

# LOWER LEG FRACTURES TREATED WITH AN EXTERNAL FIXATOR AT THE DEPARTMENT OF ORTHOPEDICS AND TRAUMATOLOGY OF THE CLINICAL HOSPITAL CENTER OF KOSOVSKA MITROVICA

## AUTHORS

Jovanović S.<sup>1</sup>, Elek Z.<sup>2,3</sup>, Denović P.<sup>1</sup>, Miljković N.<sup>2</sup>, Tomašević J.<sup>3</sup>, Petrović D.<sup>1,3</sup>

<sup>1</sup> CHC Kosovska Mitrovica, Department of Orthopedic Surgery and Traumatology

<sup>2</sup> CHC Kosovska Mitrovica, Department of Surgery

<sup>3</sup> University of Pristina, Faculty of Medicine

## KORESPONDENT

Saša Jovanović

CHC Kosovska Mitrovica,  
Department of Orthopedic Surgery  
and Traumatology

sasaajovanovic@gmail.com

## SUMMARY

**Introduction:** Fractures of the lower leg are frequent fractures of long bones that are of great importance in traumatology. The role of external fixation (SF) as a type of surgical treatment is significant and widely applied. There are 3 methods of using SF to treat tibial fractures: SF as primary and definitive treatment, SF combined with internal fixation, and conversion of SF to internal fixation.

**Objective:** To show the possibilities of SF as a definitive way of treating lower leg fractures.

**Methods:** In our paper, we analyzed 254 lower leg fractures treated with SF according to Mitković M20, which were treated at the Department of Orthopedics and Traumatology of CHC Kosovska Mitrovica. This series included 172 men or 68% of the total number of patients, and 83 or 32% women.

**Results:** The average age of patients treated with this method is between the third and fourth decades of life. Falling on the leg with twisting of the table or the entire lower part of the leg is the most common type and cause of injuries in 69%. A closed lower leg fracture was diagnosed in 220 patients (AAO 59.%, B AO 26% and C AO 15%). Adequate position of the bone fragments was achieved by the closed reposition method in 190 (%), the average healing time was 18.4 weeks. In 93% of patients, we achieved bone union.

**Conclusion:** The simple placement technique, the simplicity of the instrumentation, the wide range of indications where SF can be used, have led to the fact that it is a type of surgical treatment of great importance for lower leg fractures in small areas.

**Key words:** fracture, tibia, external, fixator.

## SRPSKI

## INTRODUCTION

Lower leg fractures are frequent fractures of long bones that are of great importance in traumatology. The incidence of these fractures according to statistics compiled by the National Center for Health Statistics in the USA alone is 492,000 fractures of the tibia and fibula per year. The role of external fixation (EF) as a type of surgical treatment is significant and widely applied. There are 3 methods of using EF to treat lower leg fractures: (EF) as primary and definitive treatment; EF combined with internal fixation and conversion of EF to internal fixation. Mitkovic-type EF, which has been used for a long time as a type of surgical treatment of lower leg fractures, has shown exceptional fixation stability and good conditions for bone healing (1,2). The perfect placement technique, the simplicity of the instrumentation, the wide range of indications where EF can be used, have led to the fact that it is a type of surgical treatment of vital importance for lower leg fractures in small areas.

## STUDY OBJECTIVE

The aim of our work is to present the overall advantages of the Mitkovic M20 EF lower leg fracture treatment in several ways. First as a primary method in the treatment method known as "DAMAGE CONTROL", then as a definitive method of treating lower leg fractures and thirdly in combination with internal fixation.

## METHODOLOGY

In our work, we analyze 254 lower leg fractures treated with the SF method according to Mitkovic using M20 EF, which were treated at the department of orthopedics and traumatology of KBC Kosovska Mitrovica as a definitive method of treatment. After hospitalization, an assessment of fracture stability and the need for operative treatment was made.

**Operative technique.** SF according to Mitković is a one-sided fixator that is placed in the tibia in safe zones using wedges. The most important thing is to apply the wedges of the fixator at an angle (convergence) of at least 60 degrees in order to obtain the correct position of the fixator. Also, it is very important that the body of the fixator is between the pegs of the fixator in the axis of the tibial diaphysis because only in this way the M20 EF shows its exceptional biomechanical properties. The wedges are placed first, followed by the rest of the fixator. In most cases, 4 wedges are placed, however, the number of wedges depends on the patient's constitution, the severity of the fracture, and based on these parameters, we can place a larger number. In some cases, when the tibial shaft fracture is included a fracture of the distal tibia, for additional stabilization of the fracture, a combined construction was made in the form of a dynamic EF M20 for the ankle joint and a standard EF for a fracture of the tibial diaphysis (3). EF in combination with internal fixation. In case of a closed lower leg fracture, a closed reduction of bone fragments and an external fixator are used after obtaining an adequate position of the bone fragments. However, in case of closed reductions, if there is an inadequate position of the bone fragments, then an open reduction is approached with a minimally invasive approach. After two to three weeks, the patient is allowed partial support on the injured leg (4,5,6,7,8).

In case of open lower leg fractures, early surgery is performed (if possible, within 6 hours from the moment of injury), then wound irrigation, hemostasis, extraction of foreign bodies, wound debridement, EF and finally drainage. After the operation, the patient is prescribed a combination of antibiotics, mainly cephalosporins of the third and third (EX) fourth generation and aminoglycosides, and in cases of severely infected wounds, metronidazole is included as the third antibiotic. All patients with open fractures are given antitetanus prophylaxis, after which a careful assessment is made again and the further course of treatment is determined, and in some cases, a new operation. EF can also be used in children after assessing the child's age, weight, type of fracture, as well as assessing the need for surgical treatment. In children, the fixator pins are applied outside the epiphyseal zone, which is the only significant difference from the treatment in adult patients. It is usually used as a prevention of thrombosis low molecular weight heparins, except in children (9).

## STATISTICAL ANALYSIS

Descriptive methods for testing statistical hypotheses were used for primary data analysis. Descriptive statistical methods used measures of central tendency (arithmetic mean), measures of variability (standard deviation), and relative numbers. Among the methods for testing statistical hypotheses, the Chi-square test was used. Statistical software package R was used for statistical processing. Statistical hypotheses were tested at the 0.05 level of statistical significance.

## RESULTS

Looking at the gender structure of our patients, the distribution was as follows: 170 men (66.93%) and 84 women (33.07%). Our youngest patient was 14 years old and the oldest was 69. Based on this, we can conclude that in our research, adult men in their forties and fifties were the most frequently injured (Table 1).

Variable	n (254)
Gender, n (%)	
Male	170 (66.93)
Female	84 (33.07)
Age, $\bar{x} \pm sd$	45.9 $\pm$ 12.5
Fracture type, n (%)	
Open	35 (13.78)
Closed	219 (86.22)
Reposition type, n (%)	
Open	55 (21.65)
Closed	199 (78.35)
Healing, n(%)	
Yes	244 (96.06)
No	10 (3.94)
Complicationsn (%)	
Yes	61 (24.02)
No	193 (75.98)
Type of complications (%)	
No complications	193 (75.98)
Infections	51 (20.08)
Non-healing	10 (3.94)

Table 1. Age structure of patients with lower leg fracture

Falling on the leg with twisting of the foot or the entire lower part of the leg is the most common type and cause of injuries in 69%, traffic trauma where we have the effect of direct force in 21%, a blow to the lower leg in 8%, and injuries caused by firearms happen in 2%.

A closed lower leg fracture was diagnosed in 219 patients (A AO 59.%, B AO 26% and C AO 15%). Surgical interventions were performed within 3 days from the date of admission. The earliest surgical intervention was performed after 4 hours (in those patients with threatening compartment syndrome and of course in polytraumatized patients in "damage control" surgery). The latest surgical intervention was performed 10 days after admission.

Adequate position of the bony bone fragments using the closed reposition method was achieved in 199 cases (90.9%), even in fractures with large comminution. In all other cases we had to do an open method and external fixation using a minimally invasive approach. In 12 cases, minimal internal osteosynthesis of the fracture was used as an additional stabilization of the fracture: screw, wire, hemicortical wedge.

35 patients with open tibia fracture participated in our study. The largest number of patients had minimal damage to the skin and soft tissues. GA type I in 19 cases (50%) and II GA in 11 patients (32.35%). 5 (17.64%) were with severe damage of III GA (1 IIIa GA, 3 IIIb and 2 IIIc). All patients with open patellar fractures were treated surgically within 6 hours of hospitalization. We applied antibiotics in the above combination. Excellent results were in the study where we performed careful wound care, repeated wound debridement, secondary sutures, as well as Tirsch's skin transplantation.

Gunshot wounds were present in 4 of our patients. We achieved satisfactory results in all four patients. In one patient, we combined classic surgical treatment with hyperbaric therapy, which resulted in faster healing.

The mean healing time is 18.4 weeks. In 93% of patients, we achieved bone fusion. Removal of EF depends on the clinical, radiographic findings and length of treatment of the patients. In those patients in whom we had indications that adequate healing had occurred, we performed a very simple test. The test consisted of removing the body of the fixator, but we kept the wedges in the bones and allowed the patient to fully rely on the operated leg, while at the same time we monitored the radiographic and clinical findings after a few days. When the clinical and radiographic findings were satisfactory, we also removed the wedges. If there was pain at the fracture site or there was a change in the radiographic findings, we continued with the treatment with external fixation. In the oldest patients, after removing the external fixation, we placed plaster immobilization to protect the resulting callus.

In Table 2, we have presented the complications of the treatment of EF-closed fractures related to soft tissues. Epidermolysis was the most common complication. Of course, we removed the blisters and dried the wounds with a spray that contained an antibiotic. Minor skin injuries (islands of post-contusion skin necrosis as well as dermabrasion) were carefully bandaged. In 8 patients, we had the occurrence of compartment syndrome of the injured lower leg, in which we had to perform a fasciotomy.

In our research, we found data that the most common complication was infection around the wedges in closed fractures, present in 51 (20%) patients. There is a lot of data in the literature related to the different classification of complications surrounding the wedges. We still used the

Variable	Repositions type		p
	Otvorena	Zatvorena	
Gender, n (%)			
Male	40 (23.5)	130 (76.5)	0.38
Female	15 (17.9)	69 (82.1)	
Age, median(min-max)	45 (18-68)	46 (14-69)	0.54
Type of fracture, n (%)			
Open	35 (100)	0 (0)	<b>p&lt;0.001</b>
Closed	20 (9.1)	199 (90.9)	
Healing, n (%)			
Yes	49 (20.1)	195 (79.9)	<b>0.009</b>
No	6 (60)	4 (40)	
Complications, n (%)			
Yes	15 (24.6)	46 (75.4)	0.64
No	40 (20.7)	153 (79.3)	
Type of complication, n (%)			
No complication	40 (20.7)	153 (79.3)	<b>0.009</b>
Infections	9 (17.6)	42 (82.4)	
Non-healing	6 (60)	4 (40)	

*Table 2. Complications on the lower leg after application of the external fixator*

simple classification described by Ward in 1984, which includes several stages of infection: erythema, itching, purulent infection, etc. We also performed a microbiological analysis by swabbing the area around the wedges, and of course checked the stability of the wedges by clinical and radiographic examination.

Patients in whom we diagnosed the presence of minor complications were treated with more intensive (daily) bandaging, and in those whose microbiological results showed the presence of pathogenic microorganisms, we treated them with antibiotics per biogram. Those patients in whom we verified severe forms of infection were treated in hospital conditions, and all those whose microbiological analysis showed the presence of pathogenic microorganisms were treated with antibiotic therapy. In all patients in whom we had signs of peg instability (7 patients) and radiographic signs that support osteolysis of the bones around the pegs, we removed the same pegs and applied them to another location (Table 2).

We found non-healing in 10 patients (3 patients with a closed fracture of the diaphysis of the tibia and 7 patients with an open fracture). Ilizaro's external fixator was used for further treatment in 2 patients, and Mitković's external fixator with a compression-distraction device was used in 7 patients. Healing was achieved in all patients (Table 2).

The questionnaire we used to evaluate these patients is EK-5D (EuroQoL). An excellent result was achieved in 83% of patients.

We did not have patients with damage to the neurovascular structure as well as deep vein thrombosis (DVT) in our study. We had no mechanical damage to the device in the form of structural breakage or bending.

## DISCUSSION

Lower leg fractures are still difficult to treat today due to the wide range of fractures and soft tissue injuries. For this reason, understanding the indications for surgical and non-surgical treatment of these fractures is of great importance for a favorable outcome. There are different opinions about the treatment of these fractures. There are several different implants that can be used in these fractures, but the use of EF is still today the first choice in the treatment of multiple fractures, which allows for safe healing of the fracture, early mobilization and rehabilitation of the patient (10,11,12). In addition to EF, intramedullary wedge osteosynthesis with high

biomechanical stability is also in use. Currently, the use of an intramedullary wedge is the method of choice in treatment, and the role of EF is mainly limited to temporary osteosynthesis (13,14,15,16,17,18,19,20,21). In our institution, EF according to Mitković has been used for the last 25 years. and more than 400 patients with a fracture of the tibial diaphysis were treated surgically using this method. Patients with open fractures of the tibial diaphysis and a high degree of bone comminution were initially treated. After we got excellent results, we expanded the list of indications for patients with closed unstable fractures. EF is also very suitable for the treatment of segmental fractures of the tibial diaphysis, as well as for large bone damage caused primarily by traffic trauma. When using EF, it is very important to ensure the correct positioning of the fixator itself, as well as adequate care of the place of insertion of the pins. If an infection occurs, it is necessary to perform a microbiological analysis of swabs taken from around the studs. We also check the stability of the wedges by clinical and radiographic examination (22,23,24). Only in this way does the external fixator show its exceptional biomechanical properties. The effect of indirect force is the most common cause of injury in more than half of the respondents, and the effect of direct force is slightly less. EF has also been used in children based

on the severity and type of fracture and has given excellent treatment results (25,26,27,28).

The average healing time is 19 weeks. And the most common complication in our study was the complication around the pegs of the external fixator (15%)(29,30,31,32,33). The percentage of nonunion fractures corresponds to data in the literature. Thromboembolic complications were not recorded in the studied series.

## CONCLUSION

The EF treatment method can be used as a definitive method even for the most severe lower leg fractures because it provides optimal biomechanical conditions for fracture healing as well as excellent osteosynthesis stability. The external fixator can be used both for closed lower leg fractures, where it gives excellent results, and for the treatment of open tibial fractures. . The method of choice for open fractures is a combination of early surgery, removal of flat bodies, debridement of vital tissues, stabilization of the fracture with an external fixator, reconstruction of soft tissue defects, antibiotic and anti-tetanus prophylaxis.

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