



Low-Frequency Ultrasound* Therapy Evaluated in Patients with Nonhealing Wounds and Vascular Insufficiency

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Introduction

This case series describes the course and outcomes of noncontact, low-frequency, therapeutic ultrasound* treatments in 3 consenting patients with severe, nonhealing wounds and significant peripheral arterial disease.

Methods

Clinical effectiveness of ultrasound treatment was assessed through changes in wound tissues, dimensions, drainage, bacterial cultures, and pain. Patient #1 had 3 infected wounds, 2 with exposed bone on left lower extremity; diabetes; severe peripheral vascular disease (PVD); congestive heart failure; renal insufficiency; lower extremity paralysis secondary to stroke; and multiple toe amputations across both feet. Patient #2 had a necrotic, dehisced, forefoot amputation due to lower limb ischemia, wound exposed to the bone; diabetes; significant PVD; and multiple angioplasty revascularizations. Patient #3 was 91 years old, had a painful, necrotic, lateral calf wound caused by an accident, and advanced arterial occlusive disease.

Outcomes

Following 17-49 ultrasound treatments, 3-8 minutes each, over 11-15 weeks, depending on wound size, all wounds markedly decreased in dimensions, drainage, pain, and bacterial burden; and granulation tissue rapidly increased, even over bone.

Conclusions

In this case series, low-frequency, therapeutic ultrasound was associated with rapid healing of severe nonhealing wounds in patients with significant arterial insufficiency preventing amputations and/or bypass surgeries.

* MIST Therapy System, Celleration, Eden Prairie Minnesota

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Patient #1: Multiple Foot Wounds

- ❖ 57-year-old man with history of diabetes mellitus, severe peripheral vascular disease (PVD), congestive heart failure, renal insufficiency, lower extremity paralysis secondary to stroke, toe amputations (2 on right and 1 on left foot)
- ❖ December 2005: two wounds on left foot that probed to the bone, one on plantar surface at 5th metatarsal head and cuboid and the other on dorsal lateral area
- ❖ Treated with cadexomer iodine, calcium alginate, gauze, and light compression dressings
- ❖ June 2006: abscess developed on lateral aspect of left foot; wounds draining copious amounts of serosanguineous fluid and wound beds necrotic with exposed bone
- ❖ Admitted to hospital for IV antibiotics and revascularization, but no target vessels found
- ❖ While hospitalized, patient developed a decubitus heel ulcer; eventually discharged on IV antibiotics.
- ❖ August 2006: began receiving MIST Therapy 3 times weekly as outpatient with calcium alginate dressing
- ❖ Immediately after MIST Therapy initiation, significant increase in granulation tissue on plantar foot wound with rapid covering of bone; plantar wound has not healed but the exposed bone remains covered and large tissue defect has filled in and remains healthy

Time point	Dimensions, cm			Treatment	Drainage	Tissue color, %				Pain (0-10)
	Length	Width	Depth			Red	Pink	Yellow	Black	
Plantar Area, Left Foot										
12/20/05	6.0	3.0	1.0	SOC	Copious	30	0	70	0	0
6/26/06	2.5	2.7	1.0	SOC	Copious	30	0	70	0	0
8/4/06	3.5	2.5	1.1	MIST + SOC	moderate	70	0	30	0	0
11/15/06	2.8	1.6	—	MIST + SOC	Moderate Bone covered	10	0	0	0	0
Dorsal Area, Left foot										
12/20/05	0.8	0.6	—	SOC	Copious	10	0	90	0	0
6/26/06	1.5	0.4	0.6	SOC	70	0	30	0	0	0
8/4/06		healed		MIST + SOC	—	—	—	—	—	—
Heel, Left Foot										
6/26/06	3.4	5.0	0.5	SOC	copious	90	0	10	0	0
8/4/06	3.5	4.2	—	MIST + SOC	Moderate	90	0	10	0	0
11/15/06	0.7	0.5	—	MIST + SOC	Moderate	90	0	10	0	0



Dec. 23, 2006



Mar. 23, 2007



Sep. 6, 2006



Dec. 28, 2006

Patient #2: Dehisced Amputation, Right Forefoot

- ❖ 69-year-old man with diabetes, significant PVD, recent history of multiple angioplasty revascularizations and painful, ischemic ulcerations of both first toes
- ❖ Jun. 2006: after failed popliteal-to-peroneal artery bypass with vein graft, underwent transmetatarsal amputation of right forefoot; below-the-knee amputation seemed a likely possibility later
- ❖ Treated with pneumatic compression device, hyperbaric oxygen, and orally administered vasodilators
- ❖ Jul. 2006: amputation wound dehisced and became necrotic
- ❖ Initially treated with surgical and enzymatic debridement and alginate; when wound continued to deteriorate, switched to topical cadexomer iodine
- ❖ Sep. 2006: wound healing had progressed little; MIST Therapy initiated and pain decreased quickly
- ❖ Follow-up X-rays showed osteomyelitis at distal edge of 2 and 3 metatarsal heads
- ❖ Feb. 1, 2007: returned to surgery for revision and subsequently wound healed completely

Time point	Dimensions, cm			Treatment	Drainage	Tissue color, %				Pain (0-10)
	Length	Width	Depth			Red	Pink	Yellow	Black	
7/25/06	3.2	8.5	—	SOC	Moderate	0	50	40	10	10
8/23/06	2.9	8.4	1.0	SOC	Moderate	0	80	20	0	10
9/13/06	2.5	8.3	—	MIST + SOC	Moderate	0	80	20	0	10
11/29/06	1.5	2.0	—	Mist + SOC	Moderate	90	0	10	0	7



Sep. 13, 2006



Nov. 14, 2006



Feb. 2, 2007

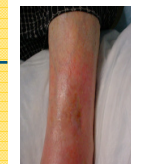
Patient #3: Lateral Left Calf Wound

- ❖ 91-year-old woman injured left lateral calf Feb. 2006 in ironing board accident
- ❖ Initially treated by home health nursing, referred to wound clinic Mar. 2006 when wound became painful and necrotic
- ❖ Ankle brachial indices indicated noncompressible vessels, waveforms consistent with advanced arterial occlusive disease
- ❖ MR angiogram: significant multilevel disease with no lesion amenable to angioplasty
- ❖ Given advanced age, continued conservative treatment and monitored healing
- ❖ Aquacel Ag increased her pain; Hydrofera blue dressing tolerated
- ❖ MIST treatments started once a week, she had rapid response to treatments.
- ❖ Dressing was switched from Hydrofera Blue to Dermagran B
- ❖ Continued to improve and subsequently healed

Time point	Dimensions, cm			Treatment	Drainage	Tissue color, %				Pain (0-10)
	Length	Width	Depth			Red	Pink	Yellow	Black	
3/13/06	3.0	1.5	—	SOC	Moderate	0	70	30	0	10
7/13/06	3.1	2.5	—	SOC	Scant	0	60	40	0	10
8/10/06	2.8	2.4	—	MIST + SOC	Scant	0	70	30	0	8
11/30/06	1.0	0.7	—	MIST + SOC	Scant	90	0	10	0	3



Nov. 8, 2006



Jan. 11, 2007