

Limited Open Reduction and Percutaneous Plate Osteosynthesis - Alternative Option to Minimally Invasive Plate Osteosynthesis in Management of Distal Tibia Fractures

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ABSTRACT

Introduction: The management of distal tibia fracture is challenging because of the limited soft tissue coverage and poor vascularity around the bone in that area. Minimally invasive percutaneous plate osteosynthesis is a novel technique in this regard but needs fluoroscopy. In unavailability of fluoroscopy or its technical malfunction, limited open reduction percutaneous plate osteosynthesis becomes useful. The aim of this study is to compare the outcomes of distal tibia fractures treated by LORPPO and MIPPO techniques in terms of duration of hospital stay, full weight bearing, union time and complications.

Methods: Twenty-two cases of closed distal tibia fractures without articular involvement or comminution operated at Koshi Zonal Hospital, Nepal from March 2014 to May 2016 were included in this study. Total 11 cases of which were treated by MIPPO whereas other 11 cases were treated by LORPPO. MIPPO technique was done only when the fluoroscopy was available.

Results: In MIPPO, the average age of the patients were 43.72 (range 23-65) years, hospital stay mean duration 8.45 (range 6-12) days, full weight-bearing walking was started in 11.27 (range 9-15) weeks and average radiological union time was 21.25 (range 18-28) weeks. In LORPPO, the mean age was 46.36 (range 25-70) years, hospital stay mean 11.81 (range 10-15) days, full weight bearing walking mean 10.63 (range 9-15) weeks and average radiological union time was 23.0 (range 19-27) weeks.

Conclusions: The outcomes are comparatively similar for both the techniques. LORPPO could be an alternative to MIPPO in the management of distal tibia fractures.

Keywords: distal tibia fracture; limited open reduction; percutaneous plate osteosynthesis.

INTRODUCTION

The management of distal tibia fracture is challenging. The optimal treatment of distal tibia fractures without articular involvement still remains a matter of controversy because of inadequate amount of soft tissue coverage, subcutaneous location and poor vascularity. There are many methods of treatment such as external fixation, intramedullary nailing, plating and plaster cast immobilization for preserving the soft tissue. Intramedullary nails are commonly used in midshaft tibial fractures. We require extensive soft tissue dissection for

open reduction and internal plate fixation which can lead to wound dehiscence and infection.¹⁻³

Minimally invasive percutaneous plate osteosynthesis (MIPPO) remains the most effective and least invasive technique of closed reduction and internal fixation. Limited open reduction plate osteosynthesis (LORPPO)

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can be an alternative choice with less soft tissue damage and can lead to better surgical results than extensive open reduction and internal fixation (ORIF).^{4,5}

We have been practicing LORPPO technique during malfunction of C-arm fluoroscopy. Objective of our study is to compare the results of MIPPO and LORPPO in terms of union rate and functional outcome.

METHODS

This cross sectional descriptive study was conducted at the Department of Orthopedics of Koshi Zonal Hospital, Nepal to analyze the outcomes between MIPPO and LORPPO surgical techniques from March 2014 to May 2016. This study was conducted according to Helsinki Declaration. All patients had signed an informed consent to undergo the surgical treatment. All the patients were assessed initially in the Emergency Department with thorough examination to rule out any associated injuries. They were provided with first aid and splintage or above knee POP slab in order to make the patient comfortable. Routine pre-anesthetic investigations and additional relevant investigations were sent from the ward. In the ward, patients were managed with leg elevation on Bohler-Braun splint, ice compression and with needful medications. Surgery was undertaken after improvement of the soft tissue conditions and other anesthetic concerns. Routine preparation and draping of injured limb was done after spinal anesthesia with thigh tourniquet on supine position.

Pre-contoured locking compression plates were used in all patients for tibia fixation with proximal and distal 2 to 3 locking screws and most of the fibula fractures were not fixed, if necessary fixed with k-wires only. In LORPPO technique small incision was made on the antero-lateral side of the tibial crest to expose the fracture line. The soft tissue impinged inside the fracture site was removed for anatomical reduction and reduction forceps and large towel clamps were used to maintain the reduction. Sometimes single or multiple

K-wires (parallel or cross configuration) were used for temporary in tibia to maintain anatomical reduction from that small incision site during plate fixation. Anatomic reduction and rigid fixation which cause first-stage fracture healing. Other steps for plate insertion were similar to that of MIPPO technique.

Intra-articular distal tibial fractures and compound fractures needing soft tissue reconstruction were excluded from the study. Pathological fractures and metabolic bone diseases were similarly excluded from the study. Intravenous antibiotic was used for three to five days in MIPPO and five to seven days in LORPPO, the doses varied based on the wound condition. Below knee plaster of Paris slabs were used in both techniques for soft tissue healing, which lasted for two to three weeks. The duration may increase up to five to six weeks based on the recovery of wound, implant fixation and patient's behavior. The alcoholic or uncooperative and noncompliant patients were restricted from weight bearing until there was clinic-radiological evidence of fracture healing. The sutures were removed on average of 11-14 post-operative days. No drain was used in either group. Active knee range of motion was allowed as soon as possible. When the postoperative swelling decreased, all patients were encouraged to mobilize without weight bearing with a pair of axillary crutches. Progressive weight bearing was started on clinico-radiological evidence of union. The full weight bearing started soon after bony union. Radiographic union was defined as the presence of callus in three of the four cortices as seen on antero-posterior and lateral radiographs.

RESULTS

The study enrolled 22 patients with distal tibia (diaphysis and metaphysis) fractures. Sex distribution and mode of injury are similar in both (MIPPO and LORPPO) groups. Relatively young and active population of age group 20-60 years are more in number sustaining distal tibial fractures (Table 1).

Table 1. Distribution of age, sex and mode of injury.

Age (years)	Male				Female				Total n (%)
	MIPPO		LORPPO		MIPPO		LORPPO		
	RTA	Fall	RTA	Fall	RTA	Fall	RTA	Fall	
20-40	1	0	2	0	1	1	1	1	7 (31.8)
41-60	1	1	2	0	2	1	2	1	10 (45.45)
61-80	0	1	0	1	1	1	0	1	5 (22.7)
Total	2	2	4	1	4	3	3	3	22 (100)

RTA= Road Traffic Accident, Fall= fall from standing height or slip on the floor

Table 2. Comparison of the data for both groups.

	MIPPO (Mean and Range)	LORPPO (Mean and Range)
Age (Year)	43.72 (23-65)	46.36 (25-70)
Duration of surgery (minute)	57.72 (45-75)	49.09 (40-60)
Interval Trauma to hospital (day)	1.8 (1-3)	1.8 (1-3)
Interval from injury to surgery (day)	4.63 (3-7)	3.81 (3-7)
Total Hospital stay(day)	8.45 (6-12)	11.81 (10-15)
Full weight bearing walking(week)	11.27 (9-15)	10.63 (9-15)
Bone healing time (week)	21.25 (18-28)	23.0 (19-27)
Associated Fibula fracture (No.)	4	3
Fibula fixed with K-Wire (No.)	2	1
Superficial infection (No.)	1	2
Recurrent /deep infection (No.)	0	1

MIPPO technique had four out of 11 cases associated fibula fractures. Out of which two needed fixation with K-wire whereas in LORPPO three out of the 11 cases had fibula fracture but only one of them needed fibula fixation (Table 2). Operative time was shorter in LORPPO that is 49.09 (40-60) minutes as compared to MIPPO 57.72 (45-75) minutes. The full weight bearing time was also earlier in LORPPO 10.63 (9-15) weeks instead of MIPPO 11.27 (9-15) weeks. Radiological bone healing time was however comparatively longer with mean 23.0 (19-27) weeks in LORPPO than that of MIPPO with only 21.25 (18-28) weeks. The hospital stay was longer with mean 11.81 (10-15) days in LORPPO versus MIPPO with mean 8.45 (6-12) days (Table 3).

Table 3. Modified Klemm and Borner Scoring System.

Outcome	LORPPO	MIPPO
Excellent	2 (18.18%)	1 (9.09%)
Good	7 (63.63%)	6 (54.54%)
Fair	1 (9.09%)	3 (27.27%)
Poor	1 (9.09%)	1 (9.09%)

In LORPPO, two patients got superficial infection, one of which had implant insertion site infection and the other had infection over tibial crest. Another one patient in LORPPO got recurrent and deep infection. In that patient, the implant was removed in 18 weeks and above knee plaster slab was applied till infection control and then ankle leg brace was applied. In MIPPO one patient got superficial infection at K-wire insertion site in the lateral malleolus and the K-wire was removed in 25 weeks. In MIPPO none had deep recurrent infection. Asymptomatic hardware prominences were seen in both techniques.

DISCUSSION

The main advantage of MIPPO technique is that small incision is used to prevent iatrogenic injury to vascular supply of bone while reducing fracture fragments and tunneling subcutaneous plate. Both ORIF and MIPPO technique for the treatment of fracture complies with the principle of obtaining equilibrium between anatomical reduction and indirect reduction as well as direct healing and indirect healing. The minimal invasive technique has its own limitations. Sometimes there can be difficulties in obtaining alignment and compression of simple fracture patterns which may further lead to delayed healing and nonunion of fracture. A small incision doesn't always mean minimal tissue trauma because some surgeons who are unfamiliar with MIPPO technique may repeatedly insert and pull out the plate, which leads to a dead space and increases infection rate or delayed union.⁸⁻¹⁰

Borg et al., described healing time less than six months as normal, between six and nine months as delayed and over nine months as fracture non-union.⁷ Sometimes, early full weight bearing may lead to plate bending. Redfern et al, permitted their group of patients to full weight bearing based on clear radiological evidence of callus formation and clinical evaluation.⁶ We allowed and encouraged patient for full weight bearing prior to fracture union based on clinico-radiological evidence. Time of full weight bearing depended on clinically pain-free weight bearing, patient's weight, age, stable implant fixation and patient's cooperativeness. It is possible that fibula fixation improves tibia alignment in some cases, but there is increased chance for delayed healing of tibia when fibula is stabilized concurrently.^{11,12}

It has been identified that open surgical exposure and internal fixation has higher rate of infection as compared to other closed or minimally invasive methods of treatment. Deep infection or wound dehiscence sometimes needs wound debridement, long antibiotic therapy, skin grafting or myocutaneous flap. Intramedullary nailing is associated with low risk of infection but it may be associated with complications

like malunion, fat embolism, compartment syndrome and anterior knee pain. Mal-alignment has been recognized when using MIPPO because the bone is not directly visualized. Fibula fracture is not fixed when tibia fracture was stable and length maintained during intraoperative reduction. Many surgeons agree that fibular fracture associated with syndesmotic or ankle mortise instability should be fixed. There is no consensus over the role of fibular fixation in extra-articular fractures of the distal tibia metaphysis. No significant difference in union rates of tibia were found when fibula was fixed with Kirschner wire or Rush nail or plate.¹³⁻¹⁵ During MIPPO in our study, CRIF with K-wire was used to fix fibula which helped to maintain the alignment and reduction of tibia, while during LORPPO, K-wire was used to fix the tibia temporarily and then fibula was fixed by giving small incision over the fractured site. The purpose was to fix fibula just to maintain syndesmotic and ankle mortise.

Orthopedic surgeons face higher risks like radiation, infection, chemical, physical and psychosocial hazards. Since MIPPO does not allow direct visualization of fracture site, surgeons are dependent on intra-operative fluoroscopy for adequate reduction and confirmation. Additional radiation exposure for confirmation to application of plate to bone and proper size screw fixation, which can extend operating time, are disadvantages in MIPPO. Improved surgical techniques

and technologies of reducing depends upon fluoroscopy. Radiation can cause substantial cytogenetic and chromosomal damage, potential increase in cancer risk and genetic defect in the off springs, erythema, burns, sterility, radiation sickness and cataracts. To avoid these potential hazards, orthopedic surgeons must follow established guidelines, take basic preventive measures when possible and be conscious of these risks.^{16,17} LORPPO can reduce operation time without radiation hazards.

Limitation of our study was small sample size sampling and single centre study. Therefore, results couldn't be generalized for Nepalese population from our study.

CONCLUSIONS

The results of our study indicate comparative outcomes between the two techniques. Hence, LORPPO could be an alternative choice if fluoroscopy is not available for distal tibia fractures.

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Conflict of Interest: None.

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