

Section: General Nursing

Range of motion (ROM) to improve foot sensitivity in patient with type 2 diabetes

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Abstract

Diabetes is a chronic metabolic disease characterized by persistently high blood glucose (blood sugar) levels, which can lead to serious damage to the heart, blood vessels, eyes, kidneys, and nerves over time. Several factors can contribute to the development of diabetic foot ulcers, including limited joint mobility, muscle weakness, poor balance, and changes in posture and gait. Individually or collectively, these issues can cause abnormal pressure distribution on the soles of the feet. Foot sensitivity disorders are a common complication in type 2 diabetes patients, often associated with diabetic neuropathy. This nerve disorder primarily affects the distal parts of the body, typically the feet, leading to symptoms such as tingling, pain, and even numbness. One beneficial physical exercise for type 2 diabetes patients involves active range of motion (ROM) exercises for the feet, combined with general foot exercises. This regimen helps improve nerve function, promote blood circulation, enhance protective sensation, improve Ankle-Brachial Index (ABI) values, and minimize the symptoms of diabetic polyneuropathy. Ultimately, these exercises are crucial in preventing foot ulcer complications. This study aims to demonstrate the effectiveness of combining ROM and diabetic foot exercises to improve foot sensitivity in patients with diabetes mellitus. The nursing care provided focused on applying combined ROM therapy and diabetic foot exercises to enhance foot sensitivity in Mrs. S, a 75-year-old woman with DM. Her primary complaint was persistent pain in both legs for approximately three years, making it difficult for her to walk normally, along with frequent tingling sensations. Examination revealed swollen legs, inelastic skin turgor, a blood glucose level (GDS) of 225 mg/dL, and cold extremities (acral coldness). A combination of ROM therapy and diabetic foot exercises was provided as education to encourage regular exercise. This was administered to Mrs. S once daily over three days. Following this implementation, the patient reported significantly less frequent tingling and felt more comfortable when walking.

Keywords: Diabetes, foot sensitivity, nursing care, prevention, Range of Motion

Introduction

Diabetes is a non-communicable disease (NCD) with numerous conditions that can lead to various complications (Hossain et al., 2024). According to the World Health Organization (WHO), diabetes mellitus is a chronic metabolic disease characterized by a gradual increase in blood glucose (blood sugar) levels over time (Galicia-Garcia et al., 2020). This chronic hyperglycaemia can cause serious damage to vital organs such as the heart, blood vessels, eyes, kidneys, and nerves (Lu et al., 2023). Poorly controlled diabetes can lead to severe complications, including cardiovascular problems, nerve damage (neuropathy), kidney damage (nephropathy), vision impairment, and even limb amputation, all of which can be life-threatening (Tomic et al., 2022). Diabetic foot ulcers are a particularly concerning complication, often exacerbated by additional factors like limited joint mobility, muscle weakness, poor balance, and changes in posture and gait. These issues, individually or combined, can cause abnormal plantar pressure distribution on the foot. Foot sensitivity disorders, often linked to diabetic neuropathy—a nerve disorder primarily affecting the distal parts of the body (typically the feet)—manifest as tingling, pain, and numbness (Wang et al., 2022). Over time, both in static and dynamic conditions, increased plantar pressure in specific areas of the feet, coupled with peripheral sensory deficits, significantly elevates the risk of skin damage and ulcer formation. Globally, the prevalence of diabetes is staggering. The International Diabetes Federation (IDF) projects that by 2025, approximately 1 in 10 adults aged 20–79 worldwide will be living with diabetes, equating to an estimated 589 million people by 2024. In Southeast Asia, this figure is expected to reach 106.9 million by 2024 (Gupta et al., 2023). Indonesia stands out as one of the countries with the highest number of people with diabetes, totalling 20.426 million individuals. This represents an age-adjusted diabetes prevalence of 11.3% in Indonesia, which is higher than the regional average for Southeast Asia (10.8%), indicating that more than 1 in 9 adults in Indonesia live with diabetes.

Diabetic foot is often associated with several functional deficits, including limited joint mobility, muscle weakness, poor balance, reduced walking speed, and decreased walking distance (Akkus & Sert, 2022; Vrátná et al., 2022). Fortunately, these issues can be effectively addressed through targeted physical exercise programs.

Remarkably, recovery from these functional deficits can be achieved within just a few weeks, often resulting in performance levels comparable to age-matched healthy individuals. These findings are highly significant because limited joint mobility and muscle abnormalities are critical risk factors for foot ulcers in diabetic patients, directly impacting posture quality and gait patterns. Therefore, structured physical activities, whether defined as exercise therapy or adapted physical activities, play a crucial role. Their primary aim is to prevent the development or progression of foot ulcer risk factors, ultimately serving as an effective preventative measure against foot ulcers in diabetic patients. Range of Motion (ROM) exercises are crucial for diabetic patients as they help improve nerve function, promote blood circulation, enhance protective sensation and Ankle-Brachial Index (ABI) values, and minimize symptoms of diabetic polyneuropathy (Matsui et al., 2019; Yang et al., 2025). Ultimately, these exercises are vital in preventing serious complications like foot ulcers.

Specifically, applying foot exercises and ROM in diabetic patients, which involves moving the foot muscles and joints, can significantly enhance foot sensitivity and local blood circulation (Francia et al., 2014; Gracia-Sánchez et al., 2025). These exercises also strengthen the small muscles in the feet, potentially preventing foot deformities. Research indicates that regular diabetic foot exercises can improve both foot sensitivity and blood sugar levels (Vastamäki et al., 2016; Cerrahoglu et al., 2016). This mechanism leads to improved blood circulation in the legs, strengthens small muscles, prevents foot deformities, increases calf and thigh muscle strength, and addresses joint limitations. The researchers hypothesize that the observed increase in foot sensitivity among participants demonstrates a direct influence of Active ROM exercises on foot sensitivity levels in individuals with diabetes mellitus. This improvement in foot sensitivity is attributed to participants' consistent adherence to and proper execution of the Active ROM exercises. Performing active ROM exercises for the feet can increase muscle strength, improve joint flexibility, and reduce plantar foot pressure. Concurrently, foot exercises further aid in improving blood circulation, strengthening small foot muscles, and preventing deformities. Together, these practices also contribute to increased calf and thigh muscle strength and overcome limitations in joint movement. This research employs a descriptive case study method, utilizing a nursing process approach. The primary purpose of this case study is to demonstrate the practical application of a combined ROM and Diabetic Foot Exercise program to improve foot sensitivity in patients with diabetes. This is achieved by evaluating the effectiveness of this combined intervention on foot sensitivity before and after its implementation. The subject for this case study is Mrs. S, a 75-year-old woman. She weighs 48 kg, is 146 cm tall, and has a Body Mass Index (BMI) of 22.5%, which falls within the normal weight range. Mrs. S's main complaint is an inability to walk normally due to bilateral leg pain that has persisted for approximately three years, frequently accompanied by tingling sensations in both legs.

Case Description

Mrs. S, a 75-year-old woman, complained of difficulty walking due to pain in both legs that had persisted for approximately three years, often accompanied by tingling sensations. On examination, both legs appeared swollen with non-elastic skin turgor, cold extremities, and a blood glucose level (GDS) of 225 mg/dL. Vital signs were: blood pressure 160/90 mmHg, temperature 36.5°C, pulse 85 beats per minute, and respiration 20 breaths per minute. The patient had a history of genetic diabetes mellitus (DM) but had not undergone any treatment. The integumentary system appeared poor, with dry skin, turgor >3 seconds, dark brown skin colour, and cold extremities. No oedema or diabetic wounds were noted. The patient reported frequent tingling in her legs, spent much of her time sitting, and required occasional assistance from family members for activities of daily living (ADLs).

Nursing Diagnosis (SDKI): Ineffective tissue perfusion (D.0009) related to hyperglycaemia, evidenced by capillary refill time >3 seconds, cold extremities, and GDS 225 mg/dL. Unstable blood glucose levels (D.0027) related to pancreatic dysfunction, evidenced by frequent fatigue and drowsiness. Expected Outcomes (SLKI): Resolution of ineffective tissue perfusion within 3x24 hours, with criteria including: Improved skin colour (reduced pallor), Improved capillary refill, Improved acral circulation, Improved skin turgor, Interventions (SIKI – Peripheral Sensation Management, I.06195): Identify causes of altered sensation, assess ability to recognize location and texture of objects, monitor skin changes and occurrence of paraesthesia, explain the purpose and procedures of diabetic foot therapy, advise avoidance of extreme temperatures (too hot or too cold), provide education on regular exercise, including ROM (Range of Motion) therapy and diabetic foot exercises, to improve foot sensitivity and reduce tingling. Implementation: ROM therapy and diabetic foot exercises were taught and administered once daily for three consecutive days. Evaluation: Day 1 (May 26, 2025): The patient reported frequent tingling and numbness in both legs, with reduced sensitivity. After ROM and foot exercises, peripheral perfusion began to improve. The patient was able to follow instructions and felt more relaxed, positively affecting symptoms. Day 2 (May 27, 2025): The patient continued to experience tingling but reported feeling better and more relaxed after exercises, and was able to rest peacefully. Day 3 (May 28, 2025): The combination of ROM therapy and diabetic foot exercises achieved the targeted outcomes. The patient no longer complained of frequent tingling or numbness, and foot sensitivity improved significantly.

Discussion

Mrs. S, a 75-year-old woman, reported frequent numbness and tingling in both legs, difficulty performing daily activities, and swelling that had persisted for approximately three years. Her blood glucose level was 225 mg/dL and

blood pressure 160/90 mmHg. These complaints align with the theoretical concepts of diabetes mellitus, where impaired foot sensitivity is a common complication in type 2 diabetes patients due to diabetic neuropathy—a nerve disorder in the distal parts (typically the feet) characterized by tingling, pain, and numbness. Based on the data obtained, the priority nursing diagnosis identified was Ineffective tissue perfusion (D.0009) related to hyperglycemia, evidenced by capillary refill time of 3 seconds, cold extremities, and GDS 225 mg/dL. Prolonged peripheral disorders can cause nerve death (neuropathy) in the feet of diabetes mellitus patients, leading to reduced or lost sensation. The management approach for Mrs. S involved a combination of Range of Motion (ROM) therapy and diabetic foot exercises. Foot exercises and ROM significantly improved foot sensitivity in diabetic patients. Mrs. S performed foot exercises twice daily for 15 minutes over three days, while continuing her diet and consuming herbal medicine, including a morning decoction of lemongrass leaves mixed with turmeric and ginger. After performing the exercises, the patient reported feeling refreshed, physically fitter, and experiencing reduced tingling in her feet. Additional recommended physical activities included aerobic exercises such as walking.

At the end of each exercise session, Mrs. S independently performed active ROM to improve blood circulation and increase leg sensitivity. The researchers assumed that the patient's direct involvement in the intervention, along with the enthusiasm of her family, contributed to the positive outcomes. This was particularly significant as the patient had never previously undergone a complementary intervention of this kind. Physical activity should be performed at least three to four times a week for a minimum of 30 minutes per session to achieve optimal results. Regular activity helps maintain blood sugar and HbA1c levels within normal limits. Conversely, excessive rest or inactivity can worsen insulin resistance, as physical activity restores cellular sensitivity to insulin, reduces central fat, and promotes muscle tissue changes. Regular ROM exercises can lower blood sugar levels by increasing muscle activity, generating heat energy, and boosting metabolism, which facilitates glucose transport into cells. Active ROM leg exercises are advantageous because they are self-administered, require minimal time, are easy to perform at home, and are cost-effective. These exercises improve nerve function, enhance blood circulation, increase protective sensation and ABI values, and minimize symptoms of diabetic polyneuropathy, thereby preventing complications such as foot ulcers. Active ROM exercises positively affect pathological factors associated with peripheral neuropathy by improving microvascular function, reducing oxidative stress, and increasing neurotrophic factors. Stimulating calf muscle contractions enhances venous return and circulation, strengthens small muscles, prevents foot deformities, and improves joint mobility. Adequate blood circulation inhibits demyelination of nerve cells, ensuring proper impulse transmission from sensory receptors. Improved venous activity also enhances arterial blood flow, delivering nutrients and oxygen to peripheral tissues.

Diabetic foot exercises are crucial for improving quality of life in type 2 diabetes patients. They help prevent complications, control blood glucose levels, reduce cardiovascular risk factors, promote well-being, and support weight loss. Interventions performed for at least eight weeks can reduce HbA1c levels by 0.66%. These exercises are simple, require minimal equipment, and can be performed indoors or outdoors for 15–30 minutes three times a week. As aerobic activities, they improve circulation, strengthen foot muscles, prevent deformities, and enhance insulin production. They also relax the body and improve blood flow. Initially, the patient's physical activity did not fully achieve the target outcomes of the SLKI (Standardized Nursing Outcomes). However, after three days of implementation, foot sensitivity improved and the SLKI criteria were met. The intervention can be continued independently every day for at least 30 minutes. Active ROM exercises help restore pancreatic function, improve oxygen supply through blood circulation, and enhance impulse transmission to the sensory nervous system, thereby controlling blood sugar and preventing complications. The findings suggest that regular combination therapy of ROM and diabetic foot exercises effectively improves peripheral blood flow, controls blood glucose levels, and reduces foot pain. These interventions can prevent chronic complications of type 2 diabetes. Daily implementation is recommended for more effective results. The evaluation of this case study highlights the complexity of sensitivity changes in the lower limbs and feet of diabetic patients, and how these changes influence balance, posture, and overall biomechanics.

Conclusion

The combined intervention was carried out by instructing the patient to rotate the foot at the ankle, pull and squeeze the toes, slide the toes, press the arch of the foot, and repeat stroking movements for 30–40 minutes, twice daily for three days. After completing the foot massage intervention, the patient was taught Active Range of Motion (ROM) exercises and instructed to perform them regularly. The combination of ROM therapy and diabetic foot exercises, provided as part of patient education to encourage routine exercise, was implemented once daily for three consecutive days. After three days, the patient reported no longer experiencing frequent tingling and felt more comfortable when walking. This intervention highlights the potential of ROM therapy and diabetic foot exercises to improve foot sensitivity and comfort in diabetic patients. It is hoped that these findings can provide valuable input for healthcare services, particularly in developing exercise-based therapies for people with diabetes. Such interventions may contribute to the prevention of complications, including foot ulcers and neuropathy, thereby improving patient outcomes and quality of life.

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