

Journal Club: 24 August 2016

Attendees: Harish Kapoor, Namal Perera, Karen Shepherd, Richard Pilling, Lazlo Toth, Tracy Xu, Varun Shenoy, Tony Theodorides, Chris Lodge, Attila Macsai
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Theme: Management options in paediatric tibia fractures

Ho CA. Tibia shaft fractures in adolescents: how and when can they be managed successfully with cast treatment? *J Pediatr Orthop* 2016;36 Suppl 1:S15-8.

Level 5 (expert opinion)

Clinical question:

When can we treat tibial shaft fractures with cast treatment only?

Methods:

- This publication is an expert opinion and review of a case series regarding the treatment of closed tibial shaft fractures in adolescents with cast.
- The outcomes are compared to the published results of flexible nailing of similar injuries. According to the author, acceptable alignment parameters for paediatric tibial shaft fractures are 10° of coronal and sagittal angulation, 50% translation and 10 mm of shortening.
- Amenable to cast treatment are:
 - Closed fractures
 - Mild to moderate swelling of the soft-tissues
 - Normal BMI
 - Two-part fractures
 - Tibiofibular fractures
- Long leg cast with knee and ankle plantar-flexed (allows easier reduction and prevents weight-bearing in non-compliant children) is applied with three-point mold technique.
- Closed monitoring of alignment over two to three weeks (serial radiographs); wedge casting is undertaken if necessary.

- The paper discusses management principles, duration of casting, union time, malunion rates and complications.

Results:

- 75 patients were treated with casts over a period of seven years at the author's institution.

Duration of immobilisation

- Six weeks in long leg cast and further 6-7 weeks in short leg cast (institutional average 13.8 weeks).

Union time and malunion rate

- The mean return to activities was 15 weeks (institutional data) and the malunion rate was 5% in the coronal plane and 3% in the sagittal plane.

Complications

- Three patients (4%) failed cast treatment and needed surgical stabilisation.
- One patient had a heel ulcer.

Conclusion:

The author concludes that cast treatment is a safe option for the majority of tibial shaft fractures (see inclusion criteria).

CRITIQUE

This publication reviews the local hospital practice of treating most tibial fractures with molded casts. It defines contraindications and illustrates the safety profile of the treatment.

Strengths of the study

- Clear and concise explanation of the treatment

Methodological concerns

- No demographic data available for the study population
- Lack of details about mechanism of injury, severity and so on
- 4% failure rate not specified

Goodbody CM, Lee RJ, Flynn JM, et al. al. Titanium elastic nailing for paediatric tibia fractures: do older, heavier kids do worse?
J Pediatr Orthop 2016;36:472-477.

Level IV (interventional study, case series with comparative analysis)

Clinical question:

Can titanium nails be used safely in children with tibia fractures above a certain age (> 14 years) and weight (>50 kg)?

Methods:

- This is a retrospective case-series of patients who underwent stabilisation of tibial shaft fractures with titanium nails.
- Patients were identified by billing records (2003-2013), age of 0-17 years and a minimum follow-up of six months.
- Data was collected including demographics, injury characteristics and radiographic data (fracture pattern). The patients were stratified by weight (< 50 kg and > 50 kg) and age group (< 14 years and > 14 years).
- Malunion was defined as 10° of angulation in the coronal and sagittal plane while union was defined as three or more cortices being bridged by callus. A significant difference in union was considered to be three weeks. Titanium nails treatment (Synthes; West Chester, Pennsylvania) was given to all patients.
- Statistical tests were Fisher's exact test (union rate), odds ratios with logistic regression (malunion) and Student's t-test (angulation in coronal or sagittal plane).

Primary endpoints

- Time to Union and final angular deformity

Secondary endpoints

- Time to weight-bearing and cast removal

Variables

- Weight, age, fracture type, fracture location

Results:

- 95 patients were included (71 males, 24 females). There were 22 open fractures.
- Ten patients required fasciotomies for compartment syndrome (identified pre-operatively).
- Motor vehicle accidents were the most common type of injury.
- All patients received titanium nails treatment and post-operative immobilisation in a cast (mean of 54 days).
- Average time to weight-bearing was 45 days.

Weight

- No differences between weight groups with respect to angulation (malunion 10-13%) and time to union (mean 89-92 days).

Age

- No differences between age groups with respect to malunion (8.2-17.7%) and time to union (89-93 days).

Fracture type

- Open fractures healed at a similar rate to closed fractures.
- Length stable fractures (intact fibula) have a higher odds ratio of delayed union (OR 4.15) and malunion (OR 1.5) *versus* unstable fractures (fibula fractured) OR 0.24 and 0.67, respectively.

Fracture location

- Proximal third fractures have a higher odds ratio of malunion (OR 9.0).

Conclusion

The authors conclude that is safe to use titanium nails in older and heavier children.

CRITIQUE

This study aims to establish the safety of elastic nails in heavier and older children. The authors accept a high malunion rate among the older age group, and at the same time using a very pragmatic approach, defining malunion as $> 10^\circ$ in the coronal plane.

Strengths of the study

- Large series
- Informative tables

Methodological concerns

- How many patients did not have complete data; how many were excluded?
- Definition of primary and secondary endpoints blurred in analysis (typical for retrospective analysis)
- Open fractures were not classified
- Statistical methods not fully explained; multivariate analysis is explained in discussion section
- No standardised protocol for post-operative immobilisation
- Operative technique is explained in the Results section (should be part of the Methods section)
- Incorrect conclusion: 18% malunion rate in the > 14 years old age group is not acceptable, albeit it not statistically significant due to low numbers
- Malunion of 5° in the coronal plane is acceptable in the published literature; therefore why was 10° used?
- Paper does not discuss interesting findings hidden in the Tables (fibula-intact fractures, fracture location affecting outcomes)

Laine J, Cherkashin A, Samchukov M, Birch JG, Rathjen KE. The management of soft tissue and bone loss in type IIIB and IIIC pediatric open tibia fractures. *J Pediatr Orthop* 2016;36:453-458.

Level IV (interventional study, case series)

Clinical purpose:

To evaluate the use of circular fine wire fixation for the treatment of Gustilo IIIB and IIIC tibial fractures in children.

Methods:

Retrospective case series including patients with IIIB and IIIC fractures between 1990 and 2010. Definition of IIIB according to authors: fractures with periosteal stripping, contamination, extensive soft-tissue injury, exposed bone and need for local or free-flap coverage. If it was associated with a vascular injury it was classified as IIIC.

Treatment strategy

- Minimal bone loss: stabilisation and soft-tissue coverage.
- Segmental bone loss: acute shortening, soft-tissue coverage and later lengthening.
- Segmental bone loss: stabilisation, soft-tissue coverage and later bone transport (unifocal or bifocal).

Primary endpoints

- Time to union, duration of frame placement.

Secondary endpoints

- Follow up time, limb alignment, leg-length discrepancy, complications.

Results

- Eight patients were identified (seven IIIB and one IIIC).
- Six patients had segmental bone loss, while two had minimal bone loss; two had acute shortening and later lengthening; three had stabilisation without shortening followed by bone transport at a later stage.
- One patient eventually had a below-knee amputation.
- Average follow-up was six years.
- Initial treatment duration in the frame was 21.6 weeks (~five months).
- Patients underwent an average of six procedures.
- Five patients needed frame modifications under GA.
- Two out of four patients with bone transport had planned iliac crest bone graft at the docking site.
- Four patients had a foot drop due to anterior compartment injury.
- Seven patients walked unaided at final follow-up.

Conclusions

The authors conclude that the Ilizarov method can successfully treat children with severe and complex tibial fractures. They propose a treatment algorithm addressing segmental bone loss in tibial fractures.

CRITIQUE

This case-series is unique in assessing the outcome of Gustilo IIIB and IIIC tibia fractures in children.

Strengths of the study

- Treatment algorithm
- Long follow-up
- Complications listed meticulously

Methodological concerns and unanswered questions

- Recruitment hospitals not specified – transfer? Tertiary referrals?
- Time to union not clearly specified
- Timing of bone grafting not mentioned
- Amputation in IIIC patient? Why did flaps fail?