

A Comparative Study of Uniplanar Unilateral External Fixation Versus Locking Plate as External Fixation in The Definitive Management of Open Fractures of Tibial Diaphysis in Adults

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Abstract:

Background: This study was taken up to analyse the benefits of unilateral uniplanar external fixator versus locking compression plate as external fixator in definitive management of open fractures of tibial diaphysis in adults.

Materials and Methods: Prospective randomized double blinded study to divide patients with computer generated randomized table.

Results: limb extremity functional scale used to assess and compare recovery.

Conclusion: : Supracutaneous plating is a cheap and effective alternative to traditional external fixation in case of open fractures of the tibia in adults and can be used as the definitive management for such fractures.

Keywords: Locking Compression Plate, Compound Fractures, External Fixation, supracutaneous plating, tibial diaphyseal fractures

I. Introduction

Modern literature recognizes Damage Control Orthopedics as an important part of Trauma management. Open fractures of the long bones, due to the ever-increasing number of vehicular road traffic crashes, communal clashes, and civilian gunshot injuries are on the rise. In the developing countries, where 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 bone setters [1,2]. Damage control Orthopedics aims to resuscitate the patient and then to halt bacterial proliferation in the open 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 [3,4,5,6]. Hence, temporary bony stabilization by external fixation is advocated [7] to achieve stable skeletal fixation to allow for fracture healing. 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 uniplanar unilateral external fixators [8] 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 [9,10]. We report in this study, comparison of the outcome of anatomically-contoured locking compression plate as an external fixator device with unilateral uniplanar external fixators among 64 adult patients for compound fractures of the tibia.

II. Materials and Methods

This hospital based comparative study was conducted on patients with open fractures admitted at the Emergency Department of orthopedics Regional Institute of Medical Sciences from September 2013 to February 2016. A total of 64 patients who had presented with open fractures of tibia (Gustillo Andersen type 2, 3A, 3B or 3C) were included in the study. 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. [9,10]. Observations and mechanisms for inducing of fractures were done. Physical examinations, assessment of neuro-vascular conditions in involved limb were carefully performed. The patients were examined and resuscitated according to ATLS protocol. After stabilization, all cases X-rays were taken AP and lateral of entire tibia and knee and ankle joints. After evaluation of the patients, all of them were transferred to operation room. The patients were divided into two groups using simple sequential randomization with Ranuni function (SAS software). The first group underwent conventional external fixation using 4.5 mm cortical or 6.5 mm cancellous Schanz pins, AO universal clamps and transverse clamps and stainless steel tubes. The second group underwent external fixation by supracutaneous plate application with 4.5mm narrow LCP and 4.5 mm cortical locking head screws.

With the patient under spinal anesthesia, the involved limb was prepared and draped in the usual standard sterile fashion. Pre-operative antibiotic treatment was given. No tourniquet was used to ensure intravenous antibiotics to reach the limb. A thorough debridement and wound washing was done. Fracture alignment was achieved prior to wound closure. Compound wound was generally closed in one layer before the placement of the AO external fixator or supracutaneous LCP, as the assembly or the plate might limit easy access to wound.

In case of the first group, the most proximal and most distal Schanz pins on either side of the fracture were fixed first to the tibia after drilling holes with 3.2mm(in case of 4.5 mm cortical Schanz pins)or 4.5 mm drill bits (in case of 6.5 mm cancellous Schanz pins). These two were connected by a single tube using AO universal clamps or transverse clamps. Then, the other pins were applied sequentially. To ensure rigid fixation, the pins closest to the fracture site are placed as close to the fracture as possible., and a second connecting tube was fixed to allow for dynamization later. The space between the lower pin and bone was kept as less as possible. Minimum two Schanz pins with bicortical purchase was kept on either side of the fracture.

In case of the second group, the plate was initially fixed to the proximal and distal fragments with a k-wire after ascertaining fracture reduction under fluoroscopy guidance. LCP was 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 was separated from the skin surface by a spacer of uniform thickness, like keeping a large needle holder. Bi-cortical locked screw fixation was preferred while using LCP as an external fixator. At least three 4.5 mm screws proximal and three screws distal to the fracture were ensured. Successive 3.2 mm holes were 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 ensuring good reduction. 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 was started.

Lefs(Limb Extremity Functional Scale) [11] is a questionnaire containing 20 questions about a persons' ability to perform everyday tasks. The LEFS (Limb Extremity Functional Scale)was used as a measure of patients' initial function, ongoing progress, and outcome, as well as to set functional goals. LEFS is also used to evaluate the functional impairment of a patient with a disorder of one or both lower extremities. It can also be used to monitor the patient over time and to evaluate the effectiveness of an intervention. The maximum score is 80. The lower the score the greater is the disability.

Results

Of the 64 patients who completed follow up, union of the fracture was seen in 100% of cases in both the traditional external fixator and supracutaneous plating group. While the union was complete radiologically in 19.6 weeks in traditional external fixator, it took 20.2 weeks in supracutaneous plating. However, malunion with unacceptable angulation was seen in 1 case(2.78%) of cases of traditional external fixator and 2cases(7.14%) of supracutaneous plating. All these cases had to undergo revision surgeries with intramedullary interlocking nailing following open deformity correction. However, the main problem was the soft tissue complications which affected 6 patients (16.67%) of traditional external fixator and 5 patients (17.85%) of supracutaneous plating. However, all the soft tissue complications were managed effectively with routine dressings and intravenous antibiotics. The end LEFS scores were satisfactory in 100% of the cases in both traditional external fixator and supracutaneous plating.

	Traditional external fixator	Supracutaneous plating
Sample size	36	28
Age of patient	38.8±13.6 years	42.4±22.6 years
Mean duration between trauma to surgery	8.2±3.6 hours	6.8±2.7 hours

Average duration of surgery	36.4±8.6 minutes	48.6±7.2 minutes
Time to radiological union	19.6±4.5 weeks	20.2±3.2 weeks
Soft tissue complications	Superficial infection	3
		2
	Skin necrosis	1
	Pin tract infection	1
Malunion	1 (recurvatum)	2 (1 valgus, 1 recurvatum)
Non union	0	0
Deep infections	0	0
Average LEFS (mean± Standard deviation)	56.5±8.5	60.2±6.3

Discussion

Both unilateral uniplanar external fixator and supracutaneous plate were equally effective in wound management as well as ultimately in achieving final resolution of fracture disease. The uniplanar unilateral frame is biomechanically a more rigid construct than LCP. However, while it is bulky, LCP fixator can be concealed under clothing making it more acceptable to patients. Hardware removal can be performed under local anesthesia in both situations. LCP 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. The use of LCP following the Multiple distal locking holes in the pre contoured plate provide more stability compared to the standard two large external fixator pins[12]. In supracutaneous plating, 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 AO fixator allows minor modification in the geometry even after pin placement. 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 [13].

III. Conclusion

Supracutaneous plating is a cheap and effective alternative to traditional external fixation in case of open fractures of the tibia in adults and can be used as the definitive management for such fractures.

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