Clinical Outcomes of Tibial Shaft Fractures in Patients Over Age Fifty Treated by Intramedullary Nailing

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INTRODUCTION

Since first being described, intramedullary fixation of tibial shaft fractures has become the treatment of choice for those fractures requiring operative treatment. Clinical outcomes of fractures treated by IM nailing have been well studied in both closed and open fractures.[1-4,7-11,14,21,22] Multiple studies have demonstrated union rates comparable to non-operative treatment with a lower incidence of malunion.

With improvements in medical care and treatment, the percentage of older patients within the general population continues to increase. Age related changes in bone quality, geometry, and healing potential may adversely affect outcomes of fracture treatment. In addition, changes in bone geometry and density may make various methods of fracture fixation less effective in the older population. Although hip fractures have been extensively studied in this population, long bone fractures, and tibia fractures in particular, have been given little attention.

MATERIALS AND METHODS

Forty-two patients, age fifty and older, with tibia fractures were treated by intramedullary nailing over an eighteen month period between Jan.1999 – July 2000 at two affiliated level one trauma centers (Mass General Hospital, Boston, MA and Beth Israel Deaconess Medical Center, Boston, MA). Patient identification was performed from operating room records at each hospital for the given study period. Inclusion criteria consisted of patient's age being greater than fifty on the day of surgery and a minimum 12 month follow up interval after the initial surgery. No patients meeting these two criteria were excluded.

A retrospective review of operating room records, hospital charts, outpatient clinic charts, and radiographs was performed. Admission records were used to identify demographic data including age of the patient on the day of surgery, which side the fracture occurred on, as well as the number and type of pre-existing medical co-morbidities at the time of admission. Initial injury radiographs were reviewed either by the author or a senior staff surgeon on the orthopedic trauma service. Classification of fractures was based on the Orthopedic Trauma Association Classification System for long bone fractures.[17] In addition, the anatomic location of fracture in relation to the isthmus was identified. Open fractures were classified according to Gustilo and Anderson based on initial operative assessment. Technical factors related to surgery were obtained from the operating room record. These included the type of entry site, the specific manufacture of nail, the locking pattern used, and whether any additional fixation in the form of blocking screws or plates was utilized.

Postoperative data was obtained from the hospital chart to assess length of stay and the number and type of perioperative complications. Postoperative alignment was assessed based on radiographs performed after surgery. Follow-up data was retrieved from outpatient clinic charts and radiographs. Time to clinical union was defined as the interval between the initial surgery and the patient's ability to bear weight without pain. Time to radiographic union was defined as the interval between surgery and the first follow-up radiographs which demonstrated callus bridging >50% of the fracture site. Fracture healing was classified as delayed if time to union exceeded 16 weeks or a non-union if it exceeded 36 weeks. Malunion was defined as angulation >10 degrees in any plane. Records were also reviewed to ascertain if any additional procedures were performed and the exact type.

RESULTS

Forty-two patients with forty-five tibia fractures (3 bilateral) treated with IM nailing were identified based on the above criteria. Twenty-six patients (twenty-seven tibias) were treated at MGH; sixteen patients (eighteen tibias) were treated at BIDMC. Average age was 64.8 years (50 – 94 years), twenty-one patients were male (one bilateral) and twenty-one patients were female (two bilateral). Seventeen fractures (38%) were classified as O.T.A. type A, fourteen fractures (31%) as O.T.A. type B, and fourteen fractures (31%) as O.T.A. type C. Eleven fractures (24%) were open. Of the open fractures, four were Gustilo and Anderson grade II; average age: 75.3 years. The remaining seven open fractures were Gustilo and Anderson grade III; average age: 60.8 years.

Patients on average had 2.7 medical co morbidities (range 0-9). Nineteen patients (45%) sustained an additional fracture at the time of injury. Five patients sustained bilateral tibia frac-

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tures; three were treated with bilateral IM nails.

Seven patients (16%) sustained ipsilateral lower extremity fractures, 4 patients (9%) sustained contra-lateral lower extremity fractures and seven patients (16%) sustained an associated upper extremity fracture.

Table 1.

Complication	Number of Patients
Delayed Union	13
Nonunion	6
Malunion	6
Infection	4
Perioperative Death	3
BKA 1	
Compartment Syndrome	3
Post-op Pneumonia	4
ARDS	1
Peroneal Palsy	1
Saphenous N. Injury	1
DVT	1

Average duration of hospitalization was 10 days (2 to 31). Nineteen patients (45%) had perioperative complications (**Table 1**). Five patients developed post-op pulmonary complications; four pneumonia, one ARDS. Three patients (7%) required fasciotomies for compartment syndrome. One patient was readmitted for bilateral DVT's. One patient had a peroneal nerve palsy post-op which partially resolved and one patient had a persistent saphenous nerve injury. Three patients (7%) died during their initial hospitalization due to the extent of their initial injuries. One patient required a revision to a below knee amputation several days after IM nailing of his tibia due to vascular complications. One patient underwent immediate above knee amputation of a contra-lateral extremity due to the severity of injury.

Of the initial 45 tibias that underwent IM nailing, nine were lost to follow-up. Four were lost due to perioperative deaths, one to amputation, and an additional 4 had no follow up data available. Average time to clinical union for the entire remaining group of 36 tibias was 23.5 weeks (8-70). Average time to radiographic union was 24 weeks (8-70). There were 13 delayed unions (36%) and 6 non-unions (17%). Sixteen patients (44%) required 34 additional procedures to obtain union. Six malunions occurred requiring 4 osteotomies in 3 patients for correction of angulation. Four of the six malunions occurred in fractures located above the isthmus. The remaining 2 malunions occurred in fractures below the isthmus.

When stratified by fracture type, fourteen of seventeen O.T.A. type A fractures were available for follow-up. Average time to union was 20.7/22.2 weeks (clinical/radiographic). There were five delayed unions (35.7%), two non-unions (14.3) and one malunion. Eleven of fourteen O.T.A. type B fractures were available for follow-up. Average time to union was 18.7/20.7 weeks (clinical/radiographic). There were four delayed (36.4%), one non-union (9%), and one malunion in this group. Of the O.T.A. type C fractures, eleven of fourteen fractures were available for follow-up. Average time to union was 31.7/30 weeks (clinical/radiographic). There were four delayed unions (36%), three non-unions (27.3%) and 3 malunions within the type C group. (**Table 2**)

Table 2.

	OTA Type A	OTA Type B	OTA Type C
Avg. Age	65.3	68.4	60.6
Follow-up	14/17	11/14	11/14
Time to Union (clinical)	20.7 wks	18.7 wks	31.7 wks
Time to Union (x-ray)	22.2 wks	20.7 wks	30 wks
Delayed Union	5 (35.7%)	4 (36.4%)	4 (36.4%)
Nonunion	2 (14.3%)	1 (9%)	3 (27.3%)

DISCUSSION

The tibia is the most frequently fractured long bone in the body with an estimated incidence of 492,000 per year.[18] Historically there has been much debate as to what constituted the best method for treatment of these fractures. This led Nicoll in 1964 to publish his often quoted observation: "fractures of the tibial shaft are important for two reasons. The first is that they are common; the second that they are controversial – and anything that is both common and controversial must be important."[15] Since then, much clinical knowledge has been gained but some of the controversy remains.

Recent published studies have documented the efficacy of intramedullary fixation for tibial shaft fractures. Hoper et al.[9] reported on a series of 62 prospectively randomized patients with closed or grade I open tibial shaft fractures. Of the patients treated without surgery, 75% had united fractures by 20 weeks. In comparison, the group treated by nailing had an 85% union rate at 20 weeks. Seven out of 29 fractures (25%) treated non-operatively required operative fixation at a later date for failure to maintain a reduction. At union, 55% of the casted patients were classified as malunited compared to 10% in the group treated with IM nailing. Court-Brown et al.[4] reported a malunion rate of 2.4%, a non-union rate of 1.6% and an infection rate of 1.6% in a similar population of patients treated with IM nails. Bone and Sucato[1] reported a significantly shorter time to union in patients treated with intramedullary nailing; 18 weeks compared to 26 weeks for patients treated in a cast.

There is also good clinical evidence to support the use of intramedullary nailing in more complex fractures including type II and type III open fractures. Wu and Shih[25] reported a 97% union rate in a series of 38 segmental tibial shaft fractures treated by IM nail. They had 1 nonunion, which healed after dynamization of the nail. Henley and Chapman[10] reported significantly better results with tibial nailing in type II, IIIA, and IIIB fractures compared with external fixation. They reported significantly lower rates of malalignment, subsequent procedures, and infection rates for the group treated with IM nailing. Even in patients initially treated with external fixation due to soft tissue injuries, intramedullary nailing appears to be the treatment of choice. Siebenrock and Schillig[22] reported a series of 135 patients initially treated with external fixation. Patients who underwent secondary intramedullary fixation had the shortest time to union, the lowest infection rate, and the lowest malunion rate when compared to patients treated with secondary plating or external fixation alone.

In comparison, our study population with an average age of 64.8 years had an overall union rate of 84% at one year. Average time to union was 24 weeks with a 16% malunion rate at healing. When stratified by fracture type more severe fractures tended to occur at a younger age. OTA type C fractures had an average age of 60.6 compared with 68.4 for type B and 65.3 for type A injuries. Average age of the seven Gustilo type III open injuries was 60.8, however, when one patient age 88 was excluded the average age fell to 56 years. Within this group of seven open fractures, there was a 29% mortality rate (2 deaths) and one patient who required conversion to a below knee amputation perioperatively (15%) resulting in a major complication rate of 43% for this group. In contrast Schandelmaier and Krettek[21] reported a series forty-one patients with grade IIIB open tibia fractures; average age 36 years. Within this group, three patients required below knee amputation (7%) and three patients died from associated injuries (7%) yielding a total major complication rate of 15%.

In our study malunion appeared to be associated with fracture location. Six malunions (17%) were identified as having angulation greater than 10 degrees in any plane. Four of the six fractures involved the proximal third of the tibial shaft; the remaining two involved the distal third. This appears to correlate with the findings of Freedman[6] who found a 16% overall malalignment and a 58% malalignment of proximal third fractures. In contrast Buehler[3] et al. reported good success in treating proximal third tibial shaft fractures with IM nailing. They report 12 of 14 patients in their series healed with a single nonunion and a single malunion.

The occurrence of compartment syndrome in 3 patients (7%) is consistent with the rate documented in the literature. Williams and Gibbons[24] reported a 7% incidence of acute compartment syndrome requiring fasciotomies in a series of 102 patients (average age 31 years) treated by IM nailing. They also cited an 18% incidence of secondary procedure to achieve union. In contrast, our study population had a secondary procedure performed in 44% of cases.

Our study has several limitations. It is a retrospective examination and has no matched pair or cohort population for comparison. It also lacks any functional outcome assessment. It identifies differences in an older patient population when compared with previously published data, however, further study is needed to determine the exact etiology of these differences.

CONCLUSION

It is only recently that age related changes in bone quantity and quality have been recognized as etiologic factors in fractures. Much study of hip, vertebral and distal radius fractures in the older population has been performed. To date no study has examined outcomes of tibia fractures in relation to patient age at the time of injury. Our study indicates that older patients sustaining tibial shaft fractures treated with intramedullary nailing take longer to heal, and required more procedures to achieve union. For type III open fractures our population had a higher complication rate than published data.

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