



A Comparative Study Evaluating the Clinical Efficacy of Skin Tapes versus Silicone Gel for the Treatment of Posttrauma Scar in the Rabbit Model

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Background: Skin tape and silicone gel are two common over-the-counter preparations used to enhance the cosmesis of keloids and hypertrophic scars of posttrauma wounds. This animal study was performed to determine the clinical efficacy of skin tape versus silicone gel in subjects with scars. **Materials and Methods:** Three New Zealand rabbits that received total 12 incision wounds which two incision wounds on one ear side and subsequent primary suturing were studied. Stitches were removed after 1 week. Silicone gel was applied right upper side of the rabbit's ear directly on surgical incision wounds, and skin tapes were also applied left upper side of the rabbit's ear directly on another surgical incision wounds after 1 week of surgery. The lower incisions in both ears were covered with sterilized gauze and served as controls. We compared two experimental groups at binaural with using Vancouver Scar Scale, Manchester Scar Scale, and The Stony Brook Scar Evaluation Scale. These are widely used in clinical practice and research to document change in scar appearance. **Results:** We describe a rabbit model for incisional wounds and scarring outcome measures. The results of scar measuring devices demonstrated that skin tape reduced scar formation as well as silicone gel. **Conclusions:** The results of cosmetic demonstrated that skin tape reduced scar formation as well as silicone gel. However, the economical and effective materials were the important subject that suffices for clinical requirement. The application of these scar prevention devices to reduce scar formation after surgical incision is worthy of future investigation. Moreover, skin tape may represent a low-cost alternative and low scar formation for closure of surgical incisions.

Key words: Skin tape, silicone gel, scar formation

INTRODUCTION

Scars are represented an abnormal and exaggerated healing response after skin injury. In addition to aesthetic concerns, scars may cause pain, pruritus, contractures, and other functional impairments.¹ Therapeutic modalities for the management of scars include topical medications, intralesional corticosteroids, laser therapy, and cryosurgery. Topical therapies, in particular, have become increasingly popular due to their ease of use, comfort, noninvasiveness, and relatively low cost. Studies

have examined the properties and effectiveness of these agents including pressure therapy, silicone gel sheeting and ointment, polyurethane dressing, onion extract, imiquimod 5% cream, and vitamins A and E for the prevention and treatment of hypertrophic scars.² The use of skin tape to treat scarring is still relatively new, and it was introduced in 1981 for the treatment of burn scars. Consequently, the study has indicated that hypertrophic and stretched scars formed during the skin tape were removed; it has suggested that tension acting on a scar is the trigger for hypertrophic scarring. Skin tape could be an effective modality for the prevention of hypertrophic scarring through its ability to eliminate scar tension.^{3,4} The hypothesis is that mechanical forces might stimulate epidermal cells proliferation and vascular remodeling in living skin. As epidermal cells growth and vascular supply are critical to wound healing and tissue expansion, applying devices with controlled mechanical loads to tissues may be a powerful therapy to treat tissue defects.⁵ However, using skin tape to support the scar may reduce multidirectional forces and prevent hypertrophic scarring.⁶ In addition, silicone has been proposed as the main form of noninvasive treatment for

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hypertrophic and keloid scars and has demonstrated significant improvements in scar elasticity in patients prone to abnormal scarring. Silicone gel, a medical device that is used to soften, flatten, and blanch hypertrophic and keloid scars to produce a more aesthetically acceptable scar and increase range of motion by improving scar elasticity. Clinical trials have already shown that silicone gel sheets are safe and effective for the treatment and prevention of hypertrophic and keloid scars if worn over the scar for 12-24 h/day for at least 2-3 months.⁷ The purpose of this study was to compare the effectiveness of silicone gel and skin tape (tape closure) for the prevention of scarring in surgical incisions wound in New Zealand white rabbits ears with healed wounds (e.g., postsurgery). This study was focus to provide a concern of efficacy for clinical scars management of keloids and hypertrophic scars formation in future.

MATERIALS AND METHODS

The Animal Care and Use Ethical Committee of National Defense Medical Center approved all procedures. Three New Zealand white rabbits weighing 2.9-4.4 kg (5-7 months of age) were kept under standard conditions.

Each rabbit received four incisions over two ears to which silicone gel (Dermatix® silicone gel) and skin tape (3M™ Steri-Strip™ Adhesive Skin Closure) were applied to the upper incisions, and the lower incisions were covered with sterilized gauze and served as controls. The three New Zealand rabbits that underwent 12 incision wounds and primary suture were studied. One week later, the sutures were removed. Silicone gel was applied directly to three surgical incision wounds daily change dressings starting 1 week after surgery. Similarly,

the skin tapes were applied directly to another three surgical incision wounds daily change dressings starting 1 week after surgery for 3 months. The remaining six incision wounds were left uncovered. The experimental design and working flow chart is shown in Figure 1.

Prior to surgery, the ear dorsum was shaved, and the skin was prepared with povidone-iodine. The rabbits were anesthetized with an intra-abdominal injection of sodium pentobarbital (30 mg/kg) and prepared for wounding. Approximately, parallel incision wounds were created on the dorsal surface of each ear down to bare cartilage. These wounds were sutured primarily with 5-0 nylons [Figure 2]. Scarring severity was assessed at 1, 2, 4, and 12 weeks after remove stitches using Vancouver Scar Scale (VSS), Manchester Scar Scale (MSS), and The Stony Brook Scar Evaluation Scale (SBSES).⁸

Statistical analysis

The data were analyzed using one-way analysis of variance, and expressed as mean ± standard error. There are three samples in each experimental group. Significant differences between groups were detected by value of *P* < 0.05 which was considered to indicate statistical significance.

RESULTS

Observation of wound healing in rabbit model is shown in Figure 3. The observer was blind to the intervention. The before and after VSS scores for each of the three groups were statistically significant (*P* < 0.05). At the beginning of injury, the VSS scores for all parameters were high (less than lesion control). Based on VSS parameters, there were reductions in total scarring severity at 1, 2, 4, and 12 weeks in the skin tape and silicone gel group. This reduction was maintained until 12 weeks for both groups, as shown in Figure 4. At week 1, no statistically difference was observed between the two treatments. At week 4, mean total scarring severity for the skin tape group was 72% better than silicone gel group (4 vs. 5.5, respectively). At week 12, mean total scarring severity for the skin tape treated group was 42% better than the silicone gel group (2 vs. 4.5, respectively).

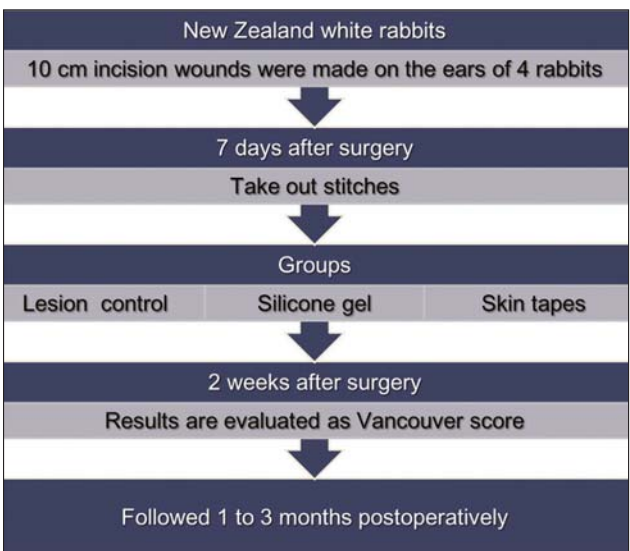


Figure 1. Experimental design and working flow chart



Figure 2. Images illustrating the surgical procedure

The VSS scores with respect to scar vascularity, pliability, pigmentation, and height are shown in Figure 5. Statistically significant differences were noted between the control and experimental groups. In Figure 5a, at week 2, the score was higher in the silicone gel group than in the skin tape group (1.57 vs. 1.43, respectively), and significantly different from control group. This reduction was maintained until 12 weeks in each study group, at which time the score in the skin tape group was less than the silicone gel group (0.50 vs. 1.00, respectively), and significant different from control group. Assessment of pliability is shown in Figure 5b. At week 1, the pliability score was lower both in the skin tape and silicone gel groups than in the control group (1.29, and 1.28 vs. 2.01, respectively) with significant difference. The reduction of pliability score was maintained until 12 weeks in each group, at which time a statistically significant difference in pliability was observed between the control and silicone gel group (1.02 vs. 0.49, respectively, $P < 0.005$).

Assessment of pigmentation results is shown in Figure 5c, and the results indicated that the skin tape treated group had greater hypopigmentation than the control or silicone gel group. At week 1, the difference between the skin tape and silicone gel group was 0.13 (1.42 vs. 1.29, respectively), and only silicone gel group is significant different from controls. At week 12, however, the skin tape group exhibited a greater reduction in pigmentation than the silicone gel group (0.48 vs. 1.00, respectively). Similar findings were observed with respect to height, as shown in Figure 5d. At week 1, both silicone gel and skin tape were lower and significantly different from control group. Furthermore, silicone gel was lower than skin tape as well (1.25 vs. 1.44, respectively). However, at 12 weeks, the height was 0.51 in the skin tape group vs. 0.98 in the silicone gel group.

All the scores associated with the items of MSS resulted different between the three groups, especially in color, appearance, and contour, as shown in Figure 6. Almost all

lesion control appeared grossly mismatching or obviously mismatching in color, slightly proud/indented or hypertrophic in contour and shiny in appearance. Wounds treated with skin tape and silicone gel had a slight mismatch, flush with surrounding skin or slightly proud/indented contour and matte appearance. The reduction of MSS was a statistically significant difference was observed between the lesion control and silicone gel group at 4 week (13.30 vs. 10.30, respectively, $P < 0.005$).

Figure 7 shows a histogram of the obtained SBSES scores. Since the distribution between high and low SBSES scores was very skewed, no correlation could be found between the length of the incision and the resulting esthetic appearance, in addition, the 12 weeks skin tape and silicone gel scars with excellent to good results (4.50 vs. 4.75, respectively).

DISCUSSION

There are three stages of wound healing: Inflammation, proliferation, and matrix remodeling/scar formation. An early inflammatory cascade ensues immediately after injury, during which much of the later outcome of scar development is dictated. The exact mechanism by which inflammation promotes scarring is not known. However, it appears that the development of scar is programmed during, and part of, the inflammatory process. Although an inflammatory response has traditionally believed to be a key event for wound healing in adult skin, studies of fetal wound healing suggest that a high level of inflammation may promote scar formation rather than enhancing wound healing. Scarring result from an abnormal fibrous wound healing process in which tissue repair and regeneration-regulating control is lost. This abnormal fibrous growth presents a major therapeutic dilemma and challenge to

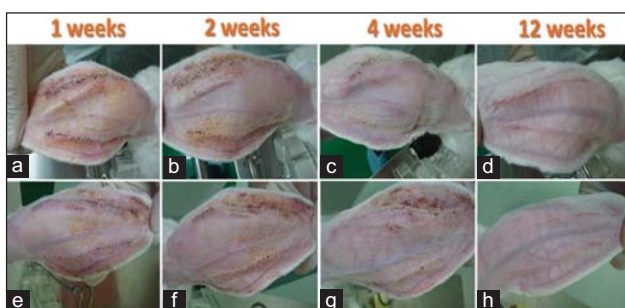


Figure 3. Observation of wound healing in the rabbit model. (a-d) Skin tape covered group. (e-h) Silicone gel treated group. The upper sides of the ears in each photo are the lesions treated with skin tape or silicone gel, and the lower sides of the ear in each photo are the untreated control lesions

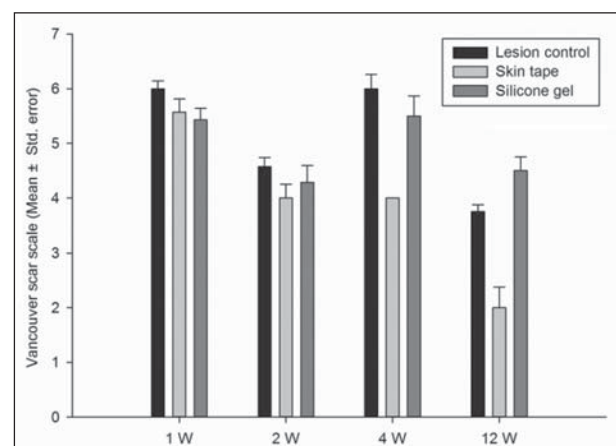


Figure 4. Evaluation of posttrauma scars by Vancouver Scar Scale (VSS). Compare with the control lesions, silicone gel resulted in a efficiency decrease with total VSS scores at 1 week, but skin tapes had a significant reduction of total VSS score at 1, 2, 4, and 12 weeks

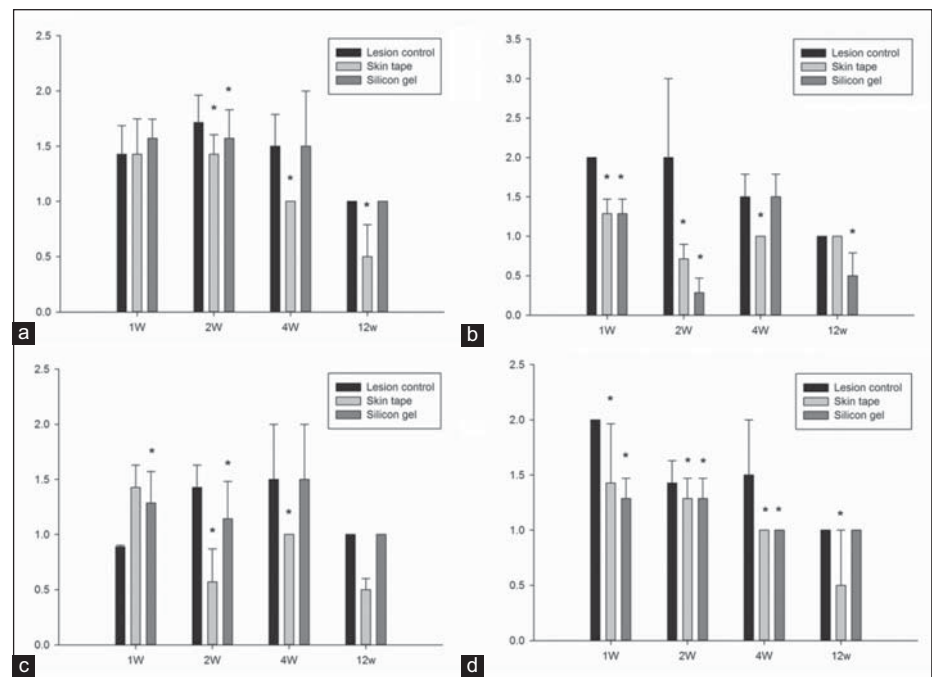


Figure 5. Statistically significant differences were noted between the control and experimental groups. (a) Scar vascularity. (b) Scar pliability. (c) Scar pigmentation. (d) Scar height. (a) Change of vascularity for the groups treated with skin tape and silicone gel. Star symbol (*) show significant reduction ($P < 0.05$) compared to control lesion values. (b) Change of pliability for the groups treated with skin tape and silicone gel. Star symbol (*) show significant reduction ($P < 0.05$) compared to control lesion values. (c) Change of pigmentation for the groups treated with skin tape and silicone gel. Star symbol (*) show a significant reduction ($P < 0.05$) compared to control lesion values. (d) Change of scar height for the groups treated with skin tape and silicone gel. Star symbol (*) show a significant reduction ($P < 0.05$) compared to control lesion values

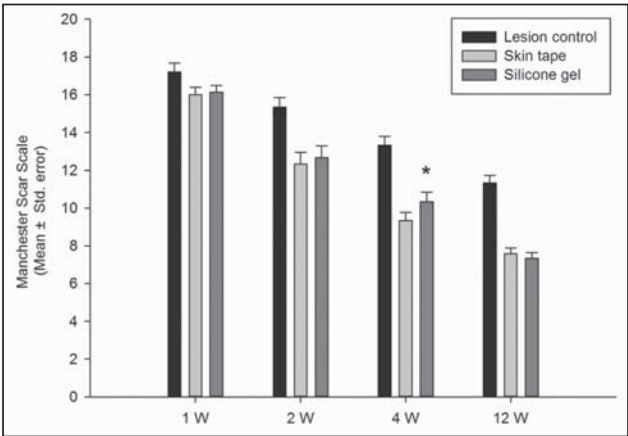


Figure 6. Evaluation of posttrauma scars by Manchester Scar Scale (MSS). Compare with the control lesions, silicone gel resulted in an efficiency decrease with total Vancouver scores at 1 week, but skin tapes had a significant reduction of total MSS at 1, 2, 4, and 12 weeks. Star symbol (*) show a significant reduction ($P < 0.05$) compared to lesion control values

the plastic surgeon because they are disfiguring and frequently recur.⁹ Cutaneous scarring observed in wounds was dependent upon the time, which has taken for the wounds to heal. For the VSS, it is the most popular used scar assessment scale at present; the same statistical measurements were examined and

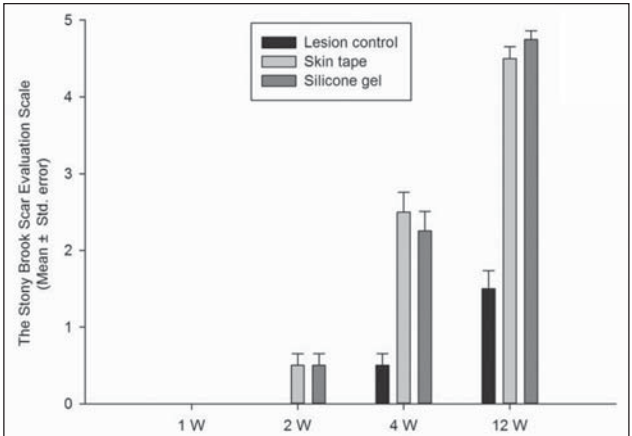


Figure 7. Evaluation of posttrauma scars by the Stony Brook Scar Evaluation Scale (SBSES). It incorporates assessments of individual attributes with a binary response (1 or 0) for each, as well as overall appearance, to yield a score ranging from 0 (worst) to 5 (best). Compare with the control lesions, skin tapes, and silicone gel resulted in an efficiency increase with total SBSES at 1, 2, 4, and 12 weeks

compared with the results of the observer scale and the VSS. In this prospective study, we have examined the effect of skin tapes and silicone gel on re-epithelialization and scarring in standardized incision wounds. There are still controversial

studies on the efficacy of silicone gel for therapy of hypertrophic scars, but no enough evidence is based on well-controlled trials after treatment. In this study, the improvements of VSS were initially treated with skin tape group and scores decreased obviously after 2 weeks. Notably, the silicone gel group was significantly improved with pliability than skin tape group at 12 week, it has indicated that silicone gel may improve proper remodeling of the scars, and then the mobility and function would be restored within chronic wound healing process. In contrast to silicone gel, progressive improvement in vascularity, height, and pliability was observed in skin tape group, though optimal improvement of scars thickness and lightening of pigmented hypertrophic scars was not achieved.

The aim of our study was the comparison between the skin incision wound treated with skin tape and silicone gel to obtain the restoration and regeneration of posttraumatic wounds. The measures of scar were satisfaction with cosmetic result, which was assessment and based on the MSS. This study also shows that the SBSES, to the best knowledge of the authors the only well-validated instrument currently available, is also useful in the evaluation of scars. A high satisfaction with the cosmetic result was reported in both groups, with no significant difference in the SBSES. However, it has been known the SBSES is designed for short-term measurement in 5-10 days, and its assessment is either 0 or 1, → SBSES is designed for short-term measurement in 5 to 10 days⁸, and its assessment is either 0 or 1, which is not matched to our experiments. As we understand, MSS and SBSES are more emphasized on the color and shape in the assessments, but vascularity and pliability are only for VSS, which might be more easily observed in our experiments with the rabbit ears that are composed of cartilages. Furthermore, MSS is more arbitrary⁸ and has showed no significant difference in all groups except for the 4th week.

It is recommended that silicone gel need to be worn at least 12 h/day for a minimum of 2 months. The mechanism of action is unknown, but it has suggested that the greater wound hydration achieved by using occlusive therapy (silicone and nonsilicone-based) then affected local keratinocytes to alter growth factor secretion and influences fibroblast regulation. It is also believed that hydration decreases capillary permeability, inflammatory and mitogenic mediators, and collagen synthesis.¹⁰⁻¹⁴ Furthermore, the development of hypertrophic and stretched scars in the treatment group only happened after the skin tape was removed, it has suggested that tension acting on a scar is the trigger for hypertrophic scarring. Skin tape is likely to be an effective modality for the prevention of scarring through its ability to eliminate scar tension.⁶ We have assessed the scarring between these two treatments after suture removed, and surprisingly the wounds treated with the skin

tape have showed a significant improvement in scar formation compared with wounds control and silicone gel.

We presented in this study a methodology to accurately classify scar variables, and evaluate the occurrence of scars during wound healing after trauma. The results demonstrated that skin tape reduced scar formation as well as silicone gel. However, the factors of efficacy and cost were important consideration to satisfy for clinical requirement. In this application of these scar prevention devices to reduce scar formation after surgical incisions, skin tape and silicone gel provide similar cosmetic outcomes for closure of surgical incisions. Moreover, skin tape may represent a low-cost alternative and low scar formation for closure of surgical incisions.

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DISCLOSURE

No benefits in any form have been received or will be received from a commercial party relating directly or indirectly to the subject of this article.

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