# Non-Operative management of closed displaced tibia shaft fractures in patients under 18 years of age: Low failure rate

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INTRODUCTION: Tibial shaft fractures are the third most common pediatric long bone fracture pattern. Historically, these fractures have been initially treated with closed reduction and casting (CRC). Recently, there has been an increasing trend towards surgical intervention as initial treatment for these injuries. In an effort to better understand if this trend is warranted, this study seeks to characterize the clinical and radiographic outcomes of a large number of children who underwent non-operative treatment with CRC as their initial treatment for pediatric tibial shaft fractures at a single tertiary care center.

METHODS: Outcomes measured included final alignment, other procedures performed, length of time to full radiographic healing as well as length of time in each method of immobilization before progressing to full weight bearing status. Patients were separated by ages into the following cohorts during statistical analysis: 4-8 years, 9-12 years, and 13+ years. Differences between continuous variables were analyzed with independent samples t-tests. Chi-square tests were used to analyze differences in categorical variables. An alpha <0.05 was considered statistically significant.

RESULTS: 137 patients met our inclusion criteria. The median age was 10.19 years (4.03-17.43). The average initial displacement among all age groups was 27.42% (±15.05%). Following initial intervention with closed reduction and casting, all age groups demonstrated an average of less than 5 degrees of residual angulation and less than 20% of residual displacement. Complete radiographic healing was seen in 127 (92.7%) patients by 3 months. Loss of reduction requiring additional clinical intervention was seen in 30 (21.9%) patients with only 5% requiring surgical intervention while malunion was seen in a total of 16 (11.7%) patients at the final visit. There were no cases of compartment syndrome or deep wound infection. Male and initial angulation were the only factors predictive of loss of reduction.

DISCUSSION AND CONCLUSION:

The results of this study do not support the increasing trend toward operative intervention of minimally displaced tibia shaft fractures in the pediatric population that has recently been noted in the literature. Initial intervention with CRC is a safe and effective treatment for the majority of children in all age groups presenting with tibial shaft fractures demonstrating minimal angulation and displacement with surgical intervention being required in only 5% of patients. Further studies are warranted to elucidate the characteristics of patients that may benefit most from initial surgical intervention.

TABLE 1. Patient intervention data

| | Mean, (SD) |
|---|---|
| Initial angulation | |
| Overall | 8.84 (8.18) |
| 4-8 years old | 9.28, (9.84) |
| 9-12 years old | 7.86, (6.93) |
| 13 years old and above | 8.12, (7.32) |
| Initial displacement | |
| Overall | 27.42% (15.05%) |
| 4-8 years old | 34.13%, (17.06%) |
| 9-12 years old | 31.11%, (15.06%) |
| 13 years old and above | 25.16%, (17.86%) |
| Residual angulation after intervention | |
| Overall | 1.49 (2.97) |
| 4-8 years old | 2.54, (3.46) |
| 9-12 years old | 2.15, (3.29) |
| 13 years old and above | 2.33, (3.76) |
| Residual displacement after intervention | |
| Overall | 16.52% (11.64%) |
| 4-8 years old | 19.75%, (14.62%) |
| 9-12 years old | 16.28%, (11.65%) |
| 13 years old and above | 15.59%, (11.15%) |

TABLE 2. Radiographic findings

| | N, (95%) | Yield % |
|---|---|---|
| Malunion[1] | | |
| >5 degrees | 13, (9.5%) | 9.7%[3] |
| >10 degrees | 3, (2.2%) | 2.2%[4] |
| Radiographic healing[2] | | |
| 6 weeks | 83, (60.6%) | 62.9%[5] |
| 3 months | 44, (32.1%) | 33.3%[5] |
| 6 months | 5, (3.6%) | 3.8%[5] |
| No follow-up radiographic images after 6 weeks[5] | 5, (3.6%) | |

[1]Described as patients that presented with >5 degrees of angulation at follow-up visits.
[2]Described as least 3 cortices healed. [3] Patients had at least 2 cortices healed.
[4]Out of 134. [5]Out of 132. N = frequency

TABLE 3. Cast data

| | |
|---|---|
| Overall casting[1] [median, (range)] | 7, (3 - 15) |
| Splint [median, (range)] | 1, (1 - 7) |
| Long leg cast [median, (range)] | 5, (2 - 10) |
| Short leg cast [median, (range)] | 3, (1 - 9) |
| Boot (cam walker) [median, (range)] | 4, (1 - 7) |
| Out of cast by 6 weeks [n/N (%)] | 49 (37.7%) * |
| Out of cast by 3 months [n/N (%)] | 127 (97.7%) * |

[1]Includes LLC and SLC. * Out of 130.

TABLE 4. Patient complications

| | LOR and intervention[1] (n = 30) | No intervention (n = 107) | OR (95% CI) | P-value |
|---|---|---|---|---|
| Age >13 in years | 11* | 22 | 2.24 (0.85-5.38) | 0.090 |
| Males | 26 | 72 | **3.16 (1.02-9.76)** | **0.041** |
| Weight >50 kg | 12 | 30 | 1.71 (0.74-3.98) | 0.263 |
| High energy (Total reported = 128) | 11* | 46 | 0.76 (0.32-1.79) | 0.668 |
| Tibia displaced | 29 | 100 | 2.03 (0.24-17.10) | 0.685 |
| Fibula involved | 6 | 35 | 0.51 (0.19-1.37) | 0.259 |
| Comminution | 6 | 12 | 1.98 (0.67-5.81) | 0.227 |
| Initial angulation | | | | |
| >5 degrees | 16 | 32 | **2.68 (1.17-6.13)** | **0.029** |
| Initial displacement | | | | |
| >25 % and <50 % | 16 | 41 | 1.84 (0.81-4.16) | 0.149 |
| >50 % | 1 | 7 | 0.49 (0.06-4.17) | 0.685 |
| Post intervention angulation | | | | |
| >5 degrees | 5 | 10 | 1.94 (0.61-6.19) | 0.319 |
| >5 and <10 degrees | 2 | 8 | 0.88 (0.18-4.40) | 1.000 |
| >10 degrees | 3 | 2 | 5.83 (0.93-36.68) | 0.070 |
| Post intervention displacement | | | | |
| >25 % | 4 | 28 | 0.48 (0.15-1.50) | 0.317 |

**Bold**: Statistically significant. [1]Intervention includes: wedging, repeat closed reduction and surgery. *Out of 27 (2 patients did not report mechanism of injury).