

Surgical scar revision using silicone gel sheet as an adjunct

ABSTRACT

Introduction: Scar is often referred to as an unattractive mark after healing of a wound. An undesirable scar may have negative social, emotional, and functional impact on the patient. It is our job as surgeons to adequately understand the expectations of the patient and counsel them for a successful procedure.

Materials and Methods: Twelve patients were randomly chosen for the study, of which five were males and seven were females. The scar tissue was removed surgically, and silicone gel sheets (SGSs) were applied on the 14th postoperative day, and the dimensions of the new scar was measured periodically up to 12 months.

Results: The study comprised of 12 patients- 5 males and 7 females. The descriptive statistics were calculated as median and interquartile range and comparison between time intervals was done using Wilcoxon signed rank test. Out of the 12 patients, 10 showing complete resolution of the scar and 2 patients had partial relapse of scar. However, they were satisfied with the final outcome.

Conclusion: Our study found that SGSs applied to surgically revised scars significantly improves their appearance. The ease of use of the SGSs also makes it patient friendly. We observed almost complete resolution of the scar in ten patients and two patients exhibited partial relapse of the scar. However, there was a significant improvement in the overall appearance of the scar, and the patients were satisfied with the results of the procedure.

Keywords: Cosmetic surgery, incisions, revision techniques, scars, silicone gel sheets

INTRODUCTION

Lay people often refer to a scar as an unattractive mark after healing of a wound. On the flip side, surgeons consider scars as an obvious outcome of violation of the dermis. A desirable scar may be camouflaged and invisible to a layman; likewise, an undesirable scar may have a negative social, emotional, and functional impact on the patient.^[1] It is our job as surgeons to adequately understand the expectations of the patient and counsel them accordingly before making a decision to perform surgical revision of a scar. It is also imperative that the patient understands that scar revision is not a process to eliminate the scar but to merely camouflage the same. The surgical technique has to be planned based on location, extent of injury, soft tissues surrounding the scar, degree of distortion, and orientation of the scar with respect to normal anatomical landmarks.^[2]


The repair cascade consists of inflammatory, proliferative, and remodeling phases. These phases overlap and are responsible for healing of defects on the dermis. During the inflammatory phase at the site of injury, violated blood vessels constrict immediately. Platelet aggregation occurs and forms the hemostatic plug. During the proliferation phase,

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fibroblasts lay out extracellular matrix at the wound site. Macrophages, adjacent extracellular matrix, and mast cells accelerate the activation of fibroblasts. In remodeling phase, the extracellular matrix supports the cells in both wounded and unwounded states. Scar formation is the final outcome of wound healing. Collagen deposition can start as early as 3 days after injury and densely packed collagen fibers start to fill the defect. The final pattern in the scar is of these densely packed fibers as opposed to the reticular fibers in unwounded margins.^[3]

When the healing is abnormal, it leads to excessive scar formation. The margins of such scars may extend beyond the margins of the original wound. Keloid and hypertrophic scars are characterized by excessive accumulation of collagen within the wound. Such scars are painful, pruritic, or cause loss of function and may even have severe psychosocial impact on the patient.^[4]

Silicone gel sheets (SGSs) have been used for scar camouflage since the 1980s. The first reported use for SGS was for burn scars in 1981 in Adelaide at a Children's Hospital. SGSs contain long chain silicone polymer (polysiloxanes), silicone dioxide, and volatile component. It spreads as an ultrathin component and works 24 h a day.^[5] The aim of our study was to test the efficacy of SGSs on surgically revised scars.

MATERIALS AND METHODS

The study was undertaken in Himachal Institute of Dental Sciences, Paonta Sahib. Twelve patients were taken for the study. Patients in the age range of 15–45 years suffering from facial scars, hypertrophic, hyperpigmented, or suboptimal scars were included in the study. Pediatric and geriatric patients, patients suffering from systemic conditions such as hypertension, diabetes, and other immunocompromised conditions and patients undergoing chemotherapy or radiotherapy were excluded from the study. An approval was obtained from the ethical committee of the institute for the study (Reference number: HIDS/PS/307).

All the patients were prepared for surgery after obtaining consent and a detailed medical history to rule out any medical conditions which might affect healing postoperatively. The surgical incision was planned based on the location and extent of the scars. Closure was done in layers using uncolored vicryl sutures (Ethicon 4-0, 5-0; Ethicon Inc., Johnson & Johnson Pvt., Ltd.,) for the internal layers and skin closure was done using Prolene 6-0 sutures. The sutures were removed 7th day postoperatively and SGSs (Eucare Lysil SGSs 10 cm × 10 cm; Eucare Pharmaceuticals Pvt., Ltd.,) were applied on the 14th postoperative day.

Surgical technique

Case 1

After a thorough patient preparation, the scar was marked before administration of local anesthesia (lignocaine 2% with 1:200,000 epinephrine). The incision design planned was a Z-plasty incision based on the location, extent, and dimensions of the scar and the surrounding tissues.

After placing the initial incision, the depth of the incision was determined to include the entire scarred tissue. Once the tissue was removed, the surrounding healthy tissues were undermined for appropriate closure.

Closure was done in 2–3 layers with minimal tension. The internal layers were closed with resorbable sutures; we used 4-0 and 5-0 Vicryl for the internal layers. Once the deeper layers had been approximated, the superficial closure was achieved using Prolene sutures; we used 6-0 Prolene sutures in our patients. The SGSs were applied on the 14th postoperative day, and instructions were given explaining the usage of SGS. The patient was advised to follow-up monthly for a period of 12 months [Figure 1].

Case 2

After thorough patient preparation, the incision design was marked before administration of local anesthesia (lignocaine 2% with 1:200,000 epinephrine). There were two isolated scars on the forehead, of which the inferior one was nearly horizontal, and the superior was nearly vertical. Two isolated elliptical incisions were planned for each scar keeping in



Figure 1: Surgical scar revision using Z-plasty (Case 1); (a) preoperative view; (b) Z-plasty incision; (c) after internal layer closure; (d) skin closure with prolene sutures; (e) 12th postoperative month; (f) silicone gel sheet (10 × 10)

mind that we aimed for the final closure line to be horizontal so that it is parallel to the resting state tension lines. The incision was deep enough to excise the scar entirely from its depth. After scar tissue removal, further dissection was done and the primary closure was done in layers using 4-0 and 5-0 Vicryl for the internal layers. The skin closure was done using 6-0 Prolene sutures [Figure 2]. The sutures were removed on the 7th postoperative day, and SGS was applied on the 14th postoperative day. At the 12th month follow-up, we observed a fine scar line visible, but the appearance of the scar had significantly improved and the patient was also satisfied with the end result.

We based the scoring on Vancouver Scar Scale (VSS) which was first described by Sullivan *et al.*, in an article “Rating the Burn Scar”^[6] and covered the parameters of pigmentation, height, vascularity, and pliability. In our study, we used the amended index of VSS by Baryza and Baryza where the parameters of height and pigmentation were modified^[7] [Table 1].

There have been other scar assessment scales reported in the literature.^[8-10] However, the amended VSS covered most of the parameters of our study, and thus we chose the same tool for assessment in our study along with additional parameters of scar length and width.

RESULTS

Our study consisted of 12 patients; five male (41.7%) and seven (58.3%) female participants. The descriptive statistics were calculated as median and interquartile range and comparison between various time intervals was done using Wilcoxon signed rank test. The level of significance

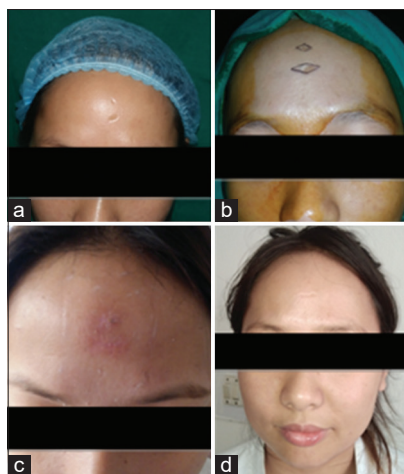


Figure 2: Surgical scar revision using elliptical incision (Case 2); (a) preoperative view; (b) outline of planned incision; (c) 1st postoperative month; (d) 12th month follow-up

Table 1: Amended Vancouver Scar Scale

Amended VSS/ burn scar index	Feature
Pigmentation (M)	
0	Normal - color that closely resembles colour over rest of one's body
1	Hypopigmentation
2	Mixed pigmentation
3	Hyperpigmentation
Vascularity (V)	
0	Normal - color that closely resembles colour over the rest of one's body
1	Pink
2	Red
3	Purple
Pliability (P)	
0	Normal
1	Supple - flexible with minimal resistance
2	Yielding - giving way to pressure
3	Firm - inflexible, not easily moved, resistant to manual pressure
4	Banding - rope-like tissue that blanches with the extension of the scar
5	Contracture - permanent shortening of scar, producing deformity or distortion
Height	
0	Normal- flat
1	>0 up to 1 mm
2	>1 mm up to 2 mm
3	>2 mm up to 4 mm
4	>4 mm

VSS: Vancouver Scar Scale

Table 2: Comparison of dimensions of scar preoperatively and 14th postoperative day (T1- T2), between 14th postoperative day and 12th postoperative month (T2- T3) and preoperative-12th postoperative month

Parameters	T1- T2	T2- T3	T1- T3
Height			
Interquartile range	0.00- 2.75	0.00	0.00
P	0.026	0.317	0.024
Length			
Interquartile range	5.25- 9.50	6.00- 13.50	6.00- 13.25
P	0.004	0.020	0.292
Width			
Interquartile range	1.00- 9.00	0.00- 7.25	0.00- 4.00
P	0.021	0.496	0.028
Vascularity			
Interquartile range	0.00	0.00	0.00
P	0.564	0.317	0.157
Pigmentation			
Interquartile range	2.00- 3.00	0.00	0.00- 0.75
P	0.004	0.461	0.006
Pliability			
Interquartile range	0.00- 2.50	0.00	0.00- 0.75
P	0.024	0.317	0.038

in the present study was fixed at a value of <0.05 . The dimensions of the scars were measured at three main intervals; preoperatively, 14th postoperative day, and the 12th postoperative month. Comparison was done between these intervals [Table 2].

The parameters evaluated in our study were the dimensions of the scar – the height, length, and width of the scar along with vascularity, pliability, and pigmentation of the scar preoperatively (T1), the 14th postoperative day when SGSs were applied (T2), and 12th month postsurgery (T3) when the scar had matured. The changes in height were seen significantly different when compared preoperatively and postoperatively on the 14th day (T1–T2; $P = 0.026$) and; preoperatively and 12th month postoperatively (T1–T3; $P = 0.024$). The width of the scar showed similar results between preoperative and 14th postoperateday dimensions (T1–T2; $P = 0.021$) and preoperative and 12th postoperative month (T1–T3; $P = 0.028$). There was no significant difference in either parameters when compared postoperatively on the 14th day and 12th postoperative month (T2–T3) which showed that no observable changes were seen between the application of the SGS on the 14th postoperative day and the maturation of the scar. That may be because we could not observe any hypertrophy or scar widening postoperatively to report with the exception to two patients. Conversely, the length of the scar showed significant changes when compared preoperatively and postoperatively on 14th day (T1–T2; $P = 0.004$) and between 14th postoperative day and 12th postoperative month (T2–T3; $P = 0.020$). The difference in length was elongation which could be attributed to the fact that most scar revision techniques we used, focused on increasing the length of the scar and orienting them to RSTLs. Some of the patients showed similar scar lengths even after the application of SGS which was concurrent to literature.^[11]

When the pliability and pigmentation were evaluated, significant changes were seen with the pliability of the scars on the 14th day (T1–T2; $P = 0.024$) and 12th postoperative month (T1–T3; $P = 0.038$) when compared preoperatively. The scar pigmentation showed similar and significant changes postoperatively on the 14th day (T1–T2; $P = 0.004$) and 12th month postoperatively (T1–T3; $P = 0.006$) when compared with preoperative values which were in contradiction to the findings of Phillips *et al.*^[11] In their study, one group of patients received hydrocolloid dressings and another group received Vaseline dressings and observed no changes in vascularity, pliability, and pigmentation of the scar. This could be because their study did not include surgical revision of

scars. Our findings, however, were in agreement with the findings of Fulton who observed the effects of SGSs on twenty patients with evolving scars. The authors found a significant improvement in the appearance of the scar in 85% of the patients, which was similar to our findings where 10 out of 12 patients (83%) showed almost complete resolution.^[12]

DISCUSSION

SGSs were first used in 1981, for the treatment of hypertrophic scarring for burn patients at an Australian Paediatric Hospital.^[13] Current SGSs are designed such that they can be worn for 24 h, washed, and then reused; although this method can be inconvenient for patients with skin irritations. Newer formulations which are meant for single use are hygienic and more cost effective. The logical mechanism of action of SGS against scars is its ability to counteract the phylogenetic process of skin healing. It has been hypothesized that wound healing is optimized for speed than the quality of healing to prevent infection.^[14] Bleasdale *et al.* mentioned that one of the proposed mechanisms of action is the ability of SGSs to occlude water. Stratum corneum when dehydrated indicates the keratinocytes in the epidermal layers to produce cytokines, which in turn indicate the fibroblasts to produce excessive amounts of collagen. The authors believe that the SGSs aid in the impaction of water levels in the immature stratum corneum, thus preventing the undesirable effects of hypertrophic scars.^[15] This has been further confirmed in the study by Chang *et al.*, who did an *in vitro* study to show the effects of silicone and hydration.^[16]

Other proposed theories of mechanisms of action of SGS are-

- The SGS transfers tension from the lateral wound edges toward the gel sheets; this provides the ideal environment for normal healing and reduces the rate of abnormal scar formation
- SGS is thought to inhibit the body's natural reaction to increase skin capillaries through hyperemia. This in turn reduces the blood flow to the injured tissues, thus reducing the exaggeration of the healing process; along with its appearance and properties
- SGS is thought to generate negatively charged static electric field because of friction between SGS and skin. These negative ions are thought to align the collagen favorably, resulting in the reduction of hypertrophic scars.^[13]

Apart from the abovementioned properties, silicones possess many skin friendly properties – biocompatibility, atraumatic removal, extended wear time, repositionability, resistant to bacterial growth, and hydrophobicity.^[17,18]

That being mentioned, there have been studies that have shown an improvement in the appearance of the scar with plastic film and Vaseline dressing.^[18] Clinical studies using rabbits have found that occlusive dressings were less effective than SGS.^[19] This could be because, SGS retains lesser water within the dressing when compared to other plastic occlusive dressing, thus proving that the semi-occlusive nature of SGS aids in scar improvement by retaining an appropriate amount of water and not excessive water.^[20] This causes a decrease in trans-epidermal water loss and normalizes the hydration state of keratinocytes, which signal dermal fibroblasts to downregulate extracellular matrix production. This suggested mechanism seems consistent with older and newer literature that supports the ability of SGS to improve the appearance of a scar.^[21]

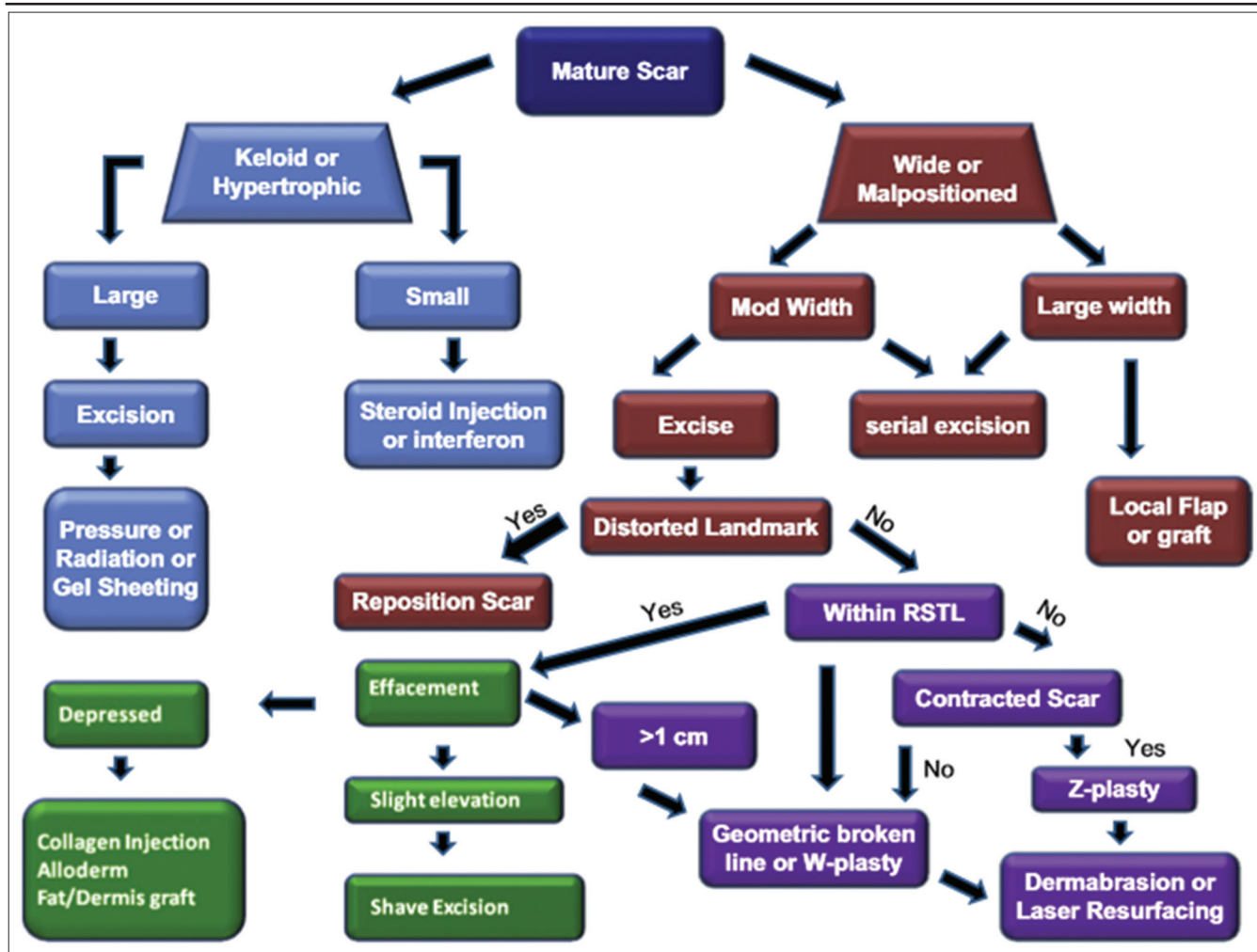
In ten out of 12 patients (83%), we observed almost complete resolution of the scar, and even in the 2 cases where there was the incomplete resolution of the scar, the scar appearance showed significant improvements in dimensions and

appearance. All patients were satisfied with the final outcome of the treatment.

The repair and revision of a scar is a complex process. There is a multitude of variables to be considered – the time when the patient received the injury and repair, the technique, and technology to be used and the individual healing process, which may affect the final appearance of the scar.^[22] As surgeons, we can follow some protocols and algorithms to ensure that the scar has a predictable outcome. Gold *et al.* and Brenner and Perro proposed an algorithm to be used for various kinds of scars to have the best possible outcomes^[23-25] [Table 3].

The limitations of our study included its small sample size and lack of patient awareness about cosmetic treatments. Consequently, due to the small sample size, we were unable to have a control group where we may compare the effects of surgical scar revision with SGS versus surgical scar revision only.

Table 3: Algorithm for scar revision^[24]



Another limitation was the scar scale we chose for the study. VSS is essentially a burn scar index, and literature supports the fact that, while the scar scale has value, it lacks validity and fulfillment of clinico-metric requirements.^[25] We faced similar challenges when it came to assessing the dimensions of the scar as our scale did not include the length and width of the scar; we added the parameters additionally to thoroughly assess the changes in the scar dimensions. Despite the limitations, we observed a significant difference in the appearance of the scar preoperatively and postoperatively up to a year, which reinforced the fact that surgical scar revision and using SGS as an adjunct is an effective way of camouflaging a facial scar. However, further research with a larger sample size is required for the same.

CONCLUSION

Scar revision is a complex procedure both technically and emotionally, for both the patient and the surgeon. A surgeon has to understand what the patient's expectations are out of the procedure and adequately counsel them so that they do not set unrealistic expectations from the surgical procedure.

We employed surgical scar revision techniques on facial scars and applied SGSs after 2 weeks to assess the efficacy of SGS on the appearance of the scar on maturation. Our study finds that facial scars can be successfully revised using surgical scar revision methods and using SGS as an adjunctive treatment until the scar matures, as it improves the appearance of the scar. Most authors believe that the capacity of SGSs to retain the ideal amount of hydration within the stratum corneum may be responsible for this effect which results in softer and flatter scars. Our study also had similar findings; however, further studies with a larger sample and a control group need to be done to adequately assess the efficacy of SGS on surgical scar revision.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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