MANAGEMENT OF TIBIAL SHAFT FRACTURE WITH CAST BRACE

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ABSTRACT

Management of tibial shaft fracture is a very controversial subject, due to wide choice of therapeutic options. We present results of 25 patients with closed or grade 1 open tibial fractures who were between 15-45 years of age and were managed with cast brace. Out of 25 fractures 21 (84%) were closed and 4 (16%) were open, 17 (68%) were transverse and 8 (32%) were short oblique. Shortening of less than one cm and angulation of less than 5 degrees in any plane were our ideal treatment parameters. At a mean follow up of 6 (3-10) months, all fractures were united although one (4%) needed open reduction and internal fixation with DCP and bone graft. The mean time for the application of cast brace was 3.5 (2-6) weeks after injury. The mean time to union was 18.5 (16-22) weeks. Union time for closed fractures was 17.6 (16-19) weeks and for open fractures 21.2 (20-22) weeks. Union was achieved in 96% of fractures. Two (8.3%) fractures healed with shortening of 1.5cm. There were angular deformities of more then 5 degree in 5 (20%) patients of which one (4%) was in varus and 4 (10%) were in valgus. There was no mal-rotation. There was full range of motion at knee due to early ROM exercises but 12 (48%) ankles had decreased ROM.

INTRODUCTION

Tibial shaft fracture is one of the commonest fractures. This is partly due to vulnerability of this bone to trauma, as one third of its surface is subscutaneous. Thomas A. R. (1991) has reported tibial shaft fracture to be nine times commoner than femoral fracture.

Different methods for management of tibial shaft fracture have been recommended. This difference of opinion has given rise to controversy about the best method and none has gained consensus (White 1975). Methods of treatment range from early weight bearing in a plaster cast or brace to open reduction and internal fixation with plates, intra medullary nailing, Ender's pins and external fixators.

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When there is a choice for several therapeutic principles, none is ideal and there is always search for the best, cost effective and least morbid method of treatment (Karlstrom 1974).

The purpose of the present study was to evaluate effectiveness of cast bracing method, which carries minimum incidence of post management complications and totally eliminates the operative and post operative risk factors, while being a cost effective method, is easily afforded by the majority of patients.

MATERIALS AND METHODS

This prospective study was conducted on 25 patients, who presented in the emergency department of Services Hospital / Postgraduate Medical Institute Lahore from May 1996 to December 1997. Only closed and grade I open tibial shaft fractures, between 15-45 years of age were included (Table 1). Metaphyseal fractures, long oblique fractures, severely comminuted fractures, grade II and III open fractures were excluded.

A detailed history, clinical and radiological assessment of the patients were documented on a standard form which was created for this purpose.

After initial management of the patient, closed fractures, requiring manipulation were reduced under intravenous sedation or general anaesthesia and long leg casts were applied with knees extended (avoiding hyper extension). Grade 1 open fractures were debrided and initially treated by irrigation with physiological saline solution and long leg cast. A window was made at the wound site for inspection and daily dressing. Intravenous anti-biotics (Cephalosporin and Aminoglycoside) were administered for first 72 hours.

Patients were allowed nonweight bearing crutch walking, after about one week. Patients were re-evaluated with new X-Rays after 1 week for displacement, angulation or loosening of the cast. If angulation increased more than 10 degrees cast wedging was done, usually after 3 weeks. Patients were reviewed fortnightly for next four weeks with antero posterior and lateral radio-graphs. Measurements of shortening, varus / valgus and anterior / posterior angulations were made on each set of films. Plaster cast was removed and cast brace applied when fracture was deformable but not displaceable, about 2-4 weeks after the first cast.

Simple aluminum made knee hinges and plaster of Paris was used for cast bracing. Cast brace was applied in two stages. First well molded below the knee cast from toes to tibial tuberosity was applied, knee was left free and then another cast just above the knee was applied, which covered about distal 2/3rd of thigh. Then with the help of an assistant hinges were incorporated in plaster cast on either side of knee joint, with joints of the hinges metallic hinges at the level of knee joint just behind the mid axial line on either wide.

Patients were encouraged to mobilize the newly free joint but not to bear weight for first 24 hours. Patients were instructed to bear weight on the injured limb when tolerable, usually 1-2 weeks after the application of cast brace. Weight bearing was progressively increased till the patient could walk without crutches.

When patients were able to bear 2/3rd of their weight and radiologically callus was apparent lower part of the cast brace was removed and thus converted into tibial gaiter cast.

Table 1: Details of 25 patients Who were managed with Cast Brace

Mean age in years (range)	29.8 (16-25)
Male : Female	22 : 3
Left : Right	11 : 14
Close : Open	21 : 4
Mean time from injury to presentation in hours (range)	15.3 (1-72)
Mean time for long leg cast in weeks (range)	3.8 (2-7)
Mean follow up time in weeks (range)	24.6 (20-44)
Level of Injury	
Proximal 1/3rd	13
Middle 1/3rd	05
Distal 1/3rd	07

Table 2: Mechanism of Injury

S. No.	Type of Accident	No. of Patients	%
1.	Motor Vehicle Accident		
	(i) Motor cycle rider	09	36
	(ii) Motor cycle pillion passenger	03	12
	(iii) Automobile occupants	04	16
	(iv) Pedestrain	05	20
2.	Fall from Height	03	12
3.	Assault	01	04
4.	Sports	00	00

Table 3: Mean healing time in weeks

Mean healing time (Range)	18.5 (16-22)
Mean Healing time for closed fractures (Range)	17.6 (16-19)
Mean Healing time for open fractures (Range)	21.2 (20-22)
Mean Healing time in isolated tibial fracture (Range)	17.7 (16-20)
Mean Healing time in fracture of both T/F (Range)	19.3 (17-22)
Mean Healing time closed transverse fractures (range)	18 (16-19)
Mean Healing time in closed oblique fractures (range)	17 (16-18)
Mean Healing time in open transverse fracture (Range)	21.3 (21-22)
Mean Healing time in open oblique fracture	20 (only one case)

Follow up carried on fortnightly till six months. Union was defined both clinically and radiologically i.e. when bridging callus was identified on radiograph and fracture site was painless on full weight bearing. The brace was then discontinued.

RESULTS

No patient was lost to follow up and mean follow up of 25 patients was 24.6 weeks. Mean age of the patients was 29.8 years, where as range of male patients was 16-52 and range of female patients was 18-32 years. Male patients were 22, where as female patients were only 3. Out of 25 fractures 11 (44%) were of left leg and 14 (56%) were of right leg. 21 (84%) fractures were closed and 4 (16%) were grade 1 open fractures. In the majority of cases middle third of the tibial shaft was fractured. There were 13 (52%) fractures in the middle, 5 (20%) in the proximal and 7 (28%) in the distal third. 19 (76%) patient presented within 6 hour and remaining 6 (24%) presented after 6 hours. Mean time from injury to presentation was 15.3 hours (Table 1). The most common mechanism of injury 84% was road traffic accident, where as other causes were fall from height and assault (Table 2). 7 (68%) were transverse and 8 (32%) were short oblique fractures. Amongst the 25 tibial shaft fractures 9 (36%) were associated with fibular fracture at the same or at another level while 16 (64%) patients were with intact fibula.

Mean time for the application of long leg cast was 3.8 weeks, for closed fractures it was 3.5 (2-6) and for open fractures it was 5.2 (4-7) weeks. Mean duration of hospitalization was 2.2 (1-4) days. 19 (76%) fractures were reduced 100% where as in 6 (24%) reduction was about 75%.Fractures were considered to have healed when bridging callus was identified on radiograph and fracture site was painless during full weight bearing. The mean union time for all type of fractures was 18. 5 weeks (range 16-22) where as out of 25 fractures one ended in non union till 24 weeks which was treated by ORIF with DCP and bone graft (Table 3). Isolated tibial fractures healed in 17.7 (16-20) weeks, when both bones of leg were fractured healing time increased to 19.7 (17-22) weeks.

On final radiographic assessment out of 24 healed tibial fractures 9 (37.5%) healed without shortening while 13 (54.2%) healed with shortening less than one centimeter and 2 (8.35%) healed with shortening of 2.5 cm. Mean shortening was 1.2 cm.

There were angular deformities more than 5 degrees in 5 (20%) patients. One (4%) patient was having 7 degree varus deformity while 4 (16%) have 7 (5-9) degree valgus angulations. 5 (20%) patients showed less than 6 degrees and 7 (28%) showed 7-12 degree anterior angulations. Posterior angulations 6 (2-10) degrees occurred in 8 (39%) patients. Plaster sore developed in 3 (12%) patients and skin maceration occurred under the brace in 8 (32%) patients.

Secondary procedures were done on 9 (36%) patients, change of long leg cast in one (4%) patient, wedging to correct angulation in 4 (16%) patients and making of windows in long leg cast in 4 (16%) patients.

DISCUSSION

Fracture healing is a complex process, which is influenced by many factors. There is considerable clinical evidence suggesting that rigid immobilization of long bone fractures is not a prerequisite for fracture healing. many authors have suggested that some movements at the fracture site encourage healing (Mc Kibbin 1978, De Bastiani et al 1978)

Kenwright et al (1991) showed that early cyclical compression and distraction micro movements of up to 1 mm increase the rate of healing in tibial osteotomies.

Clinical observation supported by some laboratory data suggest that movements between bone fragments constitute an irritant leading to a number of changes electrical, thermal and vascular, all disposing to osteogenesis.

If a fracture is not rigidly immobilized, an inflammatory reaction occurs, with the invasion of capillaries to the fracture site. The greater the number of capillaries, the more rapid is osteogenesis. Hunter J. (1974) said that vessels form bone. Truta (1963) popularized the idea that this was due to endothelial metaplasia and that endothelial cells in the lining of capillaries are capable of differentiating into osteoblasts. It is clear that cellular activity is markedly increased by fracture motion and capillary invasion from

surrounding tissues is only seen if the fracture remains mobile. The principle of fracture bracing is based upon the belief that controlled motion at the fracture site is conducive to osteogenesis (Sarmiento et al 1977, Sarmiento and Latta 1981, Sarmiento et al 1984). The fracture brace is an external splint, which is applied to fractured limb in such a way as to provide adequate support for the fracture, whilst permitting maximum function of the limb until union is complete. However brace is not a primary treatment of fracture, but is second stage management of a fracture. Bracing does not reduced the union time though it reduces the incidence of delayed union and nonunion (Hall A.J. 1985). Although origin of the cast bracing is very old as Hippocrates had described a form of tibial brace. Early weight bearing for fractured tibia has been advocated in the 20th century, but after Sarmiento's study in July 1967 this idea was popularized. Our results are comparable to other studies done by Sarmiento (1989, 1995) Puno et al (1986) Haines (1984) Khan (1997, 1989) Kyro (1991) Oni (1991) and Chapman (1996). However ankle stiffness remained a problem, as we have not used ankle hinges due to maceration and skin necrosis. But after conversion of case brace to tibial gaiter cast and active physiotherapy this problem decreased.

Our experience showed that cast bracing is an acceptable form of treatment for selected tibial shaft fractures due to the following advantages:

1. Non operative method.
2. Short hospitalization.
3. Early Mobilization.
4. High rate of fracture union.
5. Prevention of Joint stiffness.
6. No risk of infection.
7. Cost effectiveness.
8. Can be performed with out sophisticated instrumentation.

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