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Methods of Closed Reposition of Fragments in PV GSS and Their Neutralization with Gypsum or Polymer Dressings, with the Development of Measures to Prevent Secondary Dislocations

Gafforov Azamat Uygunovich

Bukhara State Medical Institute named after Abu Ali Ibn Sino, Bukhara, Uzbekistan

Abstract The frequency of unsatisfactory results after conservative treatment of closed PV GSS ranges from 2% to 36.9%. This is mainly due to the insufficiently accurate restoration of anatomical relationships in the damaged GSS, frequent repeated attempts at reduction, repeated dislocations of fragments in the plaster cast, the appearance of post-immobilization contractures, post-traumatic edema and early arthrotic changes.

Keywords Methods of closed reposition of fragments, Frequent repeated attempts at reduction, Plaster cast, The appearance of post-immobilization contractures

1. Introduction

The treatment of patients with ankle fractures, despite its constant improvement and the successes achieved, is one of the most difficult and unresolved problems of modern traumatology. This is due to the high frequency of these injuries, treatment difficulties, complications, and not always favorable results. According to Russian and foreign literature, closed PV GSS account for 10.2% to 26.1% of all skeletal bone injuries and are second only to fractures of the distal end of the radius in a "typical location". Open reduction and osteosynthesis in PV GSS also leads to a significant number of unsatisfactory outcomes, ranging from 4.3% to 39%. Along with the positive aspects - the possibility of accurate simultaneous comparison and fixation of fragments, surgical intervention has its serious drawbacks, which are that a closed fracture turns into an open one. The use of various fixatives for osteosynthesis leads to additional traumatization of soft tissues and bones, deterioration of blood circulation in the fracture area. The risk of purulent wound infection, osteomyelitis, and necrosis of the skin edges of the postoperative wound increases. Currently, from 3.0% to 53.7% of the outcomes of treatment of PV GSS are GSS contractures, improperly fused ankle fractures, false joints, long-standing talus subluxations, deforming osteoarthritis, post-traumatic edema, etc. In various regions of our country, patients with PV GSS occupy a leading place among the causes of disability, which range" from 3.1% to 39%. In solving the problem of treating patients with PV HSS, the choice of a method and method of treatment adequate to the severity of the injury is of crucial importance. At the same time, the main question is not whether surgery is necessary or can be dispensed with, but which of the methods of conservative or surgical treatment of PV GSS will be more effective in each specific case [1,3,5,7,8].

To what extent the chosen treatment method fully meets the requirements of ensuring accurate reposition, stable fixation of fragments, recularization of the injury zone and the possibility of early functional treatment.

* Corresponding author:
azamat_gafforov@bsmi.uz (Gafforov Azamat Uygunovich)
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2. Results and Analyzes

Currently, based on the created system for assessing the degree of stability of fracture fixation by various methods: theoretical analysis, mathematical modeling and experimental studies on the Zwick device, it is possible to determine and characterize the quality of fracture stabilization in each specific case during conservative and surgical treatment of PV HSS. This will make it possible to identify the weak links of fixation, improve the means of external and internal fixation by eliminating their inherent disadvantages in order to prevent complications and, thereby, expand or at least determine the indications and contraindications for their use. This is extremely necessary, since most biomechanics works related to the treatment of PV HSS do not take into account the variants of its post-traumatic instability, depending on the severity of damage to its bone-ligamentous structures,

the lever properties of fragments and the conditions of their neutralization. The problem of treating patients with PV HSS is further aggravated by the fact that generally accepted methods of rehabilitation of this category of patients lag behind modern requirements. There is no certainty about the effect of unloading and early loading on the damaged leg-foot limb segment, the timing of fracture fixation and restoration of GSS function after conservative and surgical treatment of its PV. Consequently, improving the quality of a closed reposition with fixation of fragments by means of external fixation (plaster or polymer bandages, orthoses), improving methods of stable functional osteosynthesis and rehabilitation treatment based on scientifically based biomechanical principles, opens up real opportunities for improving patient treatment outcomes. All of the above allows us to consider our chosen research topic to be very relevant from a scientific point of view and important for the needs of practical healthcare. A theoretical substantiation of the possibility of translational and rotational movements of the talus in an intact GSS has been carried out. The clinical and radiological characteristics of the plantar, dorsal and inferior subluxations of the talus are described for the first time. Biomechanical changes in the GSS caused by the specifics of its damage in subsyndesmosis, transyndesmosis, and suprasyndesmosis fractures have been studied. For the first time, a biomechanical model of a new method of closed reposition and external fixation of fragments in PV GSS has been developed. For the first time, the biomechanical conditions for closed reposition and neutralization of fragments with plaster or polymer dressings were determined for various types of PV GSS, depending on the direction of displacement of the talus. For the first time, the stabilizing capabilities of plaster casts used in the treatment of PV GSS by mathematical modeling have been experimentally analyzed and evaluated, depending on its length, method of reposition and fixation. The sequence of the stages of reconstructive and reconstructive operations for various types of GSS has been developed, depending on the severity and duration of the injury. The stabilizing capabilities of immersion osteosynthesis tools used in the treatment of patients with PV GSS on a Zwick device have been studied. A functional method of conservative and surgical treatment of PV GSS has been developed and implemented in practical healthcare [2,4,6,8].

The results of the study determined the effectiveness of the developed methods of conservative and surgical treatment of patients with PV HSS, which are clinically implemented in practical healthcare. Their complex application makes it possible to significantly improve the results of treatment of patients with PV GSS and their consequences. In an intact GCC (biokinematic pair), all the directions of translational and rotational motion of the talus characteristic of a free body in space are preserved. The superimposed connections cannot destroy any direction of movement, they can only limit a specific direction of movement in scope to the size of the gap. It is advisable to consider twelve independent directions of movement of the talus in an intact GSS as a general classification of independent directions of its movement, and all the others - sets of translational and rotational movements are combinations of them. As many translational and rotational movements as possible in a biokinematic pair (syndesmosis, diarthrosis, fracture, etc.), there will be the same number of traumatic dislocations of fragments in case of intra-articular and extra-articular damage, which dictates in each case an individual treatment strategy, the direction of fragment reposition, and options for their fixation during conservative and surgical treatment. A systematic approach to the choice of a treatment method for PV GSS should be justified by: the localization of bone and ligamentous injuries, the magnitude and direction of displacement of the talus, fragments, a variant of post-traumatic instability of the damaged GSS, the nature of fragments in terms of the presence or absence of properties characteristic of the lever and the duration of injury. At the initial admission of a patient with PV GSS to the clinic, the traumatologist needs to determine: the localization of bone and ligamentous injuries, the direction and magnitude of the displacement of the talus, the variant of post-traumatic instability of the GSS, the nature of the fragments in terms of the presence or absence of properties characteristic of the lever and the duration of the injury. X-ray examination should be performed in two projections. In a direct projection, the X-ray beam must be strictly projected perpendicular to the ankle line of the damaged GSS. In the lateral projection, the X-ray beam is directed strictly along the ankle line at the level of the articular fissure of the GSS. If the medial complex of the GSS is damaged with suspected rupture of the distal tibial syndesmosis, additional radiographs of the proximal tibia should be performed to exclude suprasyndesmotic fractures of the fibula. Before applying the "boot" bandage in the intended areas of formation of the repositioning and fixing pads, you should squeeze out the hematoma or post-traumatic edema with your hands or the reposing "cheeks" of the device. The fixation of ankle fragments in the bandage is carried out by "boots" embedded in the hardening bandage, separated by repositioning-fixing pads, which should be located on three levels (calcaneal region, supra-ankle region, at the level of the fibula head). After the applied bandage hardens, the patient is taught to walk with a full load on the injured limb. X-ray monitoring after the start of the load, if no displacement has occurred, after 7-14 days, perform the first stage of shortening the bandage along the Choparovsky or Lisfrankovsky joint. By 4 weeks after exertion, the remaining part of the bandage should be shortened according to the GSS. To clarify the technique of surgical intervention in patients with PV combined with damage to the articular surface of the distal metaepiphysis of the tibia, computed tomography of the SCS is shown. The open reposition of fragments and their osteosynthesis must be performed in a strict technological sequence, depending on the direction of displacement of the talus and the type of fracture. First, it is necessary to perform an audit of the bone and ligamentous structures without restoring them from the side

opposite to the subluxation of the talus, then in the department on the side of the subluxation. The bone and ligamentous structures of the damaged GSS should be restored first in the department where the talus bone has shifted, then in the department from where it has shifted. In case of a trans-syndesmosis fracture with bone damage to the distal tibial syndesmosis, to restore it, fibular fragments should be joined using one of the osteosynthesis options. In the surgical treatment of transsyndesmosis fractures with damage to the posterior edge of the fibula, it is necessary initially only to mobilize the fibular fracture to facilitate the reduction of the posterior edge and its osteosynthesis. Fixation of the fibular fracture should be carried out at a subsequent stage, after osteosynthesis of the posterior fracture. If the posterior edge of the tibia is damaged without moving to the inner ankle, it is rational to use posterolateral access. If the posterior edge of the tibia is damaged with a transition to the inner ankle, it is rational to use a posteromedial incision that wraps around the inner ankle from behind. After removing the stitches, it is advisable to fix the damaged segment of the "shin-foot" limb with a removable circular bandage "boots" made of polymer bandages Scotchcast and Soft Cast. A "U"-shaped splint should be made from Scotchcast. Train the patient to walk with a supporting load on the injured limb. In case of non-supporting GSS, after surgical intervention, apply the technique of developing the early motor function of the damaged GSS and the "delayed" supporting function of the damaged limb segment "shin-foot".

3. Conclusions

The nature of damage to the distal tibial syndesmosis in suprasyndesmotic fractures of the fibula is ligamentous. With surgical intervention of fibular injuries in the lower and middle third, it is more expedient to restore the damaged tibial connections in the circumference of the distal tibial syndesmosis, without implanting fixatives directly into the syndesmosis zone. In case of a head-shaped fracture of the fibula, due to the threat of damage to the fibular nerve, involving it in the postoperative scar, all types of displacement of the fibula should be eliminated and its fixation should be performed over the area of the distal fibula! syndesmosis by a positional screw. In the surgical treatment of suprasyndesmosis fractures with damage to the posterior edge of the fibula, to facilitate its reduction and osteosynthesis, it is necessary to restore the length of the fibula, with the obligatory elimination of its rotational and angular displacement.

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