The Limited Dynamic Compression Plate Fixation In Acute Diaphyseal Fractures Of The Radius And Ulna – A Prospective Study

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Citation

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Abstract

Aim: The aim of the present study is to evaluate the results of diaphyseal fractures of forearm bones treated by limited contact dynamic compression plating. Materials and methods: Twenty five patients with displaced diaphyseal fractures (closed and type1 compound) of forearm bones, both radius and ulna were managed by open reduction and internal fixation with limited contact dynamic compression plating (LC-DCP) from June 2003 to December 2005 with an average follow up of 18 months. There were 20 males and 5 females with a mean age of 32.9 years. The average interval from injury to surgery in our series was 5.8 days (3-16days). Road traffic accident was the most common mode of injury (64%). Pathological fractures were excluded. Average time of union was 13.6 weeks, 1 fracture united at the end of 28 weeks. Results: Complete radiological and functional outcome assessment was done at one year. The radiological and functional outcome was assessed using Anderson's criteria. Limited contact dynamic compression plating gave acceptable results in 96% cases. All patients achieved solid union, Functionally 24 patients achieved satisfactory results whereas one patient had unsatisfactory result in terms of decreased range of motion at elbow and wrist that improved with physiotherapy after solid union; however there was no nonunion. The most frequently occurring complications were, delayed union two patients, stiffness at elbow and wrist in one, infection in one. Conclusions: Most of our patients achieve good function of extremity with excellent union of fractures. We conclude that limited contact dynamic compression plating is a good alternative to other known forms of internal fixation devices with all the advantages of providing a stable, rigid dynamic compression of fractures with early union, and based on the sound principle of biologic fixation

INTRODUCTION

Many methods have been employed to treat the diaphyseal fractures of the radius and the ulna, these include closed reduction and immobilization in plaster cast and open reduction with or without internal fixation. The results have been highly unsatisfactory with closed methods either from non union or mal union, resulting in loss of function [1].Diaphyseal fractures of forearm bones present specific problems not encountered in the treatment of fractures of other long bones. In addition to restoration of length, apposition, and normal axial alignment, correct rotational alignment must be achieved. Applications used for internal fixation have included standard and special plates, Egger's slotted plates, Hicks lug plates, primary inlay bone grafts and intramedullary fixation with k –wires, rush rods, Sage nails etc [2, 3] with variable results. The inherent problems of these methods have been overcome with the use of dynamic compression plate, which has been considered as so called "gold standard" for the surgical treatment of diaphyseal fractures of forearm bones [4, 5, 6] Continuing this process in recent years theoretically several shortcomings of dynamic compression plates have been recognized [5, 7]. Newer implant system has been developed by AO -ASIF group, the (LC-DCP) low contact dynamic compression plate which combines both principles of dynamic compression and biological fixation [8, 9]. LC-DCP aims at reduced trauma to bone, improved healing in the critical zone covered by the plate, preservation of cortical blood supply, avoidance of stress risers at implant removal. The symmetrical self compressing plate hole and the deletion of the elongated space between the innermost screw holes makes the LC-DCP more versatile for use in any fracture type. There are groves on the undersurface of the LC-DCP that serves three purposes; 1) they improve the

blood circulation by minimizing the damage caused by contact between the undersurface of the plate and the bone. 2) they allow formation of small bony ridge underneath the plate at place that is weak other wise duo to stress concentration effect of the unhealed fracture gap at periosteal surface.3) There is more even distribution of stiffness of plate then in conventional plate. Several reports have demonstrated that newer implants can have success rate as high as other methods with low complications.

MATERIALS AND METHODS

Between June 2003 to December 2005 we treated twenty five adult patients with displaced diaphyseal fractures (closed and type1 open) of forearm bones, both radius and ulna by open reduction and internal fixation with limited contact dynamic compression plating (LC-DCP). Adult patients of either sex with fresh fractures, less than three weeks old were taken up for study. There were 20 male (80%) and 5 female (20%) patients with a male female ratio of 4:1.The patients included in our study were between 19 to 60 years with an average age of 32.9 years. Most cases 60% were in younger age group less than 30 years of age. Right side was involved in 13 (52%) cases as compared to left side12 (48%). Both radius and ulna were involved in 12(48%) cases, radius only in 32% cases and ulna only in 20% cases. Road traffic accident was the most common mode of injury accounting for 13(64%) of cases. 6(24%) had fall from height and 3(12%) had direct hit. The fractures were closed in 20(80%) cases and type 1 compound (Gustilo and Anderson) in 4(20%) cases. All the fractures were classified according to AO's classification system, 15(60%) had typeA, 6(24%) had typeB, while4 (16%) had typeC fractures. Patients with compound type2 and type3 fractures, pathological fractures, radial nerve palsy and bilateral forearm fractures were excluded in our study. The minimum interval between injuries to surgery was 3 days and maximum16 days (average 5.8 days). Average duration of surgery was 62.4 minutes (40-90 minutes).

TECHNIQUE

We used limited contact dynamic compression plating (LC-DCP) in all of our patients. All procedures were performed under general anesthesia and tourniquet application to arm. Fractures were exposed using usual surgical approaches of forearm for plate fixation, dorsal approach for ulna and proximal radius and volar approach for distal radius. After exposing fractures with limited subperiosteal dissection the ends were cleaned, hematoma evacuated and soft tissue gently and minimally retracted and both fractures were reduced correcting axial, angulatory and rotational mal alignment. The LC-DCP has uniform spacing of plate holes; this allowed us to easily shift the plate along the long axis of the bone when one fragment needed more fixation, then 6-9hole LC-DCP was used for both radius and ulna depending on the type of the fracture In general, each main fragment of the fracture was fixed with at least six cortices. Bone grafting was done wherever significant comminution occurred.

Postoperatively the limb was kept in elevation, distal neurovascular status assessed and check radiographs of forearm taken with elbow and wrist in two planes and immobilization was done depending upon the rigidity of fracture fixation and type of fracture, above elbow posterior back slab immobilization was applied in comminuted fractures and less rigid fixations. Patients were kept on antibiotics for 5 days. Passive range of motion exercises at wrist and elbow were started at 7^{th} post operative day when swelling and pain subsided. Patients were discharged on the 7^{th} post operative day. Stitches were removed at 10 days; thereafter active range of motion exercises of the elbow, wrist and hand were encouraged. Patients were followed up every 4 weeks for a period of 6 months and every 8 weeks thereafter till 1 year for clinical and radiological assessment to see the progress of fracture healing.

The patients were assessed for clinic radiological union employing the following parameters:

CLINICAL

- Appearance of the surgical scar
- Any fracture site tenderness
- Any obvious deformity

RADIOLOGICAL

- Apposition of the fracture.
- Amount of bridging callus-no, minimal, moderate or abundant.
- Fracture line.
- Implant failure.

Fracture was considered to be united when there was

obliteration of fracture gap or the presence of bridging periosteal callus in three of the four cortices on AP and Lateral radiographs. Fracture union was considered as delayed when there was presence of fracture gap or absence of progressive callus formation in the first 6 postoperative months. The results were graded according to Anderson et al [10] criteria

RESULTS

The patients were mostly young men below 30 years of age (60%) with the right side slightly more involved than the left. In 48% cases, both bones were fractured while in unilateral cases, the radial fractures predominated (8:5). The fractures were simple in 80% cases while in 20%, type 1 open fractures were seen. Majority of the cases were due to road traffic accidents (64%). All the fractures united with an average radiological union time of 13.6 weeks with 72% cases uniting by 12 weeks (Figure 1, 2 and 3). Delayed union was observed in 2 cases (8 %). The final functional outcome was assessed on the basis of Anderson's criteria and 84% cases had a satisfactory or better result. Complications included elbow and wrist stiffness, delayed union, infection and posterior interosseous nerve palsy.

Figure 1

Figure 1- Pre op photograph

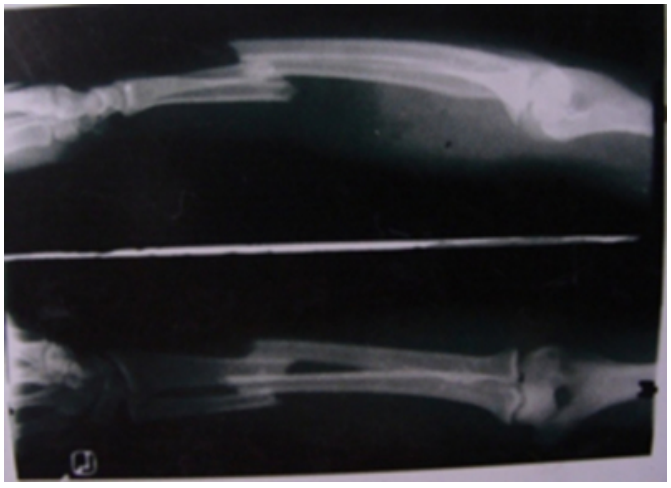


Figure 2

Figure2- Post op photograph

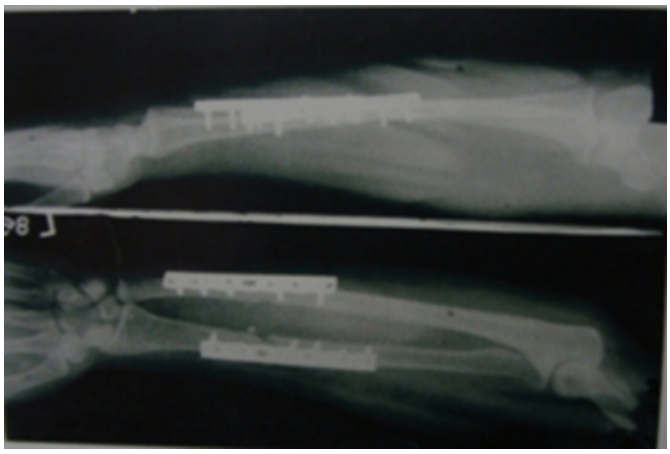
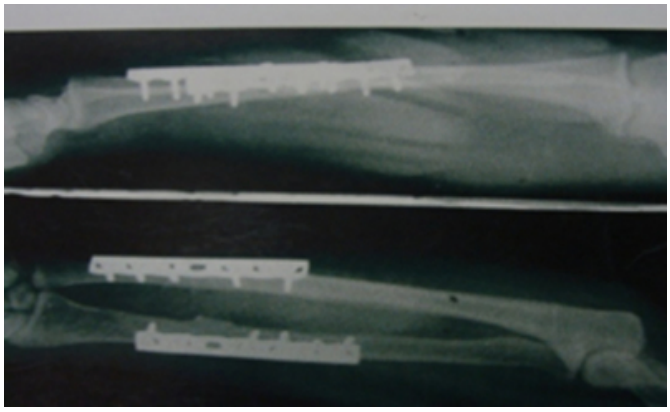


Figure 3

Figure 3- At The time of union



DISCUSSION

The basic aim of management of diaphyseal forearm fractures is to correct and maintain the axial, rotatory and appositional alignment and length of forearm bones. Open reduction and plate fixation has been the most accepted method of treatment of forearm fractures. In 1975, Anderson et al.[10] reported union rates of 98% for fractures of the radius and 96% for fractures of the ulna, with excellent or satisfactory result achieved in 86% of the patients. The concept of plate fixation is based on stress-shielding

in preventing displacement of the fracture. This may cause atrophy or porosis in the segment of bone to which a plate is applied. In the literature, the risk of refracture after removal of a plate has been reported to be 4% to 25%. To minimize this problem and improve healing rates, the AO group developed the concept of LC-DCP which emphasizes on the following:

- Preservation of blood supply
- Maintenance of optimal bone structure near the implant
- Improved healing in the critical zone in contact with the implant
- Minimal damage to the bone lining at plate removal with reduced risk of refracture

The present study was done to assess the usage of LC-DCP in forearm fractures with regard to achieving stability, incidence of union and complications therein.

The average age of our patients was 32.9 years with male preponderance which is in consonance with other series in literature (Chapman, Fernandes, Leung) [6, 12, 13] and can be ascribed to the fact that younger people especially males are more active and prone to accidents and trauma. This is more pertinent in our context as the socioeconomic considerations determine that females are usually indoors and involved in domestic chores while the younger male population is more outgoing and involved in heavy work making them more susceptible to injury. Regarding the side and location of the fractures, our study was similar to others (Chapman, Fernandes, and Leung) [6, 12, and 13]. Only 1 patient developed a superficial stitch abscess which was managed by stitch removal, daily dressings and antibiotics for 2 weeks. The low infection rate could also be attributed to the exclusion of type 2 and 3 open fractures from this study. The complications encountered in this study compared favorably when compared to other studies. Chapman [10] reported a 1.5 % incidence of non union and delayed union, 1.14 % incidence of iatrogenic posterior interrocious palsy, loosening of screws and radioulnar synostosis. We had 1 case of delayed union due to infection but no non union, 1 case of posterior interrocious nerve palsy and 4 cases of elbow stiffness. The lower incidence of complications can be ascribed to less soft tissue trauma, more biological fixation and preservation of the periosteal blood supply as compared to the usual technique. Our average healing time of 13.6 weeks compared favorably with other studies (Chapman.Fernandes, Leung) [6,12,13] The trapezoidal cross section of the plate and oblique undercuts in each screw hole ensure lesser contact area of plate to bone and better preservation of periosteal blood supply. The elimination of the middle segment and uniform spacing of the holes improves versatility of use. In conclusion, LC-DCP is a viable alternative to other forms of internal fixation in forearm fractures with the advantages of rigid, dynamic and biological fixation with better healing and lesser complications.

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