

Outcome of Locking Compression Plate (LCP) by Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO) in Closed Diaphyseal Fracture of Distal Tibia

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Abstract

Background: To determine the outcome of locking compression plate (LCP) by minimally invasive percutaneous plate osteosynthesis (MIPPO) in closed diaphyseal fracture of distal tibia

Methods: In this descriptive study patients (n=80) of either gender, 20-45 years of age with diaphyseal fractures of distal tibia were included. While patients having open, pathological, old (>3 wks), infected and fractures associated with compartment syndrome were excluded. All the patients were treated with LCP through MIPPO technique. All patients were discharged 3 days after surgery. The follow up of the patients was done at 2nd, 6th, 8th and 12th week interval. The patients were assessed for the outcome parameters (complications) i.e. delayed radiological union, palpable implant, and ankle stiffness.

Results : Mean age of male and female patients was 33.89±7.49 and 31.63±8.55 years respectively. Majority (77.2%) were male. Delayed union was observed in 9.4%. There were 12.2% patients who had palpable hardware. Ankle stiffness was observed in 7.2%.

Conclusion: Management of closed distal diaphyseal fractures of tibia with LCP through MIPPO technique is an excellent treatment method as it have increased union rate and decreased complications (Palpable implant and ankle stiffness).

Key Words: Locking compression plates (LCP), Minimally Invasive Plate Osteosynthesis (MIPPO), Closed Diaphyseal Fracture, Distal Tibia

Introduction

In the past diaphyseal and distal tibia fractures have usually been treated by closed intramedullary nailing or by the classic open approach with DCP plates. Both are related to complications such as nail or locking bolt failure, malunion, local infection complications and

bone union problems, especially after ORIF. With the introduction of Locking Compression Plates, Minimally Invasive Plate Osteosynthesis has become widely used. The plates act as internal fixators in a bridging manner, so resulting in secondary bone healing. Tibia is most commonly fractured long bone of the body.¹ Tibial diaphyseal fractures constitute approximately 21.3% of all the tibial fractures.²

Fractures of the tibia still pose a challenge to the orthopaedic surgeon due to certain peculiarities like tibia is a subcutaneous bone so there are more chances of open fracture, greater tendency of displacement of tibial fractures and more chances of post-operative infection.¹ These fractures are associated with high infection and non-union rates, and may result in limb loss in an otherwise fit and healthy adult.³ Biological plating techniques are those in which blood supply to the fractured fragments is maximally preserved to assist physiological process of bone healing wisely and optimally with minimal amount of operative intervention. Stress is laid on maintaining a precarious balance between devascularization and mechanical perfection.⁴

Minimally invasive techniques in distal tibial fractures are technically feasible and are advantageous as these minimize soft tissue injury and de-vascularization of the fracture fragments. Locking compression plates (LCP), placed through invasive techniques, have been used in recent past. The plates act as internal fixator in a bridging manner, thus resulting in secondary bone healing and also preserve the hematoma.⁵

A study was conducted by Tantray et al on fifty patients with tibial diaphyseal fractures treated with locking compression plate using MIPPO technique. The functional outcome was measured on 2nd, 6th, 8th and 12th week interval. There were 8% patients who had delayed/ no union, 12% patients had a palpable hardware and 6% had ankle stiffness.³

Currently most of the surgeons prefer open surgical techniques like open reduction and internal fixation for tibial diaphyseal fracture, which is associated with

the disadvantages of devascularization and soft tissue injury⁵ It also dislodges the hematoma present at the fracture site and hence may affect the healing. Use of LCP with MIPPO has been shown safe and successful option with the advantage of preservation of soft tissue and vascularity of bone. ⁵ It also preserves the blood clot at the fracture site. However, this technique is not a gold standard and is evolving. Different results are expected in our population in comparison to international study in the form of complications due to different expertise level and minimal awareness among patients about post operative care, so after the results we can adopt it as safe and effective for the management of closed distal diaphyseal fractures of tibia.

Patients and Methods

This descriptive study was done at Department of Orthopedics, DHQ teaching hospital Rawalpindi from March 2014 to February 2018. Patients of either gender 20-45 years of age with diaphyseal fractures of distal tibia were included in the study. While patients having open, pathological, old (>3 wks), infected and fractures associated with compartment syndrome were excluded from the study. Total 180 cases fulfilling inclusion criteria were included in the study. Demographic history and Informed consent were taken. All the patients were treated with LCP through MIPPO technique. All patients were discharged 3 days after surgery. The follow up of the patients was done at 2nd, 6th, 8th and 12th week interval. The patients were assessed for the outcome parameters (complications) i.e. delayed radiological union, palpable implant, and ankle stiffness.

Results

Total number of patients was 180. Mean age of male and female patients was 33.89±7.49 and 31.63±8.55 years respectively. Gender distribution shows that there were 139 (77.2%) patients who were male and 41(22.8%) patients were females. Male to female patients was 3.4:1 ratio. At 2nd week, the callus formation was not seen in any patient. At 6th week, callus formation was observed in 10 (5.5%) patients. At 8th and 12th week among 100 (55.6%) and 163 (90.6%) patients, the callus was seen on radiographs respectively (Table 1). Palpable hardware was observed at 2nd, 6th, 8th and at 12th week in 0 (00%), 10 (5.5%), 20 (11.1%) and 22 (12.2%) patients respectively (Table 2). Ankle stiffness was observed in 3 (1.7%) patients at 2nd week. At 6th and 8th week ankle stiffness was present in 11 (6.1%) and 13 (7.2%) patients

respectively but at 12th week ankle stiffness was observed in same 13 (7.2%) patients (Table 3). Delayed union was observed in 17 (9.4%) patients while the remaining 163(90.6%) patients had normal union (Table 4)

Table 1: Callus seen on radiographs from 2nd week till 12th week

Follow up	Callus seen on radiographs	
	Yes	No
2 nd week	0 (00%)	180 (100%)
6 th week	10 (5.5%)	170 (94.5%)
8 th week	100 (55.6)	80 (44.4%)
12 th week	163 (90.6%)	17 (9.4%)

Table 2: Palpable hardware from 2nd week till 12th week

Follow up	Palpable hardware	
	Yes	No
2 nd week	0 (00%)	180 (100%)
6 th week	10 (5.5%)	170 (94.5%)
8 th week	20 (11.1%)	160 (88.8%)
12 th week	22 (12.2%)	158 (87.8%)

Table 3: Ankle stiffness from 2nd week till 12th week

Follow up	Ankle Stiffness	
	Yes	No
2 nd week	3 (1.7%)	177 (98.3%)
6 th week	11 (6.1%)	169 (93.8%)
8 th week	13 (7.2%)	167 (92.8%)
12 th week	13(7.2%)	167 (92.8%)

Table 4: Outcome in terms of delayed union

		Frequency	Percentage
Delayed Union	Yes	17	9.4%
	No	163	90.6%
Total		180	100%



Figure 1: Pre op Xray, intraoperative image and post op Xray



Figure 2: Pre .op.and post op. Xrays

Discussion

For the treatment of closed distal diaphyseal fractures of tibia, a variety of treatment modalities have been defined. Conservative treatment can be applied to stable fractures with minimal shortening; however, malunion, shortening, joint stiffness and later on osteoarthritis have been reported in these fractures. For conventional open anatomical reduction, where open reduction and internal fixation (ORIF) is performed, large soft tissue dissection and periosteal elevation are needed. High rates of complications, such as infection (8.3-23%), delayed union and nonunion (8.3-35%), have been reported. In the last decade, minimally invasive percutaneous plate osteosynthesis (MIPPO), performed by indirect reduction, has become a successful treatment modality in complex fractures of the lower extremity.⁶⁻⁹

The aim of MIPPO is to preserve the osteogenic hematoma of the fracture and the nutritional arteries of the bone while preventing iatrogenic soft tissue damage. Vascular studies have compared cases treated by MIPPO with classic open techniques and MIPPO was found to result in higher preservation of periosteal circulation.¹⁰⁻¹² The locking compression plates are commonly used for fracture fixation through MIPPO. Locking compression plating (LCP) provides an angular stability for fixation. Locking screws prevent the plate from pressing the bone, preserving periosteal blood supply. This system stimulates callus formation due to flexible fixation. The anatomical shape of the plate prevents malalignment of the fracture and provides a better axial and angular weight distribution.^{10,13} In the past the distal diaphyseal fractures of tibia usually have been treated by closed intramedullary nailing or by the classic open approach with plates (ORIF). Both are related to complications such as nail or locking bolt failure, malunion, local septic complications and bone healing problems, especially after ORIF.⁵

In spite of use of LCP with MIPPO as internal fixator, anatomical reduction of the fracture by using indirect

reduction maneuvers before applying the plate is very important surgical step¹⁴. Malreduction and suboptimal pre-contouring of the plate can result in delayed union, non union, prominent hardware and ankle stiffness.¹⁵ MIPPO technique can restore alignment in high velocity distal diaphyseal tibial fractures and patients can expect predictable return of function. However Collinge et al. reported better results by secondary procedure like iliac crest bone grafting or per cutaneous bone marrow injection for delayed union or non union.¹⁶

In this study total 180 patients were included who presented with closed diaphyseal fractures of distal tibia of any severity. Patients were followed up at 2nd, 6th, 8th and at 12th week. Till 8th week callus formation was observed in 60% patients while at 12th week among 90% patients callus formation was observed. Overall union rate in this study was 90.6% while 9.4% patients had delayed union. Hasenboehler in his study reported that 10 (31.25%) patients at 3 months, 23 at 6(71.87%) months, and 27(84.37%) at 9 months met the criteria for a healed fracture.⁵

Shrestha treated patients with closed distal diaphyseal tibial fracture with LCP through MIPPO and followed for average duration of 18.45 months (range 5-30 months). He reported that all fractures got united with an average duration of 18.5 weeks (range 14-28 weeks) except one case of delayed union which was managed with percutaneous bone marrow injection.¹⁷

Union rate reported by various studies in which minimally invasive plate Osteosynthesis with Locking Compression Plate for distal tibial fracture was done, ranges between 83-100% respectively.^{2, 5, 18-20}

Union rate with the use of LCP with MIPPO was 90% which lies in the range of union reported in literature. However delayed union reported in different studies ranges between 5-16% respectively.^{2, 5, 21-23} and in this study delayed union was observed in 17(9.4%) patients which is consistent with the reported delayed union in patients who were treated with LCP with MIPPO.

Union time with the use of LCP with MIPPO ranges between 9-68 weeks as reported by different studies. Each study had its own specific follow up time period for patients.^{2, 5, 23, 24} In present study patients follow up was done till 12th week post operatively. At 12th week callus formation on radiograph was observed in 90.4% patients.

In present study at 12th week there were 22(12.2%) patients who had palpable hardware and 13 (7.2%) patients with ankle stiffness. M Tantray in his study showed the results of treatment of tibial diaphyseal

fractures using MIPPO technique. All the fractures united at an average of 22.25 weeks. According to his results, there were 46 (88%) patients who had excellent or good results and 4 (8%) had poor results. 4 (8%) patients had delayed union and 1(2%) patient developed superficial skin infection, 6 patients (12%) had a palpable implant and 3 patients (6%) had ankle stiffness.³ Distal tibia fracture is one of the difficult fractures to manage with all currently available treatment options. Fracture pattern, concomitant articular extension, condition of soft tissue are important factors to be considered before selection of fixation method. The results of current study shows that MIPPO with LCP is an effective treatment method in terms of union time, implant prominence and ankle stiffness in closed distal diaphyseal fractures of tibia.

Conclusion

Locking compression plates (LCP) applied through Minimally Invasive Plate Osteosynthesis (MIPPO) is a good, safe and effective technique for treating closed diaphyseal fractures of distal tibia.

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