ACGME Core Competencies

- Patient care
- Medical knowledge
- Practice based learning
- Communication skills
- Professionalism
- System-based practice

Learning Objectives

- Recognize and understand how to manage common fractures in children
- Distinguish fractures that need emergency treatment
- Describe the Salter Harris classification
- Describe possible complications from fracture care

Overview

Common Fractures in Children

- Anatomy
- Terminology
- Fracture healing
- Remodeling
- Traction
- Reductions

- Casting materials
- Tips on Casting/spinting
- Common Fractures

Pitfalls When Treating Pediatric Fractures

- Failure to make diagnosis
- Failure to promptly recognize complications
- Failure to communicate adequately with parents
Fractures for urgent ortho eval

- Unstable
- Displaced
- Intra-articular
- Risk of growth problems
- Open fractures

Quiz

Diagnosis?

(A) Wrist dislocation
(B) Scaphoid fracture
(C) Salter Harris Radius Fracture
(D) Normal X-ray

Diagnosis?

A. Torus fracture
B. Physeal fracture
C. Greenstick fracture
D. Normal radiograph

Fracture remodeling depends on:

A. Patient age
B. Fracture location
C. Plane of motion
D. All of the above

Anatomy

- Epiphysis
- Physis
- Metaphysis
- Diaphysis
Periosteum

Salter Harris

Classification

Poland 1898

Salter and Harris

• JBJS 45B 1963
• Eiphyseal fractures
Other Fracture Terminology

- Plastic deformation
- Buckle or Torus
- Greenstick
- Complete
- Bayonet
Fracture Healing

- Fracture hematoma
- Periosteum: Cambium Layer
- Osteoblast
- Osteoclast
- Remodeling

Remodeling

- Patient age
- Fracture location
- Plane of motion
Overgrowth of Long Bone Fractures

Fracture Non-unions in Children

Fracture Reductions

Analgesia/anesthesia

Fracture Reductions

- Hematoma Block
- Nitrous Oxide
- Bier Block
- Regional N Block
- Ketamine
- Fentanyl

- Midazolam
- Propofol
- Etiomideate
- General
- Others
Do we need to reduce distal radius fractures?

Do et al JPO 2003
- 34 metaphyseal fx’s
- Allowed to heal in displaced position
- 1cm short, 15° angulation
- All remodeled: 7 mo ave (3-13 mo)
- Time in ED: 3.2hr/1.3hr

Izuka et al AAP 2011
- 51 distal rad/ulna fx’s
- Age < 11
- Short arm cast
- No reduction
- All remodeled <12 mo
- Cost 1/6 as much if reduced, 1/9 as much if pinned

Pearls:
Casting and Splinting

Casting Materials
- Plaster of Paris
- Fiberglass
- Semi-rigid fiberglass
- Splints
- Others

Plaster of Paris
Antonius Mathijsen-Dutch Military Surgeon 1851
- Roll of Muslin stiffened by starch and hemi hydrate of calcium sulphate

\[
CaSO_4 + H_2O + H_2O = CaSO_4H_2O + \text{heat}
\]

Fiberglass
- Polyurethane pre-polymer on a knitted material

Pre-polymer + H_2O = Polyurethane polymer + C02
Fiberglass vs Plaster

**Fiberglass**
- Radiolucent
- Lighter, stronger, durable
- Faster curing
- Less risk thermal burn
- Cleaner application
- Reduced time to weight bearing
- Colors

**Plaster**
- Cost
- Molding ability
- Club foot casts

Gortex: Swimming cast

Shannon et al
Waterproof casts for children’s fractures
* JPO 2005

- 165 stable fractures
- 13% skin rashes
- 79% very satisfied
- 21% satisfied

Semi rigid fiberglass cast

- Can be removed by unwrapping or with a scissors

Cast Problems

- Compartment syndrome
- Thermal burns
- Cast saw cuts and burns
- Pressure sores
- Hair growth under the cast
- Skin rashes
Cotton loader position

Gelberman et al.,
Carpal pressures and wrist position in distal radius fractures J Trauma 1984
- Risk of median neuropathy when place cast in wrist flexion position

The “Tight” Cast Compartment Syndrome

- 30% Univalve the cast
- 60% Univalve and spread the cast
- 70% Also cut the padding
- 85% Complete removal of cast


Traction

Traction and spica casting for femoral shaft fractures in children
- 63 children
- Ave age 5 (2-12)
- No malunion
- No nonunion
- No rotational changes
- No loss of reduction
- 20% LLI all < 15 mm

- Today, treatment of femoral shaft fractures in children with traction followed by spica casting remains very safe and effective
Flexible Nails
Sink et al JPO 2005

Surgery
• 62% complication rate for unplanned second and third surgery
• 16% leg length change more than 2 cm: epiphysodesis
• 92% later operation to remove metal

New trends in pediatric fracture care:
Displaced Midshaft Clavicular Fractures: Nonoperative Treatment Compared with Plate Fixation of Fractures: - A Multicenter, Randomized Clinical Trial
Canadian Orthopaedic Trauma Society
JBJS 2007;89A:1-10.

Summary
Common fractures in Children
• Anatomy
• Terminology
• Fracture healing
• Remodeling
• Traction
• Reductions
• Casting materials
• Tips on Casting/spinting
• Common Fractures

Pearls of Treatment
Pediatric Fractures
• Simplest, safest treatment
• Anatomic reduction not always essential
• Growth remaining leads to remodeling
• Overtreatment can be worse than undertreatment
• Accepted shortening mm, angulation—degrees, rotation—degrees depends on the specific fracture and the child’s maturity
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Thank You
Questions?

References
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• Mazda K et al. Systematic pinning of SC fractures. JBJS 83B:888-893, 2001.