Distraction osteogenesis for posttraumatic bone defects of the leg: Comparison of classic versus integrated technique

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Introduction

- Limb salvage in the presence of posttraumatic tibial bone loss can be accomplished using the Ilizarov method[1-3]
- Internal fixation at the beginning of the consolidation phase stabilizes the regenerate and allows for early removal of the external fixator
- We compared patients with posttraumatic tibial bone loss treated with either
  - Taylor Spatial Frame (TSF) exclusively, termed the "classic technique" (Figure 1) or
  - A combination of the TSF and plating or insertion of an intramedullary nail during the consolidation phase, termed "integrated technique" (Figure 2)
- We asked: (1) Does integrated fixation decrease the time in the external fixator? (2) Is there a difference in the rate of complications between the two groups, and (3) are the results obtained at final follow-up comparable?

Materials and Methods

- From 2006 through 2012, 58 consecutive patients (58 tibiae) with posttraumatic tibial bone loss were retrospectively identified (Table 1)
- Patients were divided into two groups, "classic technique" (30 patients) and "integrated technique" (28 patients)
- Patients were only included if the tibial bone loss was posttraumatic and lengthening was exclusively performed in the tibia
- Institutional review board approval was obtained prior to initiation of the study
- Baseline demographics, surgical variables, and outcomes were compared
- Adverse events[4] were reported as (Table 3):
  1. Problem: adverse event during treatment that is fully resolved with **nonoperative management**
  2. Obstacle: adverse event that is fully resolved with an **operative intervention**
  3. Complication: adverse event with permanent sequelae
- Functional and radiographic outcomes were reported using the Association for the Study and Application of Methods of Ilizarov (ASAMI) scoring system

Table 1.

Demographics^	Overall (n=58)	Method of Bone Transport: Classic (n=30)	Integrated (n=28)	p-value
Age, years	45 (19 to 61)	43 (25 to 56)	48 (19 to 61)	0.009
Male:Female	39:19	24:6	15:13	0.0497
Infected (culture positive)	50%	53%	46.43%	0.5999
Soft tissue flap present	29.31	43%	14%	0.0195
Smoker	17%	23%	11%	0.3007
Follow-up, months	33 (6 to 90)	31 (6 to 88)	36 (6 to 90)	0.388
Preoperative LLD, mm	35 (0 to 120)	44 (0 to 120)	27 (0 to 70)	0.096
Post-Debridement Defect Size, mm	18 (0 to 70)	15 (0 to 60)	21 0 to 70)	0.171
Total Bone Loss, mm	53 (16 to 130)	57 (16 to 120)	49 (16 to 130)	0.185
Actual length achieved mm	49 (8 to 110)	53 (16 to 110)	44 (8 to 100)	0.248
Time in External Fixator, days	281 (38 to 587)	336 (136 to 587)	224 (38 to 452)	<0.001
Final LLD, mm	-3 (-30 to 9)	-9 (-20 to 9)	-4 (-30 to 0)	0.896

^Values recorded as mean (range)

Figure 1. 34 male with a 6 cm metaphyseal defect treated with the "classic method" of distraction osteogenesis. Time in frame: 302 days

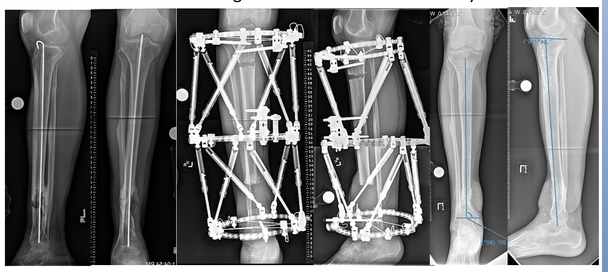
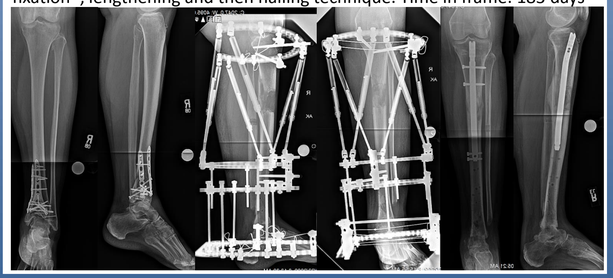


Figure 2. 50 female with an infected Pilon fracture and 4 cm of infected nonviable bone at the ankle joint. Patient was treated with "integrated fixation", lengthening and then nailing technique. Time in frame: 183 days



Results

- Baseline demographics were similar in both groups
- Mean tibial bone loss was 5.3 cm (range, 1.6 to 13 cm) and 50% of patients were actively infected.
- Patients treated with integrated fixation, had significantly less time ($p < 0.001$) in the external fixator, 7 months (range 1.3 to 15 months) compared with 11 months (range 4.5 to 15 months)
- There were 49 adverse events in 31 patients (17 problems, 31 obstacles, 1 minor complication)
- There was no difference in the severity ($p = 0.8703$) or number ($p = 0.359$) of complications between both groups
- Overall, patients required a mean of 4.05 surgical procedures (2 to 5) for limb salvage
  - There was no difference (p=0.2194) in the incidence of unplanned surgical procedures (obstacles) between groups
- All patients had no recurrence of infection and all had bony union at final follow-up
- Good to excellent ASAMI function, and bone scores were obtained in 100%, and 98% of patients, respectively

Table 2. Complications

Type	Overall (n=49) n	Overall (n=49) %	Method of Bone Transport: Classic (n=22) n	Classic (n=22) %	Integrated (n=27) n	Integrated (n=27) %
nonunion	11	22.5	5	22.7	6	22.2
pin infection	10	20.4	5	22.7	5	18.5
malunion	6	12.2	3	13.6	3	11.1
delayed union	5	10.2	2	9.1	3	11.1
equinus contracture	5	10.2	3	13.6	2	7.4
entrapment of overlying skin	4	8.2	2	9.1	2	7.4
refracture	3	6.1	1	4.6	2	7.4
osteomyelitis	2	4.1	0	0.0	2	7.4
failure of fibula to separate	1	2.0	0	0.0	1	3.7
hindfoot arthrosis	1	2.0	0	0.0	1	3.7
septic knee	1	2.0	1	4.6	0	0.0

Table 3.

Adverse Events	Overall (n=49) n	Overall (n=49) %	*Method of Bone Transport: Classic (n=22) n	Classic (n=22) %	Integrated (n=27) n	Integrated (n=27) %
Complication	1	2.0	0	0.0	1	3.7
Obstacle	31	63.3	15	68.2	16	59.3
Problem	17	34.7	7	31.8	10	37.0

*p-value 0.8703

Conclusions

- Limb salvage in patients with posttraumatic tibial bone loss is a challenging surgical entity
- A mean of 4.05 surgical procedures was required for tibial reconstruction
- The integrated fixation method allows for earlier removal of the external fixator
- The frequency of adverse events (53%) and ability to restore limb lengths are similar in both groups
- Good/excellent results can be expected in all patients, despite the high occurrence of adverse events

References

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