Purse-String Suture vs Second Intention Healing
Results of a Randomized, Blind Clinical Trial

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IMPORTANCE  Purse-string suture is a closure method that purportedly reduces the scar area compared with second intention healing. Randomized clinical trials comparing these 2 methods appear to be limited or absent.

OBJECTIVE  To determine if purse-string suture improves cosmetic outcome, healing time, and scar to defect area compared with second intention healing for circular defects on the trunk and extremities.

DESIGN, SETTING, AND PARTICIPANTS  Prospective, 2-arm, randomized, evaluator-blinded clinical trial in a single-center outpatient academic dermatology center. Patients were eligible if they were older than 18 years, able to give informed consent, and had circular or oval postoperative defects larger than 8 mm on the trunk or extremities.

INTERVENTIONS  For the purse-string treatment arm, wounds were sewn in circumferential fashion using polydiaxanone suture. Patients in the other treatment arm were allowed to heal by second intent.

MAIN OUTCOMES AND MEASURES  The primary outcome measures were the mean total Patient and Observer Scar Assessment Scale (POSAS) scores ascertained from the patient and 2 blinded observers. Secondary outcomes included the ratio of scar to initial defect size, healing time, pain scores, and complication rates.

RESULTS  Fifty-two patients were screened, and a total of 44 patients with 50 surgical sites were enrolled. Forty-two patients with 48 surgical sites completed the study. The mean total observer POSAS score was 18.38 for the purse-string group vs 19.91 for the secondary intention group, a nonsignificant difference (P = .41). Similarly, there were no significant differences for any of the following secondary outcome measures: mean total patient POSAS score (P = .96), mean scar-to-defect area (P = .61), and mean pain level at week 1 (P = .19). Statistical trends toward significance were seen in the mean healing time in favor of purse-string suture (P = .10) and scar relief, which favored second intention healing (P = .07).

CONCLUSIONS AND RELEVANCE  The purse-string suture results in similar cosmetic outcomes, scar sizes, and pain levels compared with second intention healing for circular or oval wounds on the trunk and extremities. A larger study might better define the potential differences in our secondary outcome measures of healing time and scar relief.

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T
he purse-string suture for cutaneous surgical defects was first described in 1985.1 It is a wound closure tech-
nique that is often used in cutaneous surgery for com-
plete or partial closure of circular postoperative de-
cfects.2-3 Pro-
ponents of the purse-string suture have claimed this technique reduces scar area, expedites healing time, enhances hemosta-
sis, and improves aesthetic outcome, with long-term cos-
metic and functional results being comparable with other
methods of wound repair.3-9 Data regarding outcomes of purse-
string suture have mostly pertained to colostomies10-12 or
mastopexies.13-15

In the dermatologic surgery literature, studies are primarily
composed of medical record review or case illustrations
demonstrating examples of purse-string suture of circular de-
cfects, along with variations thereof, on various anatomic sites
and with relatively good cosmetic outcome.5-16-24 Random-
ized clinical trials comparing purse-string suture with other
treatment methods appear limited in the cutaneous surgery
literature.

Second intention healing is a commonly used alternative
to purse-string suture, with acceptable outcomes and low comp-
lication rates.25 We sought to determine if purse-string su-
ture improves the cosmetic outcome, healing time, and ratio
of scar to defect area compared with second intention heal-
ing for wounds on the torso and extremities.

Methods

Study Design, Registration, Training, and Ethical Consent
In this prospective, 2-arm, randomized, evaluator-blinded, reg-
istered clinical trial, patients were continually enrolled be-
tween July 1, 2013, and October 18, 2013. Ethical approval was
obtained through the University of California, Davis, Institu-
tional Review Board before study commencement, and all pa-
ients provided verbal and written consent to enroll. An au-
thor with significant purse-string suture experience (K.O.)
trained all the study surgeons during a pig’s foot practice lab-
oratory at study inception.

Patient Eligibility
Patients were eligible for enrollment if they were older than
18 years, able to give informed consent, and had postopera-
tive defects larger than 8 mm (in greatest diameter or length
of circular or oval geometric shape) on the trunk or extremi-
ties (including the shin, hands, and feet).

Patients were excluded from the study if they were men-
tally handicapped, unable to understand written and oral Eng-
lish, incarcerated, unwilling or unable to return for follow-
up, or pregnant; if their wounds were less than 8 mm in greatest
diameter or length on the head, neck, or digits; or
if primary linear closure was preferred or recommended.

Power Analysis and Randomization
The Patient and Observer Scar Assessment Scale (POSAS), a
validated surgical outcome measure, was used as the pri-
mary outcome measure for the power analysis.26 A priori power
analysis suggested that we would need to enroll 50 patients
to obtain 80% power and an α of .05, assuming a standard de-
viation of 7, a mean difference of 6 points on the 60-point
POSAS, and a 10% patient dropout rate. Randomization was
predetermined using a freely available web service based on
atmospheric noise.27 A nurse not involved with study recruit-
ment generated the list. Study assignments obtained from the
randomization list were concealed in sealed, sequentially num-
bered opaque envelopes and stored in the office of the same
nurse who generated the list. After study enrollment, treat-
mant assignment was determined by opening the envelope in
the presence of the patient and surgeon.

Interventions and Allocation Concealment
The intervention arm was recorded in a web-based data cap-
ture form (REDCap)28 after opening the preassigned enve-
lope. The database administrator locked the form containing
the intervention type after data recording to ensure alloca-
tion concealment.

For wounds allocated to the purse-string group, under-
mining and suture preference (3-0, 4-0, or 5-0 polydioxanone
suture on a P3 needle) was based on wound size and left to the
discretion of the surgeon performing the procedure. The wound
was sewn in a circumferential fashion, with close approxima-
tion of the intradermal entry and exit points, until the entire
wound was encompassed with suture. Tension was applied to
the suture material and the wound decreased to the mini-
mum wound area possible without tissue strangulation. The
suture was then tied and allowed to remain until it dissolved
on its own accord. Following purse-string suture, patients were
told to avoid strenuous physical activity for 1 week, change their
dressings daily, and apply petroleum jelly using a cotton-
tipped applicator to the wound daily until it healed.

For the second intention healing group, petroleum jelly was
applied to the wound immediately after the procedure and a
sterile pressure dressing was applied to the area. There were
no activity restrictions; otherwise, the wound care instruc-
tions were the same as those for the purse-string group.

Assessments
The primary outcome measures were the observer and pa-
tient POSAS scores. Secondary outcomes included the ratio of
scar size to initial defect size, healing time, pain scores, and
complication rates.

We obtained basic demographic data following interven-
tion assignment at patient enrollment. This included the pa-
ient’s date of birth, sex, and race. Before intervention, the de-
fect size was measured in terms of length and width using a
sterile ruler. If the patient was randomized to the purse-
string arm, the residual unclosed defect size after closure was
also recorded after the procedure.

The patient was contacted weekly after their surgical pro-
cedure via e-mail or telephone until either their wound was
fully healed or 12 weeks had passed since enrollment. Pa-
ients were queried as to whether their wound was healed and
what their pain level was on a 1- to 10-scale, 1 being no pain and
10 being the worst pain imaginable.

The scars for both study groups were measured at a single
follow-up visit after 3 months. Two masked investigators per-

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formed most follow-up scar assessments in person (T.C. and D.B.E.), and when either investigator had been involved in the actual procedure, a different investigator was asked to perform the scar assessment. The scar area for each wound was calculated from length by width measurements using a ruler. The scar to defect ratio for both treatment arms was calculated by dividing the scar area by the unsutured postsurgical defect area. All assessment data were recorded in web-based data capture forms.28

Statistical Analysis
A t test was performed on the data obtained for the primary and secondary outcome measures for each treatment group to determine statistical significance. Complications such as infection, bleeding, spitting sutures, dehiscence, telangiectasia, erythema, contour irregularity, and hypertrophic scar were evaluated using the Fischer exact test to determine if there were any differences in rates between the purse-string and second intention groups.

Results
Fifty-two patients were screened to enroll a total of 44 patients with 50 surgical sites. Eight declined to participate: 2 were unwilling to follow up and 6 preferred an alternative treatment method. Forty-two patients with 48 surgical sites completed the study, yielding a 96% follow-up rate. Two patients, 1 from each treatment group, were lost to follow-up; both were owing to medical problems unrelated to the study.

Most of the patients recruited for this study were white men with a mean age of 69 years, most of whom had treatment sites located on the upper and lower extremities (Table 1). The demographic characteristics and surgical wounds were similar in both treatment groups.

The observer mean total POSAS score, one of our primary outcome measures, was 18.38 for the purse-string group and 19.91 for the second intention group (lower scores indicate better outcomes). This difference was not statistically significant ($P = .41$). The observer mean overall opinion scores were 4.40 for the purse-string group and 4.15 for the second intention group, a nonsignificant difference ($P = .68$). Subcategory outcomes from the observer POSAS score, such as scar vascularity, pigmentation, thickness, relief, pliability, and surface area are listed in Table 2. None of these outcomes showed statistical significance, including the measure for relief of second intention healing ($P = .07$).

The mean total patient POSAS scores were 17.76 for the purse-string group and 17.61 for the second intention group, a nonsignificant difference ($P = .92$). Similarly, there was no significant difference ($P = .96$) in the mean overall patient impression score between the purse-string group (4.04) and the second intention group (3.96). Other outcomes, such as pain, itching, color, stiffness, thickness, and contour irregularity are listed in Table 2. None of these outcomes showed statistical significance.

### Table 1. Study Demographics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total</th>
<th>Purse-String Suture</th>
<th>Second Intention Healing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients/surgical sites, No.</td>
<td>44/50</td>
<td>24/26</td>
<td>24/24</td>
</tr>
<tr>
<td>Completed</td>
<td>42/48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age, y</td>
<td>69</td>
<td>69</td>
<td>68</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>27 (61)</td>
<td>17 (65)</td>
<td>15 (63)</td>
</tr>
<tr>
<td>Female</td>
<td>17 (39)</td>
<td>9 (35)</td>
<td>9 (38)</td>
</tr>
<tr>
<td>Race, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>42 (96)</td>
<td>24 (92)</td>
<td>23 (96)</td>
</tr>
<tr>
<td>African American</td>
<td>1 (2)</td>
<td>1 (4)</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>1 (2)</td>
<td>1 (4)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Procedure type, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mohs</td>
<td>23 (46)</td>
<td>12 (46)</td>
<td>11 (46)</td>
</tr>
<tr>
<td>Excision</td>
<td>27 (54)</td>
<td>14 (54)</td>
<td>13 (54)</td>
</tr>
<tr>
<td>Surgical site, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand</td>
<td>7 (14)</td>
<td>4 (15)</td>
<td>3 (13)</td>
</tr>
<tr>
<td>Arm</td>
<td>13 (26)</td>
<td>7 (27)</td>
<td>6 (25)</td>
</tr>
<tr>
<td>Thigh</td>
<td>3 (6)</td>
<td>3 (12)</td>
<td>0</td>
</tr>
<tr>
<td>Leg</td>
<td>14 (28)</td>
<td>5 (19)</td>
<td>9 (38)</td>
</tr>
<tr>
<td>Back</td>
<td>5 (10)</td>
<td>2 (8)</td>
<td>3 (13)</td>
</tr>
<tr>
<td>Groin</td>
<td>7 (14)</td>
<td>4 (15)</td>
<td>3 (13)</td>
</tr>
<tr>
<td>Buttock</td>
<td>1 (2)</td>
<td>1 (4)</td>
<td>0</td>
</tr>
<tr>
<td>Wound size, mean (SD), cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before closure</td>
<td>6.4 (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After closure</td>
<td>1.2 (2)</td>
<td>5.2 (4)</td>
<td></td>
</tr>
</tbody>
</table>

From each treatment group, were lost to follow-up; both were owing to medical problems unrelated to the study.
Other secondary outcome measures included scar to defect ratio, healing time, mean pain score at 1 week, duration of pain level greater than 1, and complication rates (infection, bleeding, spitting sutures, dehiscence, erythema, contour irregularity, and hypertrophic scar) (Table 2 and Table 3). The mean scar to defect ratio for the purse-string group was 0.39 vs 0.43 for the second intention group ($P = .61$). The mean healing time was 5.62 weeks for the purse-string group and 7.43 weeks for the second intention group ($P = .10$). The mean pain level at week 1 was 1.69 for the purse-string group and 2.22 for the second intention group ($P = .19$). The mean duration of a pain level greater than 1 was 1.12 weeks for the purse-string group and 1.96 weeks for the second intention group ($P = .25$). Infection was reported for 1 patient in the purse-string group and for 2 patients in the second intention group ($P = .60$). The only comp-

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**Table 2. Results of POSAS Measurements**

<table>
<thead>
<tr>
<th>Scar Assessment</th>
<th>POSAS Score, Mean (SD)</th>
<th></th>
<th></th>
<th></th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Purse-String Suture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vascularity</td>
<td>4.66 (2.46)</td>
<td>4.82 (2.16)</td>
<td>.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigmentation</td>
<td>1.96 (1.84)</td>
<td>1.98 (1.48)</td>
<td>.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>2.84 (1.41)</td>
<td>3.35 (1.47)</td>
<td>.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relief</td>
<td>2.08 (0.90)</td>
<td>2.72 (1.42)</td>
<td>.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliability</td>
<td>3.12 (1.29)</td>
<td>3.24 (1.39)</td>
<td>.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface area</td>
<td>3.72 (1.52)</td>
<td>3.63 (1.35)</td>
<td>.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total POSAS</td>
<td>18.38 (6.43)</td>
<td>19.91 (6.39)</td>
<td>.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall opinion</td>
<td>4.40 (2.30)</td>
<td>4.15 (1.70)</td>
<td>.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Second Intention Healing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vascularity</td>
<td>4.82 (2.16)</td>
<td>5.21 (2.16)</td>
<td>.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigmentation</td>
<td>1.98 (1.48)</td>
<td>2.02 (1.38)</td>
<td>.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>3.35 (1.47)</td>
<td>3.87 (1.47)</td>
<td>.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relief</td>
<td>2.72 (1.42)</td>
<td>3.12 (1.47)</td>
<td>.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pliability</td>
<td>3.24 (1.39)</td>
<td>3.70 (1.39)</td>
<td>.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface area</td>
<td>3.63 (1.35)</td>
<td>4.24 (1.35)</td>
<td>.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total POSAS</td>
<td>19.91 (6.39)</td>
<td>21.92 (6.39)</td>
<td>.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall opinion</td>
<td>4.15 (1.70)</td>
<td>4.45 (1.70)</td>
<td>.68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure. Representative Scar Images at 3-Month Follow-up on the Dorsal Hand**

Before (A) and after (D) images of second intention healing are shown compared with a wound before purse-string suture (B), the sutured wound (C), and follow-up scarring (E). Arrowhead indicates the evaluated scar in the purse-string group. Scar to defect ratios were similar in both arms of the study.
Discussion

Our study found no significant differences in cosmetic outcomes as measured by blinded observers using the POSAS scale. Similarly, there were no significant differences in the secondary outcome measures of scar to defect ratio, pain, total patient POSAS score, and rate of complications.

Spitting suture was the only measured outcome with a significant difference in our study ($P = .004$) and requires no explanation. The difference in POSAS relief score might be attributable to tissue puckering that is observed following purse-string suture. The observed difference in healing time could result from the decreased wound aperture after purse-string suture. It is unclear whether these subgroup trends were the result of insufficient sample size or random variation that is expected with the use of multiple outcome measures.

Our findings regarding scar to defect size contrast with other studies, which suggested that purse-string suture may result in smaller-than-expected scars caused by other closure techniques. However, these other trials lacked comparator arms and assessments were unblinded. Consistent with other studies, purse-string suture reduced the post-operative defect size. However, this advantage was lost by the 3-month assessment. We attribute this finding to scars spreading with time in the purse-string group and wound contraction in the second intention group.

The conclusions of our study are strengthened by its a priori power analysis, randomized design with allocation concealment and blinded reviewers, and use of a validated outcome measure tool. Also, our 96% follow-up rate diminishes the chances of bias that might occur from patients excluded from analysis.

One limitation of our study was its single-center nature. Multiple sites would have expanded our study population and reduced the chances of sporadic findings. Furthermore, although the inclusion of multiple surgical sites (trunk and extremities) increases the external validity of our findings, we cannot exclude the possibility that certain anatomic locations might respond differently to purse-string suture. Although our primary outcome measure, the POSAS score, is a valid instrument, it is still subjective. Last, no in-person assessments were performed to assess wound healing. Not all patients may be able to recognize a fully healed scar.

Conclusions

Purse-string suture results in similar cosmetic outcomes, scar size, and pain level compared with second intention healing for circular or oval wounds on the torso or extremities. A statistical trend suggested that healing time might be faster in the purse-string arm and that scar relief at 3 months’ follow-up might be better in the second intention arm. A larger trial would help settle these issues.

ARTICLE INFORMATION

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Author Contributions: Drs Eisen and Armstrong had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Joo, Armstrong, King, Omlin, Kappel, Eisen. Acquisition, analysis, or interpretation of data: Joo, Custis, Omlin, Kappel, Eisen. Drafting of the manuscript: Joo, Armstrong, Omlin, Eisen. Critical revision of the manuscript for important intellectual content: Joo, Custis, King, Omlin, Kappel, Eisen. Statistical analysis: Armstrong.
The purse-string suture revisited: a useful technique for the closure of cutaneous surgical wounds.

REFERENCE


