Intra-articular fractures

- Types
  - Salter-Harris types III and IV
  - Osteochondral fractures
  - Intra-epiphyseal fractures
  - Avulsion fractures by ligament or tendon

The Salter-Harris Classification

Why worry about intra-articular fractures?

- Joint surface incongruity may lead to joint degeneration
- Physeal incongruity may lead to growth arrest or deformity
- Intra-articular fractures may not heal as well as those of shaft or metaphysis
- Joint instability may result (i.e. ACL laxity after avulsion or tibial eminence)

Principles of treatment

- Restore smooth joint surface – avoid gap or step-off
- Restore physeal alignment – avoid gaps and potential cross-healing between metaphysis and epiphysis
- Avoid damage to joint surface and physis (use small diameter implants and don’t cross physis unless you need to)
- Obtain interfragmentary stability (to encourage healing and joint stability)

If you follow these principles...
Tillaux Fracture

- S-H III of the anterolateral portion of the distal tibial epiphysis.
- Seen on the AP x-ray as a vertical fx. line in the epiphysis.

Tillaux Fracture. What attaches to the anterolateral fragment?
- Reduction maneuver? Fixation?

Case 1: 13 yo boy injured playing soccer. SH class? Eponym?

I Wouldn’t Rely on Luck

You Will Be Rewarded

You Will be Punished

If you don’t...
Tillaux Fracture

- Closed reduction maneuver: Internal rotation of the foot.
- The anteroinferior tibiotalar ligament is attached to the fragment.
- However, usually requires ORIF to reduce the joint surface.

- Growth arrest rare, since physis is already almost closed.
- Degenerative changes are common if the joint is not anatomically reduced.

Case 1

- The solution
  Fragment is reduced and fixed with a lag screw.
  The joint surface is restored.
  Ligament stability is restored.
  The fracture gap is reduced to encourage bony healing.

Triplane Fracture

- Multiplanar S-H IV fx.
- Appears as a S-H II on the lateral x-ray, combined with a S-H III on the AP x-ray.

Case 2: 12 yo boy skateboarding.

Dx.? SH Class.?

Triplane Fracture

- Occurs earlier in adolescence than the Tillaux, when more of the growth plate is still open.
- Usually in 2 or 3 parts, but may be in 4 parts.
Triplane Fracture

- CT scan very helpful in assessing anatomy and reduction and in operative planning.
- Joint step-off or interfragmentary gap of > 2 mm is (historically) unacceptable.
- Up to a 5 mm gap may be OK, step-off is much less well tolerated.

Triplane Fracture

- Closed reduction maneuver (best done under GA): Flex the knee to 90°, and plantar flex and internally rotate the foot.
- Immobilize in LLC for 3 wks., then SLC for 3 wks.
- Check reduction with CT.

Triplane Fracture

If reduction is unacceptable, proceed with ORIF, through 2 separate incisions, to reduce the joint surface.
- Start anterolateral or anteromedial, to reduce the SH III fragment.
- Add a posterolateral or posteromedial incision to address the SH II fragment if necessary. (Consider “mini-open”).

Triplane Fracture

- Growth arrest rare, since physis is already almost closed.
- Goal of ORIF is to decrease the risk of future degenerative changes.
Case 3: 10 yo boy, bike accident. Dx.? Classification?

Meyer and McKeever Classification
- Type I: Non-displaced.
- Type II: Hinged.
- Type III: Detached.
- (Type IV: Comminuted.)

Case 3: What is this a childhood analog of? Treatment?

- Childhood analog of ACL tear. The solution:
  - Fragment is reduced and fixed with lag screws which stop short of the physis.
  - The joint surface is restored.
  - Ligament stability is restored
  - The fracture gap is reduced to encourage bony healing.

Case 4: 10 yo girl fell ice skating. SH class.? 

Case 4: SH 4 of medial malleolus. CRC attempted in ED. Plan now?
Case 4: S/P ORIF. Warn parents about?

**Case 4**
- S-H III & IV fxs. of the medial malleolus are always more displaced than they appear on x-ray.
- Maintain a very low threshold for opening these.
- It is sometimes necessary to cross the physis to stabilize these fractures.
- They have an extremely high incidence of growth arrest—warn parents!

Case 5: 13 yo girl playing basketball. Dx.? SH class?

**Case 5: Intra-epiphyseal fracture of the medial malleolus. Rx.?**
- Not described by the Salter-Harris classification. The problems are:
  - 1) articular incongruity,
  - 2) functional lengthening of the deltoid ligament, and
  - 3) potential delayed healing at fracture site due to joint fluid

**Case 5**
- Fragment is reduced and fixed with lag screws which stop short of the physis.
- The joint surface is restored. Ligament stability is restored.
- The fracture gap is reduced to encourage bony healing.

Case 6: 15 yo girl playing basketball. Dx.?
Case 6: Osteochondral fracture of the lateral femoral condyle. Rx.?

This pattern is not described by the Salter-Harris classification. The problems are:
1) articular incongruity, and 2) loose body of knee.

The solution

Fragment is reduced and fixed with lag screws.
The joint surface is restored.
The fracture gap is reduced to encourage bony healing.

Principles of treatment of intra-articular fractures in children

- Restore the joint surface
- Restore the physis
- Avoid damage to joint surface and physis
- Obtain fracture and joint stability

Why Do the Principles Matter?

Put the Joint Back Together…
...Piece by Piece

14 M Bike vs Truck
No Helmet

Time to Phone a Friend
Final X-rays
6 months post-op

Questions?