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Case Report

# Management of Patients with Combined Height Injury

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**Abstract:** Background: The combined muscle-skeletal traumas (MST) are very frequent over the last few years. The emergency care try to save the life of the patient and to receive resuscitation treatment. The role of Trauma surgeon is to choose the right moment for surgery.

We present the management of patient with combined height injury, fracture stabilization, partial foot amputation, local flaps, skin grafting and HIFU – thermotherapy as scar treatment.

Materials: 40 years old mail patient, injured after a fall from 8 meters in an elevator shaft. After resuscitation treatment to control the shock the Imaging results are: burst fracture of L3 with spinal canal stenosis, fracture of the sacral bone Denis I, fracture of the right humerus in the proximal third, Monteggia fracture of the left arm, fracture of the proximal third of the right tibia as well as comminuted fractures of both calves and of both heel bones.

Results: After a few operations his final result was well healed bone fractures and a good quality soft tissue coverage allowing the patient a satisfactory quality of life.

Conclusions: Combined traumas of the muscle- skeletal system are severe, serious and difficult to manage. The good outcome in their treatment requires a team approach between the different medical specialists.

**Keywords:** muscle-skeletal traumas (MST); injury; fracture stabilization; local flaps; skin-grafting

## 1. Introduction

Combined muscle-skeletal traumas (MST) could be life - threatening and could result in lethal outcomes. They rank third in terms of mortality in men up to 45 years of age and in women up to 35 years of age. Over the last few years, there has been a surge by 15 % in the incidence rate of multiple traumas. The role of trauma surgeons in these cases is to determine the nature of muscle- skeletal damage and to outline the emergency plan to manage them. In the early post- traumatic period, it is crucial to diagnose if there are fractures of the pelvis or of long tubular bones as well as to assess the degree of accompanying soft tissue damage. (1) In combined MST, it is important to choose the right moment for surgery. Thus, the concept of damage controlled orthopedic trauma emerged. The initial stage of management is: emergency measures on vital indications and emergent transport to critical care unit for cardio-pulmonary resuscitation. Definite treatment in these patients is usually performed at a later stage, when the inflammatory response has subsided. The target is to stabilize the hemo-dynamics, to control the bleeding and other resuscitation measures and finally to perform definite fixation of the fractures with subsequent rehabilitation. (2,3) Following acute phase control and bone fixation, the soft tissue damage should be treated. The latter are usually accompanied by serious lacerations. Even in cases with limited tissue loss, trauma and tissue conqasation result in secondary necrosis and open bone and fixators defects. The soft tissue restoration in these cases presents a challenge to the plastic surgeon and often requires multiple surgical interventions

Aim: The case of a patient with multiple traumas is presented. He had multiple muscle skeletal damage following a fall from height with subsequent partial foot amputation

due to vascular soft tissue damage. After fracture stabilization he required plastic restoration with adjacent tissue transfer, free skin grafting, treatment with nano- silver and scar therapy with HIFU – thermotherapy.

The introduction should briefly place the study in a broad context and highlight why it is important. It should define the purpose of the work and its significance. The current state of the research field should be carefully reviewed and key publications cited. Please highlight controversial and diverging hypotheses when necessary. Finally, briefly mention the main aim of the work and highlight the principal conclusions. As far as possible, please keep the introduction comprehensible to scientists outside your particular field of research. References should be numbered in order of appearance and indicated by a numeral or numerals in square brackets—e.g., [1] or [2,3], or [4–6]. See the end of the document for further details on references.

## 2. Materials and Methods

This is the case of a male patient, aged 40 years, injured after a fall from 8 meters in an elevator shaft. After emergency care and splinting, he was transported to the emergency ward. There, he received resuscitation treatment to control the shock. Imaging studies based on protocols documented the presence of: burst fracture of L3 with spinal canal stenosis, fracture of the sacral bone Denis I, fracture of the right humerus in the proximal third, Monteggia fracture of the left arm, fracture of the proximal third of the right tibia as well as comminuted fractures of both calves and of both heel bones. Following testing and consultation, the patient was admitted to Intensive Care Unit until stabilization of his general condition and vital signs.

At the first stage of the surgical treatment, due to spinal canal stenosis, he underwent laminectomy with subsequent transpedicular stabilization of the fractured lumbar vertebra.

Consecutively, the following procedures were performed: stabilization of the upper extremities with plate osteosynthesis, P-plate stabilization of the sacral fracture the two pilon fractures required precise open reposition and metal osteo-synthesis. The fracture of the tibia plateau was treated with exact reposition of the joint facet and fixation with two plates: lateral and medio-posterior.



**Figure 1.** P-plate stabilization of the sacral fracture, metal osteo-synthesis of the two pilon fractures.

Due to severe fragmentation of the right heel bone and the bone deficit, it was not fixed in situ with cannulated screws. The conquesation of the soft tissues and the resulting ischaemia lead to necrosis of the distal foot and the toes.



**Figure 2.** The conquesation of the soft tissues and the resulting ischaemia lead to necrosis of the distal foot and the toes.

In this case, trans- tarsal bones amputation was necessary with closure of the defect with local tissue flap. A soft tissue flap was formed and rotated to cover the protruding bones. Limited, scattered small uncovered areas remained on the dorso- medial aspect of the foot.



**Figure 3.** Amputation, local tissue flap, debridement and nano-silver dressing for the uncovered zones.

A decision was made to apply conservative treatment with nano- silver, debridement and stage dressings due to the presence of open bone fixators, making one stage closure impossible. In two weeks granulation tissue was formed, that was covered with split-thickness skin grafts. The right thigh was the graft donor site – 0.3 mm with drainage holes. The grafts healed up successfully.



**Figure 4.** Split-thickness skin grafting.

Marginal necrosis developed in the amputation stump, attributable to disturbed soft tissue vascularization. This required serial neurectomies with staged dressings with nano silver (acticoat flex 3, acticoat flex 7). The wound areas healed up spontaneously in three weeks

### 3. Results

The patient was subject to follow-up clinically and with imaging studies in three and six months after the surgical interventions. A functional assessment was performed as well, including: presence of pain, range of joint motion and degree of mobility. Consolidation was detected in all fractures. In the right ankle joint of the amputated foot, the fracture healed with intra-joint depression as expected. This finally resulted in post-traumatic joint arthrosis. The formed plantar graft and the free grafts were vital and the donor zone was completely covered with new epithelium. At present, the patient mobilizes with a frame.

The treatment results in this case are considered successful as part of the foot was preserved in the area of the heel. This allows verticalization of the patient and independent mobility, using the heel as a point of support. Due to tissue conqueasation and damaged supplying vessels, we consider a very good result the vital tissue flap and the free grafts. The marginal necrosis as a complication was controlled and the final result was well healed bone fractures and a good quality soft tissue coverage allowing the patient a satisfactory quality of life.

### 4. Discussion

In patients with combined traumas, strict adherence to the "Damage control" protocol is of crucial importance. It allows: bleeding control, suppression of the pathological inflammatory response, excision of the devitalized tissue, reversal of the ischemic-reperfusion damage and pain control (1). Between day 5 and day 15 is the time window when definitive treatment of fractures could be performed. Following stabilization of circulation and hemo-dynamics, subsequent surgical interventions could be planned. (2) Based on our experience and on analysis of the literature data, we conclude that the safe period for definitive fracture fixation is between day 4 and 6 after the trauma, except for cases with spinal cord and/or vascular damage. In these cases, surgical treatment should be performed within 6 hours of the trauma. (3)

In the process of bone surgery and bone fixation, we followed the recommendations and the 4 principles of the AO group: (Arbeitsgemeinschaft für Osteosynthesefragen): anatomic reposition of the fracture, stable internal fixation with preserved vascularization and early patient ambulation. The exact and precise reposition of the fracture and the subsequent stable fixation with a suitable implant usually results in initial primary stability (relative/absolute) which is a prerequisite for further consolidation. (4,5,6)

In this case, the two pilon shin fractures were treated based on the classic surgical approach, offered by Rüedi and Allgöwer – reposition and fixation of the fibula, reconstruction of the tibia joint facet, implantation of a bone graft in cases with joint facet depression and /or metaphyseal defect, fixation of the metaphysis to the tibial shaft with a plate. (4) In the literature, there is data, that this approach produces very good results. In 84 pilon fractures, most authors report wound complications in 12 % and deep tissue infection in 5 % of the cases. Approximately 73,7% of the patients had a good functional result, four years after the trauma. Other authors (Bourne and all. (7) report different results. In a series of 42 high energy comminuted fractures of the distal tibia, they report 13% of deep tissue infections following surgery. Dillin and Slabaugh (8) document 55% wound complications: Teeny and Wiss (9) report 37 % incidence of wound infections in their study. The state of soft tissues in this anatomic area is "key" for the surgical management of the pilon fractures of the shin. The complex anatomy of these fractures and the delicate soft tissues in this area make surgical therapy difficult and risky.

Regarding the soft tissue defects, the Mathes and Nahai reconstructive classification is classic but still very useful classification. (10)

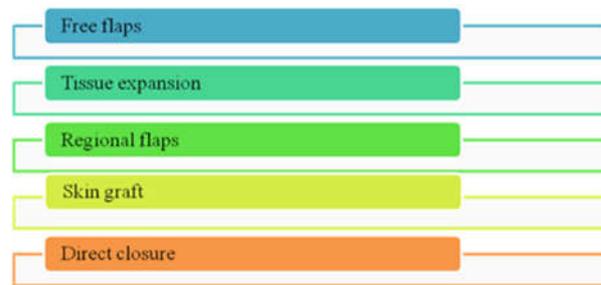


Figure 5. Based on Mathes S, Nahai F (10).

The aim of all reconstructions is the minimal post-traumatic recovery of form and function. Formation of the tissue flaps requires good vascular supply. In combined traumas and tissue conqasation, the time for definitive closure is delayed indefinitely. Reconstruction is a stage process, including wound management, infection control and debridement. (11) The regional flaps can be used to close small defects with exposed bone. In our case, it was necessary to fill a defect around the foot and ankle. (12) Split thickness skin grafts (STSG) are very useful because of their ability for quick healing and low complication rate. (13) In cases with large foot damage with insufficient adjacent tissue availability, we apply STSG to cover the soft tissues. Due to its strong antimicrobial activity, silver is a commonly used adjunct in wound care. Nanocrystalline silver acts as an antimicrobial barrier for wounds at high risk of infection or re-infection. It is appropriate for long time wound therapy.

Following the definitive closure of a combined tissue defect, formation of pathological scars is not uncommon. Management approach includes: anti-scar medication and HIFU – thermotherapy. High-intensity focused ultrasound (HIFU), is a noninvasive, nonionic technology that produces highly localized acoustic energy and is a promising new procedure for scar ablation. Scar treatment with HIFU is expected to achieve rapid ablation while producing only mild inflammation in the periphery of the targeted region. (13)

For the first time in Bulgaria, we apply this method to treat extensive scars after burns and injuries. (14) Reduction of the scar size, depigmentation and a good aesthetic result are the advantages of the HIFU-therapy. Thermotherapy, combined with anticicatricyal drugs and massage procedures, effectively treat pathological scars.

## 5. Conclusions

Combined traumas of the muscle- skeletal system are severe, serious and difficult to manage. The good outcome in their treatment requires a team approach between the different medical specialists. The final aim is preserving patient mobility and securing a good quality of life. It determines the choice of surgical interventions and the timing for surgery. In this case, the set goal was achieved with a very good final result.

**Author Contributions:** For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used “Conceptualization, V.Anastasova and S. Karamitev. E. Zanzov; methodology, V.Anastasova. A. Georgiev; software, V.Anastasova. A. Georgiev, E. Zanzov; validation, V.Anastasova., E. Zanzov, E. Krasteva, K. Atliev; formal analysis, V.Anastasova., K. Atliev; investigation, V.Anastasova. S. Karamitev; resources, V.Anastasova., E. Zanzov, K. Atliev; data curation, V.Anastasova. A. Georgiev; writing—original draft preparation, V.Anastasova. A. Georgiev, E. Zanzov; writing—review and editing, V.Anastasova. E. Zanzov, S. Karamitev ; visualization, V.Anastasova. E. Krasteva; supervision, V.Anastasova. A. Georgiev; project administration, V.Anastasova.

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