Locked Compression Plating for Peri- and Intra-Articular Fractures around the Knee

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ABSTRACT

Background:
The knee is a major weight-bearing joint of the lower limb consequently any fractures involving the proximal tibia or distal femur will compromise the knee function and stability.

Objective:
To evaluate the clinical and radiological outcome of locked compression plates in the management of peri- and intra-articular fractures around the knee.

Patients and Methods:
This prospective cohort study included 20 patients with peri- and intra- articular fractures around the knee at Orthopeadic Surgery Department, University Hospital, Al- Azhar University, and Orthopeadic Surgery Department, Al-Salam Specialized Hospital.

Results:
Regarding the demographic characteristics of the studied cases, our results indicated that the mean age of the recruited patients was 50.55 ± 13.74 years old and that 60% of patients were males and 40% were females. There was equal side distribution of fractures (50% right side and 50% left side). Regarding intraoperative complication and ROM among studied groups, our results revealed that none of the cases showed any intraoperative complications, and ROM >120 was achieved in 85% of cases while ROM equal to 90 was achieved in 15% of cases.

Conclusion:
Distal femoral and proximal tibial locking plates provide complete union and early mobilization to attain better functional outcomes in cases with peri- and intra-articular fractures around the knee.

Keywords:
Locked compression plates; Intra-articular fractures

INTRODUCTION

The goal of the orthopaedic surgeon is to restore function and early recovery. For fractures around the knee, achievement of both of these goals remains challenging. These fractures require excellent anatomical reduction and early motion to prevent joint stiffness. (1)

Fracture of the distal femur accounts for 7 percent of all femoral fractures and 30 percent of fractures of the femur excluding hip fractures. (2)

Management of tibial plateau fractures is a challenging task for orthopedic surgeons due to its controversial treatment modalities. Proximal tibial fractures account for 1.2% of all fractures and 8% offractures in old-age people. (3)

The goal of treatment is anatomical reduction, normal limb alignment, ligamentous stability, knee stability, and an early range of motion. (4)

More recent techniques such as the use of locking plates are constantly gaining popularity amongst orthopaedic surgeons. The biomechanical advantages of locking plate constructs are realized especially in complex fractures rather than relatively straightforward simple fracture patterns. (5)

Locking plates in the treatment of complex tibial plateau fractures holds many potential advantages, like increased holding power in osteopenic bone, unicortical purchase in the periarticular region, and ability to successfully and stably bridge severely comminuted meta-diaphyseal shaft areas.

AIM OF THE WORK

The goal of this study is to evaluate the clinical and radiological outcome of locked compression plates (LCPs) in the management of peri- and intra-articular fractures around the knee.

PATIENTS AND METHODS

This study includes 20 patients who have fractures around the knee fixed by locking compression plate:

Group A: fracture proximal tibia 10 patients.
Group B: fracture distal femur 10 patients.

They were recruited and assessed for eligibility at Orthopeadic Surgery Department, University Hospital, Al- Azhar University, and Orthopeadic Surgery Department, Al-Salam Specialized Hospital.

- **Inclusion criteria:**
  a) Tibial plateau fracture.
  b) Proximal tibial fracture.
  c) Distal femoral fractures.
  d) Skeletally mature patient.
  e) Fracture in osteoporotic bone.
- **Exclusion criteria**:
  a) Tibial mid-shaft fractures.
  b) Femoral mid-shaft fracture.
  c) Patient unfit for surgery.
  d) Severely damaged soft-tissue.
  e) Skeletally immature patient.
  f) Periprosthetic fractures.
  g) Non-unions.
  h) Pathologic fractures.

Recruitment and procedures applied in the study

- **Place of recruitment (place of conduction of the study):** subjects were recruited from Orthopeadic Surgery Department, University Hospital, Al-Azhar University, and Orthopeadic Surgery Department, Al-Salam Specialized Hospital.
- **Research Ethics Committee Approval and quality control:** the protocol and all corresponding documents were declared for Ethical and Research approval by the Council of Faculty of Medicine, Al -Azhar University.
- **Subjects consent:** Written informed consent was obtained from the patients before entering and start of the study.
- **Procedures applied in the study:**

Preoperative Evaluation:

All patients were assessed by trauma life support and locally examined for affected limbs and other associated injuries then splinted and radiological assessment.

Anesthesia

The operations were done under spinal anesthesia. All patients got a single dose of an antibiotic one hour before surgery.

The knee examination included measurement of the ROM of the injured knee, varus-valgus, and anterior–posterior stability, the presence of flexion contracture, extension lag, and alignment. The ROM was measured as the passive arc of movement of the examined knee. Measurements were taken with each subject in a supine position with the hip flexed on an examination table using a long-arm goniometer with 50-cm arms and central articulation. For healthy adult subjects, the normal value of ROM is between 0° and approximately 140° of knee flexion.

Any loss of reduction plate, plate lift off, screw back out or screw/plate breakage was recorded. Any other complication such as superficial or deep infection if encountered was also noted.

Statistical Analysis

Data were collected, coded, revised, and entered into the Statistical Package for Social Science (IBM SPSS) version 20. The data were presented as numbers and percentages for the qualitative data, mean, standard deviations, and ranges for the quantitative data with parametric distribution, and median with interquartile range (IQR) for the quantitative data with the non-parametric distribution.

RESULTS

Table (1): Demographic data among group A

		No	%
Sex	Female	4	40.0%
	Male	6	60.0%
Age	Mean± SD	46 ± 11.86	

This table showed that 6 patients (60%) were males and 4 patients (40%) were females, the mean age was 46.

Table (2): Side and Associated fracture, Type of fracture, Classification of the fracture, Intraoperative complication and ROM, Pain and Extension lag, Infection and Knee score and Implant failure, Delayed union and Nonunion among group A

		No	%
Side	Left	5	50.0%
	Right	5	50.0%
Type of fracture	Proximal tibia	10	100.0%
Classificationof the fracture	41A3	1	10.0%
	41B1	2	20.0%
	41B3	5	50.0%
	41C1	1	10.0%
	41C2	1	10.0%
Intraoperative complication	No	10	100.0%
ROM	>120 flexion	9	90.0%
	90 flexion	1	10.0%
Pain	Mild	1	10.0%
	No	9	90.0%
Extension lag	No	10	100.0%
Infection	No	9	90.0%
	Superficial	1	10.0%
Knee score	Mean± SD	87.85	5.71
	Range	79	95
Implant failure	No	10	100.0%
Delayed union	No	10	100.0%
Nonunion	No	10	100.0%

This table showed that 5 patients (50%) were left side and 5 patients (50%) were right side. This table showedthat the Classification of the fracture WAS 41B3 in 1 patient (10%), 41C1 in 1 patient (10%), was 41C21 patient (10%). This table showed that no patients had Intraoperative complications, ROM was >120 flexion in 9 patients (90%), was 90 flexion in 1 patient (10%). This table showed that Pain was mild in only 1 patient and the rest of the patients (90%) had no pain, no patients had Extension lag. This table showed that 1 patient had a Superficial Infection, and the rest of the patients had no infection, mean Knee score was 87.85 with a range from 79 to 95. This table showed that all patients had not to implant failure, delayed union and nonunion

Table (3): Demographic data among group B

		No	%
Sex	Female	4	40.0%
	Male	6	60.0%
Age	Mean± SD	55.1 ± 14.54	

This table showed that 6 patients (60%) were males and 4 patients (40%) were females, the mean age was 55.

Table (4): Side and Associated fracture, Type of fracture, Classification of the fracture, Intraoperative complication and ROM, Pain and Extension lag and Infection, and Knee score among group B

		No	%
Side	Left	5	50.0%
	Right	5	50.0%
Type of fracture	Distal femur	10	100.0%
Classificationof the fracture	33A1	1	10.0%
	33A2	3	30.0%
	33B1	2	20.0%
	33B2	1	10.0%
	33C2	3	30.0%
Intraoperative complication	No	10	100.0%
ROM	>120 flexion	8	80.0%
	90 flexion	2	20.0%
Pain	Mild	0	0.0%
	No	10	100.0%
Extension lag	No	10	100.0%
Infection	No	10	100.0%
	Superficial	0	0.0%
Knee score	Mean± SD	87.85	5.71
	Range	79	95
Implant failure	No	10	100.0%
Delayed union	No	10	100.0%
Nonunion	No	10	100.0%

This table showed that 5 patients (50%) were left side and 5 patients (50%) were right side. This table showed that the classification of the fracture WAS 33A1 in 1 patient (10%), 33B2 in 1 patient (10%), was 33C2 patient (30%). This table showed that no patients had Intraoperative complications, ROM was >120 flexion in 8 patients (80%), was 90 flexion in 2 patients (20%). This table showed that there wasn't any pain and Extension lag. This table showed that the rest of the patients had no infection, the mean Knee score was 87.85 with a range from 79 to 95. This table showed that all patients had not to implant failure, delayed union, or nonunion.

DISCUSSION

Proximal tibia group (A)

Regarding the demographic characteristics of the studied cases in group A, the present results indicated that the mean age of the recruited proximal tibial fracture patients was 55.1 ± 14.54 years old. 60% of patients were males and 40% were females, moreover, there was equal side distribution of fractures (50% right side and 50% left side).

Contrarily, the younger age of patients with tibial plateau fracture was demonstrated by a prospective study by ***Kumar et al.*** [(6)] that studied the functional outcome of tibial plateau fracture treated by locking compression plate and revealed that the mean age of patients was 42.4 years old and that tibial plateau fractures are more common in males than females.

Regarding functional outcomes and complications among group A, the present results demonstrated that 80% of the proximal tibial fracture-treated patients achieved ROM >120º flexion

and 20% achieved ROM equal to 90º flexion, 100% of patients reported no pain or infection. The mean knee score was 87.85±5.71.

Such findings are in agreement with ***Surwase et al.*** [(7)] that studied the functional outcome in proximal tibial fractures treated with a locking compression plate and indicated that 71% of patients had a good range of motion of 130º and 29% achieved ROM ≤ 90º flexion. The rates of complications like joint stiffness, postoperative pain, delayed union, and nonunion were low in patients with proximal tibial fractures treated with locking compression plating.

Similarly, ***Rajashekar,*** [(8)] revealed that the mean range of motion was 113º with more than 80% of patients having a knee range of motion of more than 110º. ROM of the affected knee was > 120º in 50% of cases, 100-120º in 45% of cases, and <100º in 5% of cases.

However, the incidence of infection was reported by ***Kumar et al.*** [(6)] that studied the functional

outcome of tibial plateau fracture treated by locking compression plate and found that 2 out of 30 patients had developed a superficial infection which was treated successfully by conservative methods with antibiotics and 1 out of 30 patients had developed deep infection with implant exposure which went into nonunion that could be caused by the fact that the patient had a pre-existing type 2 diabetes mellitus.

The present results revealed that none of the proximal tibial fracture patients (group A) showed no intraoperative complication, extension lag, implant failure, delayed union, or non-union.

Such findings are in agreement with ***Vasif et al.*** [9] that indicated that displaced tibial plateau fractures are best managed operatively. Optimal knee function is achieved by accurate anatomical reduction and secure fixation followed by early mobilization to attain a functional arc of motion. For minimally-displaced fractures with minimal bone defects percutaneous fixation suffices, whereas for comminuted fractures, open reduction and internal fixation are mandatory. The proximal tibial locking plate provides complete union and early mobilization to attain better functional outcomes.

Additionally, ***Surwase et al.*** [7] found that the proximal tibial locking plate provides complete union and early mobilization to attain better functional outcomes. Even in osteoporotic bone, the bone graft is not essential for the defect in the metaphyseal region as the locking compression plating internal fixator system act as a single implant and prevents collapse of fracture intraoperatively and postoperatively subsequently bone deficient will heal by callus formation.

Distal femur group (B)

Regarding the demographic characteristics of the studied cases in group B, the present results indicated that the mean age of the recruited distal femur fracture patients was 46 ± 11.86. 60% of patients were males and 40% were females, moreover, there was equal side distribution of fractures (50% right side and 50% left side).

Such findings were in agreement with ***Saini et al.*** [10] that indicated that the mean age of distal femoral fractures cases in their study was 45 years with better results obtained in both young as well as old patients with male predominance that could be attributed because males are mainly exposed to high energy trauma.

Additionally, ***Rajaiah et al.*** [11] studied the surgical management of distal femoral fractures by distal femoral locking compression plate and reported that the mean age of the patient was 44 years and 85% were males.

Regarding functional outcomes and complications among patients of group A, the present results demonstrated that 90% of distal femur fracture-treated patients achieved ROM >120º flexion, and 10% achieved ROM equal to 90º flexion. A good range of motion at the knee is attributed to early knee motion achieved with a distal femur-locking compression plate. Regarding pain, 10% of patients achieved mild pain and 90% reported no pain, the mean knee scorewas 87.85±5.71.

Such findings are in agreement with the ***Saini et al.*** [10] study that was able to achieve fracture union in all the cases along with a good range of movement (ROM) at the knee joint (mean ROM is 118º). They also reported that 2 patients out of 34 had superficial infections. None had a deepinfection. The infection subsided completely after debridement and a course of IV antibiotics according to the culture and sensitivity report.

Moreover, ***Rajashekar*** [8] studied the functional outcome of distal end femur fracturetreated with a locking compression plate and revealed that at six months of follow-up, 10 out of 20 patients achieved a range between 120 to 140º, 9 out of 20 patients achieved between 100 to 120 and 1 out of 20 patients had 95º flexion.

Additionally, ***Joyo et al.*** [12] study on the functional result in distal femoral fractures treated with locking compression condylar plate revealed that 2 out of 25 patients showed late consequences including limited knee ROM, with flexion not improving beyond 100º. They also revealed that 3 out of 25 patients had early complications: two developed superficial wound infections, and one developed wound gaping. They were treated with intravenous antibiotics and additional suturing.

Furthermore, ***Rajaiah et al.*** [11] study on the functional outcome of distal femoral fractures treated with a locking compression plate reported no deep infection and superficial infection in 2 patients out of 20.

However, ***Jhatoth,*** [13] demonstrated that in distal end femur fracture patients treated surgically with a locking compression plate, the range of flexion of 115º was achieved in only 59.38% of patients while 34.38% showed knee range of motion <90º.

The present results revealed that none of the distal femur fracture patients (group B) showed intraoperative complication, implant failure, delayed union, or non-union.

Such findings are in agreement with ***Rajashekar,***

(8) indicated that the use of a locking compression plate in distal femoral fracture promotes early radiological union, good knee range of movement, and early recovery when fracture fixation is done following all the basic principles of fracture fixation.

Similarly, a previous study by ***Saini et al.*** *(10)* revealed that a distal femur locking compression plate is an effective and reliable implant in treating distal femoral fractures AO type A and type C withminimal complications.

CONCLUSION

Distal femoral and proximal tibial locking plates provide complete union and early mobilization to attain better functional outcomes in cases with peri- and intra-articular fractures around the knee.

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