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## Review Articles

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# Management of scars with the use of silicone gel and sheets

Manejo de cicatrizes com uso de placas e gel de silicone

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## ABSTRACT

Scar formation is the natural healing response of the skin to reestablish dermal integrity after an injury. Besides being unsightly, the scars can also be hypertrophic or keloids, which makes treatment challenging and many times unsatisfactory. Ethnicity and site of the lesion have an important role in the formation of scar types, but it is not always possible to predict the final result. The use of topical silicone has been an option for scar management and the target of many publications over the years. It is believed that its early use can prevent the development of abnormal scars and treat existing scars.

**Keywords:** Scars, prevention & control; Silicone gels; Treatment

## RESUMO

A formação de cicatriz é a resposta de cura natural da pele para restabelecer a integridade dérmica após uma lesão. As cicatrizes, além de inestéticas, podem ainda apresentar-se hipertróficas ou queloidianas, tornando o tratamento difícil e, por vezes, insatisfatório. A etnia e a localização da ferida desempenham um papel importante na gênese dos tipos de cicatriz, mas nem sempre podemos prever o resultado final. O uso do silicone tópico tem sido uma opção para o manejo da cicatriz e alvo de diversas publicações ao longo dos anos. Acredita-se que o uso precoce possa prevenir o desenvolvimento de cicatrizes anormais e tratar cicatrizes existentes.

**Palavras-Chave:** Cicatrizes, prevenção e controle; Géis de silicone; Tratamento

## INTRODUCTION

In addition to being unsightly, most scars can lead to severe psychosocial distress, especially when they become hypertrophic or develop into keloids resulting from trauma, burns, and infections.

Even scars considered of excellent quality by physicians can be extremely overvalued by some patients who, unfortunately, do not have the correct understanding of the healing process, thus being vulnerable to psychological discomfort and distress.<sup>1</sup> The dissatisfaction becomes even greater if the scar originates from a surgical procedure carried out for cosmetic purposes. A recent survey indicated that 91% of patients who underwent a routine surgical procedure would appreciate any improvement in their scars.<sup>2</sup>

Several invasive and non-invasive options can be used for the prevention and treatment of these scars. One of them is the use of silicone in topical sheets or gel. The use of silicone aimed at preventing and treat hypertrophic scars saw its onset in the 1980s for the treatment of burn scars, and has become increasingly studied.<sup>3</sup> The application of silicon sheets is one of

the most common methods, and their efficacy has been proven in several clinical studies.<sup>4</sup> However, they may be more difficult to camouflage or adapt. Silicone gel, which has been introduced more recently, has gained popularity for being of straightforward application on all types of wound surfaces and easy to camouflage.<sup>5</sup>

To better understand how silicone based products can act on scars; the present study offers a brief summary of the healing process and its phases.

### Wound healing

Wound healing consists of a seamless, coordinated cascade of cellular and molecular events that interact to allow the reconstitution of injured cutaneous tissue. It can be divided into three phases: inflammation, proliferation and contraction and maturation, which take several months to complete.<sup>6</sup>

The first stage of healing (inflammatory phase) initially involves local hemostasis, in which the platelet aggregation process occurs, with fibrin deposition on the lesion and release of granules by platelets, which contain beta transforming growth factor (TGF- $\beta$ ) in addition to platelet-derived growth factor (PDGF), fibroblast derived growth factor (FGF), epidermal growth factor (EGF), prostaglandins and thromboxanes that attract neutrophils to the wound.<sup>7-8</sup>

Subsequently, more inflammatory cells reach the lesion's site, macrophages phagocytose dead tissue and debris; lymphocytes secrete cytokines; and fibroblasts produce collagen starting restoration and re-epithelialization of the skin. This first stage lasts between 48 and 72 hours.<sup>8</sup>

The second stage (proliferation phase) comprises four basic moments: epithelialization, angiogenesis, formation of granulation tissue, and deposition of collagen.

This phase begins around the fourth day after the injury has been inflicted and extends approximately up until the end of the second week. After the fibrin clot formed during hemostasis has been replaced with a new granulation tissue, the new tissue that will form the final healing starts to be produced. Angiogenesis is stimulated by tumor necrosis factor alpha (TNF- $\alpha$ ) and is characterized by the migration of endothelial cells and the formation of capillaries, critical for a proper healing and that lend a purplish coloration to the newly formed scar. The final part of the proliferative stage is the formation of granulation tissue. Fibroblasts and endothelial cells are this phase's most important cells. Dermal fibroblasts adjacent to the wound are activated and referred to as myofibroblasts. The most important growth factor for the proliferation and activation of fibroblasts is PDGF.<sup>7-8</sup> Beta transforming growth factor (TGF- $\beta$ ) is then released, stimulating fibroblasts to produce type I collagen and to become myofibroblasts, which promote wound contraction.<sup>8</sup>

These cells migrate to the granulation tissue where they produce the new collagen, causing the contraction of the dermis, whose remodeling replaces the granulation tissue with a mature collagen matrix to strengthen the repaired tissue's site. This process of remodeling involves the formation and maturation of cicatricial tissue, and may take weeks to months to complete.

Type III collagen produced at the beginning is replaced by type I collagen, thus increasing the scar's resistance. It is this balance between the formation and destruction of collagen that will provide the scar's final outcome, defining the quality (good or poor) of the scar.<sup>7-8</sup>

### Scar development

Although healing variations occur among different individuals, healing in surgical wounds generally tends to develop rapidly and with good aesthetical appearance when the final scar is aligned with the skin's tension lines. However, traumas and burns, as well as some surgical cases more commonly can develop into keloids and hypertrophic scars. In susceptible people, keloids can also emerge after minor injuries, including piercing, acne lesions and injections.

Processes that influence healing may be local, physical, general and systemic: such as age, body site, skin type / ethnicity, hormonal changes (e.g. pregnancy), linked to the existence of associated diseases (e.g. diabetes), smoking habits and alcoholism, vitamins, drugs, and nutritional status. High risk populations, such as Asians, Afro-descendants and patients with a history of keloid formation, are more likely to develop scars, especially in high-risk anatomical areas such as the lower third of the face, pre-sternal region, chest area, upper dorsum, ears, neck and deltoid region.<sup>9</sup>

A scientific paper by Bond *et al.* was published in 2008 comparing patients with less than 30 years of age and over 55 years of age, having observed a better healing in older people.<sup>10</sup>

Strategies to minimize the risk of scarring are indicated before, during, and immediately after surgery. In addition to the ideal surgical management, which includes a good technique, ideal positioning of the incision line and good coaptation of the wound's borders in the suture, crucial measures must be taken (i.e. minimizing the risk of hematoma and infection, reducing the tension of the borders of the wound in the post-operative and maintaining the use of appropriate dressings).

The hydration, protection of the initial scar tissue from ultraviolet (UV) radiation, immobilization of the wound, and the use of silicone in gel or sheets have been considered as prophylactic in the control of undesired scars.<sup>1</sup>

The wound closes in the first 48 hours after infliction of the injury, and normal scars lessen in around three months, however the full process is only complete in six months. The epidermis takes about one to two weeks to regenerate following a full-thickness wound. During this time, therapeutic prevention against scarring will have little effect because elevated collagen levels are important for thorough wound healing.<sup>11</sup>

After this period, the new, immature stratum corneum allows abnormally high levels of transepidermal water loss. This dehydration of the stratum corneum stimulates the production of cytokines, which signals the fibroblasts to synthesize and release higher levels of collagen, which can increase the volume of the scar.<sup>12</sup>

Therefore, it is important to regularly monitor the patients to indicate – if necessary – the preventive use of dressings

with silicone. Currently, there is a great aesthetic concern with the appearance of any scar, which may lead the patient to question about the use of preventive measures.<sup>13</sup>

Studies show that scars tend to have a better development under hydration and use of silicone gel already at this stage of the process, which promotes relief for the patient who often complains of sensation of irritation and itching during the healing process. The application of silicone gel immediately after the removal of the suture replicates the occlusion properties of the stratum corneum, normalizing hydration at the scar's site and decreasing the signal sent to fibroblasts to produce excess collagen cells.<sup>14</sup>

### Use of dressings with silicone

Silicone based products in both plaques and tapes, and gel are considered by many authors as the first line in the management of scars and would act both prophylactically (to ensure a better aesthetic result) and as a therapeutic option against hypertrophic or keloid scars.<sup>15</sup>

As early as in 1983, the silicone tape or sheet was considered an effective treatment for the management of burn scars.<sup>3</sup> They must be used on the scar for 12-24 hours a day for three to six months. The sheets can be reused, however need to be washed daily with neutral soap and water to avoid side effects such as skin irritations or infections. It is important to maintain full coaptation with the scar, which may be more difficult in flexor areas.

Silicon gels have been made available more recently and contain long chain silicone polymers, silicon dioxide and volatile components. They have self-drying technology that is activated in four to five minutes.<sup>16</sup> They should be applied as a thin layer on the scar, twice a day, forming a transparent film that is flexible and impermeable to water. They should not be used on open wounds.

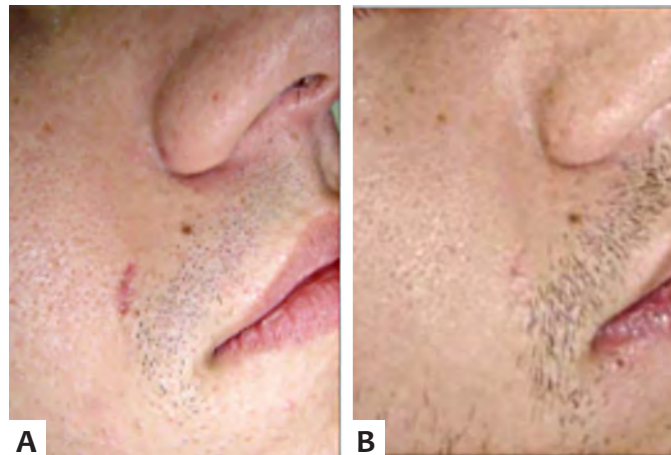
Treatment should be maintained for as long as there is aesthetic improvement of the scar. In general, a minimum of three months of use is required.<sup>16-17</sup>

Both the plaque and the gel can be indicated early on for high-risk patients, after the suture stitches have been removed. Studies show that a reduction of up to 86% of the texture, 84% of the color and 68% of the elevation of the scars can be achieved.<sup>18-19</sup>

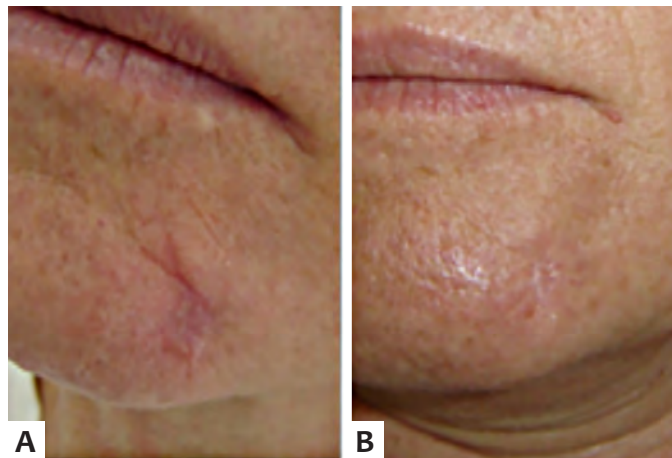
Figures 1 to 5 show excellent esthetic outcomes in surgical scars after the use of silicone gel for a minimum period of three months.

Comparative studies with silicone gels and plaques show equivalence in the treatment and prevention of scars, nevertheless gel products are more straightforward to use.<sup>20-21</sup>

In addition, gels can be applied to scars with irregular surface, of any size and in moving anatomical regions (like joints). They also do not cause aesthetic compromise as they are transparent and do not need fixation (curative).<sup>22</sup> They can be used in children as well as areas with sensitive skin, such as the eyelid region.<sup>17</sup> Also, they provide local cooling sensation, which may relieve the itching sensation typical of the first postoperative month.<sup>22</sup>



**FIGURE 1:** A - Scar resulting from the removal of a nevus in the nasolabial sulcus. B - Four months after, using silicone gel twice daily



**FIGURE 2:** A - Recent scar (basal cell carcinoma excision). B - After five months using silicone gel

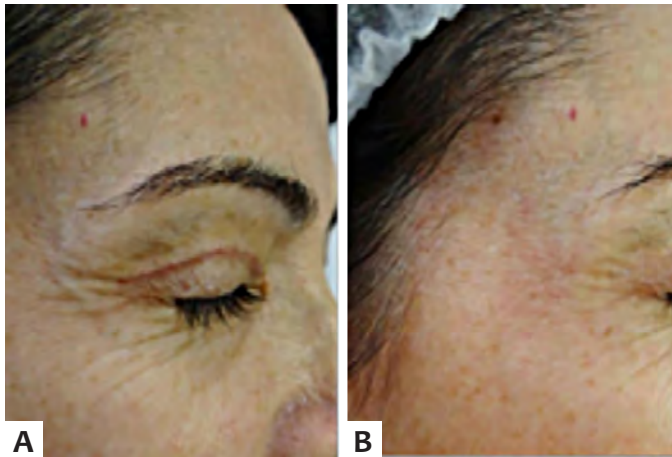
Silicone gel can also be used following cauterizations, ablative or non-ablative lasers, intense pulsed light, chemical peels (superficial, medium or deep), as well as after dermabrasion and aesthetic and oncological surgeries.

The gel version usually causes fewer side effects than sheets. On the other hand, gels need to be applied more than once a day and do not offer compression or occlusion. Local irritation, skin fissure and pruritus might occur, however these are rare events.<sup>23</sup>

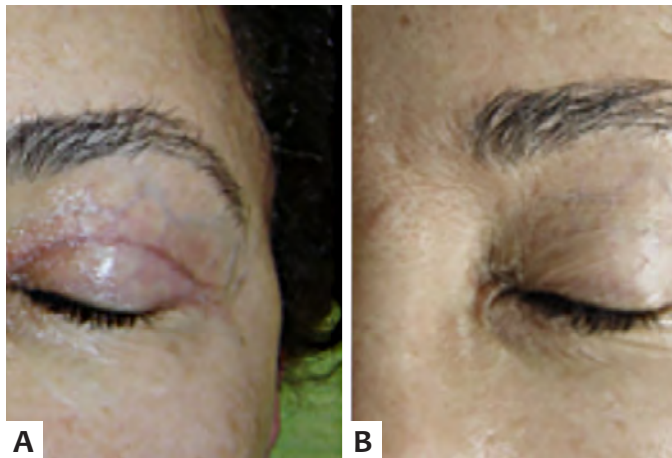
A randomized, double blind clinical trial was carried out involving 50 Asian patients with surgical scars. Silicone gel and a placebo gel were used each on one of the sides of the scar for three months. Silicone gel was associated with a significant reduction in cicatricial pigmentation, vascularity, flexibility, elevation, pain and pruritus scores when compared to the placebo.<sup>24</sup>

### Possible mechanisms of action of silicone

The literature shows that silicone sheets and gels are ef-



**FIGURE 3:** A - 14<sup>th</sup> postoperative day, upper blepharoplasty. B - After four months using silicone gel

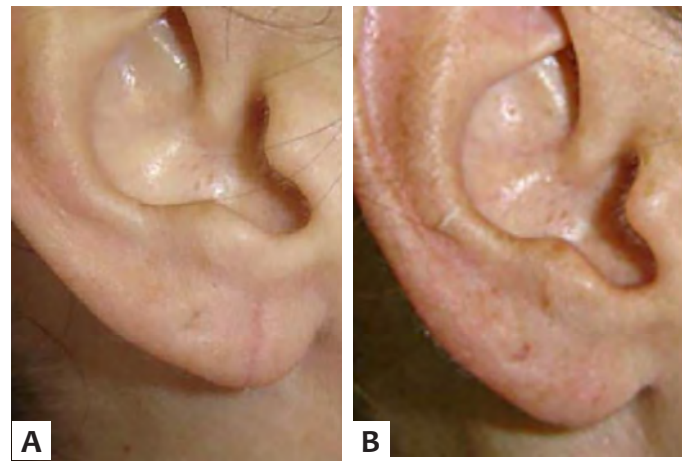


**FIGURE 4:** A - 10<sup>th</sup> postoperative day, upper blepharoplasty. B - After three months using silicone gel

fective in the treatment and prevention of hypertrophic and keloid scars.<sup>25-27</sup>

There is evidence pointing to action on the stratum corneum, reducing transepidermal water loss and raising skin surface temperature, which may increase collagenase activity.<sup>28</sup> In addition, a negative static electric field between the silicone product and the skin could cause the realignment of collagen, resulting in shrinkage of the scars.<sup>13</sup> However, occlusion and hydration of the stratum corneum are currently the most accepted as the main mechanisms responsible for the action of silicone. Hypertrophic and keloid scars are associated with abnormal levels of growth factors and this may be directly related to scar dehydration, which might take in excess of one year to return to normal levels.<sup>13, 29</sup>

Transepidermal water loss in scars dehydrates keratinocytes, releasing cytokines that activate dermal fibroblasts to increase collagen levels, which increases the scar.



**FIGURE 5:** A - 15<sup>th</sup> postoperative day, ear lobe correction. B - After three months using silicone gel

The use of silicone improves the hydration of the stratum corneum due to the fact that it reduces the loss of water; with this, a reduction in the stimulation of the fibroblasts occurs, which in turn controls the production of cytokines that regulate the production of collagen.<sup>30</sup>

Transforming growth factor beta (TGF- $\beta$ ) promotes the proliferation of fibroblasts in the site of the operative wound and stimulates the production of collagen and elastin, while inhibiting the degradation of the extracellular matrix.<sup>31,32</sup> On turn, FGF- $\beta$  normalizes the synthesis of collagen in an abnormal scar and increases the level of collagenases that degrade excess collagen. Platelet derived growth factor (PDGF), an important factor in the proliferation and activation of fibroblasts, was found to be increased in the 3 to 12 postoperative months in comparative studies of hypertrophic scars and normal scars. Recent scars treated with silicone gel film showed significantly less PDGF than untreated scars.<sup>35</sup>

According studies, the use of topical silicone improves wound hydration, leading to a decrease in the hyperactivity of the cells related to the healing process, being capable of modulating the expression of TGF- $\beta$ , PDGF and FGF- $\beta$ . There is a reduction in the expression of TGF- $\beta$ 1 and PDGF when compared to untreated scars, while there is an increase in FGF- $\beta$  expression in the dermis of treated lesions.<sup>36-38</sup>

## CONCLUSION

Unsightly scars are associated with psychosocial distress and lower levels of quality of life. Although results of systematic literature reviews point to the existence of bias in some studies, topical silicone is still the first line treatment both in the prevention of unsightly scars and, in special, in the treatment of keloid and scars, with improvement in the texture, color and elevation of the lesions. Statistically, there appear to be no significant differences between effectiveness of silicone plaques and gels; nevertheless some patients report more comfort and improvement of pruritus with gel. ●

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Subject discussion, literature data analysis, drafting of the manuscript.