

The Epidermal and Dermal Changes Associated with Microdermabrasion  
[Original Articles]

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Abstract 

**BACKGROUND:** Microdermabrasion has become a popular method of skin rejuvenation for treating dyschromia, fine wrinkles, and mild scarring.

**OBJECTIVE:** To analyze the onset and extent of the dermatologic changes associated with microdermabrasion.

**METHODS:** Ten volunteers, ages 31–62 years, underwent a series of six aluminum oxide microdermabrasion facial treatments 7–10 days apart. Skin biopsy specimens were obtained prior to the study, after three treatments, and after six treatments.

**RESULTS:** Compared to the controls, the treated areas demonstrated the following histologic changes: thickening of the epidermis and dermis, flattening of the rete pegs, vascular ectasia and perivascular inflammation, and hyalinization of the papillary dermis with newly deposited collagen and elastic fibers.

**CONCLUSION:** This study suggests that microdermabrasion produces clinical improvement by a mechanism resembling a reparative process at the dermal and epidermal levels.

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MICRODERMABRASION HAS become an increasingly popular method for producing facial rejuvenation. It has been used to treat dyschromia, fine wrinkles, acne, and scarring.<sup>1-3</sup> The appeal of microdermabrasion is based on its usefulness in patients of all ages and skin types combined with its effectiveness, simplicity, low risk, and rapid recovery. This technique employs a stream of fine sand particles directed over the skin via a compressed air delivery system. The particles and superficial cellular debris are then aspirated back into a separate container for disposal.

It has been suggested that repetitive intraepidermal injury has the ability to gradually improve photodamaged skin by stimulating fibroblast activity and new collagen deposition in the dermis.<sup>4</sup> However, these observations were made with routine light microscopy and were qualitative in nature. Our study endeavored to quantitatively analyze the onset and extent of these dermatologic changes in order to delineate the mechanism by which microdermabrasion works.

## Materials and Methods



Ten Caucasian volunteers, ages 31–62 years, consented to participate in a study to evaluate the effects of microdermabrasion. The study protocol conformed to the ethical guidelines approved by Reston Hospital's Human Research Review Committee. Photographs were taken and pretreatment 2 mm full-thickness skin biopsy specimens were obtained from the left and right postauricular areas. A microdermabrasion unit utilizing 120  $\mu\text{m}$  aluminum oxide crystals was employed. A series of six facial microdermabrasion treatments were performed at 7- to 10-day intervals on each of the 10 patients. In addition, the left postauricular area was treated and the right postauricular area, for control purposes, was not treated.

The standard protocol for each microdermabrasion treatment included cleaning and degreasing the skin followed by five to seven passes of the handpiece of the microdermabrasion unit set at 50 mmHg vacuum. The average treatment duration lasted approximately 15 minutes with the endpoint being clinical erythema. The eyes of both patients and the operator were protected during the procedure. After each treatment, patients were advised to avoid direct sun exposure for 24 hours and to use moisturizers as usual. Daily activities were not restricted following treatment. Skin care products such as antioxidants, retinols, and topical acids were avoided 6 weeks prior to and during the study period. Punch biopsy specimens were taken 0.5 cm from the original biopsy site 1 week after the third treatment and 1 week after the sixth treatment. Photographs were also taken at these treatment points.

Each biopsy specimen was fixed in a 10% buffered formaldehyde solution, processed routinely, embedded in paraffin, and cut in 4  $\mu\text{m}$  sections. Sections were stained with standard hematoxylin and eosin for light microscopy. One author (E.R.P.) reviewed the microscopic slides in a blinded fashion. Several parameters were evaluated to include epidermal and papillary dermal thickness, rete pegs, stratum corneum, evidence of basal cell hyperplasia, collagen appearance, inflammatory response, and vascular status. The slides were examined with a microscope and precision measurements were performed using a micrometer at 10 $\times$  magnification. The results were plotted according to the timing of the biopsies. A paired t-test was used to identify statistical differences in skin thickness between the treatment periods. Other changes were qualitatively noted.

Additional sections from each specimen were then prepared to identify collagen and elastic fibers. These were stained with Masson-trichrome using Verhoeff's method. One author (E.R.P.) reviewed the microscopic control slides to determine baseline content. The slides from the treated areas were then reviewed according to the treatment protocol to determine changes in collagen and elastic fiber content compared to controls. These changes were expressed qualitatively.

## Results

After three microdermabrasion treatments the epidermal thickness increased from  $45 \pm 4 \mu\text{m}$  to  $62 \pm 10 \mu\text{m}$  ( $P < .01$ ). After six treatments epidermal thickness increased to  $65 \pm 7 \mu\text{m}$  ( $P < .01$ ) ([Figure 1](#)). The rete pegs were flattened with wider spacing in each case after three and six treatments when compared to the controls. The stratum corneum normalized and achieved a healthy “basket weave” appearance in each case after three and six treatments. In 50% of the cases, mitotic figures were seen during the treatment period. This compared to no evidence of mitotic figures in the control areas during the treatment period. In the control areas, there was no evidence of basal cell hyperplasia. All treated areas demonstrated increased basal cell activity.

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Figure 1. Epidermal thickness measured prior to and during microdermabrasion treatment series.

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After three microdermabrasion treatments, the papillary dermal thickness increased from  $81 \pm 8 \mu\text{m}$  to  $108 \pm 11 \mu\text{m}$  ( $P < .01$ ). After six treatments, papillary dermal thickness increased to  $114 \pm 9 \mu\text{m}$  ( $P < .01$ ) ([Figure 2](#)). When compared to controls, the treated area showed hyalinization of the collagen fibers in the papillary dermis. This consisted of thicker, more tightly packed, horizontally oriented collagen bundles. In the control areas the papillary dermis was devoid of elastic fibers, while the elastic fibers in the reticular dermis were horizontally oriented. After three treatments an increase in elastic fibers was noted at the junction of the reticular and papillary dermis. After six treatments there was increased density of elastic fibers in the reticular dermis. The new elastic fibers in the reticular and papillary dermis were more vertically oriented as opposed to the parallel array of elastic fibers seen in normal skin. However, these new elastic fibers maintained normal caliber. When compared to the controls, the blood vessels in the treated areas were mildly ectatic after six treatments, with the presence of a perivascular infiltrate. The level of inflammatory activity increased significantly in the treated area when compared to the controls. The appearance and distribution of fibroblasts changed after microdermabrasion treatment. In the control areas, the fibroblasts were nonconspicuous and evenly distributed within the dermis. In the treated areas the fibroblasts were more conspicuous, larger, and more densely distributed within the dermis. They were especially evident around the dermal capillaries. In [Figure 3](#), the control represents normal tissue. Basal cell hyperplasia, increased fibroblasts, and inflammatory changes are seen after three treatments and six treatments. In [Figure 4](#), special stains for elastic fibers and collagen show increased deposition of these proteins in the dermis.

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Figure 2. Papillary dermal thickness measured prior to and during a microdermabrasion treatment series.

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Figure 3. Histologic changes prior to and during a microdermabrasion treatment series. (Hematoxylin and eosin; original magnification 20 $\times$ .)

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Figure 4. Histologic changes seen prior to and during a microdermabrasion treatment series. (Masson-trichrome stain with Verhoeff's method; original magnification 20×).

Discussion 

Microdermabrasion has been shown to clinically improve sun-damaged skin, fine rhytides, age spots, and some facial scars. This study demonstrated that histologic changes can be appreciated after three treatments. Stimulation of the basal layer, with epidermal thickening, flattening of the rete pegs, and normalization of the stratum corneum are most likely responsible for the initial clinical changes. After six treatments the histologic changes became most evident, with additional epidermal and papillary dermal thickening, increased dermal inflammation, and deposition of new collagen and elastic fibers in the papillary dermis. Fibroblasts, the cellular mediators of the extracellular matrix, became more numerous and conspicuous within the dermis. Finally, changes in the microcirculation may have increased the blood flow in the dermis, supporting the inflammatory process.

The inflammatory response elicited by a series of microdermabrasion treatments resembles a reparative process in the dermis and epidermis. This appears to be the mechanism by which microdermabrasion produces its clinical effects. Additional research is necessary to correlate the histologic and clinical changes and to determine the optimal treatment regimen for skin maintenance.

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