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Improvement in scar appearance with the usage of silicone gel containing vitamin C for pediatric Asian patients

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This paper was presented at the PRS KOREA 2023 on November 11, 2023, in Seoul, Korea.

Background Silicone gel has been introduced as a preventive measure for scarring, yet there is limited objective evidence supporting its effectiveness in the healing of pediatric traumatic scars. This study aimed to evaluate the impact of silicone gel enriched with vitamin C on facial scars in Asian pediatric patients.
Methods Pediatric patients aged 3 months to 12 years who underwent debridement and primary repair for simple facial lacerations were included in this study. A topical silicone gel mixture containing vitamin C was applied from the time of stitch removal until 6 months post-operation. Scars were evaluated at baseline, 1-, 3-, and 6-month post-application using a simplified version of the Vancouver Scar Scale, which assessed vascularity, pigmentation, and height. Scar color and pigmentation were quantified using a spectrophotometer, with comparisons to the symmetrical area on the opposite side of the scar. Statistical analysis was conducted using the Student t-test and repeated-measures analysis of variance, with post hoc testing for pairwise comparisons.
Results Of the participants, 33 were men, and 19 were women. By 6 months, there was a significant improvement in the scar score on the Vancouver Scar Scale across all parameters. The erythema index showed a statistically significant decrease at each timeline ($P<0.001$). Similarly, the melanin index demonstrated a significant difference between the baseline and 6 months ($P<0.001$).
Conclusions The topical application of silicone gel containing vitamin C significantly improved the appearance of fine surgical scars on the face in Asian pediatric patients.

Keywords Silicone gels / Scar / Pediatrics / Asian

INTRODUCTION

Facial scars tend to be more conspicuous in Asians than in other ethnicities. This heightened visibility has become a significant concern for patients, as well as for many plastic surgeons and dermatologists across Asia who strive to minimize the appearance of scars. Therefore, the management of facial scarring to reduce its visibility has emerged as a crucial topic, reflecting growing concerns about its impact.

Numerous studies have explored various strategies to reduce the prominence of scars following traumatic or surgical events. These strategies include the use of lasers, sunblock agents, vitamin supplements, and silicone gels [1-6]. However, most research has focused on managing abnormal scars, such as hypertrophic scars, burn scars, or keloids [3-7]. Limited attention has been given to adjunctive scar management for typical scars.

A previous study by Yun et al. in 2013 [8] introduced the combined use of silicone gel (Dermatix Ultra, Menarini) and vitamin C to prevent scarring in adult patients undergoing surgical proce-

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dures for primary closure of lacerations, scar revision, or excision of facial masses. Despite this advancement, there remains a lack of objective evidence supporting the effectiveness of this approach in the healing of pediatric traumatic scars. Therefore, this study aimed to evaluate the effect of silicone gel (Dermatix Ultra, Menarini) containing vitamin C on facial scars in Asian pediatric patients through a before-and-after comparative study of a single group.

METHODS

Patients and study design

Pediatric patients aged between 3 months and 12 years who underwent debridement and primary repair for superficial facial lacerations were included in the study. Following stitch removal, a topical silicone gel mixture containing vitamin C was applied to the affected area twice daily for 6 months. No additional treatments, such as laser therapy, were administered to the scar area. Scars were evaluated at multiple time points: baseline, and at 1, 3, and 6 months after starting the silicone gel treatment. Initially, 124 patients were enrolled in the study; however, 72 patients who missed their 6-month follow-up appointments at the outpatient clinic were excluded from the analysis. Ultimately, data from 52 patients were included in the final analysis.

Scar evaluation methods

We developed a modified version of the Vancouver Scar Scale (VSS) for the study, focusing exclusively on scar vascularity, pigmentation, and height. This simplified approach allowed us to emphasize the visibility of the scar rather than its abnormal characteristics, facilitating a more intuitive assessment of the scar's noticeability.

Erythema, or redness, of the scar was assessed using a simplified scale with the following categories: 1, no erythema; 2, pink hue; and 3, redness present. The elevation or height of the scar was categorized as follows: 1, no discernible elevation; 2, minimal elevation (<0.5 mm); and 3, significant elevation (>0.5 mm). Scar pigmentation was categorized based on its appearance: normal, hyperpigmentation, hypopigmentation.

No numeric scoring system was employed for this classification. We used a spectrophotometer to provide quantitative measurements of scar color and pigmentation [9,10]. To address the limitations of the study design, which lacked a control group, we implemented a complementary approach by using spectrometry to measure the hemoglobin and melanin indices on the contralateral side. This method effectively supplemented the evaluation of the VSS scale. For instance, if a scar was present on the left cheek, measurements of hemoglobin and melanin indices were taken at precisely corresponding locations on the right cheek, designated as the control group for the study. The melanin index measured the skin's melanin content, providing insights into the efficacy of treatments that alter pigmentation. The hemoglobin index quantified the skin's hemoglobin concentration, reflecting blood supply, redness, or the level of erythema, with higher levels indicating greater light absorption and a higher index value. These indices have been used to tailor and evaluate the effectiveness of treatments such as laser therapy, chemical peels, and topical applications, offering objective data on their impact [11-13].

Statistical analysis

Results are presented as means ± standard deviations. To evaluate differences across various time points, we employed the Student t-test and the repeated-measures analysis of variance (ANOVA) method. The Student t-test was used to compare baseline measurements with those taken 6 months postoperatively for the 52 patients initially included. Medical records for scar evaluations at median intervals were unavailable for three patients. Consequently, data from only 49 patients were analyzed using repeated-measures ANOVA to assess differences across timelines. Following the initial analysis, a post hoc analysis was conducted to evaluate all possible pairs of means. A significance threshold of $P < 0.05$ was established; thus, P-values below this threshold were considered statistically significant.

RESULTS

Demographics

Out of the 52 patients included in the study, 33 were male and 19 were female. The average age of the patients was 3.37 years. The distribution of scar sites was as follows: forehead (36.5%), eyebrow (21.2%), cheek (5.8%), chin (25.0%), nose (3.8%), post auricular area (3.8%), and philtrum (3.8%). Traumatic causes included falls (11.5%), injuries from blunt objects (86.5%), and dog bites (1.9%). Scar types were evaluated 6 months after the operation and classified according to the international scar classification system suggested by Mustoe [14]. They were also sorted by the mechanism of scar formation: immature scar (0%), mature flat scar (86.5%), hypertrophic linear scar (7.5%), hypertrophic wide scar (3.8%), minor keloid (1.9%), and major keloid (0%) (Table 1).

Differences over time (6 months)

At 6 months, the experimental group showed significant improvements across all scar assessment parameters. Specifically, the pigmentation index demonstrated a marked reduction ($P < 0.001$). Similarly, the erythema index displayed a significant decrease ($P < 0.001$). The elevation index also showed statistically significant improvement ($P = 0.005$). The hemoglobin index noticeably decreased between the baseline and 6 months post-surgery ($P < 0.001$). Additionally, the melanin index exhibited a significant difference between the baseline measurements and those taken 6 months after the initiation of gel application ($P < 0.001$). The details are shown in Tables 2 and 3.

Table 1. Clinical characteristics of the patients

Variable	Value
Age (yr), mean ± SD	3.37 ± 1.75
Sex, No. (%)	
Male	33 (63.5)
Female	19 (36.5)
Scar site, No. (%)	
Forehead	19 (36.5)
Eyebrow	11 (21.2)
Cheek	3 (5.8)
Chin	13 (25.0)
Nose	2 (3.8)
Postauricular area	2 (3.8)
Philtrum	2 (3.8)
Scar type and causes of trauma, No. (%)	
Immature scar	0
Mature flat scar	
Blunt object	40 (76.9)
Fall	4 (7.7)
Dog bite	1 (1.9)
Hypertrophic linear scar	
Blunt object	3 (5.8)
Fall	1 (1.9)
Hypertrophic wide scar	
Blunt object	1 (1.9)
Fall	1 (1.9)
Minor keloid	1 (1.9)
Major keloid	0

Differences at each time point

Of the 52 patients initially included, records for three were excluded due to scheduling conflicts, leaving 49 patients for analysis. The analysis was conducted using the repeated-measures ANOVA method to evaluate differences across various time points. The erythema index showed a statistically significant reduction both for the overall period ($P < 0.001$) and at each specific time point ($P < 0.001$). The pigmentation index also demonstrated significant reductions overall ($P = 0.008$), and specifically at 3 months ($P < 0.005$) and 6 months ($P < 0.001$). However, no statistically significant decrease was observed at the 1-month mark ($P = 0.126$). The elevation index displayed a statistically significant decrease overall ($P < 0.001$) and at 1 month post-surgery ($P < 0.05$). However, no statistically significant reductions were noted at 3 months ($P = 0.167$) or 6 months post-surgery ($P = 0.748$) (Table 4, Fig. 1).

In the experimental group, the hemoglobin index showed significant differences both overall and when comparing baseline measurements with each subsequent time point ($P < 0.001$). Specifically, the index value decreased from nearly double the baseline value to 1.36 at the 6-month interval (Table 5, Fig. 2). Similarly, the

Table 2. Pigmentation, erythema, and elevation scores at baseline and 6 months (n = 52)

	VSS score, mean ± SD		P-value
	Baseline	6 mo postoperative	
Pigmentation	0.78 ± 0.95	0.09 ± 0.08	< 0.001
Erythema	1.63 ± 0.32	0.30 ± 0.33	< 0.001
Elevation	0.19 ± 0.19	0.11 ± 0.10	0.005

VSS, Vancouver Scar Scale.

Table 3. Hemoglobin index and melanin index at baseline and 6 months (n = 52)[a)]

	Scar			Normal		
	Baseline	6 mo postoperative	P-value	Baseline	6 mo postoperative	P-value
Hemoglobin index	2.54 ± 0.35	1.62 ± 0.20	< 0.001	1.28 ± 0.13	1.18 ± 0.10	0.792
Melanin index	1.29 ± 0.23	1.02 ± 0.12	< 0.001	0.99 ± 0.04	1.00 ± 0.02	0.564

Values are presented as mean ± SD.
[a)]To quantify the scar color and pigmentation, a spectrophotometer was applied.

Table 4. Pigmentation, erythema, and elevation scores at baseline and 1, 3, and 6 months postoperatively (n = 49)

	VSS score, mean ± SD				P-value
	Baseline	1 mo postoperative	3 mo postoperative	6 mo postoperative	
Hemoglobin index (control)	1.29 ± 0.37	1.23 ± 0.23	1.17 ± 0.23	1.19 ± 0.32	0.761
Pigmentation	0.76 ± 0.96	0.61 ± 0.86	0.20 ± 0.54	0.10 ± 0.31	0.008
Erythema	1.65 ± 0.52	1.23 ± 0.59	0.87 ± 0.64	0.32 ± 0.47	< 0.001
Elevation	0.20 ± 0.14	0.16 ± 0.37	0.12 ± 0.33	0.10 ± 0.30	< 0.001

VSS, Vancouver Scar Scale.

melanin index in the experimental group demonstrated significant differences overall and when compared from baseline to each time point (P < 0.001). The ratio initially stood at 1.3 between groups and decreased to approximately 1.1 by the 6-month interval (Table 5, Fig. 3). Although most cases exhibited improvement in overall score and a narrowing of the gap compared with the control group over the 6 months, some scars remained visible after this period.

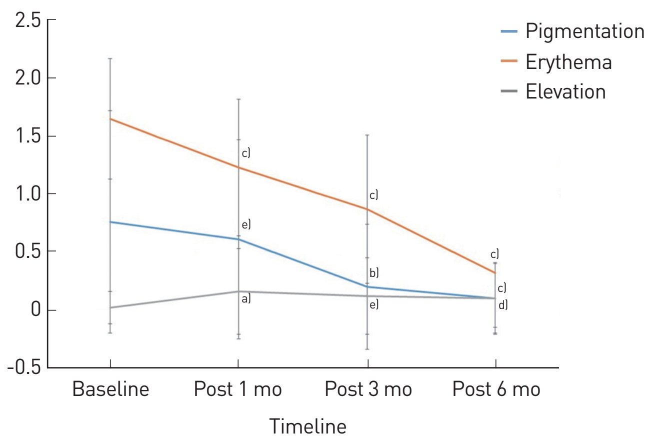

Fig. 1. Pigmentation, erythema, and elevation scores (mean ± SD) at baseline and 1, 3, and 6 months postoperatively. The P-value shown is relative to the baseline. [a]P < 0.05; [b]P < 0.005; [c]P < 0.001; [d]P > 0.5; [e]P > 0.1.

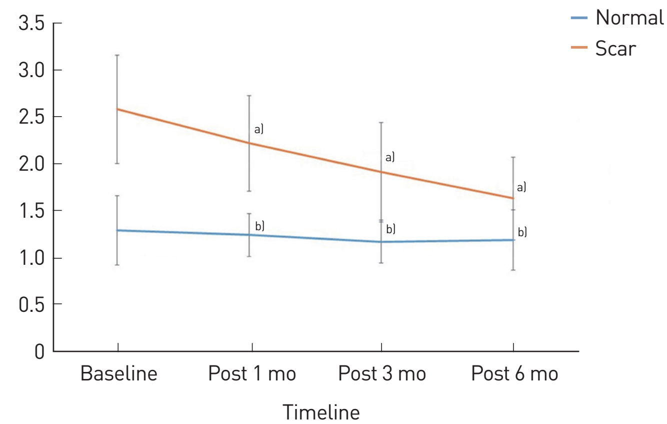

Fig. 2. Comparison of the hemoglobin index (mean ± SD) between the control group and experimental groups at baseline and 1, 3, and 6 months postoperatively. The P-value shown is relative to the baseline. [a]P < 0.001; [b]P > 0.5.

Table 5. Hemoglobin index and melanin index at baseline and 1, 3, and 6 months postoperatively (n = 49)[a]

	VSS score, mean ± SD				P-value
	Baseline	1 mo postoperative	3 mo postoperative	6 mo postoperative	
Hemoglobin index (control)	1.29 ± 0.37	1.23 ± 0.23	1.17 ± 0.23	1.19 ± 0.32	0.556
Hemoglobin index (experimental)	2.58 ± 0.58	2.22 ± 0.51	1.91 ± 0.53	1.63 ± 0.44	< 0.001
Melanin index (control)	0.98 ± 0.20	0.97 ± 0.22	0.95 ± 0.22	0.99 ± 0.17	0.712
Melanin index (experimental)	1.24 ± 0.22	1.06 ± 0.19	1.01 ± 0.16	1.01 ± 0.22	< 0.001

VSS, Vancouver Scar Scale.
[a]To quantify the scar color and pigmentation, a spectrophotometer was applied.

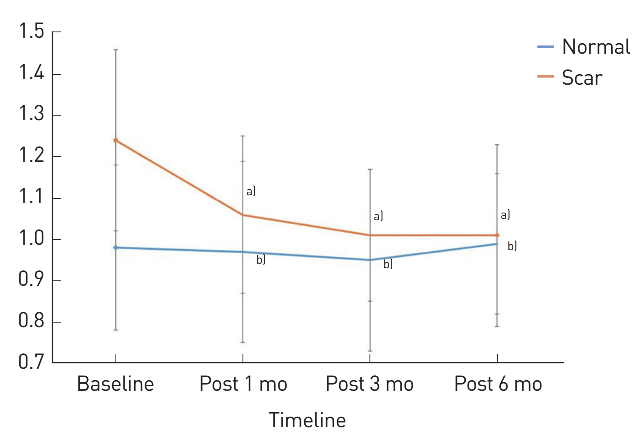

Fig. 3. Comparison of the melanin index (mean ± SD) between the control group and experimental groups at baseline and 1, 3, and 6 months postoperatively. The P-value shown is relative to the baseline. [a]P < 0.001; [b]P > 0.5.

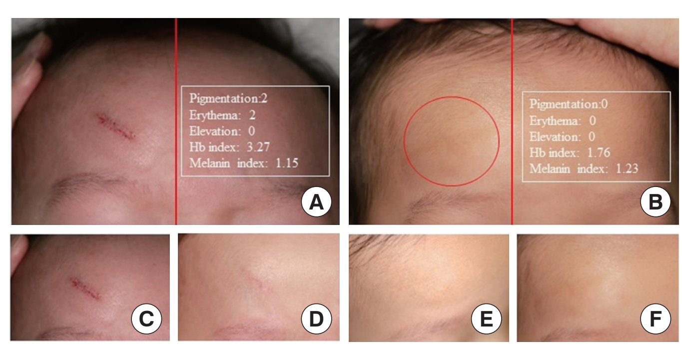

Fig. 4. Photographs of a 1-year-old boy with a forehead laceration from blunt trauma. By 6 months, the scar had matured significantly with reduced pigmentation, elevation, and erythema. (A, B) The upper two images compare baseline and 6-month follow-up photographs of the scar with its contralateral side. (C-F) Subsequent images depict the scar at baseline and 1, 3, and 6 months postoperatively.

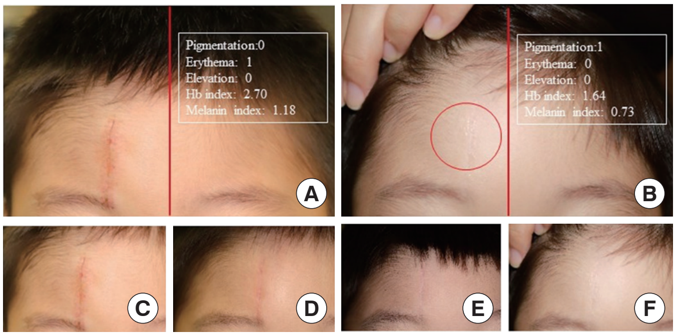

Fig. 5. Photographs of a 4-year-old boy with a forehead laceration from a blunt object. At 6 months, the scar had matured, displaying diminished pigmentation, elevation, and erythema. (A, B) The upper two images compare baseline and 6-month follow-up photographs of the scar with its contralateral side. (C-F) Subsequent images illustrate the scar's progression at baseline and 1, 3, and 6 months postoperatively.

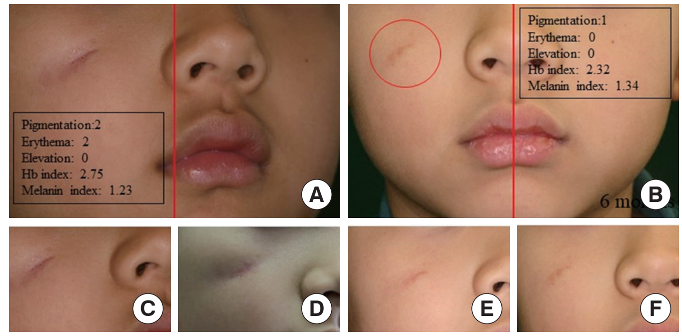

Fig. 6. Photographs of 7-year-old boy with a laceration of the right cheek from a blunt object. At 6 months, the scar remained visible, exhibiting noticeable pigmentation. (A, B) The upper two images contrast baseline and 6-month follow-up photographs of the scar with its contralateral side. (C-F) The subsequent images show the scar's appearance at baseline and 1, 3, and 6 months postoperatively.

Case 1

A 1-year-old boy presented with a forehead laceration caused by contact with a blunt object. After debridement and primary repair, Dermatix Ultra was applied twice daily. Comparisons of the scar's pigmentation, erythema score, and hemoglobin index with baseline measurements showed notable reductions. By the 6-month mark, the scar had matured effectively and showed satisfactory improvement (Fig. 4).

Case 2

A 4-year-old boy sustained a forehead laceration from contact with a blunt object. Following debridement and primary repair, he was treated with Dermatix Ultra applied twice daily. When comparing the scar's metrics to baseline, reductions in the erythema score, melanin index, and hemoglobin index were evident by the 6-month postoperative assessment. Overall, the scar showed significant maturation and improvement (Fig. 5).

Case 3

A 7-year-old boy sustained a laceration on his right cheek after coming into contact with a blunt object. Following debridement and primary repair, the patient was treated with Dermatix Ultra twice daily. When comparing the scar's metrics to the baseline, there was a relative improvement in the erythema score and hemoglobin index. However, the scar remains visible, and pigmentation is noted (Fig. 6).

DISCUSSION

The management of pediatric facial scars is particularly challenging in Asian populations, where scars tend to be more pronounced. This concern is significant for both patients and healthcare professionals. Our study evaluated the effectiveness of a topical silicone gel enriched with vitamin C (Dermatix Ultra) in improving the appearance of scars in Asian pediatric patients. Vitamin C offers multiple benefits for skin health. It acts as a powerful antioxidant, protecting the skin from oxidative stress caused by environmental factors and mitigating the effects of photoaging, such as collagen degradation and the formation of wrinkles [15]. Additionally, vitamin C reduces melanin production and pigmentation by inhibiting tyrosinase activity [16,17]. It also plays a vital role in collagen production by serving as a cofactor that stabilizes enzymes and activates transcription factors, which enhances skin structure and function, as evidenced by an increase in dermal papillae density [18].

Our findings demonstrate promising results with the use of Dermatix Ultra. At the 6-month evaluation, significant improvements were observed in various scar parameters, including pigmentation, erythema score, elevation, hemoglobin index, and melanin index. Specifically, reductions in pigmentation and erythema scores were consistently observed across multiple time points, indicating the gel's efficacy in reducing scar visibility and discoloration.

Furthermore, individual case analyses provided tangible evidence of the beneficial effects of Dermatix Ultra on scar maturation. Both case 1 and case 2 demonstrated significant improvements in scar appearance, with notable reductions in erythema scores and hemoglobin indices by the 6-month postoperative assessment. These results highlight the potential benefits of early and consistent application of Dermatix Ultra in achieving favorable scar outcomes in pediatric patients.

Our research builds upon the foundational work by Yun et al. (2013) [8], which explored the combined use of a specific topical agent in adult patients, employing a similar assessment method and follow-up period. However, our study is distinguished by several key factors. Primarily, it focused exclusively on pediatric patients, a group that presents unique challenges and considerations in scar management. In comparison to the adult study group in Yun et al. [8], our pediatric group, which included children under 12, demonstrated faster improvement in wound healing when treated with Dermatix. Additionally, we utilized a statistical analysis method known as repeated-measures ANOVA. This rigorous approach involves repeated measurements of the same variables over time, enhancing the accuracy of the research by capturing subtle fluctuations and variations across different timelines. This granularity in our analysis enabled a more precise assessment of data at each evaluation point.

While our study provides valuable insights into the effectiveness of Dermatix Ultra in scar management, it has several limitations that warrant consideration. These include a relatively small sample size due to patient exclusions and the absence of a control group for comparative analysis. The lack of a control group is considered a major limitation, as it compromises the objectivity and internal validity of the study results. Additionally, the observed changes in scar appearance could potentially be influenced by natural healing processes or other external factors not accounted for in our study design. However, as noted in the Methods section, to mitigate the absence of a control group in scar evaluation, spectrometry was utilized to measure erythema and melanin index on the contralateral side of the scar, thereby complementing the study design.

Future studies will be designed to include both untreated scar groups and scars treated solely with silicone, facilitating a more robust comparative analysis. This approach will aid in isolating the specific effects of Dermatix Ultra and provide a clearer understanding of its efficacy compared to other treatments and natural healing processes. Additionally, incorporating larger cohorts and conducting randomized controlled trials could further clarify the optimal application protocols and long-term effects of Dermatix Ultra in managing pediatric scars. Furthermore, our study primarily focused on the visual aspects of scars, while the physical properties, such as surface texture and hardness, were not examined. Addressing these physical aspects in future research would provide a more comprehensive evaluation of scar management techniques.

In conclusion, the topical application of Dermatix Ultra, which contains vitamin C, presents a promising therapeutic approach for enhancing the appearance of facial scars in Asian pediatric patients. Continued research and clinical evaluations are crucial to optimize treatment protocols and improve scar management strategies for this vulnerable population.

NOTES

Correction

This article was corrected on August 22, 2024, for manufacturer information.

Conflict of interest

This study was funded by Menarini Inc., and the protocol number was MARK/18Derma-SCar/IIT/001. Except for that, no potential conflict of interest relevant to this article was reported.

Ethical approval

The study was approved by the Institutional Review Board of Severance Hospital (IRB No. 2018-1301-011) and performed in accordance with the principles of the Declaration of Helsinki.

Patient consent

We explained the procedure to the patients and their guardians, and obtained their prior consent to use their images in publication.

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