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CASE REPORT

The use of micro-plasma radiofrequency technology in secondary skin graft contraction: 2 case reports

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Abstract

Secondary skin graft contraction leading to cosmetic deformity remains a great challenge. These two case reports present serious skin graft contraction and the treatment with micro-plasma radiofrequency technology. Two patients presented with complaints of post-burn depigmentation on the forehead and the hand, respectively, and received dermabrasion and thin split-thickness skin grafting. Then, many localized contraction lesions occurred after 4 weeks. The treatment selected was non-surgical removal using micro-plasma radiofrequency technology with the following energy parameters: a roller tip at 80 watts, three passes in different directions. No complications were observed. The contracted skin was ablated without affecting the pigment distribution. The consequents were that the color, appearance, and texture of the grafted skin matched the adjacent skin well and had better patient acceptance.

Key Words: *ablation, micro-plasma, radiofrequency, secondary skin graft contraction*

Introduction

The skin contraction after a thin or ultrathin split-thickness skin graft (STSG) is a normal physiology that can cause cosmetic deformity for a long term. This process of secondary contraction is the result of the biological behavior of the graft and wound bed, relating to the proportion of the dermis harvested from the donor site (1), and depends on cross-linking of specific collagen fibrils in the dermis (2). Treatments of skin contraction include splinting and pressure therapy against contractile forces for several months after surgery, resulting in cumbersome and prolonged medical treatment. However, the researches about treatment of secondary contraction have progressed slowly and the understanding of the underlying mechanism remains little.

Micro-plasma radiofrequency treatment has recently been used for minimally ablative fractional resurfacing of scars. The radiofrequency energy acts on nitrogen gas to form a grid of high-energy foci called "plasma sparks," resulting in a portion of the atoms being ionized and applied evenly onto the skin. This causes epidermis ablation and stimulates thermal collagen denaturation and neocollagenesis with minimal thermal injury to the surrounding tissues (3,4). We found that micro-plasma radiofrequency technology as a novel approach can effectively treat secondary skin graft contraction.

Case reports

Case 1

A 28-year-old man sustained a fire burn on face, leaving hyperpigmented scars and irregular areas of depigmentation on his forehead, when he was two years old. He was concerned about the social consequences of the irregular pigmentation, and consulted us for dermabrasion and STSG. The surgery was performed under general anesthesia. The grafts (0.1–0.2-mm thickness) were harvested from unburned skin on his left thigh and were smoothly applied to the dermabraded forehead (depigmented area).

The grafts and donor site healed without complications within 10 days. Unfortunately, secondary contraction of the grafted skin occurred after 4 weeks, and became severe after 8 weeks (Figure 1B). The treatment selected was micro-plasma radiofrequency technology to remove the right and middle contracted

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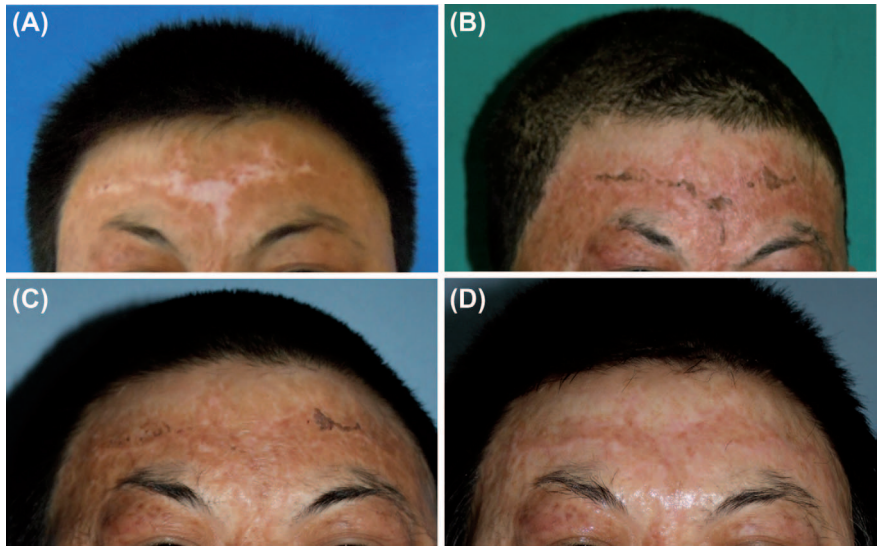

Figure 1. (A) A 28-year-old man presented with irregular areas of depigmentation on the forehead. (B) Two months after dermabrasion and STSG, there was severe grafted skin contraction. (C) Two months after the first micro-plasma radiotherapy treatment, there was an excellent improvement in the right and middle sides while the skin contraction was still presented on the left forehead. (D) Six months after micro-plasma radiofrequency treatment, the color, appearance, and texture of the treated skin matched well with the adjacent skin.

lesions. The procedure was performed under surface anesthesia with 10% lidocaine cream (Qinghua Pharmaceuticals, Beijing, China) under plastic wrap for 60–90 min. Then he underwent micro-plasma radiofrequency treatment (Alma Lasers, Israel) using a roller tip at 80 W, with three passes in different directions to evenly distribute the energy onto the skin. Sterile saline and erythromycin eye ointment were applied to the treated area daily for 6 days to prevent infection. The patient was instructed to strictly avoid sun exposure for at least 3 months.

Two months after the micro-plasma radiofrequency treatment, the contracted skin on the right and middle side disappeared while the contraction on left forehead was still present (Figure 1C). Then he accepted the second treatment to remove the remaining lesions due to the satisfying results. After 6 months, the color, appearance, and texture of the grafted skin matched the adjacent skin well without affecting the pigment distribution (Figure 1D).

Case 2

A 41-year-old man presented with irregular areas of depigmentation on the dorsum of his right hand seven months ago. The area of depigmentation

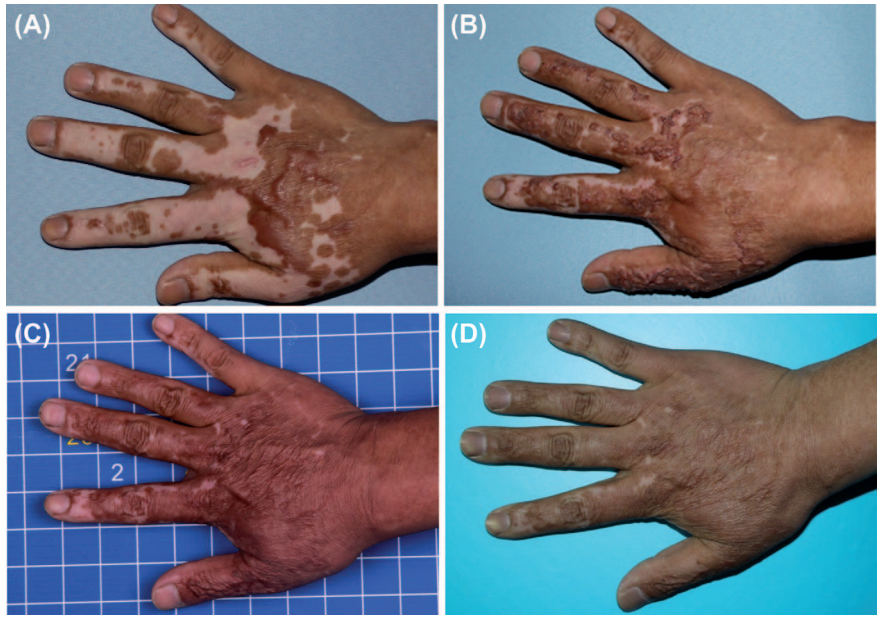

Figure 2. (A) A 41-year-old man presented with irregular areas of depigmentation. (B) Two months after dermabrasion and STSG, there was severe grafted skin contraction. (C) Two months after micro-plasma radiotherapy treatment, there was an excellent improvement in the skin contraction. (D) Six months after micro-plasma radiofrequency treatment, the color, appearance, and texture of the treated skin matched well with the adjacent skin, and the scars were no longer raised.

covered about 40% of the dorsum of his hand (Figure 2A). Then he underwent dermabrasion and STSG surgery (except for the distal 2nd finger and the 5th finger, which were not treated).

After 8 weeks, the contraction reduced the size of each graft (Figure 2B). He received micro-plasma radiofrequency treatment using a roller tip at 80 W, with three passes in different directions. Two months after the treatment, there was an excellent improvement in the skin contraction, and the pigment distribution was more uniform than before (Figure 2C). Because of the high cost of treatment, no further treatment was requested. After 6 months, the color, appearance, and texture of the grafted skin matched the adjacent skin perfectly (Figure 2D). Although there were still small areas of depigmentation and the skin became slack, the patient was pleased with the results. It should be noted that the patient did not use sunblock after the treatment (Figure 2C), but the resulting darker skin eventually matched the color of the adjacent skin.

Discussion

STSG is versatile in wound covering. However, secondary skin contraction is an inevitable physiological phenomenon, especially when the skin is grafted onto incompletely abraded wound bed. Treatment of the secondary skin contraction often requires further surgical excision and skin grafting (5). The current cases presented an effective non-surgical method of micro-plasma radiofrequency technology to treat the secondary skin contraction. Significant improvement in the secondary contraction was observed by comparing the photographs taken before and after the operation (Figures 1 and 2). Furthermore, this technique can be used to treat hyperpigmented scar simultaneously (Figure 2).

The novel micro-plasma radiofrequency device can cause epidermal fractional ablation and strongly stimulates collagen remodeling in the dermis (3, 4). Thermal collagen denaturation and neocollagenesis result in homogeneous transformation of the upper dermis over 1–3 months, with a dose-dependent effect (4). However, the mechanisms underlying plasma treatment on skin contraction were unclear. In our opinion, it was clear that micro-plasma radiofrequency technology would ablate the thickened scab skin without affecting the pigment.

The impact of micro-plasma radiofrequency treatment on the skin depends on the spatial orientation of the tip. When the tip of the pixel roller contacts the skin, the discharge of radiofrequency energy at the electrode head forms plasma sparks, resulting in micro-thermal zones (4). If the skin has many peaks and valleys or is not homogeneous, the distribution of plasma energy is unequal, with peaks receiving more energy than valleys. Furthermore, it is not dependent on natural biologic chromophore (3,4). Micro-plasma radiofrequency treatment is relatively safe and does not result in hypopigmentation, scar formation, or other complications when used to treat skin contraction. It is a quick procedure that can be performed within 10 min under local anesthesia, and requires minimal recovery time (3).

In conclusion, we present the first reported cases of micro-plasma radiofrequency treatment of secondary skin contraction. This treatment is simple, effective, and clinically useful. Stable and reliable animal models are needed to further investigate the mechanisms underlying this treatment.

Declaration of interest: The authors have no conflict of interest or any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. This clinical study was approved by the Ethical Committee of the Plastic Surgery Hospital, CAMS and PUMC.

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