

# Outcome Analysis of Fixed angle Locking Plate in Comminuted Patella Fractures : A Single Centre Prospective study from South India with Early Results

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## Learning Point of the Article:

To learn a new technique that serves as an effective option in management of highly comminuted patella fractures by providing excellent mechanical stability and clinical outcomes.

## Abstract

**Introduction:** Comminuted patella fractures pose a challenge to orthopaedic surgeons, since tension band wiring and cerclage is not effective and often lead to loosening of wires, hardware problem, dislocation of fracture and failure of osteosynthesis resulting in post-traumatic osteoarthritis and knee stiffness. The aim of this study is to evaluate the clinical outcome in patients with AO 34C2 and 34C3 highly comminuted patella fractures treated with unidirectional fixed angle titanium patella locking plate.

**Materials and Methods:** Twelve patients who presented with AO 34C2 and 34C3 comminuted patella fractures, aged between 18-79 years were included in the study. All fractures were reduced and fixed with unidirectional angle fixed stable titanium patella locking plate. Knee range of motion and knee outcome survey activities of daily living scale (KOS-ADL) was used to evaluate the outcome.

**Results:** Union of fracture was achieved in all twelve patients. Mean flexion at final follow-up was 123° (110°-130°). None of the patients had extensor lag. One patient had hardware irritation which resolved at final followup.

**Conclusion:** This technique serves as an effective option in highly comminuted patella fractures by providing excellent mechanical stability resulting in anatomical reduction, excellent functional outcome, lower incidence of hardware irritation or failure of osteosynthesis.

**Keywords:** Patella fracture, comminuted, locking plate, osteosynthesis, patellectomy

## Introduction

Patella fracture are rare, being 1% of total skeletal fractures [1]. Patella is an important unit of knee extensor mechanism, playing a pivot role in knee flexion, kneeling and squatting. Osteosynthesis in comminuted patella fractures is challenging since absolute articular reduction is necessary as incongruity of 2mm and more, leads to patella-femoral osteoarthritis [2]. Tension band wiring has been a gold standard modality of treatment for transverse patella fractures, but not the optimum treatment in case of comminuted patella fractures for the

following reasons (a) tension band wiring requires an intact cortical buttress to convert the tensile forces into compressive forces (b) during healing of fractures, in order to resist bending, compression and tension, the fractures need to be accurately reduced and fixed with absolute rigidity to obtain the best possible outcome [3,4] (c) in comminuted fractures, the principle of Tension band does not apply in almost all cases (d) Tension band wiring does not work during knee extension. All these limitations lead to the development of other modalities of better fixation for comminuted and osteoporotic patella

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## Author's Photo Gallery



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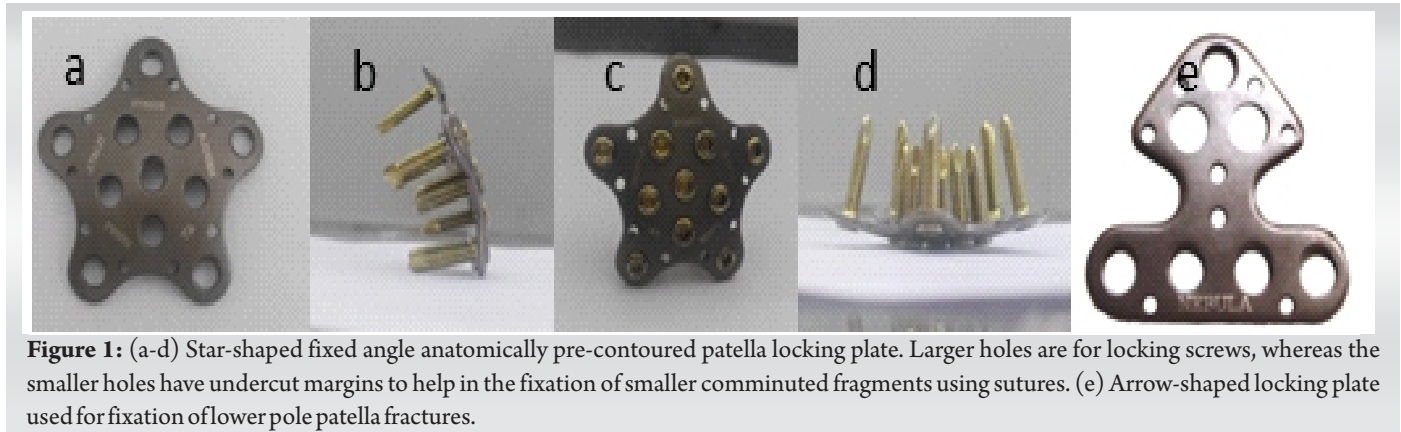
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**Figure 1:** (a-d) Star-shaped fixed angle anatomically pre-contoured patella locking plate. Larger holes are for locking screws, whereas the smaller holes have undercut margins to help in the fixation of smaller comminuted fragments using sutures. (e) Arrow-shaped locking plate used for fixation of lower pole patella fractures.

fractures and various plates such as mesh plate, hook plate and mini plate. In our study, we used a star shaped unidirectional angle fixed anterior titanium locking plate with multiple suture holes and undercut margins which help in preserving small bony fragments for achieving anatomical reconstruction. These precontoured plates recess into the soft tissue, torn retinaculum is repaired onto the plate using sutures which helps in reducing hardware irritation as patella is subcutaneous (Fig. 1). Only few studies have been done till now and our study has given comparable results [5].

### Materials and Methods

This prospective observational study was conducted from 2021 to 2023, at an Orthopaedic Speciality Hospital. Twelve patients fulfilling the inclusion criteria and giving consent were included in the study. The aim of the study was to analyse the functional and radiological outcome of comminuted patella fracture fixed with locking plate.

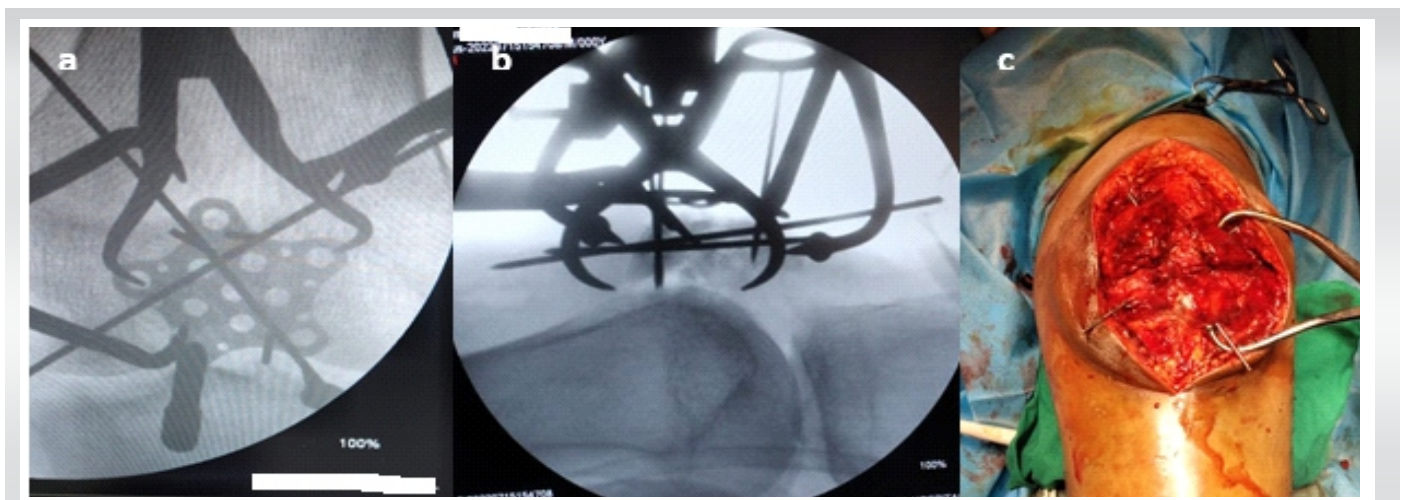
**Inclusion criteria :** (1) Age 18 years to 79 years, (2) AO 34C2 and 34C3 comminuted patella fractures with displacement and

articular incongruity, (3) Fractures < 3 weeks old.

**Exclusion criteria :** (1) Ipsilateral lower limb fractures around the knee, (2) Open wound, (3) Anterior knee soft tissue defects, (4) Patella fractures post Total Knee Replacement.

### Technique

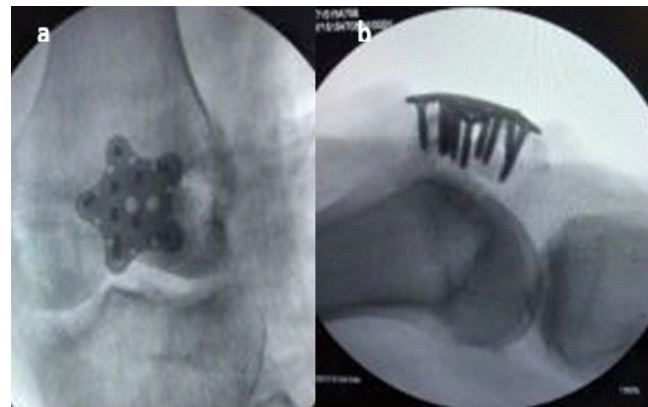
Standard Midline Longitudinal approach was used, raising a thick soft tissue flap to make sure the plate is covered adequately. Usually, a 2 cm lateral or medial arthrotomy was done to clinically palpate the articular reduction. The fracture edges are carefully exposed, minimizing unnecessary periosteal dissection to maximize perfusion and keep soft tissue attachments to comminuted fragments. The fracture site is carefully debrided of nonviable tissue and any small fragments that cannot be incorporated into the reduction are removed and saved for possible bone grafting. Fragment reduction and compression of major fragments, via clamp application, must be performed first, when possible, before plate application. Reduction was then secured using k wires, following which appropriate size star shaped locking plate was chosen according



**Figure 2:** (a-b) Intraoperative anteroposterior and lateral fluoroscopy views showing the application of reduction clamps and k-wires to achieve fracture reduction before fixing the plate to the patella. (c) Intraoperative clinical image showing an application of reduction clamps and k-wires to achieve reduction before fixing the plate to the patella.



**Figure 3:** (a) Intraoperative clinical image showing fixation of the retinaculum and the comminuted bony fragments to the patella plate using a non-absorbable braided suture. (b) Intraoperative clinical image showing complete repair of the torn retinaculum & adequate soft-tissue cover over the plate.



**Figure 4:** Intraoperative anteroposterior and lateral fluoroscopy views are taken to ensure articular congruency and anatomical reduction.

to the size of the patella and fracture pattern (Fig. 2).

The unidirectional angle fixed titanium locking plate by Nebula (from India) (3.5mm screw system) was used in all patients. It has suture holes to fix the comminuted small bony fragments to the plate using non-absorbable braided suture (Fig. 3). Once fixation with locking screws is completed, a finger is passed through the lateral arthrotomy to check for any breach of articular surface by screws. Intraoperative anteroposterior, lateral and skyline fluoroscopy views are taken to ensure articular congruency and anatomical reduction (Fig. 4). Knee range of motion is performed to ensure stable fixation.

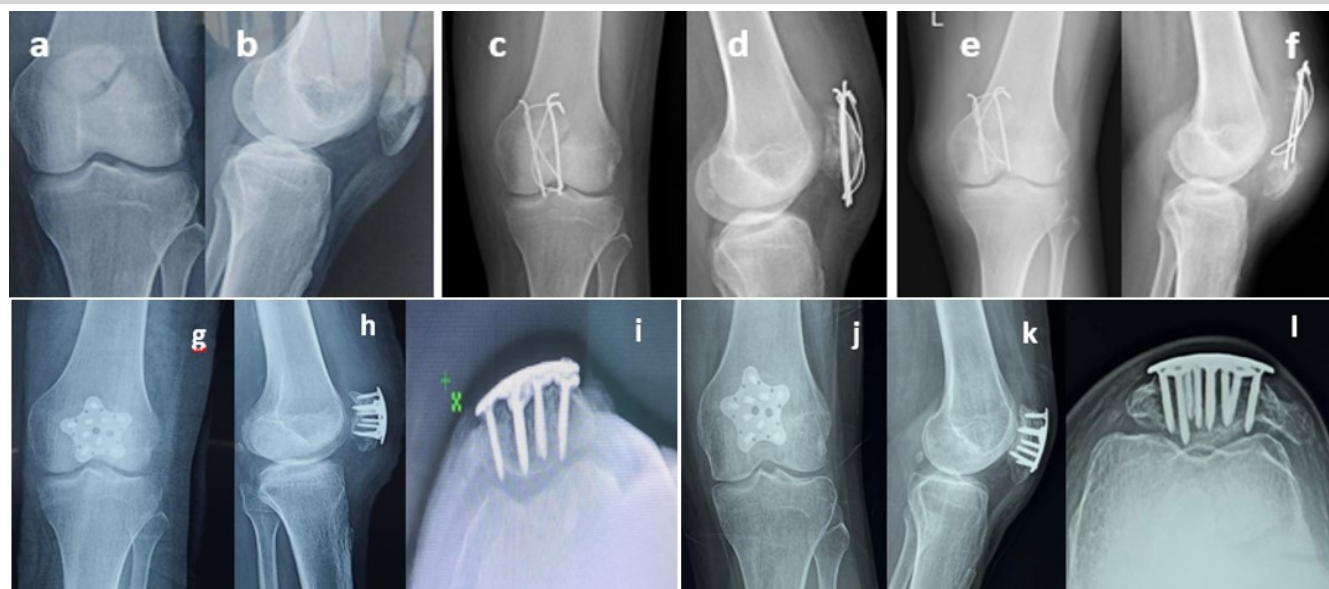
### Results

Over the course of 2 years, 80 patients presented with patella

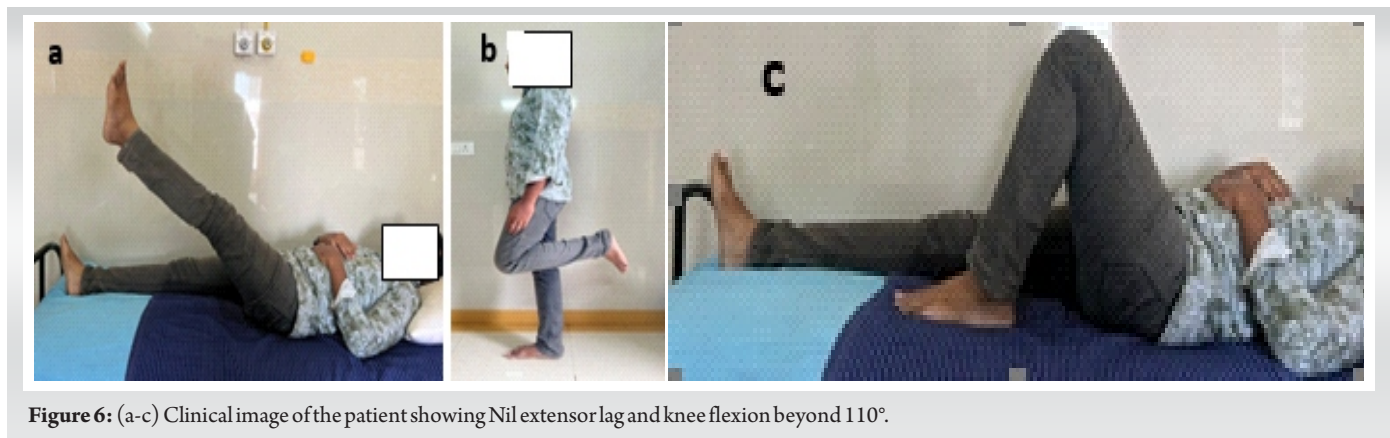
fractures at our center, out of which 12 patients had comminuted patella fractures. Informed consent was obtained from 12 patients and were included in the study.

Out of 12 patients, 1 was female and 11 were male. Average age was found to be 42 years. Average time of follow-up was 1.2 years. Out of 12 patients, all 12 (100%) achieved union. One patient (8%) had anterior knee pain and difficulty while kneeling due to implant impingement. No elective implant removal was done.

One patient (25/Male) had suffered a transverse patella fractures, which was fixed using standard Tension band wiring, following which he again suffered a fall to the same knee 2 weeks postoperatively, which had resulted in failure of tension band wiring and comminution of the fracture fragments (Fig. 5 a-b).



**Figure 5:** (a-b) Pre-operative radiology of the patient with transverse patella fracture, (c-d) Radiology of the same patient's patella fixed with tension band wiring, (e-f) Radiology showing failure of tension band wiring post fall on the same knee after 2 weeks. (g-i) Radiology of the same patient taken at 1 week postoperatively showing good reduction and good articular congruity. (j-l) Radiology of the same patient taken at 1 year postoperatively showing, no patella-femoral osteoarthritis and no loosening of screws.



**Figure 6:** (a-c) Clinical image of the patient showing Nil extensor lag and knee flexion beyond 110°.

The tension band wiring was removed, fracture reduced and fixed using star shaped patella plate, which had went onto unite well (Fig. 5g-l). and achieved knee flexion of 130 degrees without any extensor lag at 1 year follow-up (Fig. 6).

During follow-up, all the patients had full recovery of extensor mechanism. The mean flexion achieved was 123 degrees (110 to 130 degrees), 6 patients achieved knee flexion of 120 degrees, while 5 patients achieved 130 degrees of knee flexion (Fig. 7 & 8). Almost all patients were able to sit cross legged except one patient with preexisting medial compartment osteoarthritis.

The influence of symptoms on daily activity is shown in Table 1 and the functional outcome in Table 2, both of which had been evaluated using the knee outcome survey activities of daily living scale (KOSADL).

No patient had severe disability in daily activity (Table 1) and the functional outcome of the patient was also well acceptable (Table 2).

Eleven out of 12 (92%) patients were pain free or slightly affected by pain in daily activity. Eleven out of 12 (92%) did not have knee stiffness. Ten out of 12 (83%) did not have problem in walking. One out of 12 (8%) patients had difficulty in kneeling on the front. None had difficulty in standing. One patient with preexisting Medial Compartment had some restrictions in daily

activity. The average ADL score was 86%, which means the function of the patient's knee in daily life returned to an average of 97% to their function before trauma.

### Scoring

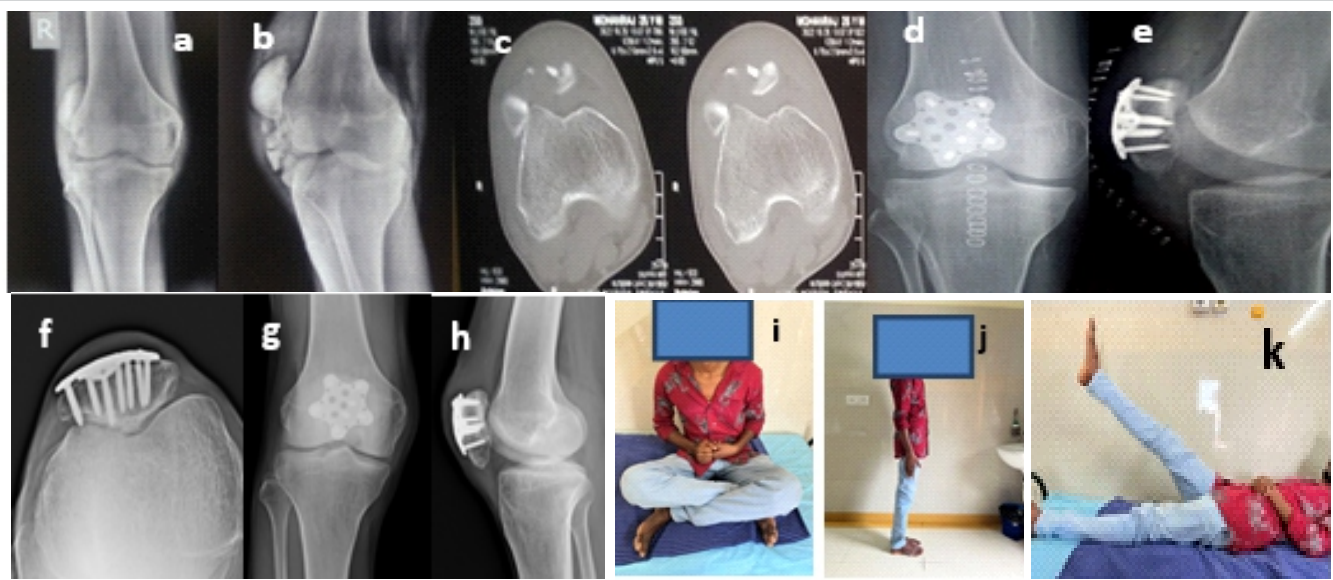
Each row has a maximum of 5 points and the lowest of 0 points, 5 being given to the best outcome and 0 to the worst. The first column is scored 5 points, followed in successive columns by scores of 4, 3, 2, 1, and 0 for the last column. The total points for all patients was calculated which came out to be 818, and then divided by 70 (maximum points for individual patient)\*12 (total no. of patients in study). The average ADLS score calculated was  $818 / (70 * 12) \times 100 = 97\%$ . (Table 3).

### Discussion

In this study, we have done a prospective functional analysis of comminuted patella fractures using fixed angle titanium patella locking plate and compared it with the available relevant data of tension band wiring. Tension band wiring tends to fail in comminuted patella fractures, as it requires an intact cortical buttress [6,7]. In our study, using an anatomically precontoured locking plate, we were able to achieve union in all our cases. Dy et al. in his meta-analysis reported a reoperation rate of 34% post



**Figure 7:** (a and b) Pre-operative radiology showing comminuted patella fracture, (c) Intraoperative image showing multiple small bony fragments with a fracture in the coronal planes. (d and e) Post-operative radiology showing fracture fixation using patella plate, (f and g) Clinical image showing knee extension and flexion at 8-week post-operative.



**Figure 8:** (a-c) Pre-operative radiology showing comminuted and displaced patella fracture, (d and e) Post-operative radiology showing anatomical reduction and good articular congruency. (f-h) 1-year post-operative radiology showing anatomical reduction and good articular congruency. (i-k) 1-year post-operative clinical image good knee flexion, nil extensor lag, and good clinical recovery.

tension band wiring compared to 5% in the locking plate group. Smith et al. observed that almost 22% patients treated with tension band wiring suffered from displacement in the perioperative period, which was overcome by the use of a more rigid construct like locking plate [8,9].

Biomechanical studies by Wurm et al [10] and cadaveric studies by Thelen et al. [11,12] have proved the superiority of locking plate to tension band wiring. This has enabled early rehabilitation protocol and prevention of knee stiffness which occurs with tension band wiring. Our recommended post-op protocol is to start weight bearing immediately as tolerated, passive knee flexion of up to 90 degrees with brace support for the first 2 weeks and then 120 degrees passive to active assisted knee flexion over the next 4 weeks.

Tension band wiring in comminuted fracture results in wire breakage, failure to achieve absolute stability and failure to

achieve articular congruity [13-15], which can be overcome by Patella locking plate which maintains compression and provides a rigid construct. Partial and complete patellectomy leads to a poor extensor mechanism, especially in younger population and also issues while performing total knee replacement at a later stage. Our surgical technique allows direct clinical visualization of the articular surface which avoids the development of patella-femoral joint arthritis which leads to better outcome.

In our study, a good functional recovery of range of motion was observed, with 123 degrees as an average and 11 patients achieving more than 120 degrees of knee flexion. Only one patient had a knee flexion of 110 degrees due to pre-existing Patello-femoral osteoarthritis and Medial compartment Osteoarthritis. Most of the patients were symptom free, only one patient had pain which affected his daily activity slightly, the reason being pre-existing knee osteoarthritis. One patient had

	I do not have the symptom	I have the symptom, but it does not affect my activity	The symptom affects my activity slightly	The symptom affects my activity moderately	The symptom affects my activity severely	The symptom prevents me from all daily activity
Pain	10	1	1	0	0	0
Stiffness	11	1	0	0	0	0
Swelling	10	2	0	0	0	0
Giving way, buckling, or shifting of the knee	11	1	0	0	0	0
Weakness	12	0	0	0	0	0
Limping	11	1	0	0	0	0

**Table 1:** Influence of symptoms on daily activity (knee outcome survey activities of daily living scale).

	Activity is not difficult	Activity is minimally difficult	Activity is somewhat difficult	Activity is fairly difficult	Activity is very difficult	I am unable to
Walk	10	1	1	0	0	0
Go upstairs	10	1	1	0	0	0
Go downstairs	11	1	0	0	0	0
Stand	11	1	0	0	0	0
Kneel in front of your knee	11	1	0	0	0	0
Squat	11	1	0	0	0	0
Sit with your knee bent	10	1	1	0	0	0
Rise from a chair	11	1	0	0	0	0

Table 2: Functional limitations with activities of daily living (knee outcome survey activities of daily living scale).

pain while kneeling, but improved with activity modification . This pain may be attributed to scar of the wound rather than the implant itself.

Wurn et al.[5] had done a similar study in Germany, using a similar plate, which included patients with periprosthetic patella fracture and failed tension band wiring , in which they had achieved a range of motion of 127 degrees and complication rate of 6%. The average ADL score in their study was 77% as compared to 97% in our study. The results are almost reproducible in the Indian Population, except for a better outcome in our study. They had a lesser ADL score as they had a larger proportion of patients who had undergone multiple surgeries resulting in larger anterior scar ( Table 4 ).

Singh S et al [17] had conducted a similar study in the Indian

population, using a fixed angle locking plate, among 20 displaced, osteoporotic patella fractures, with excellent outcome, with mean flexion of 124 degrees and average ADL score of 86 percentage , comparable to our study.

The advantages of plating over tension band wiring , cerclage & patellectomy in comminuted patella fractures are preserving maximum bone stock while achieving anatomical reduction and stable fixation, which is important for normal quadriceps excursion. It has minimum wound problems, less hardware failure, lesser hardware irritation, reduced incidence of knee stiffness due to early rehabilitation and better articular reduction.

The disadvantages include

	Age/Sex	Knee flexion	Extensor lag	Complication	Follow up
1	25/M	120	Nil	Nil	1 year
2	28/M	130	Nil	Nil	1.5 years
3	26/M	120	Nil	Nil	1 year
4	50/M	130	Nil	Nil	1 year
5	45/F	120	Nil	Nil	1 year
6	30/M	120	Nil	Nil	1 year
7	42/M	130	Nil	Nil	1 year
8	46/M	120	Nil	Nil	1.5 years
9	55/M	130	Nil	Pain while kneeling	1 year
10	70/M	110	Nil	Nil	1 year
11	54/M	120	Nil	Nil	1.5 years
12	30/M	130	Nil	Nil	1 year

Table 3: Master chart.



	Mean knee flexion (degrees)	Activities of daily living score (percentage)
Wurm et al. [10]	127	77
Singh et al. [17]	124	86
Our study	123	97

**Table 4: Comparison of clinical outcome with similar studies.**

- (a) Penetration of screws intra-articularly if not cautious  
 (b) Hardware cost

### Limitations

This was a prospective cross-sectional analytical study and direct comparison of the patella plate fixation with other modalities of treatment was not done. This study had a small sample size; further studies with bigger sample size and comparison with other modalities will aid in providing better comparative results.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

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### Conclusions

Based on our study, we conclude that angle fixed patella locking plate is an optimum modality of fracture fixation in comminuted patella fractures and in cases of failed tension band wiring as it is a more bone preserving implant which provides excellent mechanical stability and anatomical reduction leading to excellent functional outcome and decreased incidence of hardware irritation or failure of osteosynthesis. The better biomechanical strength has helped patients in early rehabilitation and early return to their daily life.

### Clinical Message

Treating comminuted patella fractures have always been a challenge. This technique proves to be an effective option in managing them and also obtaining good clinical and functional outcome.

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**Consent:** The authors confirm that informed consent was obtained from the patient for publication of this case report

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