National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2018; 2(4): 175-179
Received: 16-08-2018
Accepted: 18-09-2018

Dr. Aalok Shah
Assistant Professor, Department of Orthopaedics, GCS hospital, Ahmedabad, Gujarat, India

Dr. Vikki Parikh
Associate Professor, Department of Orthopaedics, GMERS, Dharapur, Patan, Gujarat, India

Dr. Vimal Gandhi
Associate Professor, Department of Orthopaedics, GMERS, Dharapur, Patan, Gujarat, India

Correspondence
Dr. Vikki Parikh
Associate Professor, Department of Orthopaedics, GMERS, Dharapur, Patan, Gujarat, India

Assessment of outcomes of locking compression plates for fractures of distal end of femur

Dr. Aalok Shah, Dr. Vikki Parikh and Dr. Vimal Gandhi

Abstract
Objective: To evaluate the result of locking compressive plate in different types and severity of distal femoral fractures both clinically and radiologically.
Methods: 40 male and 10 female patients aged 18 to 85 (mean 39.9) years treated with locking compressive plate for distal femoral fracture. The causes of injury were vehicular accidents (n=45), falls (n=5). According to AO classification, the fracture were classified as type 33A1 (n=20), 33A2 (n=7), 33A3 (n=4), 33C1 (n=17), 33C2 (n=12) and 33C3 (n=1). Most fracture were closed (n=41); Gustilo-Anderson type I (n=4), type II (n=4), type III (n=1). Clinical and functional outcomes were assessed using "KNEE SOCIETY SCORE".
Results: The mean time to union was 17.99 weeks. 60% of patients had knee flexion of more than 90 degrees. One osteoporotic women with Gustilo type I 33A1 had moderate occasional pain. At 6-month follow-up 42 had excellent and 7 had good results? One 33C2 fracture had poor result. Out of 30 intraarticular fracture 24 had excellent and 5 had good results? No patient developed malunion, nonunion or implant failure.
Conclusion: Locking compressive plate achieves favourable biological fixation for distal femoral fractures with few complications. Even with osteoporotic bone the distal end of plate never loosened. The outcome depends primarily on the etiology of the fracture, the severity of the injury, concomitant trauma, bone quality and early post-injury intervention, good surgical technique, anatomical reduction particularly in intraarticular fracture without varus and valgus collapse, stable biological fixation and early post-operative mobilization.

Keywords: Locking compressive plate, distal femur fracture, Ao classification, knee society score, Gustilo-Anderson classification

Introduction
Distal femoral fractures reportedly account for less than 1% of all fractures and comprise between 4%–6% of all femoral fractures. [1, 2, 3] Fractures in the distal femur have posed considerate therapeutic challenges throughout the history of fracture treatment because they are usually compound, comminuted, readily deformed because of muscle forces acting on the distal fragment, prone to result in functional impairment of the knee joint and ankle joint because of injury to quadriceps system and often occur in comminuted or intercondylar in "T" or "Y" fashion its management still evokes much controversy. Conservative treatment results with significant morbidity coupled with common complications of malunion, shortening, slow recovery of knee motion and prolonged recumbency with its own complications. Knee stiffness and loss of range of motion (ROM) may develop with immobilization [4], and these often contribute to a poor outcome [5]. All these complications have led to widespread attempts at open reduction and internal fixation. Definitive treatment of distal femoral fractures requires maintenance or restoration of distal femoral alignment to preserve the function of the extremity.[6] Significant improvement in anatomical and functional results with application of newer technique & also we come across the various implant used for open reduction and internal fixation for various patterns of fracture. We have analysed the results of locking compressive plating in various types of fractures of distal femur.

Materials and Methods
The prospective study of 50 patients was carried out treated for fractures of distal end of femur with distal femur locking compressive plating. All the patients were operated by single senior

Surgeon. Patients with minimum 6 months follow up were included. Full length roentgenograms in anteroposterior and lateral views were taken of affected limb for diagnosis and to know extent of intraarticular communication. Patients with open injuries were subjected to debridement and lavage under anesthesia. All patients were provisionally immobilized on Thomas' splint with proximal tibial skeletal pin traction while awaiting definitive surgery. Fractures classified according to AO/MULLER [7] classification.

Procedure

After giving anaesthesia, pt is shifted on table in supine position, tourniquet applied, after painting & drapping, skin incision kept on lower lateral aspect of thigh, subcutaneous and tensor fascia lata cut. Vastus lateralis retracted anteriorly. Reduction done under IITV guidance. Plate of approximate size kept and fixed with appropriate size locking screws. Reduction checked, drain kept and closure done in layers and tourniquet deflated. Post op static quadriceps exercise, knee bending and non-weight bearing allowed depending on fixation and pattern of fracture. All patients were followed up at 6 weeks interval till signs of fracture union and subsequently at quarterly intervals.

Patient assessment

Patient were evaluated using KNEE SOCIETY SCORING SYSTEM [8]. Also postoperative squatting, cross-legged sitting, return to work, over all complication, and complication requiring active intervention, limb length discrepancy, deformity, knee range of motion and weight bearing. Radiological signs of union, implant status and status of joint were also assessed on X-rays. Accordingly weight bearing was allowed.

Scoring

Pain	
None	50
Mild or occasional	45
Stairs only	40
Walking and stairs	30
Moderate	
Occasional	20
Continual	10
Severe	0
Range of Motion	
(5 degrees =1 point)	25
Stability (Maximal Movement in Any Position)	
Anteroposterior	
<5 mm	10
5-10 mm	5
> 10 mm	0
Mediolateral	
<5 degrees	15
6-9 degrees	10
10-14 degrees	5
>15 degrees	0
Subtotal	
Deductions (minus)	
Flexion contracture	
5-10 degrees	2
10-15 degrees	5
16-20 degrees	10
>20 degrees	15
Extension lag	
<10 degrees	5
10-20 degrees	10
>20 degrees	15
Alignment	
5-10 degrees	0
0-4 degrees	3 points each degree
11-15 degrees	3 points each degree
Other	20
Total deductions	
Knee score[*]	
Function	
Walking	
Unlimited	50
>10 blocks	40
5-10 blocks	30
<5 blocks	20
Housebound	10
Unable	0
Stairs	

Normal up and down	50
Normal up; down with rail	40
Up and down with rail	30
Up with rail; unable down	15
Unable	0
Subtotal	
Deductions (minus)	
Cane	5
Two canes	10
Crutches or walker	20
Total deductions	
Function score[*]	

Grading for the knee society Score
1. Excellent 80-100 Score
2. Good: 70-79 Score
3. Fair: 60-69
4. Poor: Below 60

Results

A total of 50 patients, ranged from 18 years to 85 years with 20 patients had extra articular and 30 patients had intraarticular fracture were operated within 1-10 days period. According to knee score 84% patient had excellent result, 14% patient had good result, 2%patient had poor result & 0% patient had fair result. According to knee society function score 46 (92%) Patients had excellent result, 2 (4%) patient had good result. (39) 78% of the patients could resume their pre-injury job/lifestyle. Ratio between male to female was 4:1.

(8) 16% patients either had difficulty or had to change their job/ lifestyle due to difficulty in sitting cross-legged, squatting and restricted knee movements. (3) 6% patients had to leave their pre-injury job due to severe restriction of knee movements.

21 (42%) were having associated injuries, 7 (14%) were having ipsilateral lower limb injuries and 1(2%) have ipsilateral upper limb injuries, 4(8%) patients having contralateral lower limb injuries and 3(6%) patients having contralateral upper limb injuries due to high velocity road traffic accident.

40% patients were manual labourers, 22% were farm labourers, 20% were housewife and 18%. Patients had other occupations like millworker, housewife, students BSF soldier and office worker

All the patients who sustained vehicular accident 88% patient had excellent or good result and 1 patient had poor result with vehicular accident.

Presence of comminution and intraarticular extention are important factors in determining the final results. 20 (40%) patients had extra articular fractures. All of them having excellent or good results at final follow up. 30 (60%) patients were having intraarticular fractures. 17(34%) patients with type C-1 and 12 patients (24%) with type C-2 and 1 patients (2%) with type C-3 fractures. Out of those 30 patients 24 (80%) had excellent result, 5 (16.6%) had well, 1 poor results in C-2 # type due to associated injuries. Out of 9 (18%) open fractures, 7 (16%) had excellent result and one had good result and one had poor result in open grade II due to ipsilateral associated lower limb injury.

80% of our patients were able to walk normally without using aids. 9 (18%) walk with one stick support and one patient walk with walker at 6 months follow up.

45 (90%) of our patients were able to walk for unlimited distance and 5 (10%) patients were able to walk > 10 blocks, 74% patients have normal up & down and 24% patients have normal up & down with rail. Only 1 patient having difficulty in climbing stairs due to open fracture and other comorbidities

39(78%) had no lower limb shortening. 6(12%) have shortening <1.5 cm, 3(6%) have shortening 1.5-2.5 cm and 2(4%) have shortening >2.5 cm due to comminuted injury

According to knee society score, 13(26%) have no pain, 36(72%) have mild (occasional) pain, 1(2%) had moderate (occasional) pain due to associated intraarticular tibia fracture

(39)78% of the patients could resume their pre-injury job/lifestyle. (8) 16% patients either had difficulty or had to change their job/ lifestyle due to difficulty in sitting cross-legged, squatting and restricted knee movements. (3)6% patients had to leave their pre-injury job due to severe restriction of knee movements.

Table 1: Knee score.

Results	Patients	Percentage (%)
Excellent	42	84
Good	7	14
Fair	0	0
Poor	1	2
Total	50	100

Table 2: Functional Knee Score

Results	No. of patients	Percentages
Excellent	46	92
Good	2	4
Fair	1	2
Poor	1	2
Total	50	100

Table 3: Return to Work

Results	Patients	Percentage (%)
Pre-injury lifestyle	42	84
Pre-injury lifestyle with difficulty	5	10
Part time job	3	6
Total	50	100

Discussion

Owing to the increase in vehicular accident and industrial mishaps, high velocity trauma not only increases the number of distal femoral fracture but also their complexity. Now we are seeing more number of open injuries, comminuted fractures and complex intraarticular fractures of distal femur. Fractures of distal femur are notoriously difficult to reduce, align and stabilize as they are usually comminuted and readily deformed by the muscle forces acting on the distal fragment. These fractures commonly involve a major weight bearing joints and henceforth result in functional impairment. In order to preserve a normal knee function, it is must to maintain normal mechanical axis, ensure stability and restore full range of motion, especially in Indian culture where squatting and sitting cross legged is must as a routine. This is difficulty to accomplish especially in the phase of compromised soft tissue in open fractures, variable

bone quality and associated medical conditions of the patients.

There are much of controversies going on regarding the best method of treatment for the distal femoral fractures because of varying results. In the past closed treatment with traction, application of cast following preliminary traction was used for treatment of open and closed distal femur fractures. Outcomes after non operative treatment were generally unsatisfactory, with a high incidence of ankylosis, varus and valgus malalignment, shortening and malrotation. Except in extreme circumstances, operative treatment for supracondylar femoral fractures is the standard, while nonsurgical treatment has largely fallen out of favor as the result of further advances in technique and implants.[9] As a result, since the late 1970s, open reduction and internal fixation by means of plate and screws osteosynthesis had emerged as the gold standard of operative therapy. They act on the internal fixator principle in order to bridge meta-Physeal comminution. [10, 11] The primary goal of surgery with locking plates is to achieve union with bridging callus through relative stability which allows movement at the fracture gap. The biomechanical principle of relative stability allows a relative dynamic deformation [12], which induces secondary callus formation when compared to primary callus formation in absolute stability. [13] Locking plates present multiple points of fixation even in case of low bone quality; the screws, once locked to the plate, do not pull the fragments towards the implant. Locked implants are typically indicated in patients with osteoporosis, fractures with metaphyseal comminution where the medial cortex cannot be restored, or with a short articular segment [14, 15]. Since, the plate does not depend on the friction created at the bone-plate interface to provide stability, the plate does not have to contact the bone directly which helps in preserving the periosteal blood supply [15, 16, 17]

We had patient of age ranging between 18-85 years, which covered young (78%) and elderly (10%). The majority of our patients were in middle age group (78%) in 25-55 years. The mean age was 39.7 years. We have found a bimodal age presentation of fracture at very young age with very active and fast life and at very old age with severe osteoporosis.

Ratio between male to female was 4:1. The dominance of male because of - male are involved in outdoor activities hence more vulnerable to vehicular accident and social customs, certain task eg. Working at heights, driving, and labour work and travelling.

Majority of our patients 46(92%) were operated between 1-5 days. 4 (8%) patients were operated after 5 days due to associated injuries, open injury, and pre-existing illness. The longer injury - operation interval in our study was related to open injuries which required debridment prior to definitive surgery, medical comorbidities and associated injuries. The advantages of early fixation of fractures are short hospital stay, early mobilization, better muscle strength, improved union and good knee range of motion.

NO intra operative or immediate / early post-operative complications were encountered. In 1 (2%) have knee joint stiffness and post op arthritis at long term follow up due to associated ipsilateral intraarticular tibia fracture. 4 (8%) have superficial infection and 1 (2%) have deep infection due to open and comminuted injury. There was no malunion or nonunion in our patients.

Maximum number of patients are in knee range of motion 90-100 degree and 16 (32%) have extension lag <10, and 1 (2%) of patient have extension lag between 20 degree. 66% of patient have squatting and cross leg sitting with ease, 28% have squatting with difficulty & 6% have squatting not possible. The possible cause for restriction range of movement in our study were: associated soft tissue trauma at time of injury, associated degenerative disease of knee joint like osteoarthritis, intraarticular comminution and open injuries leading development of intraarticular adhesions, improper physiotherapy and compliance of patients. Taking consideration of Indian life style and working pattern much importance was given to knee range of motion which was necessary for patient to be able to sit cross legged and squat.

Conclusion

The result in terms of the knee society score and radiographs shows that the outcome depends primarily on the etiology of the fracture, the severity of the injury, concomitant trauma, bone quality and early post-injury intervention, good surgical technique, anatomical reduction particularly in intraarticular fracture without varus and valgus collapse, stable and biological internal external fixation and early post-operative mobilization. The anchoring of distal femur locking compressive plate in the condyle is very reliable. Even with osteoporotic bone the distal end of plate never loosened. With osteoporotic bone or comminuted fractures, we recommend a medium or long locking compressive plate and bicortical anchoring of shaft screw. Intraarticular type C fractures tends to have poor result as regards with pain and function more because of the nature of the injury than to the implant, which limits movement and causes loss of strength more than instability. Despite the number of open and comminuted fractures, such serious complication as deep infections, implant failure, malunion, nonunion were not a problem. This was due to therapy that include debridment and antibiotic prophylaxis. Thus we can safely recommend the locking compression plate is a very useful implant system when managing fractures of the distal femur including complicated fractures like comminuted, intraarticular and osteoporotic fractures.

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