





## ■ Case Report

# Ultrasonic-assisted wound debridement: An emerging treatment modality for recalcitrant diabetic foot ulcers

## *Ultrasonik cerrahi debridman sistemleri: İnatçı diyabetik ayak ülserleri için güncel bir tedavi yöntemi*

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### Abstract

Chronic wounds remain one of the most challenging problems facing healthcare professionals with their ever-increasing impact on various domains of healthcare and well-being . Numerous management modalities have been proposed to reduce the clinical burden and healthcare costs associated with chronic wounds . Given the pivotal role debridement plays in wound care, it became a focus of interest for new therapeutic strategies in recent years . Herein, we report our experience with the Syllable™ Ultrasonic Surgical Debridement System manufactured by Maveria Medical Devices Inc. in a patient presenting with recalcitrant grade 3 stage D diabetic foot ulcers by the UT (University of Texas) system.

**Keywords:** ultrasonic debridement, bioburden, diabetic foot ulcer, biofilm

### Öz

Kronik yaralar, giderek artmakta olan etkileriyle sağlık profesyonellerinin karşılaştığı en zorlu sorunlardan biri olmaya devam etmektedir. Kronik yaralarla ilişkili klinik yükü ve sağlık maliyetlerini azaltmak için birçok modalite önerilmiştir. Debridman, yara bakımında oynadığı kritik rol nedeniyle son yıllarda yeni terapötik stratejiler için ilgi odağı haline gelmiştir. Bu vaka raporunda, geleneksel tedaviye dirençli, UT sistemine göre grade 3 stage D diyabetik ayak ülseri ile başvuran bir hasta üzerinde kullanılan Syllable™ Ultrasonik Cerrahi Debridman Sistemi ile olan deneyimimizi sunuyoruz.

**Anahtar Kelimeler:** ultrasonik debridman, biyoyük, diyabetik ayak ülseri, biyofilm

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Orcid: 0009-0001-6868-3202

Doi: 10.18663/tjcl.1491866

Received: 29.05.2024 accepted: 30.09.2024

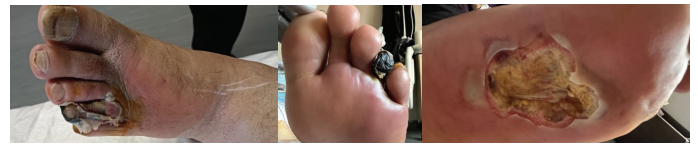
## Introduction

Diabetic foot ulcers (DFUs) represent the leading cause of non-traumatic lower extremity amputations and hospital admissions in diabetic patients. The triad of neuropathy, peripheral arterial disease, and secondary infection has been shown to be the underlying mechanism for the development of DFUs. The success of limb salvage and definitive reconstruction depends on addressing each of these components with pressure off-loading, glycemic control, treatment of comorbidities, revascularization measures and above all, local wound care. Elimination of devitalized tissue, preservation of viable tissue and inhibition and eradication of the biofilm are all matters of paramount importance in wound bed preparation. There is an emerging interest in ultrasound-assisted wound debridement which offers, unlike mechanical and surgical debridement, a selective debridement option with effective removal of the biofilm, minimal patient discomfort, and shorter downtime. Multiple studies in recent years have yielded evidence that UAW (Ultrasonic-Assisted Wound Debridement) can be a rational alternative to surgical wound debridement. Our experience with the Syllable™ UAW system is consistent with the literature in terms of non-inferiority and in some respects, superiority.

## Case

A 52-year-old patient with a medical history of uncontrolled, long-standing diabetes mellitus type 2, coronary artery disease, carotid stenosis and peripheral artery disease (PAD) presented to the wound care center with a rapidly evolving ulcer on the plantar surface of the left foot and wet gangrene of the 4th digit. Physical examination revealed a plantar ulcer involving deeper structures and wet gangrene of the 4th and 5th digits (figure 1). Absent pedal pulses and chronic PAD-related changes were noted bilaterally. Metatarsal periosteal reaction and cortical irregularities were noted in the radiographs pointing in the direction of metatarsal osteomyelitis. Initial lab workup showed elevated acute phase reactants (APRs) with a WBC of  $24 \times 10^9/L$  and a CRP of 242 mg/L, compatible with diabetic foot infection. The patient was admitted to our wound care center, wound cultures were obtained and the patient was put on broad-spectrum antibiotics. Wound culture results revealed a growth of *Proteus mirabilis* and multidrug-resistant *Acinetobacter baumannii*. A lower extremity computed tomography angiography (CTA) was obtained which revealed a left-sided total occlusion of the posterior tibial artery (PTA) and the fibular artery and critical stenosis of the anterior tibial artery

(ATA) and the tibial-fibular trunk. The cardiology department was consulted to achieve revascularization of the limb. ATA was successfully revascularized with percutaneous balloon angioplasty while PTA remained occluded. Immediately after the revascularization, metatarsophalangeal disarticulation was performed for the necrotic digits and a more conservative approach was adopted for the plantar defect. Weekly sharp wound debridement was performed with no signs of improvement (figure 2). Following the failure of surgical debridement and the persistence of subacute osteomyelitis, the Syllable™ Ultrasonic Surgical Debridement System was used on the wound bed on a twice-a-week basis. After 6 sessions of UAW debridement combined with NPWT, a well-granulated wound bed was achieved with negative culture results. Following the initiation of UAW, APRs showed a steady decrease and by the 3rd week, CRP and WBC were in the normal range.



**Figure 1.** initial presentation



**Figure 2.** timeline of wound progression prior to UAW, demonstrating expansion of the wound and persistence of debris despite attempts at surgical debridement combined with NPWT.



**Figure 3.** Wound bed following 6 sessions of UAW debridement, demonstrating healthy granulation tissue, prepared for definitive reconstruction.

## Discussion

UAW debridement systems rely on ultrasonic activation of a liquid medium with low-frequency ultrasonic waves created by sonotrodes to generate microbubbles in the wound bed. Upon collapse of the microbubbles, ultrasonic energy is transformed into heat, disintegrating slough, necrosis and biofilm, effectively debriding the wound bed, reducing the bioburden, and preparing it for definitive reconstruction or healing by secondary intention. A myriad of other mechanisms, mostly of a chemical nature, have been suggested for the apparent effectivity of UAWs ranging from depolymerization of molecules to augmentation of oxidative processes, but the physical process of cavitation is believed to be the main mechanism underlying its well-founded success in wound bed preparation. In addition to UAWs's ability to selectively debride the wound bed, UAWs allow efficacious removal of the biofilm for which available and effective treatments are scarce. The Syllable™ Ultrasonic Surgical Debridement System by Maveria Medical Devices Inc. (Ankara, Türkiye) was used on our patient on multiple occasions in both inpatient and outpatient settings, NPWT was used in between each session as an adjunct to UAW debridement.

## Conclusion

Diabetes remains the leading cause of lower extremity amputations. With its incidence projected to double by 2030 compared to the figures from 2000, local wound care and other limb salvage interventions have become increasingly crucial in the management of DFUs. Meticulous wound bed preparation and minimizing bioburden lie at the root of wound care, failure of which often mandates amputations. With the recent increase in studies yielding evidence for UAWs' ability to eradicate/suppress biofilm and prepare the wound bed, UAWs have become a subject of interest for wound care specialists. As the psychological, social, and economic burden of diabetic foot ulcers continues to increase, the need to enhance patient comfort while ensuring adequate debridement becomes vital. Given the central role debridement plays in wound bed preparation and ultimately limb salvage, the demand for effective, efficient, and easy-to-operate debridement modalities grows. UAW systems excel among their competitors with claims of effective reduction of bioburden and preservation of vital tissue. This report intends to investigate whether UAW is up to par with surgical debridement. Our experience with the Syllable™ Ultrasonic Surgical Debridement System parallels the current literature.

With its reliable performance and easy-to-use, intuitive design UAW systems offer a strong alternative to traditional surgical debridement in hard-to-heal wounds.

## Conflict of Interest

The authors have no conflict of interest associated with this report.

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