

Selective resection of the bone with preservation of soft tissues (“empty toe technique”) combined with negative pressure wound therapy for treatment of osteomyelitis of the great toe - a case report

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CASE REPORT

Abstract— Diabetic foot ulceration (DFU) is a serious complication of diabetes mellitus and one that is difficult to treat. In many cases of DFU, chronic osteomyelitis occurs in the foot. The present paper describes the course of treatment for chronic osteomyelitis of the great toe with metatarsophalangeal arthritis using selective resection of the bone-preserving the soft tissues (the “empty toe technique”). Following the procedure, to promote surgical wound healing, negative pressure wound therapy (NPWT) was administered for 7 days, with a constant pressure of -120 mmHg. The presented method was found to be effective in treating osteomyelitis in a patient with DFU, partially preserving the function and completely preserving the shape of the treated toe.

Keywords—negative pressure wound therapy, diabetic foot, amputation

I. INTRODUCTION

DIABETES mellitus is a growing public health concern. One of its complications is diabetic foot ulceration (DFU), which occurs in more than 6% of diabetic patients.¹ In many DFU cases, chronic osteomyelitis occurs, often involving the forefoot. In these cases, local treatment combined with targeted antibiotic treatment is used.²⁻⁴ Preserving the function of the limb is a major therapeutic objective. The scope and extent of any surgical intervention depend on the condition of the foot and patient’s response to treatment. In many cases, antibiotic treatment proves ineffective due to poor penetration of the antibiotic into the bone, necessitating the use of increasingly radical surgical treatment. Conservative procedures may result in DFU recurrence.⁵ Sadly, even small resections may affect the biomechanics of the patient’s foot. To avoid extensive amputations, only the infected part of the bone is removed, with the smallest possible margin around the damaged and dead tissue.^{6, 7} Only when this way

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Figure 1. Pre-surgery foot radiograph showing signs of chronic osteomyelitis.

of treatment fails does radical amputation become necessary.

Local surgical treatment of DFU is widely used in combination with negative pressure wound therapy (NPWT), which has proven particularly valuable in assisting the healing of the surgical wound.^{8, 9} The subsequent sections of this paper describe the course of treatment for chronic osteomyelitis



Figure 2. The great toe after the selective resection of both phalanges and the metatarsophalangeal joint (empty toe technique).

of the great toe with metatarsophalangeal arthritis using selective resection of the bone-preserving the soft tissues (the “empty toe technique”), combined with NPWT and antibiotic treatment.

II. CASE REPORT

A 44-year old male patient with type 1 diabetes presented with inflammation and phlegmon in the great toe of the right foot. Inflammatory symptoms had intensified over the previous 14 days. Following clinical examination and radiography, chronic osteomyelitis was diagnosed, with an inflammatory reaction in the surrounding soft tissue 1. The patient was scheduled for surgery. On admission, standard first-line antibiotics were started Taromentin 2 x 1,2 g i.v. (1000 mg amoxicillin + 200 mg clavulanic acid) and samples were collected for culture.

The patient was anesthetized with an injection of 2% lignocaine at the base of the great toe. A 3 cm longitudinal incision was made on the lateral surface of the toe. Using this approach, both phalanges and the metatarsophalangeal joint were dissected free and removed. The head of the first metatarsal bone was preserved, with the articular surface removed. Soft tissue in the toe was preserved, with only small portions adjacent to the bone and affected by inflammation



Figure 3. Radiograph of the treated foot on the 1st post-operative day.

removed 2. Following the procedure, the wound was dressed using a non-woven dressing impregnated with Povidone. An X-ray was performed 3.

The radiograph showed a small fragment of the lamina of the distal phalanx remaining after the resection, which had not been visible during the surgery. The dressing was first changed after 24 hours. The next day, NPWT was started. The foam dressing was cut so as to cover the wound without filling the space left by the resected phalanges. The dressing was sealed, and constant negative pressure of -120 mmHg was applied 4.

After 3 days of NPWT, the dressing was removed. The wound was clean and granulating, with no signs of infection. A fresh dressing was applied, and NPWT was continued for 4 subsequent days. 5 days after the procedure, the antibiotic susceptibility test results revealed a *Streptococcus agalactiae* strain sensitive to Augmentin; therefore, the previous antibiotic treatment was continued until the 9th postoperative day. Throughout the NPWT period, the volume of drained serosanguineous fluid was approx. 50 mL total. NPWT was discontinued on the 9th postoperative day (after 7 days of administration). The wound was clean, granulating abundantly, with no inflammatory discharge 5.

The patient was discharged after 10 days of hospitalization and subsequently treated on an outpatient basis. He was



Figure 4. The foot with the NPWT dressing.

instructed to use a post-operative shoe for 6 weeks. The patient changed his dressings himself and was followed-up periodically at a diabetic foot clinic. Four months after the surgery, the wound was fully healed and the patient reported no complaints 6.

After 6 months, a follow-up examination was performed. The patient was in overall good condition. The surgical scar was pale, with no inflammation 7. The patient reported no pain in the foot or the treated toe. The toe had a normal blood supply and temperature. The patient reported impaired sensation in the toe, indicative of neuropathy, the same as before the onset of inflammatory symptoms. The range of passive dorsiflexion was 30 degrees, plantar flexion – 5 degrees. After flexion, the toe spontaneously returned to the initial position. Soft tissue compactness and elasticity was similar to that found in healthy toes. The toe had no active mobility. The patient reported no significant difficulties in walking. No areas of excessive load, in the form of corns and calluses or other plantar tissue deformations, were found. The arch of the foot was normal. An X-ray was performed 8. In the distal portion of the toe, within the site from which the distal phalanx had been removed, and directly adjacent to the remaining bone fragment seen in the previous radiograph 2, there was an expanding area of extraskelatal bone formation, which seemed to be filling the space from which the distal phalanx had been removed.



Figure 5. The surgical wound after 7 days of NPWT.



Figure 6. The surgical wound 4 months post-operatively.



Figure 7. The surgical wound 6 months post-operatively.

III. DISCUSSION

The treatment method used, the “empty toe technique”, enables the soft tissue of the toe to be preserved despite amputation of the phalanges. Thus, the toe itself is preserved. When only a portion of the phalanges is removed, the toe can be reconstructed using antibiotic-loaded bone cement and stabilized with an external fixator.¹⁰ In the present case, such a course of treatment was not possible, as both phalanges and part of the joint required resection. A decision was made, though, to preserve the soft tissue of the toe. Benefits of this technique for the patients are mainly aesthetic and psychological in nature, as the treatment leaves no external signs of amputation. Preserving the toe may increase the patient’s compliance with treatment and willingness to undergo further treatment. In theory, this technique also offers an opportunity for future reconstruction of hard tissue. One question concerns the function of the toe. When DFU is treated surgically, the impact of the treatment on gait mechanics, and on static and dynamic load distribution in the treated foot, is an important consideration.^{11, 12} It seems that the “empty” toe does not have a significant stabilizing function. With regard to gait mechanics, the removal or preservation of soft tissue is most likely insignificant. However, preserving the shape of the foot improves the fit of footwear. If the toe is fully amputated, the fit must be ensured e.g. by using



Figure 8. Radiograph of the treated foot 6 months post-operatively, showing an extraskeletal bone formation process.

filler inserts. Another potential concern is the flaccidity of the “empty” toe, which might cause discomfort for the patient or lead to subsequent mechanical injury. The 6-month follow-up showed that the treated toe retained its shape, compactness, and elasticity despite bone removal, and the patient reported no inconvenience or discomfort.

The surgical wound was healed using NPWT, a common method in DFU treatment. Arguably, it was NPWT that made it possible for the wound to heal. NPWT assists in soft tissue healing by evacuating the discharge, proinflammatory factors, and bacteria, while promoting granulation within the area from which bone was removed. Thus, the “empty” toe is partially filled, regaining some of its compactness and elasticity. The presented “empty toe technique” for selective resection of the bone-preserving the soft tissues, combined with NPWT and antibiotic treatment, is a promising treatment for chronic osteomyelitis affecting toe phalanges and metatarsophalangeal joints. Further studies are warranted to confirm its effectiveness.

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