

RESEARCH

The effect of Steri-Strip orientation on wound healing: A survey of current applications and trends amongst surgeons

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Abstract

Wound closure strips are used in the repair of superficial, low tension wounds, lacerations, and surgical incisions. They represent an inexpensive, easy, and painless way to close such wounds or as an adjunct in a multi-layered closure. There is debate over correct orientation (transverse, oblique, zig-zag or parallel) and importance of wound closure strips relative to the incision. The purpose of this research was to examine the closure techniques amongst Canadian plastic surgeons and current applications of wound closure strips using an online survey circulated to members of the Canadian Society of Plastic Surgery. Participants answered a series of multiple choice and short answer questions regarding their practice, closure techniques and use of wound closure strips. A total of 120 plastic surgeons (30.0%) completed the survey with 89.9% reporting wound closure strips usage. Of respondents who used wound closure strips, 57.2% used them in more than half of all wound closures. Parallel orientation to the wound (52.3%) and perpendicular orientation (30.8%) were the most common techniques employed, and these were applied in a consistent fashion (90.6%) covering the whole wound (78.1%). Most plastic surgeons agreed there is a need to further study adhesive strips. This survey of Canadian plastic surgeons has demonstrated the variability that exists in wound closure strip application technique, orientation and intended function. These findings suggest further investigation of wound closure strip usage may be needed to help guide clinical practice.

The four most commonly used wound closure techniques are adhesive strips, sutures, staples, and surgical glue, with the former two options being the most commonly employed.¹ Wound closure strips are mostly used to provide additional wound support after suture removal or as an adjunct with buried dermal or absorbable running subcuticular sutures in low-tension wounds to add stability to the site.² Studies have assessed the use of wound closure strips for the repair of surgical skin incisions and traumatic lacerations, assessing the relative effectiveness compared to other common modalities.³⁻⁵ When comparing adhesive strips used with buried sutures to traditional layered closures, no difference was seen in scar contour, erythema and overall cosmesis between the two methods for surgical incisions.³ In the short term, wound closure strips can show improved cosmetic outcomes and patient satisfaction for certain wounds; however, both methods provide the same long-term cosmetic results.^{4,5} Wound closure strips are therefore sometimes considered a time- and cost-effective alternative to sutures for both traumatic lacerations and surgical incisions.

Wound closure strips, such as Steri-Strips™ (3M®, Two Harbours, MN, USA), are a form of adhesive tape used in the closure of superficial, low tension wounds, lacerations, and surgical incisions.¹ Given their ease of application, wound closure strips are used in a variety

of settings, including the emergency department and operating suite. Wound closure strips are inexpensive, easy, and painless to apply, which is why they are sometimes preferred to other forms of wound closure methods such as sutures or staples in conscious patients. When compared to cutaneous sutures, wound closure strips provide faster closure times, avoid visible puncture marks, and decrease the risk of tissue strangulation and needle-stick injuries.³ Additionally, follow-up visits for suture removal are not required when using wound closure strips, making them a favourable and cost-effective option.

There have been several observational studies and opinions published on the topic of optimal application for adhesive tapes.⁶⁻⁸ The authors are unaware of any clear consensus or randomized control trial reported supporting the use of one orientation (i.e. transverse, oblique, zig-zag or parallel) for wound closure strips over another relative to the incision. A study in healthy volunteers assessed Steri-Strips™ adherence over time for different patterns of parallel orientations (no edges, tacked, overlapping). The study found that the application of strips in a parallel, non-overlapping fashion after complete coating of the skin surface with mastisol had the best adherence over time on healthy skin.⁷ It has also been reported that transverse application of adhesive strips in high tension areas such as the back after a latissimus dorsi flap were more susceptible to shearing effects and subsequent

Table 1: The complete list of questions and answer choices included in the distributed survey

1. What is your surgical specialty?	8. How often do you use Steri-Strips?	d. Combination e. Other
a. Plastic Surgery	a. Rarely (<10%)	13. Why do you prefer the technique indicated above? (Please check all that apply)
b. General Surgery	b. Some procedures requiring closure (10-49%)	a. Reduced wound tension
c. ENT Surgery	c. Most procedures requiring closure (49-89%)	b. Looks neater
d. Other	d. All procedures requiring closure (90-100%)	c. Faster application
2. Country of Residency	9. What do you use Steri-Strips for? Please check all that apply	d. Better adherence
a. Canada	a. Trauma/emergency closures	e. Less chance of blistering
b. United States	b. Skin closures after procedures with a small (<5cm) incision	f. Other
c. Other	c. Skin closures after procedures with a large (>5cm) incision	14. For the closure of the same incision, do you place all Steri-strips in a consistent orientation (transverse, parallel etc.)? If no, please specify
3. Province of Practice	d. Skin closures after procedures with punch incisions	a. Yes
a. Alberta	10. For you, what purpose do Steri-Strips serve? Please check all that apply	b. No
b. British Columbia	a. Reducing the tension across the wound	15. Do you overlap Steri-Strips when placing them on the wound?
c. Manitoba	b. A dressing to assist with wound healing (Band-Aid)	a. Yes
d. New Brunswick	c. Improved cosmesis (hides the suture line while healing)	b. No
e. Newfoundland and Labrador	d. Progressive tension-assisted closure using principle of creep	16. Do you completely cover the whole wound when using Steri-Strips?
f. Nova Scotia	e. Other	a. Yes
g. Ontario	11. Are there any wounds where you would not use steri-strips? (Please check all that apply)	b. No
h. Prince Edward Island	a. Loose closure with drainage expected	17. Have you experienced any complications with the use of Steri-Strips? If you answer yes, please specify
i. Quebec	b. Fragile, elderly skin	a. Yes
j. Saskatchewan	c. Closed with large suture (>3.0 nylon)	b. No
k. Other	d. Irregular surface over joint	18. There is a need for more reliable evidence to advise placement orientation of Steri-Strips. Please rate your agreement with this statement.
4. Years of Practice	e. Other	a. Strongly Agree
a. <4	12. When using Steri-Strips, what orientation do you place them relative to the wound most often? Please select the most common application method you use	b. Agree
b. 5-10	a. Parallel	c. Neutral
c. 10-20	b. Perpendicular	d. Disagree
d. >20	c. Zig-zag	e. Strongly Disagree
5. Do you use adhesive strips for wound closure in your practice?		19. Do you think there is a difference in outcomes/side effects in regards to Steri-Strips orientation along the wound? If so, explain and offer any additional comments on your personal approach to Steri-strip use
a. Yes		
b. No		
6. Do you use the Steri- brand of adhesive tape?		
a. Yes		
b. No		
7. For a straight line incision closure (eg. abdominoplasty) select all that apply for skin closures in your practice:		
a. Deep dermal sutures		
b. Running intracuticular/subcuticular		
c. Staples		
d. Skin adhesive/glue (Dermbond)		
e. Adhesive strips (Steri-strips)		
f. Other		

*If you use Ster-Strips in your practice, please complete the remaining questions

blistering.⁸ For these anecdotal reasons, it is believed that application of adhesive tapes parallel to wounds maintains good adherence and avoids blistering complications.^{7,8}

While the manufacturer of Steri-Strips™ advises that they be applied transversely across the wound with supporting (tacked) parallel strips applied away from the incision forming a railroad pattern, there is variability in clinical practice since the rationale and outcome evidence for this method is lacking.⁸ The purpose of this study was to examine variability in closure techniques among Canadian plastic surgeons and current applications trends of wound closure strips.

Methods

Institutional ethics approval was obtained for this study. The study was unfunded. A total of 429

plastic surgeons identified as active members of the Canadian Society of Plastic Surgeons (CSPS) were invited to participate in this study. An introductory email was sent to CSPS members via the Society's web server list. This included the informed consent form and a link to participate in the study. All data captured was anonymous and only surveys from a unique IP address were included in the subsequent analysis to avoid multiple responses by the same participant. Participants answered a series of multiple choice and short answer questions regarding their practice, closure techniques and use of wound closure strips (Table 1). More specifically, the survey evaluated frequency of wound closure strip use, orientation of placement, perception of function and complications of use. The responses were saved and analyzed on a secure Dalhousie server using Opinio™ (ObjectPlanet®, Oslo, Norway).

Survey answers were calculated as a relative frequency percentage to identify trends in wound closure strip use. For each question, the total number of participants that selected an answer choice relative to the total number of participants that answered that question was calculated and expressed as a percentage. Any individual survey response with incomplete information was not included in the analysis.

Results

A total of 120 plastic surgeons (30.0%) completed the survey according to the inclusion criteria. The majority (96.7%) were Canadian surgeons from Ontario (38.3%, Figure 1). The majority of respondents (74.2%) had been in practice for greater than 10 years (Table 2). Wound closure strip use was used by 89.9% of respondents, with 82.9% using the Steri-Strip™ brand specifically.

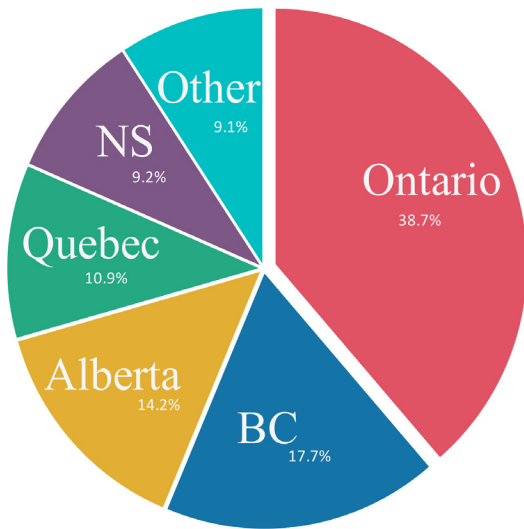


Figure 1: The geographic location of survey respondents practice

The most common methods employed for closure of a straight-line incision such as abdominoplasty were deep dermal sutures (94.2%) and running subcuticular/intracuticular (94.2%) followed by the application of wound closure strips. Use of skin glue (22.3%), micropore tape (7.5%) and staples (2.5%) were also reported (Table 3).

Table 2: The geographic location of survey respondents practice

	Answer Chosen	Positive Response Frequency
Training	Plastic Surgery	100
	Canadian Residency	98.31
Experience	<5 years	14.29
	5-10 years	11.76
	10-20 years	29.41
	>20 years	44.54

Table 3: Frequency of methods employed for the closure of a straight-line incision

	Answer Chosen	Positive Response Frequency
Closure Method	Deep Dermal	94.17
	Running subcuticular	94.17
	Use of adhesive strips	89.92
	Steri-strips	82.91
	Skin Glue	21.67
	Staples	2.5

In the group that used wound closure strips, 57.2% used them in more than half of all wound closures. These included large incisions (88.6%), small incisions (86.7%), traumatic lacerations (22.9%) and punch biopsy incisions (13.3%). The strips were thought to function as a dressing (66.4%), reduce tension (64.5%) and improve cosmesis by hiding sutures (54.2%). With regard to the orientation in which wound closure strips were applied relative to the incision, parallel orientation (52.3%) and perpendicular orientation (30.8%) were the most common techniques employed, and these were applied in a consistent fashion (90.6%) covering the whole wound (78.1%). Some surgeons (56.2%) described overlapping the strips when applying them (Figure 2). Seventy percent of surgeons experienced complications with wound closure strips, most commonly blistering (82.7%). Most plastic surgeons (73.9%) were neutral, agreed or strongly agreed that more reliable evidence was required to determine if wound healing outcomes differed depending on how wound closure strips were applied relative to the incision.

Discussion

This survey of Canadian plastic surgeons has demonstrated that deep-dermal and running subcuticular/intracuticular sutures are most commonly used for wound closure. It is evident that adhesive strips such as Steri-Strips™ are often used as an adjunct to these methods forming part of the multi-layered closure utilized in both traumatic and elective surgical incisions. There was no definite variation in these trends according to geographic location, years of experience or country of training for the plastic surgeon.

The results of this study demonstrate substantial disagreement on how wound closure strips are applied. While the manufacturer of Steri-Strips™ recommends that they be applied in a non-overlapping and transverse orientation relative to the incision line with supporting strips away from and parallel to the incision line, no justification for this recommendation is provided.⁹ Although most surgeons (52.3%) apply wound closure strips parallel to the wound, a large number (30.8%) still apply them perpendicular. Therefore, there is poor adherence to the manufacturer’s recommendations. The variability in practice is likely based on anecdotal experience. Based on the authors limited literature

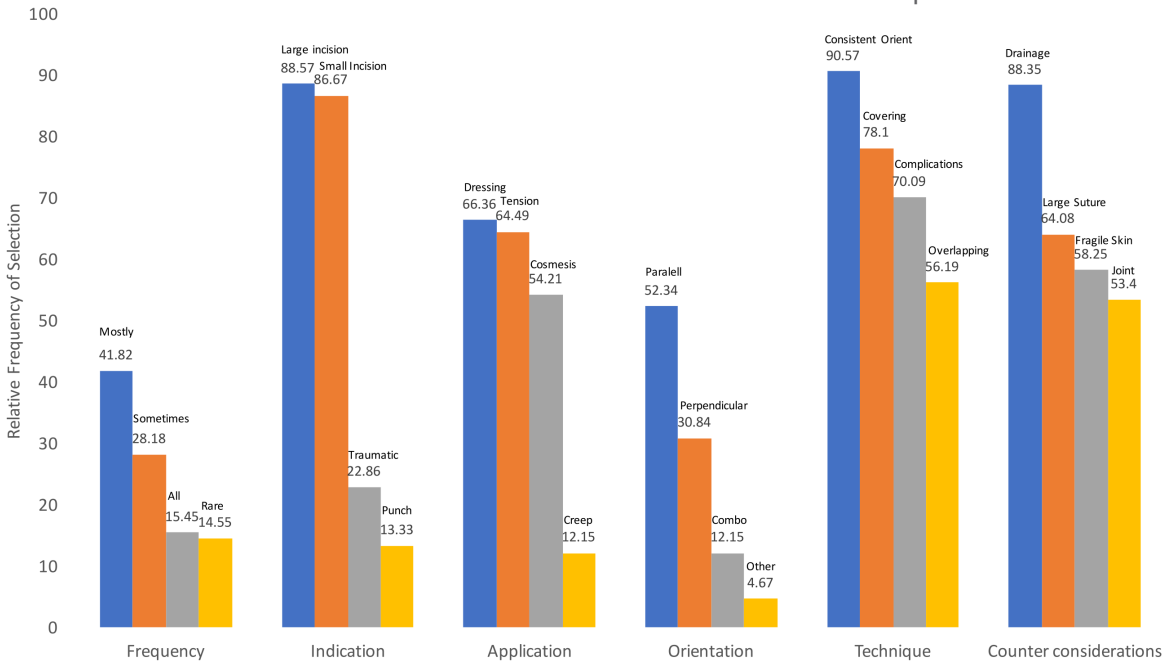


Figure 2: A description of how adhesive tapes are used by plastic surgeons that utilize them as part of wound closure

search, they are unaware of any study demonstrating superiority between one method of application compared to another.

The importance of these findings becomes evident when considering how wound closure strip application technique may affect wound healing. Scar appearance may be different based on the method selected. Furthermore, using wound closure strips is not an entirely benign component of wound closure. Orientation could be a determinant in complications such as blistering, where perpendicular placement is thought to play a larger role. As with any surgical intervention, an evaluation of risks and benefits must be weighed to justify usage in a scenario. Many surgeons responding to the survey agreed that there is a need to study wound closure strip use to determine what benefit, if any, it provides.

The study's limitations included a low response rate (30.0%) and potential selection bias that must be interpreted accordingly. The survey's self-reported design has an associated reporting bias that fits a plastic surgeon's perspective of the event rather than an objective observational account. The wounds encountered by plastic surgeons may differ from those in the emergency room or general practitioner's office, but the principles of multi-layered technique still apply to all wounds that can be closed primarily. Plastic surgeons are often consulted in complex wound situations and difficult closures, so we believe the methods employed commonly in the survey are applicable to most wounds (deep and superficial) requiring a skin closure. The survey's results prompt the need for more reliable evidence with regard to correct adhesive strip application orientation. Although a formal literature review was not completed, the authors were unaware of any randomized control

trial or consensus guideline that supports the use of a particular orientation for wound closure strips.

Plastic surgeons pride themselves on precise, multi-layered closures to optimize cosmetic outcomes. Scarring is an important element of wound healing, and is influenced by the type of wound closure method used. It is unclear whether differences in the orientation, number and degree of overlap of wound closure strips influence scar quality. This survey of Canadian plastic surgeons demonstrates a lack of a consensus on whether and how wound closure strips are applied.

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