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# Various Applications of Purse-String Suture and Its Cosmetic Outcome in Cutaneous Surgical Defects

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**Background:** Purse-string suture is a simple technique to reduce wound size and to achieve complete or partial closure of skin defects.
**Objective:** To classify situations in which purse-string sutures can be utilized and to assess the long-term size reduction and cosmetic outcome of the final scar.
**Methods:** Patients (93 from Severance hospital and 12 from Gangnam Severance hospital) in whom purse-string sutures were used between January 2015 and December 2019 were retrospectively reviewed. Wound site, final reconstruction method, repair duration, final wound size, and Vancouver scar scale were assessed.
**Results:** A total of 105 patients were reviewed. Lesions were located on the trunk (48 [45.7%]), limbs (32 [30.5%]), and face (25 [23.8%]). Mean ratio of wound length/primary defect length was 0.79±0.30. Multilayered purse-string suture showed the shortest duration from excision to final repair ($p$<0.001) and most effectively minimized the scar size (scar to defect size ratio 0.67±0.23, $p$=0.002). The average Vancouver scar scale measured at the latest follow-up visit at least 6 months postoperatively was 1.62, and the risk of hypertrophic scarring was 8.6%. There was no significant difference in the Vancouver scar scale and the risk of hypertrophic scarring between the different surgical method groups.
**Conclusion:** Purse-string sutures can be utilized in many stages of reconstruction to effectively reduce scar size without compromising the final cosmetic outcome.

**Keywords:** Dermatologic surgical procedures, Mohs surgery, Wound closure techniques

## INTRODUCTION

Surgical excision of benign and malignant skin lesions results in defects on the skin. Conventional methods of closing these defects include secondary intention healing, primary closure, skin flap, and skin grafting. In addition, purse-string suture can be used to repair the defects. It is done by running deep muscular fascial or subcuticular sutures around cutaneous defects.

Since it was first introduced in 1985 in dermatologic surgery[1], the purse-string suture has been used for the closure of various cutaneous surgical defects. This technique is particularly useful for large circular defects after Mohs surgery[2] and facial skin defects[3,4]. It has been continuously reported as an effective surgical method to reduce scar size, minimize bleeding risk, and reduce skin graft requirements[5-7]. These advantages of purse-string sutures lead to reduced operating time. An early retrospective review showed the usefulness of purse-string suture for complete or partial closure of round skin defects with favorable long-term cosmetic outcomes and acceptable postoperative complications[8]. A randomized clinical trial comparing purse-string sutures and secondary

intention healing resulted in similar cosmetic outcomes, scar size, and pain levels[9].

Purse-string sutures can be used in various ways. It can be used as the sole method of wound closure or employed to reduce wound size before applying side-to-side simple sutures. Sometimes, it is used before local flap or skin graft surgeries. We aimed to retrospectively review the clinical photographs of patients who received purse-string suture and assess the efficacy of different ways of utilizing the purse-string sutures.

## MATERIALS AND METHODS

We retrospectively reviewed the clinical records of 105 patients in whom purse-string sutures were used to repair skin defects between January 2015 and December 2019 in dermatology at Severance Hospital and Gangnam Severance Hospital, Seoul, Korea. This study was approved by the Institutional Review Board of Severance Hospital with a waiver for informed consent (IRB no. 4-2021-0283). Nevertheless we received the patients' consent about publishing the photographic materials. Patient demographics, surgical sites, and biopsy-proven diagnoses were collected. The patients were divided into three groups. In the first group, surgical defects were closed with multilayered purse-string sutures only. They were performed on a single day or in several stages at weekly intervals. The second group received skin graft or local flap surgery eventually, but purse-string sutures were used to reduce the defect size beforehand. In the last group, purse-string sutures were used to approximate the margins, and then primary repairs were performed. Fig. 1 shows an example of a staged multilayered purse-string suture. Fig. 2 and 3 show typical cases of delayed skin graft, local flap, and primary repair following purse-string sutures.

The duration between the initial excision and final repair date was calculated. Cosmetic outcomes of final scars were measured using the Vancouver scar scale[10]. The scoring system evaluates vascularity, pigmentation, pliability, and height (Supplementary Table 1). Scars with a height score greater than 0 were regarded as being elevated. Clinically evident hypertrophic scars were also observed. Photographs were taken at each date of surgery and during the follow-up consultations. The final scar was assessed at least 6 months after the final repair. We compared the initial defect size and the final scar diameter and estimated the relative ratio in the 0.1 units. All numerical values are expressed as mean±standard deviation. One-way ANOVA and Kruskal-Wallis tests were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp.). Multivariate logistic regression analysis was performed to evaluate the effect of closure methods, initial defect size, scar location, and subjects' age on scar quality.


**Fig. 1.** Typical patient who underwent multilayered purse-string suture only. (A) Initial defect after Mohs surgery. (B) On the day of Mohs surgery, first stage purse-string suture was done. (C) Second stage purse-string suture was done after two weeks. (D) Final scar, three years after surgery.

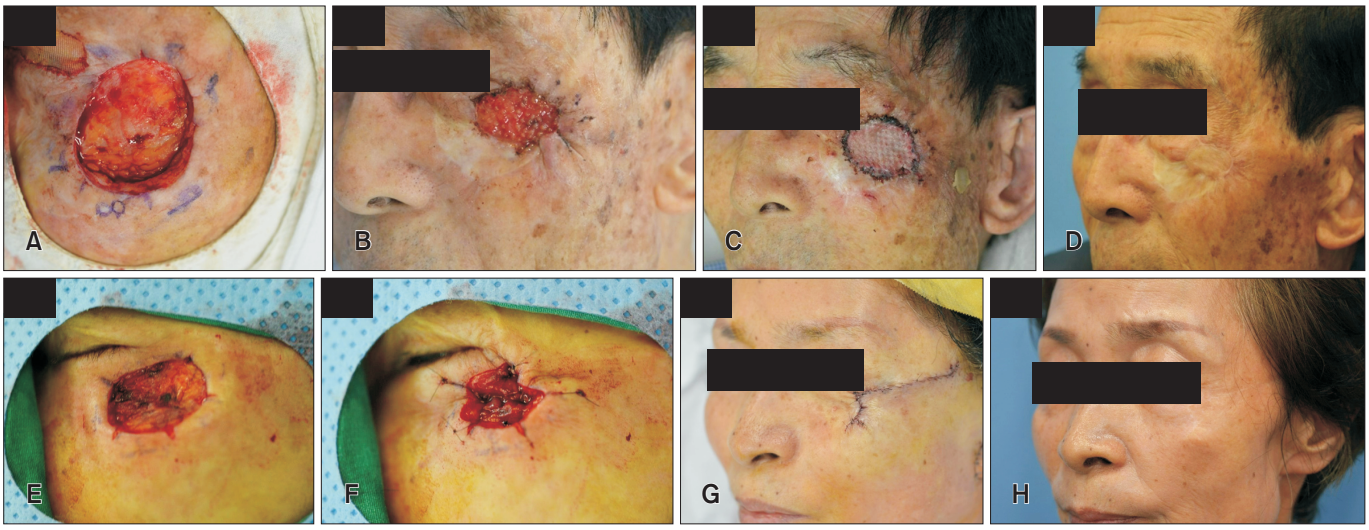


Fig. 2. (A~D) Typical case of purse-string suture followed by delayed skin graft. (E~H) Typical case of purse-string suture followed by delayed local flap.

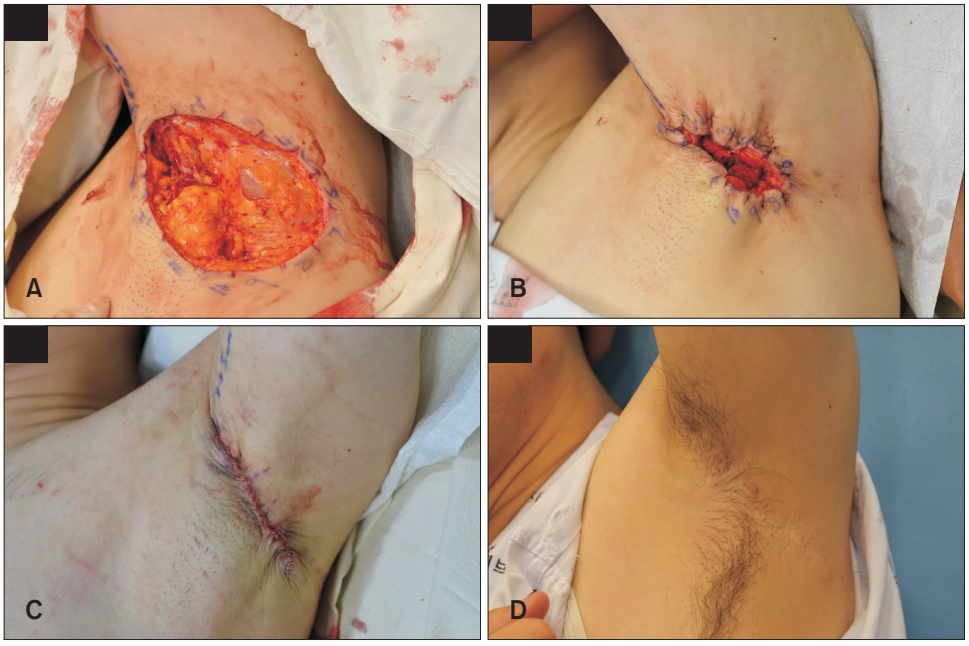


Fig. 3. Typical case of wound closure with purse-string suture followed by delayed primary repair. (A) Initial defect after Mohs surgery. (B) Purse-string suture was used to reduce the defect size. (C) One week after initial purse-string suture, complete closure with simple suture was done. (D) Final scar, one year after surgery.

## RESULTS

The patient demographics and characteristics are shown in Table 1. Among the 105 patients reviewed, 53 (50.5%) were male and 52 (49.5%) were female. The average age was 54.2 years. Shape of initial defect was mostly round or oval. The value obtained by multiplying the long axis and the short axis was defined as defect size although this does not represent the exact dimensions. Final scar length was defined as the length of longest axis. The common pathologic diagnoses were malignant melanoma (35 [33.3%]), dermatofibrosarcoma protuberans (23 [21.9%]), basal cell carcinoma (10 [9.5%]), Merkel cell carcinoma (8 [7.6%]), and squamous cell carcinoma (8 [7.6%]), all of which are major indications for Mohs micrographic surgery (Supplementary Table 2). Surgical sites were located on the trunk (48 [45.7%]), extremities (32 [30.5%]), and face or neck (25 [23.8%]). The average size of the final scar was 79% of the initial surgical defect size. The average Vancou-

**Table 1.** Patient demographics and characteristics (n=105)

| Characteristic | Value |
|---|---|
| Sex | |
| Male | 53 (50.5) |
| Female | 52 (49.5) |
| Age (yr) | 54.2±19.0 |
| Site | |
| Face | 25 (23.8) |
| Limb | 32 (30.5) |
| Trunk | 48 (45.7) |
| Reconstruction method | |
| Multilayered purse-string suture only | 43 (40.9) |
| Delayed skin graft/local flap following purse-string suture | 15 (14.3) |
| Delayed primary repair following purse-string suture | 47 (44.8) |
| Repair duration | |
| 100% covered up using 1st day purse-string suture | 39 (37.1) |
| Day from 1st purse-string suture to final reconstruction (day) | 6.81±6.58 |
| Defect size ($cm^2$) | 16.3±16.8 |
| Scar to defect size ratio | |
| Final scar length/primary defect diameter | 0.79±0.30 |
| Final scar | |
| Vancouver scar scale | 1.62±1.76 |
| Elevated scar | 16 (15.2) |
| Hypertrophic scar | 9 (8.6) |

Values are presented as number (%) or mean±standard deviation.

ver scar scale measured on the latest follow-up visit at least 6 months postoperatively was 1.62 and the mean duration from excision to final repair was 6.81 days.

Among the three different surgical methods, delayed primary repair after purse-string suture (47 [44.8%]) was most commonly employed, followed by multilayered purse-string suture only (43 [40.9%]). The repair duration, initial defect size, final scar/primary defect size ratio, and cosmetic outcome according to the purse-string suture method are shown in Table 2. Multilayered purse-string suture alone took an average of 3.43 days from excision to final repair, while delayed skin graft/local flap and delayed primary repair took 10.53 days and 8.66 days, respectively. The difference in repair duration was statistically significant ($p<0.001$), and significantly higher numbers of patients (79.1%) were 100% covered up in one day with multilayered purse-string suture only. The initial defect size was largest in the delayed skin graft/local flap group and smallest in multilayered purse-string sutures group ($p=0.047$). All three methods effectively reduced the scar size to smaller than the initial defect size. There was a significant difference in the degree of size reduction among the three groups. The largest size reduction was seen in the multilayered purse-string suture group, which resulted in a 33% reduction in scar size compared to the initial defect size. The risk of hypertrophic scarring was slightly higher in the multilayered purse-string suture group, although this difference was not statistically significant.

According to the anatomic locations, the extremities showed numerically greater reduction in the scar size (mean scar/initial defect size ratio 0.71) than the face (0.82) or trunk (0.83), although the difference was not statistically significant ($p=0.211$) (Table 3). The face and neck showed the lowest Vancouver scar scale of 1.25, while the extremities and trunk resulted in a mean Vancouver scar scale of 1.75. The proportion of elevated scars and hypertrophic scars on the face was 14.3% and 7.1%, respectively. These were lower than the proportions of extremities (elevated scar, 18.7%; hypertrophic scar, 9.4%) and trunk (elevated scar, 17.8%; hypertrophic scar, 8.9%). However, the differences were not statistically significant ($p=0.437$, 0.944, and 0.949 for Vancouver scar scale, risk of elevated scar, and risk of hypertrophic scar, respectively). The specific locations of the face and neck lesions and their scar quality and size are shown in Supplementary Table 3. Although statistical comparison was not feasible due to the small sample size, lesions on the cheek had the lowest Vancouver scar scale of 0.31 and the largest scar length to initial wound size ratio was 0.91. Greatest size reduction was observed in the scalp and upper eyelid, both of which showed scarring to defect size ratio of 0.50.

Face and extremity wounds were most often closed with multilayered purse-string suture only (50% each), while lesions on the trunk were often closed by delayed primary repair (55.6%) after purse-string sutures. Repair duration showed no significant difference between anatomical locations ($p=0.423$).

Multivariate logistic regression on Vancouver scar scale using subject age, initial defect size, location of the scar, and closure technique is shown in Supplementary Table 4. All variables including initial defect size did not correlate to scar quality.

**Table 2.** Repair duration, degree of wound size reduction and final scar quality based on different repair methods using PSS

| | Multilayer PSS only | Delayed skin graft/ local flap following PSS | Delayed primary repair following PSS | *p*-value |
|---|---|---|---|---|
| Number | 43 (40.9) | 15 (14.3) | 47 (44.8) | |
| Site | | | | 0.416 |
| Face | 12 (27.9) | 4 (26.7) | 9 (19.1) | |
| Limb | 16 (37.2) | 4 (26.7) | 12 (25.5) | |
| Trunk | 15 (34.9) | 7 (46.7) | 26 (55.3) | |
| Repair duration | | | | |
| 100% covered up with 1st day PSS | 34 (79.1) | 1 (6.7) | 4 (8.5) | <0.001 |
| Days from 1st PSS to final reconstruction | 3.43±5.57 (1~21) | 10.53±6.68 (1~23) | 8.66±6.11 (1~35) | <0.001 |
| Defect size ($cm^2$) | 11.5±13.3 | 21.2±17.5 | 19.1±18.6 | 0.047 |
| Scar to defect size ratio | | | | |
| Final scar length/primary defect diameter | 0.67±0.23 | 0.91±0.41 | 0.87±0.29 | 0.002 |
| Final scar | | | | |
| Vancouver scar scale | 1.79±1.95 | 1.87±1.96 | 1.38±1.54 | 0.465 |
| Elevated scar | 10 (23.2) | 4 (26.7) | 4 (8.5) | 0.115 |
| Hypertrophic scar | 5 (11.6) | 1 (6.7) | 3 (6.4) | 0.650 |

Values are presented as number (%) or mean±standard deviation (range). PSS: purse-string suture. Statistical significance was considered when the *p*-value was below 0.05.

**Table 3.** Repair duration, degree of wound size reduction and final scar quality based on different surgical locations

| | Face & neck | Extremities | Trunk | *p*-value |
|---|---|---|---|---|
| Number | 28 (26.7) | 32 (30.5) | 45 (42.8) | |
| Reconstruction method | | | | |
| Multilayered purse-string suture only | 14 (50.0) | 16 (50.0) | 13 (28.9) | |
| Delayed skin graft/local flap following purse-string suture | 4 (14.3) | 4 (12.5) | 7 (15.5) | |
| Delayed primary repair following purse-string suture | 10 (35.7) | 12 (37.5) | 25 (55.6) | |
| Repair duration | | | | |
| 100% covered up with 1st day purse-string suture | 11 (39.3) | 14 (43.7) | 15 (33.3) | 0.646 |
| Day from 1st purse-string suture to final reconstruction | 5.36±4.92 | 7.25±7.11 | 7.29±6.95 | 0.423 |
| Scar to defect size ratio | | | | |
| Final scar length/primary defect diameter | 0.82±0.38 | 0.71±0.26 | 0.83±0.27 | 0.211 |
| Final scar | | | | |
| Vancouver scar scale | 1.25±1.90 | 1.75±1.61 | 1.75±1.82 | 0.437 |
| Elevated scar | 4 (14.3) | 6 (18.7) | 8 (17.8) | 0.944 |
| Hypertrophic scar | 2 (7.1) | 3 (9.4) | 4 (8.9) | 0.949 |

Values are presented as number (%) or mean±standard deviation. Statistical significance was considered when the *p*-value was below 0.05.

## DISCUSSION

A purse-string suture can be used as a sole wound closure method or used to reduce the defect size before final repair. Either way is helpful in reducing scar size and skin graft requirements[6,7]. Purse-string suture can also minimize bleeding risk because it can save the rigorous undermining process before local flap surgeries and enhance hemostasis by providing uniform tension to the wound edge[8]. We find it particularly useful for temporary closures between consecutive stages in

slow Mohs micrographic surgery.

We analyzed scar size reduction and cosmetic outcomes according to different utilization methods. Regardless of how a purse-string suture was applied, the average final scar length was smaller than the initial defect's long axis length. This indicates the effectiveness of purse-string suture in terms of scar size because, if not for the purse-string suture, a circular defect would have left a scar two to three times the length of the defect size with a local flap surgery[11,12] or a simple elliptical closure[13]. Our results showed that the average scar size was 79% of the original defect size, which is comparable to a 77.1% reduction in a previous prospective study[14]. The decision on which method to be used in utilizing purse-string sutures may be greatly affected by the size of initial defect. Larger surgical wounds are likely to require skin graft or local flap surgery as this group of patients had the largest mean defect size.

In our study, the patients' surgical sites were distributed in various anatomical locations throughout the body. Among the anatomic sites, extremities showed the smallest final scar to defect size ratio, although this was not statistically significant. Considering that the extremities have little skin laxity, our results show how purse-string suture can effectively reduce scar sizes regardless of the anatomic location. Cosmetic outcome measured using the Vancouver scar scale was superior on the face and neck, especially the cheek, which is consistent with a previous study that graded scar cosmetic result on a 4-point scale[2].

We also investigated whether reducing scar size compromises the cosmetic outcome of scars. The average final Vancouver scar scale score was 1.62. One previous retrospective study of 63 cases in an Asian population with face and neck surgical wounds that were closed using purse-string suture alone reported an average Vancouver scar scale of 1.11. This favorable outcome may be attributed to the relatively small defect size, ranging from 6 to 20 mm in diameter[15]. Although our results are not as good as those of this study, it seems to be an acceptable level compared to conventional simple sutures or local flap surgical scar outcomes considering large defect size ranging from 1.0 to 6.5 cm. Therefore, purse-string sutures effectively reduce scar size without compromising the final cosmetic outcome.

The mean duration from the initial excision to the final repair was less than one week in our study. Except for those who completed wound closure in one day, the average repair duration was 10.3 days. Multilayered purse-string suture alone was associated with the shortest repair duration.

Although purse-string sutures have shown excellent clinical outcomes in various studies[9,16-18], there are drawbacks to this method. Firstly, in many cases when the repair is done in multiple stages, patients undergo more than one repair surgery because it takes time for skin to become lax before the next stage. Secondly, patients often complain of moderate to severe pain during the first few days after repair due to extreme tension in the skin, especially when the defect size is large.

This study has some limitations. First, this was a retrospective medical record review. A randomized clinical trial comparing purse-string suture only and other treatments, purse-string suture followed by local flap and direct local flap, purse-string suture followed by simple suture, and direct simple suture may clarify the advantages of each surgical method utilizing the purse-string suture. Secondly, our study has insufficient information about the incidence of various complications associated with purse-string sutures. According to our findings, postoperative wound dehiscence occurred in 6 patients, secondary bacterial infection in 4 patients, and cellulitis in 1 patient. Collecting data about other possible complications such as pain scale and the amount of bleeding may be of value in future prospective studies. Lastly, the scar quality was assessed with single tool (Vancouver scar scale). Although this method reflects many aspects of scar quality, other scar assessment methods such as visual analogue scale may have helped representing cosmetic outcome.

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The patients in this manuscript have given written informed consent to publication of their case details.

## SUPPLEMENTARY MATERIALS

Supplementary data can be found via http://anndermatol.org/src/sm/ad-21-263-s001.pdf.

## CONFLICTS OF INTEREST

The authors have nothing to disclose.

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## DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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