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Letter to the editor

Chronic prosthesis-related residual limb ulcer treated with autologous micro-fragmented adipose tissue

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A B S T R A C T

A 56-year-old male with a past medical history significant for a left below-knee amputation and a left total knee replacement presented with knee pain at a non-healing stage 2 prosthesis-related residual limb ulcer. The ulcer at the weight-bearing surface at the anterior patella had not closed despite three years of conservative management; including offloading and wound clinic follow up. To assist with the healing process, the ulcer was treated with autologous micro-fragmented adipose tissue therapy. He was injected with 8 mLs of minimally manipulated adipose tissue (Lipogems) underneath the ulcer. Upon the four-week follow-up, his pain had resolved, and the wound was significantly reduced in size with new skin appearing. The goal of this case report is to examine if autologous micro-fragmented adipose tissue can represent a feasible and safe treatment option for chronic prosthesis-related residual limb ulcers. To our knowledge, this is the first reported case using micro-fragmented adipose therapy to treat a chronic prosthesis-related residual limb ulcer.

1. Introduction

The management of prosthesis-related residual limb ulcers is a challenging issue in rehabilitation and wound care. A newly molded prosthesis may take several adjustments to fit properly, and patients often have changes in their body habitus over time; thus, physiatrists frequently encounter patients with pressure ulcers related to their prostheses. Physical medicine and rehabilitation professionals must be prepared to recognize and manage skin conditions in this population. Unfortunately, due to the increasing aging population and the high prevalence of chronic diseases related to diabetes and vascular disease, the estimated number of patients encountering amputations will only continue to rise. Patients with lower extremity amputation experience 65% more dermatologic issues than non-amputees [1], and approximately 75% of patients who use lower-limb prostheses experience skin problems [2]. The high shear forces, increased humidity, and prolonged moist contact within the prosthesis contribute to skin tissue breakdown at the prosthesis site, leading to ulceration [3]. These prosthesis-related residual limb ulcers will often translate into a negative impact on the patient's function and quality of life. The need to treat these patients who are especially vulnerable to pressure ulcers is necessary; however, there is little known effective treatment for pressure ulcers outside the standard of care, especially with those who endure recurring ulcers. The most common management for these prosthesis related limb ulcers is prosthetic discontinuance. However, prosthetic disuse can have adverse consequences for the amputee, including reduced ambulatory ability, increased fall risk, decreased physical activity, weight gain, financial hardship, and psychological implications [1]. Outside prosthesis rest, physicians will treat prosthesis-related residual limb ulcers with socket adjustments, wound dressings, surgical debridement, negative pressure wound therapy, hyperbaric oxygen, and bioengineered skin substitutes [4].

Orthobiologics have emerged as a promising therapeutic strategy to improve the healing process [5]. Adipose tissue is an abundant source of mesenchymal stem cells that provide proposed analgesic, anti-inflammatory, anti-bacterial, and reparative properties that may be key to the healing process [6]. Mesenchymal stem cells within adipose tissue secrete a variety of cytokines and growth factors that have been found to inhibit fibrosis and apoptosis, enhance angiogenesis, and stimulate the differentiation of tissue-intrinsic reparative stem cells [7]. The two most widely recognized types of adipose tissue derivatives are micro-fragmented adipose tissue and stromal vascular fraction, which are named based on how the adipose tissue is processed. The stromal vascular fraction (SVF) is generated using a centrifuge to process the adipose tissue cell components. The micro-fragmented adipose tissue (MFAT) involves using a combination of washing the pro-inflammatory oil and blood residues without the use of enzymes, additives, or separation centrifugation [8] and passing harvested adipose tissue derivative through a size reduction filter to break up the adipose tissue mechanically while preserving the microarchitecture [9]. We intend to show how autologous micro-fragmented adipose

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tissue provided healing capabilities in a case involving a chronic non-healing pressure ulcer related to a prosthesis on his residual limb.

2. Case presentation

A 56-year-old male with a past medical history of left below-knee amputation, left total knee replacement, and lumbar spinal stenosis presented with a three-year non-healing stage 2 prosthesis-related residual limb ulcer. At age 6, the patient underwent limb lengthening surgery for a significant congenital leg discrepancy. The procedure was complicated with a staphylococcus aureus infection that resulted in a below the knee amputation, and after a traumatic fall in 2006, the patient required a total knee replacement. The patient subsequently suffered a skin infection over the prepatellar weight-bearing surface in 2018 after swimming in a pool. Although this infection appeared to resolve with antibiotics, he was left with a chronic non-healing wound. The ulcer did not heal for two years despite several cycles of 4–6 weeks of prosthesis discontinuation, socket adjustments, silicone socks, and bioengineered skin grafts. In June 2020, he developed worsening of the ulcer after a hike, which caused significant pain associated with prosthetic use. The patient opted to try MFAT over a skin autograft as he wished to trial non-surgical options.

3. Methods

The patient underwent an injection of autologous micro-fragmented adipose tissue to assist with wound healing. Adipose tissue was harvested from the bilateral upper buttocks and purified using a Lipogems kit. MFAT was introduced via an 18 gauge needle in a square pattern to fill in the tissue defect subcutaneously. Roughly 2 mLs of MFAT was introduced in each of 4 sites, for a total of 8 mL. Post-operatively, he was instructed to avoid NSAIDs, avoid submerging the site underwater for 14 days, and limit physical activity for four days.

3.1. Outcome and follow-up

On the first day, the patient reported significant soreness along the injected areas. At his 4-week follow-up, the patient reported an overall improvement in his knee and no pain associated with his previously non-healing prosthesis-related ulcer. He returned to using his leg prosthesis, along with resuming his usual physical activities with no restrictions (Figs. 1 and 2).

4. Discussion

Treatment options are continually being attempted to alleviate non-healing ulcers. At present, pressure ulcers are primarily treated with conservative medical management of stage 1 or 2 pressure ulcers, while surgical management is reserved for stage 3 or 4 pressure ulcers [10]. The primary treatment option for prosthesis related limb ulcers is prosthesis discontinuation. Unfortunately, this treatment option results in a decreased ability to perform activities of daily living and a decreased quality of life. Additionally, chronic wounds often may not respond to this conservative treatment. The approach for MFAT for this non-healing ulcer was considered upon review of the literature regarding potential options, as a recent randomized control trial had found MFAT was effective for diabetic foot ulcers [11].

Wounds typically occur in 3 phases: the inflammatory phase, the proliferative phase of new tissue, and the remodeling phase [12]. However, pressure ulcers often fail to progress past the inflammatory stage. Pressure ulcers are marked by excessive infiltration of neutrophils, which are believed to be responsible for the chronic inflammation characteristics of non-healing pressure ulcers. The neutrophils release a significant amount of enzymes that destroy the connective tissue matrix and have the capacity to destroy necessary healing factors [13]. The primary factors that lead to impaired local healing are pressure, tissue edema, hypoxia, infection, maceration, and dehydration [12]. This patient's lack of healing may have been secondary to any chronic pressure from the prosthesis, limitation in local tissue perfusion, or even an indolent infection. As per the injection, mesenchymal stem cells comprise up to 2% of the cells within adipose tissue that modulate trophic, mitogenic, anti-apoptotic, and anti-microbial properties produced by growth factors and cytokines [14]. This creates an optimal microenvironment to promote wound healing.

Although promising, this case report has limitations regarding extrapolating results to patients with ulcers secondary to vascular insufficiency. This patient was reasonably active, and his amputation was related to an infection.

Fig. 1. Before MFAT procedure.

Fig. 2. 4-week f/u after MFAT procedure.

5. Conclusion

There is no documentation of micro-fragmented adipose tissue treating chronic prosthesis-related residual limb ulcers. Although this is a single case report, the treatment of autologous MFAT resulted in improved pain and pathology after four weeks.

Further documentation and research are needed to determine the treatment effect of autologous micro-fragmented adipose tissue therapy compared to other therapies to treat chronic non-healing pressure ulcers related to prosthetic use.

Author note

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