Limited contact dynamic compression in diaphyseal fractures of the humerus

Good outcome in 51 patients

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Submitted 99-08-25. Accepted 00-04-16

ABSTRACT – We reviewed 51 plate fixations for fracture of the humeral diaphysis managed during the last 3 years. The indications for surgery included non-union, delayed union, polytrauma, neurological involvement and inadequate reduction. All the fractures were stabilized with a Limited Contact Dynamic Compression Plate (LCDC Plate). We found that this plate gave adequate rotational and vertical stability to the fracture. 48 fractures healed after median 2.5 months. Early evidence of callus formation indicated minimal compromise with the vascularity of bone which may be attributed to the undercut design of the plate, causing relatively less cortical ischemia. In addition, the plate fixation was associated with fewer complications, as compared to those reported with intramedullary nailing.

A consensus has yet to develop regarding operative treatment of diaphyseal fractures of the humerus. Intramedullary nailing is considered to be appropriate for internal fixation of long bones, as the implant lies nearer to the axis of the bone and requires less extensive exposure and less stripping of soft tissues than plating. However, intramedullary nailing of diaphyseal fractures of the humerus has the disadvantage of possible decreased mobility at the shoulder or elbow joint, depending on its site of introduction (Flinkila et al. 1999). A very narrow canal in the distal part of the humerus makes intramedullary nailing difficult. It also provides very little rotational, translational and vertical stability, unless the nail is ofthe interlocking variety.

Fractures of the humeral shaft can be plated without the danger of insufficient soft-tissue coverage. A dynamic compression plate provides stable fixation. However, a large area of bone-plate contact may result in underlying cortical ischemia which the design of the Limited Contact Dynamic Compression plate tries to overcome (Paren et al. 1990). We report our experience with this plate in 51 patients with humeral shaft fractures.

Patients and methods

We treated 56 patients with diaphyseal fractures of the humerus by the LCDC plate during 1996–1998. 51 of the patients were available for the follow up and they had all a minimum follow-up of 6 months.

The average age of the patients was 37 (18–60) years and 44 of them were men. 18 patients had non-union following closed management for 4–8 months. In 5, failed internal fixation with non-union was the indication for surgery. Of these 5 patients, 4 had had prior intramedullary fixation (3 unlocked nails) while 1 had non-union with a broken plate. 13 patients had multiple injuries, 8 of whom had associated ipsilateral forearm fractures of both bones. In 6 patients, radial nerve palsy was the indication for surgery. The remaining 9 had an unstable closed reduction as the indication.

A standard posterior approach was used for patients with distal fractures (n 20) and an anterolateral approach was used in those with proximal fractures (n 31). All fractures were fixed with a 4.5

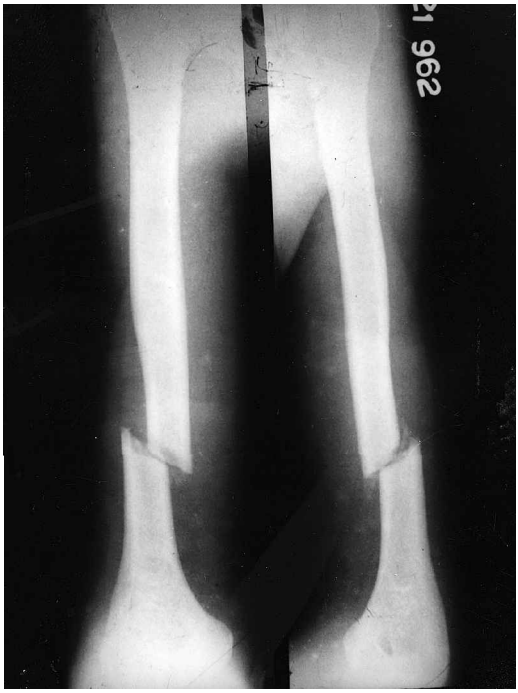

Figure 1. Preoperative radiograph.

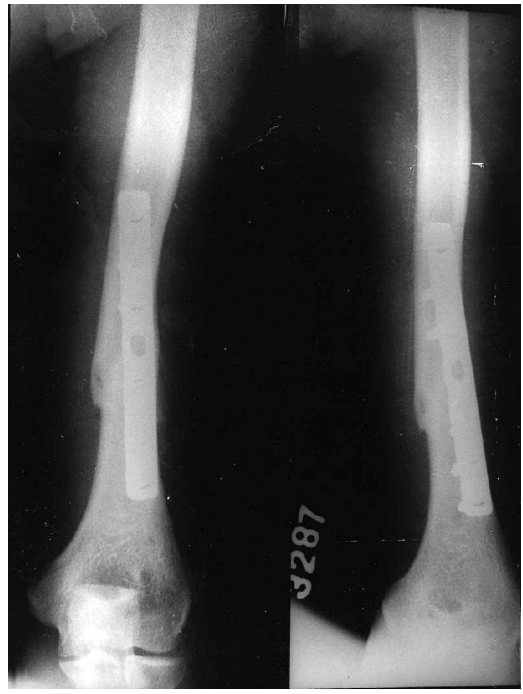

Figure 2. Radiograph showing consolidation of fracture.

mm narrow LCDC plate using 4.5 mm cortical screws, except 2 cases, in which 6.5 mm cancellous screws were used because of marked osteoporosis. At least 6 cortices were fixed on each side of the fracture (Figures 1 and 2). The forearm fractures in 8 patients were also fixed at the same time. Of the 6 cases with associated radial nerve palsy, the nerve was found interposed between the fragments in 4 patients, while it was contused in 2 cases. Fixation was supplemented with cancellous bone grafting from the iliac crest to promote osteogenesis in 30 patients. The decision to graft a fracture depended on pre- and peroperative findings, like rounding of fractures edges, avascularity of bony ends, presence of comminution and absence of soft tissue attachments to comminuted fragments. The average duration of surgery was 68 (45–120) minutes. A cuff and collar sling was applied in 34 patients which was removed intermittently to permit exercises at the shoulder, elbow and wrist joints. In the remaining 17 patients a plaster of Paris external splint was applied for an average of 3–4 weeks for various reasons like peroperative assessment of less reliable fixation because of marked comminution or poor bone stock.

The patients were evaluated with modified Stewart and Hundley (1955) criteria.

Excellent: No pain or impairment of function and with solid bony union.

Good: No pain and no impairment of function for ordinary purposes, but with limitation of motion in the elbow or shoulder of 20% or less, and with solid bony union.

Fair: Solid bony union with occasional mild pain or limitation of motion in adjacent joints of more than 20%, but with satisfactory function for light duties.

Poor: Persistent pain, limitation of motion in an adjacent joint of more than 40% and non-union.

Iatrogenic permanent radial nerve palsy or implant failure resulting in non-union were also considered to be criteria for grading the patient as poor.

Results

48 of the 51 fractures united after median 10 (8–13) weeks. We observed only 2 cases of delayed union which, after bone grafting, healed after 4

and 6 months, respectively. Loss of fixation occurred in 1 patient, in an 8-month-old fracture with marked osteoporosis, and the fixation (4.5 mm screws) had to be supported by external immobilization by a plaster of Paris cast. The fracture, however, united after 4.5 months. We found complete recovery of each case of radial nerve involvement in 6–8 weeks.

34 patients had an excellent outcome and 14 were graded as good. 2 patients had a fair outcome because of limited shoulder abduction. 1 patient had an iatrogenic postoperative complete radial nerve palsy and was graded as fair, since the nerve injury had recovered only up to grade four at 6 months. In none of the patients has it been necessary so far to remove the implants.

There were no deep infections, but 1 patient had a transient superficial infection. Delayed union occurred in 2 patients. in whom bone grafting was done after 12–14 weeks of primary surgery, resulting in union after a further 8–10 weeks.

Discussion

Non-union and polytrauma, especially ipsilateral forearm fracture, were the main indications for surgery in the present study. 6 patients had associated radial nerve palsy. Many authors, e.g., Packer et al. (1972), Garcia and Maeck (1960) and Holstein and Lewis (1963), have favored early surgery in patients having radial nerve involvement complicating humeral fractures.

Winker et al. (1993) used a broad dynamic compression plate or limited contact dynamic compression plate in their patients having humeral fractures with good results. We used narrow limited contact dynamic compression plates because of the smaller diameter of the humerus in Indian patients, as compared to a European population, the edges of a broad plate tending to overhang the humeral cortices. Moreover, a broad plate has offset holes, which are not suitable for fixation of a narrow diameter humeral shaft since the screws will then tend to be nearer the edge of bone rather than in the center.

An intramedullary nail has the disadvantage of possible reduced mobility, at the shoulder or elbow joint, where it is introduced. Foster et al. (1985) have also noted that intramedullary nailing of diaphyseal fractures of the humerus provides very little rotational, translational and vertical stability of the fracture. Flinkila et al. (1999) also reported various complications, like nonunion (22%), need for reoperations (21%) and shoulder dysfunction (37%) after operating on 126 patients who had a fractured shaft of the humerus, using an intramedullary nail. Proximal and distal interlocking screws may cause significant neurological and vascular complications.

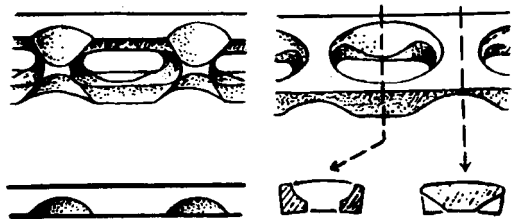

Figure 3. LC-DCP undersurfaces and cross-section showing oblique undercuts.

The average union time in our patients was 10 weeks—i.e., similar to that reported by Mckee et al. (1995). Robinson et al. (1992) found a union time of 18 weeks with intramedullary nailing and Bell et al. (1985) observed a union time of 20 weeks with DCP. These findings suggest that LCDC plates are better than other implants for humeral fractures. The decreased healing time may be due to the undercut designing of the plate, resulting in less cortical ischemia (Figure 3). In our patients, the fresh fractures healed sooner than the delayed unions and non-unions. Supplementation with bone grafts may be desirable in the cases with non-union/ delayed union or in fresh cases where peroperative findings reveal soft tissue denuding of bony fragments rendering them liable to avascularity. In our study, 49 of the fractures healed after plating, and the remaining 2 healed after bone grafting. The healing rate is similar to the series of Mckee et al. (1995) (15/17) and Bezes et al. (1995) (239/246), using LCDC plates.

We observed loss of fixation in 1 patient where the fracture was an 8-months-old non-union with marked osteoporosis. 4.5 mm cortical screws were used for fixation of the fracture. In such cases, fixation of the plate with a fully threaded 6.5 mm cancellous screw is desirable or an intramedullary nail may be a better alternative.

Bell M J, Beauchamp C G, Kellam J K, Mcmurtry. The results of plating humeral shaft fractures in patients with multiple injuries. J Bone Joint Surg (Br) 1985; 67: 293-6.

Bezes H, Massart P, Fourquet J P, Finet P, Tazi F, Tourne Y et al. The value of combining multiple screwed plates in humeral shaft fractures. Int Orthop 1995; 19 (1): 16-25.

Flinkila T, Hyvonen P, Lakovaara M, Linden T, Ristiniemi J, Hamalainen M. Intramedullary nailing of humeral shaft fractures. Acta Orthop Scand 1999; 70 (2): 133-6.

Foster R J, Dixon G L, Bach A W, Appleyard R W, Green T M. Internal fixation of fractures and non-unions of the humeral shaft. J Bone Joint Surg (Am) 1985; 67 (6): 857-66.

Garcia A, Maeck B H. Radial nerve injuries in fractures of the shaft of the humerus. Am J Surg 1960; 99: 625-30.

Holstein A, Lewis G B. Fractures of the humerus with radial nerve paralysis. J Bone Joint Surg (Am) 1963; 45: 1382-6.

Mckee M D, Seiler J G, Jupiter J B. The application of the limited contact dynamic compression plate in the upper extremity. Injury 1995; 26 (10): 661-6.

Packer J W, Foster R R, Garcia A, Grantham S A. The humeral fracture with radial nerve palsy: Is exploration warranted? Clin Orthop 1972; 88: 34-8.

Paren S M, Klaue K, Pohler O, Predieri M, Steinman S, Gautier E. The limited contact dynamic compression plate. Arch Orthop Trauma Surg 1990; 109 (6): 304-10.

Robinson C M, Bell K M, Court Brown C M, McQueen M M. Locked nailing of humeral shaft fractures. J Bone Joint Surg (Br) 1992; 74: 558-62.

Stewart M J, Hundley J M. Fractures of the humerus. J Bone Joint Surg (Am) 1955; 37 (4): 681-92.

Winker H, Vosberg W, Cyris A. Results of treatment of humerus shaft fractures. Aktuel Traumatol 1993; 23 (1): 36-41.