Research Paper

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To Study the Clinical and Radiological Outcomes of Closed Depressed Tibia Plateau Fracture Without the Use of a Bone Graft or A Bone Substitute

Medical Science

KEYWORDS : Depressed lateral condyle tibia fracture,radiological union, metaphyseal void, subchondral bone support

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ABSTRACT

Objective: This study was designed to evaluate the functional and radiological outcomes of patients with lateral condyle split depressed tibial plateau fractures treated with lateral periarticular plate without filling the void left by elevating the depressed fragments and a posteromedial buttress plate for medial condyle fracture if present.

Methods: Seventy seven cases of complex (a.o.type B.3.1 and C.3.1) tibial plateau fractures were treated with lateral peri-articular plate and a postero-medial buttress plate for medial condyle if associated in our centre from 7th January 2008 to 8th March 2011 .Seventy seven patients were followed up for a period ranging from 29 months (16-43 months) and evaluated for the radiological and final clinical outcomes by radiological measurement and by a standard questionnaire .

Results: The x rays at the latest follow up did not show any late joint collapse despite the mode of fixation or failure of fixation .Lysholm scoring done at the final follow-up showed an overall mean having results good to excellent.

Conclusion: Fixation with a peri articular proximal tibia plate gives adequate support to the subchondral bone without the need to fill the void with bone graft/bone substitute thus helps to achieve the goal which is bone union and thus reducing the morbidity and cost of the surgery.

INTRODUCTION:

Using this hypothesis we fixed 105 proximal tibia lateral condyle fracture (isolated and associated medial condyle) we subsequently followed up these patients till radiological union was observed and then 6 monthly till finally implant removal done after 11/2 to 2 years and long term follow up done for 2 years till a latest date to assess the final clinical and radiological outcomes .

Management of depressed tibia lateral condyle fracture should be appropriate , since it is important to maintain the articular congruity , as well as to have a stable fixation it being an important weight bearing joint(5.6) . Conventionally depressed tibia lateral condyle fracture are treated with adequate elevation of the depressed fragment and filling the metaphyseal void with bone graft(7) or bone substitutes (8) and fixation with peri- articular proximal tibial lateral plate .This procedure was performed under spinal anesthesia. This technique was feasible to all patients and no anesthetic complications were noted . All patients reported a relevant reduction in pain subsequently without the need to undergo bone grafting even at a later stage , thereby decreasing the morbidity of the condition with no secondary loss of reduction was observed in radiological control , no revision surgery was required which indicated that primary fixation of depressed tibia plateau fractures is a good modality of treatment as it helps reduce morbidity of the condition without restriction of the knee mobilization.

The aims of this study are as follows:

1> To conclude that bone graft as a surgery is not required in primary fixation in lateral condyle depressed tibia plateau fractures.
2> To prove that stability of the plate- bone construct remains optimum after primary bone healing was observed on x-rays irrespective of the implant being used i.e. l.c.p, or a d.c.p or the bone quality.

METHODS AND MATERIALS:

This is a retrospective study of 105 cases of tibial plateau fractures admitted in our institute operated from date 7th January 2008 to 8th March 2011 after collecting xrays from computer records were evaluated and the parameters were measured and follow up these patients till an interval mean of 28.24(10-43 months)months for evaluating the final clinical outcome by lysholm scoring and radiological outcomes in the form of collapse as joint depression or articular malalignment (i.e. tilt ,slope and gap widening) at various time intervals .Data on age, sex, mechanism and energy level of injury, AO classification, and type of fracture (isolated lateral or bicondylar) were collected by retrospective review of medical records. There were 97 men and 8 women with a mean age of 43.02 years (23 to 70 your exclusion criteria is 60 years so how can you have your higher age limit of 70 years) . The mechanism of injury was a road – traffic accident (R.T.A) in 88 (33 pedestrians , 20 car drivers and 33 cyclists) , domestic falls in 13 , and sporting injuries in 4 . Using the AO classification 51 were type B.3.1, 25 were type C.3.1,19 were type C.3.2, and 9 were C.3.3 .

Patients were admitted in their respective wards and continuous limb elevation and ice packs over and above knee slab were given and they were reviewed till their swelling subsided and wrinkles appeared. There was evidence of blister formation in 12 patients and large swelling encountered in 63 pts for which intervention was undertaken in the form of temporary stabilization in form of exfix application, till the time the soft-tissue envelope was recovered before the patients were posted for definitive surgery. All these patients underwent proximal tibia periarticular plating without bone graft or a bone substitute. As per the fracture geometry either single or dual plating were performed. Follow up x rays were evaluated subsequently.

The choice of the implant whether to use a 4.5 proximal tibia d.c.p or an l.c.p was determined on the basis of the presence of osteoporosis which was determined clinically by a radiological and intraoperative assessment of bone quality. For osteoporotic bone l.c.p (t-plate, l-plate, or condylar buttress plate) fixation, was performed and for healthy bone with a good bone stock proximal tibia d.c.p (t-plate, l-plate, or condylar buttress plate) plating performed depending upon the fracture pattern. All decisions all the surgical procedures were

Performed either by or under the direct supervision of a consultant orthopedic trauma surgeon, trained in AO techniques. In the cases in which posteromedial articular fragments present plating were done by posteromedial approach to prevent varus collapse.

The inclusion criteria's of my study are:

1. Lateral condyle split depressions more than 3mm associated with or without medial condyle involvement i.e. B31, C31, C32, and C33.
2. Closed fractures,
3. Articular depression more than 3mm,
4. Fresh fractures,
5. Age more than 19 years

The exclusion criteria of my study are:

1. Medial condylar depression less than 3 mm
2. Nonunions ,Malunions,
3. Age less than 18 years ,
4. Articular depression less or equal to 3mm.
5. Pathological fractures
6. Old fracture>3weeks

Different authors have stated different depressions of lateral condyle tibia plateau fractures as surgical indications as in table 1.

TABLE 1. The indication for surgical treatment of displaced tibial plateau fracture

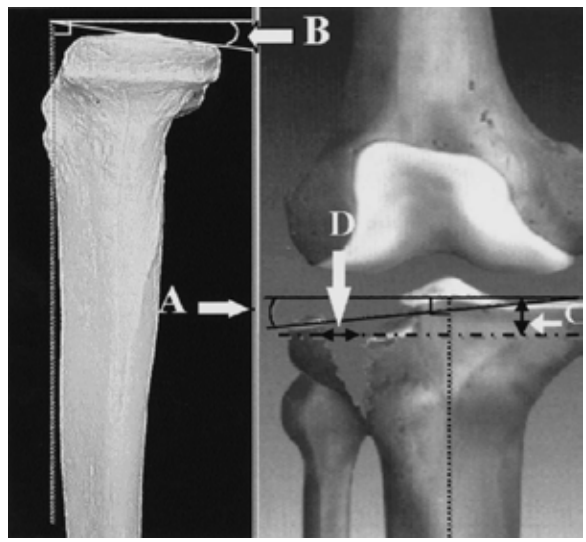
Study Year	Step-off displacement	(mm)
Rombold (9	1960	5
Hohl (10)	1956	10
Hohl (11)	1967	5
Bakalim (12)	1973	3
Burri (13)	1979	Any
Schatzker (14)	1979	Any
Perry (15)	1984	3
Decoster (16)	1988	4
Lachiewicz (17)	1990	4
Bennett, Browner (18)	1994	5
Holzach, Miller (19)	1994	2
Honkonen (20)	1994	3

Once the patient was admitted , x-rays : AP and lateral and a 2D and 3D ct scan were performed to confirm the fracture configuration and latent fracture pattern in all patients. All the associated injuries were treated accordingly .Type of fracture was decided according to Schatzkar classification. Line of treatment was decided according to the type of fracture, degree of displacement i.e. articular depression, and malalignment on radiograph , and condition of the bone of the patient . The indication for surgery in each case was exceeding displacement i.e. step-off of more than 3 mm, and articular malalignment (tilt , slope or condylar gap) of >5 degrees .(3)

RADIOLOGIC EVALUATION:

The fractures were graded using Schatzker's classification. Classification and measurements were determined independently by two observers. Interobserver differences were resolved by remeasurement by the senior author. The following aspects were assessed:

Fracture displacement and angulation were measured in all groups by the following techniques(3) (Fig. 1):



1. The tibial plateau tilt—the angle in a varus and valgus direction as measured on the anteroposterior projections perpendicular to the long axis of the tibia.
2. The plateau slope—the angle the tibial plateau makes with a line perpendicular to the long axis of the tibia on the lateral projection.
3. The articular step-off—the maximal depression or displacement of the articular surface in an axial direction on anteroposterior, lateral, or oblique projections.
4. The condylar widening—measured in comparison with the ipsilateral femoral condyles.

Radiological bone healing was stated when the fragments appeared united and there was no radiolucency and narrow uniform band of scleroses (24), proximal tibia being a cancellous bone. The loss of position i.e. joint depression or articular malalignment was determined by comparing sets of radiographs for each patient: the immediate operative films and follow-up radiographs at 4months, 1 year, and 2 years with a latest follow up x ray to check for late collapse.

All patients were mobilized from the second day and later permitted full weight bearing after confirming radiological union . In view of the observation that secondary displacement doesn't take place ,bone grafting as a surgery can be circumvented in depressed tibial condylar fractures treated with a peri articular plate .

With the help of computerized imager having magnification of 10 % the joint depression and articular malalignment (tilt, slope or condylar gap) was measured in millimeters. This method was standardized between the 2 surgeons and had good to excellent reliability (intraclass correlation coefficient: interarater reliability=0.90, P<.01; interrater reliability=0.83, P<.01). Radiological assessment done on the basis of residual depression and the secondary depression as well as articular malalignment noted post operatively . Statistical analysis was performed using chi square test and Fisher exact tests.

Patients were followed at 6 weeks ,4 months with a latest follow up , at each visit check x -ray was done and watched for joint depression and articular malalignment and radiological fracture healing was confirmed by a uniform narrow band of scleroses with no radiolucency (24)and full weight bearing was initiated at 6 weeks.

POST OPERATIVE CARE:

Gentle knee bending exercise and passive knee movement and non weight bearing walking exercises were started after 48

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hours . Patient was discharged after mean 5 days when passive knee movement crossed 90 degrees on the machine and there was no soakage on daily dressing with a clean suture line with the instruction of knee bending exercise , quadriceps extension exercise and non weight bearing walking and stitch removal on 12th post op day .

OPERATIVE PROCEDURE:

PATIENT POSITIONING:

Patients are positioned supine on a radiolucent table. A tourniquet is applied to the proximal thigh and the limb prepared and draped in the standard sterile fashion .A sandbag is placed under the ipsilateral buttock to aid proper positioning of the knee .The opposite limb is positioned out of the way by draping.

OPERATIVE TECHNIQUE.

A straight lateral parapatellar approach was used, and the lateral joint line was visualized through a submeniscal approach. The lateral meniscal-tibial ligament was incised transversely, and the meniscus was elevated with the use of numerous stay sutures or small sharp-toothed retractors. The condylar fracture line was visualized at the joint level through the submeniscal approach and distally along the lateral aspect of the shaft. The anterior compartment muscles are elevated extraperiosteally from the proximal tibia.

The condylar fracture line can be wedged open slightly like a book. The depressed articular surface was evaluated by direct vision, and an impactor was manipulated from below to disimpact and elevate the fracture fragments. To reduce a joint depression properly, a curved bone tamp was inserted deep into the compact metaphysis, and reduction was initiated with upward pressure. The major condylar fracture line should be reduced first and held with a large reduction forceps. Through the submeniscal exposure, the articular surface can be visualized and the adequacy of the major condylar articular fracture lines assessed. A small cortical window was then developed at the base of the condylar fracture line. Multiple small (2-mm) drill holes are then placed in a 1-cm oval. These drill holes are then connected with the use of a small osteotome to develop a cortical window. The small cortical window is impacted directly into the metaphysis with the use of a small curved impactor.

Periarticular Reduction:

When the fracture involves the articular surface, the articular segment is reduced anatomically and held provisionally with Kirschner wires (K-wires) The fracture was thus reduced and the reduction maintained with AO 6.5 mm cancellous interfragmentary screws . Based on preoperative planning, care was taken to place these screws in positions that do not interfere with periarticular anatomic plate with either 4.5 proximal tibias L.C.P or 4.5 proximal tibias D.C.P. Fixation of the condyle was then achieved with a 4.5 proximal tibia lcp(t plate ,l plate or a condylar buttress plate) or a 4.5 proximal tibia dcp(t plate ,l plate or a condylar buttress plate) depending on the fracture pattern , articular fragments and the quality of the underlying bone.

For the medial condyle fixation in fractures with little or no comminution, caused by a lower energy mechanism, closed reduction was performed and held with large, percutaneously placed reduction forceps by giving a valgus force for reduction and the fixation was then maintained with multiple cannulated screws. In fractures resulting from high-energy forces, buttress plate is used. The entire pes anserinus is elevated in continuity with the superficial portion of the medial collateral ligament. The elevation is done in an extra periosteal fashion and the plate was applied in direct contact with the entire medial metaphyseal surface, also in the patterns which has large posterior wedge fragment should be buttressed postero medially. In order to reach this posterior wedge fragment, incision was made postero medially and buttress plating was done.

All surgical procedures, and decisions regarding the implant to be used and the surgery, were performed prospectively by the senior author as per standard protocol mentioned above. Check radiographs were taken on the operation table before closing the wound under IITV guidance.

Post operative care:

Gentle knee bending exercise and passive knee movement and non weight bearing walking exercises were started after 48 hours . Patient was discharged after mean 5 days when passive knee movement crossed 90 degrees on the machine and there was no soakage on daily dressing with a clean suture line with the instruction of knee bending exercise , quadriceps extension exercise and non weight bearing walking till the next follow up at 6 weeks and stitch removal on 12th post op day .

FOLLOW UP:

Subsequent x-rays were performed at regular follow ups to look for signs of radiological union and to check for residual or secondary displacement or joint depression or articular mal-alignment in form tilt ,slope, depression or gap widening on a computerized imager and a latest follow up x-ray to check for late joint collapse and final clinical outcome by lysholm knee scoring .

Following criteria was selected to grade the fixation as failed on follow up x-rays as given in the table 2. And the values below it were considered acceptable.

Table 2: The criteria for failure of fixation at follow up

Step-off (mm) >3
Condylar widening (mm) >5
Plateau tilt (varus–valgus) (degrees) >5
Plateau slope (degrees) >5

Results:

The mean duration of surgery was 55 minutes (40 to 110). The men duration between times of trauma to the definite management was 6(3-8) days. The mean duration of hospital stay was 6.22 (3-8) days . Post operative evaluation of the patients was done subsequently at regular follow ups and noted at 6 weeks,4 months ,1year,2 years and with a latest follow up shows that the results were stated acceptable without any failure of fixation or significant joint depression or articular mal alignment in the saggital or coronal plane or implant loosening . There were complications noted in the form of superficial infection in 4 patients which were treated by debridement and antibiotic impregnated beads which were removed at 4 weeks and with i.v antibiotics. Full weight bearing walking was commenced on the operated limb after observing signs of radiological outcomes. The x rays at the latest follow up did not show any late joint collapse despite the mode of fixation(22), which correspond s to a biomechanical study performed .Lysholm scoring done at the final follow-up shows an mean result of good to excellent.

DISCUSSION:

Fixation of the tibia plateau fractures is challenging especially in elderly patients, because of weakness in subchondral cancellous bone as well as an impending soft tissue damage. Our main aim was to restore the articular congruity as well as maintenance of the mechanical axis through the knee joint with the help of a periarticular plate fixed with lag screws without the use of bone graft or a bone substitute .High rate of complications of bone graft have been stated(22) include donor site morbidity and pain . The goals of treatment for any intra-articular fracture are to preserve joint mobility, joint stability, articular surface congruence, and axial alignment; to provide freedom from pain; and to prevent post-traumatic osteoarthritis.

By the use of 6.5 mm cancellous screws intercondylar reduction achieved by lag technique followed by the use of periarticular anatomic plate i.e. a 4.5 proximal tibia d.c.p or an l.c.p is sufficient to maintain the articular congruency and subsequently give support to the subchondral bone . Bio -mechanical studies show that the construct stability with a periarticular plate placed in anatomic reduction show sufficient rigidity and prevents collapse in vitro in all depressed tibia fractures(21) , irrespective of the underlying bone quality i.e. osteoporotic as well as having good bone stock .Medial plating done in the patient criteria mentioned above provides a sufficient anti glide property also helps to give subchondral support and thus prevents varus collapse.

Malalignment being an important factor in predicting the outcome, most authors do not accept >5 degrees varus or valgus angulation (25, 26, 26, 27, 28).

Microscopically, post trauma there is immediate loss of proteoglycans due to decrease synthesis or increased destruction even before the cartilage changes occur thus leading to increased permeability of fluid into the bone causing damage to the chondrocytes , remaining chondrocytes restore the damaged matrix if irreversible damage doesn't occur (29)and mechanical stability is restored .Stabilization with help of a periarticular plate prevents the further damage to the chondrocytes by stabilizing of the fracture site in anatomic reduction and thus bone healing ensues obliviating the need of a bone graft or a bone substitute .

A periarticular plate with cancellous screws bridge the fracture fragments and fill the metaphyseal void over a period of time , thus decreasing the time of the surgery and morbidity of the condition , at the same time all patients showed a significant decrease in the pain symptoms and immediate post op mobilization of the knee joint and non weight bearing walking is initiated from post op day 2.

LIMITATIONS OF MY STUDY ARE:

It's a retrospective study,

- Despite the high intrarater and interrater reliability of our methods, there are no uniform radiological criteria for measuring tibial plateau depression ,
- Having a pre-op joint malorientation that is not taken into consideration,
- A line drawn to measure the joint depression is arbitrary in the fractures involving both the condyles .

CONCLUSION:

Depressed proximal tibia fixed with a periarticular plate irrespective of the implants, fracture patterns and the underlying bone quality with 6.5 cancellous lag screws is a good modality of treatment thus preventing the use of a bone graft or a bone substitute with early post operative mobilization and range of motion of the operative limb thereby decreasing the morbidity and pain of the condition. This concludes that in the presence of a biomechanically sound fixation even in the absence of bone graft or bone substitutes collapse will not occur and thus it obviates its need and thus reduces the morbidity. Thus preventing any deformity of the articular surface that may jeopardize the future of the knee by causing osteoarthritis and axis deviation.

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