Fracture Characteristics Predict Suboptimal Alignment in Pre School Femur fractures Treated in a Spica Cast

Amirhossein Misaghi, MD; Mahmoud Mahmoud, MD; Alexandre Arkader, MD; Keith Baldwin, MD, MSPT, MPH
The Children's Hospital of Philadelphia

Children's Hospital of Philadelphia
Division of Orthopedics

Penn Medicine

Background

- Low energy fractures of the femoral diaphysis in pre-school children are a common injury
- Standard of care includes closed treatment with or without reduction and casting, typically with a one or two legged spica cast.
- Usage of operative techniques such as elastic nailing are controversial in this patient population, but indications often include failure to maintain acceptable alignment.
- "Acceptable" alignment should be maintained in casting, AAOS guidelines were unclear in terms of when to intervene when casting does not result in acceptable alignment.
- Our goal was to identify the incidence of unacceptable alignment at cast removal.
- Additionally we wished to identify factors which could lead to increased risk of unacceptable alignment at healing

Methods

- 132 children between the ages of 3-6 years old identified over an 11 year time frame who had diaphyseal femur fractures treated by closed means at a single Level 1 pediatric trauma hospital
- Fractures were assessed at initial injury, upon cast removal and at final follow up
- Two raters assessed whether the alignment was "Acceptable" per Lovell and Winter's Criteria (less than 20 degrees angulated in any plane and less than 3cm of shortening (ICC 0.816 excellent agreement)
- Multivariate Binary Logistic Regression was performed to assess independent risk factors for unacceptable alignment at healing

Results

Table 1: Demographics and fracture patterns for patients with optimal and suboptimal alignment

	Demographic data		
	Optimal group(N=85)	Sub-optimal group(N=47)	P value
Average age (Ys)	3.5	3.7	0.143
Average weight lb	16.7	17.1	0.543
sex			0.466
Male/female	64/21	38/9	0.532
Mecahnism of injury			0.081
Fall	62	35	
Sport	8	1	
M/V accident	3	7	
Accident	9	3	
Other	3	1	
Fracture pattern			0.049
Transverse and comminuted	9	11	
Spiral and oblique	76	36	
Fracture site			0.114
Proximal	10	12	
Mid-shaft	64	31	
Distal	11	4	

Table 2: Initial and final displacement for patients with optimal and suboptimal alignment

	Radiographic change		
	Optimal	Suboptimal	P value
Before casting :			
Initial shortening in mm (average)	19.6	20.1	0.795
Initial coronal angulation(average)	11.2	15.0	0.1
Initial sagittal angulation(average)	8.8	11.1	0.209
Before cast removal			
Shortening in mm (average)	16.5	19.2	1.12
Coronal angulation(average)	5.1	11.4	<0.05
Sagittal angulation(average)	6.9	14.5	<0.05

Multivariate risk factors

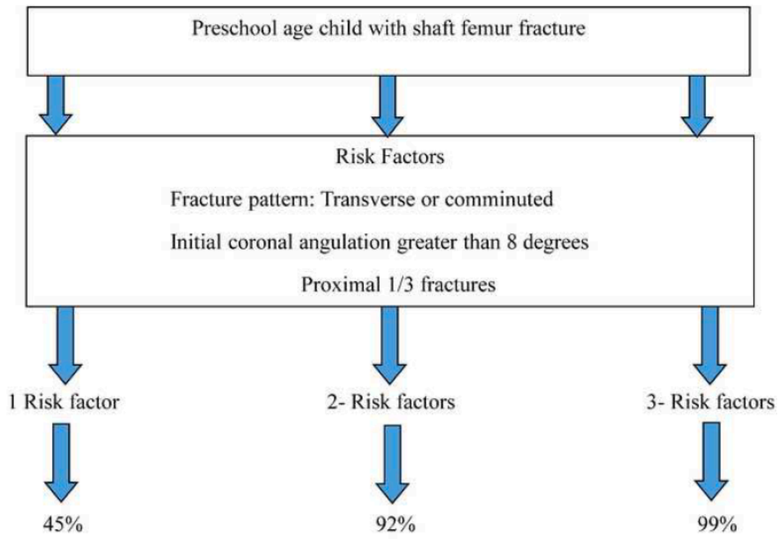

Figure 2: Algorithm for determination of risk of suboptimal alignment in preschool femur fractures.

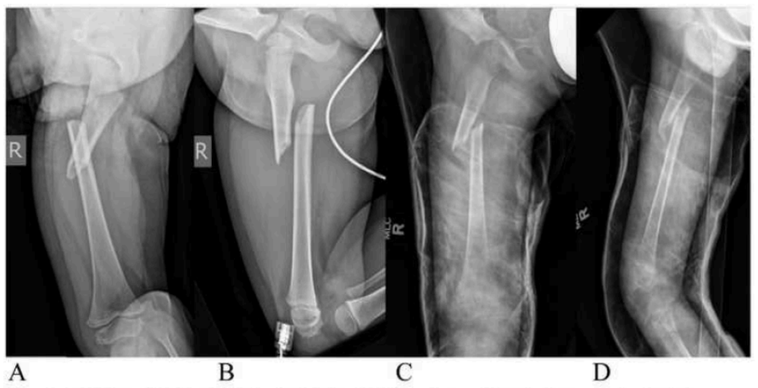

Figure 1: (A ,B) shows initial AP and LAT views for 3.5 male with LT femur fractures (shortening 47mm, coronal and sagittal angulation are37,5;respectively). (C, D) shows AP and LAT views 6 weeks later immediately before cast removal (shortening 24, coronal and sagittal angulation 30,24;respectively).

Figure 3. This 2.8 year old male presented after a fall off a bunk bed with a (A) proximal 1/3 comminuted femur fracture.(B) the fracture was originally reduced into valgus, a trauma shears is held over the cast to mark the desired area of wedging if it is necessary. (C) Seen back at 10 days there had been loss of reduction into varus and shortening. (D) Although alignment was improved with wedging there was residual varus and shortening. (E) At healing there was enough varus and shortening for our panel to consider it non acceptable by Lovell and Winters criteria. (F) at 1 year the patients neck shaft angle was 132 and no leg length difference. No clinical complaints.

Results (Summary)

- 35.6% of patients healed in suboptimal alignment following cast treatment of diaphyseal femur fractures
- Fractures which had the greatest chance of healing in suboptimal alignment were comminuted or transverse fractures, fractures which were in the proximal 1/3 of the diaphysis and fractures with more than 8 degrees of coronal angulation at presentation.
- Having one of these risk factors resulted in a 45% chance of unacceptable alignment at healing. Having 2 factors resulted in a 92% chance and 3 factors had 99% chance of healing in unacceptable alignment
- In spite of this, at final follow up only 1 patient had a leg length discrepancy(LLD) of 2 cm and 2 patients had a LLD of 1 cm.
- No patient had revision surgery or osteotomy at final follow up
- No long term follow up was available.

Discussion

- A little over 1/3 of patients treated with closed reduction and spica casting healed in unacceptable alignment
- High risk fractures were identifiable using characteristics available at the time of injury, and include
  - Transverse or Comminuted fractures
  - Proximal 1/3 Fractures
  - Fractures with greater than 8 degrees of coronal angulation at presentation
- Long term sequelae of "unacceptable" alignment in this age group is currently unknown

Conclusions

- Although 1/3 of preschool diaphyseal femur fractures heal in what would be considered to be "unacceptable" alignment, the long term sequelae of this is currently unknown
- We saw very minimal deleterious effects of this alignment in our population, with only one child needing even a small lift due to a 2cm LLD
- Due to the lack of long term follow up it is unclear to us at this point if any child will need surgery as a result of the malalignment at healing
- Although it is likely that a majority of these will remodel with time, it is difficult for us to say this with any certainty due to lack of long term follow up
- If these results hold up over time it is possible that we will need to revisit our ideas about "Acceptability" of alignment in this population.

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