

A Comparative Study between External Fixation Versus Locking Compression Plate in Management of Extra Articular Proximal 1/3 Tibia Fractures

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Abstract:

Background

Fractures occurring in the proximal tibia of extra articular type often results from high-energy trauma with comminution and displacement problems. Most authorities agree that operative management of these fractures is best option in order to optimize patient outcomes. We want to assess which treatment method would be a best option for the patient with less complications and quicker recovery.

Objective

To evaluate the effects of external fixation and LCP techniques in the management of extra-articular proximal third tibial fractures in terms of bone union time, infection, postoperative complications, operative time, bleeding and cost effectiveness of both techniques.

Materials and Methods

The study was carried out on 40 patients with proximal third tibia fractures of AO classification type 41 A2 (transverse metaphyseal) and 41 A3 (comminuted metaphyseal) who received surgical treatment at the orthopedic units of the first affiliated hospital of Jiamusi university, between December-2014 to March-2016. The subjects of the study were patients aging between 35-45 years old, 22 male and 18 female. Patients were divided into 2 groups depending on the surgical treatment received; observation group comprised of 20 patients treated by external fixation and the control group comprised of 20 patients treated by Open reduction internal fixation with locking compression plate. Pathological fractures, fractures due to malignancy were excluded from the study. Clinical and radiological follow-up was performed at one month, 2 months, 3 months, 6 months and 12 months post operatively for both groups. Patients were systematically assessed for knee function, post operative infections, healing time, intra operative bleeding and surgical time, state of reduction after one week. Knee function was graded using Rasmussen Knee score. Clinical data was summarized and a data base established after which SPSS18.0 software was used to choose the appropriate statistical analysis method and conclusions were obtained.

Results

32 patients showed up for post operation checkup after one-month, 2-months, 3-months, 6-months, after 1 year 20 patients showed up. At one week post op, radiological assessment showed that 18-patients (93%) got anatomical reduction in LCP group as compared to 16-patients (80%) in the external fixation group. Average duration of bone union in external fixation was 14-weeks and that in LCP group 16-weeks. 2 cases in the external fixation group had pin tract infection, which were resolved with administration of antibiotics and local pin site care; no infection was noted in the LCP group. There were 2 cases of delayed union in LCP group and these were re operated using locking plates and auto bone grafts. No deep venous thrombosis, pneumonia or bed sores developed in any group patients. There was one case of bed sore in LCP group. There was initial knee stiffness in EF group and mean knee range of motion was 122 degree and that in LCP group as 126 degree. Continuous passive motion was started as soon as the pain subsided. After 2-months and 6-months follow ups, no radiographic signs of osteoarthritis detected. Mean Rasmussen knee score was good 25 in EF group patients and good 24.5 in LCP group. Mean weight bearing time was 13-weeks post operatively for both groups. No cases of compartment syndrome detected in both groups. Checkup after 1-year of both group patients, all were full weight bearing with satisfactory range of motion.

Conclusions

Both methods of treatment have good results. Treatment with External fixation is less invasive, less soft tissue dissection and less infection chances are there. Also short operative time, less time to bone healing, less bleeding and no need for surgical removal of implant, less post operative complications related to anesthesia and comparatively cost effective method.

Keywords: *external fixation, proximal tibia, fractures, locking compression plate.*

Abbreviations:

EF	External fixation
ORIF	Open reduction internal fixation
LCP	Locking Compression Plate
BO	Biological Osteosynthesis
AO	Arbeitsgemeinschaft für Osteosynthesefragen
MIPPO	Minimally Invasive Percutaneous Plate Osteosynthesis
MIPO	Minimally Invasive Plate Osteosynthesis
DVT	Deep Venous Thrombosis
Ext. Fix	External fixation

1. INTRODUCTION

Extra-articular proximal tibia fracture is not uncommon and accounts for about 5–11% of all tibial fractures [1, 2, 3, 4]. Many problems related to treatment and accompanying injuries complications arose and treatment of such fractures made surgeons to develop several fixation techniques and approaches with meager attention to the optimal management plan. Conventional (AO) plating requires exposure of the fracture and extensive dissection of the soft-tissue, thus carrying the risks of bleeding, infection and soft-tissue healing problem. Although problems like soft-tissue healing and avoiding deep infections can be largely sorted out with external fixator, yet it bears the risks of malunion, non-union and pin track infection; another big limit to this procedure is patient's dissatisfaction. Introduction of the locking plate (LCP) in the fracture fixation, the fixation of proximal tibia fracture has brought a dramatic change. Fixation of proximal third tibia fractures with the locking plates has demonstrate excellent results [5,6,7,8]. External fixation has a long history; it was first documented by Hippocrates when he used a splint for tibial fractures [9]. The development of external fixation devices that were directly attached to the bone started in the mid-19th century [10,11,12,13,14]. Langenbeck was the first to describe a technique that offered sufficient stability to the fracture site in 1851 [15, 16]. At the turn of the century, the concept of unilateral external fixation was invented [17, 18, 19]. In 1928, the swiss surgeon Raoul Hoffmann introduced an external fixation system concept that was able to provide length, alignment and rotational control in a rigid construct.

External fixation remains a versatile option for fixation of both open and closed fractures. However, pin-track infection and malunion are frequent complications [20]. Due to its wide range of indications, such as peri-articular fractures, articular dislocation and polytrauma [21, 22, 23, 24, 25, 26], external fixation stands out by its simplicity in regard to initial treatment [27]. Recently, an increasing rate of primary fracture treatment with spanning external fixation was observed and was explained by changes in logistics, economic aspects, or an increased use of damage-control techniques.

The purpose of this article is to report the clinical and radiological outcome of locked compression plating (LCP) and external fixation technique in management of proximal third tibia fracture.

2. MATERIALS AND METHODS

Adult patients suffering from proximal third tibial fractures that were treated with external fixator and locking compression plates between December 2014 and March 2015 were included in the study. The study was carried out on 40 patients with proximal third tibia fractures which were classified according to AO classification, type 41 A2 (transverse metaphyseal) and 41 A3 (comminuted metaphyseal) who received surgical treatment at the orthopedic units of the first affiliated hospital of Jiamusi university. Institutional Review Board approval and informed consent were obtained. Patients with articular extension were excluded. The subjects of the study were patients aging between 35 ~45 years old, 22 male and 18 female. Patients were divided into 2 groups depending on the surgical

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treatment received ; observation group comprised of 20 patients treated by external fixation and the control group comprised of 20 patients treated by Open reduction internal fixation with locking compression plates. All patients were treated by experienced surgeons who were well familiar with the principles of external fixation and plating techniques .Pathological fractures, fractures due to malignancy were excluded from the study. Approximately six weeks after surgery, partial weight bearing was encouraged. Full weight bearing was not permitted until consolidation of the fracture site Clinical and radiological follow-up was performed at one-month, 2-months, 3-months, 6-months and 12-months post operatively for both groups Rehabilitation was started as the pain subsided with quadriceps exercises and continuous passive motion of the knee joints . Patients were systematically assessed for functional, clinical, radiological and subjective outcome into account like knee function, post operative infections, healing time, intra operative bleeding and intraoperative time, state of reduction after one week. Knee function was assessed and graded using Rasmussen Knee score. Clinical data was summarized and a data base established after which SPSS18.0 software was used to choose the appropriate statistical analysis method and conclusion were obtained.

3. RESULTS

There were no significant differences in the age, gender, sex and fracture distribution were found in both groups treated. Majority of the patients 85% (34/40) presented with isolated injuries. Mechanism of injury included athletic injuries 30%(12/40), motor-vehicle accidents 40%(16/40),domestic injuries 18%(7/40) and other causes 12%(5/40) .In both groups no body suffered from deep wound infections. There were 3 cases of superficial pin tract infections, 1 case of superficial wound infection in the external fixation group, 2 cases of superficial wound infections in the LCP group which were managed with local pin site care and administration of antibiotics. Deep venous thrombosis and compartmental syndromes were not found in both the groups.

Table1. Comparing Post-operative complications in both groups

Groups	Pin tract Infection	superficial wounds	Deep wound	compartment syndrome	Bed sores	Delayed union
Ext.Fix	3	1	0	0	0	1
LCP	0	2	0	0	1	0

We compared the post operative complications in both groups of patients came to conclude that the ex.fix group has few post operative complications as compared to LCP group.

In this table we made two groups of patients and separated them on the basis of gender using chi square test $\chi^2 = 0.902$, $P = 0.342 > 0.05$, which means there is no significant difference in the distribution of patients in both groups thus making these two groups comparable to each other in context of this study.

Table2. Comparing gender distribution in both groups

Groups	Male	Female	Total	X2	P value
Ext.Fix	10	10	20	0.902	0.342
LCP	12	08	20		

The mean operation time was 90 minutes (80-105 min) for LCP and mean operation time for ext.fix was 50 minutes (40-65min). Mean blood loss was 160 mL (100-230 mL) for LCP and mean blood loss was 25 ml (20-40) for ext.fix group. Incision length in LCP group is 10 cm and that in Ex. Fix group is about 3 cm.

Table3. Comparing Intra-operative parameters of both groups

Groups	Bleeding (ml)	operative time (min)	Incision length (cm)
Ext.Fix	20 ± 05	40± 08	3 ± 0.5
LCP	160 ± 10	90 ± 10	10 ± 2

From this table we analyzed the results. We come to know that operation time, amount of bleeding and incision length are all comparatively of small magnitude in external fixation group as compared to the LCP group. These results are statistically significant.

Table4. Comparing mechanism of injury in both groups

Groups	Traffic accidents	fall from heights	domestic falls	x2	P value
Ext.Fix	14	4	2	0.770	0.680
LCP	13	6	1		

Here two groups of patients were grouped and analyzed according to the cause of injury using chi square test. Majority of injuries occurred due to road traffic accidents followed by fall from heights and domestic falls .using chi square test we came to know that there are some small difference in the cause of injury but these differences are not statistically different and thus both groups are comparable to each other in this context. $X^2=0.770$, $P=0.680>0.05$.

Table5. Comparing both groups patients for side of injury

Groups	Right	Left	Total	x2	P value
Ext.fix	12	08	20	0.519	0.417
LCP	11	09	20		

Two groups of patients were analyzed based on the side of the injury using chi-square test. $X^2=0.519$, $P=0.417>0.05$ which means no statistically significant difference in both groups and thus these two groups are comparable to each other.

Table6. comparing both groups for types of fractures

Groups	AO 41A2	AO 41A3	TOTAL	X ²	P value
Ext.fix	14	06	20	0.125	0.723
LCP	15	05	20		

A Comparative Study between External Fixation Versus Locking Compression Plate in Management of Extra Articular Proximal 1/3 Tibia Fractures

Two groups of patients separated by fracture type were analyzed using rank sum test. $X^2 = 0.125$, $P = 0.723 > 0.05$ which means there was no statistically significant difference among the two groups which made them able to be compared against each other.

Table 7. Comparing bone union time in both groups

Groups	healing time (weeks)	Range (weeks)	Ambulation (weeks)
Ext.fix	14	10-24	2 ± 0.9
LCP	16	10-28	2 ± 0.2

Comparing both groups of patients on the basis of hospitalization time and time to bone union we come to know that in external fixation group the time for bone healing is comparatively shorter to that of LCP group. On the other hand the hospitalization is longer in orif group as compared to ext.fix group. These differences are statistically not significant and both groups can be compared.

4. DISCUSSION

4.1. Key Findings

Though LCP and external fixations both has good clinical results still the following points need discussion before planning surgery for patients undergoing proximal t1/3 tibia fracture. Importance of intra operative time is such that each extra hour of intra operative time increases infection chance by 78%. From our results it is clear that intra operative time is much with LCP as compared to external fixation^[28, 29]. As the intraoperative time is more, there are more chances of developing deep venous thrombosis, pressure sore and pneumonia in patients with LCP technique there is excessive dissection of soft tissue and wide exposure of bone is necessary for good visuality of the fracture zone. Thus more dissection of soft tissue will have more chances of infections in such technique. On the other hand in external fixation method, there is no much dissection of soft tissue minimizing infection chances^[30, 31, 32, 33]. In LCP as we mentioned earlier, bone exposure is important and in this process we may destroy periosteum. Periosteum is important in blood supply to the fractured area. Damage to periosteum may alter bone healing process. In external fixation there is minimal or no damage to the underlying periosteum^[34, 35].

It is obvious that with LCP technique, primary bone healing with absolute stability occurs which is slower than relative stability provided by external fixation. Thus comparatively it will take longer time in healing for LCP than that of external fixation^[36, 37, 38]. We use general anesthesia for LCP technique and there are complications with it. On the other hand for external fixation regional anesthesia with less complication would be sufficient. In LCP technique, after the fracture is properly healed, implant removal will need a second time surgery. Again there would be dissection of soft tissue and infection chance maybe there. In external fixation there is no need of any second time surgery instead these fixator can be removed easily^[39, 40].

Skin and soft tissues are allergic to implants. There may be pain and irritation due to implants like LCP and others. The implant has to be there in the fractured bone for a longer period of time as compared to external fixator. According to published data there is possibility of fatigue crack and implant failure in LCP technique^[41, 42, 43]. Finally if we compare the costs of both the procedures, we come to know that LCP technique requires minimum two surgical procedures as compared to external fixators. Keeping this in mind and cost of LCP, external fixators are comparatively inexpensive.

5. CONCLUSIONS

From this comparative study it is concluded that:

Both External Fixation and LCP are equally useful techniques External Fixation technique results in less amount of bleeding, less soft tissue dissection decreasing chances of infection and less periosteal damage decreasing union time compared to LCP technique.

External fixation results in less scar tissue formation and having short operative time decreasing the chances of post operative complication chances as compared to LCP technique. Furthermore with External Fixation technique, there is no need of surgical removal of implant as well, no need for general anesthesia which makes it cost effective compared to LCP technique.

5.1. Conflict of Interest

There are no conflicts of interest.

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