Simple Plan of Treatment for Aseptic Non-Union of Diaphyseal Fractures of Long Bones

S K GHAURI M AKRAM F BASHIR
Department of Orthopaedic Surgery, K. E. Medical College/Mayo Hospital, Lahore
Correspondence to Dr. Shakeel Khan Ghauri, Assistant Professor Orthopaedics

Background; The treatment of nonunion of long bones using internal fixation with compression plate is not a common practice but review of literature does not condemn it. Closed intramedullary nailing is frequently recommended, but at times it is not feasible. In this study, the role of internal fixation with compression plate for the treatment olong bones nonunion has been evaluated. **Method:** All the patients in this study were treated by freshening the fracture ends, opening the medullary cavities, fixing the fractures with DCP and packing autogenous cancellous bone graft aroud the nonunion site. There were 20 patients with average age of 36 years. There were 17 males and three females. There were nine femoral, eight tibial and three humeral nonunions. The initial treatment was operative in eight , with external fixarion in four, by plaster in four and by bonesetters in four. Infected cases were not included in this study. Average follow up was18.8 months. **Results:** All nonunions healed on an average at 19 weeks. There was no incidence of infection except stitch abscess in two cases, which healed after removal of stitches. There was no donor graft area morbidity. In one case a repeat bone graft was needed for delayed union. In one case of humeral non uion radial nerve palsy occurred which recovered at 10 weeks. **Conclusion;** For managing nonunion of long bones, compression plate fixation with cancellous bone grafting is useful where closed intramedullary nailing is not technically or economically feasible.
Key words: Diaphyseal fractures, long bones, aseptic non-union

A non-union is one of the more common complications of bone fractures[1]. Despite the fact that concepts and techniques for fracture treatment are continuously being improved, at present a non-union cannot be completely prevented[1]. In the literature, the incidence of non-union varies with each bone[2].

Treatment of non-union is closely related to the type of non-union. Traditionally a non union is classified into a hypervascular (hypertrophic) or avascular (atrophic) type and the principles of the treatment are quite different[2,3]. For hypervascular nonunion the main cause is insufficient fragment stability. Therefore, the treatment only requires providing sufficient stability and a satisfactory result is usually achievable. On the other hand, a vascular non-union is caused by loss of osteogenic potential and the treatment requires both providing fracture stability and provoking osteogenic potential[1].

The incidence of non union after fracture is reported to be in between 5- 10%[4]. Opening the fracture site and internally fixing with a plate is generally condemned, as opening the nonunion site further damages the blood supply, so increasing the risk of the infection and subsequently implant failure[5,6]. Review of literature usually recommends the use of intramedullary locked nail. There are certain situations in which this procedure is technically not possible[7]. Therefore, opening the nonunion site becomes necessary for example to remove the implants from previous operations, malunited fractures which need correction etc. In developing countries like ours, the cost of treatment is important as far as the choice of implant is concerned. Surgical fixation with a compression plate combined with autogenous bone grafting is a simple way to treat aseptic nonunion in long bone diaphyseal fractures.

Materials and Methods:

From January 98 to June 2004, twenty cases with aseptic nonunion of shafts of femur, tibia and humerus were treated by compression plate fixation with autogenous bone grafts from iliac crest. There were three females and seventeen males. Their average age was 36 years (range 17-50 years). There were nine femoral, eight tibial and three humeral shaft involvements. Initially the fractures were closed in fifteen and open in five cases. Among open fractures, there was one femur with G-I fracture and four tibia with G-III fractures. Seventeen fractures were located in the middle third of shaft and one was in the proximal metaphyseo-diaphyseal area and two in the distal metaphyseo-diaphyseal regions. Thirteen patients had angulatory mal-alignment. Rotatory malposition was present in three patients. No patient had limb length discrepancy more than one centimeter i.e. bone loss not more than 1 cm (Paley type A)[8].

Primarily four patients were treated by bone setters and of the rest of the sixteen, one patient was treated with intramedullary nail with derotation plate, one with closed interlocking nail, one with closed intramedullary nail, four with open K-nail, one with pin plaster, four with external fixators, three with plaster casts and one with DCP.

Bonesetters use different oils for massage and apply wooden splints to the fracture site, they repeat this procedure at different time intervals. Among these non-unions, there were five hypertrophic and fifteen atrophic non-unions. The time interval from initial injury to the procedure of compression plating was not less than seven months as non-union was defined as absence of clinical and radiological signs of union at 6 months after injury

Age	Gender	Primary Fracture	Bone Involved	Initial Treatment	Type of Nonunion	Duration to Achieve Union	Total Follow up
45y	M	Close	Rt Femur	I/M Nail	Atrophic	20w	20m
40y	M	Close	Rt Femur	I/L Nail	Atrophic	20w	25m
35y	M	Open G-I	Rt Femur	Close I/M Nail	Atrophic	26w	20m
50y	M	Close	Lt Femur	I/M Nail with DRP	Atrophic	24w	20m
48y	M	Close	Lt Femur	Plating	Hypertrophic	16w	18m
40y	M	Close	Rt Femur	I/M Nail	Atrophic	19w	17m
32y	F	Close	Rt Femur	I/M Nail	Hypertrophic	16w	16m
44y	M	Close	Lt Femur	I/M Nail	Hypertrophic	20w	18m
50y	F	Close	Lt Femur	Bonesetter	Atrophic	24w	24m
27y	M	Close	Rt Tibia	Plaster Cast	Hypertrophic	12w	20m
30y	M	Open G-IIIB	Lt Tibia	External fixator	Atrophic	18w	30m
48y	M	Close	Lt Tibia	Bonesetter	Atrophic	17w	21m
26y	F	Close	Lt Tibia	Pin Plaster	Atrophic	14w	16m
17y	M	Close	Lt Tibia	Bonesetter	Hypertrophic	20w	14m
21y	M	Open G-IIIB	Rt Tibia	External fixator	Atrophic	20w	16m
38y	M	Open G-IIIB	Rt Tibia	External fixator	Atrophic	28w	20m
22y	M	Open G-IIIB	Lt Tibia	External fixator	Atrophic	16w	17m
21y	M	Close	Rt Humerus	Plaster	Atrophic	14w	14m
49y	M	Close	Rt Humerus	Bonesetter	Atrophic	16w	12m
40y	M	Close	Lt Humerus	Plaster	Atrophic	20w	18m

Methodology: All the patients included in this study were operated upon using a compression plate augmented with cancellous bone grafting. Clinical mobility at the fracture site was confirmed. The bone was exposed only on the side of proposed placement of plate. Fracture ends were cleared of intervening fibrous tissues, mal-alignment was corrected and the medullary canal was reopened. A compression plate of appropriate size was applied preferably on the tension side unless the site was difficult to open because of over lying scarred skin. This was encountered in distal tibial nonunion in two cases. The plate was contoured to match the surface of the shaft. Autogenous cancellous graft was harvested from iliac crest and was packed into and around the non union site. Wounds were closed over suction drains. Post operatively all patients were put on prophylactic antibiotic course, which consisted of first generation cephalosporin and one of the aminoglycosides for three days.

Physiotherapy was started as soon as the pain permitted to do so. Stitches were removed after 10-12 days. Non-weight bearing crutch walking was started after 2 weeks in case of lower limb. Gradual weight bearing was started on the base of progress of healing both clinically and radiologically. Clinically the judgment was absence of pain on weight bearing for lower limb and radiologically by the presence of bridging callus.

The patients were seen in the follow up clinic at regular intervals. The follow up was performed in terms of infection (superficial and deep) union time, range of motion of adjacent joints, shortening, neurological damage, graft donor area morbidity and implant failure. The average follow up time was 17 months (range 12-30 months) only one patient with distal tibial non union needed second (repeat) bone grafting procedure.

Results:

There was stitch infection in two cases, in which after removal of stitches wounds healed. All non-unions except one healed at an average of 19 weeks (range 12-28 weeks). In one case, a repeat bone graft was performed which healed at 28 weeks. In one case, there was radial nerve palsy, which recovered after 10 weeks. Mal-alignment was corrected in all the cases and shortening was not more than 1cm in any case.

Range of motion was recorded preoperatively and at each follow up visit. In one case knee flexion was limited to 100° with femoral non union and rest of patients with femoral non union had about 15° of limitation of last flexion, but no patient complained of functional complaint. Three patients with tibial non-union had limitation of dorsiflexion with about 5° of equinus. In case of humeral non-unions all three patients regained full range of motion at shoulder and elbow.

In 10 patients, plates were removed and rests of the patients were happy with their plates. Graft donor area morbidity was not present in any case.

Discussion.

Risk of infection with open methods[6,9,10] has lead many surgeons to start close techniques. In the literature, there is little difference in the reported incidence of infection which is from 5-10% irrespective of implant or technique used[9,10,11,12]. In this series, there was no incidence of infection, although stitch infection was present in two cases.

There is presumed reduction of blood supply to bone ends after open method because of soft tissue stripping [5]. According to Barron[13] et al and Rand et al[14] the blood flow in general was similar in both rod or plate fixation of dogs' ulnae and so did the healing. Wiss et al[15] reported 96% and Weber et al[16] reported 99% union for tibial non union, Ring et al[12] reported union in 93% for femoral non union using plates, while Devnani reported 100% union rate in his study on long bone non-unions[7]. Our study showed union in all the twenty cases of non-unions.

In case of closed reamed intramedullary nailing, it is usually difficult to get the guide rod and reamers past the fibrous tissue into the medullary canal of the distal fragment. There is also inability to correct malalignment and inability to remove previous implants without opening the non union site[9,10,17,18]. Other limitations in case of intramedullary nailing is when fracture is situated close to distal interlocking holes because of increased risk of implant failure[19,20]. In case of non-unions following non-operative treatment or treatment by bonesetters the malalignment is common[7]. In case of humeral shaft fractures the reported non-union rate is from 0-50% and also the geometry of distal humerus and design of certain rods do not provide torsional stability[21,22].

Breakage of plate is one of the reasons for its condemnation[7]. This happens when patient bears weight prematurely. Other implants also break on early weight bearing[19,20,23].

Autogenous bone grafting helps union in case of reaming the medullary canal as it provides bone dust[9]. Powered reaming produces necrotic debris. Cancellous bone has better osteogenic properties[24] and helps to achieve union early[11] and so it is recommended for atrophic non unions[5,16,25]. Open bone grafting is further advocated in cases of gap at the non-union site[26,27].

This study does not condemn the use of closed locked intramedullary nailing, but it shows that plating is not absolutely contraindicated and is indicated where closed nailing is not feasible. Further it is cost effective and needs less equipment like traction table and image intensifier. This factor is important as far as our country is concerned.

Conclusion

For managing nonunion of long bones, compression plate fixation with cancellous bone grafting is useful where closed intramedullary nailing is not technically or economically feasible. Further one should strictly follow the principles of internal fixation of long bones.

References

1. Chi-Chuan, Wen-Jer Chen. A revised protocol for more clearly classifying a nonunion. Journal of Orthopaedic Surgery 2000. 8 (1): 45-52.
2. Crenshaw AH. Delayed union and nonunion of fractures. In: Crenshaw AH, ed. Campbell's operative orthogaedics, Vol. 3. St Louis" CV Mosby, 1987, 2053-2118.
3. Weber BG, Brunner C. The treatment of nonunions without electrical stimulation. Clin Orthop 1981, 161;24.
4. Einhorn TA. Enhancement of failure-healing in current concepts review. J Bone Joint Surg (Am) 1995; 77-A; 940.
5. Kessler SB, Hallfeldt KKJ, Perren SM and Schweiberer L. The effect of reaming and intramedullary nailing on fracture healing. Clin Orthop 1986; 212: 18.
6. Bucholz RW and Jones A. Fractures of the shaft of the femur; in current concepts review. J Bone Joint Surg (Am) 1991; 73-A;1561.
7. Devnani AS. Simple approach to the management of aseptic non-union of the shaft of long bones. Singapore Med J 2001; 42(1): 20-25.
8. Paley D, Catagni A, Argnani F. Ilizarov treatment of tibial non-union with bone loss. Clin Orthop 1989; 241;146.
9. Clancey GJ, Winquist RA. Non-union of tibia treated with Kunscher intramedullary nailing. Clin Orthop 1982;167;191
10. Kempf I, Grosse A, Rigaut P. The treatment of noninfected pseudarthrosis of the femur and the tibia with locked intramedullary nailing. Clin Orthop 1986; 212;142.
11. Johnson EE, Marder RA. Open intramedullary nailing and bone grafting for non-union of tibial diaphyseal fractures. J Bone Joint Surg 1987; 69-A; 375.
12. Ring D, Jupiter JB, Sanders RA, Quintero J et al. Complex non-union of fractures of the femoral shaft treated by wave plate osteosynthesis. J Bone Joint Surg 1997; 79-B; 289.
13. Barron SE, Robb RA, Taylor WG, Kelly PJ. The effect of fixation with intramedullary rods and plates on fracture-site blood flow and bone rebodelig in dogs. J Bone Joint Surg 1977; 59-A; 376-85.
14. Rand JA, An KN, Chao EYS, Kelly PJ. A comparison of the effect of open intramedullary nailing and compression plate fixation on fracture site blood flow and fracture union. J Bone Joint Surg 1981; 63-A; 427.
15. Wiss DA, Johnson DL, Miao M. Compression plating for non-union after failed external fixation of open tibial fracture. J Bone Joint Surg 1992; 74-A; 1279.
16. Weber BG, Brunner C. The treatment of non-unions without electrical stimulation. Clin Orthop 1981;161;24.
17. Zimmerman KW, Klasen HJ. Mechanical failure of intramedullary nails after fracture union. J Bone Joint Surg 1983; 65-B; 274.
18. Webb LX, Winquist RA, Hansen ST. Intramedullary nailing and reaming for delayed union or non-union of the femoral shaft. Clin Orthop 1986; 212;133.
19. Bucholz RW, Ross SE, Lawrence KL. Fatigue fracture of the interlocking nail in the treatment of fractures of the distal part of the femoral shaft. J Bone Joint Srg; 1987; 69-A;1391.
20. Hahn D, Bradbury N, Hartley R. Intramedullary nail breakage in distal fractures of the tibia. Injury 1996; 27;323.
21. Emmerson KP, Sher JL. A method of treatment of non-union of humeral shaft fractures following treatment by locked intramedullary nail; a report of three cases. Injury 1998; 29; 550.
22. Cheng J, Lau PY. Distal fracture with hypertrophic non-union; a complication of Seidel humeral nail. Injury 1997; 28;223.
23. Boenish UW, de Boer PG. Unreamed intramedullary tibial nailing-fatigue of locking bolts. Injury 1996; 27;265.
24. Heiple KG, Goldberg VM. Biology of cancellous bone grafts. Orthop Clin Noth Am 1987; 18;179.
25. Wu CC, Chen WJ. Treatment of femoral shaft aseptic non-unions comparison between closed and open bone-grafting techniques. J Trauma 1997; 43;112.
26. Court-Brown CM, Keating JF, Christie J, McQueen MM. Exchange intramedullary Nailing. Its use in aseptic tibial non-union. J Bopne Joint Surg. 1994; 77-B; 407.
27. Furlong AJ, Giannoudis PV et al. Exchange nailing for femoral shaft aseptic non-union. Injury 1999; 30; 245.