

# Noncontact, Low-frequency, Therapeutic Ultrasound for Four Cases of Complicated or Difficult-to-Manage Wounds

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## Background & Purpose

Wound healing modalities available to physical therapists include high-voltage pulsed current (HVPC), high-frequency (megahertz) ultrasound, ultraviolet C radiation, pulsatile lavage with concurrent suction (PLWS), and negative pressure wound therapy (NPWT).

Noncontact low-frequency therapeutic ultrasound (LFTU), at a frequency of 40 kHz and a therapeutic range of 0.3-0.8 W/cm<sup>2</sup>, is a new modality designed to enhance wound healing. A randomized trial showed improved healing of recalcitrant diabetic foot ulcers with use of noncontact LFTU, but limited data exist for other wound types treated in physical therapy.<sup>1</sup>

## Case Description

We report 4 cases of atypical wounds in physical therapy practice for which available modalities were not indicated or yielded insufficient outcomes. Patients included (1) 78-year-old with full thickness burns on the lower extremity who declined surgical intervention; (2) 60-year-old with allergic vasculitis who developed wounds on the lateral leg and dorsal foot with adherent yellow slough and persistent signs of inflammation; (3) 20-year-old with copious drainage from a wound in the natal cleft despite surgical repair of a pilonidal cyst 6 months prior; and (4) 26-year-old with dehiscence and undermining (5 cm) of an abdominal gunshot wound. In Patients 1 and 2, pain precluded PLWS and sharp debridement. In Patient 3 and 4, PLWS elicited significant bleeding. Additionally, for Patient 4, healing appeared to be regressing with PLWS and financial constraints precluded NPWT. In all patients, noncontact LFTU was initiated as an adjunct to standard therapy.

## Outcomes

- ◆ **Patient 1** (full-thickness burn) - Eschar was notably thinned after initiating noncontact LFTU and < 5% after 5 treatments; 100% wound closure was achieved within 3 months of initiating noncontact LFTU, despite depth of injury.
- ◆ **Patient 2** (allergic vasculitis) - Inflammation, induration, and pain markedly decreased after 6 treatments; granulation tissue increased (0% to 75%) and eschar decreased (100% to 25%) after 1 month of noncontact LFTU.
- ◆ **Patient 3** (pilonidal cyst) - 98% wound closure with no drainage was achieved after < 2 months of noncontact LFTU.
- ◆ **Patient 4** (abdominal wound dehiscence) - Undermining resolved completely within 1 month with noncontact LFTU; wound size markedly decreased.

## Discussion

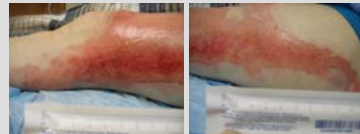
Noncontact LFTU had a positive impact on wound healing as follows: decreased eschar and increased epithelialization in a full thickness burn without surgical intervention; decreased pain and inflammation in allergic vasculitis; decreased wound tunneling and signs of infection in a patient with a pilonidal cyst; decreased undermining and bacterial bioburden without traumatizing wound bed in a fragile abdominal gunshot wound. Noncontact LFTU appears to be a useful option when other modalities are not indicated due to pain or bleeding (PLWS), time constraints (HVPC), or cost (NPWT). Randomized trials are needed to objectively evaluate noncontact LFTU for healing of atypical wounds with limited treatment options.



Low-frequency therapeutic ultrasound waves are delivered via sterile saline mist. The device does not contact the wound.

## Patient #1: Full-thickness Burn

This 78-year-old woman was malnourished and had no home care assistance. In January 2006, she presented to the emergency department with an extremely painful (7/10) and extensive deep partial-thickness burn on her left leg from spilled coffee that subsequently converted to full-thickness. She declined plastic surgery due to age and quality of life considerations. Her initial treatment included silver sulfadiazine and non-adherent dressings. Pain limited sharp debridement. One week later, a papain-urea debriding agent was initiated, but her pain increased from 5/10 to 8/10. On 1/27/06, LFTU was initiated; the patient did not report any pain with treatment. Her wounds were dressed with a silver-impregnated hydrofiber dressing. Eschar quickly thinned and pain decreased with weekly LFTU treatments. After 5 LFTU treatments, < 5% of yellow eschar remained and reepithelialized tissue had increased at the wound edges. Despite her age, nutritional status, extent of injury, and lack of surgical intervention, the wounds were 100% closed in < 3 months.



1/18/06



1/31/06

2/7/06



3/14/06

## Patient #2: Allergic Vasculitis with Resultant Wounds

This 60-year-old man with a history of hypertension and a coronary-artery bypass graft presented with 4 lateral ankle and 2 dorsal foot wounds with extreme pain secondary to allergic vasculitis that had been present for approximately 3 months with no signs of healing. The wounds were 100% covered by adherent yellow slough. He could not tolerate sharp debridement or pulsatile lavage due to pain. He was initially treated with an anti-inflammatory ointment, non-adherent dressings and compression stockings. Four days later, LFTU treatment was initiated, which immediately decreased pain and helped eliminate yellow slough. Enzymatic debridement and compression stockings were also included in the treatment plan. After 1 month of LFTU treatment, the wound beds were 75% granular and the slough was decreased to 25%. Pain was completely eliminated in 3 weeks. After 3 months of LFTU treatment, all wounds were 100% granular. The patient insisted on continuing LFTU treatment until wounds were completely closed.



3/2/06



5/8/06



8/18/06

## Patient #3: Natal Cleft Wound Post Surgical Repair for a Pilonidal Cyst

This 20-year-old man was an active college student that had 2 surgical repairs of a pilonidal cyst at the superior aspect of the natal cleft. Anxious to heal before fall semester, he presented to the PT wound management department in May, about 6 months after his second surgery. Because of copious drainage, he required constant use of a sanitary napkin. The wound bed had loose, viable, but fragile granulation tissue, without purulent drainage. The periwound was tender to palpation. Because the wound was highly vascularized, his initial treatment of pulsatile lavage with suction using a catheter tip elicited significant bleeding. One day later, LFTU treatments were initiated daily for 3 days, and then reduced to 3 times weekly. The consistency of the wound drainage improved and the amount of wound drainage decreased, likely due to elimination of trapped bacteria. With LFTU treatments, the deep tracts (2.2 cm) continued to decrease in depth. By early July drainage was completely eliminated and the wound was 98% closed.



5/24/06



6/14/06



7/18/06

## Patient #4: Abdominal Gun Shot Wound

On 2/25/06, this 26-year-old man suffered multiple gunshot wounds. After surgical repair and a complicated recovery, the patient was discharged from the hospital to home on 3/28/06. On 4/25/06, he presented to the trauma clinic with a painful (7/10), dehisced abdominal incision (14.0 cm x 4.0 cm x 3.0 cm) with an underlying abscess. The wound consisted of friable granulation tissue with 10% yellow debris at the base and 5.0 cm of undermining in all directions. Because of financial constraints, NPWT was not considered. He underwent several weeks of PLWS, which did not substantially reduce pain or stimulate wound closure. Weeks later, this therapy was discontinued due to bleeding and thinning of granulation tissue. On 6/2/06, LFTU was initiated. The wound measured 13.0 cm x 2.3 cm x 1.5 cm with 2.5 cm of undermining in all directions. After 2 weeks of treatment, the wound measured 9.0 cm x 3.0 cm x 0.3 cm, granulation tissue had increased, and signs of infection were eliminated. On 6/27/06, no undermining was present and LFTU was discontinued. The patient subsequently underwent surgical closure.



4/25/06



6/30/06

8/18/06

## Bibliography

1. Ennis WJ, Formann P, Mozen N, et al. Ultrasound therapy for recalcitrant diabetic foot ulcers: Results of a randomized, double-blind, controlled, multicenter study. *Ostomy/Wound Management* 2005;51(8):24-39.