Changing trends in the treatment of pediatric femoral fractures

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Learning objectives

• Review different treatment methods for pediatric femoral fractures in relation to different age groups
• Discuss physical impacts and psychosocial impacts of all treatment methods
• Explore how an interprofessional team approach can minimize those impacts.
Femur fractures at MCH

• Pose treatment challenges in the pediatric population
• Mechanism of injury can go from high-energy trauma to child abuse.
• AT MCH:
  ▫ We see approximately 30 femur fractures per year
  ▫ It comprises around 15% of the total fractures seen
• Patients with femur fractures are all admitted onto the surgical ward
• Length of stay can be 1 (early hip spica) to several days (traction).
Trauma team

• All femur fractures are followed by the trauma team.
  ▫ Orthopedic surgeon
  ▫ Trauma coordinator
  ▫ Social worker
  ▫ Child life specialist
  ▫ Physiotherapist
  ▫ Other consultants as needed (e.g. psychologist)
Choice of treatment depends on

1) Age
2) Mechanism of injury
3) Open vs. Closed
4) Ipsilateral tibia fracture
5) Neurovascular injury
6) Head injury
7) Multiple trauma
8) Pathological fracture
9) Social environment
Treatment Methods

Skin

1) Traction
   Cast

2) Early spica cast application

Skeletal

3) External fixation

{ }- Followed by Spica Cast

3 weeks each for a total of 6 weeks (minimum)
Treatment Methods (con’t)

4) Flexible intramedullary nails
5) Compression plate fixation
6) Interlocking nails
Single most important variable is $\rightarrow$ $AGE$
General Treatment Guidelines: Monotrauma Closed Fracture

AGE
0 - 6   - immediate spica casting
6 - 10 F - flexible retrograde IM nails
6 - 12 M - flexible retrograde IM nails
11 > F   - antegrade IM locking nails
12 > M   - antegrade IM locking nails
Treatment:
Monotrauma Closed Femur Fracture

Age 0 - 6

Traditional and reliable method of care:

- Traction (skin) for 3 weeks followed by cast treatment (3 weeks)

But.....

- ↑ hospital stay - ↑ $
- Patient cannot go home
Skin/skeletal traction
Prolonged Traction

- **Physical impacts**
  - Prolonged immobilization and its possible complications
  - Prolonged hospitalization
  - Risk of bed sores

- **Psychosocial impacts**
  - Alters self-image, feeling helpless
  - Interrupts social development
  - Interrupts educational process
  - Interrupts family routine and work routine of parents
Prolonged traction: team interventions

- Physiotherapist interventions
  - Maintain ROM and strength of uninvolved joints
  - Breathing exercises (bubbles, incentive spirometry)
  - Physiotherapy post traction as needed to regain ROM

- Social worker will:
  - Offer support to patient and family (parents and siblings) to normalize family functioning
  - Address interruption of routine and its subsequent needs (finances, respite, lodging...).
Prolonged traction: team interventions (con’t)

- Child-life specialist provides:
  - A schedule to promote daily routines
  - Comforting strategies in order to manage pain crises
  - Opportunities for self-expression e.g. pet therapy, medical play
- School services are also available during hospitalization
Early spica casting

Early spica cast application is virtually the treatment of choice in monotrauma closed femur fracture in children < 6 years of age since long term results of this method have shown to be as effective as traditional traction/cast method.
Early Spica casting

Concerns:
1) Failure to maintain alignment:
   • varus
   • shortening
2) Mobility
3) Hygiene

Solutions:
1) Proper cast molding and positioning
2) Special harness for transport
3) Education in hospital
Early spica casting

• **Physical impacts**
  ▫ Child cannot sit
  ▫ Cannot be picked up as usual because of cast
  ▫ Is at risk of developing pressure sores
  ▫ Might not fit in regular car seat and stroller
  ▫ Will not be able to use bathroom

• **Psychosocial impacts**
  ▫ Difficult return to daycare/school
  ▫ Burden of care to family and community
  ▫ Affects parents’ work schedule
  ▫ Decreases socialization with others
  ▫ Child wants to maintain autonomy and mobility
Early spica casting: team interventions

- Physiotherapist intervention
  - Teach proper positioning to parents
  - Teach proper transfer techniques
  - Review safe transportation, evaluate need for special equipment (car seat or EZ-on vest, reclining W/C)
  - Home exercises and cast precautions
  - Exercises post cast removal
EZ-on Modified vest

Traveler Plus car seat by Britax

Reclining W/C

Hippo spica cast car seat by Britax
Early spica casting: team interventions

- Coordinator will give spica cast booklet to the parents, will make sure teaching is done by RN re: cast care and hygiene, will help parents organize other services (school, CLSC...).
  

- Child life specialists gave distraction and activities ideas for child during immobilization period (in booklet).

- Social worker will address needs that can arise at the emotional level as well as the financial level.
Technique for spica casting

- Place in skin traction while waiting for O.R. time
- Under general anesthesia:
  - apply below knee cast and allow to harden
- Place patient on spica table
With affected hip and knee flexed to 90°, use casted leg as joy stick and apply traction to reduce femur fracture
Assess with fluoroscopy
Mold fracture site in valgus
Accept if:
- ≤ 1.5 cm shortening
- ≤ 5° varus
- ≤ 15° valgus
- ≤ 20° anterior or posterior bowing

- D/C patient, home next day
- Follow weekly for 3 weeks
- If above criteria not fulfilled:
  - Remove spica cast and put in skin traction or wedge cast

- Remove cast at 6 weeks
- Do not usually require intensive rehab/physio post cast removal
At the MCH, the above protocol started in March 2000.

- 98 femur fx (6 months - 6 years of age)
- Average hospital stay: 3.7 days vs. 21 days
- Only two patients necessitated wedging
- One patient required removal of spica and application of skin traction.
- Longer follow-up results will most likely show no long-term complications
This translates to 1,695 hospital days
OR
4.6 hospital years

Thereby allowing better use of hospital resources for other pathologies
Case 1: 4 year old male, fall from monkey bars, Initial AP
Case 1: Initial, Lateral
Case 1: After spica application, AP X-RAY
Case 1: Lateral X-RAY
Case 1: 3 months post-op
Case 2: 18 month old, jumped off bed, initial X-RAY
Case 2: Initial X-RAY
Case 2: After spica application, AP only
Case 2: 3 months post fracture
Contraindications to Early Spica Treatment

- Head trauma
- Polytrauma (esp. thoraco or abdominal trauma)
- Open fractures
- Pathological fractures
- Trauma X
Special Situations

Femur fracture in non-walking child:

- Suspect trauma X

Look for:

- multiple bruises
- bites
- other fractures
Special Situations

Watch out! Patient may have osteogenesis imperfecta

Look for:  - Blue sclera
           - Fracture pattern
           - Bone density
Special Situations

- Patient with femur fx and < 6 months of age (no trauma X or O.I.) - consider Pavlik harness
Special Situations

- Patient with traumatic head injury:
  - external fixation
- Multiple bone injuries:
  - standard AO plate
External Fixation

- Was becoming more popular in multiple trauma patients and in isolated femur fractures
- Provides rigid mobilization of fractures
External Fixation

- Disadvantage:
  1) Pin tract infection
  2) Refracture following removal
  3) Limb overgrowth
Elastic Intramedullary Nailing
Elastic Intramedullary Nailing

- Métaizeau and Firica in 1977 (France)
- 1st case 1989 at Ste-Justine
- Mainly used for diaphyseal fractures:
  - femur
  - forearm
  - humerus
  - tibia
In the past, the 6–12 years old age group, was treated primarily with skin/skeletal traction for 3 weeks followed by hip spica for an additional 3–4 weeks.
Elastic Intramedullary Nailing

Definition

- Type of intramedullary device
- Rods are made in titanium (2-4 mm of diameter)
- «Elasticity» property to the nail or its memory
- Extremity bent at 30° and flattened
Three point fixation

Balance configuration
Elastic Intramedullary Nailing

Indications for femoral fractures

- Diaphyseal (3 cm to physeal area)
  - 5-6 to 12 y.o.
  - closed
  - open (grade I or II)
  - pathological (benign)

- Polytrauma, head trauma
6 Weeks post ESIN
Post op ESIN
Elastic Intramedullary Nailing

Technical aspects

- Use a fracture table
- Reduce the fracture
- Entry point: metaphysodiaphyseal junction just proximal to growth plate
- Retrograde (distal)
Elastic Intramedullary Nailing

Complications

- Infection: rare, no report probably less 1%
- Refracture: secondary to early rods removal
- Malunion: imbalance configuration or inadequate reduction (rotational malunion)
- Skin irritation specially around the knees
Elastic Intramedullary Nailing

Advantages:
- Less malunion and shortening rate than traction/spica group
- Patient can return to school with crutches
- Early ROM and strengthening of injured limb
Elastic Intramedullary Nailing

Conclusion:

• Treatment of choice in femoral shaft fractures, in 6 – 12 year age group, with very few complications
Elastic Intramedullary nailing

- **Physical impacts**
  - NWB
  - High pain level post-op
  - Inability to walk normally
  - Requires an alternative to go from place to place and up and down stairs

- **Psychosocial impacts**
  - Early return to school
  - Child autonomy is mostly maintained
  - Decreases burden of care
  - Maintains socialization
Intramedullary nailing: team intervention

- Physio intervention
  - Promote early mobilization
  - Teach proper transfer techniques
  - Teach crutch-walking and stairs
  - Home exercises and precautions
  - Exercises are progressed as required
- Child life will follow for comforting strategies during pain crisis
- Social worker will follow and address needs if required
Femoral Shaft Fractures in Adolescents
• Antegraded locked intramedullary nailing is treatment of choice in adolescents
• Indications similar to adult
Complications

- Avascular necrosis*
- Effect on Greater Trochanter*
- Femoral overgrowth*
- Neurologic
- Rotational deformities
- Heterotopic ossification at insertion site
  
  * Specific to pediatrics
Avascular Necrosis

- The most severe complication
- Several “case reports” but real incidence not known
  - O’Malley: JPO 1995, 15, 21-23
  - Thometz: JBJS 1995, 77A, 1423-1426
How to avoid AVN?

- Starting point more lateral...but risk of fracture of the Greater Trochanter
- Now using lateral entry IM nail
Heterotopic Ossification
Neurologic Complications

- Riew & al JPO 1996, 16, 606-612
  - 35 Fx (10-17 yo)
  - 8 complications, 2 persisted > 1 week
  - Surgical delay > 1 week
  - Preop shortening
  - Use of boot traction
  - Peroneal and pudendal nerves
  - risks 11.4 times
Keys for Success

- Avoid IM antegrade rodding in patients <11 years of age
- Use lateral entry nail
- Do not delay surgery
Intramedullary nailing

- **Physical impacts**
  - PWB to WBAT
  - Inability to walk normally
  - Requires an alternative to go from place to place and up and down stairs

- **Psychosocial impacts**
  - Early return to school
  - Teen autonomy is mostly maintained
  - Maintains socialization
Intramedullary nailing: team intervention

• Physio intervention
  ▫ Promote early mobilization
  ▫ Teach proper transfer techniques
  ▫ Teach crutch-walking and stairs
  ▫ Home exercises and precautions
  ▫ Exercises are progressed as required

• Social worker and child life worker will follow as needed
THANK YOU!