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Dr. Gagan Khanna
Professor, Orthopaedics
SGRDIMSR, Amritsar, Punjab,
India

Dr. Sumit Bhatia
Junior Resident, Orthopaedics
SGRDIMSR, Amritsar, Punjab,
India

Dr. Aarti Dewan
Associate Professor,
Orthopaedics, SGRDIMSR,
Amritsar, Punjab, India

Dr. Divya Randhawa
MBBS, SGRDIMSR, Amritsar,
Punjab, India

Corresponding Author:
Dr. Gagan Khanna
Professor, Orthopaedics
SGRDIMSR, Amritsar, Punjab,
India

Clinical outcomes of minimal invasive plate osteosynthesis in comminuted fracture of long bones

Dr. Gagan Khanna, Dr. Sumit Bhatia, Dr. Aarti Dewan and Dr. Divya Randhawa

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Abstract

Background: MIPO technique, with less periosteal stripping, may facilitate bone healing by preserving soft tissue and promoting oxygen tension in the fracture hematoma. The present study was conducted to assess the functional and clinical outcomes of Minimal Invasive Plate Osteosynthesis in comminuted fracture of long bones.

Materials & Methods: A total of 28 patient's patients were selected for the study. After a patient with comminuted fractures of long bones was admitted to the hospital, all the necessary clinical details were recorded in proforma prepared for surgery. The cases were studied on the basis of gender, age, site of injury, classification and mode of injury. Postoperatively, patients were evaluated for radiological investigations and functional outcome.

Results: The mean age of the patients was 38.03 years and 24 (86%) were males. Outcome was excellent in 16 patients (61.54%) followed by Good in 7 patients (26.93%) and Poor in 3 patients (11.53%) due to non-union.

Conclusion: Minimally Invasive Plate Osteosynthesis (MIPO) technique using Locking Compression Plate (LCP) is a safer and better procedure than the conventional techniques used to manage comminuted fractures of long bones.

Keywords: Fracture hematoma, indirect reduction, closed reduction

Introduction

Long bones, including the Femur and Tibia are the most commonly fractured bones in the human body ^[1]. The introduction of the concept of minimally invasive plate osteosynthesis (MIPO) around the turn of this century was founded on the emerging body of evidence that both the bone blood supply and the fracture haematoma should be preserved to optimize the fracture healing process, especially in cases of extra-articular diaphyseal fractures.

The technique of 'Minimal Invasive Plate Osteosynthesis - MIPO' is based on a combination of the recent inventions in biological osteosynthesis and internal fixation technique. The "internal fixators" used for MIPO have been designed to allow less plate to bone contact without compromising stability. The screw holes are designed to allow the screw to "lock" into the plate, converting the plate/screw construct into a fixed-angle device with multiple points of fixation ^[2]. This makes for minimal vascular damage to the periosteum, whereas a conventional plate fixation relied on bone/plate friction, resulting in early bone porosity underneath the plate. The importance of preservation of periosteal vasculature during osteosynthesis in MIPO technique may contribute to the rapid formation and mineralization of callus. The MIPO technique has been shown to have multiple biological advantages, as operative exposure and soft tissue stripping are minimized. Vascular pedicles are preserved throughout realignment, as fixation is at a distance to the fracture site, leaving the fracture haematoma around the injury undisturbed.

Methods

Study design and participants

This prospective observational study included total of 28 patients. All patients fulfilling inclusion and exclusion criteria and were treated with MIPO technique were selected for the

study. The cases were studied on the basis of gender, age, site of injury, classification and mode of injury. Informed and written consent for surgery and willingness to participate in the study was obtained from all the patients.

Inclusion criteria

- Age above 12 years
- Closed fractures, Comminuted fractures of long bones
- Fractures reducible by indirect methods
- Injury presenting within 2 weeks of injury (Indirect reduction possible)

Exclusion criteria

- Compound fractures type II and above
- Simple fractures of long bones
- Patients with pathological fractures
- Active infection of skin and surrounding soft tissues of injured limb
- Articular and juxta articular fractures which may require ORIF

Postoperatively, patients were evaluated and radiological investigations were done to check any implant loosening and the progress of bone union radiologically using Hammer *et al.* 84 criteria was done. The functional outcome of the patients was evaluated by the criteria laid by Lam and Bromley. The patients

were followed up till functional recovery after surgery on a monthly basis and in some cases, subsequently also.

Results

Baseline characteristics

Out of total 28 patients, 24 (86%) were males and 4 (14%) were females. The age varies from 14 years to 72 years with the mean age of 38.03 years. Maximum numbers of patients were in the age group of 21-40 years i.e. 19 patients (67.8%). The commonest mode of injury was road traffic accident (RTA) in 22 (78.57%) patients; fall from height was responsible for 4 (14.28%) patients and assault in 2 (7.15%) patients. Left side was common side of injury in 19 patients (67.85%) followed by right side in 9 patients (32.15%). Tibia fractures (AO 41, 43) are common present in 15 patients (53.58%) and Femur fractures (AO 32, 33) present in 13 patients (46.42%). Among 28 patients, 2 patients were lost to follow up and out of remaining 26 patients radiological union was seen in 23 patients (88.46%) and non-union were seen in 3 patients (11.54%).

Clinical and Functional Outcomes

The functional outcome is assessed in our group of 26 patients by criteria laid down by Lam 1964, the ROM of adjoining joint is assessed. Outcome is excellent in 16 patients (61.54%) followed by Good in 7 patients (26.93%) and Poor in 3 patients (11.53%) due to non-union. (Fig. 1).

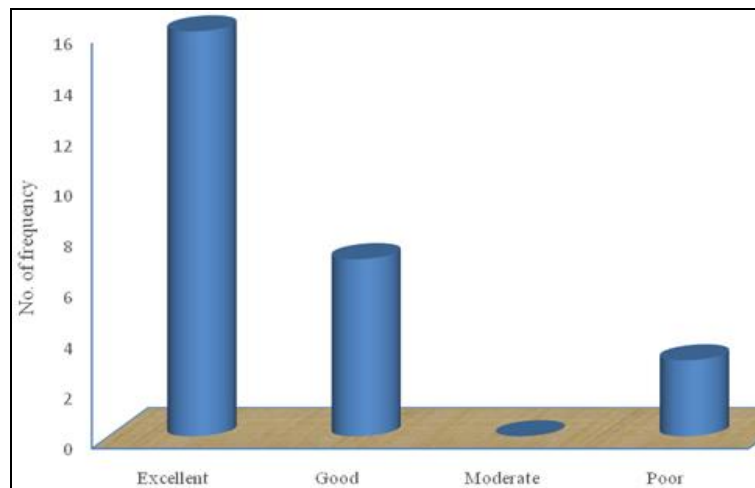


Fig 1: Functional outcome- rom assessed

A total of 8 Post-operative complications were observed in our study. Most common complication was Non-union present in 3 patients (11.54%) with 2 cases each of distal femur (AO 33A3) and 1 case of comminuted fracture shaft femur (AO 33 B3 -

Type C). Limb length discrepancy present in 2 patients (7.69%), Knee stiffness was present in 1 patient (3.84%), superficial infection of Fracture Proximal tibia (AO 41 A3) in 1 patient (3.84%) and Malunion occurred in 1 patient (3.84%).

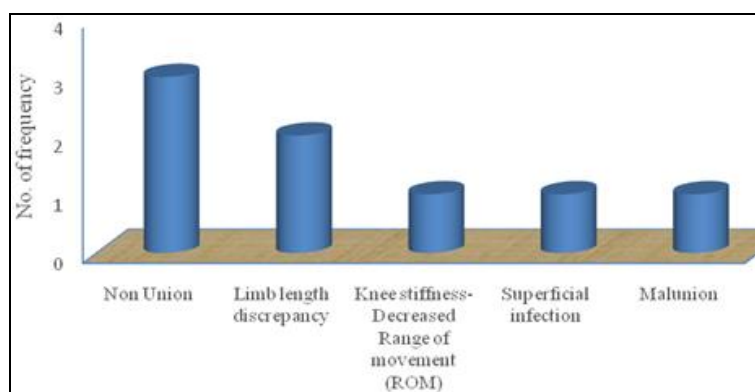


Fig 2: Post-operative complications

At each follow up, ROM of adjoining joint was assessed. Fracture union both clinical and radiological and its progression

fracture healing from radiographs according to Hammer *et al.* and range of movement of nearby joint was examined.



Fig 3: represents clinical photographs showing range of movement

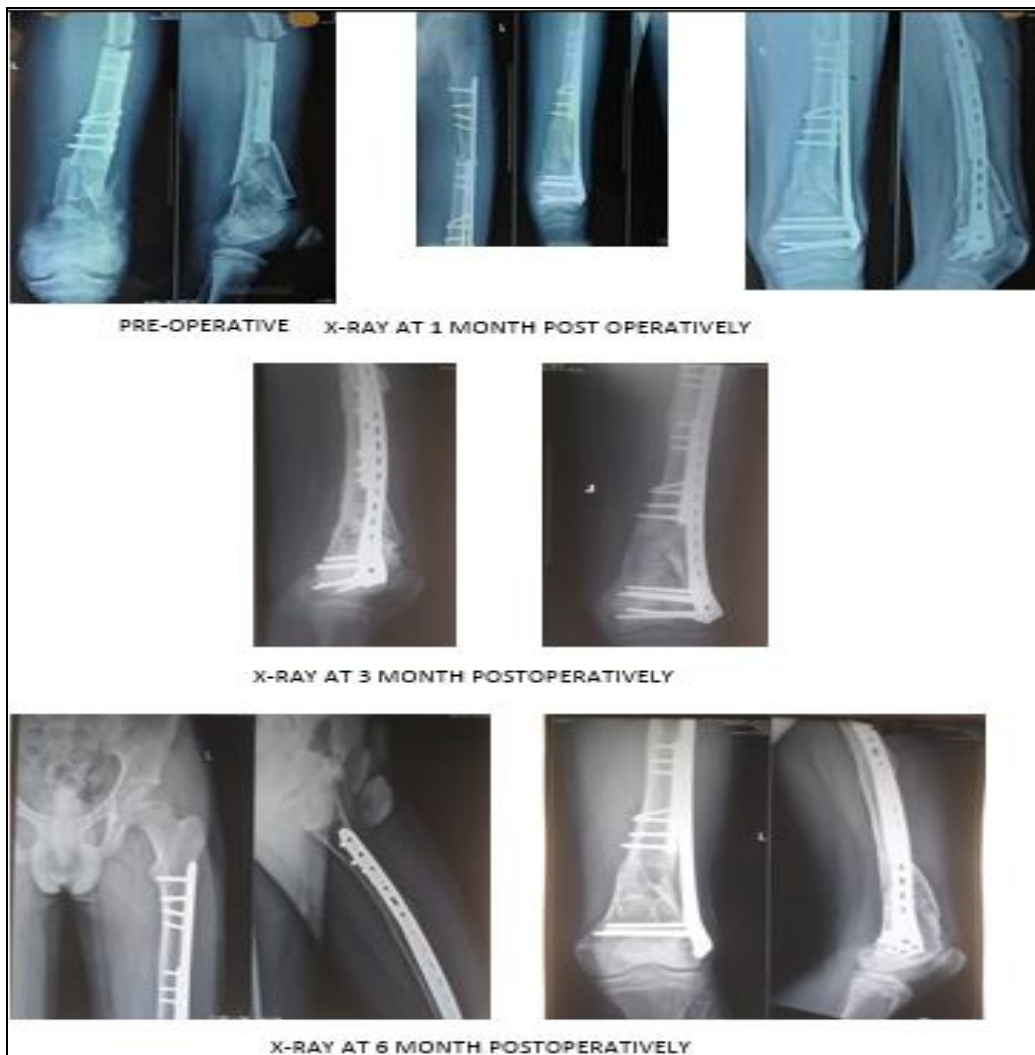


Fig 4: Shows radiological outcomes. X-rays with both AP view and Lateral views was done at day 1 post operatively

Discussion

Functional outcome and ROM of adjoining joint was assessed in all the patients as per the criteria laid down by Lam and Bromley^[4] All the patients of tibia fracture had intact dorsiflexion and plantar flexion at ankle joint with no restriction in ROM at knee joint either. 3 patients of non-union had poor functional outcome as per criteria laid down by Lam and out of which one patient (7.69%) of comminuted fracture shaft femur–Distal diaphyseal and metaphyseal (AO 32 C 2 – type K) had restricted ROM at knee joint. This patient of polytrauma had severe comminution, and due to non-mobility of the adjoining joint for longer duration there is restricted ROM of knee joint. Early weight bearing resulted in implant failure. Mandal *et al.*^[4] reported 3 (12%) patients of restricted ROM in series of patient treated with MIPO in comminuted fracture of long bones.

A total of 8 Postoperative complications were observed among the 26 patients followed up in our study. Most common complication in our study we observed was non-union present in 3 patients (11.53%) with 2 patients of distal femur (AO 33 A3) and 1 patient of comminuted fracture shaft femur (AO 33 B3 Type C). None of the patients of tibia fracture had non-union, 3 patients of non-union were observed in the patients of femur fracture and various factors influenced the process of healing resulting in non-union in these patients.

One patient of comminuted fracture distal femur (AO 33 A3), resulted in non-union leading to implant failure for which ORIF with bone grafting at the fracture site was done. During the surgery sclerosed bony margins with fibrous tissue were present at the fracture site. The bone had undergone thermal necrosis, due to impact of intense heat generated because of gunshot injury.

Other case was that of comminuted fracture shaft femur (AO 32 C2) who had implant failure with plate bending along with proximal loosening of screws and varus deformity occurred post operatively at 5 months. Severe comminution, age of patient and early weight bearing are factors that influenced bone healing leading to non-union which led to implant failure.

In another patient of comminuted fracture distal femur (AO 33 A3), severe comminution and early weight bearing leads to non-union resulting in implant failure. Patient had undergone ORIF later for the same. Andalib *et al.*^[5] reported 1 (2%) patient of non-union in series of 49 cases underwent MIPO for comminuted fractures of long bones. In the study conducted by Mandal *et al.*^[4], 1 patient (4%) had non-union in 25 cases of comminuted fracture of long bones treated with MIPO.

Limb length discrepancy of less than 2.5 cm was present in 2 (7.69%) patients that is not so significant. There was shortening observed in two cases of fracture femur with 1.5cm and 1 cm respectively that was corrected with shoe raise later. Andalib *et al.*^[5] reported 2 (4.08%) patients with negligible (1 cm) limb length discrepancy.

In our study superficial infection in patient of Fracture Proximal tibia (AO 41 A3) in 1 (3.84%) patient was observed in our study, which was treated with antibiotics as per culture sensitivity and ASD done routinely. The study by Raiturker and Salunkhe^[6] reported 1 (6.25%) patient of superficial infection treated with antibiotics.

One (3.84%) patient in our study of comminuted fracture distal femur (AO 33 A3) had malunion with 10° of internal rotation and 15° varus deformity. Andalib *et al.*^[5] had 1 (2%) patient of malunion with 10° of internal rotation.

Conclusion

Our study conducted showed good to excellent results in terms

of prognosis, functional outcome and very less complications were observed. Minimally Invasive Plate Osteosynthesis (MIPO) technique using Locking Compression Plate (LCP) is a safer and better procedure than the conventional techniques used to manage comminuted fractures of long bones. MIPO led to faster rehabilitation and restoration of normal functioning of the affected bone. The rate of infection was very low due to better soft tissue handling intra operatively and minimal soft tissue exposure during surgery. A cautious intraoperative clinical and fluoroscopic control is required in MIPO technique. Since it is a recent development, which requires careful handling of soft tissues and a meticulous surgical technique, the expertise of the surgeon becomes a limitation.

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Author's Contribution

Not available

Conflict of Interest

Not available

Financial Support

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