



## **TACTICS OF TWO-STAGE SURGICAL TREATMENT OF OPEN FRACTURES OF LIMB BONES IN COMBINED TRAUMA**

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<b>Article history:</b>	<b>Abstract:</b>
<b>Received:</b> April 26 <sup>th</sup> 2024 <b>Accepted:</b> May 24 <sup>th</sup> 2024	The article describes the development of a two-stage treatment algorithm for open fractures of the foot bones in 120 patients with joint injuries (DGU No. 28443, from 10/19/2023). It was developed to prevent severe complications in patients with joint injuries, taking into account the severity of the patient's overall condition, by using a minimally invasive method to stabilize the bone fragments with an external device (FAP: 2023 0097, from 03/17/23). After stabilizing the patient's overall condition, the second stage involves the application of modern treatment methods, which is substantiated to improve treatment outcomes.

**Keywords:** joint injury, open fractures, external fixation device, two-stage treatment. jarrohlik yo'li bilan

**IMPORTANCE.** Treatment of patients with multiple injuries remains one of the urgent problems of modern traumatology and orthopedics. Multiple injuries are one of the top three leading causes of death in people under 40 years of age, they are the leading cause of death. In cases of multiple injuries, the severity of the victims' condition is caused by shock, bleeding, damage to internal organs, and traumatic brain injury. The opinions of specialists regarding the treatment tactics for injuries to the bones of the extremities and the method of surgical intervention vary: from extrafocal osteosynthesis for emergency indications, the use of various methods after stabilization of the patient's condition to simple immobilization or skeletal traction [1].

Currently, a two-stage tactic of surgical treatment of severe open fractures of the leg bones is generally accepted. The goal of the first stage is to prevent infection by performing staged surgical treatment of the wound and temporary stabilization of the fracture, the second stage is to restore limb function by final stabilization of the fracture using internal fixation [2]. According to many researchers, open fractures of the long bones of the extremities are a frequent component of combined injuries (from 21.4 to 48.9%), which are usually characterized by a high frequency of primary defects of the skin, underlying soft tissues and bones [1-3,5,6]. In this regard, it is necessary to further improve the tactics and methods of treating victims with combined trauma, which should be aimed at reducing the trauma of osteosynthesis and preventing general and local complications [4,7,8].

Numerous studies have shown that only surgical fixation of fragments provides optimal conditions for consolidation of open fractures of long bones of the extremities and prevention of local complications [10,11]. However, the choice of osteosynthesis technique, as well as the timing of its implementation, still causes controversy among specialists [9]. The aim of the study is to improve the treatment results of patients with open fractures of the bones of the lower extremities with combined trauma by developing a two-stage treatment system.

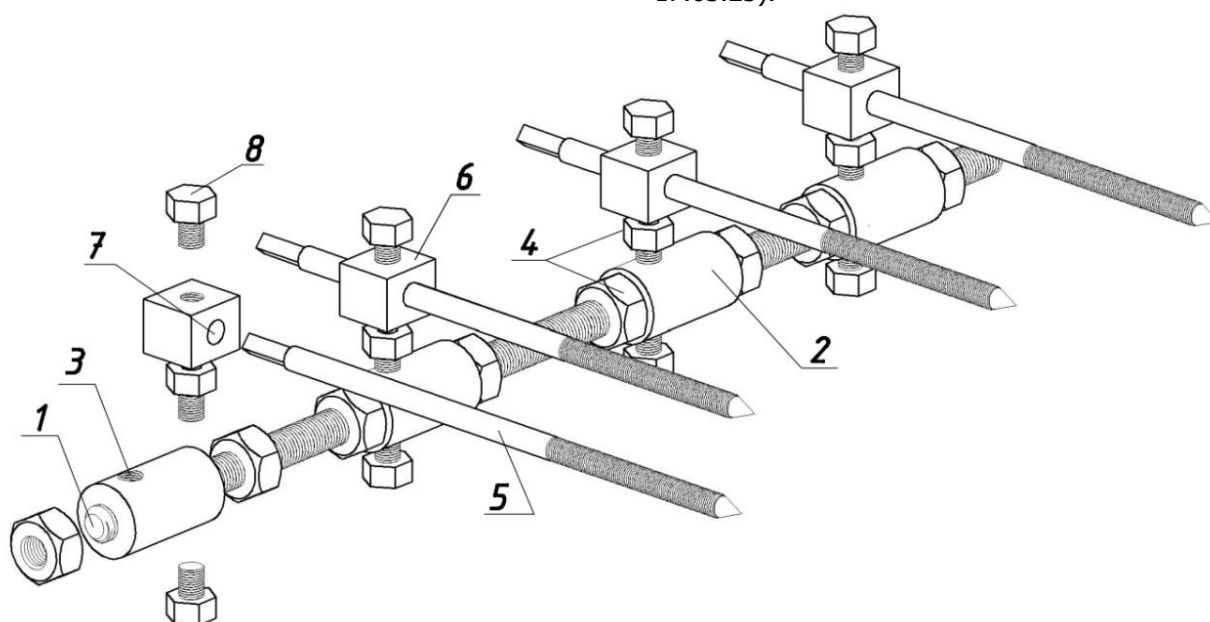
**MATERIAL AND METHODS.** The study included patients with open fractures of the long bones of the lower extremities with combined trauma who were treated in the hospital of the Republican Specialized Scientific and Practical Medical Center of Traumatology and Orthopedics in 2022-2024. There were 98 males (82%) and 12 females (18%). The average age of the patients was 40.5±11.9 years.

Traumatic shock of I-II degree was observed in 102 (85.6%) victims. 12 (10.7%) people were in a state of severe shock or in a terminal state. Fractures of the femur and tibia occurred in 29 (24.5%) patients, tibia - in 45 (37.7%), femur - in 8 (6.8%). The severity of open fractures was assessed according to the classification of O.N. Markova, A.V. Kaplan (1975). According to this classification, patients most often had type I (46-38.8%) and type II (42-34.3%) injuries. Type III (32-26.9%) injuries were recorded somewhat less frequently.

Fractures were combined with damage to other segments: with craniocerebral trauma - in 55 (45.9%), with humerus fractures - 12 (9.4%), 7 (5.9%) with

spinal fracture - in 12 (10.6%), clavicle fractures - in 4 (3.5%), pelvic bone fracture - in 8 (7%), calcaneal fracture - in 10 (8.2%), patella fracture - in 5 (4.7%), rib fractures - in 5 (4.7%). Mixed fat embolism was observed in 32 (12.7%) patients, mainly (71.4%) on the 2-3rd day after admission. In 18 (15.0%) patients, mainly with fractures of the tibia and combined fractures of the tibia and femur, deep vein thrombosis of the lower extremities most often developed on the 2nd-6th day.

An analysis of the features of medical care showed that more than half (55.9%) of patients were operated on the 2nd-6th day, almost a third (30.9%) - on the 7th-10th day after hospitalization. The choice of treatment method depended on the location, number and nature of fractures, as well as the duration of the injury [16]. To improve the treatment results for patients with open fractures of the lower limb bones with combined injury, we have developed a Rod Apparatus for the Treatment of Long Bone Fractures (FAP: 2023 0097 dated 17.03.23).



**Fig. 1. Rod apparatus for treating fractures of long bones.**

1 – threaded rod, 2 – turnbuckle, 3 – threaded hole on turnbuckle, 4 – nut, 5 – bone rod, 6 – rod holder, 7 – rod holder hole, 8 – bolt (general view, axonometric projection).

We have also proposed a two-stage algorithm for the treatment of open fractures of long bones of the extremities in patients with concomitant trauma (No. DGU 28443 dated 19.10.2023) [1,11,12]. The algorithm, created on the basis of the Kaplan-Markov classification, allows choosing an individual treatment method (extrafocal, extramedullary, intramedullary osteosynthesis) depending on the extent of soft tissue damage. Two-stage surgical treatment of open

fractures in concomitant trauma consisted of the following: in case of an unstable severe condition of the patient, surgeries were performed for vital indications, shock therapy, wound toilet with fixation of the fracture with an external fixation rod apparatus (EFR). After the wound healed and the patient's condition stabilized, the external fixation apparatus was replaced with intramedullary synthesis with locking rods and with a plate for intra- and periarticular fractures (table).

Table

Criteria for stabilization of open fractures according to the classification of O.N. Markova, A.V. Kaplan

Type of open fracture according to Markova-Kaplan		Method of fixation of fragments at the 1st stage				
		plaster cast	АВФ	БИОС	Extra-bone osteosynthesis	amputation
I	A	IA (8) IB (6)	IB (18) IV (14)	IB (12)	IB (12)	

I	B	IA (4)	IIB (14) IIV (12)	IIA (8)	IIA (8) IIB (4)	
III	V	IIIA (2)	IIIB (18) IIIV (14)	IIIA (4)	IIIA (8)	
V						IV (2)

Note: The number of fractures is given in brackets.

The choice of treatment method depended on the nature of the combined injury and the location of the fracture. To characterize the injury, we used the classification by O. N. Markova and A. V. Kaplan, which uses a system of numbers and letters to indicate the size and degree of damage:

- I - wound size up to 1.5 cm,
- II - wound size 2-9 cm,
- III - wound size over 10 cm,

A - fracture with minor limited damage to soft tissues, the viability of soft tissues is preserved or slightly impaired,

- B - fracture with moderate soft tissue damage, partial or complete impairment of tissue viability in a limited area,

- C - fracture with severe soft tissue damage and impairment of their viability over a significant area.

In addition, this classification additionally includes grade IV, denoting fractures with extremely severe tissue

damage: crushing, crushing, fragmentation, and impairment of the integrity of the main arteries.

- for grade IIIB - extrafocal fixation, Fat embolism developed in 28 (12.7%) patients, mainly in those with bilateral fractures. Nine (32.1%) victims had open fractures.

*Clinical example. Patient Toshboyev Anvarjon, 26 years old, was injured on car accident in 28.02.24. Transferred to the Traumatology and Orthopedics, Tashkent, Uzbekistan, Tashkent Regional Branch of the Republican Scientific Center of Emergency Medicine, (case history 1924/2024). After clinical and radiological examination, the following diagnosis was established: Combined injury, closed craniocerebral injury, brain contusion, open fracture of the middle third of the left tibia with displacement of bone fragments. Traumatic shock II-III degree. First aid was provided in the admission department by the resuscitation team, primary surgical intervention, anti-shock measures.*

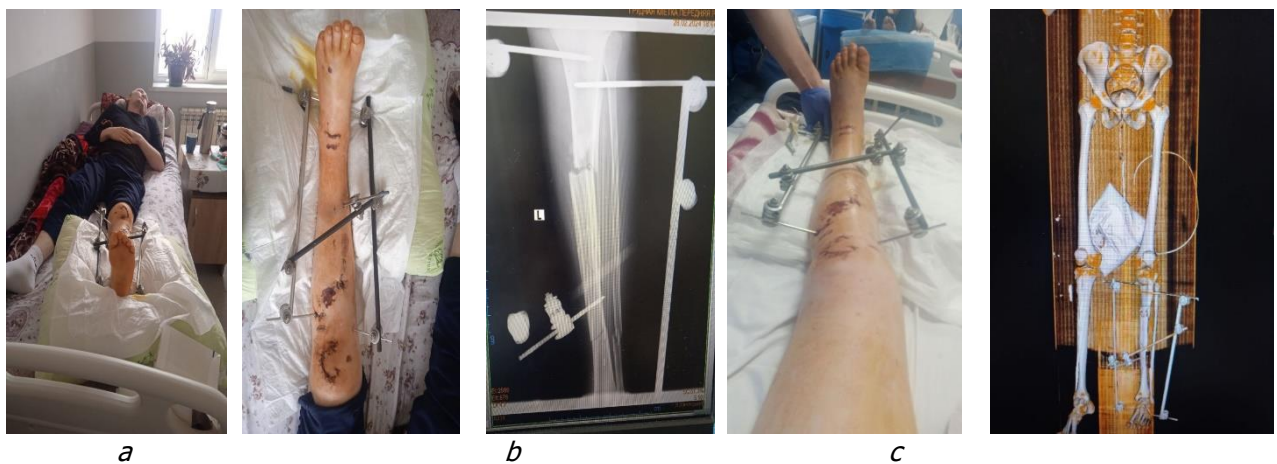


Fig. 2. Radiograph of the patient upon admission (a); appearance of the patient after surgery (b).

a

b

Fig. 3. Photo of the patient after surgery (a, b).



*At the first stage, osteosynthesis was performed using a rod apparatus, at the second stage - a locking pin. The patient underwent clinical and radiographic examination, after which he was hospitalized in the shock ward, where intensive anti-shock infusion therapy was started. In the intensive care unit, on the 3rd-4th day, against the background of intensive measures, the patient developed a picture of fat embolism (tachycardia > 120 beats / min, fever over 38 ° C, drowsiness, impaired consciousness - stupor, petechial rash appeared on the anterolateral surface of the chest, on the skin of the neck and mucous membranes). During the radiographic examination, scattered small foci of darkening in the form of a "snow storm" were observed in the lungs. Urine analysis for the presence of fat: +++.*

*Against the background of intensive therapy for fat embolism, after stabilization of the patient's indices and general condition, osteosynthesis of the tibia was performed using a rod device. A month after stabilization of the patient's condition, external fixation devices were replaced with intramedullary osteosynthesis using blocking rods. A year later, the patient returned to his previous job.*

### **CONCLUSIONS**

1. The choice of treatment method for open fractures of limb bones in victims with combined injuries depends on the severity of the condition, the nature of damage to internal organs and the location of fractures of the limb bones.
2. Two-stage treatment of open fractures of limb bones in patients with combined injuries, which includes primary surgical treatment and fixation of the fracture with external fixation devices, after stabilization of the victim's condition, replacing external fixation devices with intramedullary osteosynthesis with locking rods and with a plate for intra- and periarticular fractures,

improves the anatomical and functional results of treatment of victims.

3. The developed algorithm for two-stage treatment of open fractures of the lower limb bones can be recommended for use in clinical practice.

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