ORIGINAL ARTICLE

Management of complex tibial plateau fractures: A comparative study of Ilizarov external fixation method with or without minimal internal fixation

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ABSTRACT

BACKGROUND: Complex tibial plateau fractures present significant challenges due to severe articular comminution and soft tissue complications. There is still no consensus in the current literature regarding the optimal treatment for these fractures. This study aims to evaluate the clinical and radiological outcomes of complex tibial plateau fractures treated with Ilizarov external fixation with or without minimal internal fixation.

METHODS: This retrospective study analyzed 62 patients with Schatzker type V or VI tibial plateau fractures, with a minimum follow-up duration of three years. Patients were divided into two groups: one treated with circular external fixation (Ilizarov method) combined with minimal internal fixation and the other treated with circular external fixation alone. Clinical, functional, and radiological outcomes were assessed, including knee range of motion (ROM), Knee Society Score (KSS), Kujala Score, and Visual Analog Scale (VAS) score.

RESULTS: At the latest follow-up, Group 1 demonstrated better functional and clinical outcomes compared to Group 2. The mean knee range of motion in Group 1 was 116.56° versus 97.83° in Group 2 ($p<0.05$). Group 1 also had higher KSS scores (92.43 vs. 79.06) and Kujala Scores (94.75 vs. 90.6) and lower VAS scores (1.13 vs. 3.33) (all $p<0.05$). Flexion contracture and extension lag were significantly less prevalent in Group 1, with fewer cases and lower severity. Circular external fixators were removed earlier in Group 1 (120.43 days) compared to Group 2 (157.06 days) ($p<0.05$), with a lower incidence of delayed union in Group 1. Varus malalignment was also less frequent and less severe in Group 1. No major complications, such as neurovascular injuries, septic nonunion, or deep venous thrombosis, were reported in either group. Both groups exhibited similar rates of minor complications, primarily pin tract infections, which resolved with appropriate treatment.

CONCLUSION: Ilizarov external fixation, with or without minimal internal fixation, is an effective treatment method for complex tibial plateau fractures. However, patients in whom the joint was anatomically reduced demonstrated better anatomical reduction, improved range of motion, earlier weight-bearing, and enhanced functional recovery, highlighting the superiority of this approach. These findings support the recommendation of this combined technique as the preferred treatment for such challenging fractures.

Keywords: Intra-articular fracture; anatomical reduction; tibial plateau; Schatzker; external fixation; internal fixation; Ilizarov; Knee Society Score (KSS); Kujala.

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INTRODUCTION

Intra-articular fractures of the proximal tibia, caused by axial loading often combined with angular forces, are referred to as tibial plateau fractures.[1,2] As a result of the magnitude and direction of the initial forces acting on the plateau, various combinations of intra-articular fractures involving comminution, impaction, and/or varus or valgus angulation, along with posteromedial fragments, have been reported. These fractures are classified according to the Schatzker classification into six groups.[3]

Complex tibial plateau fractures, resulting from high-energy trauma and classified as Schatzker type V (bicondylar) and type VI (with additional metaphyseal-diaphyseal separation), present one of the most challenging problems for orthopedic trauma surgeons due to significant articular comminution and associated soft tissue complications.[4-6] The primary goal in the treatment of complex tibial plateau fractures is not only to achieve stable osteosynthesis and bony union through the reconstruction of the articular surface and restoration of the mechanical axis of the leg, thereby enabling a functional range of motion (ROM), but also to restore the soft tissue envelope, which is often severely damaged in Type V and VI tibial plateau fractures.[2,7,8]

Various treatment options have been proposed for complex tibial plateau fractures. Conservative methods have been shown to yield inferior results, including an inability to restore the articular surface, articular collapse, instability, varus or valgus deformities beyond acceptable limits, and poor functional outcomes.[9,10] In contrast, open reduction and internal fixation (ORIF) using single or double buttress plating has been associated with excessive stripping of the soft tissue envelope, leading to compromising periosteal circulation and devitalization of bone fragments. This approach has been reported to have a high incidence of severe complications, including infection, wound dehiscence, soft tissue necrosis, pain, stiffness, and poor functional outcomes despite adequate articular restoration. Additionally, some cases have demonstrated an inability to achieve proper articular restoration even with open access, as well as instability, post-traumatic arthritis, and soft tissue complications requiring reoperations.[2,3] The use of ORIF for complex tibial fractures is still controversial due to its invasiveness and the extensive soft tissue dissection and stripping involved, which may lead to additional trauma and contribute to the aforementioned complications.[11,12]

To address the potential complications and reduce the need for revision surgeries associated with ORIF using plating, external fixation has gained significant interest over the years as a treatment for complex tibial plateau fractures.[1,8,13] The Ilizarov method[14] has been effectively applied not only to acute complex tibial plateau fractures but also to pseudoarthrosis, post-traumatic deformities, and both open and comminuted closed fractures.[4,8,15] Circular external fixators using the Ilizarov technique have been reported to provide acceptable alignment, stabilization, and reduction while promoting soft tissue recovery.[5,6,16-18] Studies have shown that combining the Ilizarov method with minimal internal fixation, using cannulated screws or K-wires, enhances the restoration of the articular surface while minimizing excessive soft tissue damage. This combination offers high fixation stability, facilitates early mobilization, and results in improved knee range of motion, leading to better functional and radiological outcomes.[6,19]

The objective of this study was to compare external fixation using the Ilizarov method alone with external fixation combined with minimal internal fixation in the treatment of complex tibial plateau fractures to evaluate clinical, functional, and radiological outcomes.

MATERIALS AND METHODS

A total of 392 patients with tibial plateau fractures were identified at our institution. Among them, 198 were diagnosed with Schatzker type V or VI complex tibial plateau fractures and underwent operative treatment at the same institution.

Patients were included in the study if they met the following criteria:

- Diagnosed with a complex tibial plateau fracture (Schatzker type V or VI).
- Treated with a circular external fixator (Ilizarov method) with or without minimal internal fixation.
- Skeletally mature at the time of the injury (age>18 years).
- Sustained an acute injury without prior treatment.
- Had a minimum follow-up duration of three years.
- Were ambulatory prior to injury.
- Able to attend regular follow-up appointments.
- Willing to participate in the study.

Patients were excluded if they met any of the following criteria:

- Having a complex (Schatzker type V or VI) tibial plateau fracture treated with open reduction and internal fixation.
- Skeletally immature at the time of injury.
- Had a non-acute injury (<2 weeks) or received initial treatment elsewhere before being referred to our institution.
- Had a follow-up duration of less than three years.
- Unable to attend regular follow-up appointments.
- Unwilling to participate in the study.

Based on these criteria, 136 patients were excluded from the study for the following reasons: 35 patients were treated with ORIF, 29 had non-acute injuries, 31 received initial treatment at another institution before being referred to ours, 32 opted to continue follow-up at hospitals in their home cities rather than at our institution, and nine declined to participate in the study. As a result of meeting the inclusion criteria, 62 patients

were enrolled in the study. Informed consent was obtained from all patients, allowing the use of their preoperative, intraoperative, and postoperative data, including photographs and videos, for publication while ensuring their identities remained confidential. Ethics committee approval was obtained from Istanbul University Faculty of Medicine Dean's Office Clinical Research Ethics Committee (Approval Number: E-29624016-050.04-2861158, Date: 10.09.2024).

The study population was divided into two groups. Group 1 consisted of patients treated with a circular external fixator (Ilizarov method) combined with minimal internal fixation (Fig. 1). Group 2 consisted of patients treated with a circular external fixator (Ilizarov method) without minimal internal fixation (Fig. 2).

Group 1 comprised 32 patients (11 females, 21 males) with a mean age of 54.4 years (range: 24-84) and a mean follow-up duration of 149.06 months (range: 72-228). All patients sustained high-energy injuries, including 21 motor vehicle accidents, nine falls from significant heights, and two gunshot wounds). Regarding additional injuries, one patient had an elbow fracture-dislocation and a femoral head fracture, another had contralateral scapula, iliac wing, and third and fourth metacarpal fractures. Additionally, one patient sustained contralateral femoral shaft and patella fractures, while another had a C6-C7 fracture-dislocation without neurological deficits.

Group 1 comprised 30 patients (7 females, 23 males) with a mean age of 54.1 years (range: 29-85) and a mean follow-up duration of 149.7 months (range: 48-288). All patients sustained high-energy injuries, including 23 motor vehicle accidents, six falls from significant heights, and one gunshot wound. In terms of additional injuries, two patients had contralateral femoral shaft fractures, one had an ipsilateral intertrochanteric femur fracture, one had a contralateral calcaneus fracture, one had a contralateral distal radius fracture, and one had a contralateral lateral malleolus fracture.

Both groups were comparable in terms of demographic characteristics, including age and mean follow-up duration ($p>0.05$) (Table 1).

Both groups underwent treatment with circular external fixators using the Ilizarov method, ensuring proper length, alignment, and rotation. In addition, Group 2 received two 6.5-mm cancellous cannulated screws, inserted through a mini-incision or percutaneously, to achieve optimal restoration of the articular surface after confirming proper reduction with K-wires and reduction clamps by using image intensifier. Open fractures were managed with immediate irrigation, debridement, and intravenous (IV) antibiotics. Gradual knee ROM exercises were initiated on the fifth postoperative day for both groups.

Patients were functionally evaluated using knee ROM, Knee Society Scores (KSS) to assess overall knee function, Kujala Score to assess anterior knee and patellofemoral pain, and Visual Analog Scale (VAS) score to assess overall knee pain.

Patients were evaluated radiographically using standard standing anteroposterior and lateral X-rays preoperatively and at the latest follow-up visit. Additionally, stress X-rays were performed at the latest follow-up to assess any instability. The decision to remove the fixator was made once union tissue was observed on anteroposterior (AP) and lateral radiographs, with bridging achieved between both bone ends.

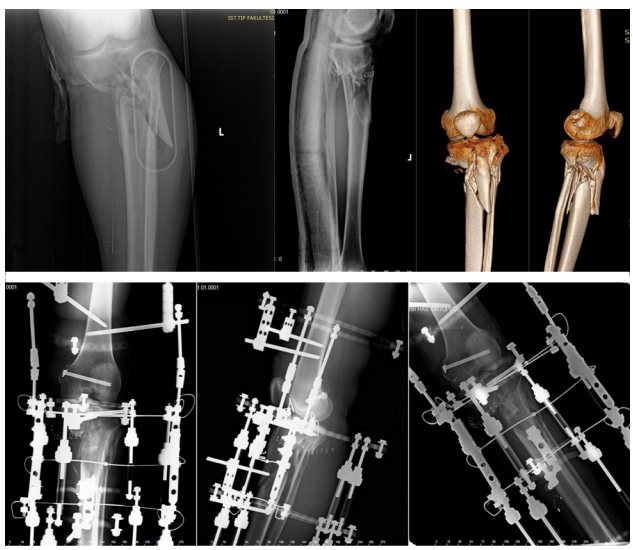

Figure 1. Complex tibial plateau fracture in a 35-year-old man treated with a circular external fixator (Ilizarov method) combined with minimal internal fixation.

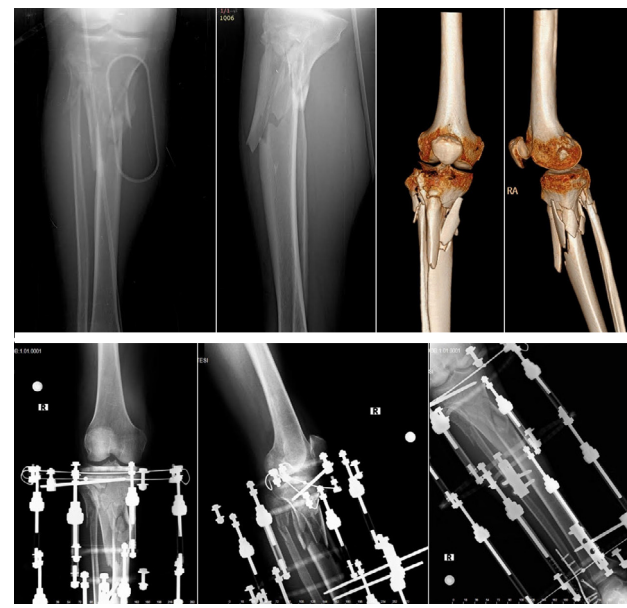

Figure 2. Complex tibial plateau fracture in a 43-year-old man treated with a circular external fixator (Ilizarov method) without minimal internal fixation.

Table 1. Demographic characteristics of the participants

	Group 1 (n=32)	Group 2 (n=30)	p
Age (years), n (min-max)	54.4 (24-84)	54.1 (29-85)	0.892
Gender			
Female	11	7	0.456
Male	21	23	
Education			
Primary School	9	8	0.392
High School	8	9	
University	15	13	
Marital Status			
Married	25	24	0.524
Unmarried	7	6	
Duration of Follow-up (months)	149.06 (72-228)	149.7 (48-228)	0.912

n: Number; min: Minimum; max: Maximum; p: Homogeneity of Variances.

After fixator removal, the extremities were protected with a removable splint, and patients were allowed partial weight-bearing for 4-6 weeks. Complications, including osteomyelitis, limb length discrepancy, flexion contractures, extension lags, mediolateral and anteroposterior instabilities, and delayed bone union, were documented.

For statistical analysis, SPSS software (version 22.0; SPSS Inc., Chicago, IL, USA) was used. Student's t-test was applied for quantitative comparisons between the two groups, with data expressed as mean±standard deviation (SD). The Chi-square test and Fisher's exact test were used for categorical variable analysis where appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

At the latest follow-up appointment, Group 1 demonstrated better functional and clinical outcomes compared to Group 2. The ROMs was 116.56° (range: 105°-130°) in Group 1 and 97.83° (range: 70°-115°) in Group 2 ($p<0.05$). The KSS was 92.43 (range: 88-95) in Group 1 and 79.06 (range: 64-91) in Group 2 ($p<0.05$). The Kujala Scores was 94.75 (range: 92-98) in Group 1 and 90.6 (range: 88-95) in Group 2 ($p<0.05$). The VAS Score was 1.13 (range: 0-3) in Group 1 and 3.33 (range: 2-5) in Group 2 ($p<0.05$). In terms of all functional scores, Group 1 was found to be superior to Group 2, with high statistical significance. In terms of flexion contracture, six patients in Group 1 had a 5° contracture, while one patient had a 10° contracture. In Group 2, In Group 2, four patients had a 5° flexion contracture, while nine patients had a 10° contracture ($p<0.05$). Similarly, regarding extension lag, three patients in Group 1 had a 5° extension lag, while in Group 2, four patients had a 5° extension lag, and three patients had a 10° extension lag ($p<0.05$). These findings indicate that Group 1 had significantly better results in terms of both flexion contracture and extension lag compared to Group 2 (Table 2).

Circular external fixators were removed after an average of 120.43 days in Group 1 and 157.06 days in Group 2 ($p<0.05$). Bony union was achieved in all cases in Group 1, with only one patient (3.1%) experiencing delayed union. In Group 2, although all cases achieved bony union, four patients (13%) had delayed union ($p<0.05$). Even though the circular external fixators were removed significantly earlier in Group 1, the rate of delayed union was statistically significantly lower in this group.

After complete bony union, six patients in Group 1 were found to have a 5° varus malalignment. In Group 2, three patients had a 5° varus malalignment, one patient had a 7° of varus malalignment, and three patients had a 10° of varus malalignment ($p<0.05$). No anteroposterior instability was detected in either group. Statistically, Group 1 had significantly less varus malalignment, both in frequency and severity, compared to Group 2.

No cases of neurovascular injury, septic nonunion, external fixator intolerance, pin loosening, deep venous thrombosis, or the need for amputation were observed. Four patients in Group 1 (9.3%) and three patients in Group 2 (10%) ($p>0.05$) developed pin tract infections, all of which resolved spontaneously with appropriate wound care and antibiotics. No other complications, including limb shortening or osteomyelitis, were detected in either group. Both groups exhibited similar rates of pin tract infections as the only postoperative complication.

Table 2. Between-group analysis of outcome measures

	Group 1 (n=32)	Group 2 (n=30)	p
Knee ROM, mean (min-max)	116.56 (105-130)	97.83 (70-115)	<0.05
KSS Score, mean (min-max)	92.43 (88-95)	79.06 (64-91)	<0.05
Kujala Score, mean (min-max)	94.75 (92-98)	90.6 (88-95)	<0.05
VAS Score, mean (min-max)	1.13 (0-3)	3.33 (2-5)	<0.05
Number of Patients with Flexion Contracture, n (%)			
Total	7	13	<0.05
5 degrees	6	4	
10 degrees	1	9	
Number of Patients with Extension Lag, n (%)			
Total	3 (9.4)	7 (23.3)	<0.05
5 degrees	3 (9.4)	4 (13.3)	
10 degrees	-	3 (10.0)	
Bony Union, n (%)	31 (96.9)	26 (86.7)	<0.05
Delayed Union, n (%)	1 (3.1)	4 (13.3)	
Varus Malalignment, n (%)			
Total	6 (18.7)	6 (20.0)	<0.05
5 degrees	6 (18.7)	2 (6.7)	
7 degrees	-	1 (3.3)	
10 degrees	-	3 (10.0)	
External Fixator Removal Time (days)	120.43	157.06	<0.05

n: Number; min: Minimum; max: Maximum. p<0.05 is considered statistically significant. KSS: Knee Society Score; VAS: Visual Analog Scale.

DISCUSSION

Complex tibial plateau fractures (Schatzker type V and VI), typically resulting from high-energy trauma, are characterized by severe comminution, intra-articular involvement, and extensive soft tissue damage.[1,3,11] The primary treatment principles for these fractures include achieving proper reduction with precise articular reconstruction, along with acceptable alignment and restoration of the lower extremity's mechanical axis.[7,15,20] The optimal management of complex tibial plateau fractures remains challenging and controversial. Over the past few decades, various authors have advocated different treatment modalities, yet no consensus has been reached regarding the best approach for these complex injuries. However, according to the literature, ORIF with dual plating, as well as hybrid and circular external fixation, with or without limited internal fixation, are among the most commonly used treatment options for tibial plateau fractures.[13,17,21] Regardless of the technique employed, the primary goals of treatment are to achieve anatomical joint restoration, provide stable osteosynthesis to facilitate early mobilization and weight-bearing, and prevent complications associated with soft tissue damage.[22,23]

While open reduction and internal fixation using single or double plates has advantages, such as direct visualization and stable reduction with articular restoration, it has also been associated with severe complications. Many authors have reported disastrous outcomes, including skin and soft tissue necrosis, high infection rates, and eventual failure.[6,11,19] Yang et al.[24] reported deep infections in 5 out of 12 patients (41.7%) who underwent ORIF for Schatzker type VI fractures. Mallik et al.[25] reported wound infections in 80% (4/5) of patients treated with ORIF, with additional osteomyelitis occurring in 40% of cases. Young and Barrack, in their series on patients with tibial plateau fractures treated with ORIF, found an infection rate of 31.6% (6/19) for single buttress plating and 87.5% (7/8) for double buttress plating.[12] Similarly, Moore et al.[26] reported an infection rate of 23%, along with wound dehiscence in 72.7% (8/11) of patients with bicondylar tibia fractures treated with ORIF using two T-plates.

The Ilizarov method of external fixation allows for multiplanar stabilization of fractures while minimizing soft tissue damage, making it a valuable treatment option for complex tibial plateau fractures. However, the primary goal of surgical treatment for intra-articular fractures is to restore the articular surface while ensuring stable fixation. Stamer et al.[27] reported that patients with complex tibial plateau fracture who underwent joint restoration had better outcomes compared to those whose articular surfaces were not restored. Likewise,

in a study conducted by Catagni et al.,[2] which included 59 patients with complex tibia fractures, the results were found to be highly favorable in patients treated with internal fixation of the joint. In this study, effective intra-articular reduction with limited open reduction was successfully performed in 32 patients. Similar to previous findings in the literature, our study demonstrated better clinical outcomes in the group in which the joint was anatomically restored. In a study where the joint was restored with internal fixation, the reported knee range of motion was 112°.[4] However, Gaudinez et al.[28] reported a mean range of motion of 85° in patients who achieved good joint reduction, while Morandi and Pearse[29] reported an ROM of 113°. In the study of Zecher et al.,[30] the minimum ROM achieved by patients was 90°. In our study, the knee range of motion in patients who underwent anatomical joint restoration was 116.56° (range: 105°-130°), while it was 97.83° in the other group. Additionally, we observed that the average postoperative joint range of motion in our study was greater than that reported in other similar studies.

Clinical and functional evaluations were performed using the Knee Society Score, Kujala Score, and VAS score.[31] Overall, we found that the clinical and functional scores of patients who underwent anatomical joint restoration were statistically significantly better. According to the KSS, the mean score was 92.4 in patients with anatomical reduction, compared to 79.1 in those with non-anatomical reduction. In a study by Kumar and White,[17] a mean KSS of 83 was reported in patients who achieved anatomical restoration. Additionally, in nine patients (21%) with non-anatomical reduction, the average KSS score was 52. However, El Barbary et al.[4] reported a mean KSS of 87.7, while Mikulak et al.[32] found a mean KSS value of 78.5 in patients with anatomical reduction. In addition, the Kujala Score and VAS score were used to evaluate patients' pain. According to the Kujala Score, the mean score was 94.75 in patients who underwent anatomical reduction, compared to 90.6 in those treated with an external fixator alone. Similarly, in the VAS assessment, the mean score for patients with anatomical reduction was 1.13, whereas it was 3.33 in the other group. At the final follow-up, our study demonstrated that both clinical and functional scores were better in the patient group that underwent anatomical joint restoration.

All frames were removed after bony union was achieved. The average duration of external fixator removal in both groups was slightly longer than previously reported in the literature. The fixator removal time was 17.1 weeks (120 days) in the joint restoration group and 22.4 weeks (157 days) in the other group ($p<0.05$). This period was reported as 11.8 weeks in the study by Subramanyam et al.[33] Similarly, Marsh et al.[6] reported an average duration of 12 weeks, while Watson et al.[18] found a mean duration of 16.6 weeks in their study on tibial plateau fractures treated with joint restoration. Bony union was achieved in all cases in Group 1, with only one patient (3.1%) experiencing delayed union. In Group 2, although all cases achieved bony union, delayed union was noted in four patients (13%) ($p<0.05$). Even though the circular external fixators were removed significantly earlier in Group 1, the rate of delayed union was statistically significantly lower in this group.

El Barbary et al.[4] reported varus deformity in one patient during the follow-up of complex tibial plateau fractures treated with joint restoration. Katsenis et al.[7] reported malalignment of less than 10° in two patients and more than 10° in four patients. Similarly, Marsh et al.[6] observed varus deformity of approximately 8° in two patients in their series. In our study, bony union was achieved in all patients. After complete bony union, one patient in the joint restoration group developed a varus deformity of approximately 5°. However, in the other group, a total of six patients had varus deformities ranging from 5° to 10°. Group 1 showed statistically significantly less varus malalignment and a lower degree of deformity compared to Group 2.

Four patients in Group 1 (9.3%) and three patients in Group 2 (10%) ($p>0.05$) developed pin tract infections, all of which resolved spontaneously with appropriate wound care and antibiotics. No other complications, including shortening or osteomyelitis, were observed in either group. Both groups exhibited similar rates of pin tract infections, which was the only postoperative complication reported.

The extent of soft tissue damage and the risk of subsequent infection are known to be critical determinants of functional outcomes. Our infection rates are comparable to those reported in previous studies on Schatzker type V and VI tibial plateau fractures treated with external fixation. Kumar et al.[17] reported osteomyelitis in four patients and amputation due to infection in three patients. Katsenis et al.[7] found one case of infected nonunion in their study, while Kataria[34] reported two cases of superficial wound infections and three cases of pin tract infections. In our study, four patients in Group 1 (9.3%) and three patients in Group 2 (10%) ($p>0.05$) developed pin tract infections, all of which resolved spontaneously with appropriate wound care and antibiotics. No other complications, including shortening or osteomyelitis, were observed in either group. Both groups exhibited similar rates of pin tract infections, which was the only postoperative complication reported. Importantly, these infections did not affect the final clinical outcomes in our study.

In general, this study emphasizes the clinical success and low morbidity of a treatment method that combines minimally invasive joint reduction with the Ilizarov technique for the management of Schatzker type V and VI tibial plateau fractures.

CONCLUSION

This study highlights the clinical success and low morbidity of a treatment method that utilizes minimally invasive joint line reduction in combination with the Ilizarov technique for the treatment of Scthazker type V and VI tibial plateau fractures. This approach has proven to be highly effective in treating these complex fractures, which are often associated

with extensive soft tissue damage, by ensuring proper limb alignment and anatomical joint restoration. The findings of this study are consistent with similar research in the literature. The observed reduction in severe complications related to soft tissue damage, particularly infections, along with improved anatomical reduction, consequently leading to better range of motion, earlier weight-bearing, and enhanced functional recovery, demonstrates the superiority of this treatment method. These findings support the recommendation that this technique should be the treatment of choice for such injuries.

Ethics Committee Approval: Ethics committee approval was obtained from Istanbul University Faculty of Medicine Dean's Office Clinical Research Ethics Committee (Approval Number: E-29624016-050.04-2861158, Date: 10.09.2024).

Informed Consent: Informed consent was obtained from all patients.

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ORİJİNAL ÇALIŞMA -

Kompleks tibial plato kırıklarının yönetimi: Minimal internal tespitli veya minimal internal tespitsiz ilizarov eksternal fiksasyon yönteminin karşılaştırmalı çalışması

AMAÇ: Kompleks plato tibia kırıkları, ciddi eklem parçalanması ve yumuşak doku sorunları nedeniyle önemli zorluklar içerir. Mevcut literatürde bu kırıkların optimal tedavisi için bir fikir birliği bulunmamaktadır. Bu çalışmada, İlizarov eksternal fiksasyonu ile minimal internal fiksasyon uygulanarak veya uygulanmadan tedavi edilen kompleks tibia plato kırıklarının klinik ve radyolojik sonuçlarını değerlendirmeyi amaçladık.
GEREÇ VE YÖNTEM: Bu retrospektif çalışmada, Schatzker tip V veya VI tibia plato kırığı olan ve en az üç yıllık takip süresi ile tedavi edilen 62 hasta incelendi. Hastalar iki gruba ayrıldı: bir grup (Grup 1) minimal internal fiksasyon ile birlikte sirküler eksternal fiksasyon (Ilizarov yöntemi) ile tedavi edildi, diğer grup (Grup 2) ise sadece sirküler eksternal fiksasyon ile tedavi edildi. Eklem hareket açıklığı (EHA), Diz Derneği skorları (KSS), Kujala skorları ve görsel analog skala (VAS) skorları dahil olmak üzere klinik, fonksiyonel ve radyolojik sonuçlar değerlendirildi.
BULGULAR: Son kontrollerde, Grup 1, Grup 2'ye kıyasla daha iyi fonksiyonel ve klinik sonuçlar gösterdi. Grup 1'de ortalama diz hareket açıklığı (EHA) 116.56° iken Grup 2'de 97.83° idi ($p<0.05$) ve daha yüksek KSS skorları (92.43'e karşı 79.06), Kujala skorları (94.75'e karşı 90.6) ve daha düşük VAS skorları (1.13'e karşı 3.33) vardı (tümü $p<0.05$). Grup 1'de fleksiyon kontraktürü ve ekstansiyon defisiti olan hasta sayısı daha azdı ve aynı zamanda kontraktür ve defisit miktarı daha düşük derecelerdeydi. Sirküler eksternal fiksatörler Grup 1'de (120,43 gün) Grup 2'ye (157,06 gün) kıyasla daha erken çıkarıldı ($p<0,05$) ve Grup 1'de kaynama gecikmesi oranı daha düşüktü. Varus deformitesi Grup 1'de daha az sayıda ve şiddetteydi. Her iki grupta da nörovasküler yaralanma, septik kaynamama veya derin ven trombozu gibi majör komplikasyonlar bildirilmedi. Her iki grupta da başta pin dibi enfeksiyonları olmak üzere benzer oranlarda minör komplikasyon görüldü ve bunlar uygun tedavi ile düzeldi.
SONUÇ: İlizarov eksternal fiksasyonu, minimal internal fiksasyon ile birlikte ya da birlikte olmadan kompleks plato tibia kırıklarının tedavisinde etkili bir yöntemdir. Bununla birlikte, eklemin anatomik olarak redükte edildiği hastalarda daha iyi anatomik redüksiyon,artmış hareket açıklığı, erken yük verme ve daha fazla fonksiyonel iyileşme tespit edilmiş ve bu yöntemin üstünlüğü gösterilmiştir. Bu bulgular eşliğinde bu kombine tekniğin bu tür zorlu kırıklar için tercih edilen tedavi yöntemi olarak önerilmesi desteklenmektedir.

Anahtar sözcükler: Eklem içi kırık; anatomik redüksiyon; plato tibia; schatzker; eksternal fiksasyon; internal fiksasyon; ilizarov; kss; kujala.

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