

Case Report

Foot Exercises as an Innovative Therapy for Diabetes Mellitus Ulcers: A Case Report

Senam Kaki sebagai Terapi Inovatif untuk Ulkus Diabetes Melitus: Laporan Kasus

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Abstract

Diabetic foot ulcers (DFUs) remain a major complication of type 2 diabetes mellitus (DM), often leading to prolonged healing and increased morbidity. Foot exercises have been proposed as an adjunct therapy to enhance circulation and promote tissue recovery. This case report describes a 59-year-old female patient with type 2 DM presenting with a foot ulcer treated with diabetic foot gymnastics twice weekly for three weeks, in combination with standard wound care. Wound assessment using the Bates-Jensen Wound Assessment Tool (BWAT) demonstrated significant improvements, including reduction in wound size and depth, decreased exudate, and enhanced granulation and epithelial tissue formation. The patient's BWAT score decreased following the intervention, indicating improved tissue perfusion and peri-wound skin condition, thereby accelerating healing. The exercise regimen also supported better muscle strength, joint mobility, and overall foot function, contributing to improved quality of life. This case illustrates the potential role of foot exercises as a simple, low-cost, and effective complementary therapy for managing DFUs, warranting further investigation through controlled studies.

Keywords: diabetes mellitus; foot exercises; diabetic foot ulcers

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Case Report

Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by elevated blood glucose levels resulting from absolute or relative insulin deficiency, with associated cellular dysfunction, insulin resistance, or both.¹ DM can lead to complications that include microvascular disease (due to small blood vessel damage) and macrovascular disease (due to artery damage). Patients with DM with microvascular complications such as diabetic peripheral neuropathy (DPN) are at high risk of foot edema and ulcers, which can ultimately lead to amputation.² Diabetic peripheral neuropathy (DPN) is a common complication of diabetes and presents as paresthesia, especially in the feet and hands.³ One of the serious complications of diabetes mellitus (DM) is slow healing, recurrent inpatient treatment, requiring intensive and expensive care, and can lead to a decrease in quality of life due to suffering from Diabetic foot ulcers (DFUs). There is a 12% to 25% risk for DM patients to develop DFU during their lifetime, and DFU accounts for 40% to 60% of nontraumatic amputations. Additionally, if DFU occurs once, the likelihood of recurrence within 3 years is 35%-40%, and within 5 years, 70%. The incidence of DFU is 1% to 4% among DM patients, with a prevalence of 3% to 10%. The goal of DFU treatment is to prevent limb loss and improve quality of life.^{3,4}

Exercise can improve vasodilation and blood flow to tissues, aiding wound healing and accelerating DFU healing.⁵ Foot gymnastics is one of the therapies for patients with DM with DFU, so it can control patients' blood glucose.⁶ Several studies have shown the effectiveness of foot exercises in improving wound healing in type 2 diabetes patients with foot ulcers.⁷ These exercises have been shown to reduce ulcer size and depth, with greater benefits observed in those who exercise more.⁵ Furthermore, foot exercises have been shown to improve the quality of life for type 2 diabetic patients, providing comfort, reducing pain and nerve damage, controlling blood sugar, and increasing blood circulation in the feet.⁸ However, although physical therapy modalities, including foot exercises, appear to be useful in treating diabetic foot wounds, further randomized clinical studies are needed to confirm their effectiveness. The novelty of this study is the evaluation of the effectiveness of structured foot exercises as a non-pharmacological complementary therapy to accelerate diabetic foot ulcer (DFU) healing in type 2 diabetes mellitus patients, by simultaneously assessing clinical parameters and tissue perfusion. In this article, we will discuss the effects of foot exercises on DFU in patients with type 2 DM.

Case Report

Case Report

TN D is 59 years old and married. The client said she has had diabetes mellitus for about 8 years, with a history of obesity, rarely exercising, and likes to consume sweet foods and drinks, thus having an unhealthy lifestyle. Upon assessment of the patient, a wound was found on the left metatarsal, characterized as wet, measuring 4 cm in length and 2.5 cm in width. The wound was still red and showed no signs of pus. Currently, the patient takes 500mg of metformin twice daily after meals and 5 mg of glimepiride twice daily before meals.

The patient received routine wound care twice a day, in the morning and afternoon, using sterile equipment and normal saline solution. Diabetic foot gymnastics was performed for 3 weeks, twice a week, with each session lasting 60 minutes. After gymnastics, an assessment was made using the Bates-Jensen instrument.⁹ This Bates-Jensen assessment was conducted to assess 13 wound edges, with the highest score being above 60, indicating that the wound condition was worsening. In contrast, lower scores indicated that the wound condition was healing. The 13 assessment items include wound size, depth, wound hole, type of necrotic tissue, amount of necrotic tissue, type of exudate, amount of exudate, skin color around the wound, edema, tissue hardening at the wound edge, granulation tissue, and epithelial tissue. After diabetic foot gymnastics, the evaluation results showed that the patient's wound condition improved: the previous length of 4 cm decreased to 0.5 cm, and the wound depth resolved, involving partial skin thickness, including the epidermis.

The wound edges were visible with the wound base, no wound holes were found, the amount of necrotic tissue was not visible, there was watery exudate with a pink colour, the skin color around the wound was bright red, non-pitting edema tissue extending <4 cm from around the wound, tissue hardening at the edge induration <2 cm around the wound, no granulation tissue, wound epithelialization closed (Figure 1).

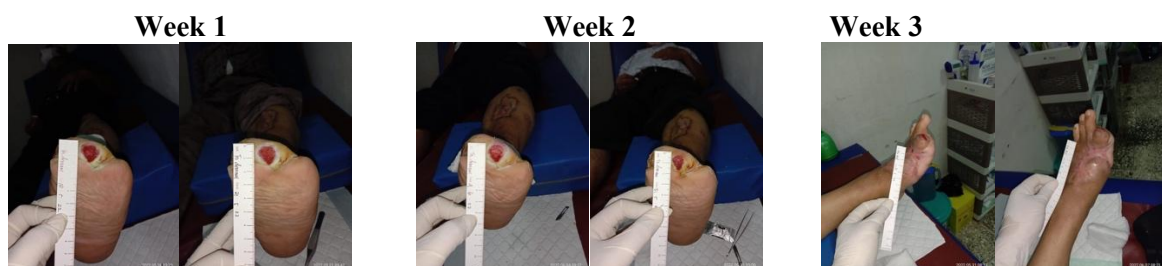


Figure 1 Patient's Wound Repair

Case Report

Figure 2 illustrates the sequence of diabetic foot exercises (step of foot gymnastics) administered as a non-pharmacological adjunct therapy for diabetic foot ulcer healing, beginning with the patient sitting on a chair with heels on the floor and toes extended upward, followed by lifting the soles of the feet with the heels remaining on the floor, elevating the toes, placing the toes on the floor while lifting the heels, and finally straightening and raising the legs. These movements are designed to activate the intrinsic muscles of the foot, improve ankle and metatarsophalangeal joint mobility, and enhance peripheral blood circulation in the ulcerated foot area, thereby supporting granulation and epithelialization processes that are subsequently evaluated using the Bates-Jensen Wound Assessment Tool.



1. The patient sits on a chair



2. The heels of the feet are on the floor, and the toes are extended upwards



3. The heels of the feet are on the floor while the soles of the feet are lifted



4. The toes of the feet are lifted upwards



5. Toes on the floor and heels lifted



6. Legs straightened and raised

Figure 2 Step of Foot Gymnastics

Case Report

Discussion

Wound care and foot exercises were performed six times over three weeks, each session lasting one hour, and successfully improved the wound. Foot exercises showed significant results, despite the short exercise duration used as an intervention to reduce diabetic foot ulcer areas, allowing for rapid changes to occur.

Exercise improves blood circulation/blood flow, thereby providing sufficient oxygen delivery to tissues that are injured due to DM complications.¹⁰ Changes in the wound in patients become pink due to the degenerative processes of the skin layer.^{11,12} Blood sugar levels significantly impact the healing process in diabetes mellitus. Wound healing is a complex process that involves numerous cells. The wound healing process consists of several phases: coagulation, inflammation, proliferation, and remodeling. Wound healing is also defined as a complex and dynamic process that results in the repair of anatomical structures and tissue function.⁷

Diabetic patients perform diabetic foot exercises to help improve blood circulation in the foot area. Foot exercises can help improve foot deformities. Foot exercises can also help improve calf muscle strength and thigh muscle strength, as well as enhance joint mobility. Diabetic foot gymnastics, performed on the soles of the feet, especially in problem areas, stimulates nerve points related to the pancreas, allowing insulin to be produced through nerve points located in the soles of the feet. Motor strength of the feet after foot exercises is stronger so that daily activities can be done well, such as climbing stairs and doing household chores or tasks, also improving limb function in patients with diabetic neuropathy.^{1,3}

Foot exercises have been studied for their effectiveness in the treatment of type 2 diabetes mellitus ulcers. Research has shown that foot exercises can help improve blood circulation, strengthen small muscles in the feet, and prevent foot deformities.¹³ Various types of foot exercises have been investigated, including gymnastics models that combine aerobics, balance training, resistance training, and leg training.¹⁴ These exercises are feasible and applicable to diabetic patients, helping to prevent or reduce the risk of diabetic foot ulcers.¹⁵ Additionally, a foot-ankle exercise program for 8-12 weeks may improve the ankle joint range of motion and first metatarsophalangeal joint range of motion, and signs and symptoms of neuropathy in people at risk of foot ulcers.¹⁶

Conclusion

The findings from this study suggest that foot exercises for three weeks can aid the wound healing process. With the result that the wound becomes pink, further research can be conducted on it, and it can be used as an alternative nursing action for diabetic patients.

Case Report

Suggestion

Researchers suggest that for further research, foot exercises should be performed for 30 minutes for 3 months, and clinic nurses can be one of their nursing actions for diabetic patients.

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