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ORIGINAL ARTICLE GENERAL RECONSTRUCTION

Effective Wound Closure With a New Two-Component Wound Closure Device (Prineo™) in Excisional Body-Contouring Surgery: Experience in Over 200 Procedures

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Abstract
Background In excisional body-contouring surgery the surgeon is often confronted with time-consuming closure of long wounds. Recently, a new combination of a self-adhering mesh together with a liquid 2-octyl cyanoacrylate adhesive (Prineo™; Ethicon, Inc., Somerville, NJ, USA) has been introduced to replace intracutaneous running suture.
Methods An observational study was undertaken to evaluate the efficacy of the new wound closure device in excisional body-contouring procedures between January 2008 and November 2010. Wound characteristics were recorded in a prospectively maintained database.
Results During the study period, 224 procedures in 180 patients were undertaken. Twenty-seven patients had two subsequent operations and four patients had three subsequent operations. Application of the new device was easy and safe and patient satisfaction with the results was generally high. However, intense local allergic reactions were seen in 4 patients (1.8%), which necessitated early removal and topical corticosteroid treatment.
Conclusions Prineo™ enables the surgeon to perform a quick and smooth skin closure, especially in long incisions frequently encountered in excisional body-contouring surgery. The application is fast and easy if basic guidelines are respected. Operating time is saved by eliminating the need for time-consuming intracutaneous running sutures. Removal is easy and painless for the patient. However, there is a potential for local allergic adverse effects of which the surgeon must be aware.

Keywords Body contouring · Wound closure · Wound dehiscence · Prineo™ · Adverse reaction

Body-contouring surgery after massive weight loss is one of the most expanding fields in plastic surgery [1]. Typical operations include circumferential body lifts [2–4], upper body lift [5], thigh lift [6, 7], brachioplasty [8], and mastopexy [9]. Usually closure of incisions in these operations is time-consuming due to the lengthy wounds that are typically encountered when using resorbable subcutaneous sutures and nonresorbable intracutaneous sutures. Thus, alternative skin closure systems such as 2-octyl cyanoacrylate (Dermabond™; Ethicon, Inc., Somerville, NJ, USA) have been introduced with good success and safety [10–12]. Prineo™ (Ethicon) is a new development in topical skin adhesives, combining a self-adhering, pressure-sensitive adhesive (PSA), polyester-based mesh for temporarily holding together the approximated skin edges of an incision and a 2-octyl cyanoacrylate liquid adhesive formulation for final skin closure. This two-component system

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adds further stability and applicability to wound closure compared to a liquid adhesive alone. By sparing long intracutaneous sutures, wound closure time is significantly reduced and wound edge ischemia diminished. The goal of this report is to present our experience with this new skin closure system in a large series of excisional body-contouring procedures.

Patients and Methods

From January 2008 until November 2010, 180 patients (m:f = 13:157) underwent some type of excisional body-contouring surgery. The mean age at surgery was 41.0 years (range = 19–70 years). In this time period 224 procedures were performed. In general, the tissue adhesive was used on long incisions for which the advantages of a rapid wound closure system are more significant. This wound closure device was not used on patients with a known history of allergic reaction to cyanoacrylates. After the excisional procedure was completed and hemostasis was obtained, the wound was closed in either a two- or a single-layered fashion, approximating the superficial fascial system and the dermis, with resorbable sutures (Vicryl; Ethicon). After the wound was closed sufficiently on a subcutaneous and dermal level, Prineo™ was applied to the wound as suggested by the manufacturer (Fig. 1). For evaluation of the effectiveness of this new wound closure device, wound characteristics were prospectively recorded in the patient database.

Results

Prineo™ wound closure system was applied safely and effectively in most of the 224 procedures without any disadvantages compared to conventional wound closure. The different types of procedures in which the Prineo™ wound closure system was successfully administered are given in Table 1. The application of Prineo™ as described in Fig. 1 is safe and simple and allows for rapid and efficient wound closure. Time reduction was most evident in closure of straight lengthy incisions by eliminating the need for time-consuming intracutaneous running sutures. Table 2 compares total operating times in three common types of excisional body-contouring procedures between the traditional wound closure technique (resorbable subcutaneous sutures plus running nonresorbable intracutaneous suture) and the Prineo™-type wound closure technique.

No major wound-healing disturbances compared to conventional wound closure were recorded. Even in cases with partial loosening of the adhesive tape, no wound

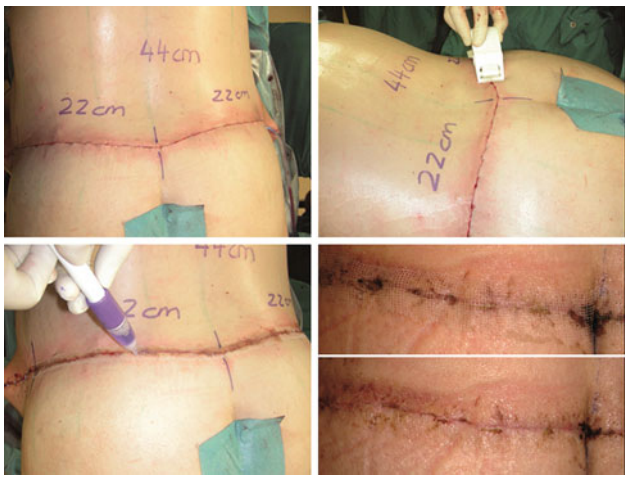

Fig. 1 After sufficient wound closure in a two-layered fashion is achieved, the wound is prepared for application of the self-adhering, pressure-sensitive-adhesive, polyester-based mesh by thorough cleaning (*top left*). The mesh is successively applied for accurate wound edge approximation without tension. Care has to be taken not to stretch the mesh band since this will result in reduced adherence to the skin (*top right*). By using a pen applicator, the 2-octyl cyanoacrylate liquid adhesive is administered along the entire mesh covering the wound (*bottom left*). The liquid cyanoacrylate is allowed to dry and polymerize. The photos in the lower right show the wound on the 14th postoperative day before (*above*) and after (*below*) removal of the self-adhering tape

dehiscence occurred. However, there were minor wound-healing complications encountered in this series that were subjectively lower compared to our previous patient group in which we did not use Prineo™. These were comparable to previously reported incidences of wound-healing complications [12]. However, this comparison was not performed on a statistical basis and is therefore rather anecdotal. In cases of wound-healing complications, such as partial superficial wound breakdown, Prineo™ was removed with scissors around the breakdown and local wound management was initiated accordingly. Removal of the Prineo™ system during the regular outpatient visit 2 weeks after surgery in uncomplicated cases was completed easily with a forceps with only minimal discomfort for the patient compared to removal of nonresorbable stitches (Fig. 1). Thus, patient satisfaction with this new wound closure device was generally high due to the lack of pain sometimes encountered during traditional skin suture removal. Scar quality was also satisfactory on long-term follow-up (Fig. 2) when compared to regular wound closure methods, but this was not assessed in a standardized manner.

In 4 of the 224 (1.8%) procedures, intense local allergic reactions with considerable itching in the vicinity to the Prineo™ wound closure system were observed (see Figs. 3 and 4). The procedures involved included two reduction mammaplasties, one upper arm lift, and one vertical thigh

Table 1 Summary of the different indications for Prineo™ wound closure system

Indication	No. of procedures
Body lift	61
Upper body lift	8
Lower/central body lift	53
Abdominoplasty	55
Reduction mammaplasty	41
DIEP/TRAM donor site closure	18
Scar revision	13
Vertical thigh lift	16
Upper arm lift	13
Other	7
Total	224

Table 2 Comparison of mean total operating times in three common types of body-contouring procedures between traditional and Prineo™ wound closure

	Traditional wound closure (min) (range)	Prineo™ wound closure (min) (range)	Time reduction typically achieved (mean) (min)
Inverted-T reduction mammaplasty	124.5 (103–153)	106.7 (95–117)	17.8
Abdominoplasty	118.3 (88–143)	103.8 (88–124)	14.5
Lower body lift	297.4 (197–385)	263.7 (180–310)	33.7

See text for further explanation

lift. The local reactions were managed conservatively by topical corticosteroid skin ointment and further wound healing was uneventful. In all four patients, the allergic reaction to Prineo™ occurred after previous use of this wound closure device.

Discussion

To the best of our knowledge this is the largest patient study with the new wound closure device Prineo™. We were able to show that this new modality is safe and its application is advantageous in long straight wounds compared to traditional skin sutures.

Excisional body-contouring procedures are increasingly part of plastic surgery practice due to the increase in bariatric procedures. Wound closure in these procedures takes a significant amount of time due to long straight wounds. These wounds are typically closed using resorbable subcutaneous sutures and time-consuming nonresorbable

Fig. 2 Three examples of scar quality after wound closure with Prineo™ at 1-year follow-up. The *top* row shows an abdominoplasty with rectus plication, the *middle* row a lower body lift, and the *bottom* row an inverted-T reduction mammaplasty

intracutaneous sutures. Besides being time-consuming, intracutaneous sutures increase wound edge ischemia and inflammation, which play a major role in wound healing and final scar appearance. Therefore, alternative wound closure systems such as 2-octyl cyanoacrylate (Dermabond™) have been used with good success [10–12]. Recently, the Prineo™ wound closure system was introduced, representing the next generation of skin adhesives [13]. It consists of two components: a self-adhering, pressure-sensitive adhesive (PSA), polyester-based mesh for approximation of skin edges and a 2-octyl cyanoacrylate liquid adhesive for final skin closure. Thus, compared to Dermabond™, this system adds an additional layer of stability with the mesh. The mesh is then rigidly reinforced with the liquid adhesive. In our opinion, this addition has two advantages. First, rolling off the mesh with the

Fig. 3 Patient with local allergic reaction to the Prineo™ wound closure system on the right thigh after vertical thigh lift

Fig. 4 Patient with an allergic reaction after *upper-arm* lift during an *upper-body* lift procedure. The skin reaction extends beyond the area of application, with redness and blistering. However, no wound dehiscence occurred during the healing process

specially designed device enables exact wound edge approximation to some degree that cannot be achieved with Dermabond™. Furthermore, the rigid mesh also protects the wound against shear forces better then the liquid adhesive alone. However, we did not evaluate this in a scientific randomized manner. Therefore, further studies are needed to confirm the superiority of Prineo™ over Dermabond™ since there are also increased costs for this new device. It would also be interesting to compare Prineo™ with the other new wound closure modality, the barbed sutures such as Quill™ or V-Loc™. In our opinion, Prineo™ will not replace traditional or barbed sutures in closing more irregular wounds since flexibility in wound edge approximation is inferior.

Currently, it is our practice to use Prineo™ only in cases in which we encounter long straight wounds since we feel that in these instances the new system has the most benefit. These instances also include revision of longer scars or closure of flap donor sites such as the anterolateral thigh flap. One reason for this is that final adjustments in skin alignment after subcutaneous closure, such as insetting of the areola in reduction mammaplasty, are not very feasible with this new device. However, its fast and easy application in long, already subcutaneously closed wounds is the most important advantage of this new device. In addition, the other big advantage of Prineo™ is its removal. We typically remove Prineo™ after 14 days, similar to a running intracutaneous suture. The tape can be peeled off very easily with minimal patient discomfort. From a patient's perspective this is the most striking advantage since almost all patients fear taking out skin sutures. They particularly like the concept that their wound was "glued" instead of sutured. Later in our series, patients even asked ahead of the operation if their wounds could be glued instead of using traditional skin sutures.

We encountered some problems when first using the device so we adjusted our technique of application. For instance, in circumferential truncal contouring, the patient is lying on the closed wound after being turned over on the operating table. Due to the pressure, blood oozes through the wound and soaks the Prineo™ and sticks to the adhesive. During the first dressing change, the chance for inadvertent removal of the Prineo™ is relatively high. Thus, as with every new technique there is a learning curve with this new wound closure device. From our experience with 224 procedures, we developed some basic guidelines that we found very valuable for safe and effective use of the Prineo™ wound closure device:

1. Exact wound closure and approximation of wound edges in a two-layered subcutaneous fashion is mandatory before application.
2. Meticulous hemostasis has to be achieved to prevent oozing from the wound edges, thus minimizing adherence of the mesh–cyanoacrylate combination to adhesive tapes.
3. The wound has to be thoroughly cleaned before application of the self-adhering mesh.
4. The self-adhering polyester-based mesh has to be applied/rolled off onto the approximated wound without any undue tension since this would cause stretching of the mesh resulting in less adherence.
5. The 2-octyl cyanoacrylate liquid adhesive is administered with a pen applicator along the entire mesh covering the wound. The liquid cyanoacrylate is then allowed to dry and polymerize according to the manufacturer's recommendation.
6. We always apply Steri-Strips™ (3M Health Care, Minneapolis, MN, USA) to cover the glued mesh to prevent adhesion to the final dressing and consequent accidental removal during the first dressing change.

Apart from these beneficial aspects there are also some disadvantages to Prineo™. Although there are reports about allergic reactions to 2-octyl cyanoacrylate [14], hardly any adverse effects about the Prineo™ wound closure system have been published so far [15]. In our series of 224 procedures in 180 patients, local allergic reactions to the Prineo™ wound closure system were encountered in 4 patients (1.8%). It is important to note that in these four patients the allergic reaction occurred after previous usage of this new wound closure device. Thus, it is obvious that the patients had been sensitized to one of the components of Prineo™ during their first operation. However, all of these local allergic reactions could be managed conservatively by application of local corticosteroid ointment. One patient required further treatment of subsequent hyperpigmentation in the inframammary fold [15]. When there is a local allergic response, early removal of Prineo™ is required to remove the causative agent and prevent further progression. Usually this takes place during the first ambulatory visit 1 week after the operation. At this

time the allergic reaction becomes obvious. This is a very stressful situation for both the patient and the surgeon since the allergic reaction causes a lot of discomfort to the patient and early removal of the device might lead to wound dehiscence. The surgeon must be aware of this potential adverse effect of which the patient has to be informed accordingly. One way to avoid this complication is to apply this new wound closure device in only one procedure and avoid it in subsequent operations.

Conclusion

Prineo™ enables the surgeon to perform a quick and smooth skin closure, especially long incisions frequently encountered in excisional body-contouring surgery. The application is fast and easy if basic guidelines are respected. Operating time is saved by eliminating the need for time-consuming intracutaneous running sutures. Removal is easy and painless for the patient. However, there is a potential for local allergic adverse effects of which the surgeon must be aware.

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