Preliminary Report

Evaluation of Histologic Changes After Microdermabrasion in a Porcine Model

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Background: There is a paucity of scientific information on the histologic changes associated with the clinical response to microdermabrasion.

Objective: In this study we sought to evaluate those changes in the skin after microdermabrasion, using a porcine model.

Methods: Using the left flank of an 8-week-old pig, we tattooed 4 areas with “A,” “B,” “C,” and “D.” Each of these areas was subdivided, in a gridlike fashion, from the dorsal to the ventral surface into 3 × 3-cm squares, which were numbered 1 through 8. Vacuum was initiated at 25 mm Hg the first week and increased by 5 mm Hg for each of 7 weeks to a high of 55 mm Hg in week 7. Biopsy specimens from each grid were obtained weekly. These samples were stained with hematoxylin and eosin and with the Verhoff/Van Geison (elastin) stain. Blinded histologic review of the biopsy specimens was performed by a dermatopathologist. Histometric analyses of the biopsy specimens were performed in which dermal thickness (millimeters), collagen-bundle thickness (microns), and epidermal thickness (microns) were all measured.

Results: Dermal thickness was increased by as much as 40% in the thinner skin and by 27% in the thicker skin. Similarly, the increase in collagen-bundle thickness was 22%, whereas the increase in the epidermal thickness was 9%.

Conclusions: The findings of this preliminary study appear to indicate that microdermabrasion produces real increases in dermal thickness, collagen-bundle thickness, and epidermal thickness. Histologically, the procedure produces changes similar to those seen after dermabrasion, laser resurfacing, and chemical peels. (Aesthetic Surg J 2004;24:136-141)
course of therapy, the patient can undergo periodic additional treatments, depending on the needs determined by the physicians and the patient.

Though typically used for aging skin, the process of microdermabrasion has also been touted to improve scars and even stretch marks, which are frequently found on the abdomen and breasts after childbirth. The procedure may be also useful in the removal of tattoos. There is a paucity of scientific information about the histologic changes associated with the clinical response to microdermabrasion. In this study we sought to evaluate those changes in the skin after microdermabrasion, using a porcine model.

Methods

Using the left flank of an 8-week-old pig, we tattooed 4 parallel rectangular areas with “A,” “B,” “C,” and “D.” Each area was subdivided, dorsally to ventrally, into 3 x 3-cm squares, which were numbered 1 through 8. We then chose control squares, one from each paired square, in a dorsal-anterior to ventral-posterior fashion, to make allowances for differential skin thickness and growth; these control squares were not treated (Figure 1).

The corresponding experimental squares were subjected to microdermabrasion with a Parisian Peel apparatus (Aesthetic Technologies, Scottsdale, AZ). Each treated square was subjected to 3 passes with the microdermabrader (1 horizontal, 1 vertical, and 1 oblique pass). The initial treatment was started with a vacuum of 25 mm Hg the first week, and the vacuum was increased by 5 mm Hg each week to a peak of 55 mm Hg over a 7-week treatment period.

Biopsy specimens from each experimental and control square were obtained weekly. These samples were stained with hematoxylin and eosin stain (H&E) and with the Verhoff/Van Gieson (elastin) stain. Blinded histologic review of the biopsies was performed by a dermatopathologist. Histometric analyses of the biopsy specimens were performed with the use of a digital imaging system (Image Pro Plus System, Media Cybernetics, Carlsbad, CA). We measured dermal thickness (millimeters), collagen-bundle thickness (microns), and epidermal thickness (microns). These parameters were expressed as a percent ratio of growth of the treated square at the conclusion of the study compared with that of the same treated square at the beginning of the study. Similarly, the growth values in the control square were expressed as a percent ratio of growth of the control square at the conclusion of the study compared with that of the same control square at the beginning of the study. Our grid design allowed for differences in thickness in the pig’s skin, where dorsal skin is thicker than ventral skin, as well as growth changes over the course of the experiment.

Treatment of the animals used in this study con-
formed to the standards set forth in the U.S. Public Health Services Policy on Humane Treatment of Laboratory Animals and the Guide for the Care and Use of Laboratory Animals.

Results

Dermal thickness, collagen-bundle thickness, and epidermal thickness were all increased in the treated groups. In the control group, the dermal-thickness growth ratio increased in a range from 29% to 39% in thin and thick skin, respectively, as a result of normal pig growth. In the treated group, the dermal-thickness growth ratio ranged from 69% to 66% in thin and thick skin, respectively. Therefore dermal thickness increased by an average of 40% in thin skin and by an average of 27% in thick skin in the treated group (Figures 2 and 3).

The growth ratio of collagen-bundle thickness ranged from 34% to 46% in the control group, with an average growth of 42%. In the treated group, the growth ratio ranged from 59% to 63%, with an average of 62%. Therefore collagen-bundle thickness increased by an average of 20% in the treated group (Figures 4 and 5).
The growth ratio of epidermal thickness in the control group ranged from 42% to 49%, with an average of 45%. The growth ratio of epidermal thickness in the treated group ranged from 51% to 56%, with an average of 54%. Therefore epidermal thickness increased by an average of 9% in the treated group (Figures 6 and 7).

**Discussion**

Microdermabrasion has gained widespread acceptance in recent years in the treatment of the signs of aging and other surface irregularities caused by sun exposure and scarring. An alternative to other treatment modalities such as dermabrasion, chemical peels, and laser resurfacing, it results in less morbidity and fewer complications. In spite of its widespread use, objective data about the changes that occur in the skin at the cellular level with each successive treatment are scarce. The long-term effects of these changes are also poorly documented.

Porcine skin and human skin are very similar histologically. In this pilot study, involving a domesticated pig, we found that microdermabrasion appears to produce increases in dermal thickness, collagen-bundle thickness, and epidermal thickness. Dermal thickness was increased by 40% in the thinner ventral skin and by 27% in the thicker dorsal skin. Collagen-bundle thickness increased by 22%, and epidermal thickness was increased by 9%.

Histologically, microdermabrasion produces changes...
that are similar to those seen after dermabrasion, laser resurfacing, and chemical peels.1-7 One possible shortcoming of this pilot study, however, is the additional factor of the differential growth of the pig’s body over the time required for the course of 7 treatments: The pig grew from 8 to 88 kg over the course of 8 weeks.

Conclusion

We have developed a growing-pig model for the study of the histologic effects of microdermabrasion. We believe that this methodology is an effective tool with which to quantify changes in skin rejuvenation and scar and stretch-mark improvement associated with microdermabrasion.

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References


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