



## Distal tibial pilon fractures (AO/OTA type B, and C) treated with the external skeletal and minimal internal fixation method

Zbrinjavanje preloma distalnog pilona tibije (AO/OTA tipa B, C) metodom spoljašnje skeletne i minimalne unutrašnje fiksacije

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### Abstract

**Background/Aim.** Distal tibial pilon fractures include extra-articular fractures of the tibial metaphysis and the more severe intra-articular tibial pilon fractures. There is no universal method for treating distal tibial pilon fractures. These fractures are treated by means of open reduction, internal fixation (ORIF) and external skeletal fixation. The high rate of soft-tissue complications associated with primary ORIF of pilon fractures led to the use of external skeletal fixation, with limited internal fixation as an alternative technique for definitive management. The aim of this study was to estimate efficacy of distal tibial pilon fractures treatment using the external skeletal and minimal internal fixation method. **Methods.** We presented a series of 31 operated patients with tibial pilon fractures. The patients were operated on using the method of external skeletal fixation with a minimal internal fixation. According to the AO/OTA classification, 17 patients had type B fracture and 14 patients type C fractures. The rigid external skeletal fixation was transformed into a dynamic external skeletal fixation 6 weeks post-surgery. **Results.**

This retrospective study involved 31 patients with tibial pilon fractures, average age 41.81 (from 21 to 60) years. The average follow-up was 21.86 (from 12 to 48) months. The percentage of union was 90.32%, nonunion 3.22% and malunion 6.45%. The mean to fracture union was 14 (range 12–20) weeks. There were 4 (12.19%) infections around the pins of the external skeletal fixator and one (3.22%) deep infections. The ankle joint arthrosis as a late complication appeared in 4 (12.90%) patients. All arthroses appeared in patients who had type C fractures. The final functional results based on the AOFAS score were excellent in 51.61%, good in 32.25%, average in 12.90% and bad in 3.22% of the patients. **Conclusion.** External skeletal fixation and minimal internal fixation of distal tibial pilon fractures is a good method for treating all types of intra-articular pilon fractures. In fractures types B and C dynamic external skeletal fixation allows early mobility in the ankle joint.

**Key words:** tibial fractures; orthopedic procedures; external fixators; internal fixators; treatment outcome.

### Apstrakt

**Uvod/Cilj.** Prelomi distalnog pilona tibije podrazumevaju spoljašnje artikularne prelome metafize tibije i teže unutrašnje artikularne prelome pilona tibije. Ne postoji univerzalni metod za lečenje preloma distalnog pilona tibije. Ovi prelomi se leče metodom otvorene redukcije i stabilne fiksacije (ORIF) i spoljašnjom skeletnom fiksacijom. Visok procenat komplikacija na mekom tkivu udružen nakon primarne ORIF preloma pilona, nameće upotrebu metode spoljašnje skeletne fiksacije sa minimalnom unutrašnjom fiksacijom, kao alternativnu tehniku za konačno izlečenje. Cilj rada bio je da se utvrdi efikasnost lečenja distalnog pilona tibije primenom metode spoljašnje skeletne i mini-

malne unutrašnje fiksacije. **Metode.** Prikazali smo seriju od 31 operisanog bolesnika sa prelomima pilona tibije. Bolesnici su operisani metodom spoljašnje skeletne fiksacije sa minimalnom unutrašnjom fiksacijom. Prema AO/OTA klasifikaciji 17 bolesnika imalo je prelom tipa B, a 14 prelom tipa C. Kruta spoljašnja skeletna fiksacija je transformisana u dinamičku spoljašnju skeletnu fiksaciju šest nedelja posle operacije. **Rezultati.** Retrospektivnom studijom analiziran je 31 bolesnik sa prelomima pilona tibije, prosečne starosti 41,81 (21–60) godina. Prosečno vreme praćenja iznosilo je 21,86 (12–48) meseci. Procenat zarastanja preloma iznosio je 90,32%, nezarastanja 3,22% i lošeg zarastanja 6,45%. Prosečno trajanje zarastanja preloma iznosilo je 14 (12–20) nedelja. Bilo je 4 (12,19%) in-

fekcija oko klinova spoljašnjeg skeletnog fiksatora i 1 (3,22%) duboka infekcije. Artroza skočnog zgloba kao kasna komplikacija, pojavila se kod 4 (12,90%) bolesnika. Sve artroze su nastale kod bolesnika koji su imali prelom tipa C. Krajnji funkcionalni rezultati na osnovu AOFAS skora bili su odlični kod 51,61%, dobri kod 32,25%, ume- reni kod 12,90% i loši kod 3,22% bolesnika. **Zaključak.** Spoljašnja skeletna fiksacija i minimalna unutrašnja fiksa-

cija preloma distalnog pilona tibije dobra je metoda za le- čenje svih tipova intraartikularnih preloma pilona. Kod preloma tipa B i C, dinamička spoljašnja skeletna fiksacija dozvoljava rane pokrete u skočnom zglobu.

**Ključne reči:** tibija, prelomi; ortopedске procedure; fiksatori, spoljni; fiksatori, unutrašnji; lečenje, ishod.

## Introduction

In contrast to the rotational mechanisms that result in mal- leolar fractures and fracture-dislocations of the ankle, distal tibial pilon fractures typically result from high-energy axial- loading mechanisms. Distal tibial pilon fractures include extra- articular fractures of the tibial metaphysis and the more severe intraarticular tibial plafond or pilon fractures. The clinical mani- festation of this fractures difference is the generation of osteo- chondral fracturing, comminution and displacement of the weight-bearing articular portion of the tibial plafond and distal tibial metaphysis, as well as the development of marked swell- ing, blistering and devitalization of the surrounding soft-tissue envelope typically identified in tibial pilon fractures. These fractures are estimated to comprise 3% to 10% of all tibia frac- tures and less than 1% of lower extremity fractures. These high energy injuries, usually caused by falls from heights or motor vehicle accidents, are often open fractures and they are fre- quently associated with additional trauma in other areas of the body<sup>1-3</sup>. They are one of the most challenging injuries in ortho- paedic traumatology<sup>4</sup>. Several treatment methods are recom- mended for the treatment of these injuries including external skeletal fixation, intramedullary nailing, and plate fixation<sup>5-8</sup>. The aim of this study was to estimate efficacy of a treatment of a distal tibial fracture (AO type B and C) using the method of ex- ternal skeletal fixation combined with minimal internal fixation.

The high rate of soft-tissue complications associated with primary open reduction, internal fixation (ORIF) of distal tibial pilon fractures led to use of external skeletal fixation, with limited internal fixation as an alternative tech- nique for definitive management. Our aim was to analyze original results of distal tibial pilon fractures treatment using the external skeletal and minimal internal fixation method.

## Methods

The patients with distal tibial fracture were operated on at the University Orthopedic and Traumatology Clinic, Niš. The patients with intra-articular fractures (AO/OTA types B and C) were operated on using the method of ex- ternal skeletal fixation and minimal internal fixation. To perform minimal internal fixation, screws and K-wires were used. In patients with types B and C fractures, rigid external skeletal fixation was transformed into dynamic external skeletal fixation 1.5 month later. All fractures were classified according to the AO/OTA classification<sup>9</sup>. The Gustilo-Anderson classification system was used for

all open fractures<sup>10</sup>. To perform external skeletal fixation, a Mitkovic's unilateral external skeletal fixator was used. To analyze the final functional results, the AOFAS scoring system was used<sup>11</sup>.

## Results

This retrospective study involved 31 patients with distal tibial pilon fractures. According to the AO/OTA classifica- tion, 17 patients had fractures type B and 14 patients frac- tures type C (Figures 1-5 and 6-9 respectively). The average age was 41.81 (21-60) years, and there were 20 male pa- tients and 11 female patients. Open fractures appeared in 11 (35.48%) patients. A total of 10 (32.25%) fractures were ca- used by car accidents, 14 (45.16%) by falls from heights, whereas 7 (22.58%) fractures appeared under different cir- cumstances, such as in accidents at work, falls from stairs, or as a result of slip and fall accidents on an even surface. The average follow-up of the patients was 21.86 (12-48) months. There were 28 (90.32%) unions, 1 (3.22%) nonunions and 2 (6.45%) malunions. The mean to fracture union was 14 (range 12-20) weeks. As regards complications, infection around the pins of the external skeletal fixator appeared in 4 (12.19%) and deep infections appeared in 1 (3.22%) patients. Ankle joint arthrosis as late complication appeared in 4 (12.90%) patients. All arthroses appeared in patients with fractures type C. According to AOFAS, the final functional results were excellent in 16 (51.61%) patients, good in 10 (32.25%), average in 4 (12.90%) patients and bad in 1 (3.22%) cases. All the patients were operated on as urgent cases, immediately after hospitalization.



**Fig. 1 (A and B) – Radiographs of distal tibial pilon fracture (AO/OTA type C) after the injury.**

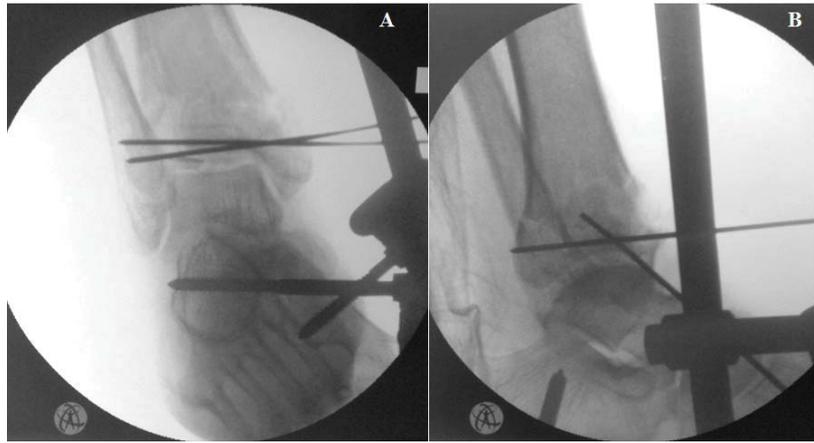


Fig. 2 (A and B) – Radioscopic views after external skeletal fixation and minimal internal K-wires fixation.



Fig. 3 – Radiographs views after the surgery (A), and after 1 month (B).



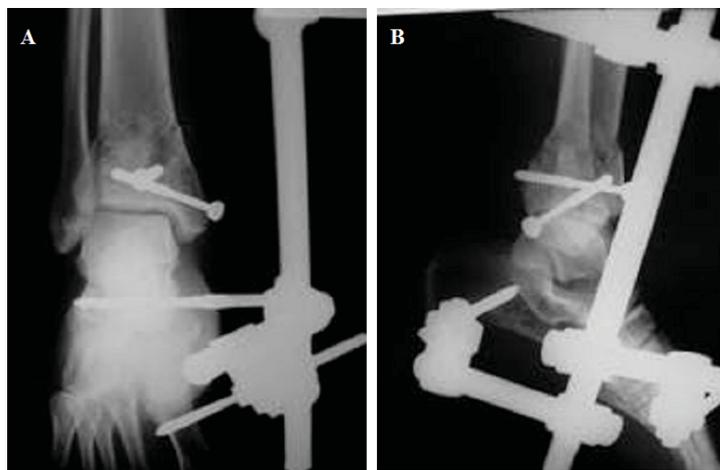
Fig. 4 – Radiographs after external skeletal fixator removal, 14 weeks after the injury.



**Fig. 5 – A) Rigid external skeletal fixation of distal tibial pilon fracture (ligamentotaxis); B) Dynamic external skeletal fixation (the same patient 6 weeks after the surgery).**



**Fig. 6 – Radiographs of distal tibial pilon fracture (AO/OTA type C) after the injury.**



**Fig. 7 (A and B) – Radiographs after external skeletal fixation and minimal internal screws fixation.**



**Fig. 8 – Radiographs after external skeletal fixator and screws removal.**



**Fig. 9 – The final functional result 4 months after the injury.**

### Discussion

In the decade 1980 to 1990 numerous publications favoured the approach to distal tibial fractures that included external skeletal fixation as primary stabilization, with or without some form of limited internal fixation. This was in reaction to numerous complications that were observed previously following ORIF<sup>12</sup>. High-energy distal tibial fracture with soft tissue compromise remains a treatment dilemma. Clinical series from the 1980 and 1990 using primary ORIF had complications rates of greater than 50%, most related to soft-tissue complications and infections, including amputation rates as high as 17%<sup>13,14</sup>. The high rate of soft-tissue complications associated with primary ORIF of pilon fractures led to use of external skeletal fixation, with limited internal fixation as an alternative technique for definitive management. Hybrid external skeletal fixation with limited open

reduction has proved to be a safe, reproducible, and effective treatment modality for this complex fracture<sup>15</sup>. Distal tibial fractures are serious injuries which most frequently appear in car accidents or in falls from heights. There is no universal method in treating these fractures. The most frequent methods are operation, open reduction and internal fixation, intramedullary fixation, plate fixation, external skeletal fixation. Some authors recommend a two-step procedure. After applying the external skeletal fixation, an internal plate fixation is performed<sup>6-18</sup>. We used the external skeletal fixation as one-step procedure in the treatment of distal tibial pilon fracture. We presented the results of distal tibia fracture treatment using the method of external skeletal fixation combined with minimal internal fixation (AO/OTA fractures types B and C). Studies show that minimal internal fixation and external skeletal fixation achieve good results in the treatment of these fractures. A higher percentage of superfi-

cial infections around the pins does not affect the final outcome of the treatment<sup>19</sup>. Bone<sup>1</sup> also describes satisfactory results in the application of this method. In fractures type B and C, it is necessary to achieve fracture reduction and articular tibial surface reconstruction. Fixation by means of screws and K-wires is open and minimal. External skeletal fixator pins are placed, 2 in the proximal fragment, and 2 in the foot. One pin is placed in the calcaneus, the other in the I metatarsal bone. After that, the external skeletal fixator frame with clamps and carriers of the clamp placed. In this way, rigid fracture fixation is achieved, and it transforms into dynamic fixation 6-week post-surgery, which allows early ankle joint mobility<sup>20</sup>. A dynamic external skeletal fixation is placed on an already existing external skeletal fixator construction with additional carriers of the clamp and clamps. This system for external skeletal fixation is suitable for additional interventions, such as fracture position correction while the apparatus is carried. Studies describe this method of treatment as definitive or temporary method, after which intramedullary or plate fixation of fracture will be per-

formed<sup>21</sup>. Our experience in the treatment of these fractures as definitive method and our results are very encouraging, giving us right to consider this method suitable for treating all types of distal tibial pilon fractures. It is important to emphasize that these fractures are considered as urgent, and they should be treated urgently. Urgent surgical intervention reduces the possibility of complications.

### Conclusion

External skeletal fixation of distal tibial and pilon fractures as one-step procedure is a good method for treating all types of fractures. In fractures types B and C, dynamic external skeletal fixation allows early mobility in the ankle joint.

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