Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1218765
J Health Sci Med 2023; 6(2): 347-352

Comparison of anterior midline incision and double incision in the surgical treatment of tibial plateau fractures

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Cite this article as: Bozduman Ö. Comparison of anterior midline incision and double incision in the surgical treatment of tibial plateau fractures. J Health Sci Med 2023; 6(2): 347-352.

ABSTRACT

Aim: Tibial plateau fractures are complex fractures that often develop after high-energy trauma, often involving intra-articular fractures. They are rarely treated conservatively. Surgical planning and approach are very important in preventing possible complications. In this study, we compared two different incisions in the same fracture types.

Material and Method: A total of 26 patients (20 males-6 females) with tibial plateau fractures were included in the study. Twelve of the patients were selected from those using anterior midline incisions, and 14 from those using double incisions as anterolateral and posteromedial incisions. The mean age of the patients is 50.8 (24-76) years. The distribution of patients according to fracture classification was 9 Schatzker type-6, 17 Schatzker type-5. Average follow-up time is 34.1 months (24.5-42.2). Postoperative complications, union time, joint range of motion, radiological Rasmussen criteria, Medial Proximal Tibial Angle (MPTA) and Posterior Proximal Tibial Angle (PPTA) measurements, Lachman and valgus-varus stress tests for ligament stability evaluation, Hospital for Special Surgery (HSS) and visual analogue scale (VAS) assessments were performed to evaluate the clinical status of the patients. Results were compared between both incision groups.

Results: Union in the anterior midline was 11.07 (±1.68) weeks and bilateral union was 9.96 (±1.35) weeks (p :0.074). Rasmussen scoring was 14.83 (±2.16) in the anterior group and 14.57 (±2.13) in the bilateral group (p:0.760). The MPTA was 85.35 (±3.97) degrees in the anterior group, and the MPTA was 86.40 (±3.74) degrees in the bilateral group (p: 0.492). PPTA was 80.77 (±1.95) degree in the anterior group, and PPTA was 80.85 (±1.78) degree in the bilateral group. HSS score was 70 (±9.02) in the anterior group and HSS score was 71.71 (±1.15) in the bilateral group (p:0.681). Rom was measured as 101.67 (±12.67) degrees in the anterior group and 107.86 (±13.54) degrees in the bilateral group (p: 0.243). The VAS anterior group was 2.83 (±1.64) and the VAS bilateral group was 3.36 (±2.09) (p:0.491).Instability was seen in 1 patient in the anterior group and 1 patient in the bilateral group (p:1). Infection was observed in 1 patient in the anterior group and in 3 patients in the bilateral group (p:0.598).

Conclusion: The anterior incision is as effective a surgical approach as bilateral incision in correct patient preferences. Surgical site visibility in anterior incision is satisfactory. The principal aspect is to perform the correct surgical planning for the correct patient.

Keywords: Tibial plateau fracture, anterior midline incision, visual analogue scale

INTRODUCTION

Tibial plateau fractures occur after high-energy trauma with serious complications (1). They are usually caused by the rotational compression effect of high-energy forces in the valgus or varus position of the fixed extremity, such as a pedestrian's leg being hit by a car bumper (2). The Schatzker classification system is the most common classification of tibial plateau fractures used in the literature: it is based on the location of the fracture, its size and the amount of collapse of the bone (3).

Less invasive techniques and often anterolateral and posteromedial double incision approaches have been used to avoid postoperative wound problems. However, the reduction quality is close to 50%, even when anterolateral and posteromedial approaches are used in the resultant radiological evaluations (4).

In some multicomponent tibial plateau fractures, even two incision techniques are not sufficient to achieve reduction, therefore several incisions are needed. The anterior midline incision method described by Perry may be a suitable alternative for comminuted tibial plateau fractures (5).

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Received: 14.12.2022 **Accepted:** 01.02.2023

The anterior midline incision, which is an approach that orthopedic surgeons are accustomed to due to total knee arthroplasty, provides adequate visualization of the inside of the joint, either by medial parapatellar incision or by removing the meniscus from the lateral or medial side. The aim of this study was to compare anterior midline and bilateral incisions in the same fracture configurations.

MATERIAL AND METHOD

The study was carried out with the Samsun Training and Research Hospital Clinical Researches Ethics Committee (Date: 02.02.2022, Decision No: 2022/2/9). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. The informed consent was waived due to the retrospective nature of the study and the fact that the assessment utilized anonymous research findings.

A total of 137 patients with proximal tibia fractures treated between the 1st of January 2015 and the 1st of December 2022 were evaluated. Patients with Schatzker type 1,2,3,4, limited follow-up, other techniques, open fractures, as well as patients requiring a fasciotomy, were excluded from the study. Twenty-six patients (twenty males and seven females) with Schatzker types 5 and 6 treated with anterior midline and bilateral approach were included in the study. Anterior incision was used in twelve of these patients, and anterolateral and posteromedial double incisions were used in fourteen of them.

Surgical Technique

The patients were placed in the supine position by applying a tourniquet to the extremity to be operated under spinal/epidural anesthesia. The knee was supported below at approximately 75 degrees of flexion. The knee was lifted in the form of a flap by entering through a straight incision from the anterior midline, without detaching the subcutaneous tissue. In some patients, the joint was opened anteriorly with a medial parapatellar incision, and in some patients, the lateral and/or medial menisci were released, making the intra-articular visible without touching the extensor mechanism. The fascia on the muscle was opened and the anterolateral muscles were lifted subperiosteally from the bone as a block. The incision was extended proximal and distally in some patients, depending on how far back it was required to go. Compression fractures involving the joint were removed, the gradations at the joint level were corrected and they were temporarily fixed with neighbours. After the fracture line was reduced under scopy control, fractures were detected with lateral and medial plates and/or screws from anterior to posterior. It was ensured that the skin was not detached during the procedures. The protection of muscle fascia and subcutaneous structures together as a block is aimed at preventing possible tissue nutrition and preventing necrosis (**Figure 1, 2, 3**).

Figure 1. Anterior midline incision

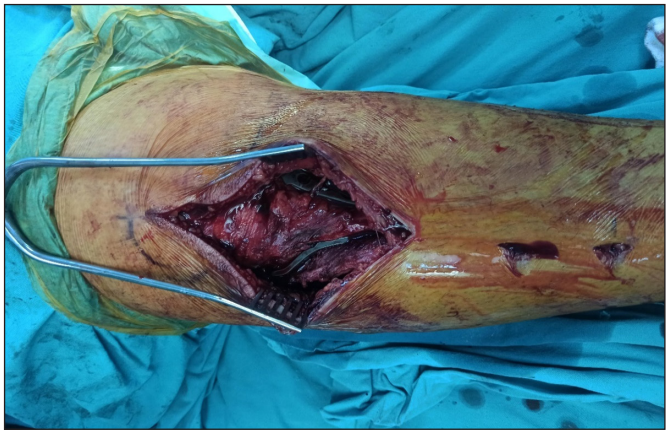

Figure 2. Anterior midline approach dual plate without medial parapateller incision.

Figure 3. Anterior midline approach with meniscus release without medial parapateller incision dual plate x-ray

In the Anterolateral and Posteromedial approaches, the patients were placed in the supine position by applying a tourniquet to the extremity to be operated under spinal/epidural anesthesia. The knee was supported under approximately 75 degrees of flexion, and the subcutaneous tissues were lifted up to the fascia in the form of a flap by entering through the anterolateral and posteromedial incisions. The fascia was opened and the muscles were lifted subperiosteally from the bone. The joint capsule was opened, and the menisci were released from the places where they were attached to the tibia and the inside of the joint was visualized. The steps in the joint were corrected and supported with grafts and fixed with plates under the control of scopy (**Figure 4**).

Figure 4. Bilateral incision; anterolateral and medial for dual plating

In both approaches, a drain was placed in the patients and a temporary long leg splint was placed after the operation. The splints of the patients were removed early postoperatively or 10 days later, and Range of Motion (ROM) exercises were started with an angle-adjustable knee brace. Patients who were thought to have adequate fracture union during their follow-up were taught progressive load-increasing exercises and started walking.

The patients were controlled clinically and radiologically every month. After 6 months of follow-up, the patients were evaluated clinically in terms of visual analog scale, Hospital for Special Surgery (HSS) knee score, ROM and Ligament instability. HSS results ≥85 were considered excellent, 70-85 good, 60-69 moderate, and <60 poor.

Pain was assessed on a visual analogue scale (VAS) ranging from 0 to 10 cm. The VAS was performed in two sections. In the first section we asked the patients to score their pain near the fracture site during Daily activity. Anterior group VAS 2,83 (1-7) 1 patient marked who is go on revision 7, Bilateral group 3,35 (1-7), 3 patients marked 7 whose were operating more than one and still unstable knee motion.

Figure 5. Bilateral approach dual plate x-ray

The Rasmussen radiological criteria, Medial Proximal Tibial Angle (MPTA) and Posterior Proximal Tibial Angle (PPTA) were evaluated radiologically. If the MPTA is between 85° and 90°, PPTA is between 77° and 84° and <3 mm stepping, this is considered as anatomical reduction.

Statistical analysis

The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS), version 15.0 for windows. Categorical variables were expressed as frequencies and continuous variables were expressed as mean and standard deviations. The Shapiro-Wilk test was used to assess normal distribution of the continuous data. The Student t test and chi square test were used to compare continuous variables and categorical variables between anterior and bilateral group. A p value less than 0.05 was indicative of statistical significance for all comparisons.

RESULTS

A total of twenty-six patients (20 males and 6 females) with tibial plateau fractures were included in the study. Twelve of the patients were selected from those using anterior midline incisions, and fourteen from those using double incisions as anterolateral and posteromedial incisions. The mean age of the patients was 50.8 (24-76) years. The distribution of patients according to fracture classification was 9 Schatzker type-6, 17 Schatzker type-5. The average follow-up time was 34,1 months (24.5-42.2).

Union in the anterior midline was 11.07 (±1.68) weeks and bilateral union was 9.96 (±1.35) weeks (p: 0.074). Rasmussen scoring was 14.83 (±2.16) in the anterior group and 14.57 (±2.13) in the bilateral group (p:0.760). The MPTA was 85.35 (±3.97) degrees in the anterior group, and the MPTA was 86.40 (±3.74) degrees in the bilateral group (p: 0.492). PPTA was 80.77 (±1.95) degrees in the anterior group, and PPTA was 80.85 (±1.78) degrees in the bilateral group. HSS score was 70 (±9.02) in the anterior group and HSS score was 71.71 (±1.15) in the bilateral group (p:0,681). Rom was measured as 101.67 (±12.67) degrees in the anterior group and 107.86 (±13.54) degrees in the bilateral group (p: 0.243). The VAS anterior group was 2.83(±1,64) and the VAS bilateral group was 3.36 (±2.09) (p:0.491). Instability was seen in one patient in the anterior group and one patient in the bilateral group (p:1). Infection was observed in one patient in the anterior group and in three patients in the bilateral group (p:0.598) (**Table 1**).

Table 1. Clinical and radiological results of patients with tibial plateau fracture

	Group	N	Mean	Standart deviation
Age	Anterior	12	44.83 years	10.83
	Bilateral	14	55.93 years	11.12
Bony union	Anterior	12	11.07 weeks	1.68
	Bilateral	14	9.96 weeks	1.35
Follow-up time	Anterior	12	34.69 months	5.69
	Bilateral	14	33.62 months	6.13
Rasmussen scoring system	Anterior	12	14.83 points	2.16
	Bilateral	14	14.57 points	2.13
MPTA	Anterior	12	85.35 degrees	3.97
	Bilateral	14	86.40 degrees	3.74
PPTA	Anterior	12	80.77 degrees	1.95
	Bilateral	14	80.850 degrees	1.78
HSS	Anterior	12	70.00 points	9.02
	Bilateral	14	71.71 points	11.55
ROM	Anterior	12	101.67 degrees	12.67
	Bilateral	14	107.86 degrees	13.54
VAS	Anterior	12	2.83 points	1.64
	Bilateral	14	3.36 points	2.09

MPTA: Medial Proximal Tibial Angle, PPTA: Posterior Proximal Tibial Angle, VAS: visual analogue scale, HSS: Hospital for Special Surgery, ROM: Range of Motion.

DISCUSSION

Schatzker Type V and VI plateau fractures, particularly posterior fractures that distort the joint, are often challenging fractures. Therefore, many different treatment strategies such as anterolateral, posteromedial incisions and fibular osteotomy have been developed (4–7). Currently, many new approaches are reported, and the anterior midline approach is one of them.

The need for knee arthroplasty may arise, as the gradation of the joint after these fractures can lead to pain and arthrosis. There are many studies in the literature related to this (8–11). None of our patients needed arthroplasty treatment until this study.

Chakraverty et al. (12) recommend anterior midline incision in patients with tibial tubercle fracture and lateral plate placement. In their study with seventeen patients, Çakar et al. (13) reported that the joint visibility achieved by entering the anterior midline incision in the medial parapatellar was satisfactory for fracture reduction.

In the colon-specific plating method performed by Selvaraj et al. (4), the anterior incision may not be sufficient for the posterior plate only, out of the single plate, double plate and triple plate used, but we suppose that this rosin can be resolved with anterior-posterior screws since the joint can be seen easily.

We believe that fewer incisions will reduce soft tissue complications, in parallel with the study by Kumar et al. (14), in which they published the results of less extensile indirect reduction in 2021, though we believe that reduction by visualizing the joint would be more appropriate since indirect reduction of intra-articular fractures often results in failure.

In the study by Cıtak et al. (15) in which they compared the results of single plate and double plate in bicondylar fractures without posteromedial fractures, they could not find a significant clinical difference. Although the double plate provides a more rigid stability biomechanically, it has not been seen clinically. In our opinion, this is valid for posterior fracture fragments. We believe that if an articular surface that does not have a step with an adequate sagittal plane is provided with screws, it will give clinically sufficient results.

In the study of Wang et al. (7) in 2021, they showed that the combined use of double lacquer and compression screws decreased the rate of reduction loss and increased clinical satisfaction. In our study, we believe that a reduction reinforced with double plate and anterior posterior compression screws, which are used more frequently in anterior incision, is effective on good results.

In a study conducted by Raj et al. (16) on thirty patients with tibial plateau fractures in 2021, they reported good to excellent results with bilateral incision double plate. Various complications were encountered in five patients, but there was no non-union or malunion as a result. They reported radiological results that were close to anatomical results. Similar results were obtained in both groups in our study.

According to Mandal et al. (17), their series of Schatzker V/VI fractures, a single midline incision resulted in a higher rate of postoperative skin necrosis compared to the double incision technique. However, such a result

was not encountered in our study, and we suspect that the possible difficulty is excessive detachment of the skin. In contrast, Barei et al. (4) reported deep wound infection in 8.4% of them after combined anterolateral and posteromedial combined tibia operations for bicondylar tibial plateau fractures.

Guild et al. (18) reported that anterior midline incision is a safe and adequate surgical approach when performed by an experienced surgeon, and there is no difference in terms of infection or reoperation with bilateral incision, as a result of the largest series of retrospective studies using 41 anterior midline incisions in 92 patients and 51 bilateral incisions. Similar results were obtained in our study, and we did not see any difference between the two approaches in terms of postoperative clinical satisfaction.

Lifting the skin as a flap on the muscle fascia without separation is important with regard to possible skin necrosis. In the 2013 study by Cho et al. (19), when the muscle and skin were separated as flaps, it was stated that the functional status of postoperative patients may be different as a result of deltoid and MCL damage in the medial region and LCL and other collateral ligament damage in the lateral region. However, in a complex fracture involving the joint, it is impossible to objectively demonstrate that the functional outcome is impaired.

This study has many limitations. Open fractures were not included because their natural course is prone to infection. Not all surgical operations are performed by the same surgeon, and surgical experience may make a difference between the results. Although the classification of fractures is similar, some surgeons' medial parapatellar incision and some surgeons' access to the joint by removing the lateral and medial meniscus, may result in different results in the same approach, but our number of patients was insufficient to evaluate this. Another shortcoming of the study is that radiological results cannot be made by seeing the articular surface in detail with tomography, because it poses an ethical problem to perform postoperative computed tomography for each patient. None of our patients had had arthrosis leading to knee replacement yet, but we think that if this happens, the anterior midline incision will be a safer approach. The principal question concerning the anterior midline incision is the reduction of posterior fractures. Visual reduction of the knee joint with either the medial parapatellar or lateral or medial approach and fixation of the posterior elements with screws is sufficient in most cases. Although the mechanical superiority of the posterior plate is not discussed, we believe that its necessity should be discussed.

CONCLUSION

The anterior midline incision is an adequate approach for the reduction of many fractures involving the joint. In this approach, it is important not to detach the skin, but to lift it as a flap over the muscle fascia in terms of possible skin necrosis. It is satisfactory in terms of visibility of intra-articular fractures and advantageous in terms of prosthetic surgeries which may be needed in the future.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of the Samsun Training and Research Hospital Clinical Researches Ethics Committee (Date: 02.02.2022, Decision No: 2022/2/9).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer reviewed.

Conflict of Interest: The authors declare that they have no conflict of interest.

Financial Disclosure: The authors declare that this study has received no financial support.

Author Contributions: The author declares that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

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