Comparative Study of Interlock Nailing Versus Dynamic Compression Plating in Fractures of Tibia – A Study of Sixty Cases

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ABSTRACT

Background: *In modern era high speed vehicular traffic accidents fractures of the tibial shaft are common injuries among the long bones and mainly affect young adults, i.e. individuals at their peak of physical and work capacity. The present study was a comparative study between interlock nailing and Dynamic compression plating (DCP) in the treatment of fractures of tibia. The purpose of the study was to determine the outcome and comparing the two different modalities of the treatment.*

Material methods: *The Study includes sixty consecutive patients with fracture tibia [closed and open Gustio & Anderson grade 1 only] treated with Dynamic compression platting and interlock nailing 30 in each group and were assessed clinically and radiologically and followed up to three years.*

Results: *90% patients had good to excellent results with 10% having fair results and no poor results. In DCP group there were 10 excellent, 15 good and 5 fair results whereas in interlock nailing group 15 patients had excellent, 14 patients had good results and 1 patient showed fair result.*

Conclusion: *We conclude that DCP is a better mode of fixation for proximal and distal tibial facture and interlock nailing is ideal implant in diaphysial and segmental fractures*

Key words: *Fracture, Tibia, Interlock nail, DCP, Implants, Diaphysial fracture.*
Mesh terms: *Adult, Fracture fixation, Age, Male female, Infection*

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INTRODUCTION

In this modern era of industrialization and mechanization high speed vehicular traffic accidents fractures of the tibial shaft are common injuries among the long bones and mainly affect young adults, i.e. individuals at their peak of physical and work capacity. Due to their frequency, topography, mode of injury and sometimes type of treatment, they have become a major source of temporary and permanent disability. In spite of all the advances, fractures of the tibia still pose a challenge to the orthopedic surgeon as non-union and infections are quite common. The optimum management of tibial shaft fracture is not controversial now a days due to advanced techniques like interlocking. Before going into details of different modalities of treatment of tibial shaft fractures, it is necessary to be conversant with the anatomy and the blood supply of the bone.

Nelson and many other investigators have studied the problem of vascular supply of long bones. They generally conclude that 3 main systems of vessels supply long bones.[1]

(a) The epiphyseal - metaphyseal
(b) The nutrient (Arteria nutricia tibiae)
(c) The periosteal

These systems are closely interrelated in their distribution. Internal fixation where indicated, either intramedullary or extramedullary, provides excellent method of treatment with good anatomical and functional results. Plating allows an anatomical reconstruction of the bone, maintains mechanical stability and re-establishes endosteal vascular continuity. When compression plating or interlock nail is used active exercises can be started early and ultimate union is quickened[13]. This reduces the morbidity period considerably. The main dis-advantage reported with plating has been skin necrosis with resultant infection and restricted weight bearing.

Earlier in the present century, surgeons applied plates merely to fix two bone fragments in approximate alignment. Mechanical failures were frequent owing to metal reaction as well as to inadequate design of screws and plates. Use of interfragmentory compression by applying plates under tension along the longitudinal axis of the bone was reported by Danis. The concept was further explored and perfected by Muller and Allgower.[3,2,4] The Dynamic Compression Plating (DCP) enabled a congruent fit between the screw and plate hole at different angles of inclination and has proved successful in achieving axial compression.

Intramedullary nailing popularized by Kuntscher for shaft fractures of the lower extremities has proven its value. The appeal of intramedullary techniques derives from the perception of the surgeon of ease of surgical techniques, protection of soft tissue envelop of the tibia and early weight bearing. With the introduction of reaming, indications for intramedullary nailing were greatly extended.[5]

Fixation with multiple intramedullary pins was advocated on the premise that stacking of multiple curved pins exerts a spring force to resist angulations and rotation. The pins rely on cortical contact and continuity for axial stability. Although they had all the advantages of unreamed nailing, they had the disadvantage that they could not be used in the treatment of comminuted fractures as there tends to be shortening and displacement of such fractures. Another problem was the high incidence of non-union.

Intramedullary fracture fixation serves to stabilize fracture fragments and maintains alignment of fragments along the shaft axis, while permitting physiological micro-movement at the fracture site during functional activities. Acting as an internal splint, the implant serves as load-sharing device substituting for fracture bone, absorbs the rotational and lateral bending forces that occur during motion and weight bearing and fracture healing progresses with the formation of peripheral callus. By allowing motion of adjacent joints, rehabilitation is concurrent with treatment and 'stress-shielding' is thought to be minimal using these techniques (Tarr and Wiss, 1986).[6]Introduction of interlocking nailing has further widened the scope of closed intramedullary nailing. Dynamic locking refers to the placement of transfixing screw only in the shorter fragment which is susceptible to rotational instability and allows intermittent compression at the fracture site during early weight bearing. Dynamic fixation is used typically in fracture of upper or lower-third of the shaft in the absence of comminution.

When the fracture is comminuted or unstable to compressive or rotational forces, interlacing screws must be placed above and the below the fracture i.e. static locking to maintain length of bone. Shortening and malrotation are controlled by transferring the axial and rotational Stresses through nail rather than through the fracture Site.

MATERIAL AND METHODS

The present study included 60 patients of fracture of tibia who were admitted in the department of orthopaedics over a period of one year. Only closed and open(grade 1 Gustilo & Anderson) tibial fractures were included in the study. Informed and written consent was taken. Medically fit patients were taken up for surgery. Thirty patients were treated with platting and thirty with interlocking nail.

Primary treatment was given in the form of splint age, prophylactic antibiotics, analgesics, anti inflammatory drugs, intravenous fluids if required.The results are assessed on the basis of Alho and Ekelandcriteria's(Clinical Orthopaedics (231), 205-15 1988). [7]

Table 1: Start of Partial Weight Bearing

Time in Weeks	DCP		Interlock	
	No. of Cases	% age	No. of Cases	% age
1-2	-	-	15	50
3-6	-	-	9	30
7-9	10	33.33	4	13.33
10-12	10	33.33	1	3.33
13-15	8	26.67	1	3.33
>15	2	12	-	-
Total	30	100	30	100

Table 2: Full Weight Bearing

Time in Weeks	DCP		Interlock	
	No. of Cases	% age	No. of Cases	% age
Up to 12	-	-	10	33.33
13-16	16	53.33	16	53.33
17-20	12	40	3	10
21-24	2	6.67	1	3.33
Total	30	100	30	100

Table 3: Time of Union

Time (in weeks)	DCP		Interlock	
	No. of Cases	% age	No. of Cases	% age
<12	-	-	-	-
13-16	17	56.67	19	73.33
17-20	9	30	4	20
21-24	4	13.33	2	6.67
Total	30	100	30	100

Table 4: Hospital Stay after Surgery

Hospital Stay (in days)	DCP		Interlock	
	No. of Cases	% age	No. of Cases	% age
1-5	9	30	15	50
6-10	15	50	12	40
11-15	6	20	3	10
Total	30	100	30	100

In dynamic compression plating (DCP), the fracture site was be exposed, open reduction and internal fixation was done with minimum 8-10 hole DCP in simple transverse or oblique fracture and in proximal or distal tibial fracture. After closing the wound bandage was applied and non-weight bearing active exercises encouraged from second or third day. Interlocked nailing was done in transverse or communited fracture of diaphysialregion. Entry portal was made by making a 5 cm incision along the medial border of patellar tendon. Insert a curved awl through the metaphysic anteriorly to gain access to the medullary canal. Confirm proper position on anterior-posterior and lateral fluoroscopic views before awl insertion. Direct the awl nearly perpendicular to the shaft when it first penetrates the cortex, but gradually bring it down to a position more parallel to shaft as it is inserted more deeply to prevent violation of posterior cortex. If reamed technique is chosen, ream the canal in 0.5 mm increments. Choose a nail diameter that is 1 to 1.5 mm smaller than the last reamer used. If an unreamed technique is chosen, ream only the cancellous bone of the entry portal to accommodate the proximal portion of the nail. Use two proximal locking screws in most fractures. Perform distal locking by using a freehand technique. Patient was assessed clinically and radiologically on regular intervals, every 4 weeks for assessment of union and restoration of function. Any complication if encountered was recorded

RESULTS

The results are assessed on the basis of **Alho and Ekelandcriteria's**(Clinical Orthopaedics (231), 205-15 1988). [7]

This, criteria considers six aspects:

1. Tibial mal-alignment and shortening.
2. Range of knee motion and extensor lag.
3. Range of ankle motion.
4. Foot Motion.
5. Pain in limb.
6. Swelling.

Criteria	Grade 1	Grade 2	Grade 3	Grade 4
	Excellent	Good	Fair	Poor
A.Tibial malalignment and Varus/Valgus				
(Degrees)	2.5º	5º	10º	>10º
Shortening (cm)	1	2	3	>3
B. Range of knee motion				
Flexion	>120	120	90	<90
Extension Defects	<10º	10º	15º	>15º
C. Range of ankle motion				
Dorsiflexion	>20º	20º	10º	<10º
Planterflexion	>30º	30º	20º	<20º
D. Foot motion (as compared to normal)	5/5	2/3	1/3	<1/3"
E. Pain in the Limb	None	Sporadic	Significant	Severe
F. Swelling	None	Minor	Significant	Severe

Table 5: Results as Per Criteria

Results	DCP		Interlock		Total	
	No. of cases	% age	No. of cases	% age	No. of cases	% age
Excellent	10	16.67	15	25	25	41.67
Good	15	25	14	23.33	29	48.33
Fair	5	8.33	1	1.67	6	10
Poor	-	-	-	-		
Total	30	50	30	50	60	100

Intraoperative complications were very few. In the DCP group mainly skin closure was the problem faced in 4 cases; reduction was difficult in 3 cases of DCP. In interlocking nailing group the difficulties found were mainly concerning distal locking. Distal locking was not possible in 2 cases. Drill bit broke in 1 case. There were no cases of nail, plate or screw breakage in any group. Partial weight bearing with crutches was allowed as and when patient was pain free. 24 (80%) patients were bearing weight partially within first 6 weeks after operation in interlock nailing group, as in fig 1,2. It helped in early union as well as well as in early mobilization of joints. In DCP group partial weight bearing was started mainly between 6-12 weeks (66.66%). It was allowed only when it was judged clinically that patients were doing well and radiologically started showing signs of callus formation. No patient who had DCP was allowed to bear full weigh on the extremity before twelve weeks were completed, whereas 33.33% nailing patients were fully bearing weight by 12 weeks. By 16 weeks 26 (86.66%) and 16 (53.33%) patients respectively in interlock nailing and DCP was fully weight bearing.

In the present study, 90% patients had good to excellent results with 10% having fair results and no poor results. In DCP group there were 10 excellent, 15 good and 5 fair results whereas in interlock nailing group 15 patients had excellent, 14 patients had good results and 1 patient showed fair result.

DISCUSSION

Closed nailing aims at avoiding periosteal stripping and maintain reduction while the fracture heals by peripheral callus bridging. Closed nailing is the most biological way of treating the fracture shaft tibia. Open reduction and internal fixation with plates and screws provide a rigid fixation and anatomical alignment. This method is an excellent method for the treatment of tibial malunionand non-union, as anatomical reduction is achieved and the fracture is sufficiently exposed so that bone ends may be freshened and bone graft added. This technique has an advantage over the intramedunary nailing in the patients who had external fixators, since it avoids the pin tracts (Wiss, 1986)[8]

Fig. 1: Showing range of flexion

Weight bearing

X-RAYS

Pre-Operative **Post-Operative**

Fig. 2

Weight bearing **Showing range of flexion**

Pre-Operative

Post- operative

Concept of intramedullary nailing has revolutionized the management of the diaphyseal fractures of the tibia. This concept dates way back to the ideas of intramedullary pegsand now has developed to the most sophisticated interlocking nails and is very good method of treatment of open and closed fracture of tibia superseding all other modalities of treatment.[9]In this study, 54 fractures (90%) were closed and 6(10%) were open (Gustilo and Anderson grade 1). Most of the fractures were either transverse (50%) or oblique (40%), comminuted 4 (6.67%) and 2 (3.33%) segmental.

Observation regarding level of fracture showed that in this series, tibia fracture were commonest at middle third (63.33%), followed by lower third (23.33%). Out of 38 cases involving the middle third of tibia, 23 were fixed by interlock nail and 15 by DCP. 6 out of 8 patient involving the proximal one third and 9 patients out of 14 involving the distal third were treated by dynamic compression plating whereas in the rest of 7 patients interlocking nail was used. In a prospective randomised trial Im et al. in 2005 concluded recently that ORIF can restore alignment better than IM nailing. They treated 64 consecutive distal tibial fractures with ORIF or IM nailing.[10]In 14 patients (46.67%) the diameter of the interlocking nail used was 10 mm, in 10 patients (33.33) 9mm nail was used and 8mm diameter was used in only 6 (20%) patients. The most frequently used length of nail was 32cm in (36.67%) of cases followed by 30cm (33.33%), 28cm (16.67%) and in 4 case (13.33%) 34 cm nail was used.

25 (83.33%) fractures were locked in static mode giving very good stability to the construct and only 5 (16.67%) were dynamically locked. The number of bolts used was 4 in majority 25 (83.33%) cases where 2 screws each were put proximally and distally. In 3 cases (10%) two bolts put distally and one bolt proximally. In 2 cases (6.67%) one bolt was put on each side of fracture. Careful preoperative planning with consideration for fracture pattern and soft-tissue condition helps guide implant selection and minimize postoperative complicationsBedi A et all in 2006.[11]24 (80%) patients were bearing weight partially within first 6 weeks after operation in interlock nailing group. It helped in early union as well as well as in early mobilization of joints. In DCP group partial weight bearing was started mainly between 6-12 weeks when patients were doing well clinically and radiologically started showing signs of callus formation. No patient who had DCP was allowed to bear full weight on the extremity before twelve weeks were completed, whereas 33.33% nailing patients were fully bearing weight by 12 weeks. By 16 weeks 26 (86.66%) and 16 (53.33%) patients respectively in interlock nailing and DCP was fully weight bearing. (Hernández-Vaquero Det al 2012)[12]

Union was assessed clinically when there was no tenderness or pain on fracture site on full weight bearing and radiologically when there was evidence of bridging callus the fractures site, as shown in fig. 1,2. Huang p et all in 2008 observed in his study of 80 cases that Plate-screw osteosynthesis could attain satisfactory results in uncomminuted tibia shaft fractures, and locked intramedullary nailing is more appropriate in comminuted fractures.[13]

Fractures united in 100% cases in the present study.. Time of union ranged from 12 weeks to 24 weeks in both groups with an average of 17.93 weeks in DCP group an 16.13 weeks in interlock

nailing group. 86.67% in DCP group and 93.33% in interlocked nailing group united by 20 weeks.

Males were found to be the most common victims (81.66%). 38.33% males were in DCP group and 43.33% in nailing group. This is due to more out preponderance is more outdoor activities of males, as these are also seen in fig. 1,2,3. Most of the reported series from the literature also show this trend of sex (Bone et al 1986 - 81.8%, Wiss 1986 - 75%, Henly 1989 - 92%).[6,8] In the present study (85%) patients were discharged within 10 days of surgery. In the series of Court Brow et al (1996)[14.] average stay in hospital was only 7.1 days after operation. The average time in hospital following AO plating is 12-15 days (Tyo li 2012).[15]Fractures united in 100% cases in the present study. Time of union ranged from 12 weeks to 24 weeks in both groups with an average of 17.93 weeks in DCP group an 16.13 weeks in interlock nailing group. 86.67% in DCP group and 93.33% in interlocked nailing group united by 20 weeks.

Kwok CS et al conducted a study to undertake a systematic review to determine whether there are advantages in using plate or nail fixation for distal meta-diaphyseal tibial fractures with or without articular involvement. They concluded that plate fixation compared with intramedullary nailing is associated with a reduced risk of fracture malalignment with no differences in bone union, wound complications, and superficial infection or deep infection.[16]

Vallier et al conducted randomized, prospective comparative study of plate versus intramedullary nail fixation for distal tibia shaft fractures. Study was done on one hundred four skeletally mature patients with extra-articular distal tibia shaft fractures. They concluded that high primary union rates were noted after surgical treatment of distal tibia shaft fractures with both nonlocked plates and reamed intramedullary nails. Rates of infection, nonunion, and secondary procedures were similar. Open fractures had higher rates of infection, nonunion, and malunion. Intramedullary nailing was associated with more malalignment versus plating. Fibula fixation may facilitate reduction of the tibia at the time of surgery.**[17]**

RESULTS

Tao yu et all observed in their study of 880 fractures that both nailing and plating have equal outcome in terms of results and efficacy.[15]In the present study, 90% patients had good to excellent results with 10% having fair results and no poor results. In DCP group there were 10 excellent, 15 good and 5 fair results whereas in closed interlock nailing group, 15 patients each had excellent, 14 patients had good results and 1 patient showed fair result.

The present study consisted of 60 patients with fracture shaft of tibia. Out of these 30 patients were treated by DCP and 30 patients with Interlock nailing and results were compared. The age of patients ranged from 18-63 years with mean age of 34.07 years. The mean age in DCP group was 36.3 years and of interlock nailing group was 31.87 years. Majority of patients (81.67%) were males. Road side accidents accounted for 88.33% of cases. Fall from height, fall of heavy weight and assault were other contributing factors. Both sides were almost equally involved.75% patients had closed fractures and 25% had open grade 1 fractures.30% of the patients had associated injuries. Autogenous cancellous bone grafting was done in eight cases.

Dynamization was done in three cases of interlock nailing. Both the modalities lead to union DCP on an average of 17.93 weeks and interlocked nailing with average 16.13 weeks. The operative time for DCP is lesser than that for interlocked nailing.

Interlocked nailing as compared to DCP is a more technically demanding procedure with intraoperative problem mainly regarding distal locking. Interlocked nailing allows earlier weight bearing as compared to DCP leading to earlier return to employment and lesser knee and ankle stiffness. Mild knee pain can be seen in interlocked nailing. Skin necrosis in a problem with DCP but can be minimized by anterolateral plate placement for proximal and careful handling of tissues.

CONCLUSION

Interlocking nail is very good method of treatment of fracture tibia if proper alignement, angulation and reduction is maintained and with good postoperative care results are more than ninty percent. And dynamic platting is good for proximal & distal tibia. We conclude that DCP is a better mode of fixation for proximal and distal tibial facture and interlock nailing is ideal implant in diaphysial and segmental fractures.

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