

## Original Article Orthopaedics

# ANALYSIS OF DONOR SITE COMPLICATIONS AT THE ANTERIOR ILIAC CREST HARVEST SITE FOR TREATMENT OF TIBIAL PLATEAU FRACTURES

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Article submitted on: 31 August 2019

Article Accepted on: 07 September 2019

### Abstract

**Introduction:** In tibial plateau fractures with intraarticular depression and metaphyseal comminution, bone grafting or the use of a bone substitute may be required. Harvesting autologous iliac crest bone graft for other orthopedic procedures has complications. The aim of this study was to evaluate the complication rate after harvesting bone graft as used for the treatment of tibial plateau fractures.

**Patients and methods:** Patients treated in a tertiary care hospital with operative intervention for tibial plateau fractures with iliac crest bone graft between January 2015 and December 2018 were included in this retrospective study. Patients' records were evaluated and clinical evaluation was performed at follow-up.

**Results:** 46 patients (20 females, 26 males, mean age  $55.2 \pm 14.9$  years) were included in this study. Follow-up was mean  $4.3 \pm 1.2$  years. Only minor complications such as hematoma could be identified; in one patient, repeat surgery for bleeding was performed. No nerve injuries, long-term pain, fractures, infections or wound healing disturbances could be seen. The use of a drain, the type of wound closure or amount of harvested bone did not influence complication rate.

**Conclusion:** This study shows that harvesting of iliac crest bone graft for the treatment of tibial plateau fractures is a safe procedure with a very low complication rate.

**Keywords:** Tibial plateau fractures Iliac crest bone graft  
Donor site complications

## Introduction:

Bone grafting is a commonly performed surgical procedure to augment bone regeneration in a variety of cases in orthopaedic surgery. Autologous bone graft remains to be the 'gold standard' and the iliac crest to be the most common harvesting site.<sup>1</sup> Malunion, late collapse, non union and pseudarthrosis rates in patient undergoing surgery have reported as high as 7-8 percent.<sup>2,3</sup> Autogenous bone grafting has been the method of choice to achieve union and fill in the gaps for many years. While bone graft substitutes are costly, autogenous bone grafts are easily available at low cost and harbor osteoinductive osteoconductive and nonimmunogenic properties. The intramedullary canal of long bones represents another potential site for large volume of autologous bone graft harvesting and is recently being used as an alternative donor site. Reduction of tibial plateau fractures and maintain a level of well aligned congruent joint is key to a satisfactory clinical outcome and is important for the return to pre-trauma level of activity. Stable internal fixation support early mobility and weight bearing. The augmentation with bone graft or bone graft substitute is often required to support the fixation to maintain reduction. Reduction of depressed tibial plateau fractures leaves void in metaphyseal area to provide subchondral support and prevent late subsidence. Also, in cases of metaphyseal comminution bone grafts or substitutes are helpful in promoting union.

However, harvesting of autologous bone graft is associated with morbidity and a number of complication.<sup>4,5</sup> Although iliac crest graft harvesting is thought to impart high perioperative morbidity, we have found little

information to support assumption. Patient has significant postoperative pain. Studies evaluating show variable rate of complications in harvesting autologous iliac crest. However reports of complications have led to widespread search for alternatives. Bone graft substitutes have been used in treatment of tibial plateau fractures. The graft substitutes evaluated in the included studies were calcium phosphate cement, hydroxyapatite granules, calcium sulphate, tricalcium phosphate, demineralised bone matrix, allografts, and xenograft.<sup>6,7</sup> Main disadvantage of bone graft substitutes is that they are not cost-effective.<sup>8</sup>

Patient has significant postoperative pain. Studies evaluating results of harvesting autologous iliac crest show variable rate of donor site complications.<sup>9</sup> Controversy exists regarding choice of material to fill void and stimulate union: bone grafts or bone graft substitutes.<sup>10</sup> The aim of this study was to evaluate donor site complications after harvesting bone graft as used for the treatment of tibial plateau fractures.

## Material and Methods:

Between January 2015 and December 2018, 94 patients with tibial plateau fractures presented at our institute. 46 adult patients (26 males and 20 females) between 19 and 75 years, presenting with acute, closed and unstable proximal tibial fractures which required both grafting and internal fixation, were included in this retrospective study. In this study, open reduction and internal fixation augmented with autologous bone grafts was performed to fill residual gaps. Excluded from the study were patients with metabolic bone disease, type 1 diabetes or uncontrolled type 2 diabetes, malignancy or on

treatment with systemic steroids or immunosuppressive therapy, infection at the operative site, peripheral vascular disease, alcoholism, substance abuse, correlated peripheral nerve damage, pregnancy or breast feeding. This investigation was performed in accordance with the ethical standards of the Declaration of Helsinki and all the patients gave informed consent prior to being included in the study. In all patients anterior iliac crest grafting was performed using standard technique. Radiographs and CT scans (Fig 1) was taken preoperatively to examine the fracture, for surgery planning and to classify fracture according to Schatzker.<sup>11</sup>

Bone graft from ipsilateral iliac crest were put under fluoroscopy with a minimally invasive technique from the contralateral side of the fractured tibia or through the bony window used for reduction and internal fixation was performed. Progressive load bearing was allowed after 2 weeks for Schatzker II and III and after 4 weeks for type IV and VI. Clinical follow up was performed at 1, 3, 9 and 12 months and subsequently every six months; including radiographic analysis and knee functional grading. X-ray review allowed the assessment of osteosynthesis stability, preserved alignment of the joint surface following reduction, bone substitute resorption and fracture healing. WOMAC score was applied to assess knee function.<sup>12</sup> At each follow up, patients were examined clinically for complications at graft harvest site like pain hematoma, infection, paresthesia and gait disturbance.

## Results:

Out of 94 patients with tibial plateau fractures presented at the emergency department of a tertiary

care hospital over the 36 month recruitment period, 46 patients were eligible for study. There were 26 males and 20 females, met the inclusion criteria and were included and treated by the authors: the patients ranged from 19 to 75 years, mean 47 years. Schatzker classifications were type II (24 patients), type III (20 patients), type IV (1 patients) and type VI (1 patients); thirty three patients (all type II and 9 patients out of type III) were operated with two percutaneous cannulated screws which were inserted through the lateral side before that a distal medial window was prepared to reduce the fracture and to introduce the bone graft ; the remaining 13 patients (11 patients out of type III , all type IV and all type VI ) needed an angled stable sliding plate with screws and the bone substitute was inserted directly by the lateral approach. The interim follow-up period was an average of 23 months (16–54 months) as presented in Table 1. Radiographic analysis (Fig 2) demonstrated that a loss of fracture reduction was maintained within the satisfactory range of 2 mm in 43 patients (93.47 %). three patients (6.52%) had more than 2 mm subsidence.

### WOMAC Score:

WOMAC score<sup>12</sup> is primarily used to assess pain, stiffness and physical function in patients with osteoarthritis of the knee and hip. We used the WOMAC score in our study to look for early secondary knee osteoarthritis after tibial plateau fractures. The average WOMAC score in our study was 6.83, which is a good outcome on the scale between 0 [best] and 96 [worst]. Nine patients had a WOMAC score of 0. 24 patients had a score of 1-11 and 13 had a score of 12-21. None scored more than 21.

Two patients had severe post op pain. One developed haematoma, one patient had seroma. Total of 8.69% patients had complications at donor site at some point of time in postoperative period.

### Discussion:

Complications related to anterior iliac crest graft harvesting have been reported previously and include pain haematoma, infection, neuropraxia of the lateral femoral cutaneous nerve, ilioinguinal and iliohypogastric injury, gait disturbance, peritoneal perforation hernia and cosmetic deformity. Fracture of iliac bone and gait disturbance are other known complications. However meticulous surgical technique that implements various safety margins can reduce these complications. Usually preoperative pain is moderate in severity can be controlled with standard pain protocols.

According to investigators, the calcium phosphate paste, called Alpha-Bone Substitute Material (Alpha-BSM), was injected or placed into a defect and then hand-packed. It was associated with fewer adverse effects than autogenous iliac crest bone graft (AIBG), including a notably reduced incidence of graft subsidence at three to 12 months.<sup>13</sup>

Ong et al in their study on bone graft substitutes and bone grafts stated that there was no significant statistical difference between the groups for post-operative articular reduction, long-term subsidence, and WOMAC scores. The degree of subsidence was not related to age or fracture severity. Authors concluded that use of autologous or allogenic bone graft allows better recovery of long-term flexion, possibly due to reduced inflammatory response compared with synthetic bone composites.

However, all other parameters, such as maintenance of joint reduction and subjective outcome measures were comparable with the use of hydroxyapatite calcium carbonate bone graft. This study shows that synthetic bone graft may be a suitable alternative in fixation of unstable tibia plateau fractures, avoiding risk of disease transmission with allograft and donor site morbidity associated with autograft.<sup>14</sup>

Hanke et al in their comparative study on 46 patients with mean age of patients was  $59.7 \pm 12.5$  years and follow-up was  $8.6 \pm 0.9$  years for SBG A and  $11.6 \pm 1.4$  years for SBG B concluded that in most cases SBG A was completely resorbed in a homogenous pattern, while SBG B was still visible on the X-ray images revealing a peripheral resorption pattern. A loss of reduction ( $>2\text{mm}$ ) could be observed in two patients with SBG A and two patients with SBG B, although only one of them had an impaired knee function.<sup>15</sup>

Jubel et al presented in their results that Norian SRS can be used to fill metaphyseal bone defects in tibial plateau fractures. Clinical and radiological results are comparable to those of fractures treated with autologous bone graft. The high compression strength allows early full weight bearing without the risk of secondary loss of reduction.<sup>16</sup>

We treated these injuries in a more systematic way, utilizing the benefits of both plating and iliac crest bone grafting. The subjective score as scored by the patients themselves regarding various symptoms was excellent in most of the patients. The average postoperative knee flexion in our study was  $118.09^\circ$ , which is equivalent to results in recent literature. The average knee range of movement in

the randomized controlled trial by the Canadian Orthopedic Trauma Society was 109° in the plating group and 120° in the circular external fixator group.<sup>17</sup> Only 3 (6.52 %) patients had residual step off more than 2 mm. 8.69% patients had donor site complications which were of mild nature. (Table 3)

Limitations of our study include its retrospective nature, small sample size, single centre study and short follow up. We did not assess whether patients were able to return to their pre-injury jobs after surgery.

### Conclusions:

In the present study of 46 patients who underwent surgery for tibial plateau fractures with anterior iliac crest grafting to fill subchondral and metaphyseal gap, morbidity at donor site was minimal and based on the high success rate, may be an attractive option in patients who cannot afford bone graft substitutes.

**Table 1**

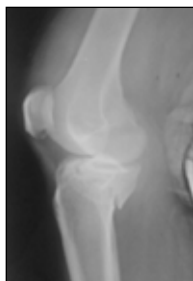
Age (years)	46.3 (34-63)	
Sex		
Schatzker	II	24
	III	20
	IV	1
	VI	1
BMI		
ORIF		

**Table 2**

Number of patients	Residual step off	Schatzker classification
43	< 2 mm	N 24 II 19 III
2	2- 5 mm	N 1 III 1 VI
1	>5 mm	N 1 Type IV

**Table 3**

Complication	Number
Postoperative pain	2 (4.34 %)
Haematoma	1(2.17%)
Infection	nil
Seroma	1(2.17%)
Paresthesias	nil



**Preoperative Radiograph**



**Preoperative CT scan**



**Postoperative AP radiograph**



**Postoperative Lateral Radiograph**

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