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Functional outcome of internal fixation for tibial plateau fracture

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Abstract

Being an intra-articular fracture of a major weight bearing joint-accurate anatomical alignment and reconstruction are essential. The treatment mandates on early mobilization to avoid stiffness and limitation of movements which are major handicaps in squatting and cross-legged sitting in our social life.

The authors who have written extensively about this subject are generally in agreement that the result of treatment are dependent on the intra articular comminution and the presence or absence of step deformity on the weight bearing surface. If the step deformity can be eliminated by accurate anatomical reduction and if the reduction can be maintained, a good result can be usually anticipated. We have reported our experience in this study.

Keywords: functional outcome, internal fixation, tibial plateau fracture

Introduction

Fractures of the tibial plateau are serious injuries that frequently result in functional impairment. The emphasis in treating displaced fractures is on anatomical restoration of articular surface, repair of soft tissue injuries and rigid internal fixation to obtain a stable painless knee joint with normal range of motion controlled by well-functioning muscles.

Tibial plateau fractures constitute 1% of all fractures and 8% of fractures in the elderly. Isolated injuries on the lateral plateau account for 55% to 70% of tibial plateau fractures, as compared with 10% to 25% isolated medial plateau fractures and 10% to 30% complex bicondylar lesions. From 1% to 3% of these fractures are open injuries ^[1]. Due to increase in motor vehicle accidents we are prone to more number of complex tibial condyle fractures.

Intra-articular fractures management has always been a challenge to Orthopaedic Surgeons.

The management of tibial plateau fracture proposed by different authors remains controversial. Apley (1956) – skeletal traction with early motion. Scotland and Wardlaw advocated the use of case bracing.

Schatzker (1979) *et al.* ^[3] following clinical reviews of large series of patients with tibial plateau fractures, concluded that displaced fractures require open reduction with anatomical restoration of the articular surface, fixation of the fracture with cancellous screws to provide rigidity of the fixation, and buttressing of the cortex to prevent collapse and early mobilization to prevent stiffness generally produces the best results.

Other reasons for poor results in patient with tibial plateau fractures may be failure to recognize a concomitant ligamentous or meniscal injury. Martin ^[4] (1960) noted that tibial plateau fractures resulting from a combination of axial compression, sheer force and abduction or adduction force may in addition to the fracture, be associated with a major ligamentous injury. An abduction force in a young patient can lead to a combination of lateral tibial plateau fractures with tearing of medial collateral ligament with or without anterior cruciate ligament tear. The associated ligamentous injury is less likely to occur in older patients with osteoporosis. Thus the degree of ligamentous injury and the degree of osteoporosis may affect the outcome.

Aims and objectives

1. To achieve a congruous articular surface with good axial alignment and sound bony union

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and early mobilization to avoid stiffness with less number of complications.

2. To evaluate the results of management of tibial plateau fractures by operative treatment.
3. To compare our results with those available in the literature.

Materials and Methods

The present study deals with the management and post operative assessment of 40 cases of tibial plateau fractures that were fixed with buttress plate at "Government Tuticorin medical college, Tuticorin" of which 26 cases were under retrospective study from the period of March 2015 to May 2017, and other 14 cases were under prospective study from May 2017 till date.

Type of study

Combined – retrospective and prospective.

Patient selection criteria

- Adults
- Both sexes
- Patient with Schatzker [3, 66, 67] type II to type VI revealed on radiograph.
- Patients having closed injury of the affected knee joint.
- Data collection for the patients selected was done with the help of Proforma (Annexure A).

All fractures were classified according to Schatzker [3, 66, 67] classification

After careful pre op evaluation, we operated the cases with buttress plate. Routine post op follow-up was done and results recorded as per the observations made during follow-up.

Results

The stud in our series was to manage and assess the post operative results of tibial plateau fractures fixed with buttress

plate. Total number of patients in our series were [30].

The mean follow up was 13.5 months. Result was assessed by using Rasmussen's [18] radiological and clinical score of 30

points.

All the 40 patients who had been taken up for the study were closed fractures which were classified using Schatzker's classification and according to which there were 3 cases (7%) in Type II, 5 cases (12%) in Type III, 9 cases (23%) in Type IV, 13 cases (33%) in Type V and 10 cases (33.3%) in Type VI.

Bone grafting during fixation was done in 15 cases (27%) in our series.

Fracture neck of fibula was commonest associated injury (6 cases) in our series.

None of fracture fibula were fixed during surgery and none had any post operative complication.

Regarding instability, none of the patients had symptomatic instability but clinically 4 cases had anterior drawer test positive with translation <4mm (grade-I). PCL instability was noted clinically (grade I) in 1 case and was treated conservatively. 3 cases had LCL (lateral collateral ligament) injury and repaired. None of the patients had signs of MCL (medial collateral ligament) injury.

Discussion

The treatment of tibial plateau fractures has been under discussion for several decades and various modalities of internal and external fixation are tried to get the best possible results. But no single method has given uniformly good results in everybody's hand. Out of the various modalities described, fixation of tibial plateau fractures with buttress plate or cancellous screw or both and if required bone grafting is the most widely accepted modality of treatment.

According to Benirschke *et al.* [69] 1992 in their series an open wound present in 30-35% of Schatzker's type IV, V & VI and 86% of the remaining fractures are associated with significant closed injuries to the soft tissue. In our studies we took up only closed fractures to find out the results after buttress plating.

In addition, autogenous cancellous bone graft was used in 15 cases to augment fixation in fractures associated with articular depression.

Out of forty patients 36 were males and 4 were females. The significantly pattern demanding males to be engaged in outdoor activities and driving automobiles, thus exposing them to a greater risk. The sex ratio is inclined towards males in most other studies with Burri C *et al.* [22] having 67%, Delamarter R *et al.* [70] and Sarmiento A *et al.* [23, 26] having 76% and 57% males, whereas Blokker C.P. *et al.* [28], Rasmussen P.S18, and Roberts J.M. *et al.* [15] had only 53%, 55% and 53% males respectively. "The exception to this trend was seen in study of Schatzker *et al.* [3] in which ratio was reversed with females constituting 60% of the study group.

In our study out of forty patients the right side were involved in 22 (55%) and left side in 18 (45%) patients. According to Delamarter R *et al.* [70] in their series of 306 patients who reported right side to be involved in 64% cases.

The main etiologies identified for the mode of trauma were road traffic accidents, fall from height and direct trauma. Out of all these the most common etiology was road traffic accidents which accounted for 90% cases in our study. Sarmiento A *et al.* [23, 26] and Burri C *et al.* [22] attributed more than *et al.* [28] had majority of cases due to road traffic accidents but the percentage was less (43.7%). On the contrary Paul F.L. *et al.* [31] had falls as major etiology in their study above road traffic accidents. Road traffic accidents being the major contributor to these fractures in our study can be well explained from the mechanization and expansion of

high velocity vehicles on road. Also more and more people are using automobile for transportation and therefore exposing themselves to high velocity trauma of which tibial plateau fracture is a part. The most common age group affected is 18 to 40. The affected population is socially and economically active which is a big social trauma to family and society.

The most common pattern encountered in our series was Schatzker type V fracture (33%). The next most common pattern was Schatzker type VI fracture (25%). Biyani A *et al.* [71] found Type II to be most common type of fracture but in our series the Type II was 10% only. Rasmussen P.S18 reported involvement of the lateral condyle alone in 71% of the cases. Schatzker *et al.* [3] reported type III to be most common in their series (36%) but in our series the Type III was 6.7% only.

The series published by Young 39 (1994) using double plate for the bicondylar fractures had a complication in the form of deep infection in about 84% of patients. There was no such complication in our series like deep infection, skin necrosis as we used single buttress plate through midline approach.

Radiologically the depth of depression does influence the prognosis Porter 72 1970. According to his study a depression of 10-14mm gave a satisfactory result, but depression over 14mm gave a final unacceptable result.

In our series, the type of injury and the amount of depression were the deciding factors and CT Scan was done in most of the cases for preoperative assessment. The same criteria were kept in mind during post-operative assessment of results.

In our series 40 cases were taken up for operative management which included 3 cases (7%) in type II, 5 cases (12%) in type III, 9 cases (23%) in type IV and 13 cases (33%) in type V, 10 cases (25%) in type VI.

During surgery, effort was made to achieve anatomical reduction of the fracture irrespective of the degree of comminution and without disturbing the soft tissues to great extent. The degree of acceptable articular displacement is a matter of controversy. More than 2mm of articular incongruence was considered as an indication for internal fixation as advised by Tscherny H [37] and Lobenhoffer P *et al.* [46].

The post operative fracture depression and condylar separation/displacement was within 0-4mm in all the 40 cases. Blokker C.P. *et al.* [28] stated that the single most factor in predicting outcome was the adequacy of reduction. A residual step of >5mm at weight bearing was associated with unsatisfactory results in his series.

Bennett 44 (1994) in his studies documented that most of the meniscal injuries were associated with Schatzker's Type IV and collateral ligaments with soft tissue injury associated with Type II. Our studies confirmed the fact that type II injuries were associated with collateral ligament (10%) as compared to the other authors (23%).

After fixation, under anesthesia patients were tested clinically for associated ligamentous injury. The most common ligament injury found in our study was midsubstance ACL tear in 4 cases but repair was not a priority. Van Glabbeek F *et al.* [49] in their study found ACL tear in 3 cases which were not operated in same sitting. Even Hung S."S. *et al.* [73], Ohdera T *et al.* [51] and Van Glabbeek F *et al.* [49] using arthroscope in treatment for fracture fixation did not repair ACL in first sitting. At follow up none of these cases in our series reported instability on walking though they had clinical instability and were not operated for same. Van Glabbeek F *et al.* [49] in their study treated 2 cases with ACL tear

conservatively. None of the cases in our series had avulsion type of injury of ACL. In our series the 4 cases showed mild instability clinically as they had anterior drawer test positive with translation <4mm (grade 1) after an average follow up of 13.5 months, but none of them had symptomatic instability. All patients were treated conservatively and had satisfactory results.

PCL instability clinically (grade I) was noted in 1 case in our series which was treated conservatively. Rasmussen P.S.^[18] in his study also noted PCL tear in I case.

In our series 3 cases had lateral collateral ligament injury and ligament repair was done. Rasmussen P.S.^[18] reported 10 cases of medial collateral ligament injury with 1 case of lateral collateral ligament injury. Van Glabbeek F *et al.*^[49] reported 1 case of complete medial collateral ligament injury.

The most common associated extra articular injury was fracture neck of fibula seen in 6 cases and the cause is obvious, as fibula is in close proximity to tibia and the forces which causes fracture of lateral condyle (valgus combined with axial compression) may fracture fibula too. None of them were fixed and also they didn't had any complication like common peroneal nerve palsy before surgery and during post operative follow up. Van Glabbeek F *et al.*^[49] in their study reported 1 case of neuropraxia post – operatively not related to surgery which recovered on follow up. Rasmussen P.S.^[18] noted 6 cases of palsy in his study with partial recovery in each.

The earlier the mobilization is started after operative procedures either, in the form of physiotherapy in the bed or mobilization with weight bearing, the better the results, Julian^[74] (1965) started full weight bearing without support after 2 to 3 weeks post operatively. Porter^[72] (1970) in his studies of 137 patients operated for similar fractures allowed weight bearing at an average period of seven weeks. 15 patients with depressed fractures studied by Rhombold^[75] (1960), mobilization was started on the first post operative day. Crutch walking started after an average period of 5 weeks gave encouraging results. Segal D^[38] 1993 in his study of 44 patients, treated operatively, mobilized at an average period of 6 weeks gave a functionally good results. In our series we didn't started full weight bearing till signs of union appeared (8-12 weeks), but we started active and passive knee bending gradually from the 3rd to 4th post op day. Only partial toe touch was advised, then gradually shifted to partial and then full weight bearing when signs of union appeared.

Post operatively simple crepe bandage and knee brace (to prevent Varus of Valgus stresses) was given to every patient of ours. Fowble C.D. *et al.*^[76] and Gill T.J *et al.*^[77] who used arthroscopy assisted reduction also used hinged knee brace in their patients.

Knee bending and CPM (continuous passive motion) was started gradually by 3rd to 4th day in our series. Fowble C.D *et al.*^[76] and Gill T.J *et al.*^[77] started immediate mobilization. Paul F.L *et al.*^[31] stated that patients immobilized for >3 weeks, had mean range of motion 14° less than those immobilized for shorter periods. Rasmussen P.S.^[18] and Dreannan D.B. *et al.*^[24] considered 6 weeks to be upper limit of knee mobilization for restoring normal range of motion.

Using Rasmussen P.S.^[18] clinical score (Table no 10) we had 100% excellent to good results in our series. Even Lobenhoffer P *et al.*^[46] in his study found 65% excellent to good results. Another study by Roshdy M.EL-Sallab *et al.*^[78] had 100% excellent to good result with none showing poor or fair results.

Procedures where arthroscopy was used the results were no

different. Even study by Lobenhoffer P *et al.*^[46] in 1999 found only 90% excellent to good results when he compared two groups of thirty three patients, ten of whom were treated by arthroscopy reduction and he concluded that there is no significant benefit. Another study by T. Scheerlinck *et al.*^[45] who used percutaneous techniques aided arthroscopically. 78.9% of the results were excellent, 13.2% good, 7.9% fair and none was poor. Van Glabbeek F *et al.*^[49] reported 90% excellent to good results. In our series, the arthroscopy was not used due to the expected complication of extravasations of fluid in these fractures.

Comparing the radiological score using Rasmussen P.S.^[18] score system (Table 11) we had 100% excellent to good results where as Lobenhoffer P *et al.*^[46] in 1999 had 69% Excellent to good results with 31% fair to poor result.

Comparing the results of different methods, prolonged surgery time in non experienced arthroscopic surgeons, can lead to a higher rate of deep infection and deep thrombophlebitis as reported by Belanger M and Fadale P^[79] and Chang Y.H *et al.*^[47] Good result in image intensifier assisted in depressed fractures as compared to few inferior results in arthroscopically assisted due to inability to lift the depressed fragment has been reported by Ali A.I- Mukaimi *et al.*^[53] In image intensifier assisted no cases were reported with compartment syndrome as reported by Belanger M and Fadale P^[79] and Chang Y.H *et al.*^[47] and is technically easier specially in simple fractures and multiple injured patients except in significant ligamentous injuries and for children with fractures of the median eminence as reported by Lobenhoffer P *et al.*^[46] Regarding complications only 1 case of ours reported with knee stiffness with bending upto 90° only.

We had no case of superficial or deep infection reported. Study by Roshdy M.EL-Sallab *et al.*^[78] reported 1 case of superficial infection where as deep infection was noted in 23% or more after open osteosynthesis, as recorded by Young M.J. and Barrock, R.L.^[39]

Conclusion

Our Series

- The anterior midline approach is ideal for the exposure and fixation of tibial plateau fractures as it gives access to both tibial condyles, less incision problems, possible to reduce and fix the posterior fracture fragment under c-arm control, and helpful for future joint replacement if required.
- Proper imaging on radiolucent top operating table, accurate reduction and stable internal fixation of tibial plateau fractures is very necessary to achieve an optimal result.
- The primary fixation of condylar pieces by K-wires or joint spanning fixator helps in healing of soft tissues and reduction of edema. The enough time should be given to soft tissues to settle down and the signs of improvement are, swelling resolved – skin becomes loose (wrinkles appearing) and there is no erythema or cellulitis. The stable fixation of tibial plateau fracture with buttress plate and if required bone grafting helps in maintaining the fracture reduction and bone healing even in elderly and osteoporotic bones.
- The tibial head buttress plate which was used in all of our case can be used on medial or lateral side of tibial condyle depending on the type of fracture.
- The depression in the articular surface more than 2mm and varus-valgus angulation at metaphysis-diaphyseal

junction is unacceptable.

- Post operative knee brace application protects knee from varus – valgus stresses and gradual knee bending exercises (both active and passive) from the 3-4th post operative day helps to improve range of motion and thus prevents stiffness of knee and helps in regeneration of cartilage.
- A 100% (excellent to good) results in our series was noted and which was comparable to those in the literature.

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