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External Locking Compression Plate for Open Fractures of Long Bones

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Abstract: ***Background: soft tissue management in open fractures of the long bones is a definitive challenge for orthopaedic surgeons and at the same time bulky external fixators are very cumbersome for patients. Supracutaneous plating using a locking compression plate (LCP) as an external fixator in compound fractures is as effective and stable as conventional external fixators.*** **Objective:** ***The purpose of our study is to describe results of using the locking compression plate (LCP) as an external fixator in the treatment compound fractures of long bones. Methods: A total of thirty patients underwent "supracutaneous plating" of the long bones (fourteen tibia, eight femur, seven humerus, one ulna) including forearm bones using a locking compression plate. Average age was 41 years. Regular screw tract dressings were done. Average period of follow-up was 14 months. Results: The plate was in situ for an average of 20 weeks. There were no clinically significant screw site infections. In all 30 patients the plate was kept in place until there was complete consolidation both clinically and radiologically. At the latest follow-up (average 15 months), all patients were fully weight bearing with a fully healed fracture site. All patients were infection-free with well-healed wounds. Conclusion: Most external frames for the lower leg are bulky and cumbersome, causing significant problems for the patient. To circumvent these issues, we have used an anatomically-contoured supracutaneous locking compression plate as external fixator in compound fractures of the long bones***

Keywords: Locking Compression Plate; Compound Fractures; External Fixation, supracutaneous plating, long bone fractures.

1. Introduction

Open fractures of the long bones are common in developing countries and are mostly due to the ever-increasing number of vehicular road traffic crashes, communal clashes, and civilian gunshot injuries. In these countries, functional emergency medical services are often nonexistent and patients with open fractures usually present late to the hospitals, some of who would have had some intervention by traditional bonesetters[1,2.] The ultimate aim of management of open fractures is to halt bacterial proliferation in the wound and in the circulation, remove dead and nonviable tissues by extensive wound debridement, and ensure adequate coverage of exposed bone. The instability of the fracture after debridement will compromise eradication of infection and wound healing [3456]. Hence, temporary bony stabilization by external fixation is advocated [7] to achieve stable skeletal fixation to allow for fracture healing. The choice of antibiotics used for preventing infection in these injuries is often determined by local or institutional antibiotic policies [8]. Methods of achieving soft tissue cover after wound debridement are fairly standardized and the choice of technique may be determined by practice location and the experience of the attending plastic surgeon. However, the modalities of skeletal stabilization are very variable as they are dictated by the experience of the trauma surgeon, the availability of implants and or explants as well as the peculiar fracture characteristics. The most common technique of skeletal stabilization in open fractures is the use of external fixators [9] Most of the external fixator frames used in fixation are bulky and cumbersome to the patient, causing inconvenience to them in day to day activities and may also cause disturbance in movement of the extremity involved and gait in case of lower limb, while trying to clear from the opposite limb. Locking compression plate as an external fixation device has been described in the management of open fractures, non-union, septic arthritis and even as an adjunct in distraction osteogenesis [10, 11]. We report in this study, the outcome of anatomically-contoured locking compression plate as an external fixator device among thirty adult patients for compound fractures.

2. Materials and Methods

This interventional study was conducted on patients with open fractures admitted at the Emergency Department of orthopedics Regional Institute of Medical Sciences from September 2013 to April 2015. After taking x ray of the involved bone, antibiotic prophylaxis including cefazolin (2 g/8 hours) plus gentamicin (3-5 mg/kg/day) were administered and continued for 5 days. For contaminated wounds, penicillin was added to the mentioned regimen. Prophylaxis against tetanus was considered for all patients. [10,11]. Observations and mechanisms for inducing of fractures were done. Physical examinations, assessment of neuro-vascular conditions in involved limb were carefully performed. Soft tissue injuries were classified based on Gustillo method. After stabilization, all cases X-rays were taken AP and lateral of total length of involved bone. After evaluation of the patients, all of them were transferred to operation room.

Figure 1: Open fracture femur. Preliminary debridement

With the patient under spinal anesthesia, the involved limb is prepared and draped in the usual standard sterile fashion. Pre-operative antibiotic treatment is given. No tourniquet is used. This is to allow intravenous antibiotics to reach the compound area. A thorough debridement and wound wash is given. Fracture alignment is achieved prior to wound closure. Compound wound is generally closed in one layer before the placement of the LCP, as the plate might limit easy access to wound. The plate is initially fixed to the proximal and distal fragments with a k-wire after certaining fracture reduction under fluoroscopy guidance.

Figure 2: placement of LCP after reduction forfracture femur

LCP is placed as close to the bone as possible, yet still allowing some space for swelling and regular wound care, to increase the mechanical stability of fixation. It is separated from the skin surface by a spacer of uniform thickness, like keeping a large needle holder. We prefer bi-cortical locked screw fixation when we use LCP as an external fixator. For the distal tibia and femur, at least four screws (4.5 mm) proximally and three to four screws (3.5 mm) distally is recommended. Successive holes are drilled over locking drill-guides through stab incisions made over the intact soft tissue envelope and screws are placed first distally and later in proximal fragment after ensuing good reduction.

Figure 3: Soft tissues are closed after fixation

Figure 4: Pre and post op x ray of femur fixation

Regular screw tract and compound wound dressings were done. Range of movement exercises and non- weight bearing walking was allowed from immediate post operative day. After 4 weeks, they were allowed toe- touch partial weight bearing for next 6 weeks, and followed by partial weight bearing for 4 weeks. According to the stability of fixation and healing of fracture, complete weight bearing started in lower limb fractures

3. Results

Total of thirty patients underwent “supracutaneous plating” of the long bones (fourteen tibia, eight femur, seven humerus, one ulna) including forearm bones using a locking compression plate. Twenty two patients (73.3%) were male and 8 patients (26.6%) were female. Mean age was 41.1 ±21.2 years, mean weight was 63.7 ±16 kilograms, and mean height was 159.1 ±3.7 centimetres. Eleven patients (36%) were smokers. Road traffic accidents - accounted for 24 patients (80%). Average time to fixation was 20.3 ±9 hours and average hospital stay was 41.5 ±9.6 days. Mean operative time was 98 ±18 minutes. Mean follow-ups were 14 months (range 9 to 25 months). 28 fractures (93%) achieved union, average union time in 15.2 weeks ranging from 12 weeks to 19 weeks. The plate was in situ for an average of 20 weeks (range 18 - 28). In all patients the plate was left in place until full bony healing both clinically and radiologically was obtained. Two patients (6%) had complications. one patient had delayed union; one had non-union of the fracture. At the end of the follow-ups, 29

patients (96.6%) were community ambulators. We did not see any significant screw tract infections or any loosening or failure of the hardware. The skin seems to tolerate the screws well and even seems to "adhere" to the screw. At the latest follow-up at an average of 15 months (range 8 - 22), all patients were fully weight bearing with a well formed callus.. All patients were free of infection with well-healed wounds.

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Figure 5: open fracture of humerus, serial x rays at post op, 3 weeks, 6 weeks and 10 weeks

Table 1: Showing results

	No. of cases	*Avge age of the patient*	*Avg duration of radiological union*	*Avg duration plate was kept*
Femur fractures	8	34yrs	16 weeks	16 weeks
tibia	14	47yrs	19 weeks	20 weeks
humerus	7	42yrs	13 weeks	14 weeks
ulna	1	39yrs	11 weeks	11 weeks
total	30	41yrs		

4. Discussion

LCP as an external device is superior and advantageous than other standard and circular external frames. LCP fixator can be concealed under clothing making it more acceptable to patients.

Figure 6: External appearance of implant after soft tissue wound healing.

There is much less tendency for the frame to strike the contra lateral lower leg in the swing-through phase of either leg during ambulation.

Figure 7: Patient walking with implant after radiological union

Hardware removal can be performed under local anaesthesia. It imparts a less conspicuous radiographic silhouette compared with traditional fixators allowing ease of assessment of healing of fracture to treating surgeons. Small amounts of axial micro-motion may reduce stress shielding of fracture site. Load sharing during weight bearing may stimulate the developing callus until bony union. Controlled dynamisation by removing screws closest to the fracture site is possible, allowing some measure of control to the load sharing process. Multiple distal locking holes in the pre contoured plate provide more stability compared to the standard two large external fixator pins[14]. Unlike the traditional fixation, mono-axial nature of locking head screw trajectory reduces the ability to compensate for imperfect placement, making it mandatory that anatomical reduction should be achieved prior to placement of first screw. While traditional constructs can be strengthened by stacking connecting rods, it is not possible for LCP external fixation. A Kloen's strategy of double LCP fixation should be employed in such cases requiring enhanced stability [15].

5. Conclusion

Obviously, our group of patients is relatively small and the indications limited. However, the consistent positive results using Locking compression plate as external fixator support our opinion such that we feel our described use of this plate is easy and very well tolerated by patients**.**

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