Basrah Journal Of Surgery

Bas J Surg, March, 15, 2009

A COMPARATIVE STUDY FOR MANAGEMENT OF CLOSED TIBIAL SHAFT FRACTURES BY EXTERNAL FIXATION VERSUS PLATING

ALAA ABDUL HUSSAIN

MB,ChB, FICMS, Orthopedic Surgeon, Lecturer, Dept. of Surgery, College of Medicine, University of Basrah, Basrah, IRAQ

Abstract

In this prospective study, 25 patients with closed tibial shaft fractures were treated by two different methods of treating fracture tibia ie, external fixation and plating. Thirteen patients were treated by uniplanar unilateral external fixation device AO/ASIF type and 12 patients treated by plating.

There were 22 male and 3 female, there age ranges from 12-45 years. Seventeen patients sustain car accident as a cause of tibial fracture, associated fibular fractures were in 17 patients. There was no case of malunion in both modalities of treatment. Average time of fracture union with external fixation was 24 weeks.

In external fixation union rate was 46%, delayed union 31% and non union 23%, complications were pin tract infection 46%, ankle stiffness 31%, algodystrophy 31% and broken schanz screws in 15.3%. Average time of fracture union with plating was 22.5 weeks.

In plating, union rate was 59%, delayed union 33% and non union 8%; while complications were superficial infection 8%, deep infection 8% and ankle stiffness 8%. The non union was 100% in the middle 1/3 and 75% was transverse fracture configuration. The degree of soft tissue injury, fracture site and configuration has a great effect on union, delayed union, non union and infection also will affect the choice of treatment. In our study we try to evaluate two different modalities of treatment, which are plating and external fixation as definitive method of treatment of closed tibial shaft fracture and we try to compare between the 2 as regards of different aspect like; time of union and complication in each modality and its relation with type of fracture site, configuration, degree of soft tissue injury, this in turn will guide us to a better or more proper choice of treatment modality in the future.

Introduction

Tibia is currently the most commonly fractured long bone in the body[1]. Fracture shaft tibia is a common and frequently perplexing problem in our locality. Fractures of the tibia constitute 22.4% of all fractures that require hospital admission[2].

The blood supply to the tibia is more precarious than that of bones enclosed by heavy muscles[3]. Fractures of the tibia generally are associated with fibula fracture, because the force is transmitted along the interosseous membrane to the fibula[4]. In fracture tibia the torsion fractures tend to create a longitudinal tear of the periosteum and may not disrupt endosteal vessels, whereas transverse fractures usually tear the periosteum circumferentially and completely disrupt the endosteal circulation[5]; this is a corner stone in choosing the modality of treatment. Indeed tibial shaft fracture is more difficult to manage than to diagnose.

Patients & Methods

Between March 2007 to August 2008, twenty-five patients with closed tibial shaft fracture were treated by 2 different modalities in Al-Mawani hospital and Basrah General Hospital. Thirteen were treated by unilateral uniplanar external

fixator AO/ASIF type as primary and definitive method of treatment and 12 treated by plating.

Associated fibular fracture was seen in 17 patients. There were 15 right tibial fractures and 10 left tibial fractures. Fasciotomy was done for 3 patients at day of admission for imminent compartment syndrome. Five patients have been multi-traumatized 2 cases have fasciomaxilary fracture 2 have fracture femur and 1 case with stable fracture pelvis. Severity of soft tissue injury was evaluated and graded according to Teshrene classification[6]. Severity of bony injury classified according to AO classification system.

Operative Procedure: Patients were operated upon in supine position, prophylactic antibiotic was given at induction of anesthesia a third generation cephlosporine (cefotaxime 1 gram) then 1 gram 3 times daily for 5 days, shaving of the skin, washing the leg with antiseptic solution and tourniquet applied. In cases where external fixation was used open reduction were done with minimal soft tissue dissection, a three schanz screws of 4.5 mm diameter were placed in each major fragment connected to a single bar applied according to the technique recommended by the AO group the safe corridor described by Behrens and Searls[7]. Drilling of the near cortex but not penetrate the far cortex. While in cases of plating a heavy duty plate was used, screw number range from 4-5 in each major segment.

Cancellous bone graft have been taken from upper tibia in 4 cases with external fixation and 5 cases with plating when comminution is present. The operating time in external fixation range from 45-60 minutes, while in plating range from 50-90 minutes.

Post operative care: After local signs of healing (about 14 days), removal of stitches done in all cases. Complete cast above knee joint applied in cases treated by plating for about 6 weeks. Instruction of intensive physiotherapy of the ankle by encouraging range of movement and active isometric quadriceps muscle exercise. Allowing patient up and walking non weight bearing on crutches after 5-10 days in external fixation, and 3-5 days in plating.

Follow up done twice weekly in the first month then once monthly till union occur by clinical and radiological evaluation. In cases treated by external fixation partial weight bearing is allowed around 14 weeks and full weight bearing is allowed around 20 weeks, dynamization needed for 2 patients. Removal of external fixator was done 8-28 weeks after observing clinical and radiological sign of union after that walking P.O.P cast applied for about 4-6 weeks, the shortest period (8 weeks) was for the youngest (12 years) patient. In plating a cast was applied for 6 weeks then partial weight bearing with crutches around 10 weeks after observation of early signs of callus formation on x-ray, then full weight bearing allowed around 12 weeks.

Results

Patients in this series were 3 women and 22 men. There age range between 12-45 years. There was no case of malunion in both modality of treatments. The middle third represent-ted the highest incidence for both external fixation (77%), plating (66%) and 72% for all cases.

The time of fracture union in external fixation averaged 24 weeks with range of (16-32) weeks.

In externally treated tibiae fracture union within the expected period (that is 16 weeks) had occurred in 6 out of 13 (46%), while delayed union (more than 16 weeks) in 4 out of 13 (31%) and non-union (more than 24 weeks) in 3 out of 13 (23%) figure 1. The time of fracture union in plating averaged 22.5 weeks with range of (15-30) weeks.

Fracture union with in the expected period had occurred in seven cases out of

12 (59%), while delayed union in four cases out of twelve (33%) and nonunion only in one case (8%) as shown in fig. 2.

Figure 1: Union rate in external fixation

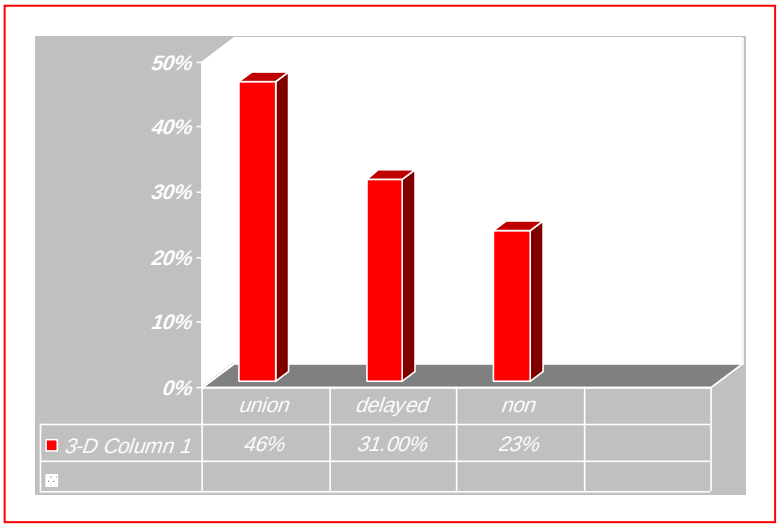
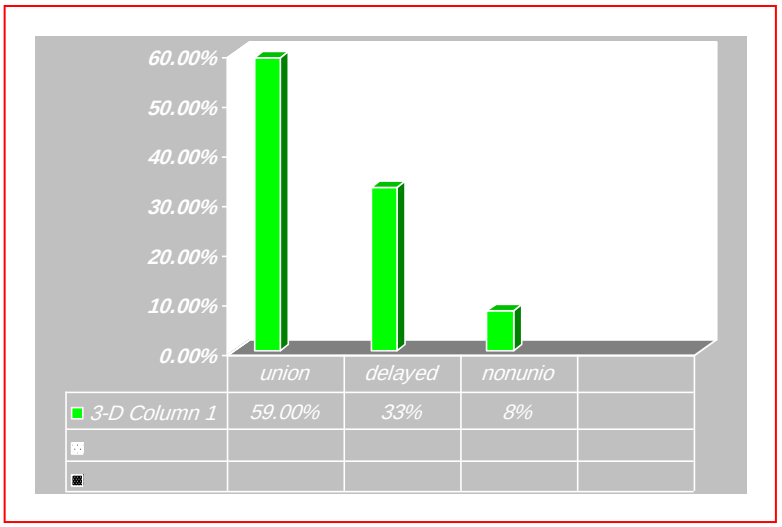


Figure 2: Union rate in internal fixation



Complications that we face in external fixation was pin tract infection in 6 cases (46%) which was treated by daily dressing and systemic antibiotic cover there was no deep infection or osteomylitis and no need for schanz site to be changed, ankle stiffness in 4 cases (31%), algodystrophy in 4 cases (31%), non union in 3 cases (23%) and broken schanz screws in 2 cases (15.3%) fig. 3. Complications that were reported in cases treated by internal fixation was superficial infection in 1 case (8%), deep infection and osteomylitis in 1 case (8%) and ankle stiffness in 1 case (8%) figure 4. There was strong correlation between fracture configuration and fracture site with delayed or nonunion. Total cases of non union were 4 in both modalities; 3 cases were transverse (75%) and one case spiral (25%). All cases was in the middle 1\3 (100%). Regarding delayed

union number of cases was 8; 4 cases (50%) of them were transverse, 3 cases

Figure 3: Complication of external fixation

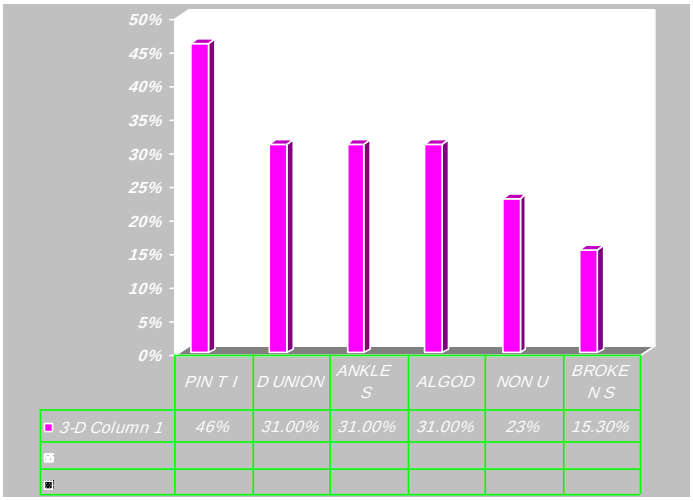
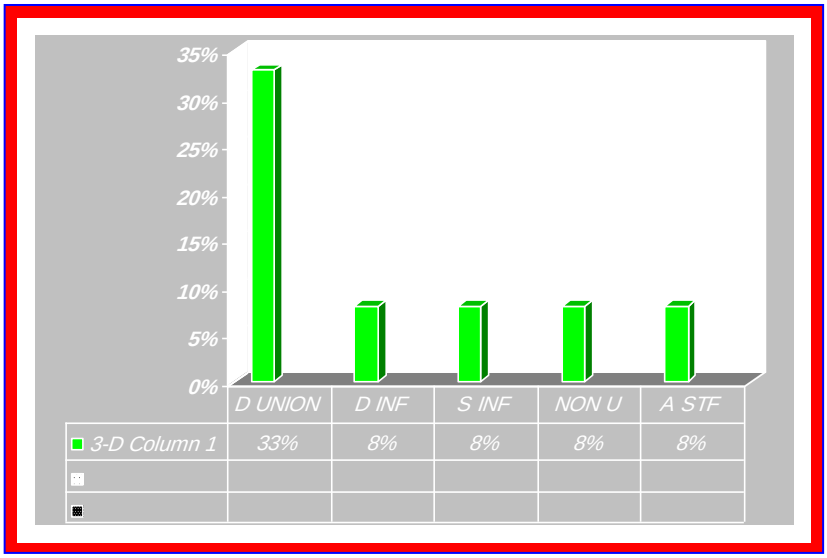


Figure 4: Complications of plating



(37.5%) was comminuted and 1 case (12.5%) was oblique. Seven cases of them were in the middle 1\3 (87.5%) but 1 case in the upper 1\3 (12.5%). Non union was 75% with external fixation, while in plating it is only 25%. Delayed union was 50% with external and 50% with plating figure 5.

The amount of soft tissue damage (Tschrene classification) is correlated with the incidence of infection, delayed union and non union figure 6.

Figure 5: Correlation between delayed and non union with fracture site, configuration and modality of treatment

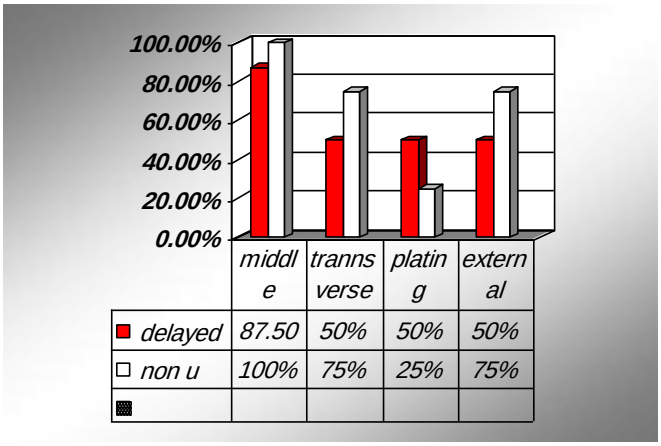
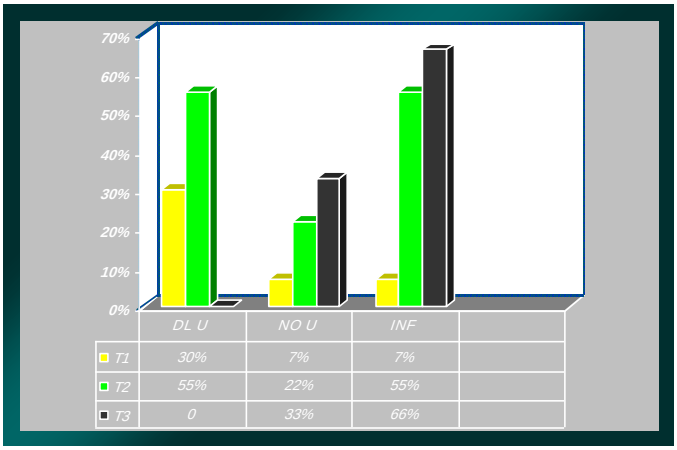


Figure 6: Correlation of degree of soft tissue injury with complications



Discussion

All forms of treatment for closed tibial fracture carry with them a real risk of complication and that complications are often unavoidable consequence of tibial fracture management. Different complications have varying consequences on final outcome[8].

Operative time was less with external fixation (45-60 minutes) than in plating (50-90 minutes); because with external fixation no need for large skin incision and less extensive soft tissue dissection; most of the time the incision is as little as the fracture site can be hold while the pins can be inserted percutaneously; in contrast to plating large skin incision

with subcutaneous and muscles planes dissection and more periosteal stripping are needed in order to insert the plate and hold it with bone holders and safe application of screws.

Union rate is within the expected period of time in external fixation was 46%, which is less than reported by Hamdan[2] who reported 78.6% and Mubder[9] who reported 80%.

The non union rate of externally treated tibial fractures in this study was 23% which correspond to Hamdan (21.4%)

and higher than Mubder (6%). Average time of fracture union in external fixation was 24 weeks which is less than Mubder who reported 28 weeks but correspond to Behrens F[7] who reported 25 weeks.

The causes of non union that we face in external fixation were; sever soft tissue injury (T3) with fasciotomy in 1 case; 1 case with associated injury that was compound fracture of contra lateral tibia; the other with butterfly segment (B1 in AO classification) fracture configuration.

The delayed union in externally fixed fractures was 31% in our series but we could not find result concerning delayed union in other studies.

The causes of delayed union with external fixation were; 1 with segmental fracture (C2 in AO classification); 1 with associated ipsilateral fracture femur, and the other 2 with transverse fracture configuration.

Union rate with internal fixation a (59%) which is much less than that reported by Karalezli et al 2003[10] who report 96% and Coles C P et al[8] who report 97.4%.

While the rate of delayed union with internal fixation was 33% in our study we did not find a comparable results in other papers. Non union was 8% which is more than Coles et al[8] who reported 2.6% and 4% by Karalezli et al[10]. The non union result in our series was because of deep infection in 1 case ,while delayed union because of superficial infection in 1 case, 2 case was with butterfly segment (B2 in AO classification).

The other complication of external fixation was pin tract infection 46% which does not correspond to Behrens and Searls[7] where the result 12%. Other studies parallel with the results in this series as 42% by Edge and Denham[11], 49% by Hamdan[2] and 40% by Mubder this can be overcomed by; trying to keep only the smooth part of the schanz screw outside the skin , the drilling must be with sharp drill protected by drill sleeve which eliminates heat necrosis of soft tissue and bone and lastly by effective pin and frame care by the patient[7].

Ankle stiffness in external fixation was 31% in this study which correlate with Nesbakken et al[12] 30.7% and Mubder (33%)[9] but higher than Hamdan who reported 14% and Thakur and patanker (10.9%)[13];while ankle stiffness with plating was 8% which is superior to other modality of treatment (external fixation 31%) and correspond to Karalezli et al[10] who report 8%. We think that the cause is due to lack of proper physiotherapy and some times the frame acts as obstacle for proper ankle movements and pins some times may tethers the movement of tendons and muscles that glides smoothly without pins. So internal fixation must be so rigid that plaster can be discarded with and joint movements started immediately this adopted by Muller[14].

One of the most serious and frightful complication that we face with plating is infection. The incidence of infection in plating was 16%; 8% was superficial infection and 8% was deep infection which is less than Harilaos T. et al[15], who reported 28% but higher than Karalezli et al who report 8%[10].

The incidence of superficial infection with plating in this study was 8% which less than Olerud and Karlstrom[16] who report 12% and correspond to Batten and associates[17] who report 8% and Coles[8] who report 9%.

Deep infection with plating in this study was 8% which is much higher than Coles[8] (4%) and 1% by Olerud and Karlstrom[16].

This study had found strong correlation between delayed union and non union with fracture site in tibia as delayed union 87.5% in the middle while all cases of non union occurred in fractures that were located in the middle third which similar to Ellis[18], Allum and Nowbray[16] who support the idea of correlation

between fracture site and delayed union or non union.

Others do not blame the fracture site as a cause like Sarmiento[20] and O.O.A.Oni et al[21], but Nicoll[14] although he found higher rate in the middle but he blame other parameters to influence like fracture configuration, infection, age …etc.

Associated fibular fracture; we found that there is no significant effect of intact fibula on healing of fracture tibia as claimed by Jackson and Macnab[22].

Our findings are similar to those reported by Allum and Nowbray[19] and Hooper, Buxton and Gillespie[50]. Others claim that partial fibulectomy is a viable option in the management of tibial delayed and non-union[24].

Conclusions

1. Both external and internal fixations for closed fractures of shaft of tibia had their own advantages and disadvantages depending on the degree of soft tissue injury, associated injuries level of fracture and fracture configuration.
2. When indicated plating of tibia can be used as a modality of treatment with good results and relatively lower complication rates in terms of fracture union when compared to external fixation but with added risk of serious bone infection.
3. Transverse configuration and fractures in middle third of tibial shaft together with the degree of soft tissue injury have direct effect on the incidence of delayed union, non union and infection. This will affect the choice of modality of treatment.
4. Intact fibula has a little significant role in the incidence of delayed union and non union in tibial shaft fractures.

References

1. Alho A, Benterud JG, Hogevold HE, et al: Comparison of functional bracing and locked intramedullary nailing in the treatment of displaced tibial shaft fractures. Clin Orthop 1992 Apr; (277): 243-50.
2. Thamer A. Hamdan; the treatment of open and closed fractures by primary external fixation and bone graft: Bas. J surg .sep.2005.38-44.
3. A. Paige Whittle; Fractures of lower extremity; in Sterry Canale ; Campbell s operative orthopedics; ninth edition; Mosby ;1998; 47; 2067-2093.
4. Russell TA: Fractures of the Tibia and Fibula. In: Fractures in Adults, 4th ed. Philadelphia: Lippincott-Raven; 1996: 2127-2201.
5. A. Paige Whittle; Fractures of lower extremity;in Sterry Canale; Campbell s operative orthopedics; tenth edition; Mosby; 2003;51; 2754-2755.
6. Tscherne HC (1984) The management of open fractures. In Fractures With Soft Tissue Injuries (eds Tscherne H,GotzenL). Springer, Berlin.
7. Fred Behrens, Kate Searls :external fixation of tibia basic concepts and prospective evaluation; J B J Surj vol. 68 B No. 2 march 1986:246-254.
8. Chad P; Coles MDM; Chael Gross MD; Closed tibial shaft fractures; management and treatment complications a review of the prospective literature. JCC vol.43 no.4; 2000.256-262.
9. Mubder A; treatment of closed unstable tibial shaft fracture by unilateral uniplanar external fixation is a second operative step necessary; Bas J Surg, September, 11 ,2005 .64-70.
10. Karalezli; the comparison of the clinical results of locked intramedullary nailing and open reduction internal fixation in tibial shaft fractures; Gulhane tip dergisi (2003). 45 (4); 343-349.
11. Edge AJ, Denham RA; External fixation complicated tibial fractures. J B J Surg .Br 1981;63 B;92-97.
12. James H. Beaty; orthopaedic knowledge update -6. Home study syllabus. 1999.
13. Thakur AJ ,Latankar J;open tibial fracture treated by uniplanar external fixation and early bone grafting; J B J Surg. 1991;73-BP; 448-451.
14. E.A.Nicoll;fractures of the tibial shaft;a survey of 705 cases.J B J Surg. vol.46 B,NO.3. August 1964.373-387.
15. Harilaost T et al: delayed union and non union of tibial shaft fractures;a review of 100 cases; J B J Surg Am ;1964;46;557-569.
16. Olerud S , Karlstrom G ;tibial fracture treated by AO compression osteosynthesis . experiences from five years material. Acta orthop. Scand suppl ,1972 ;140 ; 1-104.
17. Batten RL ,Donaldson LJ , Aldridge MJ ;Eexperience with the AO method in the treatment of 142 cases of fresh fracture of the tibial shaft treated in UK . injury 1978 ;10; 108-14.
18. Ellis H ;the speed of healing after fracture of the shaft of the tibia .J B J Surg Br 1958; 40B, 42-6.
19. Allumm RL, Nowbray MAS;Aretrospective review of healing of fractures of shaft of tibia with special reference to the mechanism of injury.Injury, 1980; 11: 3004.
20. Sarmiento A.A;Functional below the knee brace for tibial fractures.J B J Surg Am, 1970; 52 A:295-311.
21. O.O.A.Oni; the healing of closed tibial shaft fractures ;J B J Surg. vol 70 –B, no. 5, Nov 1988.
22. Jackson RW ,Macnab I; Fractures of the shaft of tibia; a clinical and experim. study, Am J Surg, 1959; 47:543-57.
23. Hooper G, Buxton RA, Gillespie WJ. Isolated fractures of the shaft 0f the tibia Injury, 1981; 12: 283-7.
24. Butt M, Mir BA, Halwai MA, Farooq M, Dhar SA. Partial resection of fibula in treatment of ununited tibial shaft fractures. Indian J Orthop, 2006; 40: 247-9.