Treatment of non-healing, post-traumatic wound with high frequency ultrasound of 10 MHz: A case study

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ABSTRACT

We present a case of a non-healing, post-traumatic wound, which as an alternative to reconstructive surgical intervention, was successfully treated with a new non-invasive, high-frequency ultrasound of 10 MHz.

Keywords: Post-traumatic wound, non-healing, non-invasive treatment, high frequency ultrasound, 10 MHz

1. INTRODUCTION

The treatment of post-traumatic wounds can often be a complex problem for doctors, especially if they develop into the chronic wounds. In such cases, aesthetically and functionally satisfying results can then often only be achieved using plastic reconstructive surgery. Whereas the reconstruction of soft tissues can be crucial in order to save the patient’s extremities, such interventions are often performed without regard to any subsequent consequences and complications. Open fractures are considered to be particularly problematic because of the potential contamination of the wound. They often cause soft tissue and bone infections, which can lead to the partial loss of extremities, with significant limitations in the patients’ quality of life.

A reliable, therapeutic alternative to reconstructive surgery for the treatment of such wounds during their transition from acute to chronic wound conditions does not currently exist. Here, we report a case of a non-healing, post-traumatic wound, which was successfully treated with a high-frequency ultrasound of 10 MHz.
2. EPICRISIS

A 12-year-old, male patient with a complex, third degree, luxated, comminuted fracture of the ankle after a kart-race accident on 15.07.2011. After immediate care at the place of accident - including repositioning, splinting and analgesic sedation - the patient was transported to a children’s surgery department of a maximum care hospital, where he was immediately operated upon.

Intra-operatively, the entire joint bands of medial ankle were completely ruptured. The soft tissue was strongly contused and the wound was contaminated by soil. The talus demonstrated multiple shears (Fig 1). The ligament and nerves as well as the blood vessels were structurally continuous. After intubation anesthesia, the wound was cleansed and the bone fragments were readapted.

Subsequently, the open repositioning and reconstruction of the capsular-ligamentous complex were carried out using sutures with layer-by-layer wound closure. The intra-operative investigation as well as the post-operative x-ray and CT check showed the correct axial repositioning with the restoration of the articular surface and the readaptation of the multiple bony fragments as far as was possible. This was followed by a further immobilisation with a splint.

![Figure 1. Post-traumatic wound on the day of accident, 15.07.2011.](image_url)

The initial wound healing process was normal. Three days later, the initial signs of an infection could be seen, with increasing, progressive demarcation. This resulted in a 12x5 cm
necrotic zone developing from the medial malleolus up to the Achilles tendon. Throughout the duration of hospitalisation, the patient received antibiotics as well as the local application of antiseptic. Ten days later the patient was released from hospital with a splint and the above-described necrosis. Over the next nine days, the extent of the necrosis intensified – the necrotic area deepened and spread further. In the case of further wound depression or the progression of necrosis, a skin graft would have been needed. The state of the soft tissue was deemed critical by a plastic surgeon consultant.

To avoid surgical intervention, an interdisciplinary decision was made to remove the necrosis (Figures 2,3) and to treat the wound daily with high-frequency ultrasound using LDM® technology in combination with local antiseptic therapy. This decision was based on present case studies as well as on Wellcomet GmbH’s pilot study into treatment of *ulcus cruris* (Kruglikov and Kruglikova, 2011), which have all demonstrated a rapid wound-healing process when this technology has been applied.

### 3. TREATMENT PROTOCOL

Treatments were done with the commercially-available LDM®-MED machine (Wellcomet GmbH, Karlsruhe, Germany). The ultrasound intensity was controlled by the digital, ultrasound power meter UPM-DT-10 (Ohmic Instruments Co., USA).

Altogether, 29 treatments were delivered in outpatient settings. Initially, therapy took place five times a week and then every two days, from the 23rd session. After eight sessions, the treatments ceased for five days. After 22 sessions treatment stopped for 14 days and, after 26 sessions, for seven days.

The following parameters were used: ultrasound frequency – 10 MHz; pulsed 1:2, intensity – initially 1.0 W/cm² and from the third treatment – 1.2 W/cm²; treatment time – approximately 20 minutes (from the 15th treatment this was approximately 10 minutes due to the significant reduction of the wound surface). During the treatment both the whole wound and the surrounding tissue at least 3 mm from the wound edges were treated uniformly. Sterilised US
gel was used as a coupling medium. The control investigation was done one and four weeks after the last treatment. All treatment results were photo-documented in a standard manner.

4. RESULTS

Figures 3-8 show a dynamic regression of the wound as the treatment progresses.

Figure 2. Before the removal of necrosis, 04.08.2011

Figure 3. Before the 1st treatment, 05.08.2011

Figure 4. Before the 5th treatment, 11.08.2011
Even after the 1st session, the strong granulation of the wound could be clearly observed. In the further course of treatment, the size of the wound surface from the edge to the inside markedly decreased and the granulation layer on the wound floor was developed (Figures 4-
6). These local measures managed to almost completely close the wound after 22 sessions. During the pause in treatment that followed, the wound demonstrated further spontaneous, positive signs of healing (Figure 7). The last six treatments were provided merely as a supportive measure.

5. CONCLUSION

The application of high-frequency ultrasound of 10 MHz could save the patient further operations, with their possible complications and the development of stigmatizing scars as well as additional hospitalisations. The treatment was free of both pain and side effects and was accepted well by the patient. Pigmentation on the wound edge was of a post-inflammatory nature and could be neither avoided nor later improved by these treatments.

REFERENCES