

# Successful treatment of a high-risk diabetic foot ulcer by ozone therapy and collagen powder: a case report

Hooman Mohammad talebi<sup>1</sup>, Javad Javaheri<sup>2</sup>, and Mohammad Sadegh Fakhari<sup>2</sup>

<sup>1</sup>Isfahan University of Medical Sciences

<sup>2</sup>Arak University of Medical Sciences

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**Running title: Treatment of a high risk diabetic foot ulcer**

Hooman Mohammad talebi (MSN) 11 Hezar-jarib Street, Isfahan University of Medical Sciences, Isfahan, Iran., Javad Javaheri 22 Alam-al-Hoda Street, Shahid Shiroodi Street, Arak, Markazi province, Iran (MD), Mohammad Sadegh Fakhari\* (MD) 33 Alam-al-Hoda Street, Shahid Shiroodi Street, Arak, Markazi province, Iran, corresponding author

1; faculty of nursing and midwifery, Isfahan university of medical sciences, Isfahan, Iran

Master of nursing, Wound therapist

0000-0001-5530-0826 nursehooman@yahoo.com

2; Assistant Professor of community medicine, Department of Health and Community Medicine, Arak University of Medical Sciences

MD, Diabetologist

0000-0002-5342-6094

Javaheri\_115@yahoo.com

3; Student research committee, Arak university of medical sciences, Arak, Iran

MD

0000-0002-0350-447X fakharisadegh@gmail.com

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There was no conflict of interest among authors.

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## **Successful treatment of a high-risk diabetic foot ulcer by ozone therapy and collagen powder: a case report**

### **Abstract**

This case report presents a successful non-surgical outpatient approach for managing a high-risk diabetic foot ulcer with tendon exposure in an older adult with uncontrolled diabetes mellitus and severe heart failure. Due to the patient's comorbidities, surgical intervention was not an option, leading to the utilization of ozone therapy, collagen powder and Phenytoin ointment. The significance of this case lies in the treatment of a high-risk foot ulcer through a non-surgical approach, considering the patient's uncontrolled diabetes and severe heart failure. Diabetic foot ulcers are debilitating and life-threatening complications, often resulting in amputations, socio-psychological burdens, and lifestyle changes. Conventional treatment methods have shown limited success, necessitating the exploration of new and innovative approaches. The use of ozone therapy has emerged as a potential treatment, but its safety and efficacy in diabetic foot ulcers require further investigation. The positive outcomes observed in this case report suggest that ozone therapy may be a viable option for treating diabetic foot ulcers, and further studies are recommended to evaluate its effectiveness.

### **Key messages**

- A high risk diabetic foot ulcer is treated by ozone therapy and collagen powder.
- The goal of this study was to report a high risk case, treated by ozone therapy and collagen powder.
- ozone therapy and collagen powder can improve healing process of diabetic foot ulcers.

### **Keywords**

Diabetic Foot Ulcers, Wound Management, Ozone Therapy

#### **Introduction:**

Diabetic foot ulcers (DFUs) cause a significant challenge for diabetic patients, with a heavy economic and health burden on both the patients and their family(1). Patients condition become more vulnerable when there is a risk of amputation and tissue loss. Despite microcirculatory dysfunctions and neuropathic complications in diabetic patients, older adult patients are more susceptible to DFU and its consequences due to degenerative effects of aging(2). surgical interventions such as secondary flap prostheses or other plastic surgery methods is needed to treat high-risk DFUs. Indeed, older adults with cardiovascular diseases or ages above 70 years have limitations to perform surgical methods, which forces wound therapist and the medical team to choose non-surgical methods(3).

In this case, we report a high risk tendon exposed DFU healed by ozone therapy and collagen powder and phenytoin ointment.

#### **Case presentation:**

The patient, a 73-year-old Iranian male with uncontrolled diabetes mellitus, presented with a large diabetic ulcer on his right foot's Achilles tendon that had been present for three months (figure.1). The patient had a history of heart failure with an ejection fraction of 30% and previously undergone angiography and

pacemaker insertion. He had been self-administering metformin (500 mg, BD) for the past seven years, and scars on other parts of his foot indicated a history of multiple healed ulcers.

Upon examination, the patient presented with a Wagner II, tendon-exposed, non-infected ulcer measuring 10 cm in length and 4.2 cm in width, with 9.5 cm of Achilles tendon exposed out of the tendon sheath. The condition had deteriorated due to previous unnecessary surgical debridement, and the ulcer had only a few granulated tissues in the wound edges, with most of the ulcer occupied by the tendon.



Fig.1 Day 1; tendon exposed diabetic foot ulcer

The patient was using regular gauzes to dress the ulcer, but the tendon was at risk of dehydration tensions and necrosis. The patient was referred to a surgeon for surgical treatment, but due to his cardiovascular conditions, the medical team decided to perform non-surgical methods.

In order to manage diabetes; Initial laboratory results indicated a HbA1C of 9.2% and mean blood glucose of 226mg/dl. Synoripa 5/500 BD and daily dose of Gliclazide 30 mg were prescribed. The wound care nurse provided education on off-loading and diabetic diet tips. By the 10<sup>th</sup> day, the fasting blood sugar returned to the normal range. Dressing of the ulcer using silver dressings and hydrogels commenced, and betaine-polyhexanide solution was used as a proper disinfectant in every dressing session. After 20 days of every two days dressing, the healing process seemed to be very slow. Considering the tendon-exposed, time was extremely vital for the medical team to save the tendon by granulating the ulcer. Therefore, as the ulcer had a margin of granulated tissue, 0/5 gram of collagen powder along with Phenytoin ointment was used each session to boost the granulation process. Furthermore, as complementary treatment, the patient underwent ozone therapy by 70 mcg/dl(1). Local ozone therapy was conducted using a plastic tent on the patient's foot over 24-days period in 12 sessions. By the day 44, the ulcer was totally granulated, and the Achilles tendon seemed to be safe (figure.2).



Fig.2 Granulation phase

In order to manage the exudate and prevent maceration on the pre-wound skin and wound edge, a foam dressing was applied to the ulcer for another 20 days (figure.3).



Fig.3 Epithelialization phase

Meanwhile, a new HbA1C and FBS test were performed, and the results (6.9% - 104 mg/dI) indicated that the diabetes is under control. By the day 65, almost all the ulcer was covered by the new immature skin (figure.4) and the patient returned to his daily activities.

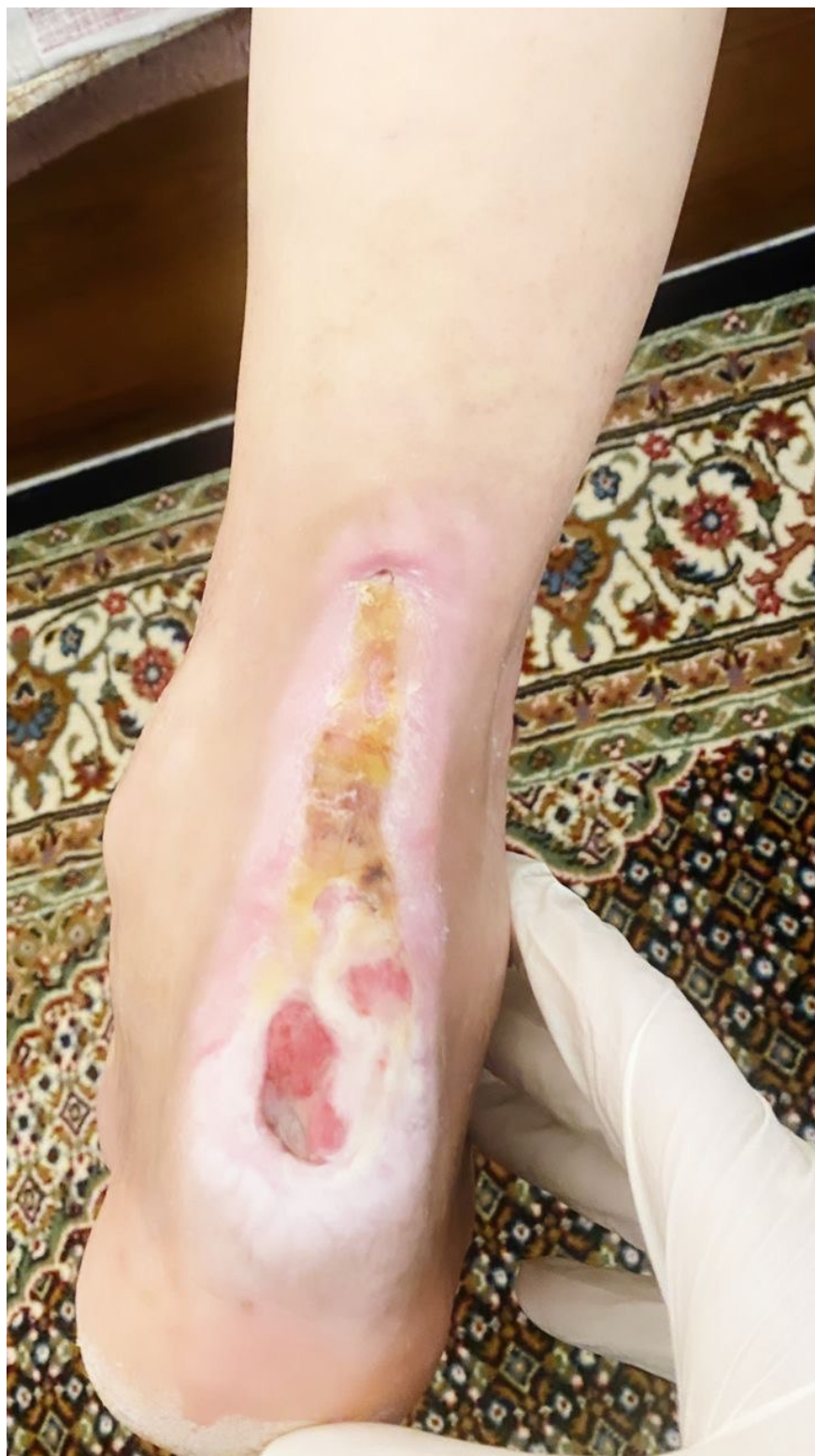


Fig.4 Day 65; healed ulcer



In order to complete the treatment, the patient and family were educated by the wound care nurse and physician about dressing with foam dressings until the new skin matured.

## Discussion

In this case report, we present the successful treatment of a high-risk diabetic foot ulcer in an older adult using ozone therapy and collagen powder. The patient's comorbidities, including uncontrolled diabetes mellitus and severe heart failure, precluded surgical management, necessitating a non-surgical approach in an outpatient setting.

Diabetic foot ulcers are a life-threatening and debilitating complication of advanced diabetes, often resulting in amputations and substantial socio-psychological burden for patients. Prevention is a key component of diabetic foot ulcer management (4). Additionally, managing underlying diabetes is crucial to prevent further microvascular changes and decrease the recurrence rate. Conventional treatment methods for diabetic foot ulcers have had limited success, highlighting the need for new and innovative approaches (5).

While local muscle flaps are the preferred option for small foot and ankle ulcers with exposed bone or tendon, non-surgical approaches can serve as an alternative, especially when patients have comorbidities. Soft tissue defects involving tendons in the foot and ankle present challenges in healing due to limited availability of epithelial cells and lack of soft tissue coverage, further compounded by additional comorbidities such as severe heart failure (6).

Ozone therapy has emerged as a potential treatment modality in recent years. Possible mechanisms associated with wound healing in ozone therapy include antibacterial effects, growth factor release, and tissue oxygenation (7). However, improper application of ozone therapy can lead to respiratory tract damage, gastrointestinal symptoms, and headaches (8).

The use of ozone therapy in diabetic foot ulcers remains controversial, and its safety and efficacy have not been extensively investigated. Previous case reports utilizing ozone therapy for diabetic foot ulcer management have shown positive results, but these studies used different methods such as ozone bagging (9, 10). In our case, we utilized ozone therapy by tent.

A study by Kadir et al. showed that ozone therapy as an adjunct to standard treatment did not significantly impact the healing process but did reduce bacterial infections (11). Additionally, Uzun et al. reported a case in which intralesional ozone injection resulted in severe foot infection and necrosis, suggesting the potential risks of ozone therapy (12). However, it is important to note that the patient in the Uzun et al. study had poor adherence to diabetes treatment, which may have contributed to the negative outcome.

Conclusion:

In conclusion. Critical tendon exposed diabetic foot ulcers can be healed rapidly by ozone therapy and collagen powder. Consequently, preventing tendon loss and further complications is more convenient when the healing process is faster. The authors recommend additional research in this area to better understand the wound healing process in diabetic foot ulcers and to determine the optimal use of ozone therapy as a non-surgical treatment option.

Declarations:

1. Ethical approval and consent to participant A written informed consent was obtained from the next of kin. Authors confirm that all methods were performed in accordance with institutional ethical standards and Declarations of Helsinki.
2. Consent for publication A written informed consent for publicly reporting the information of the condition was obtained from the participant.
3. Availability of data and materials All data are available from the corresponding author on reasonable request.

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