



Arthroscopic Assisted Internal Fixation (AAIF) of Tibial Plateau Fractures; A Novel Technique

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Abstract

Introduction: *The difficulty in achieving precise reduction using conservative methods and the higher morbidity associated with traditional surgical methods have led to the development of semi invasive techniques. The treatment of tibial plateau fractures with AAIF is one method that is associated with lower morbidity, less extensive surgical dissection. Furthermore, arthroscopy allows the surgeon to diagnose and treat concomitant intra-articular injuries.*

Methods and Materials: *This study consisted of 25 patients with closed fractures of tibial plateau in adults of both sexes and was conducted in the post-graduate department of orthopaedics Bone and Joint Surgery Hospital, Government Medical College Srinagar from September 2011 to October 201. After thorough pre-operative work-up AAIF was done in all 25 patients and in some patients bone grafting was done elevating the depressed articular fragment in these cases fixation was done using 2 or 3 hole proximal tibial locking compression plates.*

Observations and Results: *In our study 14 patients had type II (split depression of lateral condyle) tibial plateau fractures, 7 patients had type I fractures. 2 patients each with Type III and type IV tibial plateau fractures. Most common type of intra-articular injuries in our study was meniscal injuries comprising of 40% of all cases. Lateral meniscal injuries were more common than medial meniscal injuries, because lateral condyle fractures were more than medial condyle fractures.*

Discussion: *Review of the literature suggests AAIF to be equal to or better than open reduction internal fixation (ORIF) in achieving anatomical reduction. In the study of H. Kiefer et al (2001) of a series of 31 fractures, 25 showed anatomical reduction at a mean of 25 months. F. Van Glabbeek and van Riet (2002) were unable to arthroscopically reduce only 1 of 20 split/depression fractures.*

Conclusion: *AAIF is a novel technique in the treatment of properly selected cases of tibial plateau fractures because of diagnosis and treatment of associated intra-articular soft tissue injuries and visualization of chondral surface reduction.*

Keywords: *Arthroscopy, Tibial Plateau, Soft-tissue injuries.*

Introduction

Tibial plateau fractures make up 1% of all fractures and 8% of fractures in elderly. Lateral tibial plateau fractures account for 55 to 70% of

cases. Medial tibial plateau fractures account for 10-25%. 10 to 30% are bicondylar fractures. 1 to 3% are compound fractures^(22,31,39,59,62). Traditional surgical methods achieve satisfactory

results in 70–80% of cases however, these methods have a high incidence of complications including loss of reduction, infection, and septic arthritis.⁶² The goals of treatment are restoration of normal alignment, joint congruity, joint stabilization and, ultimately, the prevention of degenerative osteoarthritis.^{19,20,25,31,59}

There have been many options for the treatment of tibial plateau fractures in orthopaedic literature including conservative treatment, external fixation, open reduction-internal fixation (ORIF) and arthroscopically assisted osteosynthesis.⁹ The ultimate goal of the intra-articular fracture treatment should be the precise restoration of the joint surface and stable fixation to allow immediate Postoperative non-weight-bearing exercises.^{9,20} The difficulty in achieving precise reduction using conservative methods and the higher morbidity associated with traditional surgical methods have led to the development of semi invasive techniques.^{20,62} The treatment of tibial plateau fractures with AAIF is one method that is associated with lower morbidity, less extensive surgical dissection.^{4,18,20,44} Furthermore, arthroscopy allows the surgeon to diagnose and treat concomitant intra-articular injuries.^{9,18,20}

Indications for surgical management of tibial plateau fractures has been inconsistent with limits of acceptable articular displacement ranging from 2 to 10 mm.^{7,38,44} Residual tilt of the tibial plateau and varus or valgus malalignment have been associated with higher risk of arthrosis.⁷ Biomechanical studies on articular step-off show that a 6-mm step-off of the lateral plateau produces 7.6 degrees of increased valgus and a 208% increase in contact pressure.^{7,39,44} Holzach (1994)²⁷ has recommended surgical treatment of ski-related plateau fractures with 2 mm or more of displacement. Honkonen(1994)²⁸ evaluated outcomes in 131 tibial plateau fractures and recommended surgical management for more than 5 degrees of valgus malalignment, more than 3 mm of articular step-off and more than 5 mm of condylar widening. In actuality, multiple factors likely contribute to long-term outcome, and

consideration should be given to fracture type, presence of laxity on examination, location of articular displacement (central vs submeniscal) associated soft tissue injuries, and patient's factors such as age, activity level, and co-morbidities.^{2,38,44}

The goal of the treatment is to obtain a stable joint permitting early range of motion for cartilage nourishment and preservation to prevent post traumatic osteoarthritis.⁴² The advantages of arthroscopic management of tibial plateau fractures are^(2,9,18,20,22,23,25,31,38,44,55,62)

- 1) Direct visualization of chondral surface reduction
- 2) Accurate fracture reduction
- 3) Anatomical restoration of joint surface
- 4) Reduced morbidity in comparison with arthrotomy
- 5) Diagnosis and treatment of associated meniscal and ligamentous injuries
- 6) Thorough joint lavage
- 7) Removal of loose fragments
- 8) Early post op recovery.

Methods and Materials: This study consisted of 25 patients with closed fractures of tibial plateau in adults of both sexes and was conducted in the post-graduate department of orthopaedics Bone and Joint Surgery Hospital, Government Medical College Srinagar from September 2011 to October 2013. As tibial plateau fractures are rare, 1% of all fractures and more complex tibial plateau fractures type V and types VI were excluded from the study^{2,23} so only 25 cases were included which was consistent with number of patients studied by other authors which in most cases was less than 25. Final follow up was done at 6 months. Patients aged more than 18 years of either sex with closed tibial plateau fracture Type I to type IV according to Schatzker classification were included in the study. The patient were operated in supine position in all patients surgery was conducted under spinal anesthesia.²⁰ A pneumatic tourniquet was used in all cases with the affected leg off of the end of table.^{31,38,55,62} Portal sites were marked before doing arthroscopy.

Arthroscopy knee was done via standard anteromedial and antero-lateral portals.^{35,55,62}

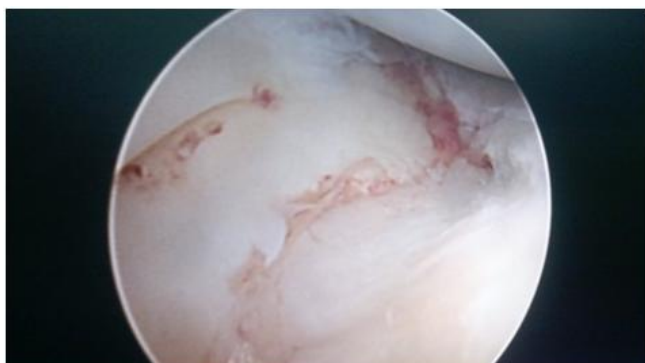


Thorough joint lavage was done to remove blood clots, fragments of loose bone and articular cartilage.^{31,35,38,44,55,62}



In all cases inflow pressure was kept minimum to reduce risk of fluid extravasation and increase in compartment pressure.^{31, 44}

The joint was carefully examined for associated injuries, including cruciate ligaments and menisci.^{9,31,38,62}



A probe was inserted through one of the portals to examine the fracture site. Debridement of the fracture site was performed.^{31, 38} In cases where fracture visualization was impaired by overlying

meniscus retraction of meniscus was done by hooked arthroscopic probe.⁴⁴

In case of tibial plateau with articular depression elevation of articular surface was done by approaching the lateral tibial plateau through inverted L shaped incision.^{7,31,55} Horizontal limb of the incision was extended from the tibial tuberosity to Gerdy's tubercle and vertical limb was extended lateral to the tibial crest just below the fracture line, muscle origin was reflected laterally until fracture was exposed.⁷ Lateral fragment was retracted to give access to the central part of the tibial condyle, exposing the depressed articular surface and cancellous bone of the central depression.⁷ In some cases cortical window was made below the area of depression and elevation of the depressed fragment was done using bone punch.^{18,25,31,38,62}



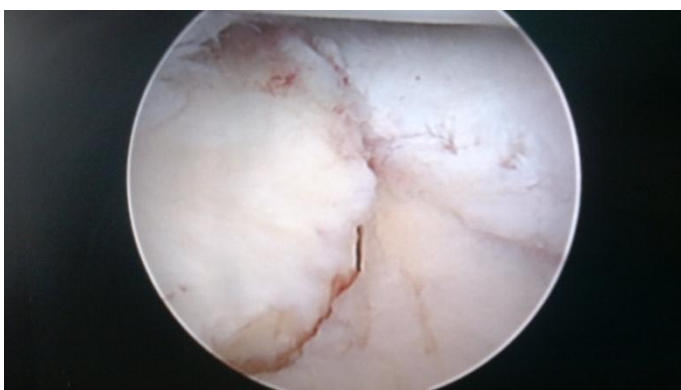
Bone punch was inserted beneath the depressed articular fragments or through the cortical window and by slow and meticulous pressure elevation of the articular fragment and compressed cancellous bone was done.^{22, 31, 38, 44} The resultant bone defect was filled by the bone graft taken from the ipsilateral iliac crest.^{2,18,22,31,38} As the fragments were elevated and reduced temporary fixation was done with K wires. Reduction was confirmed by arthroscopic examination.^{22, 31,38,55,62}

After reduction fracture was stabilised using proximal tibial locking compression plate.^{10,44} Plate was precisely fitted with tibial condyles. Plate was secured to the condyle with appropriate locking cancellous screws of sufficient length to engage the opposite cortex. Locking screws of 4.5mm were used to attach the plate to the shaft of tibia.^{7,10}

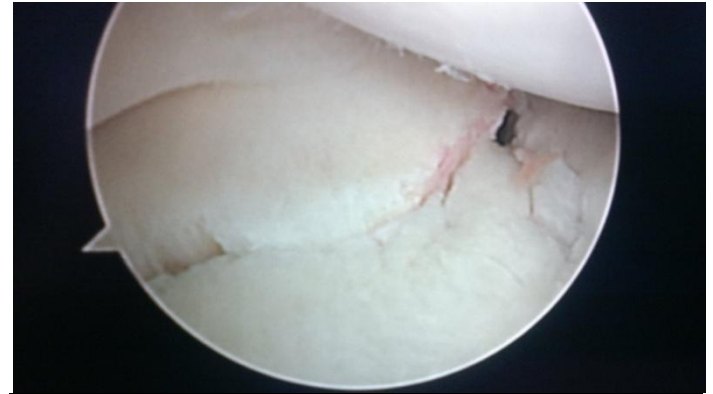


In case of Split tibial plateau fractures Type I and Type IVa with little or no comminution and little central depression reduction was done using joy stick technique.^{9,18,22,31,38,44,62} A kirschner wire or Steinman' pin was introduced into fracture fragment to facilitate manipulation under fluoroscopic guidance. When an adequate reduction was achieved fixation was done using 6.5 cannulated screws of appropriate length.^{9,18,22,38} In case of greater comminution and osteoporotic bones either cannulated screws were used along with washer or proximal tibial locking plate was used through small incision over fracture site.^{22,31,44}

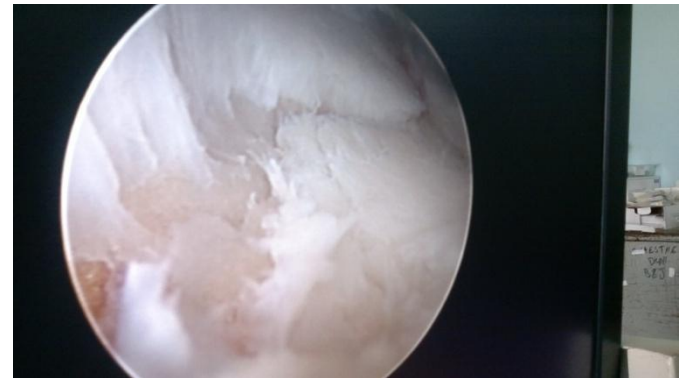
Pre-reduction arthroscopic view of split tibial condyle fracture



Arthroscopic view during reduction with joy stick technique



After reduction arthroscopic view



After fixation of fracture arthroscopic examination was done to confirm the reduction of articular surface, and in patients with meniscal injury partial meniscectomy was done.^{9,18,22,38} Tourniquet was released. Hemostasis was achieved. Wound closure done.



Crutch walking with non weight bearing was allowed as soon as pain was relieved and anesthesia effects were over usually on first post operative day.^{18,23,31,38} Active ROM exercises was started 2nd post-operative day onwards with goals of 0 -90 deg. at 2 wks and full range of motion at

6wks.^{9,18,22,31,38} Partial weight bearing was allowed at 9-12 weeks and full weight at 13-16 weeks depending upon clinical and radiological assessment of fracture healing and type of fracture and any other complication.^{2,22,23,31,58,62} Final assessment was done after 6 months and patients were assessed clinically by Rasmussen grading system.^(9,18,20,37,55,62)

Observations and Results: The patients in our study ranged in age from 21-57 years of age with mean age of 39.28 years. Average age for males was 34.92 years and average age for females was 43.61 years. Right limb was involved in 10 (40%) of cases where as left limb was involved in 15(60%) of cases. Left side was involved more than right side. In our study 14 patients had type II (split depression of lateral condyle) tibial plateau fractures, 7 patients had type I fractures. 2 patients each with Type III and type IV tibial plateau fractures. Most common type of intra-articular injuries in our study was meniscal injuries comprising of 40% of all cases. Lateral meniscal injuries were more common than medial meniscal injuries, because lateral condyle fractures were more than medial condyle fractures. The reason for less no. of cruciate and collateral ligament injuries in our study was exclusion of high energy type V and type VI tibial plateau fractures. Plate was used in all those cases where elevation of depressed articular surface and bone grafting was done. In our study average partial weight bearing time was 10.68weeks and ranged from 9-12weeks. In our study average time to full weight bearing was 15.84weeks with range of 15-18weeks. Average union time in our series was 16.48 weeks and ranged from 15-20 weeks. Rasmussen score in our series ranged from 19 to 30 with mean score of 27.5. Over all 21 out of 25 patients showed excellent results, three patients with good and one patient with fair results. There was no case with poor results. All fractures united and most of patients 21 out of 25 returned to their pre injury status.

Case No. 12



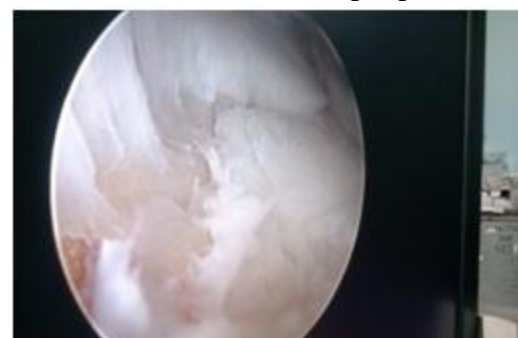
Pre-operative AP View



Pre-operative Lateral View



Pre reduction Arthroscopic picture



Post reduction Arthroscopic picture

Case No. 12



Post-operative AP view



Post-op Lateral View



Final follow Up AP view



Final Follow-up Lateral View

Case No. 12



No extension Lag



Full ROM



Able to sit cross legged

Discussion

Gardner (2006)²¹ et al found that soft tissue injury could be predicted based on plain radiographic findings. Articular depression of more than 6 mm and widening of more than 5 mm were associated with lateral meniscal tear in 83% (vs 50% for less displacement) and more than 8 mm was associated with increased risk of medial meniscal tear (53% - 78%). Review of the literature suggests AAIF to be equal to or better than open reduction internal fixation (ORIF) in achieving anatomical reduction. In the study of Bernfeld (1996)⁵ et al of a small series of 9 fractures, all reductions remained anatomic at a mean follow-up of 10 months. Fowble et al(1993)¹⁷ found all of their 12 ARIF patients remained anatomic versus only 6 of 11 for the ORIF group. In the study of H. Kiefer et al(2001)²⁶ of a series of 31 fractures, 25 showed anatomical reduction at a mean of 25 months. F. Van Glabbeek and van Riet (2002)¹⁸ were unable to arthroscopically reduce only 1 of 20 split/depression fractures. T. Ohdera and Tokunaga (2003)⁵⁶ reported 16 of 19 type II and III fractures were able to be anatomically reduced via ARIF. T. Gill and Moezzi⁵⁵ were able to correct articular depression from an average of 7.7 to 0.8 mm in 25 patients. Arthroscopy holds advantages in patient cosmesis and, more importantly, soft tissue handling. Less iatrogenic soft tissue injury may reduce intra-articular scarring, thus improving recovery of range of motion. Wound healing and risk of infection may be improved for higher energy fractures, and postoperative pain may be less. Some of these factors have been examined in the literature. Even

as early as 1985, Jennings³² noted more rapid recovery, with earlier return of knee motion and reduced pain in 21 patients. T. Ohdera and Tokunaga (2003)⁵⁶ found easier and faster rehabilitation, with time to recovery of 120 degrees of knee flexion 4.6 versus 9.1 weeks for ORIF.

Conclusion

Arthroscopic assisted reduction and fixation is reliable safe attractive, and excellent option in the treatment of properly selected cases of tibial plateau fractures because of. Diagnosis and treatment of associated intra-articular soft tissue injuries. Visualization of chondral surface reduction. Thorough joint irrigation. Removal of loose fragments. Accurate fracture reduction with limited soft tissue dissection. Decreased risk of knee stiffness and more rapid recovery.

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