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Analysis of Open Reduction Internal Fixation and Bone Graft for Different Types of Tibial Plateau Fractures

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Abstract

Objective: To explore clinical effects of internal fixation and open reduction in treatments of tibial plateau fractures.

Methods: From January 2010 to January 2018, seventy-six patients, who were diagnosed with the tibial plateau fractures, were treated in our hospital. According to Schatzker classification, the numbers of cases for type Ⅰ, type Ⅱ, type Ⅲ, type Ⅳ, type Ⅴ and type Ⅵ were 16, 18, 22, 10, 6 and 4, respectively. Bone graft was conducted simultaneously in patients with bone defects who were treated with internal fixation and open reduction.

Results: Seventy-six cases were followed up from 12 to 36 months, with a mean time of 20.4 months. All patients had bony union. According to the HSS knee score, the excellent and good rate was 73.69%

Conclusion: Operation is one of the effective methods to treat the tibial plateau fractures and vary according to different fractures. And the occurrence of postoperative complications is strongly associated with the fracture severity. Anatomical reduction, bone graft, stable fixation and early functional exercise are the keys to reduce complications.

Key words: Fracture; Tibia plateau; Internal fixation; Bone graft

1. Introduction

Tibial plateau fracture is a kind of the intra-articular fractures, and its methods of treatments and outcomes are different due to different causes of injury and different types of fractures (Dirschl & Dawson, 2004). Improper handling predisposes to knee pain, instability, and dysfunction. Internal fixation and open reduction are one of the effective methods to treat the tibial plateau fractures. Personalized treatment according to different fracture types and accurate grasp of surgical indications, timing and surgical methods can improve knee function and reduce complications. From January 2010 to January 2018, 76 cases of tibial plateau fractures were treated surgically with good results in our hospital, and the analysis results are reported as follows.

2. Materials and Methods

2.2 General Information

76 patients (28 females and 48 males) were included in this group, aged from 19 to 65 years old (mean age: 37.5). There are four causes including traffic accident (60 cases), fall injury (6 cases), downhole squatting and canning injury (6 cases), of weight crush injury (4 cases). The time of fracture surgery ranged from 2 h to 5 days after injury.

2.2 Fracture Classification

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According to Schatzker classification (Prasad, Lewis, Haddad, Paringe, & Mohanty), there were 16 cases of type I (simple lateral plateau split), 20 cases of type II (lateral condyle split with articular surface collapse fracture), 22 cases of type III (simple central collapse articular surface impacted and subsided, lateral cortex still intact), 8 cases of type IV (medial condyle fracture can be simply split or comminuted or collapsed fracture, often involving the tibial spine), 6 cases of type V (bicondylar fracture, simultaneous medial and lateral condyles split but its lower metaphysis and diaphysis maintain continuity), and 4 cases of type VI (tibial condyle fracture with metaphysis and diaphysis separation). There were 4 cases of lateral collateral ligament rupture, 10 cases of medial collateral ligament rupture, 10 cases of meniscus injury, 4 cases of common peroneal nerve injury and 42 cases of Bone graft for articular surface collapse. Preoperative X-ray films and knee CT scans were routinely taken.

1.3 Operation Technique

1.3.1 Operation Time

Operation time was determined by the type of fracture and general condition. The operation time of fracture was from 3h to 7d after injury, which was determined according to soft tissue injury, limb circulation and general condition. Open reduction and internal fixation were performed as early as possible.

1.3.2 Operative Incision

The choice of surgical approach was based on the classification of the preoperative fracture. Fractures of Schatzker type I, II, and III involving the lateral plateau were treated with a lateral arc incision of the knee. Fractures of schatzker type IV, V, and VI were treated with a medial arc incision, a lateral arc incision and "Y" incision of the anterior part of the knee, respectively. In the case of Schatzker type VI associated with posterior condyle tibial plateau fracture, an anterior midline incision was applied to the anterior fracture, and the posterior tibial plateau fracture was treated with a surgical approach of the posterior condyle in the tibial plateau (Bhattacharyya et al., 2005). Using an "S" or " ⌐" shaped incision, entering along the medial aspect of the medial gastrocnemius muscle, subperiosteal dissection avoids injury to the vascular nerves, clearly exposing the posterior condyle of the tibial plateau. In the absence of meniscal injury, the periosteum can be incised transversely at the inferior border of the meniscus without injuring the bursa for the articular surface exposure. An intraoperative photograph of the incision and maneuver is shown in Figure 1A. Among the patients with tibial plateau fractures, there were, 4 cases of lateral collateral ligament rupture, 10 cases of medial collateral ligament rupture, 5 cases of meniscus injury and 4 cases of common peroneal nerve injury.

1.3.3 Reduction and Fixation Method

Schatzker I fracture were fixed with bone bolts or cancellous screws, and Schatzker II to VI were fixed with bone bolts, cancellous screws, "T" or "L" shaped support plates, and anatomical plates. Expose the tibial plateau outside the periosteum and explore the joint cavity (Verhoeven & C.). Primarily, the the tibial plateau articular surface was reconstructed and temporarily fixed with Kirschner wire, and the reduction and the presence of bone fragments remaining in the joint space were examined by X-ray during surgery (Chen, Zhang, He, Liu, & Zeng, 2014). Subsequently, an anteromedial or lateral cortical bone window (0.5cm×0.5cm) was opened at the site of 2cm below the fracture end, the bone window was inserted with the posterior edge of the tibial plateau processor, and the collapsed part of the cancellous bone was lifted up together with the articular surface of the cartilage to flatten the articular surface. Finally, the bone defect under the platform was filled with screw or plate fixation followed by bone graft. When the articular surface was collapsed ≥ 5 mm, bone graft was necessary for bone defects under the articular surface after reduction. Bone graft was performed in 42 cases, all of which were autogenous iliac bone graft. Good reduction of the articular surface was confirmed with a C-arm X-ray machine after surgery. There were 10 cases of meniscal injury, all of which underwent primary repair. A primary repair was performed during the lateral collateral ligament injury. Both 4 common peroneal nerve injuries were detected as traction injuries, yet with poor postoperative recovery. The incision was routinely placed with half-tube or negative pressure drainage.

1.3.4 postoperative management

Preoperative and intraoperative prophylactic antibiotics were administered, and 5000U of low-molecular-weight heparin calcium was injected subcutaneously at 12 hours after surgery, once a day for 7 days to prevent deep venous thrombosis of the lower extremities. Antibiotics were applied for 5 to 8 days postoperatively, and stitches were removed 12 to 16 days postoperatively. It is

routinely fixed with a long leg brace, and the duration of fixation is determined by the type of fracture and the stability of the fixation. Type I fractures were fixed for 4 weeks, and types II and VI were generally fixed for 5 to 8 weeks. Quadriceps contraction exercise and straight leg raising exercise can be performed during brace fixation, CPM exercise and active knee flexion and extension exercise can be performed after brace removal, and weight training can be performed gradually according to fracture healing after 3 months.

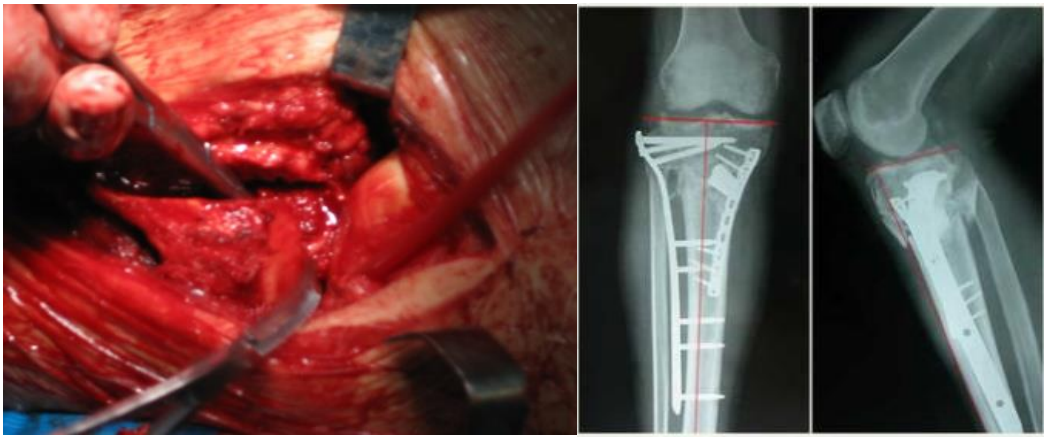

Figure 1. **The intraoperative and postoperative cases. (a) an intraoperative photograph of the incision and maneuver. (b) a case of postoperative reexamination x-ray examination.**

3.Result

3.1 Efficacy Evaluation

The knee joint function score was performed 12 months after operation. According to the HSS knee scoring criteria (Słupik & Białoszewski, 2007), comprehensive judgment is made according to the pain, function, activity, muscle strength, knee flexion deformity and the stability of knee joint. In this group, the functional assessment was poor in 4 cases, fair in 12 cases, and good in 20 cases excellent in 40 cases.

3.2 Treatment Results

76 patients were followed up for 12 to 36 months (mean time: 20.4 months). All of the patients were followed up for bony union, and the healing time of fracture ranged from 8 to 15 months (average time: 11.5 months). According to HSS scoring criteria, excellent and good were 39 cases (51.32%) and 21 cases (27.62%), respectively. 11 cases (14.47%) and 5 cases (6.58%) were fair and poor, respectively. Excellent and fair rate was 78.94%. All the above results were showed in Table 1. A case of postoperative reexamination X-ray examination result is shown in Figure 1.

Table 1. **Results of The Postoperative Healing**

Group	n	Excellent (%)	Good (%)	Fair (%)	Poor (%)	Excellent+ good (%)
I	16	10	6	0	0	100
II	18	9	3	4	2	66.7
III	22	11	7	4	0	81.8
IV	10	4	3	2	1	70.0
V	6	3	2	0	1	83.3
VI	4	2	0	1	1	50.0
Total	76	39	21	11	5	78.94

4. Discussion

Correct classification of tibial plateau fracture before surgery is key to the success of treatment in tibial plateau fracture. In addition, tibial plateau fracture is one of the intra-articular fractures that may have varying degrees of articular surface compression and displacement, affecting knee joint apposition, stability, and motion. It is difficult to accurately reflect the specific situation of fractures in plain X-radiographs, while CT scans can reflect the area and degree of collapse in the articular surface and displacement in the fracture fragments. The specific location of the fracture can assist in the selection of surgical approach,

reduction and internal fixation methods and whether to perform bone graft. The Schatzker classification of tibial plateau fracture, which emphasizes the local characteristic changes of tibial plateau fractures, has strong clinical utility. Each category has a clear surgical plan that clinicians can refer to for options.

Grasp of surgical indications and the selection to surgical incision. Surgical treatment is necessary for patients with obvious articular surface collapse and displacement, fracture and dislocation, combined with ligament injury and instability. Eduardo et al.(Moran et al.) considered that lateral malleolus bone block displacement > 5 mm or valgus more than 5°, and joint collapse > 5 mm all should be treated surgically. According to the results of X-ray and CT examination, the classification of fracture was judged and the appropriate surgical approach was selected, so as to facilitate the reduction and bone graft fixation of fracture and reduce complications. For Schatzker type I, II and III fractures involving the lateral plateau, a lateral arcuate incision of the knee was selected, which could well expose the fracture site. Schatzker type IV, V, and VI fractures were treated with a medial arc incision, a lateral arc incision and "Y" incision of the anterior part of the knee, respectively. The tibial plateau was well exposed by all three incisions and fixed by internal and external double plates. In the case of Schatzker VI with posterior condyle fracture of the tibial plateau, Anterior midline incision was made in front of the incision, and "S" or " ⌐" shaped incision was used posteriorly, and subperiosteal dissection can avoid injury to the vascular nerves and clearly expose the posterior condyle of tibial plateau. In the case of no meniscus injury, after entering the incision in front of the knee, cut the periosteum horizontally at the lower edge of the meniscus, below the meniscus, without injuring the bursa and exposing the articular surface, which can reduce the damage to the medial side of joint and facilitate the recovery of joint function.

The anatomic reduction, rigid internal fixation and adequate bone graft were required for treating tibial plateau fractures (Huang, Zhou, & Jiang, 2008; Verhoeven & C.). In tibial plateau fractures, rigid internal fixation, articular surface anatomic reduction, and bone graft after reduction of the collapsed fracture are the three elements of internal fixation surgery. The anatomical reduction of tibial plateau fractures should meet the following requirements: (1) restore the width of the tibial plateau; (2) correct the collapse, restore the smoothness of the articular surface, bone graft in the bone defect area; (3) restore the tibiofemoral angle (Dirschl & Dawson, 2004). The importance of articular surface leveling is well recognized, and rigid internal fixation is also necessary, which lays a good foundation for early functional exercise of the knee. Reduction and internal fixation can only play the role of supporting and preventing the displacement of fracture fragments. For the compressed cancellous bone, a large bone cavity is left after the bone block is punched and reduced, and the bone graft must be filled. An anteromedial or lateral cortical bone window of 0.5 cm×0.5 cm was opened 2 cm below the fracture end, and a bone window was inserted with the posterior edge processor of the tibial plateau to lift up the collapsed part of the cancellous bone together with the articular surface of cartilage in the same direction, and the periosteal elevator could not be used to pry up the fracture fragment, because this could cause the medial or lateral fracture fragment to sink, thus affecting the repair of the articular surface.

Postoperative knee functional exercise and weight bearing are particularly important. The main factors affecting knee joint function are intra-articular adhesion and contracture of surrounding soft tissues. In order to prevent ankylosis, early postoperative CPM exercise can reduce knee joint adhesion and expand knee joint range of motion. However, the long leg brace is usually used for postoperative fixation, and the fixation time is determined according to the type of fracture and the stability of fixation. Type I fractures were fixed for 4 weeks, and types II to VI were generally fixed for 6 to 8 weeks. Quadriceps contraction exercise and straight leg raising exercise were performed during brace fixation, and CPM exercise and active knee flexion and extension exercise were performed after brace removal. The premature weight-bearing after internal fixation of tibial plateau fracture may cause the reduced articular surface to collapse again, while the tibial plateau fracture is one of the intra-articular fractures (Segal, Mallik, Wetzler, Franchi, & Whitelaw, 1993). Excessive external fixation time will surely affect the joint function, and long-term non-weight-bearing may also cause the platform collapse due to osteoporosis. Therefore, the weight-bearing training was gradually performed according to the fracture healing condition after 3 months after operation to prevent the subsidence

of particular surface. Every surgical plan has its advantages and limitations. No matter what kind of plan, it is necessary to achieve anatomical reduction of the joint, stable fixation of fracture fragments, good bone graft support to reconstruct the metaphysis and early functional exercise.

Reference

Bhattacharyya, T., Mccarty, L. P., Harris, M. B., Morrison, S. M., Wixted, J. J., Vrahas, M. S., & Smith, R. M. (2005). The posterior shearing tibial plateau fracture: treatment and results via a posterior approach. *19*(7), 508; author reply 508.

Chen, Z. X., Zhang, W., He, H. H., Liu, M. J., & Zeng, D. H. (2014). [Biomechanical study on a net-fixation of Kirschner wire in treating depressed tibial plateau fractures]. *China Journal of Orthopaedics & Traumatology, 27*(5), 418-421.

Dirschl, D. R., & Dawson, P. A. (2004). Injury severity assessment in tibial plateau fractures. *Clinical Orthopaedics and Related Research®, 423*, 85-92.

Huang, H. T., Zhou, Z., & Jiang, N. (2008). [Clinical analysis of surgical treatment of tibial plateau fracture with internal fixation]. *21*(9), 696.

Moran, E., Zderic, I., Klos, K., Simons, P., Triana, M., Richards, R. G., . . . Lenz, M. Reconstruction of the lateral tibia plateau fracture with a third triangular support screw: A biomechanical study. *Journal of Orthopaedic Translation, 11*, 30-38.

Prasad, P. S. R., Sheethal, Lewis, J., Haddad, Z., Paringe, V., & Mohanty, K. Three-column classification and Schatzker classification: a three- and two-dimensional computed tomography characterisation and analysis of tibial plateau fractures. *European Journal of Orthopaedic Surgery & Traumatology, 24*(7), 1263-1270.

Segal, D., Mallik, A. R., Wetzler, M. J., Franchi, A. V., & Whitelaw, G. P. (1993). Early weight bearing of lateral tibial plateau fractures. *294*(294), 232-237.

Słupik, A., & Białoszewski, D. (2007). A comparative analysis of the clinical utility of the Staffelstein-score and the hospital for special surgery knee score (HSS) in monitoring physiotherapy of total knee replacement patients--preliminary study. *9*(6), 627-635.

Verhoeven, & C., A. Bone turnover, joint damage and bone mineral density in early rheumatoid arthritis treated with combination therapy including high-dose prednisolone. *Rheumatology, 40*(11), 1231-1237.