OPEN ACCESS
Freely Available Online

INTERNATIONAL JOURNAL OF SURGICAL TECHNIQUES

ISSN NO: Coming Soon

Case Report

DOI: Coming Soon

Possibility to Influence Treatment of Open Tibial Fracture by Negative Pressure Wound Therapy

MUDr. Miroslav Budoš[1,*], MUDr. Radek Veselý[2]

[1]Traumatology dep., Bata Hospital Zlín, Chzech Republic.

[2]Trauma Hospital of Brno, Department of Traumatology at the Medical Faculty, Masaryk University of Brno, Ponávka 6, Brno, Czech Republic, Europe.

Abstract

Modern medicine gives treatment options even in cases, where this has not been possible in the past. We want to present how negative pressure wound therapy (NPWT) helps in limb salvage. The case report brings our insight and experience on how to be successful with NPWT.

We present a high-energy injury with an open tibial fracture IIIB according to Gustillo-Anderson classification [11]. NPWT is an excellent option to treat extensive soft tissue injury. NPWT is also beneficial in the application of the dermoepidermal graft as we have found. We can confirm that this therapy contributed to a faster healing of soft tissues compared to classical wound healing.

Corresponding author: MUDr. Miroslav Budoš, Traumatology dep., Bata Hospital Zlín, Havličkovo Nabřeží 600 Zlín, Czech Republic, Europe, Tel. No: +420 777 608486

Keywords: high energy injury, open tibial fractures, soft tissues injury, negative pressure wound therapy, limb salvage, osteosynthesis, dermoepidermal graft

Received: Oct 14, 2019 **Accepted:** Nov 07, 2019 **Published:** Nov 14, 2019

Editor: Inarei JosÃ© Pnarei JÃºnior, Faveni-Faculty New Immigrant Sale, Brazil.

Introduction

Medicine, as well as other disciplines over the past few years, has had a progressive rise in the field of healing. Today's possibilities push the treatment forward and we are able to heal effectively what we could not be able heal in the past. We want to present two case reports with serious injury of tibia and soft tissue. These are two high-energy limb trauma with an open tibial fracture. The mechanism of injury in both cases is the passing of the limb by the bus wheel. Both patients were treated in a specialized clinic and the procedure of diagnostic and osteosynthesis was standard trauma protocol. An important part for the treatment of soft tissues was the vacum therapy called negative pressure wound therapy or vacum assisted closure therapy (V.A.C.). In both cases there was no injury to marginal vessels and nerves. Ischemia on the periphery or missing pulse was not detected. Mess score classification was used to determinate surgery strategy. [1]

NPWT is a modern and successful treatment of soft tissues. The principle of therapy is a closed system of controlled negative pressure environment wound. The vacuum system drains the exudate into the special container. Eliminates infection or reduced bacterial colonization in the wound. Vacuum stimulates granulation by local hyperemia and also promotes neovascularization. Secretion removal further contributes to reducing soft tissue swelling around the wound and reducing limb edema. [2][3-8]

Biological acceptability has been demonstrated in animal models where vacuum therapy leads to decreased swelling, increased tissue perfusion and increased granulation tissue.[3-8]

An open fracture and high-energy trauma in relation to the time of treatment present a risk of slow bone healing. NPWT heals faster soft tissue and gives the possibility of better bone healing.

Materials and Methods

We present two case reports with serious injury of tibia and soft tissue. It is high-energy limb trauma with an open tibial fracture. Both patients were treated at a specialized traumatic clinic with standard traumatic guidance. Urgent initial laboratory examination, diagnostics (X-ray, CT, AGCT) and osteosynthesis up to 6 hours with soft tissue treatment.

An important part for the treatment of soft tissues was the negative pressure wound therapy. We cooperate with Hartmann company and use Vivano device.

The method that influenced treatment in these cases was vacuum therapy. The principle is a closed system of controlled negative pressure environment wound or defect. The wound is primarily cleaned and free of necrotic parts and then covered with a special polyurethane foam. Then the wound with foam is covered with a special thin foil. A closed environment is created. In the middle of the foil is a hole with a special port with tubing, which is connected to the device. The device maintains a stable vacuum 125 mmHg and removes secretions from the wound. The vacuum is maintained continuously throughout the treatment period.

The vacuum system drains the exudate into the special container. Eliminates infection or reduced bacterial colonization in the wound. Vacuum stimulates granulation by local hyperemia and also promotes neovascularization. Secretion removal further contributes to reducing soft tissue swelling around the wound and reducing limb edema. [2,3-8]

In our case we are using vNPWT for open fractures of tibia type G-A IIIB. Parts of the skin cover were destroyed by injury. Parts were loss of skin and subcutaneous defects or necrotic decollemetal parts. In this case we used a synthetic skin cover at the beginning (Synkryt), and then vacuum therapy.

We hade used dermoepidermal graft as a method of definitive closure of skin defects. This method is simple and has less nutritional requirements than a full thickness graft.

Graft is in thickness 0.3-0.4 mm and contains dermis and epidermis structures. Removal graft performed using an electrodermatome in the required size.

Standard metods to acute treatment in the department of emergency admission is debrits of the limb, desinfection, antiseptic dressing, temporary fixation, diagnostics (X-ray, CT, angiography, angio CT), initial ATB therapy, urgent preoperative preparation, transport to the operation hall.

Our Acute Surgery methods are complete limb debritman, excision of necrotic parts of skin, subcutis, removal of other microscopic impurities. Than stabilization of the tibia OS by external fixation. Reconstruction of soft structures, muscles, fascias, subcutis and skin. Application of Synthetic Skin Cover / Synkryt / or NPWT immediately. Limb wound dressing for vacuum therapy is every 4-5 days.

Case No.1 involves injuries to a 70 year old woman who was driven over by a bus wheel in the area of the tibia shaft. Primary diagnoses have been established as an open fracture of the tibia by Gustillo-Anderson IIIB [11]. Laceration of soft tissue in central part of tibia. Other diagnoses of injury are fracture of tali et ossis calcanei, fracture of ossis metatarsi No.I, fracture of ossis cuneiformis medialis. Hypertension, hypercholesterolemia is related to personal amanesis. There was no injury to marginal vessels and nerves. Ischemia on the periphery or missing pulse was not detected and MESS absolute indication of amputation <7.[1] If MESS score is greater than 7, we have to think about limb amputation. Table 1, Fig 1 - 32.

Case No.2 is about a man of 44 years old, where the injury caused by falling in ebrieta under the wheels of the bus. Primary acute treatment in the district hospital and then transferred to the Trauma Center of the Regional Hospital with open fracture of the tibia by Gustillo-Anderson IIIB [11]. Extensive decollement of soft calf tissues up to the knee. Other diagnoses included the fracture of malleoli lateralis, acute hemorrhagic shock, traumatic shock, crash syndrome, acute alcohol intoxication.

Case No: 2

Male 44 years old

9.October 2015 - acute surgery

Revision of limb perfusion and pulsation of marginal vessels. There was no detected injury of marginal vessels and nerves. MESS Absolute indication of amputation <7

Revision of soft tissue - extensive contusolaceration of the lower limb from the Achilles tendon through the whole calf to the medial side of the thigh - circular detachment of the skin and subcutis from the fascia, macroscopic contamination.

Application of external fixation and Ki wires to stabilization of fragments.

Reconstruction of the skin cover - excision of necrotic parts, covering defects using artificial skin Synkryt. Fig 33 - 50

Results

Both cases of treatment open tibial fracture using NPWT have been cured successfully. The median

Table 1. MESS Absolute indication of amputation > 7

From: Primary amputation vs limb salvage in mangled extremity: a systematic review of the current scoring system

Energy	Low	1
	Medium	2
	High	3
	Very High	4
Ischemia	Perfused	1
	Pulse absent	2
	Cool, Paralized, insansate	3
Shock	SBP>90	0
	Transient	1
	Hypotension, Persistent Hypotension	2
Age	<30	0
	30-50	1
	>50	2

Case No.1

Figure 1. 22 January – primary surgical treatment in the operating room

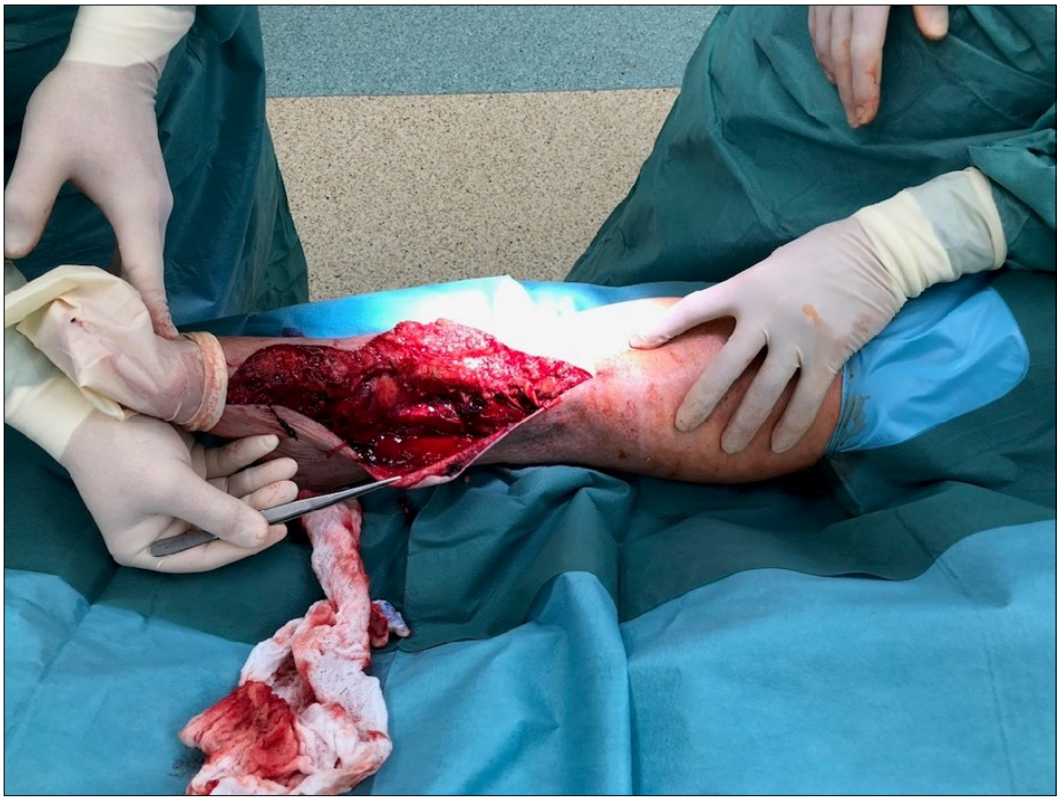

Figure 2. 22 January – primary surgical treatment in the operating room

Figure 3. 22 January – primary X-ray oblique splinter fracture of the tibia shaft

Figure 4. Debriteman and removal of macroscopic impurities Fracture stabilization using external fixator Reconstruction of soft tissue, subcutis and skin, necrectomy Installation of flushing lavage

Covering defects with artificial skin – Syncryt

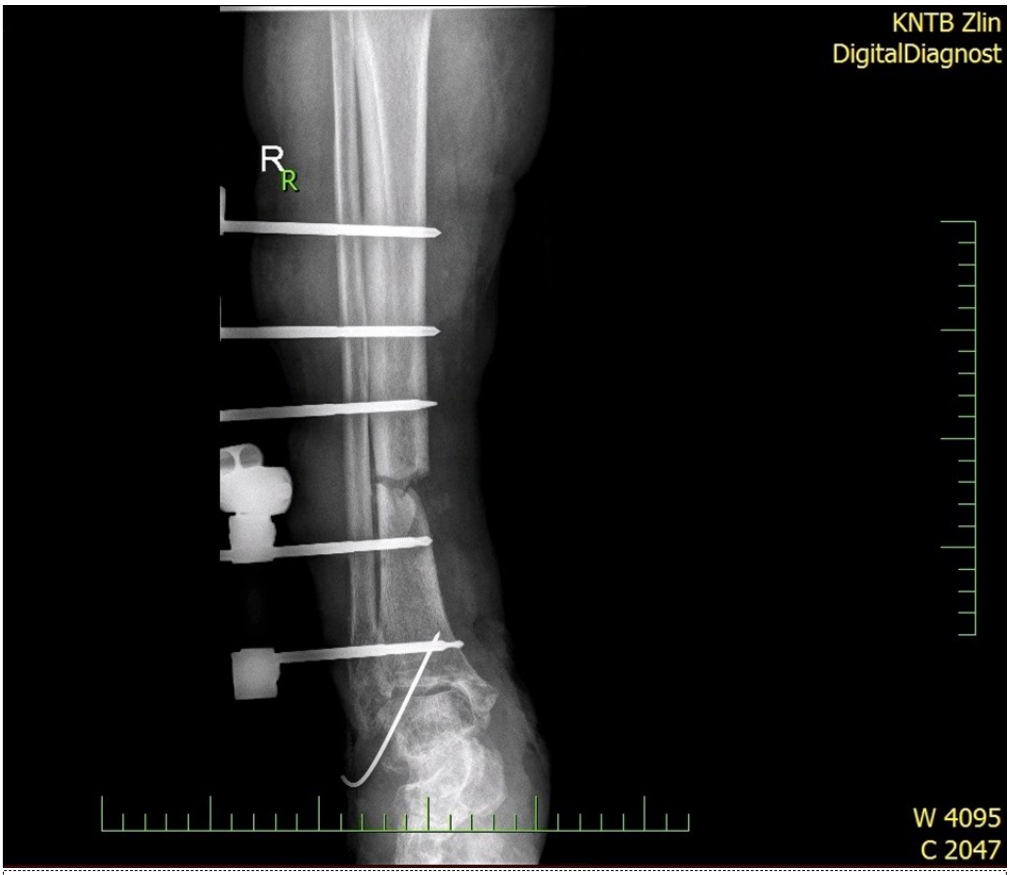

Figure 5. 22 January – primary X-ray - Fracture stabilization using external fixator

Figure 6. 22 January – primary X-ray - Fracture stabilization using external fixator

Figure 7. 9 February
Extensive necrosis of skin and subcutis in the area of primary limb laceration
Progression of the skin necrosis line demarcation

Figure 8. 9 February
Extensive necrosis of skin and subcutis in the area of primary limb laceration
Progression of the skin necrosis line demarcation

Figure 9. 9 February.

Extensive necrosis of skin and subcutis in the area of primary limb laceration

Progression of the skin necrosis line demarcation

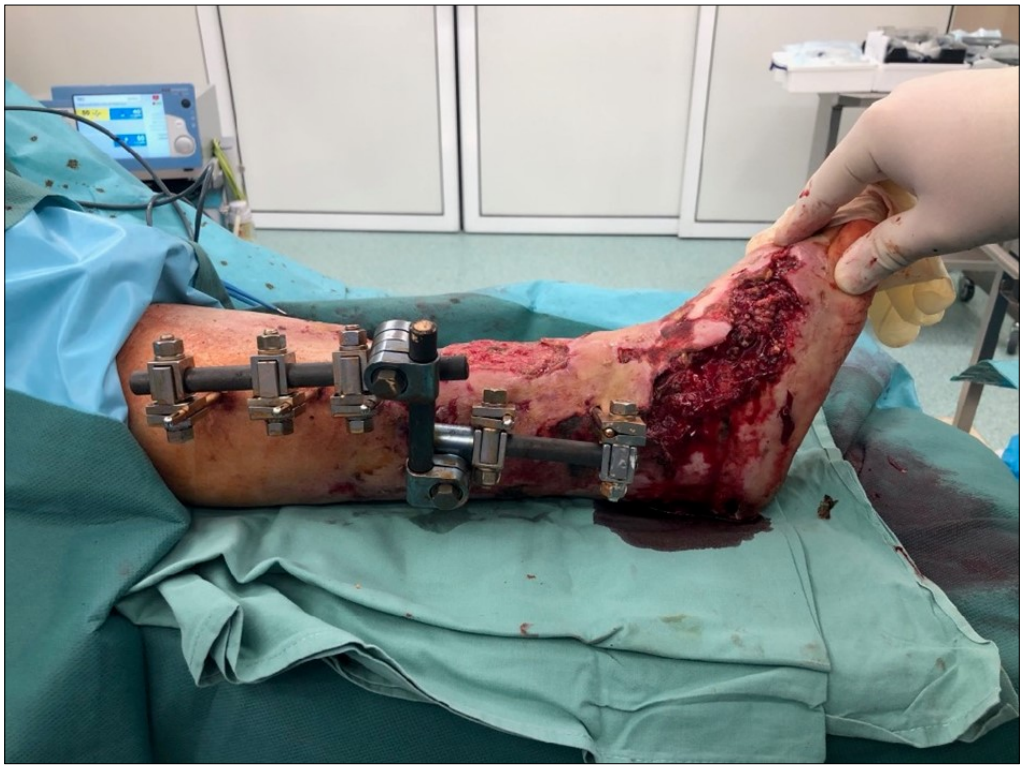

Figure 10. 19 February

performed necrectomy, vitalization of subcutis, application negative pressure wound therapy

Figure 11. 19 February

performed necrectomy, vitalization of subcutis, application negative pressure wound therapy

Figure 12. 19 February

performed necrectomy, vitalization of subcutis, application negative pressure wound therapy

Figure 13. 19 February

application of negative pressure wound therapy Vivano

application of polyurethane foam, foil, central port with tubing

Figure 14. 19 February

application of negative pressure wound therapy Vivano

application of polyurethane foam, foil, central port with tubing

Figure 15. 19 February
application of negative pressure wound therapy Vivano
application of polyurethane foam, foil, central port with tubing

Figure 16. 19 February
application of negative pressure wound therapy Vivano
application of polyurethane foam, foil, central port with tubing

Figure 17. 4 March - after one removing the vacuum therapy
demonstration of subcutaneous granulation
wound dressing changing every 5-6 days

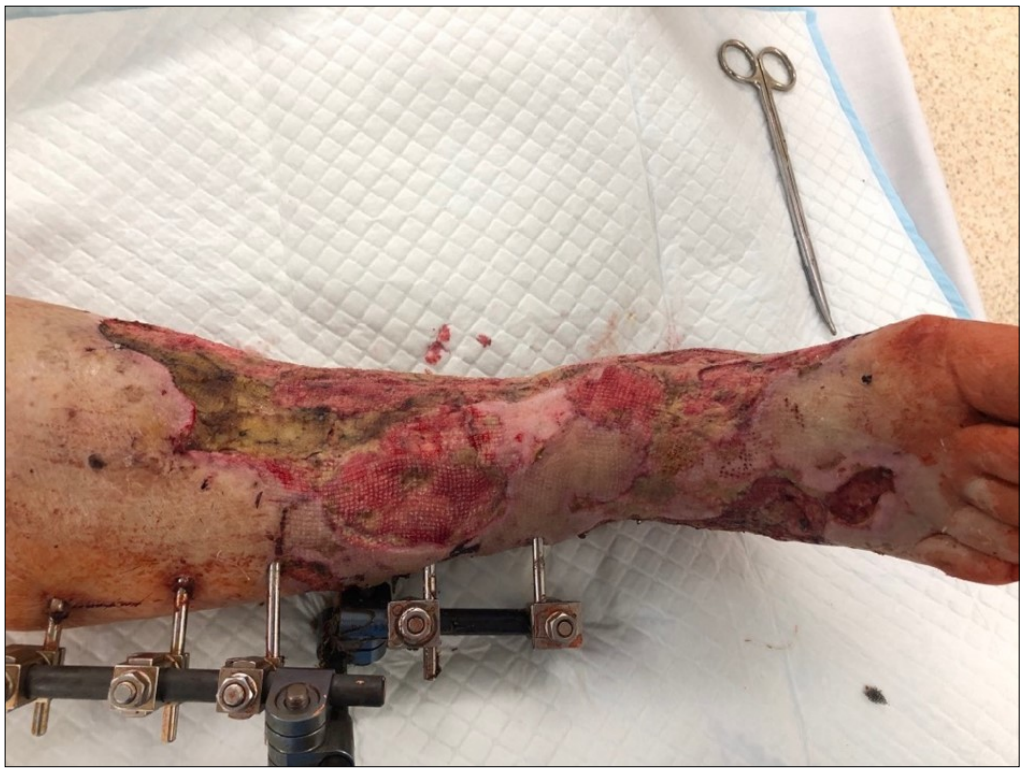

Figure 18. 4 March - after one removing the vacuum therapy
demonstration of subcutaneous granulation
wound dressing changing every 5-6 days

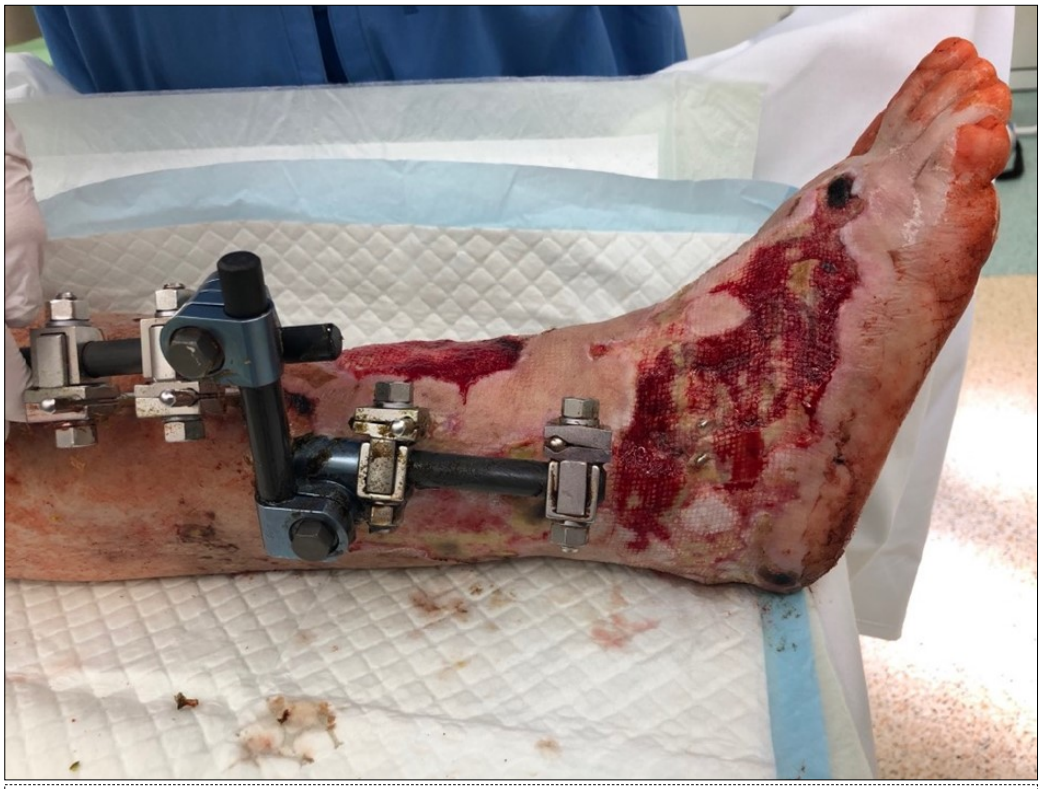

Figure 19. 4 March - after one removing the vacuum therapy
demonstration of subcutaneous granulation
wound dressing changing every 5-6 days

Figure 20. 19 March
Defect of limb already clean with granulation ready for application of dermoepidermal graft

Figure 21. 19 March

Defect of limb already clean with granulation ready for application of dermoepidermal graft

Figure 22. 19 March

Defect of limb already clean with granulation ready for application of dermoepidermal graft

Figure 23. application of dermoepidermal graft with vacuum therapy of 90mmHg

Figure 24. application of dermoepidermal graft with vacuum therapy of 90mmHg

Figure 25. application of dermoepidermal graft with vacuum therapy of 90 mmHg

Figure 26. after removing the therapy

dermoepidermal graft successfully fixed

Figure 27. after removing the therapy
dermoepidermal graft successfully fixed

Figure 28. 23 April
Surgery conversion of osteosynthesis
Removal external fixator and implantation intramedullary tibial nail
Gradual bone healing - last X-ray september 2019

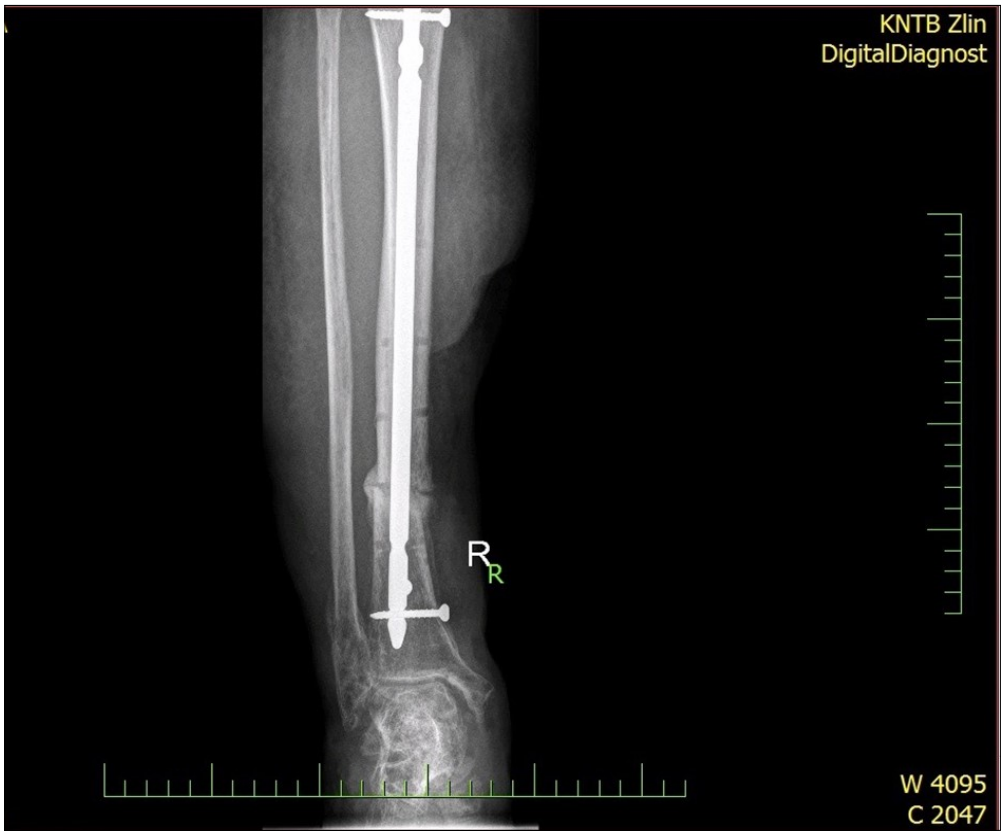

Figure 29. 23 April
Surgery conversion of osteosynthesis
Removal external fixator and implantation intramedullary tibial nail
Gradual bone healing - last X-ray september 2019

Figure 30. Gradual healing of small defects over the months may - august

Figure 31. October 2019
skin cover completely healed
8 months from the injury to heal soft tissues

Figure 32. October 2019
skin cover completely healed
8 months from the injury to heal soft tissues

Figure 33. X-ray documentation of the whole treatment of tibia fracture
External fixation was used throughout the treatment until bone was healed
From 9.October 2015 to 2.February 2017

Figure 33. a) 9.10.2015 X-ray

Figure 33. b) 9.10.2015 X-ray

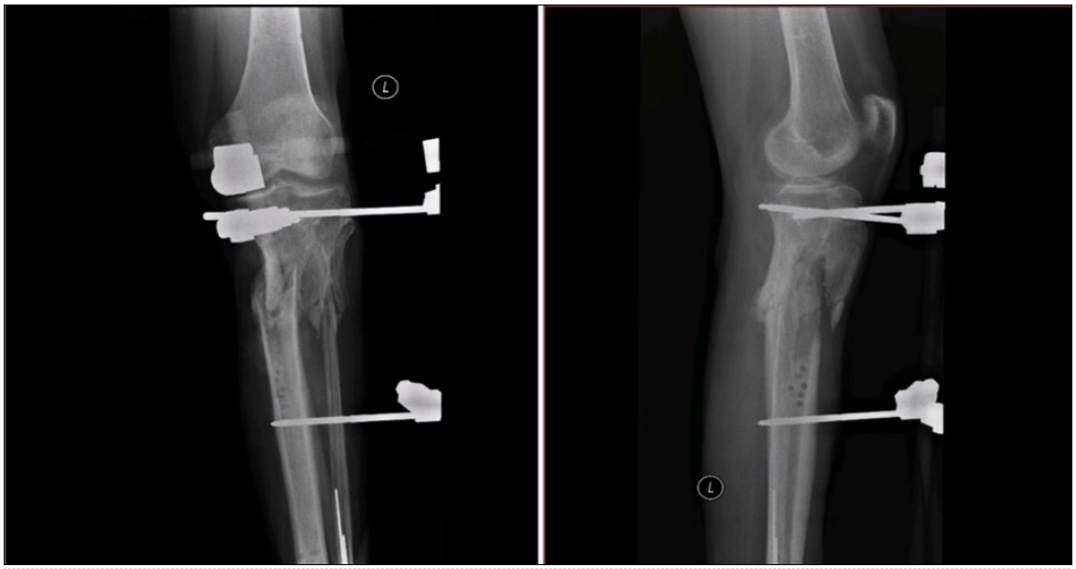

Figure 33. c) 9.2.2016 X-ray

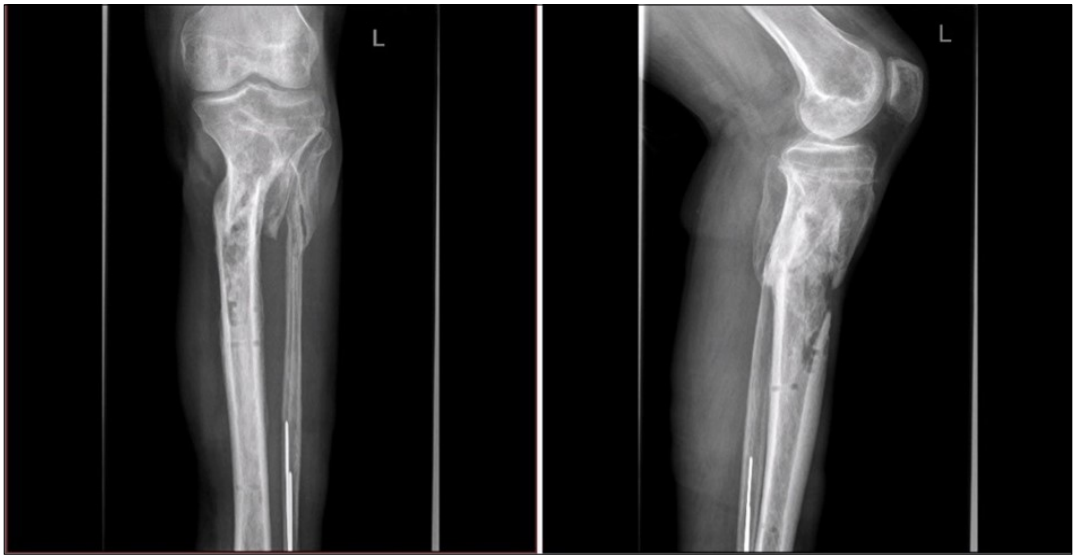

Figure 33. d) 4.8.2016 X-ray

Figure 33. e) 2.2.2017 X-ray

Figure 34. After 2 weeks
Progression of the skin necrosis line demarcation

Figure 35. After 2 weeks
Progression of the skin necrosis line demarcation

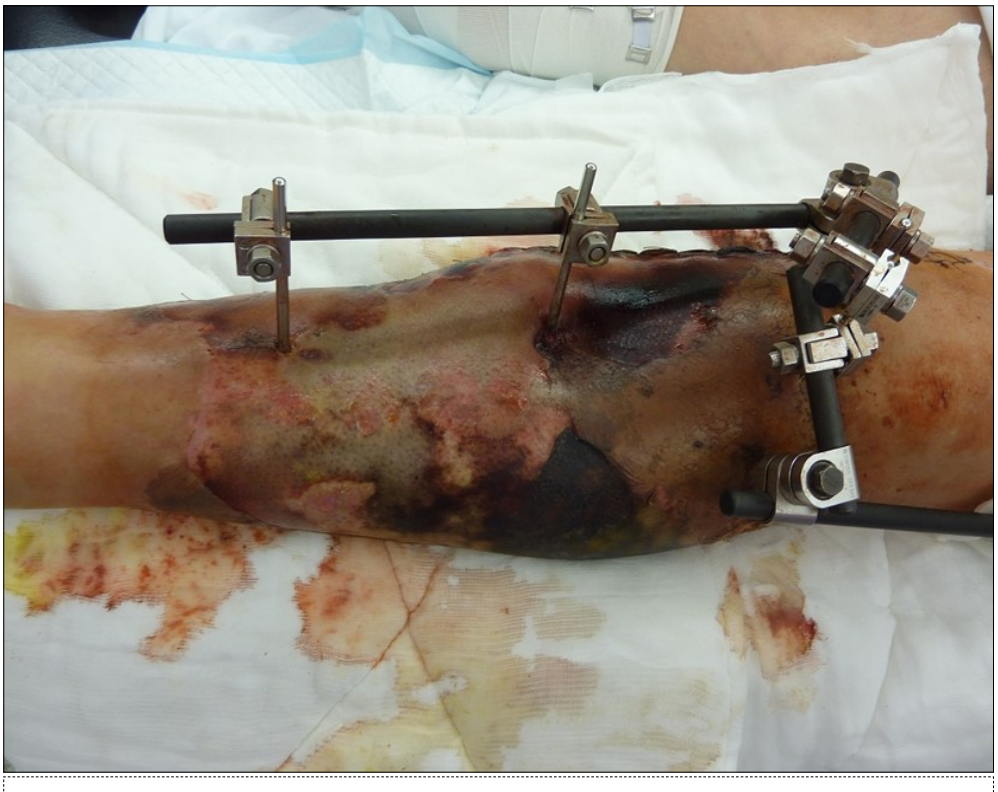

Figure 36. After 2 weeks
Progression of the skin necrosis line demarcation

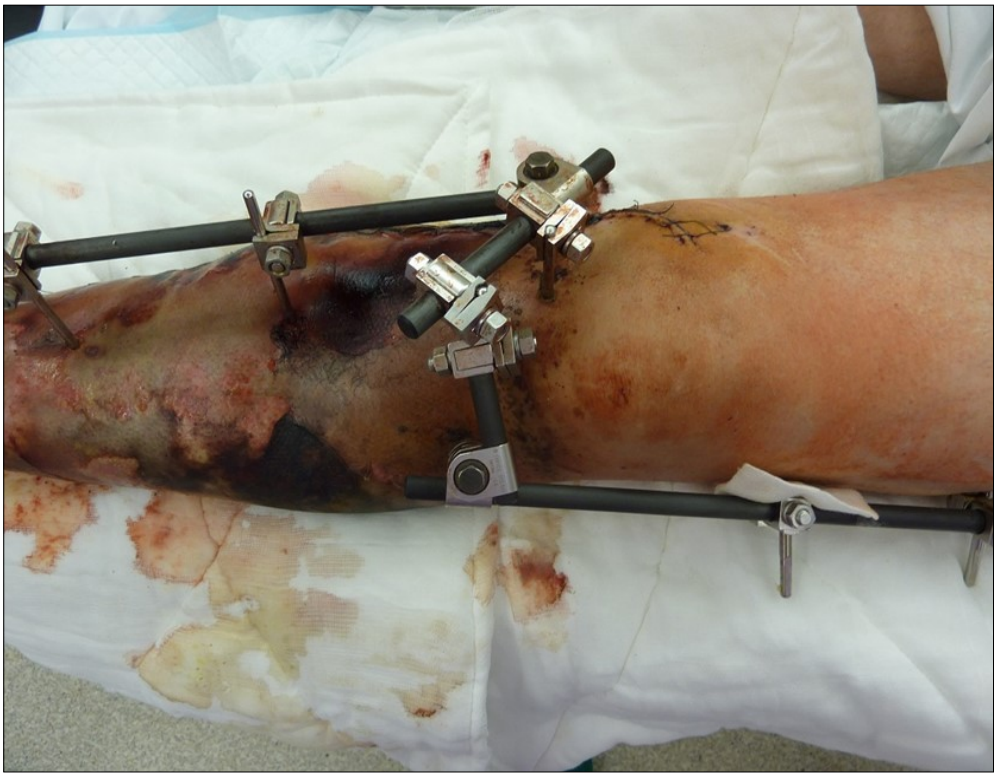

Figure 37. After 2 weeks
Progression of the skin necrosis line demarcation

Figure 38. After 2 weeks
Progression of the skin necrosis line demarcation

Figure 39. After 2 weeks
Progression of the skin necrosis line demarcation

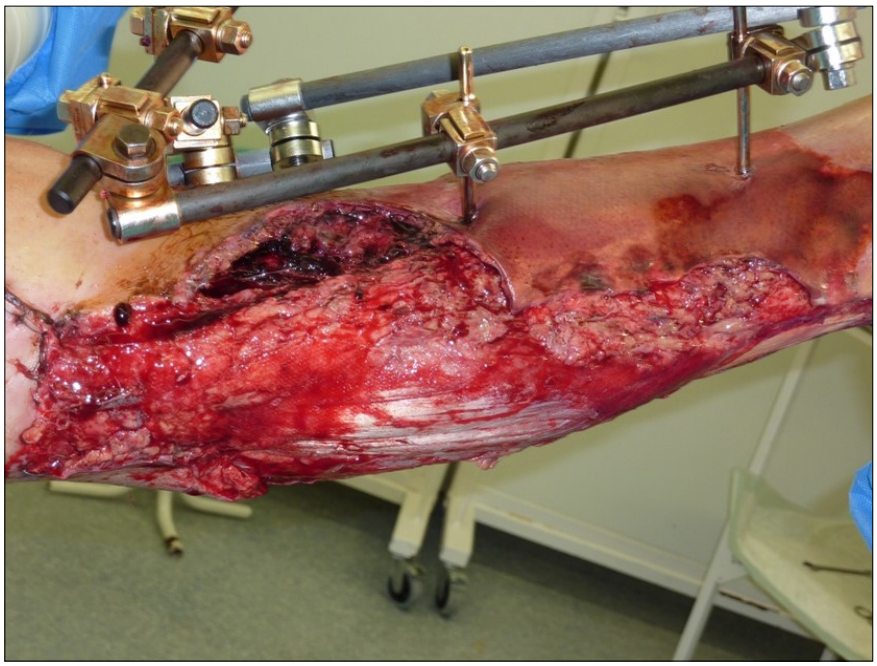

Figure 40. After 3 weeks performed necrectomy, vitalization of subcutis, application negative pressure wound therapy

Figure 41. Picture of dressing changing of negative pressure woud therapy after 5weeks
demonstration of subcutaneous granulation
wound dressing changing every 5-6 days

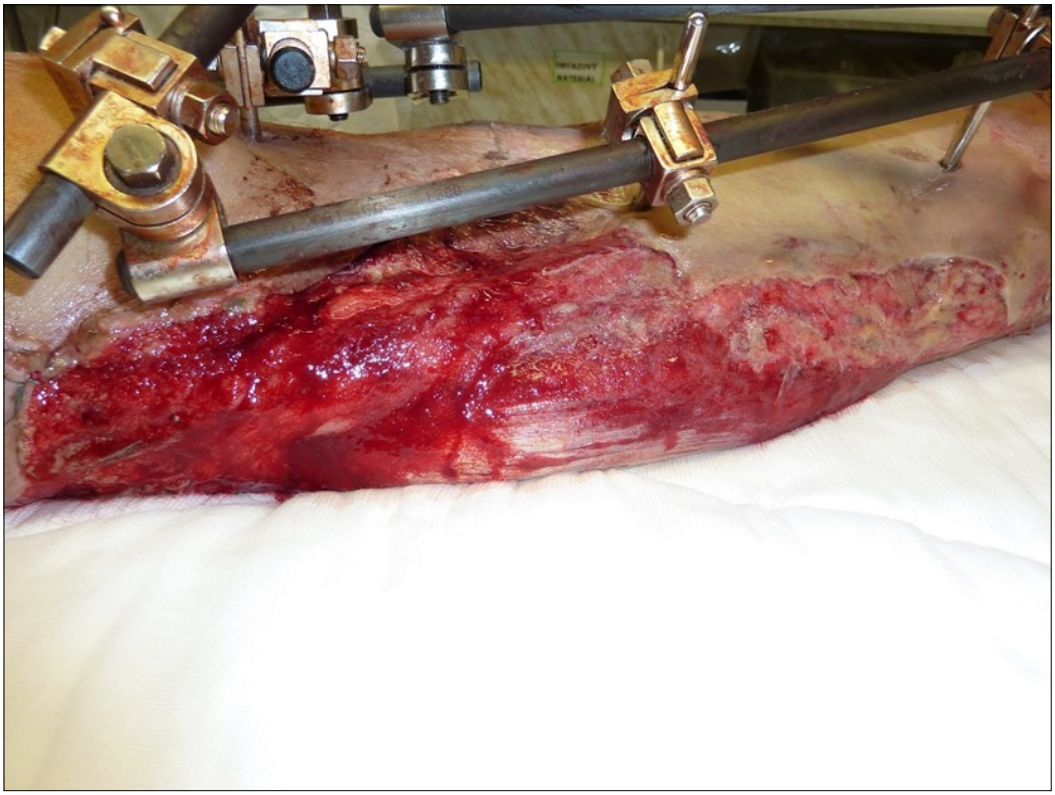

Figure 42. Dressing changing negative pressure woud therapy after 5 weeks
demonstration of subcutaneous granulation
wound dressing changing every 5-6 days

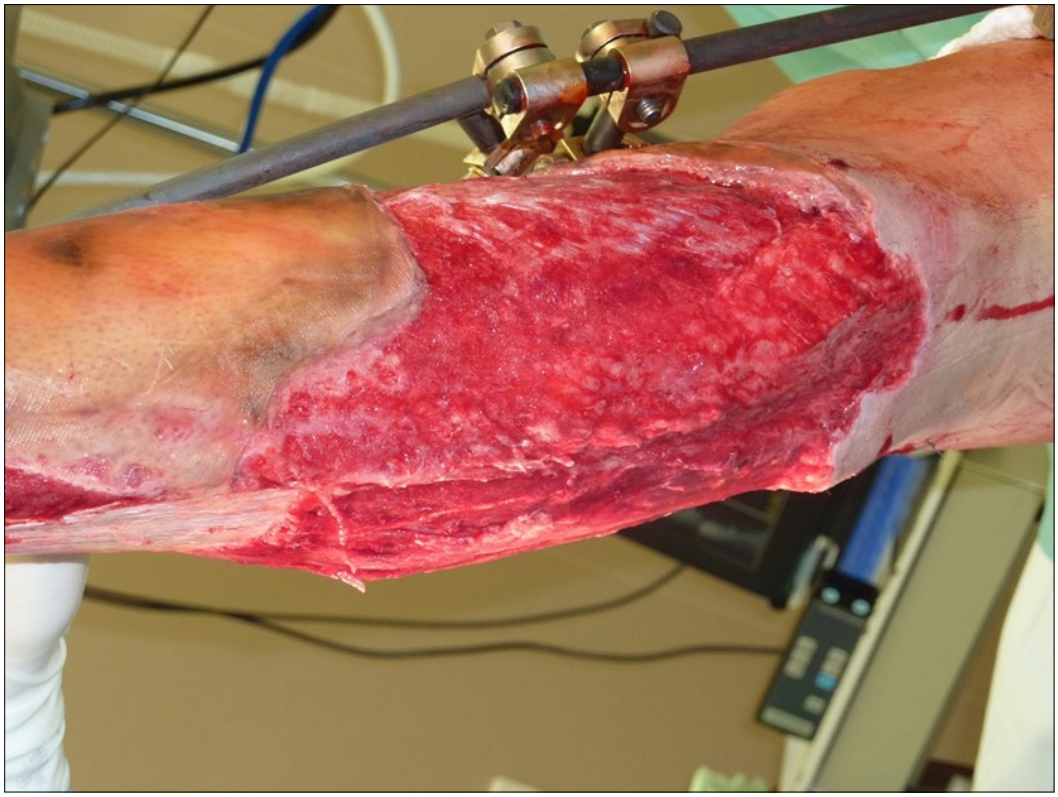

Figure 43. Dressing changing negative pressure woud therapy after 7 weeks
advanced granulation suitable for application of dermoepidermal graft

Figure 44. Dressing changing negative pressure woud therapy after 7 weeks advanced granulation suitable for application of dermoepidermal graft

Figure 45. Application of dermoepidermal graft in individual steps from December 2015 to January2016
use of vacuum therapy with good graft fixation and graft drainage

Figure 46. Application of dermoepidermal graft in individual steps from December 2015 to January2016

use of vacuum therapy with good graft fixation and graft drainage

Figure 47. January 2016

resection of the tibial avital cortica and resuture

Figure 48. January 2016
resection of the tibial avital cortica and resuture

Figure 49. Jun 2016
skin cover completely healed
9 months from the injury to heal soft tissues

Figure 50. Skin cover completely healed

9 months from the injury to heal soft tissues

duration of treatment was 8.5 months. The case report No.1., old lady was cured of skin cover and skeleton in 8 months. The case report No.2., 44 years man was heal in 9 months but his soft tissue injury was more extensive. Standard ATB procedures were used during treatment.

Individual photos present how quickly and effectively NPWT can help heal a soft tissue defect. The use of this therapy was essentially underestimated until the skin cover healed. A case report of NPWT confirms, that treatment of severe limb injury can be positively influenced. Therapy positively affects the rate of healing, elimination of bacterial load and ultimately successful healing of the dermopeidermal graft

Discussion

Discussion of limb salvage or amputation is appropriate for such serious injuries. However salvaged limb does not guarantee functionality, normal life, a pain-free extremity or employability [9, 10]

We think that the NPWT has made treatment relatively fast with minimal complications. Classical therapy for wound healing would take longer and be uncertain according to more risk of bacterial load and slow granulation of soft tissues.

This method is considered the method of choice in the treatment of severe limb injuries with soft tissue laceration. After successful therapy, limb function is another target in the treatment.

Conclusion

The great advantage of therapy is the acceleration of wound healing and overall shortening of the patient's treatment. Our case reports provide a view of treatment using vacuum therapy. Presented case report confirms the effectiveness and importance of therapy.

Treatment with NPWT shortens the length of hospitalization, lower the number of regular dressings, therefore, treatment is economically effective in a complex concept.

Recent experience has determined that this method is required for each trauma of this type.

Abbreviations

NPWT – negative presure wound therapy

V.A.C – vaccum assisted closure

ATB – antibiotics

G-A Gustillo Anderson open fracture classification

125 mmHg – pressure 125 millimeters of hydrargyrum

Ethics

We received consent from the participants of the case report to the presentation.

References

1. Johansen K, Daines M, Howey T, Helfet D, Hansen Jr ST. Objective criteria accurately predict amputation following lower extremity trauma. J Trauma. 1990;30:568–73.
2. Morykwas MJ, Argenta LC, Shelton-Brown EI, McGuirt W. Vaccum-Assisted Closure: a New Method for Wound Control and Treatment: Animal Studies and Basic Foundation. *Ann Plast Surg* 1997;38 (6): 553-562
3. Morykwas MJ, Falter BJ, Pearce DJ, Argenta LC. Effects of Varying Levels of Subatmospheric Pressure on the Rate of Granulation Tissue Formation in Experimental Wound in Swine. *Ann Plast Surg.* 2001;47(5):547-551
4. Argenta LC, Morykwas MJ. Vaccum-Assisted Closure: a New Method for Wound Control and Treatment: Clinical Experience. *Ann Plast Surg.* 1997;38(6): 563-576, discussion 577
5. Webb LX. New Techniques in Wound Management: Vaccum-Assisted Wound Closure. *J Am Acad Orthop Surg.* 2002;10(5):303-311
6. Fabian TS, Kaufman HJ, Lett ED, et al. The Evaluationof Subatmospheric Pressure and Hyperbaric Oxygen in Ischemic Full-Thickness Wound Healing. *Am Surg.*2000; 66(12):1136-1143
7. Genecov DG, Schneider AM, Morykwas MJ, Parker D, White WL, Argenta LC. A Controlled Subatmospheric Pressure Dressing Increases the Rate of Skin Graft Donor Site Reepithelialization. *Ann Plast. 1998;40 (3):219-225*
8. Chen S-Z, Li J, Li X-Y, Xu L-S. Effects of Vacuum-Assisted Closure on Wound Microcirculation: an Experimental Study. Asian J Surg Asian Surg Assoc. 2005;28(3):211-217
9. Fodor L, Sobec R, Sita-Alb L, Fodor M, Ciuce C. Mangled lower extremity: can we trust the amputation scores? Int J Burns Trauma. 2012;2 (1):51–8.
10. Giuseppe Rosario Achiro, Sergio Sessa, Andrea Piccioli, Giulio Maccauro. Primary amputation vs limb salvage in mangled extremity: a systematic review of the current scoring systém, 2015; https:// doi.org/10.1186/s12891-015-0832-7
11. Gustilo-Anderson Classification - Paul H. Kim, Seth S. Leopold Clin Orthop Relat Res. 2012 Nov; 470(11): 3270–3274. Published online 2012 May 9. doi: 10.1007/s11999-012-2376-6