OPEN SHIN FRACTURE WITH AGRARIAN CONTAMINATION, SOFT TISSUE AND BONE DEFECTS, TREATED WITH PROXIMAL HEMI-SOLEUS FLAP AND MASQUELET TECHNIQUE

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Abstract- This document presents a clinical case of an open tibial fracture. The patient is a 51-year-old male, who suffered a farming accident. He presented with an III A open fracture of the shin and MESS score of 6. There were osseous and soft tissue defects with polymicrobal contamination. A proximal hemisoleus flap successfully reconstructed the skin loss. Masquelet technique was implemented for bone substitution. The fracture healed for a period of 11 months. There was no deep infection. The foot was functional in spite of the 10° equinus contracture. Discussed is the rationality of the chosen methods and the available alternatives.

Key words: - Open tibial fracture, proximal hemisoleus flap, Masquelet technique

1. Introduction

The open fractures with severe soft tissue damage present significant treatment challenge in spite of the widely available emergency care and broad spectrum antibiotics. When tibia is involved, there is a tendency for delayed union and non-union in 9 to 12 % of the cases[1]. The decisions concerning preservation of the limb, the extent the initial debridement, early soft tissue coverage, as well as the timing of definite stabilisation determine the clinical outcome. In the current paper, we seek answers to those questions and try to illustrate our treatment logic with a case report that put our team to the test.

2. Material and method

The patient is a 51-year-old male suffered an agrarian accident. A front loader crushed his right shin. There was an open tibial fracture AO type 42 B1 with an avascular free fragment. The surrounding soft tissues were not only crushed, but also heav-

ily, grain inseminated (fig.1). The foot was well perfused, with normal plantar, but deficient dorsal sensation. The open fracture was graded as type IIIA according to the Gustilo-Anderson classification[2]. MESS (mangled extremity severity score) was rated as a 6-a limb with gross contamination, soft tissue avulsion, reduced pulse, patient older than 51 years[3]. LSI limb (salvage index scoring system) was rated as a 4-a limb with arterial and nerve contusion, bone loss more than 3 cm, laceration of 2 and more muscle compartments, significant contamination and delayed skin coverage[4].

Fig. 1 Open tibial fracture AO type 42 B1. Free and devascularised fragment. Massive contamination

Triple antibiotics (Cefasolin 1g 3x1, Amikacin 500 mg 1x2, Metronidazole 500 mg 3x1) were started immediately. Patient was brought to the operation room .The wound was debrided and copiously irrigated. The free bone fragment was discarded. The fracture was stabilised with an external fixation (ex.fix.) (fig.2A). A second look debridement was done on the next day. A polumetylmetahcrilate (PMMA beads loaded with

Vancomycin and Gentamicin were implanted), (fig.2B) . The soft tissue defect was covered by a proximally based hemisoleus flap and split skin graft (fig. 2C). Polymicrobal flora was isolated from the wound cultures (Raoultella (Klebsiella) ornitholytica, Bacillus sporogenes, Kluyvera ascorbata (CDC Enteric Group 8), Enterococcus faecium). Targeted antibiotic therapy along with the surgical management prevented the deep infection. After 14 days, most of the wound had healed. Apex necrosis of the muscle flap was debrided and healed uneventfully under secondary intention. That concluded the first stage of treatment.

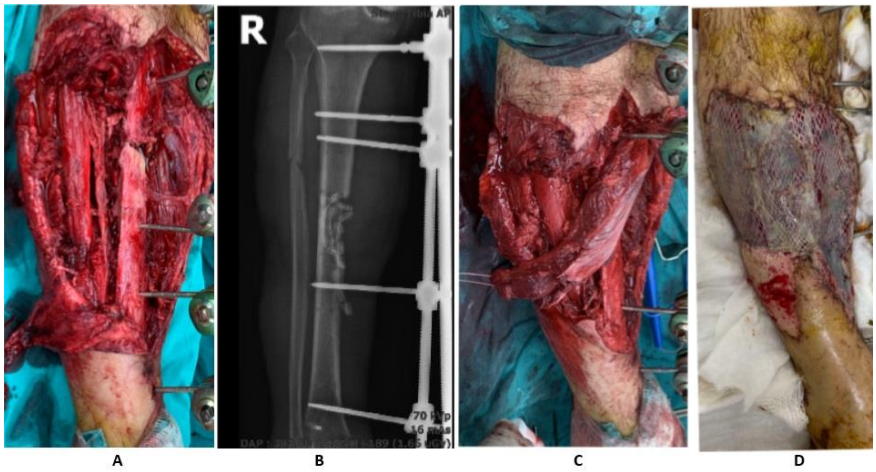

Fig. 2, **A**-Initial debridement and ex. fix. Stabilisation, **B**-Application of antibiotic loaded PMMA beads, **C**-Soft tissue coverage with proximal hemisoleus flap, **D**-Split thickness skin graft

The second stage commenced after 60 days (fig.3). At this point, the soft tissue flap had matured enough to make a new surgical procedure possible. The external fixator was removed, followed by a 7-day safety period. The fracture was then fixed with an intramedullary nail. The PMMA beads were removed. The bone defect was filled by bone cement (loaded with gentamicin and vancomycin) as the first stage of a Masquelet procedure[5].

The third and final stage of the fracture treatment was performed after 60 days (fig.4). The cement spacer was removed after careful dissection and preservation of the newly formed bioactive membrane. The gap was then filled with a bone graft harvested from the iliac crest.

The fracture united after eleven months, there were no signs of deep infection. The patient could walk without crutches .The sensitivity on the dorsal skin of his foot was still deficient and there was a fixed equines contracture of about 10 degrees (fig.4).

The patients was satisfied with the result and did not want any further operations.

Fig. 3 **A**-Soft tissue condition, **B**-Ex.Fix.removed, safety period -7 days, **C**-Definitive intramedullary fixation+Masquelet stage 1

Fig. 4 X-ray and clinical result at 11-th month.

3. Discussion

The deep infection rate after a severe open tibial fracture reaches up to 40%[6]. Our case report illustrates the successful collaboration of a trauma and a plastic surgeon's team. The challenges we faced were extensive tissue damage, substantial skin defect, massive contamination, bone defect and significant bone devascularisation. The MESS and LSI scores were borderline, so amputation was a considered option. It would have

shortened the treatment period, without any risk of deep infection or osteomyelitis. The well perfused and neurologically intact plantar region, as well as the demand of the patient, justified the decision to preserve the limb.

The aggressive debridement was a condition sine qua non for achieving bacterial control. Proximal hemisoleus flap was used for consequent tissue reconstruction. The method is described by Tobin in 1985[7]. The muscle has independent blood supply that allows its application for either medial or lateral coverage[8,9]. Raising the entire muscle is rarely necessary, thus lessening the residual morbidity[10]. Medial hemisoleus has also a rather constant blood supply facilitating its mobilisation[11]. That is why we decided to use it in our case. The muscle flap ensures a well vascularised coverage that prevents bacterial colonisation and makes further surgical procedures possible[12,13]. The method is also relative simple and reliable, with low donor site morbidity. We didn't have the technical competence to utilise a microsurgical composite free flap, that would have solved bone and soft tissue deficiency in a single procedure. So we had a bone gap to fill. A radical resection with consequent acute shortening was considered. Because of the early muscle flap coverage, we chose the Masquelet technique. The local PMMA antibiotic bead ensured bacterial control. The vascularity of the muscle flap, as well as the favourable properties of the biomembrane, assured uneventful bone healing.

The significant muscle damage, as wells as the prolonged ex. fix. time (2 months in total), led to functional deficiencies. A faster conversion would have been advantageous for the recovery. One year after the incident, the patient could walk without crutches, but his ankle joint had a 10° dorsal flexion deficit. Because of his remote inhabitance, he didn't receive enough rehabilitation, but was satisfied with the result and refused further surgical interventions.

4. Conclusion

The proximal hemisoleus flap ensured a well vascularised coverage. Several therapeutic goals were achieved- infection control, safe surgical approach and bone healing stimulation. It also worked in synergy with the Masquelet technique, providing enough blood supply for the formation of the bioactive membrane.

The membrane promoted the integration of the bone graft, thus leading to solid bone healing. Both methods combined made limb salvage possible.

5. References

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