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Comparison of Running Cutaneous Suture Spacing During Linear Wound Closures and the Effect on Wound Cosmesis of the Face and Neck
A Randomized Clinical Trial

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IMPORTANCE Surgeons have varying opinions on the ideal cutaneous suture spacing for optimal cosmetic outcomes. To date, no studies concerning the effect of suture spacing on cosmetic outcomes exist in the literature.

OBJECTIVE To compare outcomes and wound cosmesis achieved with running cutaneous sutures spaced 2 vs 5 mm apart.

DESIGN, SETTING, AND PARTICIPANTS This randomized clinical trial was conducted at the University of California, Davis dermatology clinic from November 28, 2017, to June 15, 2018. Fifty-six patients 18 years or older with surgical fusiform wounds (from Mohs procedure or surgical excision) on the head or neck with assumed closure lengths of at least 3 cm were screened. Six patients were excluded, 50 patients were enrolled, and 48 patients were followed up.

INTERVENTIONS Fifty surgical fusiform wounds were randomized to running cuticular closure with 2-mm spacing on half and 5-mm spacing on half.

MAIN OUTCOMES AND MEASURES At 3 months, patients and 2 masked observers evaluated each scar using the Patient and Observer Scar Assessment Scale (POSAS).

RESULTS A total of 50 patients (mean [SD] age, 71.1 [11.4] years; 43 [86%] male; 50 [100%] white) were enrolled in the study. The mean (SD) sum of the POSAS observer component scores was 10.7 (4.3) for the 2-mm interval side and 10.8 (3.5) for the 5-mm side at 3 months (P = .77). No statistically significant difference was found in the mean (SD) sum of the patient component for the POSAS score between the 2-mm interval side (10.2 [4.7]) and the 5-mm interval side (11.5 [6.4]) at 3 months (P = .24). No statistically significant difference was observed in mean (SD) scar width between the 2-mm side (0.9 [0.6] mm) and the 5-mm side (0.8 [0.4] mm; P = .15).

CONCLUSIONS AND RELEVANCE No statistically significant difference in wound cosmesis or total complications were noted between running cuticular sutures spaced 2 vs 5 mm apart. Both suturing techniques resulted in similar cosmetic outcomes and complication rates. Surgeons may want to consider whether the extra time involved in placing very closely spaced cuticular sutures is worthwhile.

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Supplemental content

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Epidermal sutures are commonly used as part of layered wound closure in cutaneous surgery. This suture technique is used to fine-tune wounds by correcting potential step-offs, approximating wound edges, and contributing to wound edge eversion. Although dermal sutures are responsible for most of the wound edge approximation and eversion, epidermal sutures may also play a significant role.

There appears to be significant variation among surgeons regarding the spacing between sutures. Some prefer closely spaced sutures, believing they result in better wound edge apposition and eversion and less potential edge misalignment. Others believe closely spaced sutures result in prolonged operative time, additional tissue trauma, and more foreign material within the wound, potentially worsening outcomes. A literature search of the MEDLINE database yielded no studies published on the effect of cutaneous suture spacing on wound cosmesis.

Intervals of 5 mm between sutures have been advocated by some as an appropriate standard for laceration repairs.[1] This appeared anecdotally to be on the longer spectrum for suture spacing for dermatologic surgeons. Similarly, 2-mm suture intervals appeared to be on the narrower end of the spectrum. Thus, we used a split-wound/split-scar model to compare the effects of 5- vs 2-mm running cuticular suture spacing (as part of a layered closure) on wound cosmesis.

Key Points

Question How does cutaneous suture spacing during wound closure affect wound cosmesis?

Findings In this randomized clinical trial of 50 adults, no significant difference was found in wound cosmesis between 2- and 5-mm running cutaneous suture spacing.

Meaning Running cutaneous sutures spaced 2 vs 5 mm apart result in similar cosmetic outcomes.

Methods

Study Design

In this randomized clinical trial, patients were continuously enrolled from November 28, 2017, to March 31, 2018, with follow-up completion on June 15, 2018. We used a split-wound/split-scar model to minimize the number of uncontrolled variables. Split-scar models have been used in the past to assess cuticular suturing techniques.[2-4] Ethical approval was obtained through the University of California, Davis Institutional Review Board before study commencement, and all patients provided verbal and written informed consent to enrollment. The trial protocol can be found in the Supplement.

Patient Eligibility and A Priori Power Analysis

Inclusion criteria for study enrollment included age of 18 years or older and presence of surgical fusiform wounds on the head or neck with assumed closure lengths of at least 3 cm. Eligible patients were those who were able to give informed consent themselves and who were willing to return for a follow-up visit in 3 months. Exclusion criteria included wounds less than 3 cm in length, wounds not located on the head or neck, incarceration, pregnancy, wounds unable to be closed with primary closure, age younger than 18 years, mental disability, the inability to understand written or oral English, unwillingness to consent, or unwillingness to return for a follow-up visit.

A power analysis using a paired *t* test with 90% power to detect a difference of 3 points on the 60-point Patient Observer Outcome Scale and an SD of 6 (based on prior studies[4,5] at this institution) with an α of .05 indicated that we would need to enroll 42 patients. We assumed an attrition rate of approximately 20% and enrolled 50 patients.

Randomization, Allocation, Concealment, and Interventions

Surgical fusiform wounds (after excision or Mohs micrographic surgery) were divided in half and labeled as A and B, with A by convention always superior relative to the patient or on the left side from the surgeon's perspective and B the opposite of A. A randomization list was generated before study recruitment from a freely available web service (https://www.random.org/). The list was transferred in an Excel file and uploaded onto the randomization module of a web-based study data capture system (Research Electronic Data Capture [REDCap])[6] by a physician uninvolved in recruitment, intervention, and assessment. Before cutaneous suture placement, wound edges were undermined 1 cm to allow for easy placement of subcuticular sutures. Polydiaxanone was used for subcuticular sutures, and 5-0 fast-absorbing gut was used for cuticular sutures. The size of the subcuticular suture material was determined by the individual surgeon and varied by location but was kept the same for both sides of the wound.

A subcuticular suture was always placed in the center of the wound, and if the wound edges on either side of the wound were not fully approximated, additional subcuticular sutures were placed on both sides of the wound equidistant from the wound center. The process was repeated until the wound was fully closed along its entire course.

After labeling, undermining, and placing subcuticular sutures, a study researcher (L.R.S., D.B.E.) would consult the randomization module on REDCap[6] and only the surgeon (L.R.S., R.K.S., or D.B.E.) would be informed of the allocation assignment. Allocation assignments revealed only 1 patient at a time in the REDCap system, maintaining concealment for future patients. A single randomization sequence was used. Wounds were not restricted to the left and right but could also be vertical or diagonal. Each side was then marked using a gentian violet marker and a ruler at increments of 2 or 5 mm starting from the midpoint of the wound. Running cuticular sutures were then sewn in place along the drawn gentian violet marks. Each wound edge was elevated with 1 × 2 tooth-tipped Adson forceps with tying platforms before needle insertion. The needle entered the skin edge 3 to 4 mm from the wound edge and exited the same distance on the opposing side before advancing the needle to the next marked suture interval.

Figure 1. CONSORT Flow Diagram

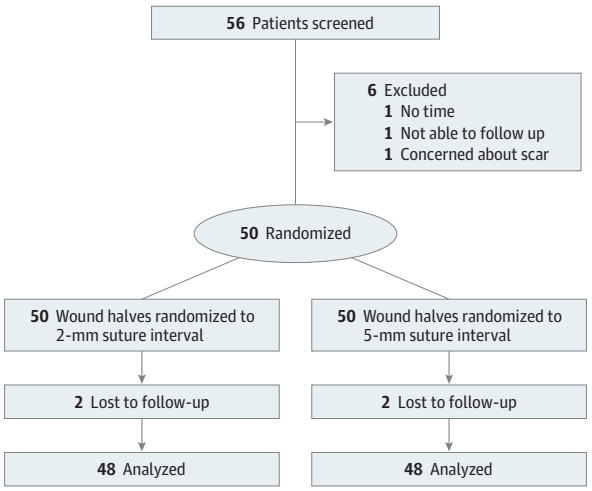


Table 1. Baseline Characteristics of Study Population and Surgical Procedure Data

Characteristic	Finding (N = 50)[a]
Age, mean (SD), y	71.1 (11.4)
Sex	
Male	43 (86)
Female	7 (14)
White race	50 (100)
Training level of surgeon	
Attending	17 (34)
Mohs fellow	27 (54)
Resident	6 (12)
Location of surgical procedure	
Preauricular	10 (20)
Postauricular	3 (6)
Neck	3 (6)
Cheek	13 (26)
Chin	2 (4)
Forehead	13 (26)
Temple	6 (12)
Indication	
Mohs surgery	48 (96)
Excision	2 (4)
Assessment time, mean (SD), m	3.1 (0.4)
Excision length, mean (SD), cm	5.4 (1.5)

[a] Data are presented as number (percentage) of patients unless otherwise indicated.

After the wound was sutured, a sterile pressure bandage was applied over petrolatum, and the patient was instructed to abstain from all physical activity for 7 days and to gently remove the pressure dressing in the shower 24 hours later. Although the patient was masked to the intervention assignments, the sutures would be visible to the patient after the dressing was removed.

Assessments

We evaluated our primary outcome of cosmetic appearance of the scar 3 months after surgery. We chose the 3-month timeframe because surgical assessments of scars at this time are at least moderately correlated with those at 12 months.[7] Furthermore, differences in interventions tend to diminish with time,[5,8] and if a difference existed between interventions, it would be less likely to be detected at a more distant assessment time. Secondary outcomes included the incidence of hematomas, suture abscesses, seromas, necrosis, or dehiscence. We also evaluated the scar width 1 cm from the midpoint of the scar for both halves at the 3-month follow-up visit.

Cosmetic appearance was evaluated in person by the patient and 2 masked observers who were not present during the intervention using the validated Patient and Observer Scar Assessment Scale (POSAS).[7] This scale is based on a 10-point scoring system; a score of 1 represents normal-appearing skin, and 10 represents the worst scar imaginable. The total score ranges from 6 to 60, and the lower the score, the more representative of normal-appearing skin. The POSAS has been used in numerous surgical studies[3,4,9,10] and has been proven to be a valid outcome measure when 2 independent observers are used.[11] In our study, 2 masked observers who were not present during the procedure were asked to evaluate the following features of each half of the scar: vascularity, pigmentation, thickness, relief, pliability, surface area, and overall opinion. The primary outcome measure was the mean of the sum of the observer scores. Patients completed the patient-centered POSAS to assess pain, pruritus, color, thickness, stiffness, irregularity, and overall opinion of the scar.

All study data were collected and managed using REDCap tools hosted at the University of California, Davis Medical Center.[6] REDCap is a secure, web-based application designed to support data capture for research studies, providing (1) an intuitive interface for validated data entry, (2) audit trails for tracking data manipulation and export procedures, (3) automated export procedures for seamless data downloads to common statistical packages, and (4) procedures for importing data from external sources.[6]

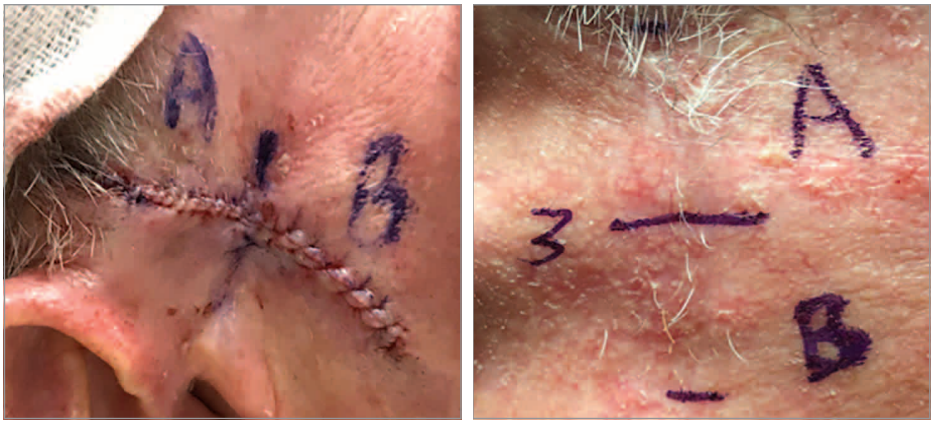
Statistical Analysis

Data were analyzed based on the intention-to-treat principle. We applied summary statistics to describe baseline demographic and clinical characteristics of the patient population. Because the comparison between the 2- and 5-mm suture spacing occurred for each patient, we used pairwise comparisons to analyze the differences between these 2 suture-spacing methods to evaluate investigator scar assessment, patient scar assessment, surgical complications, and other adverse events. Specifically, to assess differences in continuous outcomes between the 2- and 5-mm suture spacing, we used the paired *t* test to test the null hypothesis that the true mean difference was zero. For nonparametric evaluations, we used the Wilcoxon matched-pairs signed rank test, which tests the equality of matched pairs of observations; we tested the null hypothesis that both distributions

Figure 2. Postoperative Wound and Surgical Scar

A Immediate postoperative wound

B Surgical scar at 3-mo follow-up



A, Immediate postoperative wound. The suture interval was measured and marked with a gentian violet marker before placement of the cuticular sutures. The increments are visible adjacent to the sutures. B, Surgical scar at 3-month follow-up. In this patient, 2-mm suture spacing was used on the side labeled A and 5-mm suture spacing on the side labeled B.

were the same. All results achieving a 2-tailed $P < .05$ were considered to be statistically significant. All analyses were performed with Stata/MP 13 (StataCorp).

Results

A total of 56 patients were screened for participation, and 6 were excluded, leaving 50 patients in the study (mean [SD] age, 71.1 [11.4] years; 43 [86%] male; 50 [100%] white) (**Figure 1**). The patients were enrolled after undergoing Mohs micrographic surgical procedures (48 patients [96%]) or surgical excision (2 [4%]) (**Table 1**). A fellowship-trained dermatologic surgeon performed the study intervention in 17 cases (34%), a dermatologic surgery fellow in 27 cases (54%), and a dermatology resident in 6 cases (12%). Of the 50 patients enrolled, 48 were available for the 3-month follow-up visit (Figure 1). Table 1 provides demographic details of the patients. This study's population mainly reflects outcomes among older and white individuals, who are representative of those who undergo most cutaneous surgical procedures at our institution.

No significant difference was found in our primary outcome measure, the mean sum of the POSAS component scores of the masked reviewers for the 2 closure techniques, with a mean (SD) score of 2.1 (1.0) for the 2-mm side and 2.2 (0.8) for the 5-mm side ($P = .71$) (**Figure 2**). Similarly, no significant differences in mean (SD) reviewer POSAS scores were found between individual components for vascularity (1.9 [1.0] for 2 mm vs 1.8 [0.9] for 5 mm; $P = .62$), pigmentation (1.3 [0.6] for 2 mm vs 1.4 [0.6] for 5 mm; $P = .49$), thickness (1.6 [1.0] for 2 mm vs 1.7 [0.7] for 5 mm; $P = .58$), relief (1.8 [1.0] for 2 mm vs 1.9 [1.0] for 5 mm; $P = .65$), pliability (2.1 [0.9] for 2 mm vs 2.1 [0.9] for 5 mm; $P = .59$), surface area (2.0 [1.0] for 2 mm vs 1.9 [0.8] for 5 mm; $P = .77$), and overall opinion (2.1 [1.0] for 2 mm vs 2.2 [0.8] for 5 mm; $P = .71$) at the 3-month assessment (**Table 2**). In addition, no significant difference was found in the mean (SD) patient POSAS scores between the sides of the scars for pain (1.2 [0.7] for 2 mm vs 1.2 [0.8] for 5 mm; $P > .99$), pruritus (1.1 [0.4] for 2 mm vs 1.1 [0.6] for 5 mm; $P = .70$), color (2.1 [1.5] for 2 mm vs 2.0 [1.5] for 5 mm; $P = .62$), stiffness (1.8 [1.3] for 2 mm vs 2.4 [1.8] for 5 mm; $P = .01$), thickness (1.9 [1.4] for 2 mm vs 2.1 [1.7] for 5 mm; $P = .58$), irregularity (2.1 [1.6] for 2 mm vs 2.6 [1.8] for 5 mm; $P = .13$), and overall opinion (2.1 [1.5] for 2 mm vs 2.4 [1.7] for 5 mm; $P = .28$). There was no statistically significant difference for mean (SD) scar width at 3 months between the sides of the scars with suture spacing of 2 vs 5 mm (0.9 [0.6] mm vs 0.8 [0.4] mm; $P = .15$) (Table 2). The mean (SD) width of the 2-mm spaced suture side was 0.9 (0.6) mm, and the mean width of the 5-mm-spaced suture side was 0.8 (0.4) mm ($P = .15$). There was 1 case of wound dehiscence that affected both the 2- and 5-mm spaced suture sides. One patient noted bleeding for a few days 5 weeks postoperatively at a site where 2-mm suture spacing was used. The patient did not seek medical care, and no hematoma or bleeding was noted at follow-up. Three suture abscesses were noted at the 5-mm-spaced suture sites. One patient had a wound infection 3 days postoperatively noted at both the 2- and 5-mm-spaced suture sites and did not return for follow-up. No hematomas, seromas, or necrosis were documented. Furthermore, no significant difference was found between the sum of the adverse effects between the 2 interventions (5 in the 2-mm group and 6 in the 5-mm group) (Table 2).

Discussion

No difference was found in the appearance of scars from cutaneous surgical procedures when using running cutaneous sutures spaced 2 vs 5 mm apart as judged by 2 masked observers and the patients themselves. Adverse events also did not significantly differ between study groups.

Strengths and Limitations

Strengths of this study include a priori power analysis, true randomization, masked observer assessment, allocation

Table 2. Mean (SD) Scar Width, Mean (SD) Patient and Observer POSAS Scores, and Number of Complications at 3-Month Follow-up

Outcome Measure	Suture Spacing		*P* Value
	2 mm (N = 50)	5 mm (N = 50)	
Scar width, mm	0.9 (0.6)	0.8 (0.4)	.15
Patient POSAS score			
Pain	1.2 (0.7)	1.2 (0.8)	>.99
Pruritus	1.1 (0.4)	1.1 (0.6)	.70
Color	2.1 (1.5)	2.0 (1.5)	.62
Stiffness	1.8 (1.3)	2.4 (1.8)	.01
Thickness	1.9 (1.4)	2.1 (1.7)	.58
Irregularity	2.1 (1.6)	2.6 (1.8)	.13
Total score	10.2 (4.7)	11.5 (6.4)	.24
Overall opinion	2.1 (1.5)	2.4 (1.7)	.28
Masked reviewer POSAS score			
Vascularity	1.9 (1.0)	1.8 (0.9)	.62
Pigmentation	1.3 (0.6)	1.4 (0.6)	.49
Thickness	1.6 (1.0)	1.7 (0.7)	.58
Relief	1.8 (1.0)	1.9 (1.0)	.65
Pliability	2.1 (0.9)	2.1 (0.9)	.59
Surface area	2.0 (1.0)	1.9 (0.8)	.77
Total score	10.7 (4.3)	10.8 (3.5)	.85
Overall opinion	2.1 (1.0)	2.2 (0.8)	.71
Complications[a]			
Dehiscence	1	1	.65
Hematoma	0	0	
Seroma	0	0	
Suture abscess	3	4	
Necrosis	0	0	
Other[b]	1	1	
Sum of complications	5	6	

Abbreviation: POSAS, Patient and Observer Scar Assessment Scale.

[a] Statistical analysis was performed only on the sum of complications according to our predetermined data analysis plan to reduce chances of spurious findings.

[b] Infection.

concealment, use of a validated outcome instrument, and a low attrition rate. In addition, operations were performed by physicians with a variety of experience levels, which improves the external validity of the findings.

The primary limitation of this study was its single-center design. Multicenter studies are generally less susceptible to bias and include a greater diversity of patients and surgeons. Our study enrolled primarily elderly white patients. Other age and racial/ethnic groups may have responded differently to our interventions. Furthermore, surgery sites were restricted to the head and neck, which are under less tension, and thus our findings may not be generalizable to other parts of the body. Other body sites are thought to heal differently and thus require more study. Of note, the scalp and the nose were not represented in this study.

A search of the MEDLINE database on July 24, 2018, revealed no other studies concerning our topic when the keywords *suture spacing* were used. Thus, we have no other findings with which to compare results.

The possible benefits of using wider-spaced cutaneous sutures for wound closure include decreased procedure time, suture material used, and trauma to the skin. These potential benefits were not part of our study design and thus also need to be studied in the future.

Conclusions

Wound cosmesis outcomes did not differ between running cutaneous sutures spaced 2 vs 5 mm apart on the face and neck. Both techniques result in similar cosmetic outcomes and complication rates. Therefore, surgeons may want to consider whether the extra time involved in placing very closely spaced cuticular sutures is worthwhile.

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Author Contributions: Drs Eisen and Sklar 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.
Concept and design: Sklar, Eisen.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Sklar, Pourang, Eisen.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Armstrong.
Administrative, technical, or material support:

Pourang, Dhaliwal, Sivamani, Eisen.
Supervision: Eisen.

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REFERENCES

1. Thomsen TW, Barclay DA, Setnik GS. Videos in clinical medicine: basic laceration repair. *N Engl J Med*. 2006;355(17):e18. doi:10.1056/NEJMvcm064238

2. Moody BR, McCarthy JE, Linder J, Hruza GJ. Enhanced cosmetic outcome with running horizontal mattress sutures. *Dermatol Surg*. 2005; 31(10):1313-1316. doi:10.1097/00042728-200510000-00009

3. Wang AS, Kleinerman R, Armstrong AW, et al. Set-back versus buried vertical mattress suturing: results of a randomized blinded trial. *J Am Acad Dermatol*. 2015;72(4):674-680. doi:10.1016/j.jaad.2014.07.018

4. Custis T, Armstrong AW, King TH, Sharon VR, Eisen DB. Effect of adhesive strips and dermal sutures vs dermal sutures only on wound closure: a randomized clinical trial. *JAMA Dermatol*. 2015;151 (8):862-867. doi:10.1001/jamadermatol.2015.0174

5. Kappel S, Kleinerman R, King TH, et al. Does wound eversion improve cosmetic outcome? results of a randomized, split-scar, comparative trial. *J Am Acad Dermatol*. 2015;72(4):668-673. doi: 10.1016/j.jaad.2014.11.032

6. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research Electronic Data Capture (REDCap): a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381. doi:10.1016/j.jbi.2008.08.010

7. Draaijers LJ, Tempelman FR, Botman YA, et al. The Patient and Observer Scar Assessment Scale: a reliable and feasible tool for scar evaluation. *Plast Reconstr Surg*. 2004;113(7):1960-1965. doi:10.1097/01.PRS.0000122207.28773.56

8. Alam M, Posten W, Martini MC, Wrone DA, Rademaker AW. Aesthetic and functional efficacy of subcuticular running epidermal closures of the trunk and extremity: a rater-blinded randomized control trial. *Arch Dermatol*. 2006;142(10):1272-1278. doi:10.1001/archderm.142.10.1272

9. Jina H, Simcock J. Median sternotomy scar assessment. *N Z Med J*. 2011;124(1346):57-62.

10. Mosterd K, Arits AH, Nelemans PJ, Kelleners-Smeets NW. Aesthetic evaluation after non-invasive treatment for superficial basal cell carcinoma. *J Eur Acad Dermatol Venereol*. 2013;27 (5):647-650. doi:10.1111/j.1468-3083.2011.04347.x

11. Eom JM, Ko JH, Choi JS, Hong JH, Lee JH. A comparative cross-sectional study on cosmetic outcomes after single port or conventional laparoscopic surgery. *Eur J Obstet Gynecol Reprod Biol*. 2013;167(1):104-109. doi:10.1016/j.ejogrb.2012.11.012