The extended posterolateral approach for split depression lateral tibial plateau fractures extending into the posterior column: 2 years follow up results of a prospective study

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Objective: To prospectively study the outcome of surgically treated split depression lateral tibial plateau fractures extending into the posterior column using the extended posterolateral approach.

Methods: Twenty-one patients with split depression lateral tibial plateau fractures (AO: 41-B3) with extension into the posterior column were treated with open reduction and internal fixation through an extended posterolateral approach with osteotomy of the fibular neck ± Gerdy tubercle. Follow up radiographs was assessed for quality of articular reduction and limb axis. Functional assessment was performed at last follow up using the Tegner-Lysholm score. Complications pertaining to the surgical approach were recorded.

Results: The approach was performed in 15 patients with a fibular neck osteotomy alone and 6 patients required a Gerdy's tubercle osteotomy also. All fractures and osteotomies had united. Anatomical articular reduction was achieved in 16 patients. Radiological limb alignment was restored in all patients except for a reversed posterior slope in 1 patient. Arthritic changes were seen in 3 patients. The mean Tegner-Lysholm score was 87.3 (range: 76–95) at last follow up. No specific complications related to the surgical approach like common peroneal nerve injury and lateral instability of the knee was encountered.

Conclusion: The extended posterolateral approach offers excellent exposure posterior to the fibular head to perform articular reduction and fixation achieving satisfactory radiological and functional results in split depression lateral tibial plateau fractures extending into the posterior column.

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Introduction

Split depression lateral tibial plateau fractures can be high velocity injuries characterised by varying degrees of comminution and articular depression. Conventionally the anterolateral approach is used to address these fractures by direct reduction and plate fixation. However, fractures extending into the posterolateral corner (lateral part of the posterior column of tibial plateau) behind the fibular head are difficult to access with the conventional anterolateral approach [1,2]. Various approaches have been described to access isolated posterolateral condyle fractures [3–7] in small number of patients but long term prospective studies are still lacking. With this background, we describe the mean 2 years follow up results of extended posterolateral approach in which the entire lateral structures namely the extensors of the leg, Gerdy's tubercle and the fibular head can be elevated safely to provide access to the entire lateral plateau to address complex split depression lateral plateau fractures extending into the posterior column.

Methods

The study was a prospective analysis of select patients with lateral tibial plateau split depression fractures approved by the institutional review board. Closed, displaced AO: 41-B3 fractures with extension into the lateral part of the posterior column (based on the 3 column classification of proximal tibia fractures, Fig. 1) on

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the CT scan were included in the study. Undisplaced fractures, fracture extension into the medial part of the posterior column requiring dual surgical approaches, fractures with established compartment syndrome, open fractures and pathological fractures were excluded.

Twenty-one patients satisfying the inclusion criteria under-went internal fixation using an extended posterolateral approach with a fibular neck osteotomy ± Gerdy’s tubercle osteotomy. A CT scan was obtained to plan and develop the surgical tactic preoperatively.

Surgical approach

The surgery was performed with the patient supine under a sub-arachnoid block. A lazy S incision was made along the course of the biceps tendon crossing the knee joint between the fibular head and the Gerdy’s tubercle.

The common peroneal nerve (CPN) was identified and released beyond the level of the planned osteotomy. The extensor muscles were elevated from the tibia leaving a cuff of tissue for later repair. The fibular neck was osteotomised with an oscillating saw without violating the proximal fibio-fibular joint. In cases with pre-existing fibular head or neck fracture, the fracture plane was developed to get access to the posterolateral corner. The fibular neck osteotomy provides posterolateral exposure from the PCL insertion to the posterior margin of the IT band allowing plating of the broken posterolateral rim, posterolateral articular reconstruction and lateral plating. The tubercle of Gerdy was osteotomised in complex cases where an unrestricted anterior access to the plateau was required to achieve articular reduction. The osteotomy was performed with an oscillating saw without violating the articular cartilage and the IT band was reflected anteriorly and proximally (Fig. 2).

Fracture reduction and fixation

The posterolateral wall was reduced first and stabilised provisionally with K wires and pointed clamps. Antiglide fixation of the posterolateral wall was performed using a 3.5 mm reconstruction plate. Plate fixation was avoided in undisplaced posterolateral wall fractures. Depressed articular fragments were then disimpacted and reconstructed to the reduced posterolateral wall under vision. The articular fragments were held together with subchondral K wires or 3.5 mm screws. Resultant metaphyseal void was bone grafted from the iliac crest. The lateral wall was reduced last and compressed to restore the condylar width before completing fixation with a 3.5 mm precontoured fixed angle raft plate. The fibular head was reduced and fixed with a 4 mm/6.5 mm intramedullary cancellous screw (Fig. 3). The Gerdy’s tubercle was reduced to its bed and secured with screws through the plate or independently.

Post operative regimen and follow up

Patients were allowed active knee range of movements from day 1. Weight bearing was restricted initially. Patients progressed to full weight bearing by 12 weeks. Outpatient follow up visits were done at 3, 6 and 12 weeks followed by 6 and 12 months. Range of motion analysis and plain radiographs were performed at each visit after 6 weeks to assess fracture union, alignment, articular reduction and loss of fixation or reduction during follow up. Articular reduction was classified as anatomical, good (<2 mm step) and poor (>2 mm step). Other radiological parameters assessed were the femoro-tibial angle (FTA, normal: 180 ± 5°), medial proximal tibial angle (MPTA, normal: 87 ± 5°), lateral posterior slope angle (LPSA, normal: 9 ± 4°) and condylar width (CW, normal: <5 mm compared to opposite side) as described by
Barei et al. [8] and Honkonen [9], Tegner–Lysholm scores were recorded during follow up visits till 1 year and through a telephonic interview at last follow up. A radiologist blinded to the clinical outcome assessed all radiographs and a team of blinded trainees assessed clinical and functional outcome.

Statistical analysis

The results were analysed statistically using SPSS (version 16, Chicago, IL). The loss of fracture reduction over the follow up period on basis of studied radiological parameters were analysed using the paired T test. The influence of surgical approach, articular reduction and presence of degenerative changes at the tibiofemoral joint on the Tegner–Lysholm score was analyzed using the independent T test. The level of significance was kept at P < 0.05.

Results

The mean follow up was 32 months (range: 24–41 months). The mean age was 39 years (range: 26–54 years). There were 14 males and 7 females. Radiological fracture union was evident in all patients at 12 weeks (Figs. 4 and 5). All osteotomies had united. All wounds healed satisfactorily. There were no incidences of CPN injury. No evidence of lateral knee instability was seen. Lateral meniscal lesions were seen in 9 patients. Two of them were partially resected and the remaining 7 menisco-capsular lesions were repaired to the lateral capsule. Deep vein thrombosis was diagnosed in 1 patient. One patient underwent removal of a loose K wire during follow up. No graft site morbidity was seen at follow up.

The articular surface reduction was classified as anatomical in 16 patients and good in 5 patients. The femoro-tibial axis, MPPTA and condylar width were anatomically restored in all patients. Except for 1 patient who had a LPSA of 1°, all patients had their posterior slope restored within normal limits. The mean LPSA at the last follow up showed a statistically significant change (P = 0.02) compared to the immediate postoperative values. Other radiological parameters did not show a significant change during follow up (P > 0.05, Table 1). The mean knee arc of motion was 138° (range: 120–155°). No flexion contracture or extensor lag was seen. The mean Tegner–Lysholm score was 87.3 (range: 76–95) at last follow up. Patients with non-anatomical articular reduction and presence of degenerative changes at the lateral tibio-femoral compartment had significantly lower Tegner–Lysholm scores. The addition of Gerdy’s tubercle osteotomy did not affect the functional scores, lateral knee stability or wound healing. The quality of articular reduction was not improved by addition of Gerdy’s tubercle osteotomy (Table 1).

Discussion

The surgical treatment of tibial plateau fractures has evolved significantly in the last two decades. New surgical approaches, development of a column specific approach [10] to deal with complex fractures and introduction of low profile anatomically contoured locked compression plates have all helped in improving surgical outcome of these difficult fractures. The use of CT scan has tremendously helped understanding the complexity of these fractures [11] and has allowed surgeons to use fracture specific surgical approaches and implants.

The posterolateral column between the PCL and the back of the fibular head is difficult to access surgically and fractures involving this portion can pose significant challenges. Approaches specific to access fractures in the posterolateral corner were described by Solomon et al. [5], Carlson [3] and a few other authors [12–16]. These approaches are useful to address fractures isolated to the posterolateral corner. The surgical exposure used in this study is based on the approach described by Solomon except for addition of Gerdy’s tubercle osteotomy, which expands the surgical exposure to cover the entire lateral plateau. This allows the surgeon to perform satisfactory articular reconstruction in complex split depression fractures involving the entire lateral plateau. The healing after this extensile approach is satisfactory as

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<td>B) Surgical approach</td>
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<td>C) Articular reduction</td>
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<td>D) Arthritic changes</td>
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Bold values indicate statistical significance.

Fig. 4. A 51-year-old patient with a complex lateral plateau fracture. CT shows broken posterolateral rim with impacted posterolateral articular surface. Post operative and follow up radiographs show excellent articular reduction.

Fig. 5. Twenty-six-year old patient with a split depression fracture extending into the posterolateral corner with a minimally displaced posterolateral rim. Articular surface reduced anatomically and stabilised with posteriorly placed subchondral screws.
evident by the excellent union rates, lack of instability and nerve complications in the study population. Luo et al. [17] described the reverse L approach for 3-column fixation of complex bicondylar fractures. The authors describe stabilisation of the posterolateral cortical rim with a contoured plate through a modified posteromedial approach but expressed difficulty in performing articular elevation under vision through the approach. The extended posterolateral approach offers good exposure of the posterolateral area to perform direct articular reduction and fixation as well as antiglide fixation of the unstable posterolateral cortical rim. The articular depression can be easily elevated and grafted and supported with a raft plate unlike the reverse L approach. It can be performed supine, which obviates the need for a floating prone position or any change in patient positioning thereby enabling easy fluoroscopy. It can be combined with the conventional posteromedial approach in supine position to perform 3 column fixation in complex fractures. We recommend the extended posterolateral approach for complex fractures of the lateral condyle, which requires fixation of the posterolateral plateau in addition to lateral buttress plate fixation. The approach provides excellent exposure made possible by osteotomies of the fibular neck and the Gerdy’s tubercle. The approach is biological and safe to perform as evident by high union rates, and lack of complications in our study.

The limitations of the study include small number of patients and lack of control group. The sample was small due to the relative rarity of the relevant fracture pattern but this is still the largest sample size reported so far. We were convinced that an anterolateral approach could not help achieve anatomical articular reduction in these fractures, so having a control group was not justifiable. Comparison with historic controls is subject to bias and is limited by availability of complete relevant records. All data were collected prospectively and blinded surgeons and trainees performed all analysis.

To summarise, the extended posterolateral approach provides excellent exposure of the lateral tibial plateau to address select split depression fractures extending into the retrofibular area. The approach helps achieve anatomical reduction and stable fixation of these fractures without increased complications.

Conflict of interest

The authors declare no conflict of interest.

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References