How To Address Hypertrophic And Keloid Scars

The management of scars has come a long way over the years but still poses a significant problem both to the physician and the patient. This author reviews the clinical presentation of abnormal scars as well as the development of numerous treatments for the management of hypertrophic and keloid scars.

By Andrew Rice, DPM, FACFAS

Understanding the science of how a scar forms has allowed the development of numerous treatments for the management of these scars. (See “A Brief Overview On Scar Formation” on page 46.) Product development with well-controlled clinical studies provides evidence-based outcomes for the physician to be able to make knowledgeable decisions on how best to manage and treat abnormal scar formation.

Most normal scars are flat and become less noticeable with time. However, there are often situations in which the body produces too much fibrous tissue, leading to an extra thick or raised scar. This is an abnormal and overly proliferative response to the remodeling phase of the wound healing cascade that results in the formation of problematic scars. Such scars include two distinct types (hypertrophic scars and keloid scars) that differ both morphologically and histologically.

**Hypertrophic scars.** These are prominent red areas located inside the borders of the original injury. The collagen formation is in a disorganized and skewed arrangement rather than the normal parallel orientation. The hypervascularity gives rise to the erythematous appearance. Hypertrophic scars tend to be quite inelastic in nature and are often associated with pruritus and pain. In some cases, hypertrophic scars may shrink and fade on their own.

**Keloid scars.** These are raised, deep red areas that tend to cover much more area than that of the original injury. Even when one surgically removes keloids, they tend to recur and do not subside over time. People may refer to keloids as “scars that do not know when to stop.” Previous research provides evidence that keloids have a genetic basis with researchers reporting both autosomal dominant and recessive genes, especially in those individuals with multiple lesions.

Biologically, keloids are characterized by a collection of atypical fibroblasts with excessive deposition of extracellular matrix components, especially collagen, fibronectin, elastin and proteoglycans. Oliver and co-workers and Babu and colleagues found that keloid-derived fibroblasts exhibit as much as a fourfold increase in the rate of fibronectin biosynthesis compared to fibroblasts from normal dermal and normal scars.

Researchers also believe this pathologic process is influenced by certain growth factors. Transforming growth factor beta (TGF-β) and platelet-derived growth factors (PDGF) are the key factors in modulating contraction in normal skin fibroblasts. TGF-β is also a possible contributor to keloid formation. TGF-β promotes the chemotaxis of fibroblasts to the site of inflammation in order to induce extracellular matrix proteins. The messaging sequence and activity of TGF-β should then turn off upon completion of tissue repair. If this function does not turn itself off, abnormal fibrosis may result.

Generally, keloids contain relatively acellular centers and thick, abundant collagen bundles that form nodules in the deep dermal portion of the lesion. Research has found that collagen synthesis in these scars is 20 times greater than normal skin and three times greater than hypertrophic scars. In addition, the type I collagen is present at significantly higher levels in comparison to type III collagen.

What The Literature Reveals About Treatment Options For Abnormal Scars

There are numerous treatments for abnormal scarring and these treatments range from simple topical cosmetics to invasive surgery. Evaluation of all these options is difficult due to the limited number of well controlled, evidence-based trials. Within the published trials, there are numerous pathogeneses that can impact the overall results. Let us take a closer look at the current research on these treatment options.

**Silicone gel therapy/silicone gel sheeting.** Silicone products work by the process of occlusion and hydration of the stratum corneum with subsequent cytokine mediated signaling from keratinocytes to dermal fibroblasts. This hydrated and occluded environment decreases the capillary activity, thereby reducing fibroblast-induced collagen deposition and scar hypertrophy.

**Surgery.** There are two approaches when it comes to surgical resection of scars. One may opt for the excision and narrowing of the original scar. Alternatively, the surgeon may perform a Z-plasty and W-plasty to change the
direction of the original scar, particularly near lines of tension. Surgeons generally use the excision and narrowing procedure for widespread scars and this is the preferred method for keloids. In addition to incision scar reduction, radiation may also be necessary for the keloid scar. However, reports still indicate a 55 to 60 percent recurrence rate.

**Corticosteroids.** Intralesional injections have been a mainstay for the reduction of scars for many years. One can use injections alone or in combination with other therapies. The most common agent is triamcinolone acetonide (40 mg/cc) (Kenalog, Bristol-Myers Squibb) mixed in a 50:50 ratio with 1% lidocaine, which requires repeat dosing every two weeks. In order to achieve successful outcomes, it is important to direct the bevel of the needle down and into the upper dermis to facilitate wider dispersion of the drug. If necessary, one may mix this drug blend with hyaluronidase (150 mg) to aid in dispersion.

**Radiotherapy.** Radiotherapy is somewhat controversial due to anecdotal evidence of carcinogenic activity. However, when you obtain full informed consent, this treatment option still has value for very severe keloid scars as long as you ensure adequate protection for surrounding tissue.

**Laser therapy and dermabrasion.** Physicians have used laser therapy and dermabrasion to treat acne scars or to smooth down scars with raised or uneven surfaces. However, these techniques are less popular than they were in the late 1990s because of the increasing awareness of the potential complications and recurrence rates. In regard to laser skin resurfacing, one should advise patients that it takes several months to heal. There is often considerable discomfort as well as swelling and reddish discoloration of the treated skin.

**Cryotherapy.** Cryosurgical media (e.g., liquid nitrogen) affects the microvasculature and causes cell damage via intracellular crystals, leading to tissue anoxia. Generally, one, two or three freeze-thaw cycles lasting 10 to 30 seconds can achieve the desired effect. One may need to repeat treatment every 20 to 30 days. Cryotherapy can cause pain and depigmentation in some patients.

**Hydrotherapy.** Hydrotherapy is not a first-line treatment in the United States for scarring but is widely used in Europe for burn scars (using high pressure). However, there are no evidence-based studies available to support its use.

**Skin cosmetic camouflage.** Camouflage creams can make a significant difference to the appearance of scars by providing effective, long lasting, waterproof cover. However, this is a cosmetic cover and not a treatment modality.

**Compression therapy.** Compression therapy involves pressure, which has long been known to have thinning effects on skin. Reduction in the cohesiveness of collagen fibers in pressure-treated hypertrophic scars has been demonstrated by electron microscopy. It is generally recommended to maintain pressure between 24 to 30 mmHg for six to 12 months in order for the compression to be effective.

**Silicone Gels: Can They Have An Impact?**
Silicone gel is one of the gold standards for scarring and physicians should use it as first-line prophylaxis. Use of silicone treatment should begin soon after surgical closure when the incision has epithelialized...
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A Brief Overview On Scar Formation

A scar is an area of fibrous connective tissue that replaces normal skin (or other tissue) after injury and is the result of the biologic processes responsible for wound repair. These processes are a complex series of events involving three distinct phases including the inflammatory phase, the granulation phase and the matrix remodeling phase.

In the inflammatory phase, exudate from damaged vessels fills the wound, neutrophils trigger an inflammatory cascade and macrophages phagocytose cellular and foreign debris. During the granulation phase, macrophages secrete cytokines that promote granulation tissue formation consisting of re-epithelialization and recreation of blood vessels.

Finally, in the matrix remodeling phase, the fibroblasts proliferate and form new collagen and matrix materials. Scarring is a natural part of the remodeling phase of the wound healing process and skin tissue repair.

The type of scar that forms depends on the person’s age, heredity, sex, nutrition and the severity of the wound. The pathogenesis is still unknown but a combination of cellular, biological, genetic, immunological and endocrinological factors are likely involved.

Statistics suggest that gender is not a predisposing factor but scarring is 4.5 to 16 percent more common in individuals with darker skin. Scarring may occur at any age but generally tends to develop more predominantly in individuals between the ages of 10 and 30.

...and continue for at least two to three months with 24-hour contact whenever possible. The longer that silicone is in contact with the scar, the better the outcomes.

Silicones are synthetic polymers containing a repeating silicone-oxygen backbone and organic groups attached directly to the silicone molecule by silicone carbon bond. Depending on the length of the polymer chain and the degree of cross linking, the silicone can be a liquid, gel or rubber.

As indicated, silicone creates a hydrated, occluded environment that decreases capillary activity, thereby reducing fibroblast-induced collagen deposition. It is believed that the silicone facilitates a correction of the deficiency or overabundance of the growth factors that orchestrate the tissue repair process. The epidermis (keratinocytes) has a well known regulatory role in dermal fibroblast extracellular matrix production.

Using co-cultures of keratinocytes and fibroblasts, researchers have shown that the keratinocytes release cytokines that stimulate fibroblast proliferation and inhibit their synthesis of collagen. Employing an in vitro two-chamber cell culture model to investigate the interaction of the epidermis and dermal fibroblasts, these researchers showed that hydration, rather than the silicone itself, can modulate the effect of keratinocytes on the proliferation of skin fibroblasts. This occurs by affecting the production of soluble factors, mainly the number of lymphocytes that express CD11/CD18 adhesion molecules. This increase in hydration at the scar site (by silicone occlusion) decreases capillary activity as well as inflammatory and mitogenic mediators.

In regard to the possible physical effects of silicone gels, researchers have measured the temperature under silicone gel by detecting infrared radiation with a radiometer. The results show that the temperature of the scar is slightly warmer than its covering layers.

Oxygen tension calculations have also indicated that silicone gel does not restrict the transmission of oxygen. The oxygen transmission is 126 cm³/m² h⁻¹. The only physical effect that researchers...
have recorded is a slight increase in pressure due to the weight of the material itself. While researchers conducted these tests with pressure transducters, the effect is considered negligible in comparison with the 15 to 40 mmHg required by pressure garments.

Finally, silicone gel is impermeable to bacteria or other microorganisms (E. coli, Staphylococcus aureus, Pseudomonas spp, Klebsiella spp, Candida spp, Staphylococcus spp), and does not support the growth of bacteria.

**What You Should Know About Silicone Gel Sheets**

Silicone gel sheeting is a silicone-based dressing that is available in a variety of sizes for use over the scar. This type of gel sheeting has been available on the market for over 20 years and there are many studies supporting the use of these products. The research both in the laboratory and in well controlled clinical studies supports the hypotheses and mechanisms of action described above.

With silicone gel sheets, the material is tacky and therefore provides somewhat of a self-adhesive platform for application over the scar. However, more often than not, the dressing requires tape to hold it securely in place. Patients may wash the gel sheets and reuse them but over time, the tackiness diminishes with wash and wear.

These types of dressings, although efficacious, have fairly numerous limitations, both from a physician perspective and a patient comfort/ease of use standpoint. Specifically, patients cannot easily use gel sheeting over joints or on the intricate contours of the face due to constant mobility of the skin. In addition, the sheets are packaged in preset sizes, making large scar areas difficult to cover.

**A Closer Look At The Emergence Of Other Silicone Products**

Although silicone gel sheeting is widely used, many advances have occurred in developing the next generation of silicone products. These products provide the same efficacy as silicone gel sheeting but also have the added capability to be used on more parts of the body.

Silicone oil in emulsion-based systems (creams/ointments) are now available on the market as well as amorphous silicone gels in a tube or spray presentation.

In regard to silicone oil, clinical studies have shown it is not as effective in hypertrophic and keloid scar reduction when clinicians use it under gauze in comparison to when they cover it with an occlusive dressing. This confirms the need for both silicone and hydration/occlusion. The clinical trials using silicone oil with an occlusive dressing have provided very good results. However, the need for two products, silicone oil cream and the secondary occlusive dressing, weakens the treatment regimen as a replacement for the one-step silicone sheeting.

There are a number of amorphous silicone gels in tubes that are also available on the market. However, only one has been developed that has all the attributes of a silicone gel sheet with the ease of use and wide application both from the physician perspective and a patient acceptance standpoint.

This product, Kelo-cote gel (Advanced Bio-Technologies), is available as a gel in a tube format or a spray format. It forms a quick drying cross-linked occlusive barrier with the skin upon application. Patients apply the product to the skin in a thin layer and it rapidly dries to form a transparent, gas permeable, flexible and water impermeable silicone sheet, which adheres to the skin.

Comparative clinical studies using this product have indicated that this patented, cross-linked, amorphous silicone gel is as efficacious as silicone gel
sheeting in the management of hypertrophic and keloid scarring. BioCorneum (Advanced Bio-Technologies) is a recently developed product based on this patented technology. The product, formerly marketed as Dermatix, is an amorphous quick-drying, cross-linked silicone with the added benefit of sun screen ingredients. It is available in 10-g, 20-g and 50-g tubes to cover a variety of scars. A recent scar is very susceptible to sunburn. If it is exposed to the sun, its pigmentation will be definitive (dyschromy), a situation which can be unaesthetic when the skin has lost its tan. Accordingly, whether the scar is the result of a suture or the spontaneous evolution of a wound, patients must protect the scar from the sun during its whole evolution.

In other words, patients need to ensure protection for the scar as long as it is red or pink, which can take upwards of six months to three years for full maturation. During this time, patients must reapply protective sunscreen every two or three hours when the body is exposed to the sun.

The newly developed BioCorneum + provides the necessary protection from the sun (SPF 30) for those exposed areas while still maintaining the optimal environment for abnormal scar reduction and management. Comparative clinical studies are already ongoing with this new silicone sunscreen to determine the additional outcomes and benefits for patients and their scars.

**References**


Dr. Rice is a Fellow of the American College of Foot and Ankle Surgeons, and is board certified in foot and ankle surgery by the American Board of Podiatric Surgery. He is in private practice at Fairfield County Foot Surgeons in Norwalk, Conn. Dr. Rice is a Clinical Instructor in the Department of Orthopedic Surgery and Rehabilitation at the Yale University School of Medicine.