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REVIEW ARTICLE

The Roles of Physical Therapists in Wound Management: Part IV

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Abstract Physical therapists are important members of the comprehensive wound management team. In addition to being able to provide standard wound care, they are well prepared to treat wounds with a variety of biophysical agents that introduce electromagnetic, acoustic, and mechanical energies that enhance healing. Physical therapists also address restoration of function that is frequently compromised in patients who suffer from chronically and acutely wounded tissues.

Introduction

In the management of lower-extremity wounds caused by venous insufficiency, there are 3 interventions that may be performed by physical therapists (PTs) to facilitate wound closure and healing. The treatments include (1) edema reduction with pneumatic compression, compression bandaging, and manual lymphatic drainage; (2) application of absorbent dressings to maintain a moist wound bed; and (3) ambulation, range of motion, and strengthening exercises to prevent loss of dorsi and plantar flexion motions of the ankle resulting from progressive lipodermatosclerosis. Before using compression on these patients, the PT would perform an ankle-brachial index (ABI) to determine whether compression would be contraindicated because of arterial insufficiency, as in the case of an ABI less than 0.8. Pneumatic compression may be used to assist in reduction of edema caused by venous hypertension.[1-3] This treatment uses a pump that intermittently inflates a compression sleeve placed on the patient's edematous limb. An absorptive dressing is placed on the wound before the limb is placed into the sleeve.

An example of such a treatment is as follows: with the patient supine, the limb is elevated above heart level, and the pump parameters are set to sequentially increase sleeve pressure from distal (45 mm Hg at the ankle) to proximal (30 mm Hg just below the knee) at a cycle of 90 seconds of compression and 30 seconds of decompression for 1 hour twice a day. Following the pneumatic treatment, the PT applies a short-stretch compression bandage to the foot, ankle, and leg of the ambulatory patient to improve calf muscle pump efficiency. For nonambulatory or sedentary patients, a long-stretch bandage is applied to passively augment edema reduction. The therapist also instructs the ambulatory patient in ambulation and elevation activities to enhance edema reduction and designs an exercise program the patient can perform at home to prevent loss of ankle motion due to the insidious onset of lipodermatosclerosis.

PT Management of Patients with Arterial Insufficiency Ulcerations

Depending on disease severity, patients with peripheral arterial disease are at risk for myocardial infarction,

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cerebral vascular accident, ischemic extremity ulcerations, and gangrene. In addition to performing the ABI test, the PT will obtain more thorough diagnostic information derived from peripheral vascular tests such as toe pressures, segmental limb pressures, computed tomographic angiography, and photoplethysmography.

Electrical Stimulation for Wound Healing

PT interventions for patients who have compromised blood flow into the lower extremities are limited to conservative treatments. One treatment involves the use of electrical stimulation (ES) to salvage critically ischemic limbs from amputation in patients with diabetes. The primary basis for using ES to treat critically ischemic limbs is supported by human studies of several investigators who have demonstrated that when therapeutic electrical currents are delivered to the skin and subcutaneous tissues, a measurable and significant increase in transcutaneous oxygen ($TcPO_2$) occurs in patients with spinal cord injury[4,5] and diabetes.[6] In this context other investigators have reported that 20 of 24 diabetic patients with distal ischemic ulcers or gangrene experienced progressive limb deterioration during 5 to 6 years of treatment with antiplatelet and vasodilating drugs. After adding ES to their drug treatment regimen over a period of 1 year, 20 of 24 patients made significant progress including disappearance of ischemic pain, halting of gangrenous progression, and complete healing of ulcerations. Furthermore, after the addition of ES to their treatment protocol, pain-free walking distance and oxygen saturation measured on the toes increased significantly.[7] In a study by Peters et al,[8] patients with diabetes having impaired vascular function who had 1 foot and distal leg treated with subsensory ES for 60 minutes on 2 consecutive days showed a significant increase in perfusion in the stimulated extremity, secondary to a significant increase in $TcPO_2$ after 5 minutes of ES. The results from these studies suggest that ES increases cutaneous oxygen saturation secondary to increasing local perfusion in subjects with diabetes.

The conclusions reported in the previous 2 studies of increased $TcPO_2$ and perfusion following ES treatment of ischemic limbs is further supported by similar findings from Goldman et al,[9-12] who evaluated the effects of ES on critically ischemic, nonsurgical limbs. In a case series, they reported statistically significant increases in periwound $TcPO_2$ and enhanced healing rate and closure of 4 of 6 wounds,[9] and in a single case, ES reversed a rapidly expanding ischemic, cutaneous gangrene on the calf of a patient with end-stage renal disease. In this case, periwound $TcPO_2$ increased from 20 to 50 mm Hg.[10] In another study on ischemic limbs, Goldman et al[11] reported that ES increased $TcPO_2$ and that 90% of ES-treated wounds healed, compared with 29% of wounds that were treated with standard care alone. In their most recent study, Goldman et al[12] conducted a prospective, randomized, single blinded, sham-controlled clinical pilot study on a homogeneous subset of patients with infrapopliteal ischemic wounds. After 4 weeks wounds treated with placebo ES increased in area by 50% while during the same period, wounds treated with active ES underwent a significant decrease in size. Improved perfusion likely explains the outcomes of these small studies.

Numerous clinical studies support the use of ES for enhancing the healing of chronic wounds, including pressure and diabetic foot ulcers and ulcers of the lower extremity caused by venous and arterial insufficiency. More detailed information on the use of ES for promoting wound healing can be found in a review paper[13] and a textbook on wound healing.[14]

Exercise for Intermittent Claudication

There is significant evidence from prospective studies that supervised ambulation exercise can significantly decrease claudication pain[15] and improve maximum walking time[16-19] and the ability to carry out routine daily activities[20] in patients with mild to moderate claudication. One meta-analysis of nonrandomized and randomized trials found that ambulation exercise training improved pain-free walking in patients with claudication by an average of 180% and improved maximum walking time by an average of 120%.[15] Another meta-analysis from the Cochrane database[16] of 10 randomized controlled trials concluded that ambulation exercise training improved maximum walking time by an average of 150% compared with both angioplasty at 6 months and antiplatelet medication (pentoxifylline and cilostazol). The variability in improved walking times reported in these meta-analyses is likely related to the different study designs that were examined and is also evident in other studies.[17-19] One study that evaluated the ability of patients to carry out activities of daily living reported a 31% improvement as measured by accelerometry.[20] In the same study, self-reported physical activity increased by 62%, indicating that patients perceived improvement in their functional activities.

For key elements of a supervised therapeutic exercise training program for patients with claudication, the reader may wish to access the review article by Stewart et al.[17]

It is hoped that the information presented in this and the previous 3 parts of this column will motivate PTs in many nations to share their expertise and become involved in wound management.

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