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Original Article

Surgical Treatment of Depressed Tibial Plateau Fractures by Plating and Bone Graft

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ABSTRACT

Background: Depressed tibial plateau fractures continue to be a technical challenge facing orthopedic surgeons. Aiming to achieve anatomic joint reduction with stable fixation of the fracture are the principal challenges. Other challenges reside on complications of insufficient articular reduction. Anatomical tibial plateau fractures reconstruction is essential to prevent pain, mal-alignment, join instability of the knee and arthritis.

Aim of the work: The current work aimed to present the clinical, radiographic and functional results in patients who sustained open reduction and internal fixation [ORIF] by plating and bone graft in depressed tibial plateau fractures.

Patients and Methods: A clinical trial had been conducted in a prospective manner. It had been designed and completed at the Department of Orthopedic Surgery [Al Mataria Teaching Hospital, Egypt]. It included 37 patients with lateral tibial plateau fracture Schatzker type II subjected to ORIF with plating and bone graft. Patients were followed up for an average duration of 12 months. The study conducted from July 2019 to September 2020. Preoperatively, all participants were evaluated by clinical examination, radiological and laboratory investigations.

Results: Excellent clinical outcomes were recorded in 24 patients [64.9%], while good results were achieved in 13 patients [35.1%]. According to the radiological outcomes, results were excellent in 20 cases, good in 16 cases and fair in one case.

Conclusion: Treating depressed tibial plateau fractures type II by ORIF buttress plate and bone graft represents a viable option.

Keywords: Tibial plateau; Depressed; Plating; Fracture; ORIF.

INTRODUCTION

Depressed fracture of tibial plateau is a challenging task of orthopedic surgeon's daily practice [1]. The main challenges are achieving anatomic reduction for the knee joint reduction in association with stable fixation of the fracture, to permit early range of motion at the knee joint, aiming to regain good functional outcomes [2]. Further limitations arise from the risk of a residual intra-articular step-off due to insufficient articular reduction [3] and the ability of bone graft to fill the metaphyseal gap after reduction of the fracture with conventional bone packs [4].

Anatomical reconstruction is essential to prevent post-operative pain, malalignment, instability of the knee join and posttraumatic knee joint arthritis [5]. In the surgical management of depressed lateral tibial plateau fractures [TPF] [Schatzker II-III] [6] [constitutes > 50% of all TPF] the ultimate goal is to obtain complete articular surface reduction with stable fixation. A cortical window or other metaphyseal bone fenestrations are used to access to the subchondral bone. A pad or elevator is then inserted and to elevate the depressed bone en bloc [1]. The subchondral metaphyseal defect is generally grafted by an iliac crest bone graft to support the raised up articular surface or subchondral screws 3.5-6.5mm were used to fix the elevated bone. Graft disadvantages include pain and other donor site complications [7,8], as well as resorption of the graft leading to loss of achieved reduction [9-11].

Considering these challenges, here we intended to present our experience with ORIF of TPF with plating or bone graft in a trial to discover the standard treatment and to add to available literature.

AIM OF THE WORK

The current research was designed to present the results of surgical treatment provided for depressed TPF by ORIF with plating and bone graft.

PATIENTS AND METHODS

This is a prospective randomized controlled study that included 37 patients (a convenient sample) with closed fracture of the lateral tibial plateau Schatzker type II, managed primarily by open reduction and internal fixation [ORIF] with plating and bone graft. All were selected from El-Mataria Teaching Hospital, Ministry of Health, Egypt. The study started from July 2019 to September 2020. The age ranged between 18 and 55 years. Every patient was instructed about the study and signed a written informed consent for participation [available on request]. The exclusion criteria were open fractures, fractures Schatzker type I, III, IV, V and VI, pathological fractures and Concomitant injuries to either lower limb. Preoperative evaluation consisted of history, physical examination and radiological examination [X-ray and CT]. Staging of the fracture was based on Schatzker classification system [12].

Surgical technique: While in supine position, a tourniquet was applied except in participants with residual soft tissue oedema. A pneumatic tourniquet was used, exsanguination the limb then inflation of the tourniquet to 350 mmHg. To preserve the leg in a neural position, a pad was inserted beneath the affected hip. Another pad was put under the knee to keep it flexed about 45º. A fluoroscopy was utilized to evaluate and monitor reduction, application of K-wires and secure the screws from the articular surface. A curved anterolateral incision was used, starting 3 cm above the patella proximally and extending distally under the inferior aspect of the fracture site. Intra-articular exposure was achieved by incising the menisco-tibial ligament, with retraction of the meniscus superiorly. For exposure of the lateral condyle longi-tudinal fracture, the origin of the extensor muscles from the condylar anterolateral aspect was stripped through an inverted L-shaped incision. The origin of the muscle was reflected laterally until exposure of the fracture line was achieved. The split of the lateral condyle was used as a window to gain access to the tibial condyle central part. This fragment often hinged open like a book, permitting an exposure of the depressed articular surface.

A bone elevator was introduced well below the depressed fragments, and by slow pressure, the articular fragments were elevated in single large mass. After elevation and reduction of articular fragments, multiple small K-wires were used to achieve temporary fixation. An incision was made 1 to 2 cm posterior to the anterior superior iliac spine in the same fracture side and was extended along the crest posteriorly. Autogenous tri-cortical graft was harvested. Then the incision was closed in layers with placement of bone wax if necessary. The graft was used to fill the gap created after elevation of the depressed tibial plateau fragment. Anatomical AO lateral tibial buttress plate was used for definitive fixation. To be secured with the condyle, an appropriate cancellous screws of sufficient length were used to engage the contralateral medial cortex. A 4-5 mm, cortical screws were used to attach the plate to the tibial shaft. The meniscus was sutured back to its menisco-tibial ligament attachment. The iliotibial band was reattached. Then closure of the wound in layers with the use of a drain. No external splintage was used.

Post-operative care and follow up:

Assessment of peripheral neurovascular status and amount of blood in the drain. The drain was removed on the second day post-operative. Postoperative intravenous broad-spectrum antibiotic [third-generation cephalon-sporins] for 72 hours was given, then oral for 4 days.

Analgesics, anti-edematous and DVT prophylactic drugs were used. Stitches were removed after 2 weeks. Passive range of motion was started from day two after surgery for 2 weeks then active range of motion. Weight bearing was allowed between 10 and 12 weeks after surgery.

All patients had been evaluated clinically at three, six and twelve postoperative months. The radiological outcome had been carried out at 2, 6 and 12 weeks, then after 6 and 12 months. Assessment of clinical results was

done using Rasmussen score for clinical outcome [13]. Results were collected after 1 year postoperatively. The results were rated as follows: Excellent: 27 to 30 points, Good: 20 to 26 points, Fair: 10 to 19 points and Poor: less than 10 points. Also, radiological Rasmussen score [13] was used for radiological evaluation of all cases. The results were rated as follows: Excellent: 18 points [minimum], Good: 12 to 17 points, Fair: 6 to 11 points and Poor: less than 6 points.

Statistical analysis: the data were coded and fed to personal computer to be analyzed by the statistical package of social sciences (SPSS) version 16 (SPSS Inc., USA, Chicago). Data were expressed by their mean and standard deviation (quantitative normally distributed data) or relative frequency and percentages (Qualitative data).

RESULTS

The current work included 37 patients [28 males [75.7%] and 9 [24.3%] females]. The age ranged between 18 and 55 years [mean±SD was 40.64±10.47]. The operative time ranged from 70 to 120 minutes. Time lapse between injury to surgery was from 1 to 10 days. Excellent clinical outcomes were recorded in 24 patients, while good results were achieved in 13 patients. No poor or fair results were recorded. Radiologically, there were 20 excellent cases, 16 good results and 1 fair result. No poor results were recorded [Table 1]. Regarding complications, there were four cases of superficial wound infection that resolved with debridement and antibiotics [Table 1]. Figures [1] through [5] Describe a pre and postoperative radiological investigations of one patient as a case presentation.

Table [1]: Overall description of studies patients and the reported outcome

Variables		Statistical Measures
Gender [n, %]	Male	28 [75.68%]
	Female	9 [24.32%]
Age [years] [mean±SD; min. – max.]		40.64±10.47; 19-55
Mechanism of injury [n, %]	RTA	15[40.54%]
	MCA	9 [24.32%]
	MCCA	13[35.14%]
Affected side [n, %]	Right	21[56.76%]
	Left	16[43.24%]
Time lapse [days] [mean±SD; min. – max.]		5.05±2.61; 1- 10
Operative time [minutes] [mean±SD; min. – max.]		93.51±12.79; 70-120
Clinical outcome [n, %]	Excellent	24[64.86%]
	Good	13[35.14%]
	Mean±SD score	28.81±2.38; 22- 30
Radiological outcome [n, %]	Excellent	20[54.05%]
	Good	16[43.24%]
	Fair	1[2.70%]
	Mean±SD score	17.30±2.15; 10-20
Complications [n, %]	No	33[89.19%]
	Yes	4[10.81%]

Figure [1]: Preoperative X-ray

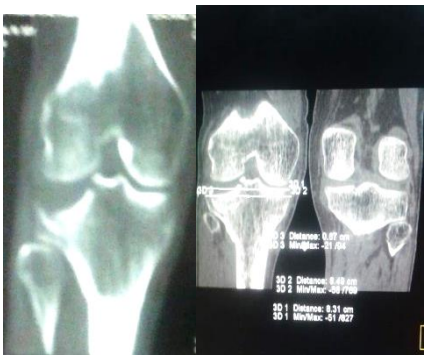

Figure [2]: Preoperative CT scan

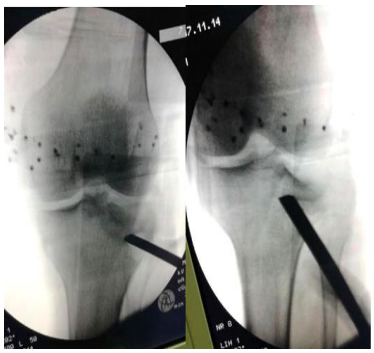

Figure [3]: Intraoperative C-arm image

Future [4]: Immediate postoperative X-ray

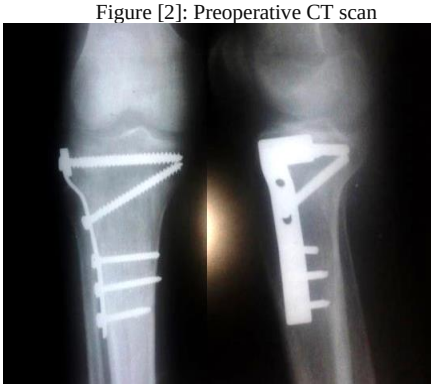

Figure [5]: Postoperative X-ray after 6 months

DISCUSSION

Fractures of the Tibial plateau are common. However, their management remains a challenge for orthopedic surgeons. Its incidence is a bimodal in distribution. Its first peak of incidence reported in younger patients with high-energy trauma. The second incidence peak is reported among elderly patients with osteoporosis due to low-energy trauma. The pathogenic mechanism of fractures explained by a combination of axial loading and varus/valgus applied forces [14].

The treatment of tibial plateau fractures is debatable. All aspects of management plan are controversial. For example, the timing of surgery, the surgical technique, the method of reduction and fixation, the postoperative rehabilitation program, all are controversial. However, a general consensus is present regarding the management principles particularly for the simple as well as the most complexed patterns of fracture [15].

In the current study, 37 patients with Schatzker type II were treated by open reduction and internal fixation [ORIF] with plating and the use of autogenous bone graft. They were followed both radiologically and functionally for one year.

All the patients were assessed in the postoperative and follow up periods functionally by Rasmussen functional score, and radiologically by Rasmussen radiological score.

Excellent clinical outcomes were recorded in 24 patients, while good results were achieved in 13 patients. No poor or fair results were recorded. Radiologically, excellent results were achieved in 20 cases, good results in 16 cases and fair result in one case. No poor results were recorded. Four patients with superficial wound infection were documented.

Molenaars *et al*. [16] reported on the outcome after ORIF of a tibial plateau fracture with a split-depression larger than 5 mm, in 38 patients. They used a peri-articular raft construction technique, achieved by a locking plate without grafting. They followed-up their patients for a mean duration of 22.8 months [range 6–36]. The outcome was excellent in 27, good in nine, and fair in two patients. A loss of reduction after full weight bearing was reported only for one patient, who had severe comminuted fracture.

Sevencan *et al*. [17] conducted a retrospective study to review files of sixty-one patients who had fractures of the lateral tibial plateau with joint depression and splitting > 3 mm [Schatzker type II fracture]. Patients were classified into two groups according to type of fixation. The first group included 24 patients who managed by the cannulated lag screw; and the second group included 37 patients, managed by lateral locking plate. In addition, 40 patients had an autograft. 25 of them were in the second group and 15 were in the first group. Patients were followed-up for 34±4 months [range 13-110].

Both groups had non significant differences regarding clinical and functional scores. Final knee flexion extension ROM was 119.7±9.4 in the plating group, while it was 121.6±9.7 in the screw group. Three patients in the second group had superficial wound infection. Authors concluded that leg screws for internal fixation had a clinical and radiological outcome similar to lateral locking plates.

Dhillon *et al*. [18] treated 8 cases of Schatzker type II fractures of the tibial plateau, treated by arthroscopy-assisted reduction and internal fixation by plating associated with bone graft. Patients started weight bearing after a mean duration of 6-12 weeks [mean 9.1 weeks]. The mean score was 28.2, indicating an excellent outcome. No patients had postoperative complications [e.g, loss of reduction, wound infection, mal- or non-union, or any neurovascular injury].

Kayali *et al*. [19] in this retrospective study, reviewed 24 patients with Schatzker type II fractures of the tibial plateau. They were treated with ORIF by raft construction through the anatomic lateral locking plate while an allograft was used to fill the bony defect. They followed-up for a duration between 12- 39 months [average 21.4 months]. They reported a score of 27.9 for Rasmussen radiologic, indicating excellent outcome. No severe complications, like osteoarthritis was reported. They concluded that construction of periarticular raft by the locking plate helps achieving and preservation of the anatomic line of the joint and to regain normal mechanical axis.

Hap and Kwek [2] stated that functional outcomes are generally favorable for the surgically treated fractures of the tibial plateau. This outcome was based on the Western Ontario and McMaster Universities Arthritis Index [WOMAC] and 36-Item Short Form Survey [SF-36] scores. Majority of treated patients returned to their work. However, > 60% of patients were unable to regain their pre-morbid sporting or exercise activities, despite a favorable outcome measured by the functional outcome questionnaires.

Vendeuvre *et al*. [20] used computed tomography scanning to analyze the step-off reduction. their primary outcome endpoint was set as the optimal reduction with residual step-off lower than 5 mm, irrespective of the fact that, any observable step-off on standard X-ray could reflect an optimal reduction

In conclusion, management of depressed tibial plateau fractures type II by open reduction and internal fixation with buttress plate and bone graft represents a good option with early range of motion.

Financial and Conflict of interest disclosure:

None

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