIVARIATE PREDICTORS**
- HISTORY OF FEVER (> 38.5°C ORAL DURING PRIOR WEEK)
- NON-WEIGHT-BEARING
- ESR>40mm/hr
- SERUM WBC>12,000

**IMAGING**
- Radiographs
- US
- MRI
  - Normal
  - Infection
DIFFERENTIAL DIAGNOSIS
- Transient synovitis
- Lymes disease
- Perthes
- JRA (2 & 10 y/o)
- Rheumatic fever
- Osteomyelitis
- SCFE
- Tumor or systemic disease

SYNOVITIS VS INFECTION
- History of viral infection (4–6 weeks)
  - Limited pain-free motion
  - Minimally abnormal LABS
  - Responds to NSAIDs
- History of bacterial infection (7–14 days prior)
  - No pain-free joint motion
  - FABER
  - WBC, ESR/CRP, Temp
  - + Bone scan

Septic hip vs transient synovitis algorithm
- NWB
- ESR > 40
- CRP > 2X nl
- T > 38.5
- WBC > 12

<table>
<thead>
<tr>
<th></th>
<th>Probability</th>
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<tbody>
<tr>
<td>0</td>
<td>0.2%</td>
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<tr>
<td>1</td>
<td>3.0%</td>
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<tr>
<td>2</td>
<td>40.0%</td>
</tr>
<tr>
<td>3</td>
<td>93.1%</td>
</tr>
<tr>
<td>4</td>
<td>99.6%</td>
</tr>
</tbody>
</table>
Septic arthritis
- Aspiration
- Tests
  - Cell count
    - > 50,000 WBC
  - Gram stain & Cx
    - Positive 30-50%
  - Glucose
    - < 30%

Treatment
- Surgical drainage
- Antibiotics
  - 6 wks IV/po
  - VARIES

Acute Hematogenous Osteomyelitis (AHO) Causeative Organisms

<table>
<thead>
<tr>
<th>NEONATES</th>
<th>GR B STREP</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>STAPH AUREUS</td>
</tr>
<tr>
<td>INFANTS AND CHILDREN</td>
<td>STAPH AUREUS</td>
</tr>
<tr>
<td>SICKLE CELL DISEASE</td>
<td>STAPH AUREUS, SALMONELLA</td>
</tr>
</tbody>
</table>
A 3 week old preterm infant born at 26 weeks gestation has a Temperature of 37 deg C, Heart rate of 150 bpm and a respiratory rate of 50 bpm. The left knee is swollen without erythema and range of motion is mildly decreased. WBC is 9.0 with 55% PMN and 10% Bands. CSF reveals 15 WBC with 80% lymphs, protein 70mg/dl and glucose 60mg/dl. UA is normal. Cultures are pending. MRI reveals increased signal in the left knee.

What is the next BEST step:
A. Arthrocentesis of the left knee
B. Bone scan of the left knee
C. Radiograph of the left knee
D. Removal of all catheters
E. Ultrasound of the left knee

---

**Legg – Calves – Perthes’**

- 3 – 12 YEARS OLD
- Pain in thigh / knee
- Limited hip abduction / IR
- + Trendelenberg sign
- X-Ray usually positive
- Half head / half dozen rule

---

**LCP Clinical Signs**

- Decreased Internal Rotation
- Decreased Abduction
- Trendelenburg Sign
A 12-year-old boy presents with an itchy rash that you diagnose as scabies. As he leaves the examination room, you note that he is limping. He is overweight, and his mother states he has been playing football to get some exercise. She believes he is limping because he was injured during football practice several weeks ago and has been complaining of left knee pain. Findings on physical examination of the knee are normal, but he complains of pain with hip motion.

Of the following, the radiographic study MOST likely to yield a diagnosis is

A. anteroposterior, lateral, and sunrise radiographs of the knee
B. bilateral anteroposterior and frog leg radiographs of the hips
C. magnetic resonance imaging of the knee
D. ultrasonography of the hip
E. ultrasonography of the knee
Slipped Capital Femoral Epiphysis

- Stable vs Unstable
- Thigh or knee pain
- Limited ABduction
- Limited Internal Rotation
KLEIN’S LINE

EPIDEMIOLOGY
- BOYS 12 – 15 Y.O.
- GIRLS 10 – 13 Y.O.
- < 10 Y.O., BOYS >16 GIRLS >14
  - METABOLIC W/U
    - < 10th PERCENTILE FOR HEIGHT
    - < 10 YEARS OLD
    - > 15 YEARS OLD
    - THYROID PROFILE AND GH LEVEL

ETIOLOGY ENDOCRINE
- GROWTH HORMONE DEFICIENCY
  - MOST COMMON
- HYPOTHYROIDISM
- PANHYPOPITUITARISM
- HYPOGONADISM
- HYPERPARATHYROIDISM
- HYPOPARATHYROIDISM
COMPLICATIONS

- OSTONECROSIS
- CHONDROLYSIS
- OSTEOARTHRITIS

TUMORS

An 8-year-old boy is brought to your office after falling from a swing at school. He complains of right leg pain. Physical examination findings are normal, except he walks with a limp. A radiograph shows no fracture, but a bone cyst is noted.

Of the following, a TRUE statement about bone cysts is that:

A. all bone cysts, regardless of type, are considered premalignant conditions
B. aneurysmal bone cysts occur most commonly in the flat bones
C. aneurysmal bone cysts typically do not cause pain
D. fractures are an uncommon complication of unicameral bone cysts
E. unicameral bone cysts occur most commonly in the humerus and femur
TUMORS

Bone matrix-producing

- Osteoid Osteoma
- Osteochondroma
- Osteosarcoma

TUMORS

Non-Matrix Producing

- Giant Cell Tumor
- Aneurysmal Bone Cyst

TUMORS

Long Bone Tumors

- Unicameral Bone Cyst
A 4-year-old boy is brought in for evaluation by his mother. He has had "intoeing" all of his life, and his grandmother took him to a doctor who prescribed expensive corrective shoes, but he has not improved. Physical examination reveals no metatarsus adductus or tibial torsion. You note that he likes to sit on his knees with his legs behind him in a "W" shape.

Of the following, you are MOST likely to find on completely unclothed examination

a. bowed legs
b. equinovarus deformity
c. femoral anteversion
d. pain over the tibial tuberosity
e. waddling gait

INTOE

- 0 – 6 MONTHS – METATARSUS ADDUCTUS
- 6 MOS – 2 YRS – INT TIB TORSION
- 2 YRS – 6 YRS – FEM ANTEVERSION
Femoral Anteversion

- Femoral neck bony alignment is anteverted 30° (15-50°) at birth
- Decreases to 20° by age 10

Kissing Patellas
Internal Tibial Torsion

- Presents 6 mos - 2 yrs
- Internal “twisting” of the tibia
  - More common than external torsion
- May present with:
  - Femoral Retroversion
  - Bowlegs

TIBIAL VERSION

Thigh Foot Angle

METATARSUS ADDUCTUS
TREATMENT OF MA

- Treat only rigid MA
- Ultrasound hips at 6 weeks
- Stretch up to 6 mos
- Cast > 6 mos
- Surgery > 6 years

CLUBFOOT

- Cavus
- Metatarsus adductus
- Calcaneal varus
- Heel equinus

OUTTOEING

- E.R. hip contracture
- Femoral retroversion
- External tibial torsion
Blount’s

- > 18 Months
- Short / Obese
- Early walker
- Family history

- Diet (Ca)
- Gait – thrust
- X-Ray
- Labs
  - Rickets
  - Metabolic dz

Blount’s

M-D angle

MD < 11 Deg = Normal
MD > 14 Deg = Blounts

GENU VALGUM

- Normal vs. Abnormal
  - Age
  - Symptoms
Vast majority of rotational and angular deformities in young children will resolve spontaneously

Know what is normal
Bracing is not used for rotational deformities (e.g. femoral version, tibial torsion)
Bowed legs need to be evaluated after age 2 especially if it is worsening or symptomatic

Pearls

SPORTS

A 12 year-old basketball player has complained of right knee pain immediately after games for 2 weeks. Although he had complained of knee pain intermittently earlier in the season, there is no history of swelling or injury of the knee. Physical examination findings of the knee are remarkable for full range of motion, no effusion, and swelling over the proximal right tibia that is tender to palpation.

Of the following, the MOST likely diagnosis is

a. jumper’s knee
b. Osgood-Schlatter disease
c. patellofemoral syndrome
d. prepatellar bursitis
e. Sinding-Larsen Johansson disease
STRENGTH TRAINING

- PRESEASON PROGRAM
- 50-60% STRENGTH INCREASE OVER 2-3 MOS
- REDUCED INJURY RISK
- MINIMAL PHYSEAL RISK
- PROPER SUPERVISION
  - PROPER TECHNIQUE
  - LOW WEIGHT, HIGH REP

Sports

- Prolonged Endurance – Damages muscle
- Marshall Test (Flexibility) – Thumb to forearm
- Strength Training – Increase risk of Lumbar strain
- Heat Related Injuries
  - Preventable with Hydration
  - Can cause Death

Nutrition

Supplements - generally recommended
- Decrease Fat – Eliminates Ca, Mg, Fe, Zn, B12
- Energy Requirements – Age, Ht, Wt, Physical Activity
Return to Activity

- Little to no swelling
- Little to no tenderness on palpation
- Full, pain-free range of motion
- Full, pain-free strength through range of motion
- Pain-free joint stability—through rehabilitation, taping, bracing, or surgery
- Full, pain-free general functional activities
- Full, pain-free or minimal discomfort during sport-specific activities

= ASYMPTOMATIC

Enhancers

<table>
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<tr>
<th>STEROIDIC DRUG</th>
<th>CATEGORY</th>
<th>GOALS OF USE</th>
<th>ATHETIC EFFECT</th>
<th>ADVERSE EFFECTS</th>
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<tbody>
<tr>
<td>Androstenedione</td>
<td>Controlled substance</td>
<td>Increase testosterone to gain muscle mass, strength</td>
<td>No measurable effect</td>
<td>Increase vascularity, increase pulse, increase heart rate</td>
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<tr>
<td>Dihydrotestosterone (DHT)</td>
<td>Controlled substance</td>
<td>Increase testosterone to gain muscle mass, strength</td>
<td>No measurable effect</td>
<td>Increase vascularity, increase pulse, increase heart rate</td>
</tr>
<tr>
<td>Growth hormone</td>
<td>Controlled substance</td>
<td>Increase muscle mass, strength, and definition</td>
<td>Decreases performance</td>
<td>Increases risk of aggression</td>
</tr>
<tr>
<td>Creatine</td>
<td>Nutritional supplement</td>
<td>Gain muscle mass, strength</td>
<td>Increase muscle mass during high-intensity workouts</td>
<td>Decreases performance</td>
</tr>
<tr>
<td>Erythropoietin</td>
<td>Nutritional supplement</td>
<td>Increase weight loss, delay fatigue</td>
<td>Increases red blood cell count</td>
<td>Central nervous system effects</td>
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Osteochondritis Dissecans

- Pain
  - Worse with activity
- Locking
- X-Ray/MRI
- Rest / Surgery
Osgood Schlatters Syndrome
- Tibial tubercle pain
- Worse with activity
- Point tender on tubercle
- Clinical Dx
- Stretching

Severs Syndrome
- Point tenderness
- Apophysis

TRAUMA
SPRAINS, STRAINS, & BUMPS

- REST
- ICE
- COMPRESSION
- ELEVATION

Salter Harris Classification

The Salter-Harris Classification of Growth Plate Injuries

WRIST SCAPHOID

- MECHANISM = FALL
- SNUFFBOX TENDER
- THUMB SPICA
A 16-year-old male was involved in a brawl with other teens. He was struck a number of times with fists and clubs, and he admits to punching some of his adversaries as well. He presents 6 hours later with complaint of pain in his wrist. Physical examination reveals moderate swelling and tenderness on the dorsum of the hand in the region of the base of the thumb and index finger. A radiograph of the hand reveals a fracture.

Of the following, the fracture that is associated with the POOREST prognosis for healing is a

a. first metacarpal fracture
b. fracture to the proximal phalanx of the thumb
c. lunate fracture
d. Salter II fracture of the distal radius
e. scaphoid fracture

COMPARTMENT SYNDROME
- PROGRESSIVE PAIN / INCREASING OPIOIDS
- PAIN WITH PASSIVE STRETCH
- PARESTHESIA
- PARALYSIS
- PALLOR
- PULSELESSNESS

SKELETAL DYSPLASIAS & MISCELLANEOUS
MULTIPLE EPIPHYSEAL DYSPLASIA

- SHORT STATURE
- STIFF JOINTS
- NEUROLOGICAL LOSS

RADIOGRAPHIC

- IRREGULAR EPIPHYSIS
  - PROXIMAL FEMUR AND HUMERUS
- MIMICS BILAT PERTHES
- HYPOPLASTIC ODONTOID

ACHONDROPLASIA

- RHIZOMELIC DWARFISM
- FLAT NASAL BRIDGE
- FRONTAL BOSSING
- GENU VARUM (FIBULAR)
- TRIDENT HAND (MR. SPOCK)
- THORACOLUMBAR KYPHOSIS
ACHONDROPLASIA

- INTERPEDICULAR NARROWING
- HORIZONTAL ACETABULAE
- DISTAL GROWTH PLATE TENTING

ACHONDROPLASIA

- INTERPEDICULAR NARROWING
- HORIZONTAL ACETABULAE
- DISTAL GROWTH PLATE TENTING
MULTIPLE JOINT CONTRACTURES

- ARTHROGRYPOSIS – NO DISLOCATIONS
- LARSENS SYNDROME – DISLOCATED JOINTS

OSTEOGENESIS IMPERFECTA VS ABUSE

OI
- TYPE 1 COL
- FRAGILE GRACILE BONES
- BLUE SCLERA
- DENTINOGEN
- BISPHOS

ABUSE
- PREMATURE
- STEPCHILD
- CORNER FXS
- RIB/SPINE FXS
- LE FXS IN NONAMBULATOR

POLYDACTYLY

STRUCTURAL – DOMINANT METABOLIC – RECESSIVE
THANK YOU and GOOD LUCK
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