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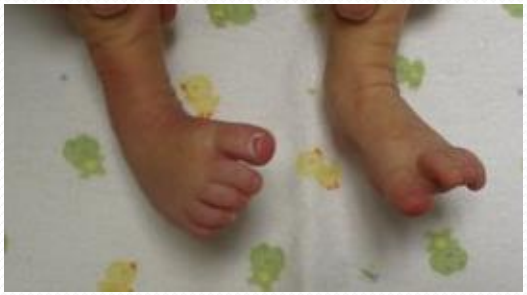
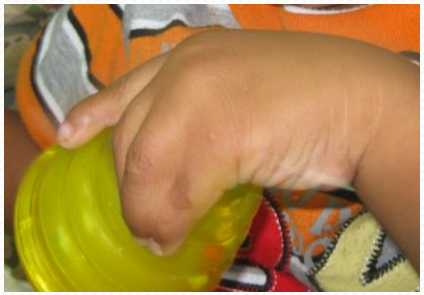
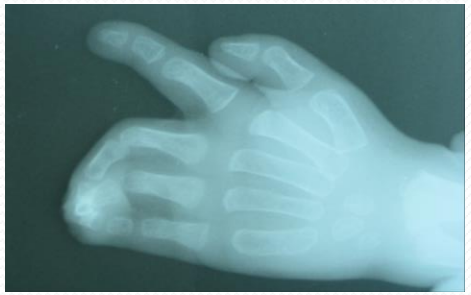
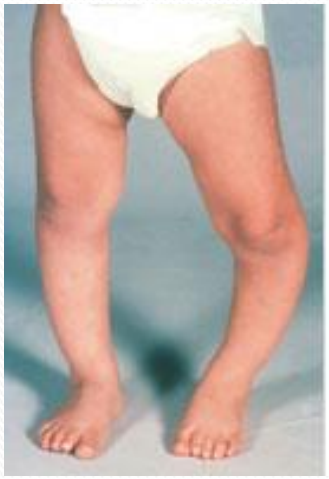
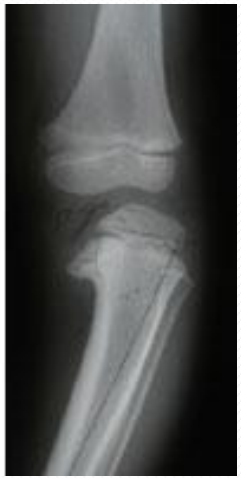
Pediatric Orthopedic Module











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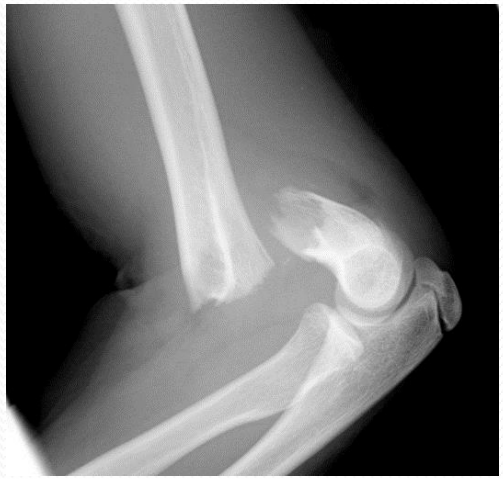


Welcome!

- Welcome to the Department of Pediatric Orthopedic Surgery at Rady Children's Hospital San Diego. We have a very strong teaching program designed to teach medical students, residents and fellows the *Art and Practice of Pediatric Orthopedics*. Your third year rotation will only give you a small glimpse of our specialty. We hope it will spark your interest in working with us in the future; either in our department or as a colleague in one of the other pediatric specialties.

- Our outpatient clinics are on the 3rd floor of the Medical Office Building, 3030 Children's Way. Please show up a 5-10 minutes before the start of clinic for a brief orientation from the clinic nurse before you start seeing patients. Call Karen Noble at x5822 if you are not sure where you should be or if you have any questions or concerns.

Orthopedic Outpatient Clinics:

- We focus on the unique musculoskeletal needs of growing children and adolescents. In addition to general pediatric orthopedic clinics, we have specialty clinics including: trauma, sports, hip, cerebral palsy, muscle disease, spinal bifida, scoliosis, early onset scoliosis, hand, and clubfoot. Know which clinic you will be involved with so you can be adequately prepared.
- The general orthopedic clinics can be very high volume and it is easy to get lost
- Find someone to follow (NP, PA, resident) learn how to take a good history and to examine the patient
- Please don't hesitate to jump in, learn, ask questions, and be a part of the team while you are here!
- We all look forward to teaching you if you are interested and involved!

Rady Children's Hospital San Diego

Orthopedic Attendings:

- *Scott J. Mubarak, M.D.*, Founder of Department. Professor of Clinical Orthopedic Surgery, UCSD
  - Specialties: Foot Deformity, Hip Dysplasia
- *Dennis Wenger, M.D.*, Director of Orthopedic Training Program; Voluntary Clinical Professor of Orthopedic Surgery, UCSD
  - Specialties: Foot Deformity, Hip Dysplasia
- *Henry Chambers, M.D.*, Director, Southern California Cerebral Palsy Center, Co-Director, Pediatric and Adolescent Sports Medicine; Professor of Clinical Orthopedic Surgery, UCSD
  - Specialties: Sports Medicine, Cerebral Palsy
- *Peter Newton, M.D.*, Division Chief, Director of Orthopedic Research; Voluntary Associate Clinical Professor of Orthopedic Surgery, UCSD
  - Specialties: Scolisis and Spine Deformity

Orthopedic Attendings:

- *C. Douglas Wallace, M.D.*, Director, Orthopedic Trauma; Associate Clinical Professor of Orthopedic Surgery, UCSD
  - Specialties: Hand, Clubfoot, Trauma
- *Maya Pring, M.D.*, Co-Director Resident Training Program, Staff Orthopedic Surgeon; Associate Clinical Professor of Orthopedic Surgery, UCSD
  - Specialties: Tumor, Deformity, Hip, Trauma
- *Burt Yaszay, M.D.*, Staff Orthopedic Surgeon; Voluntary Assistant Clinical Professor of Orthopedic Surgery, UCSD
  - Specialties: Scolisis and Spine Deformity
- *Eric Edmonds, M.D.*, Co-Director, Pediatric and Adolescent Sports Medicine; Assistant Clinical Professor of Orthopedic Surgery, UCSD
  - Specialties: Sports Medicine
- *Andrew T. Pennock, M.D.*, Staff Orthopedic Surgeon; Assistant Clinical Professor of Orthopedic Surgery, UCSD
  - Specialties: Sports Medicine

Rady Children's Hospital San Diego

Trainees

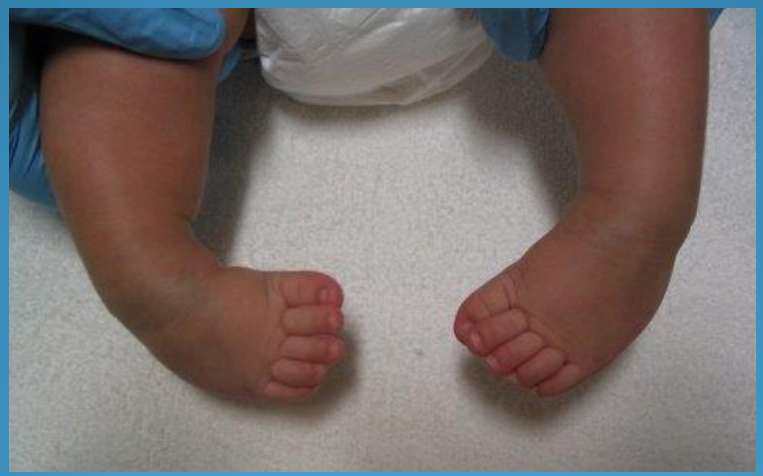
- *Fellows*: We have 4 full time pediatric orthopedic fellows and several international fellows.
- *Residents:* there are 4 orthopedic surgery residents working in our department at all times (2 from UCSD, 1 from the Navy and 1 from the Air Force in San Antonio)
- *Medical Students:* 3rd year medical students doing peds rotation will spend half days in ortho outpatient clinic. 4th year medical students can spend 2-4 weeks on the pediatric orthopedic surgery service.

Orthopedic Outpatient Clinic Team:

- *Nurses:* organize the clinics and make them run smoothly– they are a great resource and will help orient you to our busy clinics
- *Nurse Practitioners and Physicians Assistants:* run their own fracture clinics and will do the initial evaluation of patients in attending clinics and then present the patients to the attending- medical students should follow them in the beginning to learn the basic work-up of musculoskeletal problems
- *Medical Assistants:* will room the patients, record meds, allergies, etc. they can help you locate patients and get patients to the lab, xray, castroom etc.
- *Ortho techs:* will splint, cast, remove pins and sutures
- *X-ray techs:* perform x-rays per orders

Rady Children's Hospital San Diego

Clubfoot
(congenital talipes equinovarus)



Question #1:

- The typical clubfoot deformity does NOT include:
  1. Equinus
  2. Varus
  3. Adductus
  4. Calcaneus
  5. Cavus

Answer:

- **Calcaneus (dorsiflexion of the calcaneus) is the opposite of a clubfoot deformity**.

- Clubfoot deformity or **congenital talipes equinovarus** includes the following structural abnormalities:

  Cavus (plantar flexion of 1st ray)

  Adductus (forefoot)

  Varus (hindfoot)

  Equinus (ankle plantar-flexion)

  (remember the mneumonic CAVE – for deformity and order of correction during casting)

Background

- The incidence of clubfoot is ~1:1000 live births in the United States.
- The male:female ratio is 2:1.
- Bilateral involvement is found in 30-50% of cases.
- There are some genetic factors, but not straight Mendelian inheritance;
  - If the parents are normal and have one child with clubfoot, there is a 2-5% risk of a subsequent child being affected
  - If one parent and a child have clubfoot, subsequent child has a 10-25% risk
- The entire leg is effected – if only one foot is involved, the lower extremity with the clubfoot has a calf that is smaller in diameter, and shorter, even after the deformity is corrected, the foot is smaller than the normal side
- The true etiology of congenital clubfoot is unknown. Most infants who have clubfoot have no identifiable genetic, syndromal, or extrinsic cause.

The Genetics of Idiopathic Clubfoot. Clin ortho relat res, 2002 Aug; (401):39-48.
Family Studies and the Cause of Congenital Clubfoot. JBJS(Br) VOL. 46 *B, NO. 3. Aug1964*

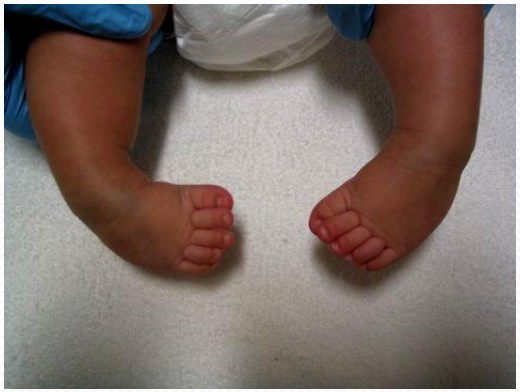
Risk Factors

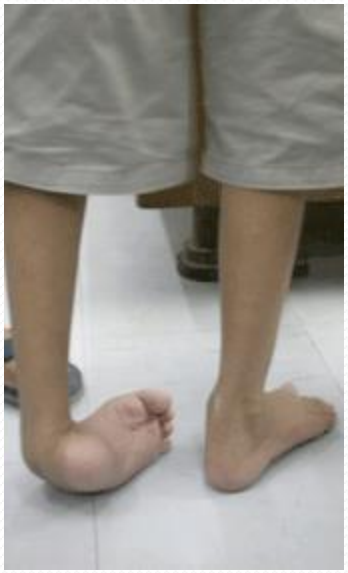
- **Sex:** Clubfoot is more common in males.
- **Family history:** If either parent or siblings have clubfoot, the child is at a higher risk.
- **Some medical conditions are associated with increased risk of clubfoot:** myelomeningocele, arthrogryposis, cerebral palsy, poliomyelitis, peroneal muscular atrophy, Streeter's syndrome…Club feet associated with a syndrome are typically much stiffer and more difficult to treatl

Am. J. Epidemiol. (2000) 152 (7): 658-665.

Presentation

- Congenital Clubfoot is present at birth, and is often diagnosed on pre-natal ultrasound.
- Clubfoot associated with neuromuscular disorders may develop and worsen over time. These feet are stiffer than congenital clubfeet and recurrence rate is higher.
- If a child is not born with clubfoot but develops the deformity, neuromuscular disorder is usually the cause.
- Left untreated, the child will walk on the lateral/dorsal aspect of the foot

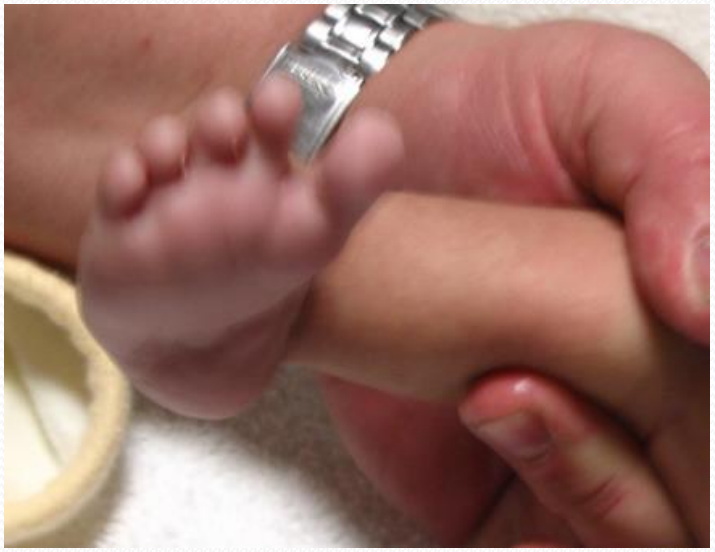




Picture rom the Ponseti website: http://www.ponseti.info/

Workup

- Seek a detailed **pmh and family history** including foot deformity, hip problems, neuromuscular disorders.
- Whenever you examine a newborn, start at the head and examine the whole child: skin, head, neck, back, hips, and last: the feet.
- A classic clubfoot will have a medial crease, a posterior crease, a curved lateral border, internal rotation and lack of dorsiflexion/abduction.



Question #2

- Which imaging modality allows for the earliest detection of clubfoot?

1. X-ray
2. MRI
3. Ultrasound
4. CT Scan
5. Diagnosis of clubfoot is only possible through a complete history and physical examination of newborn.

Proc R Soc Med. 1968 August; 61(8): 779–782.

Answer:

- *Ultrasound*

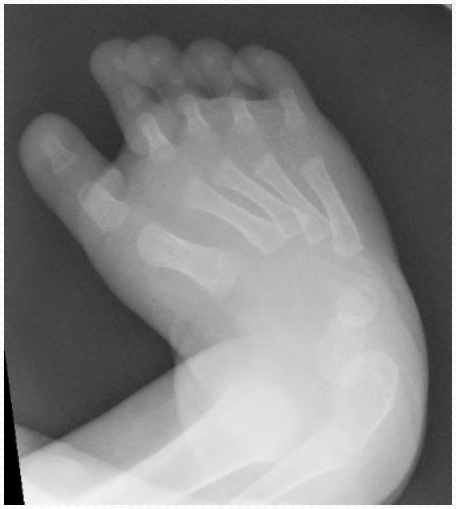
- Doctors can detect clubfoot using Ultrasound images as early as **4 months of pregnancy**.

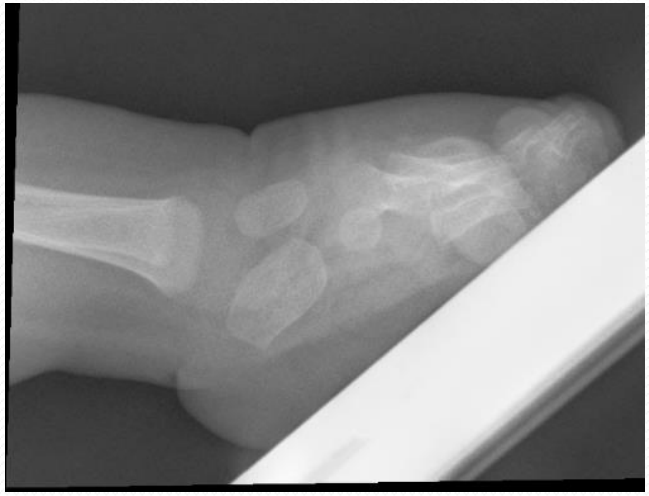
- Pre-natal detection of clubfoot gives parents time to find appropriate physicians to help them understand the diagnosis, possible associated conditions, and treatment plan.

Proc R Soc Med. 1968 August; 61(8): 779–782.

Workup

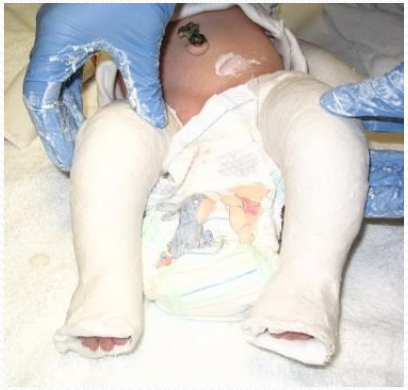
- Child should be evaluated for neuromuscular conditions
- Imaging of clubfoot is usually NOT necessary to make the diagnosis in the newborn, physical exam is diagnostic
- Xrays during treatment may be used to evaluate the correction of bony alignment and to ensure there is no iatrogenic midfoot breakdown.
- AP and Max Dorsiflexion Xrays show parallelism of the talus and calcaneus, equinus and varus position of the forefoot.





Management

- **Ignacio Ponseti , MD** developed a method of treating clubfeet that involves:
- gentle manipulation of the foot at weekly intervals for 6-8 weeks. Manipulation is done to correct the deformities in a specific sequence: **Cavus**, **Adductus**, **Varus**, and lastly **Equinus**.



- To correct the equinus, tendoachilles lengthening is usually required.
- This is followed by **casting** for 3 weeks
- Then **bracing** 22 hours/day for 3 months
- Night time brace treatment

- This method has been used successfully worldwide. Although not the only treatment option, it is the method that we have had the best results from, and the initial method that we recommend at RCHSD.

- Treatment for clubfoot is most predictable when started early and is typically started within **6 weeks of birth,** but good results have been reported when treatment is started up to age 3 years.

Question #3:

- When using the Ponseti method, which of the following components of the clubfoot deformity is recommended to be addressed last?
  1. Metatarsus adductus
  2. Cavus
  3. Supination
  4. Equinus
  5. Hindfoot varus

Answer:

- *Equinus*

- Clubfoot deformity can be broken down into the four constituent parts – cavus of the mid foot, adductus of the forefoot, varus of the hindfoot and equinus of the hindfoot. This deformity can be remembered by the mnemonic CAVE.

- Correction of the deformity is in the order of CAVE, *i.e.* the cavus is corrected first followed by the adductus, *etc*.

Question #4:

- A child with an idiopathic clubfoot is successfully treated by the Ponseti method. The risk of recurrence of the deformity is most dependent on which of the following factors?

1. Maternal age
2. Positive family history
3. Family's compliance with bracing
4. The child's age at walking
5. The child's body mass index

J Bone Joint Surg Am. 2007 Mar;89(3):487-93.

Answer:

- *Family's compliance with bracing*

- Compliance with the postcorrection abduction bracing protocol is crucial to avoid recurrence of a clubfoot deformity treated with the Ponseti method. When the parents comply with the bracing protocol, the Ponseti method is very effective at maintaining a correction, although minor recurrences are still common.

J Bone Joint Surg Am. 2007 Mar;89(3):487-93.

Management:

- The most common complication associated with clubfoot is **recurrence.**
- Children with neuromuscular disorders (spina bifida, arthrogryposis, etc.) have a much higher rate of recurrence.
- Even with treatment, clubfoot may not be totally correctable. But in most cases infants who are treated early grow up to wear normal shoes and lead normal, active lives.

Question #5:

- What is the most appropriate age for surgical treatment of clubfoot, given failure to obtain satisfactory results with non-operative management?

1. Less than 3 months
2. Less than 6 months
3. Between 6 months and 1 year
4. Greater than 1 year
5. Greater than 2 years

J Bone Joint Surg Am. 1979 Sep;61(6A):805-14.

Answer:

- *Between 6 months to 1 year*

- Surgery is indicated if there is failure to achieve satisfactory clinical and radiographic evidence of deformity correction by nonsurgical methods, for residual deformities, and for recurrent deformities unresponsive to nonsurgical measures.

- Controversy surrounds the age at which clubfoot surgery should be performed. Most surgeons operate on the child between **six months and one year of age**

J Bone Joint Surg Am. 1979 Sep;61(6A):805-14.

Developmental Dysplasia of the Hip (DDH)

Question #1:

- A 1-week old female with family history of hip dysplasia and diabetes is born via a cesarean-section due to breech positioning. She is suspected to have developmental dysplasia of hip. Which of the following is not a risk factor for DDH?

1. Female
2. Family history
3. Diabetes
4. Breech position
5. Oligohydramnios

Answer:

- *Diabetes*

- First born child, female (6:1 over males), breech, family history, and Oligohydramnios are all risk factors associated with DDH. Gestational Diabetes however has not been shown to increase the risk of DDH development.

Am Fam Physician. 2006 Oct 15;74(8):1310-1316.

Background

- Developmental Dysplasia of the Hip (DDH) refers to a spectrum of hip development abnormalities; from dysplasia to dislocatable to dislocated hips.
- A broader definition of DDH is simply abnormal growth of the hip
- Abnormal development of the hip includes the acetabulum, proximal femur, labrum, capsule, and other soft tissues.
- The overall frequency of developmental dysplasia of the hip (DDH) is usually reported as approximately 1 case per 1000 individuals

Background

- More specific terms are often used to better describe the condition; these are defined as follows:

Subluxation – This is incomplete contact between the articular surfaces of the femoral head and acetabulum.

Instability – This consists of the ability to subluxate or dislocate the hip with passive manipulation.

Dislocation – This refers to complete loss of contact between the articular surface of the femoral head and acetabulum.

Teratologic dislocation – This associated with neurologic disorders (very difficult to reduce).

Risk Factors

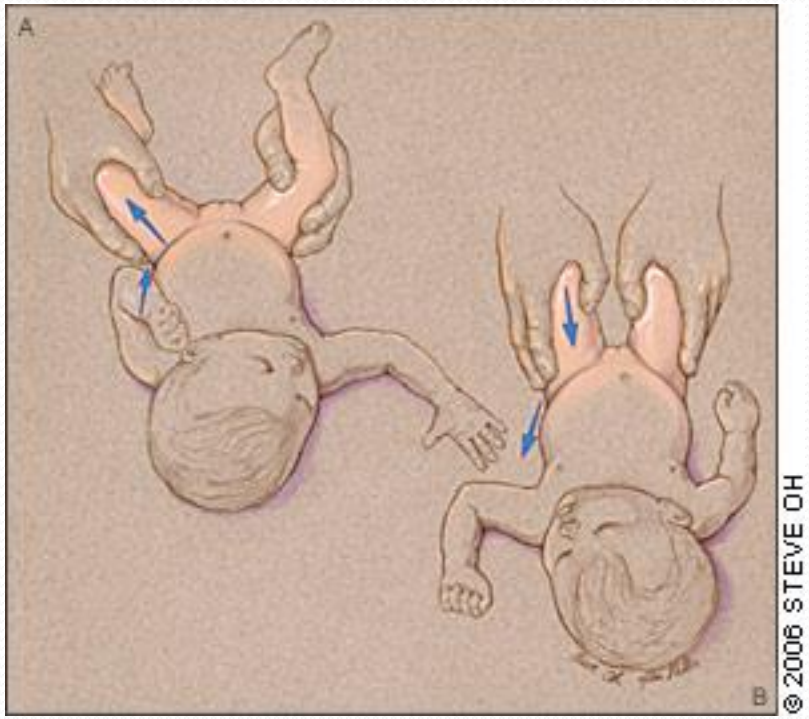
- The etiology of hip dysplasia is not clear, but this condition does appear to be related to a number of different factors

- Risk factors include
  - first born
  - female (6:1 over males)
  - breech
  - family history
  - Oligohydramnios

Archives of Disease in Childhood 1997;76:F94–F100

Presentation

- Early clinical manifestations of developmental dysplasia of the hip (DDH) can be identified during examination of the newborn.
- The classic examination finding is revealed with the **Ortolani** maneuver; a palpable "clunk" when the hip is reduced from a dislocated position.
- **Barlow** described another test for DDH that is performed with the hips in an adducted position, in which slight gentle posterior pressure is applied to the hips. A clunk should be felt as the hip subluxes out of the acetabulum.
- Hip dysplasia may only present with reduced abduction.

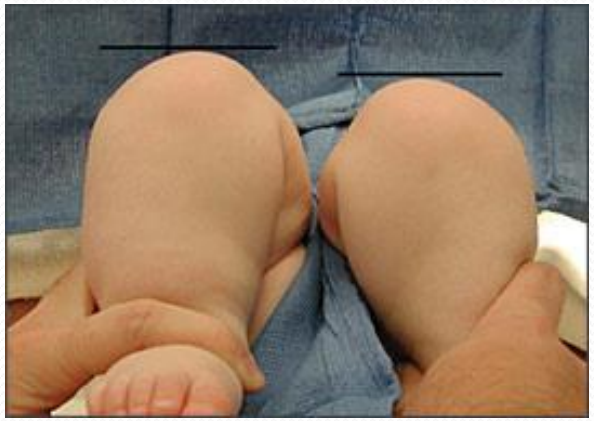


Am Fam Physician. 2006 Oct 15;74(8):1310-1316.

Presentation

- The clinical examination for late DDH, when the child is aged 3-6 months, is quite different. At this point, the hip, if dislocated, is often dislocated in a fixed position.

- The **Galeazzi** sign may identify unilateral hip dislocation. This is performed with the patient lying supine and the hips and knees flexed. The examination should demonstrate that one thigh appears shorter than the other.



Am Fam Physician. 2006 Oct 15;74(8):1310-1316.

Question #2:

- If the child suspected of DDH is not examined until she is 4 months old, which of the following physical findings is most likely to be present?
  1. Positive Barlow
  2. Positive Ortolani
  3. Positive Galeazzi sign
  4. Limited hip abduction
  5. Ipsilateral clubfoot

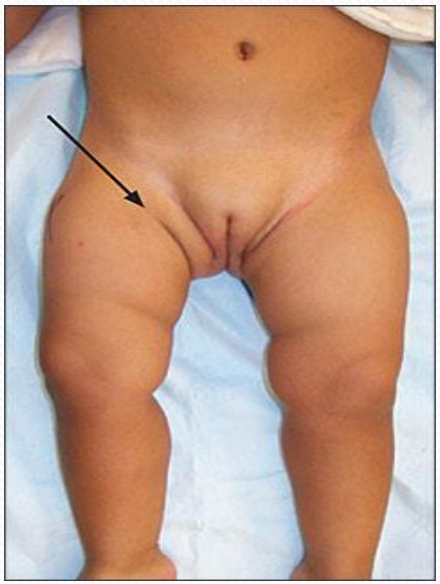
Answer:

- *Positive Galeazzi sign*

- The clinical examination for late DDH, when the child is aged 3-6 months, is quite different. At this point, the hip, if dislocated, is often dislocated in a fixed position. Therefore, exams like Barlow and Ortolani will not be as informative.

Presentation

- Additional physical examination findings for late dislocation include asymmetry of the gluteal thigh or labral skin folds, decreased abduction on the affected side, standing or walking with external rotation, and leg-length inequality



- Bilateral dislocation of the hip, especially at a later age, can be quite difficult to diagnose. Many of the aforementioned clues for a unilateral dislocated hip are not present, such as the Galeazzi sign, asymmetrical thigh and skin folds, or asymmetrically decreased abduction.

Am Fam Physician. 2006 Oct 15;74(8):1310-1316.

Question #3:

- In a 1-month-old female suspected of DDH, what is the best imaging modality to confirm our diagnosis?

1. MRI arthrogram
2. Ultrasonography
3. AP Xray of pelvis
4. Frog-Leg Xray of Pelvis

http://radiopaedia.org/articles/developmental-dysplasia-of-the-hip

Answer:

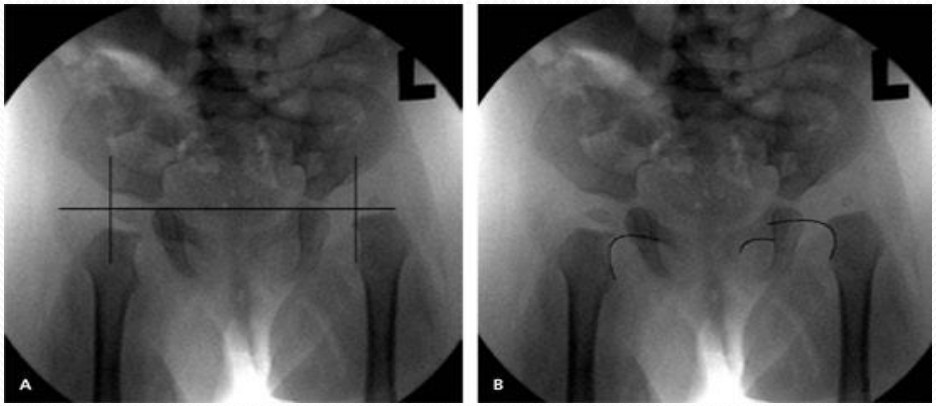
- *Ultrasonography*

- Ultrasonography is the study of choice to evaluate for DDH in infants younger than six months because it is capable of visualizing the cartilaginous anatomy of the femoral head and acetabulum

http://radiopaedia.org/articles/developmental-dysplasia-of-the-hip

Workup

- Radiographs of newborns with suspected DDH are of limited value because the femoral heads do not ossify until **four to six months** of age.
- Ultrasonography is the study of choice to evaluate for DDH in infants younger than **three months** because it is capable of visualizing the cartilaginous anatomy of the femoral head and acetabulum. U/S can also provide dynamic information; allowing physicians to visualize the instability.



http://www.wheelessonline.com/ortho/developmental_dislocation_of_the_hip

Question #4:

- What is the role of routine screening for DDH in infants using Ultrasound imaging?

1. Routine screening using an U/S is indicated in every newborn
2. Routine screening with an U/S is only indicated in the presence of a positive Barlow and Ortalani
3. There is insufficient evidence to recommend routine screening using an U/S for DDH in infants as a means to prevent adverse outcomes.
4. X-ray, not U/S should be used to screen for DDH in every newborn

Pediatrics. 2006;117:898–902

Answer:

- *There is insufficient evidence to recommend routine screening using an U/S for DDH in infants as a means to prevent adverse outcomes.*

- The U.S. Preventive Services Task Force (USPSTF) recently concluded that evidence is insufficient to recommend routine screening for DDH in infants as a means to prevent adverse outcomes.

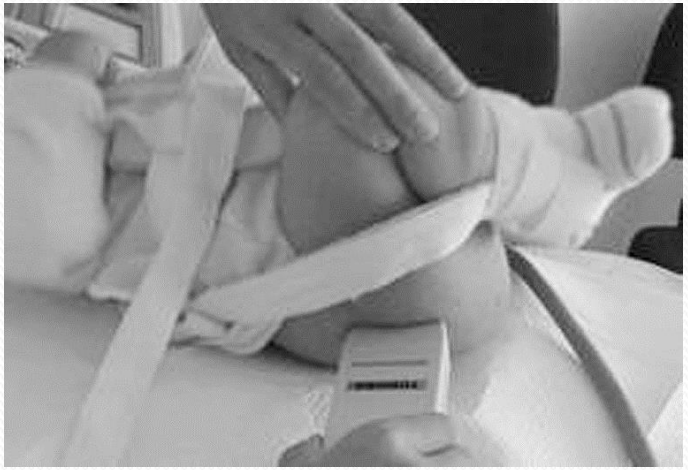
- Evidence shows that screening leads to earlier identification of DDH; however, the USPSTF concluded that 60 to 80 percent of the newborn hips identified by physical examination and more than 90 percent identified by ultrasonography as abnormal or as suspicious for DDH resolve spontaneously and require no intervention.

Pediatrics. 2006;117:898–902

Management

- The goal of treatment is to achieve and maintain reduction of the femoral head in the true acetabulum . The earlier treatment is initiated, the greater the success and the lower the incidence of residual dysplasia.

- In newborns and infants up to six months of age, immobilization in a **Pavlik harness** is tried first. If unreducible after three weeks, then an **abduction brace** is tried. If no improvement after three weeks, then **closed reduction** is tried. If this is also unsuccessful, open reduction should be performed.



Int Orthop. 2007 April; 31(2): 145–150.

Question #5:

- What is the overall success rate of Pavlik harness in treating DDH in children under 6 months?

1. 10%
2. 33%
3. 50%
4. 75%
5. 90%

Int Orthop. 2007 April; 31(2): 145–150.

Answer:

- *90%*
- The overall success rate using the Pavlik harness is about 90 percent, which means that only around 10 percent of children with DDH need the second phase of treatment.
- Again, the second phase of treatment consists of putting a cast on the hips and legs.

Int Orthop. 2007 April; 31(2): 145–150.

Management

- If the hip is irreducible by closed means, or a concentric reduction is not achieved, successful treatment requires open reduction.
- Open reduction of the hip in a child with DDH involves lengthening tendons about the hip, removing obstacles to reduction, and tightening the hip capsule once reduction is obtained.
- The goal of operative treatment of DDH is to normalize the hip joint to delay or prevent the premature onset of osteoarthritis.

Septic Arthritis

Question #1:

- A 2-week old boy is not moving his left hip. The patient was delivered 6 weeks prematurely by C-section. He has no fever. Examination reveals some mild swelling about the left proximal thigh, and passive movement of the hip appears to elicit discomfort. A radiograph of the pelvis shows widening of the femur to teardrop distance on the left side. What is the next most appropriate step in management?
  1. Observation
  2. A Pavlik harness
  3. Modified Bryant traction
  4. MRI
  5. Aspiration of the hip

Answer:

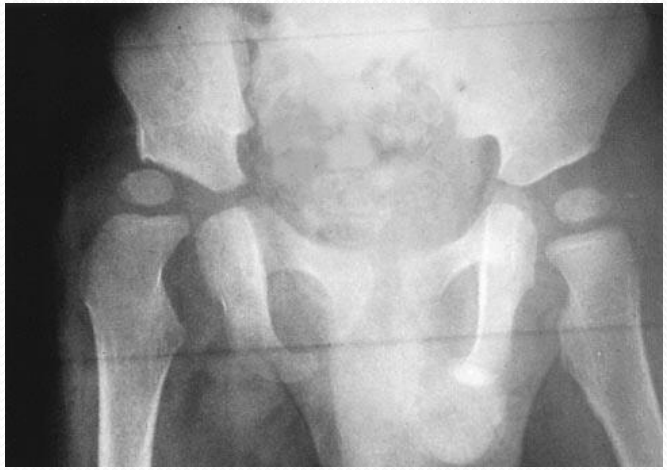
- *Aspiration of the hip*.

- Septic arthritis of the hip is a true orthopedic emergency; delay in diagnosis or treatment may result in irreversible damage to the joint. In an infant with discomfort on passive motion, the index of suspicion for a septic joint should be high.

Background

- Septic arthritis results from the presence of microbial agents in a joint space. Septic arthritis of the hip is a true orthopedic emergency; delay in diagnosis or treatment may result in irreversible damage to the joint.

- SA is a challenging clinical problem because signs and symptoms may be subtle and overlap with those found in other conditions.



http://www.orthobullets.com/pediatrics/4032/hip-septic-arthritis--pediatric

Background

- Proteolytic enzymes released by inflammatory cells can damage joint cartilage. In addition, inflammatory mediators, bacteria, and pus increase pressure within the joint, compress intra-articular vessels, and impair blood supply to the cartilage and adjacent bone.

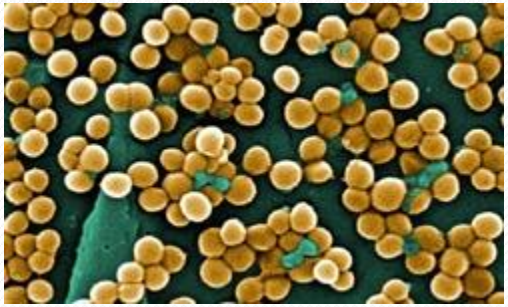
- In the hip, if the condition remains undiagnosed and untreated, contiguous spread may cause ligamentous damage, avascular necrosis of the femoral head, dislocation, and osteomyelitis.

Infectious Organisms

- **Infectious organisms vary with AGE:**
- ***Staph Aureus:***

Most common in children over 2 years of age

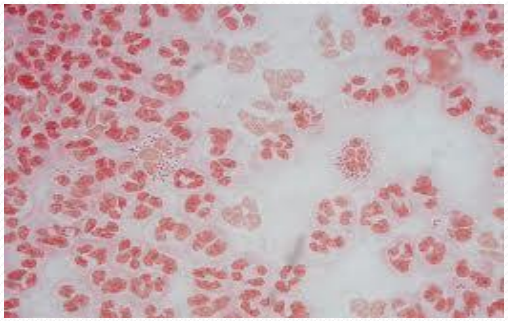
Most common in nosocomial infections of neonates



- ***Neisseria gonorrhoeae:***

Most common organism in adolescents

Patients usually have a preceding migratory polyarthralgia, multiple joint involvement, and small red papules



- ***Group A beta-hemolytic streptococcus:***

Most common organism following varicella infection

- ***Group B streptococcus:***

Most common in neonates with community-acquired infection

Question #2:

- Given that the 2-week old girl has hematogenous septic arthritis of her hip and there are no open lesions and no other sites of infection. The most common infecting organisms include **Staph. aureus** and:
  1. Group B Strep and gram-negative bacilli
  2. Kingella kingae and Haemophilus influenza B.
  3. Neisseria gonorrheae and Borrelia burgdorferi
  4. Yersenia species and Haemophilus influenza B
  5. Kingella kingae and Mycoplasma variants

Answer:

- *Group B Strep and gram-negative bacilli*

- Group B strep is most common in neonates with community-acquired infection. Groups B, G, C, and F, in order of decreasing preponderance, are also isolated, especially in patients with immunocompromise, diabetes mellitus, malignancy, and severe genitourinary or gastrointestinal infections.

- Gram-negative bacilli account for approximately 10 to 20% of cases. The most common gram-negative organisms are *Pseudomonas aeruginosa* and *Escherichia coli.*

Presentation

- Acute joint inflammation marked by severe pain and swelling is the hallmark of septic arthritis (SA).
- If lower extremity joints are involved, parents often report that children cannot bear weight and that they resist all efforts to move the involved joint.
- Children typically have involvement of a single joint; lower extremity joints, especially the knee and hip, account for most cases.
- The shoulder is the most common upper extremity joint to become infected.
- Neonates are more likely to have infection in multiple joints (polyarticular disease).

Questions #3:

- After the confirmation of septic arthritis of the hip in this premature infant. What is the most critical next step is to evaluate for:

1. child abuse.
2. necrotizing enterocolitis.
3. septic arthritis of another joint.
4. an underlying autoimmune disorder.
5. an underlying inflammatory disorder.

Answer:

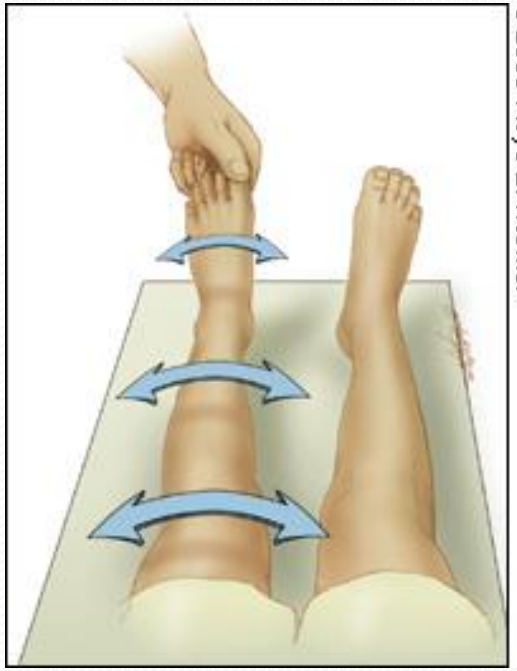
- *Septic arthritis of another joint*

- Neonates are more likely to have infection in multiple joints (polyarticular disease). Therefore, one should evaluate the other joints to rule out infection once septic arthritis of one joint is suspected.

Presentation

- A septic joint may be so painful that the child does not tolerate any range of motion, resulting in pseudoparalysis.

- If the knee or hip is involved, an ambulatory child refuses to walk or bear weight on the affected limb.



Am Fam Physician. 2000 Feb 15;61(4):1011-1018.

Workup

- Diagnosis of septic arthritis (SA) is established by a combination of clinical findings and results of synovial fluid analysis. Clinicians should have a low threshold for performing arthrocentesis, especially for children with a painful monoarthritis, significantly limited range of motion, and no plausible noninfectious explanation

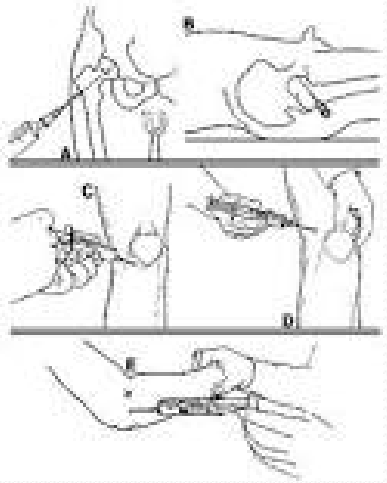
- Hip aspiration:

Indicated whenever high suspicion for infection

Required to confirm diagnosis

Joint aspirate will show

  - WBC usually > 50,000 with >75% PMN's
  - glucose 50 mg/dL less than serum levels



Question #4:

A 2-year-old child refused to walk 3 days prior to being see because of pain in the left hip. The pain has gradually subsided and the child is now walking. He is afebrile and has full motion of the hips. Laboratory studies show a normal CBC with differential and C-reactive protein. An ultrasound shows a joint effusion in the right hip. What is the most likely diagnosis?

1. Juvenile inflammatory arthritis
2. Septic arthritis
3. Osteomyelitis of the femur
4. Leukemia
5. Toxic synovitis

Answer:

- *Toxic or transient synovitis*

- Transient synovitis is a diagnosis of exclusion. The diagnosis can be made in the typical setting of pain or limp in a young child who is not generally unwell and has no recent trauma. There is a limited range of motion of the hip joint.

- If septic arthritis needs to be ruled out, joint aspiration can be performed under ultrasound guidance. In transient synovitis, the joint fluid will be clear. In septic arthritis, there will be pus in the joint, and inflammatory markers will be distinctly elevated.

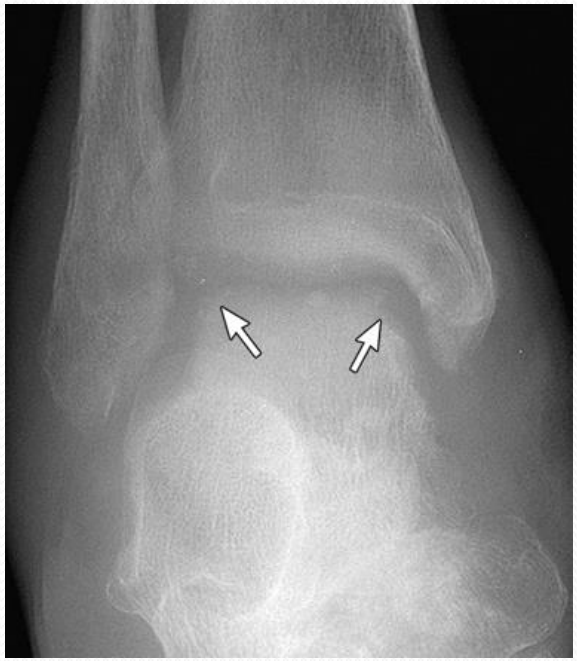
Workup

- 90% chance of septic arthritis if
  - WBC > 12,000 cells/ml
  - inability to bear weight
  - fever > 101.3
  - ESR > 40
  - CRP > 2.0 (mg/dl)
    - temperature > 101.3 (38.5c) is the best predictor of septic arthritis followed by CRP of >2.0 (mg/dl)

Imaging

- X-Ray:

Although plain radiography may reveal an effusion as widening of the joint space with displacement of fat planes, it is **insensitive** in the diagnosis of septic arthritis (SA) early on. Radiographs obtained later may show bony changes.



- U/S:

Ultrasonography is a simple and relatively inexpensive technique for detecting a hip effusion. This test has a **greater sensitivity** than plain radiography and may also show osteomyelitis

Radiology, August 2008, 248, 378-389.

Question #5:

- What is the first step of management once the diagnosis of hip septic arthritis of the hip is established?

1. 3-4 weeks of oral antibiotic therapy
2. 1-2 weeks of IV antibiotic therapy
3. Encourage early passive range of motion.
4. Emergent irrigation and drainage

Answer:

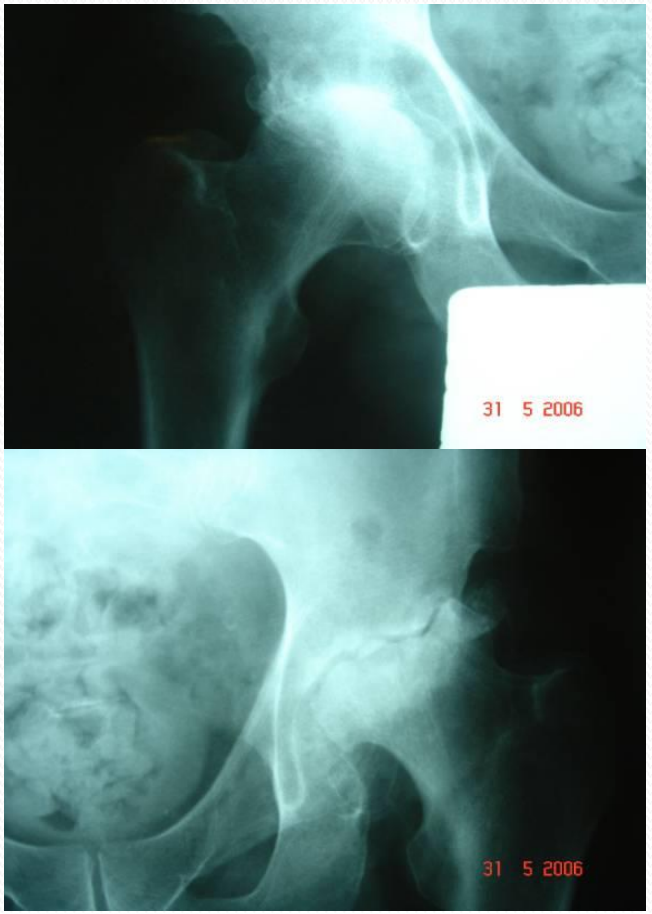
- *Emergent irrigation and drainage*

- Septic arthritis of the hip requires emergent irrigation and drainage to minimize risk of aseptic necrosis of the femoral head.

Management

- Septic arthritis of the hip requires emergent irrigation and drainage to minimize risk of aseptic necrosis of the femoral head.

- When initiating antibiotic therapy always include coverage for MRSA until cultures show otherwise. Begin with Clindamycin and adjust once the lab results are back.



http://www.jortho.org/2007/4/2/e14/

Management

- Once an organism is identified, an appropriate antibiotic is selected, and the child is demonstrating a good clinical response, continue outpatient therapy with either high-dose oral antibiotics or parenteral antibiotics.

- Urgent arthrotomy and open drainage is usually performed in septic arthritis of the hip or shoulder, septic arthritis of other joints if no improvement occurs within 3 days of starting antimicrobial therapy, or if a large amount of pus or debris is aspirated during diagnostic arthrocentesi

Slipped Capital Femoral Epiphysis (SCFE)

Question #1:

- Patients with slipped capital femoral epiphysis are more likely to experience a delay in definitive diagnosis if they initially present to a physician reporting which of the following problems?

1. Limp
2. Hip pain
3. Knee pain
4. Proximal thigh pain
5. Buttock pain

J Pediatr Orthop. 1999 Jul-Aug;19(4):455-60.

Answer:

- *Knee Pain*

- Even though isolated distal thigh or knee pain or both is a common presentation of SCFE, when compared with the more classic presentation of SCFE, they lead to a higher rate of unnecessary radiographs, misdiagnoses, and severe slips, potentially increasing long-term morbidity.

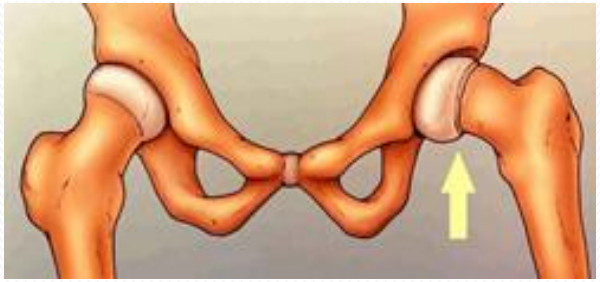
J Pediatr Orthop. 1999 Jul-Aug;19(4):455-60.

Background

- Slipped capital femoral epiphysis (SCFE) is an unusual disorder of the adolescent hip where the ball at the upper end of the femur (femoral head) slips off in a backward direction.

- Although SCFE is a rare condition, an accurate diagnosis combined with immediate treatment is critical.

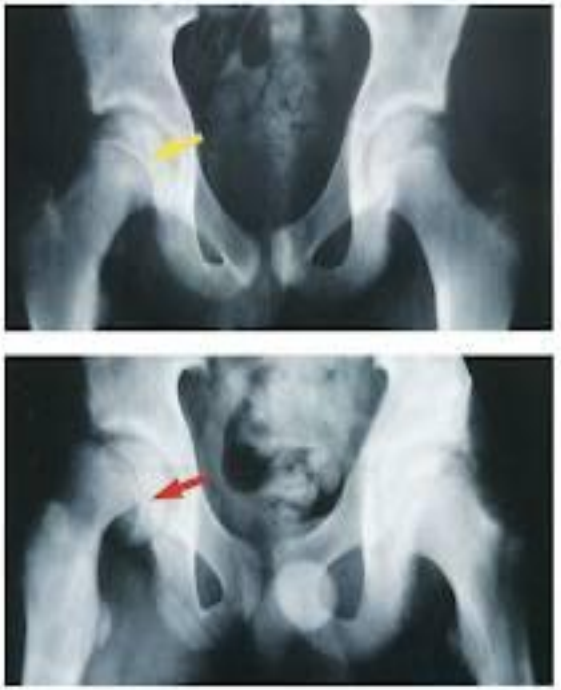
- Despite the fact that the underlying defect may be multifactorial (eg, mechanical and constitutional factors), SCFE represents a unique type of instability of the proximal femoral growth plate.



http://orthoinfo.aaos.org/topic.cfm?topic=a00052

Background

- The overall incidence for SCFE in the United States is 10.8:100,000. The incidence rate in boys (13.35 per 100,000) is higher than in girls (8.07 per 100,000).
- When compared with white children, black children have a higher incidence rate at 3.94 times, and Hispanic children have a 2.54 times higher incidence rate.
- In general, about 20% of patients have bilateral involvement at the time of presentation. It is felt that an additional 20-40% will subsequently progress to bilateral slips.



www.seattlechildrens.org/medical-conditions/bone-joint-muscle-conditions

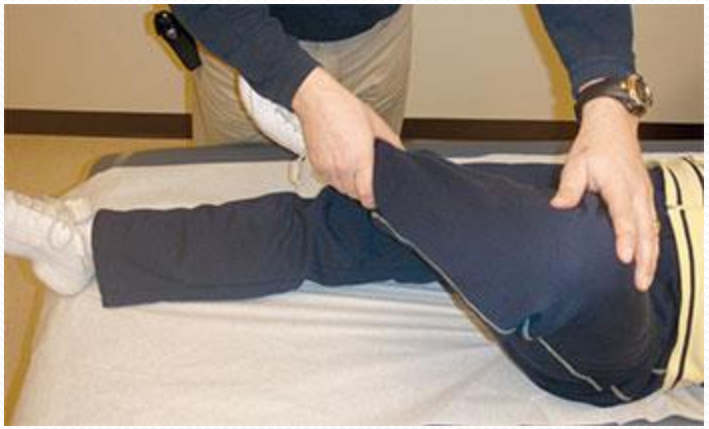
Risk Factors

- The most important risk associated with SCFE is **obesity**. Other less common medical causes include hypothyroidism, low growth hormone level, pituitary tumors, and renal osteodystrophy.

Presentation

- Slipped capital femoral epiphysis (SCFE) is most common in the adolescent period (ie, boys aged 10-16 years, girls aged 12-14 years). Males have 2.4 times the risk compared with females.

- Symptoms are waddling gait, loss internal rotation in the hip joint, externally rotated foot, pain in the knee / groin or hip.



American family physician 57 (9): 2135-42, 2148-50.

Question #2

- The classification of SCFE into stable and unstable types is based on:

1. Duration of symptoms
2. Radiographic stability on fluoroscopic exam
3. Ability to bear weight on the affected extremity
4. Remodeling of the femoral neck
5. Degree of displacement present

http://www.orthobullets.com/pediatrics/4040/slipped-capital-femoral-epiphysis

Answer:

- *Ability to bear weight on the affected extremity*
- It is important to determine if the lesion is stable or unstable.
- "Stable" SCFEs allow the patient to walk
- "Unstable" SCFEs do not allow the patient to walk at all; It is more similar to an acute fracture. These cases carry a higher rate of complication, particularly of AVN.

http://www.orthobullets.com/pediatrics/4040/slipped-capital-femoral-epiphysis

Question #3

- Approximately what percentage of stable vs unstable cases of SCFE progress to develop AVN of the femoral head?

1. <1% vs 50%
2. 10% vs 50%
3. <1% vs 75%
4. 10% vs 75%
5. Rate of AVN is approximately equal with both conditions if left untreated

J Child Orthop. 2007 July; 1(2): 121–125.

Answer:

- *<1% vs 50%*
- The unstable forms of SCFE are rare but can have disastrous consequences on the anatomy and the function of the hip.
- AVN is a devastating complication of unstable SCFE, secondary to the interruption of epiphyseal vessels.
- AVN incidence varies between 25% and 50% of cases and seems to increase when a reduction of the displacement is performed under general anesthesia

J Child Orthop. 2007 July; 1(2): 121–125.

Presentation

- Always examine both hips. Assess the active and passive range of motion in both hips. In patients with unilateral complaints, this comparison allows the clinician to compare the affected and unaffected sides for differences.

- If SCFE is present, the lower extremity may externally rotate. Internal rotation is decreased in nearly all hips with SCFE. Internal rotation is often painful.

- If concerned about acute SCFE, provider should NOT attempt range of motion since it may make it worse

American family physician 57 (9): 2135-42, 2148-50.

Workup

- Appropriate laboratory tests should be completed for endocrinopathies and medical disorders ONLY if the patient does not have the bodily habitus concerning with SCFE.

- Atypical presentation is considered for children who present with SCFE who are younger than age 10 years or as well as for children who are not obese.

Question #4

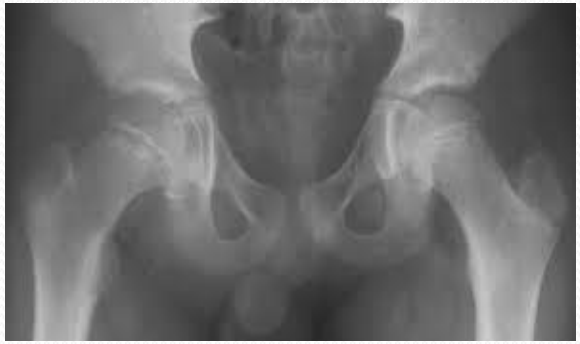
- What is the preferred imaging modality for establishing the diagnosis of SCFE?

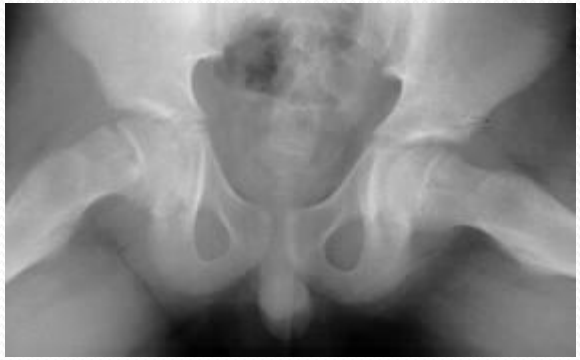
1. Ultrasound of hips bilaterally
2. AP and frog-leg lateral Xrays of both hips
3. MR Angiography of both hips
4. SCFE diagnosis is made based on clinical presentation and physical exam. Imaging is not necessary for diagnosis.

http://orthoinfo.aaos.org/topic.cfm?topic=a00052

Answer:

- *AP and frog-leg lateral Xrays of both hips*
- Radiography is needed for patients eight to 15 years of age with new-onset limping and pain in the hip, groin, thigh, or knee.
- It is important to inform the radiologist of the clinical context and that SCFE is suspected so that the diagnosis can be ruled out.
- Radiography needs to include AP and frog-leg lateral views of both hips to diagnose SCFE.



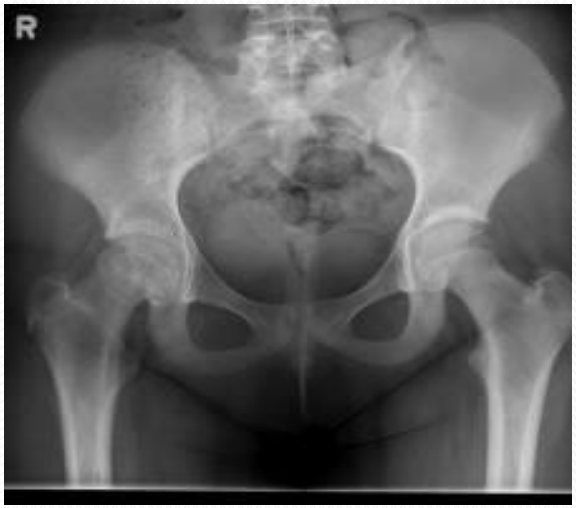


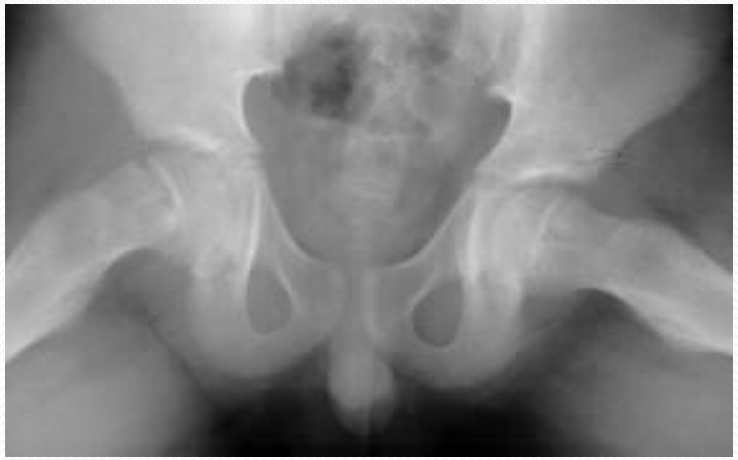
http://orthoinfo.aaos.org/topic.cfm?topic=a00052

Workup

- Obtain AP and frog-lateral radiographs of the pelvis or bilateral hips. (Do Not obtain frog-leg is hip movement is too painful)

- Note any bony changes of the femoral neck and head because they may demonstrate chronic adaptive changes remodeling as the femoral head displaces.

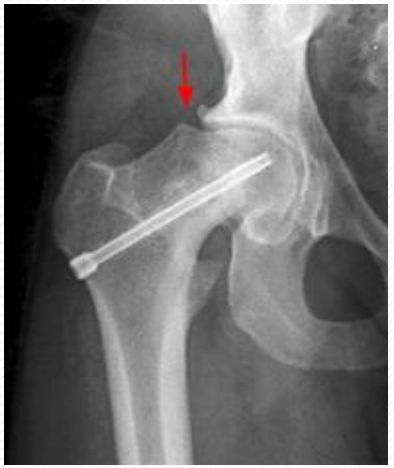




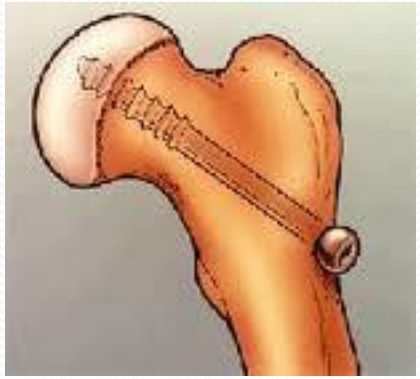
http://orthoinfo.aaos.org/topic.cfm?topic=a00052

Management

- Treatment of slipped capital femoral epiphysis (SCFE) is emergent; therefore, early and accurate diagnosis is paramount. There is no role for observation or attempts at closed reduction.



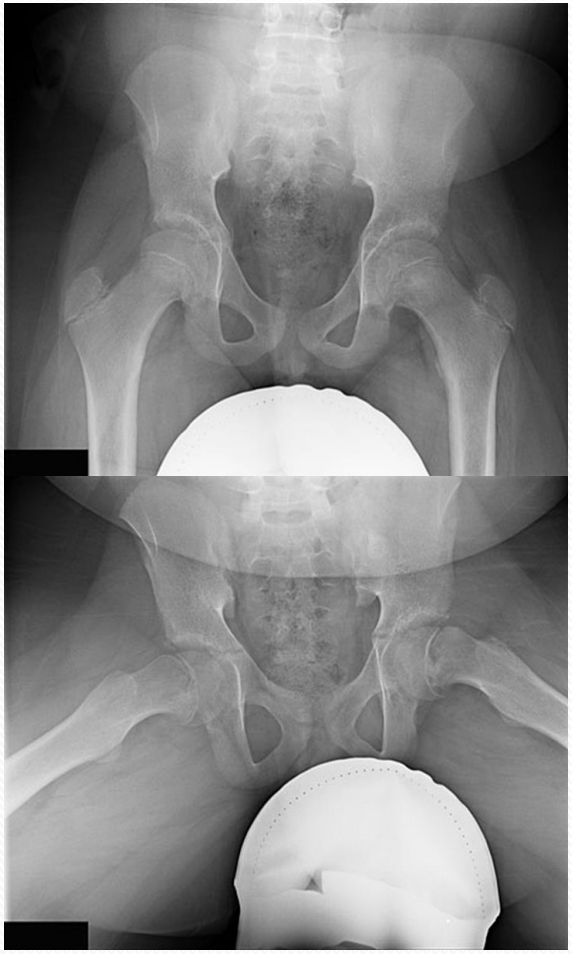
- Treatment requires placement of one or two pins into the femoral head to prevent further slippage. External in-situ pinning is the gold standard of treatment. Open reduction and pinning which is associated with a high risk of AVN.



http://orthoinfo.aaos.org/topic.cfm?topic=a00052

Question #5

- A 12-year-old boy reports a 6-week history of left hip pain. He denies any history of trauma or fever. Examination reveals diminished internal rotation of both hips and discomfort with this maneuver. Radiographs are shown. What is the most appropriate management?



1. Surgical in situ pinning of the left hip
2. Surgical dislocation with reduction of the left slipped capital femoral epiphysis
3. In situ pinning of bilateral hips
4. Bed rest
5. Application of a hip spica cast

J Pediatr Orthop. 2010 Jan-Feb;30(1):31-6

Answer:

- *In situ pinning of bilateral hips*

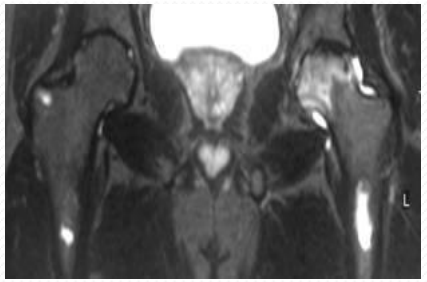
- Goal of treatment are to prevent the femoral head from further slippage and to eliminate hip impingement, which is the usual cause of arthritis.

- The standard of care for SCFE is limited open surgery that uses steel screws and pins (internal fixation) to hold the femoral head onto the femur to stabilize it prevent it from slipping further; this is the standard of care for SCFE

J Pediatr Orthop. 2010 Jan-Feb;30(1):31-6

Management

- Once SCFE is suspected, the patient should be non-weight bearing and remain on strict bed rest
- It should be regarded as an orthopaedic emergency as further slippage may result in occlusion of the blood supply and AVN.
- Even with treatment this condition may lead to: avascular necrosis (up to 50% in unstable cases), degenerative hip disease, gait abnormalities and chronic pain. SCFE is associated with a greater risk of arthritis of the hip joint later in life.



Nelson Textbook of Pediatrics. 18th ed. Philadelphia, Pa: Saunders Elsevier; 2007:chap 677.

In-toeing

Question #1:

- Which of the following statements is correct regarding in-toeing?

1. In the vast majority of children younger than 8 years old, in-toeing will almost always correct itself without treatment.
2. In-toeing is often associated with pain and difficulty to walk/run if not treated.
3. In-toeing is most commonly treated by corrective foot and ankle surgery.
4. Children who suffer from in-toeing often show a delay in their ability to start walking independently.

Answer:

- *In the vast majority of children younger than 8 years old, in-toeing will almost always correct itself without treatment.*
- In-toeing is commonly not associated with pain or delayed walking.
- In-toeing, if persistent and severe, will be treated conservatively

http://orthoinfo.aaos.org/topic.cfm?topic=a00055

Background

- Intoeing is a relatively common foot deformity of infancy or childhood where there is inward deviation of the forefoot relative to the hindfoot.
- Other names for this condition in the literature include bean-shaped foot and hooked-foot.
- The incidence of metatarsus adductus is reported to be between 0.1 and 1 percent of live births.
- Intoeing is often first noticed by parents when a baby begins walking, but children at various ages may display intoeing for different reasons.

Background

- Occasionally, severe intoeing may cause young children to stumble or trip as they catch their toes on the other heel. Intoeing usually does not cause pain, nor does it lead to arthritis.

- In the vast majority of children younger than 8 years old, intoeing will almost always correct itself without the use of casts, braces, surgery, or any special treatment.

- A child whose intoeing is associated with pain, swelling, or a limp should be evaluated by an orthopaedic surgeon.

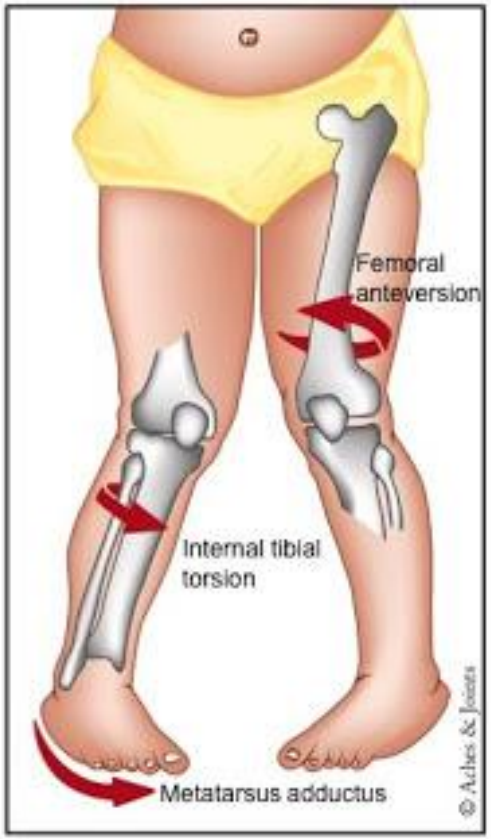
http://www.healthychildren.org/English/health-issues/conditions/orthopedic/pages/Pigeon-Toes-Intoeing.aspx

Background

- The cause of intoeing depends on where the change in alignment is centered. There are three common conditions causing intoeing:

1. Curved foot (*metatarsus adductus*)
2. Twisted shin (*tibia torsion*)
3. Twisted thighbone (*femoral anteversion*)

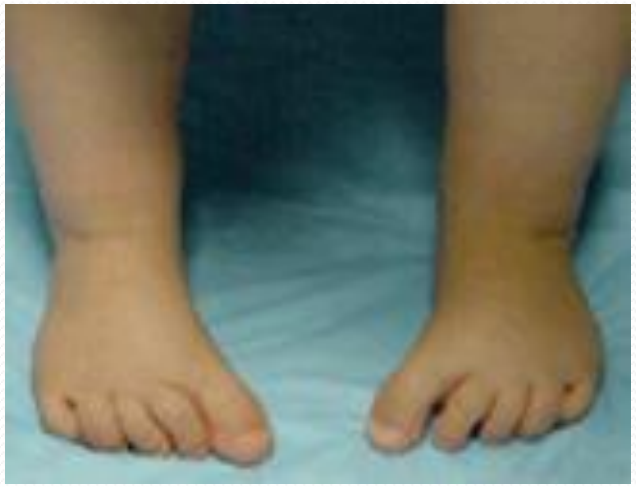
- Each of these conditions may run in families. They also can simply occur on their own or in association with other orthopaedic problems.



http://aftabphysio.blogspot.com/2012/11/intoeing.html

Presentation

- ***Curved Foot (Metatarsus adductus):*** This is when a child's feet bend inward from the middle part of the foot to the toes. Some cases may be mild and flexible, and others may be more obvious and rigid. Severe cases of metatarsus adductus may partially resemble a clubfoot deformity.



http://orthoinfo.aaos.org/topic.cfm?topic=a00055

Question #2:

- At what age should one start considering treatment for persistent curved foot or Metatarsus adductus?

1. Treatment should begin at birth
2. Treatment should begin before 3 months of age
3. Treatment should begin between 3-6 months of age
4. Treatment should begin after 6 months of age

http://orthoinfo.aaos.org/topic.cfm?topic=a00055

Answer:

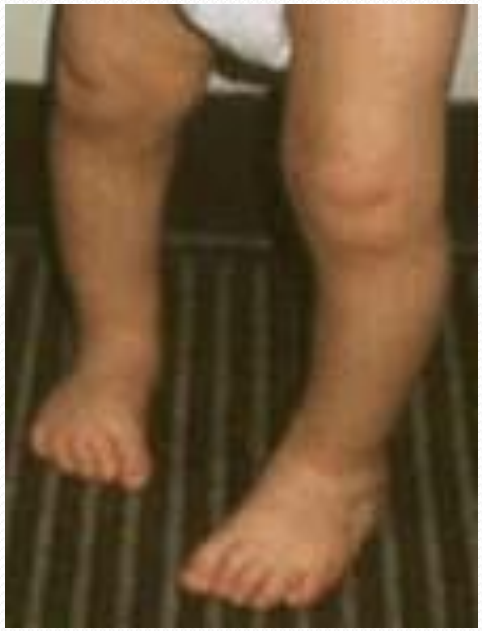
- *Treatment should begin after 6 months of age*

- Babies aged 6 to 9 months with severe deformity or feet that are very rigid may be treated with casts or special shoes with a high rate of success

Presentation

- ***Twisted shin (Tibial Torsion):*** Tibial torsion occurs if the child's lower leg (tibia) twists inward. This can occur before birth, as the legs rotate to fit in the confined space of the womb.

- When the child begins walking, the feet turn inward because the tibia in the lower leg, just above the foot, points the foot inward. As the tibia grows taller, it usually untwists.



http://orthoinfo.aaos.org/topic.cfm?topic=a00055

Question #3

- What is the best first step of management in a 4 year-old child with in-toeing due to tibial torsion?

1. Serial casting
2. Special shoe braces
3. Surgical cutting and ‘untwisting’ of the tibia
4. Observation

http://orthoinfo.aaos.org/topic.cfm?topic=a00055

Answer:

- *Observation*

- Observation is the best treatment for intoeing due to internal tibial torsion. This condition generally improves gradually until about the age of 6 years

- Historically, braces, casts and special shoes were used to treat internal tibial torsion. The most commonly used brace was a pair of shoes connected by a bar. We now know that tibial torsion gets better in nearly all cases without the use of any type of special shoe, cast or brace.

http://orthoinfo.aaos.org/topic.cfm?topic=a00055

Presentation

- ***Twisted thighbone (femoral anteversion):*** Femoral anteversion (also known as excessive femoral torsion) occurs when a child's femur turns inward.

- The upper end of the thighbone, near the hip, has an increased twist, which allows the hip to turn inward more than it turns outward. This causes both the knees and the feet to point inward during walking.

- Children with this condition often sit in the "W" position, with their knees bent and their feet flared out behind them.

http://orthoinfo.aaos.org/topic.cfm?topic=a00055

Management

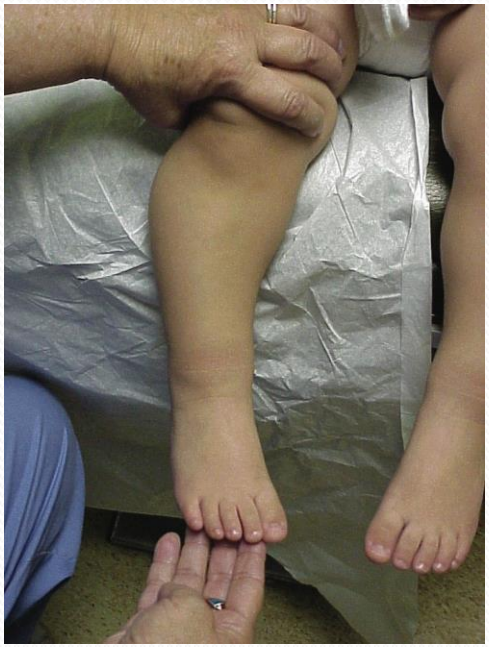
- Metatarsus adductus improves by itself most of the time, usually over the first **4 to 6 months** of life. Babies aged 6 to 9 months with severe deformity or feet that are very rigid may be treated with casts or special shoes with a high rate of success

- Tibial torsion almost always improves without treatment, and usually before school age. Surgery to re-set the bone may be done in a child who is at least 8 to10 years old and has a severe twist.

- Femoral anteversion spontaneously corrects in almost all children as they grow older. Surgery is usually not considered unless the child is older than 9 or 10 years and has a severe deformity that causes tripping and an unsightly gait.

Management

- Intoeing usually doesn't cause serious problems, even if it doesn't go away by itself. Sometimes children with intoeing have problems getting shoes that fit, because of the curve of their feet. This fitting problem might make parents consider treatment for their child. Intoeing doesn't cause arthritis or clumsiness.



http://www.podiatrytoday.com/article/6580?page=3

Scoliosis

Question #1:

- What is the most important predictive factor for curve progression in Adolescent Idiopathic Scoliosis?

1. Curve magnitude at presentation
2. Female gender
3. Male gender
4. Skeletal maturity at presentation
5. Family history of idiopathic scoliosis

Spine. 2009 Apr 1;34(7):697-700.

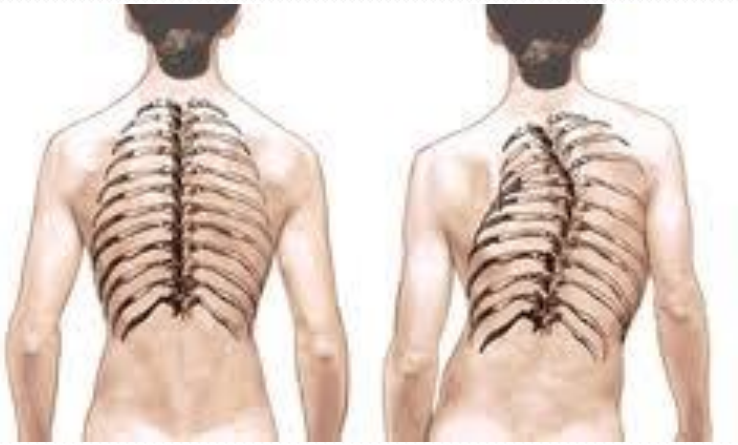
Answer:

- *Curve magnitude at presentation*
- Initial Cobb angle magnitude is the most important predictor of long-term curve progression.
- Studies suggest an initial Cobb angle of 25 degrees as an important threshold magnitude for long-term curve progression.
- Initial age, gender, and pubertal status were less important prognostic factors in our study.

Spine. 2009 Apr 1;34(7):697-700.

Background

- Scoliosis is a sideways curvature of the spine that occurs during the growth spurt during puberty. While scoliosis can be caused by conditions such as cerebral palsy and muscular dystrophy, the cause of most scoliosis is unknown.
- Most cases of scoliosis are mild, but some children develop spine deformities that continue to get more severe as they grow.
- An especially severe spinal curve can reduce the amount of space within the chest, making it difficult for the lungs to function properly.

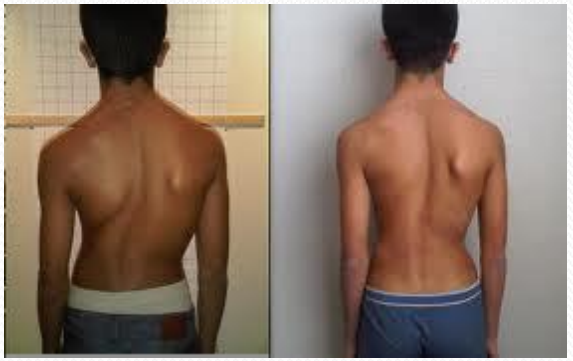


http://www.scoliosisassociates.com/subject.php?pn=idiopathic-scoliosis-009

Background

- Scoliosis is present in 2 to 4 percent of children between 10 and 16 years of age. The ratio of girls to boys with small curves of 10 degrees is equal but increases to a ratio of 10 girls for every one boy with curves greater than 30 degrees.

- The prevalence of curves greater than 30 degrees is approximately 0.2 percent, and the prevalence for curves greater than 40 degrees is approximately 0.1 percent.



Am Fam Physician. 2001 Jul 1;64(1):111-117

Background

- Risk factors for developing the most common type of scoliosis include:

Age: Signs and symptoms typically begin during the growth spurt just prior to puberty. This is usually between the ages of 9-15 years.

Sex: Although both boys and girls develop mild scoliosis at about the same rate, girls have a much higher risk of the curve worsening.

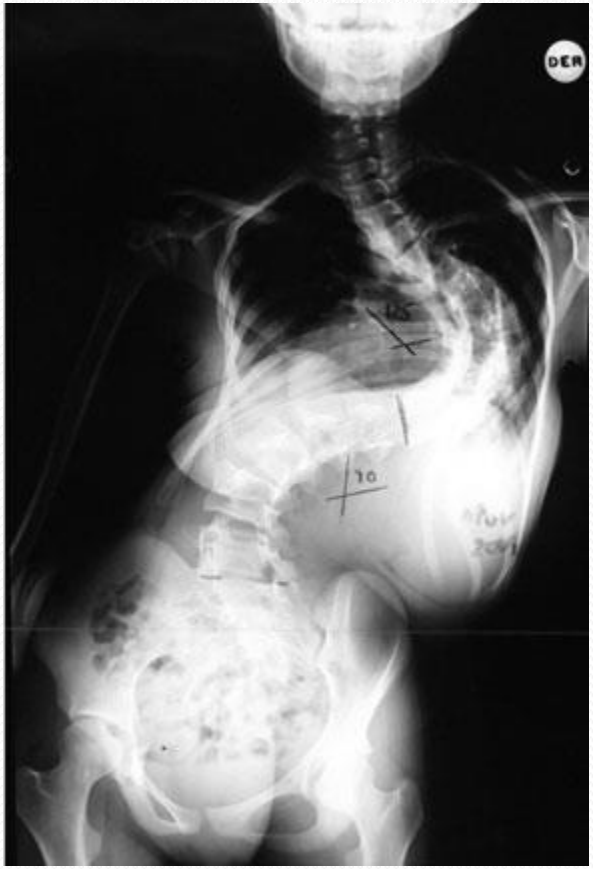
Family history: Scoliosis can run in families, but most children with scoliosis do NOT have a family history of the disease.

Presentation

- Once a diagnosis of scoliosis has been made, the primary concerns are whether there is an underlying cause and if the curve will progress.

- The three main determinants of progression are **patient gender**, **future growth potential** and **the curve magnitude at the time of diagnosis.**

- The magnitude of the curve is best determined by measurement of the **Cobb angle**, which is derived from a standard posteroanterior standing radiograph of the spine.



http://www.srs.org/patient_and_family/scoliosis/idiopathic/adolescents/

Question #2:

- Which of the following statements best describes the American Academy of Orthopaedic Surgeons (AAOS) recommendation on screening for scoliosis?

1. AAOS recommends screening girls at ages 11 and 13, and screening boys once at age 13 or 14 years of age.
2. AAOS recommends screening girls at ages 11 and 13, but recommends against screening boys given the low prevalence
3. AAOS recommends screening all children at routine health visits at 10, 12,14 and 16 years of age
4. AAOS does not recommend routine screening of asymptomatic adolescents for idiopathic scoliosis.

http://www.aaos.org/about/papers/position/1122.asp

Answer:

- *AAOS recommends screening girls at ages 11 and 13, and screening boys once at age 13 or 14 years of age.*

- The American Academy of Pediatrics has recommended scoliosis screening at routine health visits at 10, 12,14 and 16 years of age

http://www.aaos.org/about/papers/position/1122.asp

Presentation

- Adolescent idiopathic scoliosis is primarily a diagnosis of exclusion. The history and physical examination are intended to exclude secondary causes for the spinal deformity. The patient should be asked about a family history of scoliosis, menstrual onset, and the presence of pain and neurologic changes, including bowel and bladder dysfunction. The presence of severe pain or neurologic symptoms would be atypical for idiopathic scoliosis.

Question #3

- Which is the most cost-effective method of screening for scoliosis?

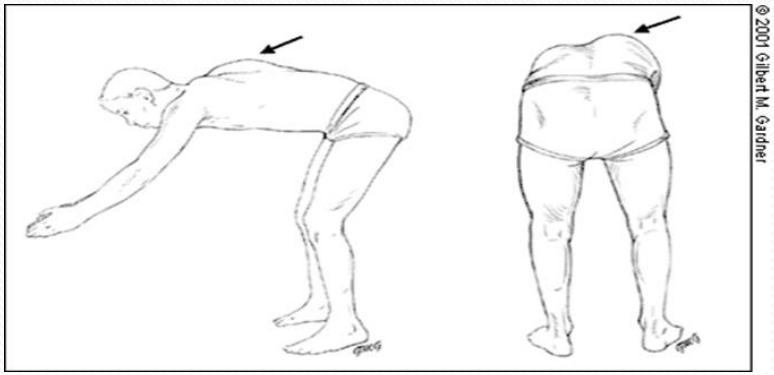
1. Cobb angle measurements
2. AP and Lateral MRI of spine
3. AP and Lateral Xray of spine
4. Adam's forward bending test
5. Schober Test

Am Fam Physician. 2001 Jul 1;64(1):111-117.

Answer:

- *Adam's forward bending test*

- The child bends forward until the spine becomes parallel to the horizontal plane. The examiner looks along the horizontal plane of the spine from the back and side to detect an asymmetry in the contour of the back known as a "rib hump"



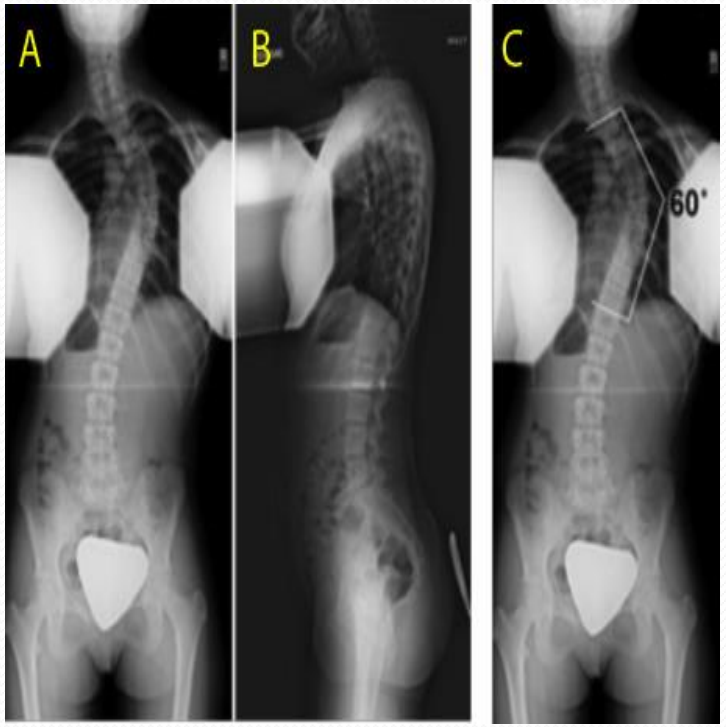
- A rib hump is a hallmark of scoliotic curves **greater than 10 degrees** and should prompt radiographic evaluation.

Am Fam Physician. 2001 Jul 1;64(1):111-117.

Workup

- Begin evaluating Scoliosis patients by taking a careful history and performing a physical exam. Perform a complete neurological exam checking for muscle weakness, numbness, and abnormal reflexes.

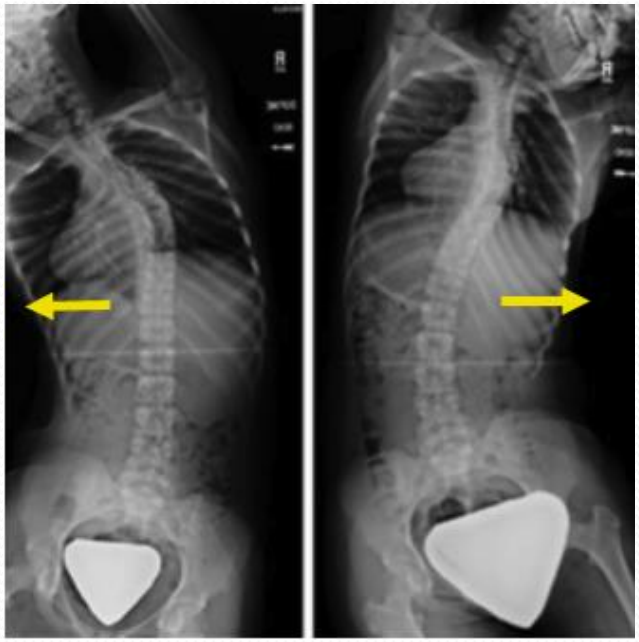
- The typical radiographic images that are obtained to define scoliosis include a standing X-ray of the entire spine looking both from the back (AP), as well as from the side (lateral).



http://www.srs.org/patient_and_family/scoliosis/idiopathic/adolescents/imaging_studies.htm

Workup

- Further radiographs can be performed to determine the flexibility of the curvature. X-rays can be taken in which the patient lays on the table and bends to the right and then to the left.

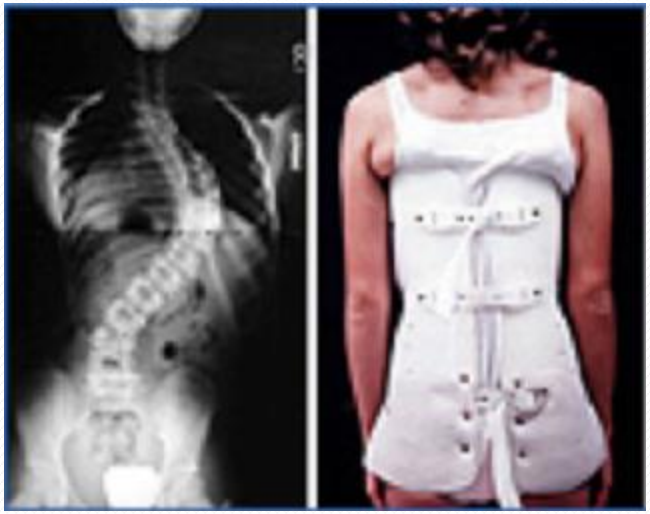


http://www.srs.org/patient_and_family/scoliosis/idiopathic/adolescents/imaging_studies.htm

Management

- Most children with scoliosis have mild curves and probably won't need treatment with a brace or surgery. Children who have mild scoliosis may need checkups every four to six months to see if there have been changes in the curvature of their spine.

- Braces **DO NOT** cure scoliosis, or reverse the curve, but it usually prevents further progression of the curve. A brace's effectiveness increases with the number of hours a day it's worn.



http://www.srs.org/patient_and_family/scoliosis/idiopathic/adolescents/bracing.htm

Question #4

- Brace treatment is recommended for adolescent idiopathic scoliosis when which of the following findings is present?

1. Any patient with a curve of greater than 25 degrees
2. Boys with a curve of greater than 20 degrees
3. Premenarchal girls with a curve of greater than 30 degrees
4. More than 5 degrees of progression in a growing child with a 20-degree curve

http://www.wheelessonline.com/ortho/bracing_for_scoliosis

Answer:

- *Premenarchal girls with a curve of greater than 30 degrees*
- Bracing has been the mainstay of non operative treatment of significant curves which have a potential to progress.
- Progression is related to size of curve, area of spine involved, & physiologic age of child.
- Curves between 30 and 40 degrees are treated with orthosis on first visit to office.
- Skeletally immature patients with significant curves (greater than 30 degrees) require bracing even if there is no evidence of progression.

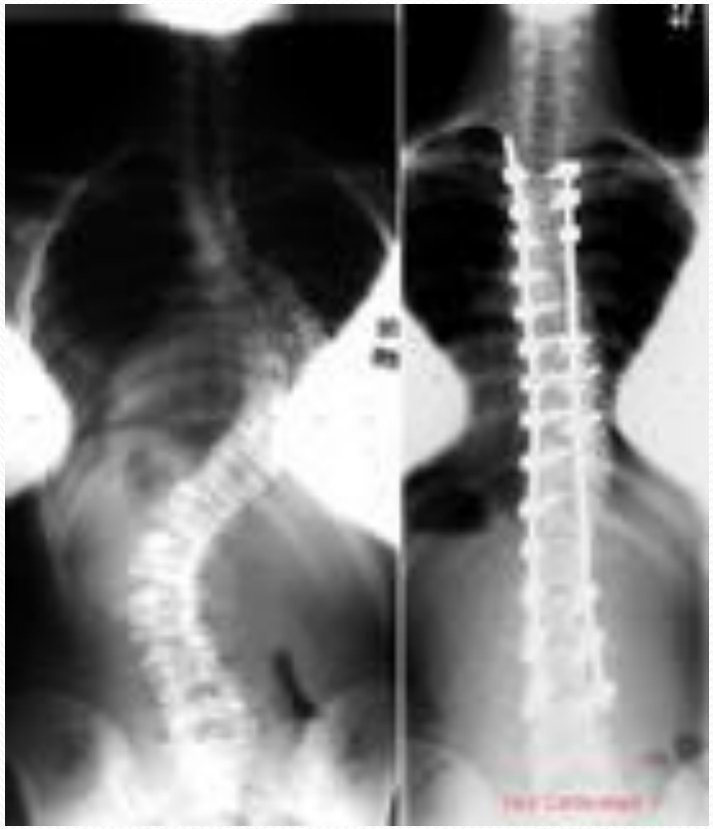
http://www.wheelessonline.com/ortho/bracing_for_scoliosis

Management

- Severe scoliosis typically progresses with time, so surgery might be suggested to reduce the severity of the spinal curve and to prevent its worsening. The most common type of scoliosis surgery is called **spinal fusion.**

- In spinal fusion, surgeons connect two or more vertebrae together, so they can't move independently. Metal rods, hooks, screws or wires typically hold that part of the spine straight and still.

- Complications of spinal surgery may include bleeding, infection, pain or nerve damage.



http://www.srs.org/patient_and_family/scoliosis/idiopathic/adolescents/

Question #5:

- What is the most serious complication associated with untreated scoliosis?

1. Gait disturbance
2. Depression associated with changes in appearance
3. Spinal cord compression
4. Paralysis
5. Lung and heart damage

Arch Phys Med Rehabil. 2006;87(12):1559-65

Answer:

- *Lung and heart damage.*

- If the curvature exceeds 70 degrees, the severe twisting of the spine that occurs in structural scoliosis can cause the ribs to press against the lungs, restrict breathing, and reduce oxygen levels. The distortions may also cause dangerous changes in the heart.

Arch Phys Med Rehabil. 2006;87(12):1559-65.