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### Case report

# The role of negative pressure wound therapy in salvaging a six-year-old child's crushed foot – A case report

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#### ABSTRACT

Crushed extremity is an infrequent injury in children and represents a major challenge for the orthopaedic surgeon. Sometimes the decision making process, whether to amputate or save a limb, is very difficult. Several scoring systems have been developed in order to determine the fate of crushed extremities, but they are not always predictive when patients are children. In the past few years, advances in bone and soft tissue reconstruction techniques have improved outcomes, even in the most extreme cases. Negative Pressure Wound Therapy has become an accepted option in the treatment of crushed limbs. We report a 6-year-old child with a crushed left foot from the running chain of his father's motorcycle. Early revascularization and stabilization along with multiple debridement and the application of Negative Pressure Wound Therapy led to salvage of the child's limb. At the end of one year follow up, he presented a very good functional and aesthetic result.

*Level of clinical evidence:* "4".

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## 1. Introduction

Crush injuries are high energy traumas that happen when a body part is forcefully compressed between two hard surfaces. They are associated with severe bone and soft tissue destruction. Their treatment represents a major challenge for the orthopaedic surgeon and the decision whether to amputate or to try to reconstruct a crushed extremity remains a difficult dilemma [1]. In an attempt to make an objective critical decision of amputation versus reconstruction, multiple scoring systems and grading have been proposed [2–5]. In the past few years, advances in bone and soft tissue reconstruction have improved the management of crushed limbs [6–8]. Negative Pressure Wound Therapy (NPWT) has become an accepted option in treating them [8,9]. We present here a 6-year-old child with a crushed left foot from the running chain of his father's motorcycle. Early revascularization and stabilization along with multiple debridement and the application of NPWT led to salvage of the child's limb and to a very good functional and aesthetic final result.

## 2. Case

In June 2015, a six-year-old boy was presented to the emergency department of our hospital, seven hours after he crushed his left foot in the running chain of his father's motorcycle. Time was spent, during transferring him from another city about 200 miles away. On arrival at the hospital, he was conscious and anxious, blood pressure was 90/70 mmHg, pulse rate 110/min, respiration rate 21/min and oxygen saturation 99%. There were extensive skin loss (10 × 7 cm large) and extensive soft tissue destruction on the dorsal surface of the middle and front left foot and two deep wounds, on the external side of the foot (9 cm large) and over the anterior ankle joint (5 cm large). Most of the extensor tendons along with the lower part of the tibialis anterior tendon were destroyed and the Achilles tendon was ruptured (Figs. 1 and 2). About 3 cm of the dorsalis pedis artery, at the mid-tarsal region were lost and capillary refill was delayed, but after Doppler examination pulses were identified over the tibialis posterior and fibular arteries. Plantar sensation was present. Anterior-posterior and lateral radiographs of the left foot and ankle joint, revealed multiple metatarsal and phalangeal fractures, extensive bone loss and complete disruption at the level of the tarsometatarsal joints. The anatomy of the second and fourth metatarsophalangeal joints was also disturbed, while the metatarsophalangeal joint of the

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Fig. 1. Preoperative picture of the left foot.



Fig. 3. Preoperative antero-posterior radiograph of the left foot and ankle.

third toe was completely destroyed (Fig. 3). Mangled Extremity Severity Score (MESS) was 8 and Mangled Extremity Severity Index (MESI) was 20.

Immediate cefuroxime 400 mg and metronidazole 500 mg were given intravenously (i.v.) and anti-tetanus protection intramuscularly (i.m.). He was then taken urgently to the operating room. Due to the patient's age and the preservation of plantar sensation and good function of the tibialis posterior and fibular arteries, a salvage attempt was advised instead of an amputation. Under general anaesthesia, surgical treatment was performed, which included vascular anastomosis of the dorsalis pedis artery, fixation of the tibialis anterior tendon to the navicular bone with the use of a suture anchor, suturing of the Achilles tendon, extensive irrigation and debridement of damaged soft tissue and removal of free devitalized bone fragments. Unfortunately, all the structures of the third toe were damaged and it was amputated. Samples for microbiological examination were also taken. Due to extensive tissue damage and the probability of high complication rate, the skin defect on the dorsolateral surface of the foot was left open and covered with hypertonic saline impregnated gauze dressings, while the other wounds were directly closed with sutures. Finally the lower leg was immobilized in a foot and ankle splint. Postoperatively saline infusions (2L 0.9% NaCl every 24 h i.v.) were given, along with antibiotics (Cefuroxime 360 mg every 8 h i.

v. and Clyndamycin 290 mg every 8 h i.v.), analgesics, and anticoagulant injections (Nadoparin 2850 i.u. every 24 h i.m.).

Additional debridement and irrigation were performed at two and four days afterwards. On the seventh postoperative day, the results of microbiological examinations were negative for infection and a Negative Pressure Wound Therapy (NPWT) device, along with a gauze impregnated with the antimicrobial polyhexa-methylene biguanide (PHMB), were applied. The entire area was covered with a transparent adhesive membrane, which was firmly secured to the healthy skin around the wound margin and a negative pressure value of 125 mmHg was used in a continuous fashion. NPWT dressings and PHMB gauze were subsequently changed every four days, resulting in wound retraction, filling of skin defect with granulation tissue and covering of exposed bones and soft tissues (Fig. 4). After twenty days of hospitalization, there were no clinical signs of infection and all microbiological and laboratory examination results were normal (Fig. 5). The application of antibiotics and analgesics was stopped and after two days the boy was discharged from the hospital. Outpatient NPWT and PHMB gauze changes were continued every four days, from a specialized NPWT nurse. Three weeks after, the application of NPWT stopped and PHMB gauze was applied alone for two more weeks (Figs. 6 and 7).

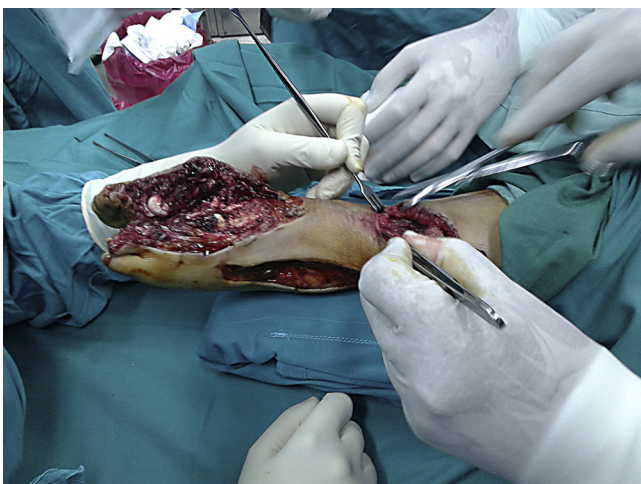


Fig. 2. Preoperative picture of the left foot and ankle.



Fig. 4. Wound retraction and filling of the defect with granulation tissue, two weeks postoperatively.

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