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Original Research Paper

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TO STUDY THE FUNCTIONAL OUTCOMES BETWEEN LCP AS SUPRACUTANEOUS PLATE VS IMLN TIBIA FOR OPEN GRADE I AND II DISTAL TIBIAL FRACTURES

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ABSTRACT Orthopaedics is an ever evolving branch. Especially for fractures that have controversies in management options, recent advances are being done. Open distal tibial fractures belong to these groups of difficult, yet very common injuries. As the necessity is the mother of invention, for such a common injury a common plate-LCP was used supracutaneously for better biological fixation and shorter duration of surgery. We have compared the results of IMLN nailing vs supracutaneous plating for open distal tibial fractures. This study was conducted on patient with distal tibial. They were randomized into 2 groups. In one group (IMLN) intramedullary locking nail and in another group Supracutaneous plating was done (SCP). Functional outcome in both groups was measured in AOFSAS score, Knee Society Score (KSS),Lower extremity functional scoring (LEFS) and Ketenjian and Shelton Criteria modified by Yokoyama. Any complications were charted. atients in SCP Group had lesser incidence of persistent pain or other chronic symptoms and were happier (better LEFS score, better Yokahama scoring) than their counterparts with interlocking nail. Using locking plate in a supracutaneous mode is a very simple, easy, rapid, reliable and effective method for management of open tibial fractures in adults, especially in terms of patient satisfaction and can be considered as an effective alternative to nailing in selected patients.

KEYWORDS : Locking compression plate, IMLN TIBIA, Distal Tibial Fractures, Gustilo and Anderson

INTRODUCTION

External fixators are popular because of their ease of application in a shorter time duration, easy availability and the limited effect on the blood supply of the tibia, but these advantages have been outweighed by the high incidences of pin tract infections, the difficulties which relate to the soft tissue management .There is also more potential for malunions/ nonunions and importantly very large apparatus which is inconvenient for the patient. Use of reamed/ unreamed intermedullary interlocking locking nails has been done by many authors especially in grade 1 and grade 2 open tibial fractures (Rand, Mosheiff, and Liebergall 1994) but the problem of infection leading to subsequent surgeries in mentioned in literature (Rand, Mosheiff, and Liebergall 1994). The numerous methods which are used for treating open fractures of the tibia are an evidence of the ongoing efforts which are being made to improve the outcomes of the treatment of these fractures and of the continuing pursuit of more efficient and advanced methods for treating these fractures. There has been a constant thinking and evaluation to fix these fractures more biologically (Mosheiff, Safran, and Liebergall 1997) with indirect close reduction and applying stable fixation to achieve early union and maximal function (Giannoudis, Papakostidis, and Roberts 2006a). Locking compression plate (LCP) applied as an external fixator fulfils this criteria and is called as supracutaneous plating (Giovannini et al. 2016). This can be an important tool in armamentarium of an orthopaedic surgeon especially in metadiaphyseal fractures with open injury (Giovannini et al. 2016) or closed injuries with precarious soft tissue Tscherne (Kerkhoffs et al. 2003) Grade 2 or 3. We in our study will compare IMLN vs SCP in open grade 1 and 2 distal tibial fractures. None of the studies in international literature is available on comparison between these two modalities of fixation

MATERIAL AND METHODS

The present study was carried out in the Department of Orthopaedics, PCMS & RC, Bhopal from July 2017 to June 2019. 40 patients in age>18 yrs who had Gustilo and Anderson type 1 and type II fracture of distal tibia of both sexes were enrolled in this prospective study.

They were randomized into 2 groups of 20 each according to the day of admission. Consultant looking after Tuesday Thursday and Saturday performed IMLN on these patients. I looking after Monday Wednesday and Friday performed supracutaneous plating.

The patients were allocated a sequential study number and there were no exclusions after randomization. Patients with pathological fractures, non-osteoporotic osteopathies such as endocrine disorders, rheumatologic disorders, diabetes mellitus, renal disease, immunodeficiency states, mental impairment or difficulty in communication were excluded. Those with open fractures according to Gustilo and Anderson type type III or fractures with a displaced intraarticular fragment were also excluded.

Table 1. Demographic Characteristics.

		MLN	SCP	OVERALL
Mean age (years) (mean± standard error)		40.80±3.35	39.81±3.31	40.29±2.33
Gender distribution	Male	12	13	25
	Female	8	7	15
Involved limb	Right	13	12	25
	Left	7	8	15
Gustillo and anderson	Type-1	11	10	21
	Type-2	9	10	19
Duration of surgery (min) (mean± standard error)		90± 3.28	89±3.53	7.1± 3.37

IMLN - Inter medullary locking nail

SCP - Supracutaneous Plating

Surgical Steps For Supracutaneous Plating

Fracture reduction is done prior to application of plate. LCP metaphyseal plate of appropriate length is chosen. The plate is initially fixed to the proximal and distal fragments with a k-wire after certaining fracture reduction under fluoroscopy guidance 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. For the distal tibia, at least four screws proximally and three to four screws distally are 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. Screw tract and wound dressing is done.

Figure 1. Preoperative X-ray Of Patient With Distal Tibia Fracture

Figure 2. Postoperative X-ray

Figure 3. Union At 22 Weeks In Scp Group

Figure 4. Union At 19 Weeks In Imln Group

Figure 5. Proximal Screw Broken In Medullary Canal Due To Drilling Through Cortex (without Going Through Medullary Canal)

Steps For Imln Technique

4 cm long incision was made from the inferior pole of patella to the anteromedial aspect of the tibial tuberosity. A patellar tendon splitting approach was used and entry point was visualized. The entry point was made with a diamond awl. Keeping the knee flexed to 90°, with the help of a curved awl, the window was tunneled to the medullary canal. Curved artery forceps was passed over the window created. The guide wire was inserted up to fracture site. Reduction was achieved by traction and closed manipulation of the limb and guide wire passed to the distal fragment. Temporary reduction achieves under fluoroscopy and maintained with K wire. In all the cases sequential reaming was done with flexible reamers passed over the guide wire and minimum 9 mm diameter nail was used. In 2 cases of small diameter canal of the patients 8 mm nail was used. The nail was introduced over guide wire. Further fine reduction under Image Intensifier was achieved and the nail was negotiated into the distal fragment with the gentle taps of the hammer over the nail head. Use of blocking screws was done in 4 cases. Locking was done in static or dynamic mode depending on the fracture pattern. Free hand technique was used for distal locking of the nail under image guidance. Impaction was done, by padded gentle strokes over the heel In few cases compounding site was around fractures site, so using minimal invasive technique partial threaded can nulated screws were passed to achieve the reduction and then supracutanoeus plate was applied. The duration of surgery was recorded from the incision to wound closure Postoperatively, IV 2nd generation cephalosporins and aminoglycoside antibiotics were continued for 4 days followed by oral antibiotics for 5 days along with limb elevation, analgesics, antacids and trypsin chymotrypsin. Dressing was changed every alternate day till stitch removal at 14 days. Post operatively below knee posterior slab was given which was removed on second postoperative day and passive ankle range of motion exercises were initiated. Full weight-bearing was restricted for 6 weeks. However partial weight bearing was initiated in both groups on 4th post operative day. Average stay in the hospital was recorded. Delayed wound healing and superficial infection were as persistent drainage from the wound for at least two days, or separation of wound edges to a width > 1 cm and a length > 1 cm (Guo et al. 2010). Since implant removal in supracutaneous group was on outdoor basis no second surgery/hospital stay was needed. Stay for the subsequent implant removal in IMLN group was added to total duration. Follow-up was done at 2 weeks, 6 weeks, 3 months and 6 months after discharge till the fracture united. In each determined follow up at and after 6 weeks, clinical assessment of range of motion, radiological evaluation for progression of fracture healing and complications were documented. The functional outcome of the ankle was assessed with the help of AOFAS (American Orthopedic Foot and Ankle Society Ankle Score) and Knee Society Score (KSS) at 12 months (Table 2). Lower extremity functional score (LEFS) and Functional Results as per Ketenjian and Shelton Criteria (Ketanjian and Shelton 1972) modified by Yokoyama et al. (Yokoyama et al. 1994) were charted. Complications like surgical site infection, deep infection, delayed union, non union and ankle stiffness were documented. The radiological outcome was assessed using the Teeny-Wiss scoring system and fracture union (Teeny and Wiss 1993) Fracture union was subject to radiographic evidence of union and pain-free weight bearing.

Table 2. Outcome Parameters Of The Study.

Parameters	IMLN	SCP	P value
Intra-operative blood loss (ml) (mean± standard error)	165.00± 5.31	100.21 ± 3.3	0.001
Duration of surgery (minutes) (mean± standard error)	80.42± 4.21	78.23±2.2	0.0014
LEFS$ score at Tweleve months (mean± standard error)	80.73± 2.14	90.23	0.001
Time for union (weeks) (mean± standard error)	19.55± 0.69	22.38± 1.39	0.078
AOFAS§ mean (95% CI) score at one year	85.9 (83.7 to 88.1)	86.1 (83.7 to 88.6)	0.085

Scores (KSS)* at 1 year	70.2	82.1	0.004
Duration of hospital stay (including implant removal)	12(8-16)+ 7(6-14)	10 (6-14)	0.003

Table 3. Functional Results As Per Ketenjian And Shelton Criteria Modified By Yokoyama Et Al

Criteria	IMLN(%)	SCP(%)	P value
Excellent • Normal	12(60)	18(90)	0.001
Good • Occasional pain with prolonged use • Joint motion, 75% normal • Trivial swelling • Normal gait	4(20)	1(5)	0.001
Fair • Pain on ordinary activity Joint motion, 50% normal • Small amount of swelling • Slight limp	3(12)	1(5)	0.078
Poor • Constant pain • Joint motion, < 50% normal • Any visible deformity • Limp, gait on cane or crutch	1(5)	0	0.065

Table 4. Complications

		Group						
		Supracutaneous Plating		IMLN		Total		P value
		Count	%	Count	%	Count	%	
Superficial Infection	yes	3	15	4	20	7	17.5	**0.012**
	No	17	85	16	80	33	82.5	
Deep Infection	yes	**0**	**0**	**1**	**5**	**1**	**5**	**0.013**
	No	20	100	19	95	39	95	
Non-Union	yes	**0**	**0**	**0**	**0**	**0**	**0**	**0.14**
	No	**20**	**20**	**20**	**20**	**40**	**100**	
Malunion	yes	**1**	**5**	**1**	**5**	**2**	**5**	**0.147**
	No	**19**	**95**	**19**	**95**	**38**	**95**	
Delayed union	yes	**1**	**5**	**0**	**0**	1	**5**	**.704**
	No	**19**	**95**	**20**	**100**	**39**	**95**	

RESULTS

100% fracture union was seen in both cases. Only one case of deep infection was seen in IMLN group where implant removal and lavage was needed as a secondary procedure. One delayed union in SCP group was managed with removal of 2 screws across fracture site under local anesthesia. Mean time for union was 22 weeks in SCP groups and 19 weeks in IMLN group. A total of 25 males and 15 females were enrolled in the study. 21 of them had Gustilo and Anderson type 1 open tibia fractures and 19 of them had type II tibia fractures. In 25 patients right limb was involved. Overall duration of surgery was 90 ± 5 min in all cases and it was comparable in IMLN and SCP groups. Intra operative blood loss was 165 ml and was more in IMLN group than SCP group (100) ml. LEFS at 1 year was 90 in SCP group whereas it was 80 in IMLN group. p value was 0.001. AOFAS score was similar in both groups showing good functional outcome around ankle joint. Knee society score was statistically better in SCP group (82) whereas in IMLN group it was 70. Duration of hospital stay (including implant removal) was 10 days in SCP group while it was 12 days for primary surgery in IMLN group but came out to be 19 days after adding the admission days for implant removal. Superficial infection occurred in 3 cases of SCP group and LCP as supracutaneous plate vs IMLN tibia for open grade 1 and II distal tibial fractures. A comparison study (RCT) on... Journal of Orthopaedic Experience & Innovation 5 4 cases of IMLN group. Incidence of malunion was 5% in both groups. Overall general well being and functional outcome was statistically better in SCP group.

DISCUSSION

Reamed or unreamed IMLN has been done regularly for Grade -1 and Grade - II open fractures of tibia either in a single stage or in staged surgeries. Literature (Wang et al. 2019; Giannoudis, Papakostidis, and Roberts 2006b) have shown good results with these methods, but also with various complications (Xu et al. 2014). Srinivas et al.(Srinivas and Nazeer 2017) in their study on 44 open tibia fracture patients has shown Intramedullary nailing for open fractures of the tibial shaft is an excellent mode of therapy. They recommend that wound debridement with or without closure along with primary interlocking nailing should be done for open fractures of the tibial shaft (from group I up to group IIIA of Gustilo classification). At a later date, SSG or flap or delayed primary closure, etc should be done.

In 10 patients the fixation done by Marti et al. (Marti and van der Werken 1991) provided enough stability to allow uneventful bone healing and/or to eliminate infection. Stability was high due to the short distance between the plate and the soft tissues. Patients were easily adapted to this new method and implant removal was easy.

In our study mean age of distribution, gender of the patient and mean duration between admission and surgery were same in both IMLN and SCP groups. So the results obtained are comparable in both groups

No non union was seen in both the groups. All 40 patients managed for open tibia fractures went into union. LCP as supracutaneous plate vs IMLN tibia for open grade 1 and II distal tibial fractures. A comparison study (RCT) on... Journal of Orthopaedic Experience & Innovation 6 However one case of delayed union was seen in SCP group which was dynamised in local anesthesia and 2 screws nearer to fracture site were removed and aggressive weight bearing was initiated it went into union. Anterior knee pain was one of the major complaints in patients operated with IMLN group. Nearly 25 % of the patients had this pain which eventually lead to implant removal and second surgery. Incidence of anterior knee pain has been noted between 31% to 86% in various studies (Cartwright-Terry, Snow, and Nalwad 2007). The protrusion of nail tip (anterior and superior prominence) has been reported as one of the contributing factors for knee pain (Keating, Orfaly, and O'Brien 1997).

Mean time for union was more in SCP group (22 weeks) as compared to IMLN group (19 weeks). This might be because IMLN is a load sharing device while SCP is load bearing device. However this was found not to be statistically significant.

We have used Ketenjian and Shelton Criteria modified by Yokohama et al for a better overall assessment of gross functional outcome of the patient as a whole. In 90 % of the case outcome was excellent in SCP group while only in 60% of the cases in IMLN group it was good. 12 percent of patients in IMLN group had pain on ordinary activity and occasional swelling. One patient had poor score as per yokohama criteria. This patient had deep infection with pouring pus from knee insertion site. Luckily fracture was united and implant removal followed by good lavage settled the infection. This was the only case of deep infection in our study of 40 patients.

We have shown good functional outcome in SCP groups owing to non involvement of knee joint for entry site (not needed in SCP) and also due to easy implant removal as an LCP as supracutaneous plate vs IMLN tibia for open grade 1 and II distal tibial fractures. A comparison study (RCT) on... Journal of Orthopaedic Experience & Innovation 7 outdoor procedure.

Except for this all other modalities are similar or slightly (statistically not significant) better in IMLN group. Our results have shown that both a closed IMLN and LCP in Supracutaneous mode can be used safely to treat grade -1 and grade - II dista metaphyseal fractures of the tibia.

CONCLUSION

Though major complications were not seen in any of the group except for a solitary deep infection in IMLN group, patients in SCP Group had lesser incidence of persistent pain or other chronic symptoms and were happier (better LEFS score, better Yokahama scoring) than their counterparts with interlocking nail. Using locking plate in a supracutaneous mode is a very simple, easy, rapid, reliable and effective method for management of open tibial fractures in adults, especially in terms of patient satisfaction and can be considered as an effective alternative to nailing in selected patients

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