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Defect closure with "8-shaped crisscross tensile suture" technique

Nebil Yeşiloğlu, MD,[a] Hakan Şirinoğlu, MD,[a,*] Kemalettin Yildiz, MD,[b] Arzu Özcan Akçal, MD,[c] and Gürsel Turgut, MD[d]

[a] Department of Plastic Reconstructive and Aesthetic Surgery, Dr. Lütfi Kırdar Kartal Training and Research Hospital, İstanbul, Turkey

[b] Department of Plastic Reconstructive and Aesthetic Surgery, Bezmi Alem Vakıf University Medical Faculty, İstanbul, Turkey

[c] Department of Plastic Reconstructive and Aesthetic Surgery, Akdeniz University Medical Faculty, Antalya, Turkey

[d] Department of Plastic Reconstructive and Aesthetic Surgery, Istanbul Cerrahi Hospital, İstanbul, Turkey

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ABSTRACT

Background: Sutures and suturing techniques compose the basis of the surgery. Although many surgical methods such as the skin grafts or flaps has been described for the closure of large defects, proper primary suturing may sometimes yield very successful results and decrease the need of complicated procedures. In this article, a new combined skin-subcutaneous tissue suturing technique called as "8-shaped crisscross tensile suture (8CTS)" designed for the closure of large skin defects is presented.

Patients and methods: One hundred forty-nine patients with an age distribution between 14 and 65 y were operated for large skin defects by using the 8CTS technique. The most common etiology of the defects was free flap donor sites, and the most common defect localization was the anterolateral thigh region. The average defect width on the axis of primary closure was calculated as 14.6 cm. The 8CTS technique is a combination of both skin and subcutaneous layers suturation and may even involve deeper layers suturation according to the depth of the defect.

Results: Eight complications including wound dehiscence, early recurrence of pilonidal sinus disease, seroma formation, skin-edge necrosis, and incisional hernia were observed. The wounds of 141 patients were treated successfully.

Conclusions: The 8CTS technique is a useful method for the closure of large defects eliminating the need of more complex procedures and providing acceptable cosmetic results while supporting both skin and subcutaneous tissue in one suture.

1. Introduction

Various skin defects located on any part of the body can be treated with many different surgical approaches such as primary closure, skin grafting, local or distant flaps, or even complex procedures like free tissue transfers [1]. Primary closure is the preferred treatment of any kind of wounds in routine surgical practice and is also the easiest solution both

* *Corresponding author*. Department of Plastic Reconstructive and Aesthetic Surgery, Dr. Lütfi Kırdar Kartal Training and Research Hospital, Kartal, Istanbul 34156, Turkey. Tel.: +90 532 4918869; fax: +90 212 559 32 44.
E-mail address: drhakansirinoglu@gmail.com (H. Şirinoğlu).

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for the surgeon and the patient as it is the first step of reconstructive ladder [1,2]. However, large wounds especially free flap donor areas, defects occurring after large tumor resections, or removal of wide pilonidal sinus disease are generally unsuitable for primary closure and split-thickness skin grafting, which have several disadvantages such as the need of a new donor area and poor cosmetic results, is usually required [3,4]. Large defects may also be repaired by gradual skin traction systems, but these methods usually increase the hospitalization period of the patient and can only be performed in selected patients [5–7]. The 8-shaped crisscross tensile suture (8CTS) technique presented in this article is a combined skin-subcutaneous tissue suturation method providing both skin and subcutaneous tissue support at one suture and may be used for the closure of large defects eliminating the need of additional methods or complex reconstruction techniques.

2. Patients and methods

One hundred forty-nine patients with an age range of 14 to 65 y (mean age: 36.4 y) were treated because of large skin defects using the 8CTS method between May 2005 and June 2013. One hundred eleven patients were male, whereas the remaining 38 were female. The most common cause of the defects was flap donor sites followed by wide mastectomy defects and pilonidal sinus surgery. One hundred forty of 149 defects were extending to the deep fascia. The mean defect width on the axis of primary closure was calculated as 12.8 cm in a range of 3.7–23.4 cm. Thirty-four of 149 patients (22.8%) had comorbidities; diabetes and hypertension were the most commonly observed comorbid diseases followed by hypercholesterolemia, chronic lung disease, and chronic renal failure. Furthermore, 16 of our 149 patients were obese. Table summarizes important details about the defects treated with 8CTS technique.

2.1. Surgical technique

Polypropylene suture (size, 1-0, 2-0, and 3-0) with sharp needle depending on the size and location of the defect is used for the 8CTS method. Before beginning to the suturation, skin undermining was performed. The planned undermining was half of the width of the defect on each side and during the undermining; skin perforators were carefully protected. In the first step, the needle is passed through the skin of side A to the subdermal plane and then through the same plane at the side B in the direction of subcutaneous tissue. In the second step, which is the second half of the figure "8," the needle is passed through subcutaneous tissue of side A and turned back to the subdermal plane of side B passing through the skin to tie the knot (Fig. 1A). If it is needed, it can be finished in mattress or half-buried mattress fashion. Deeper defects such as the pilonidal sinus defects require more than one 8CTS, and in this situation, the first 8CTS is extended with a second vertically directed 8CTS resembling a braid (Fig. 1B). In all cases with 10 cm or wider defects, the skin was supported with greasy gause pads that were removed at the third postoperative day to reduce the tension on the skin (*The Video of the technique is available as supplemental file*).

3. Results

In all patients, surgical drains were removed in the first three postoperative days, and sutures were removed at the postoperative third week (Fig. 2, Fig. 3 and Fig. 4). Eight remarkable complications were encountered among 149 patients (Table). In one patient treated for anterolateral thigh flap donor site, wound dehiscence occurred because of early suture removal performed in another center. This patient was treated with the same technique after wound debridement, and sutures were removed on the third postoperative week uneventfully. In one patient operated because of a large pilonidal sinus defect, early recurrence of the disease was detected, and

Table – Important details about the defects closed with 8CTS technique.

Cause of the defect	Number of patients	Mean (range) width (cm)*	Cases extending to deep fascia	Complications
ALT flap donor site	37	12.4 (7–16.3)	37	Wound dehiscence ($n = 1$)†
Venous flap donor site‡	14	5.4 (3.7–6.2)	14	—
Secondary to pilonidal cyst and sinus surgery§	23	14.2 (11.3–19.4)	18	Early recurrence of the lesion ($n = 1$)†
Wide mastectomy defects	26	19.9 (17.2–23.4)	26	Seroma formation with self-relief ($n = 2$)
TFL flap donor site	18	11.3 (9–14.2)	18	—
Traumatic skin avulsion (immediate repair after debridement)	16‖	8.8 (6.3–12.1)	12	Skin-edge necrosis† ($n = 2$)
Anterior abdominal wall exploratis laparotomy defect	15	12.4 (8.2–15.6)	15	Incisional hernia ($n = 2$)
All patients treated using 8CTS technique	149	12.8 (3.7–23.4)	140	Previously mentioned complications ($n = 8$)

ALT = anterolateral thigh flap; TFL = tensor fascia lata.
* This width means the dimension vertical to the axis of the wound and parallel to repair axis.
† All these complicated patients were treated again by using 8CTS technique without any additional complications.
‡ All the venous flap donor sites were at the volar aspect of upper extremity.
§ All the pilonidal cyst or sinus operations were performed by plastic surgeons.
‖ Two cases of torso, 10 cases of lower extremity, and four cases of upper extremity.

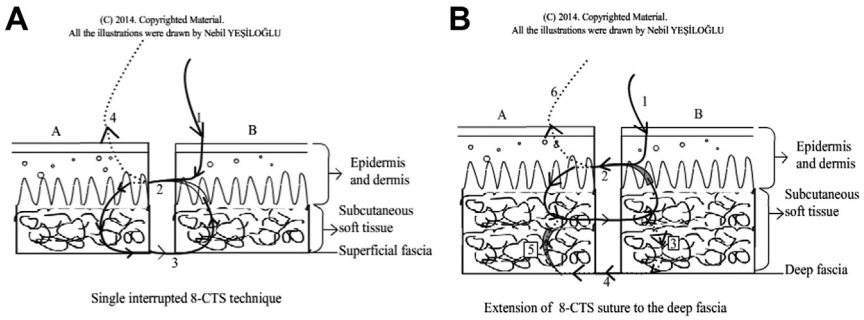

Fig. 1 – Needle passes through the skin of side A to subdermal plane and then through the same plane at the side B in the direction of subcutaneous tissue, which is followed by same sequences at the opposite side (A). 8CTS that extends to the deep fascial plane is used for deeper pockets like presacral area (B). Numbers indicate the stages of the suture sequence.

revision surgery was performed using the 8CTS technique, and the lesion was treated uneventfully. Seroma formation was encountered in two patients treated for wide mastectomy defects, which resolved spontaneously without any additional intervention. In two patients treated because of traumatic skin avulsion, skin-edge necrosis was encountered, and spontaneous secondary healing was observed. Two cases of incisional hernia were detected in defects resulted because of anterior abdominal wall explorative laparotomy. Scar tissue measurements demonstrated that the maximum scar enlargement was found to be 7 mm in the postoperative sixth month. Patients treated for skin defects located at the thigh region were able to walk and flex their knees at the second week of the operation. For patients with upper and lower extremity defects, 1 wk of immobilization period was suggested followed by gradual mobilization started at the beginning of the second week. Full mobilization was achieved at the end of the third week when the sutures were taken of. Patients with defects secondary to pilonidal sinus surgery could began to sit normally at the first postoperative day, and no wound dehiscence was encountered. Other complications such as hematoma and wound infection were not encountered. The passive and active ranges of motion of the joints located adjacent to the repaired area were not changed both in the early and late postoperative period.

4. Discussion

Plastic surgeons commonly deal with the closure of large wounds, which are mostly unsuitable for primary closure [1,2]. However, primary closure is the preferred method of wound closure because of its easiness and ability of providing the fastest wound healing [3,4]. The presented technique called as 8CTS is mainly designed to close larger defects in primary fashion by providing “two-in-one” closure of both skin and subcutaneous tissue layers together in one suture.

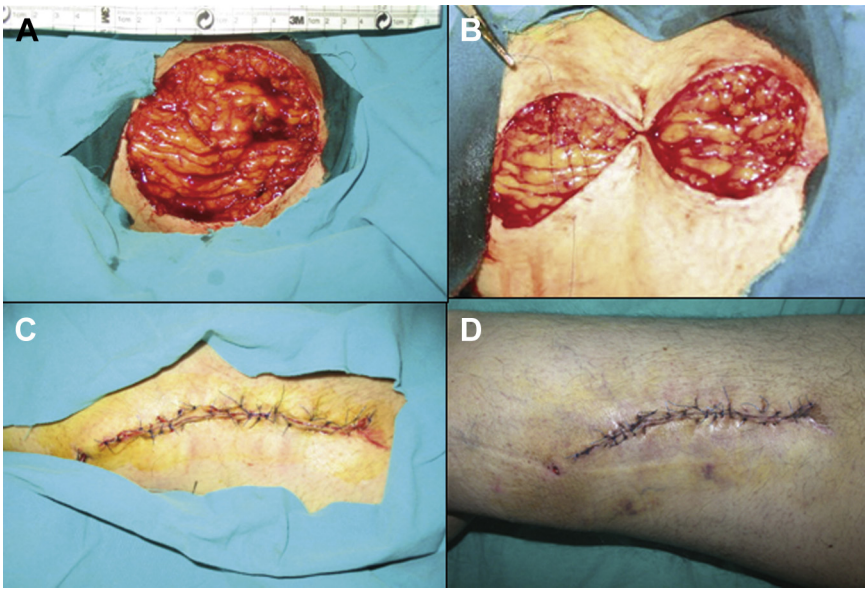

Fig. 2 – A traumatic avulsion defect at the right anteromedial area after surgical debridement (A). The defect was closed with 8TS technique using 3-0 polypropylene suture material (B, C). Postoperative seventh day (D). (Color version of the figure is available online.)

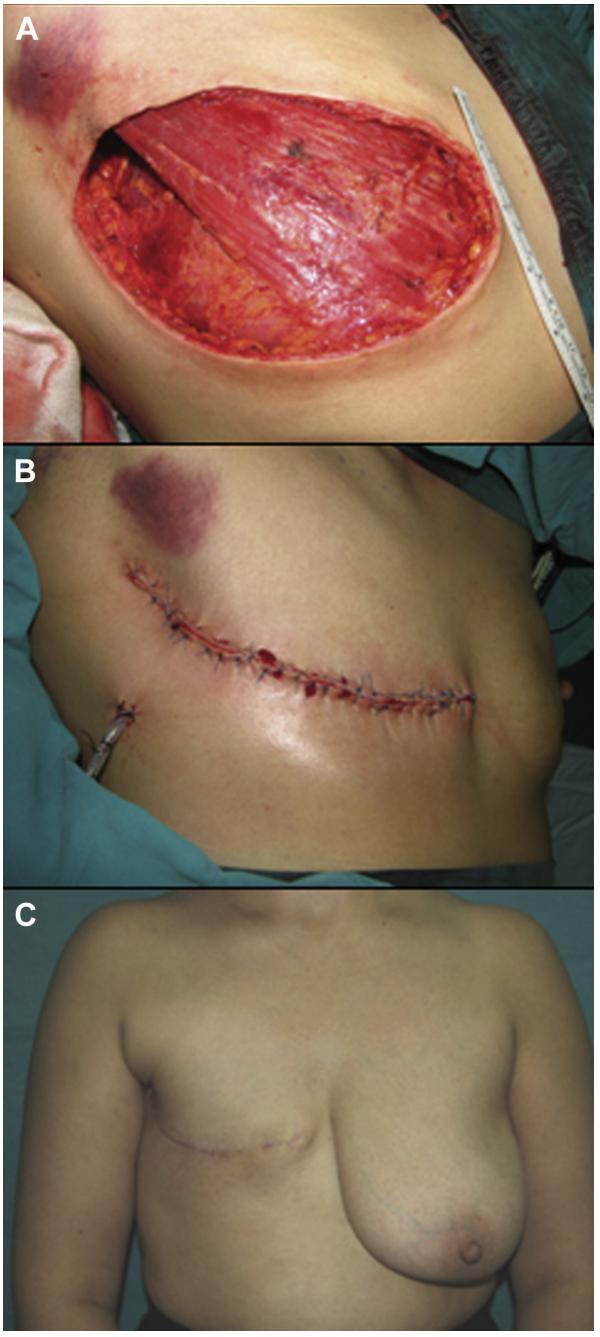

Fig. 3 – Right postmastectomy defect in a 41-y-old female patient (A). closed with 8TS technique using 3-0 polypropylene suture material (B). Result on fourth postoperative month (C). (Color version of the figure is available online.)

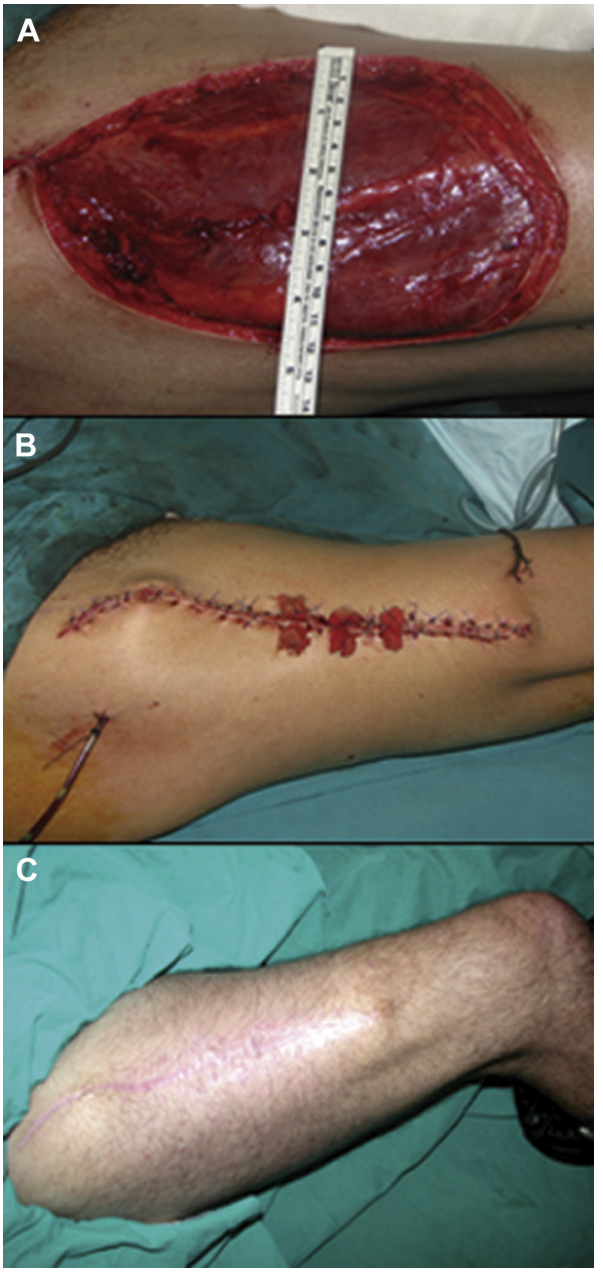

Fig. 4 – A defect at the right thigh secondary to free anterolateral thigh flap surgery (A). treated with 8TS technique (B). Postoperative fourth month (C). Only in this patient, small pieces of waxed gause were used to support skin closure. These gauses were removed at the seventh postoperative day. Defect width was 12 cm, which was same as flap size. (Color version of the figure is available online.)

Combined suturation of the skin and subcutaneous tissue was first introduced by Bölander [8] and revisited by Naimer *et al.* [9]. Those two techniques were a modified extension of vertical mattress suture that grasp some amount of subcutaneous tissue to provide double-layer closure. However, 8CTS technique provides continuous superficial and deep subcutaneous tissue crisscrosses to support all these structures in one suture. In deeper cavities, it may include the deep fascia to prevent dead space formation by including the fascia of Scarpa in abdominal wall, presacral fascia in pilonidal sinus surgery, and deep fascia of upper and lower extremities.

Traditional suturing techniques include frequently two separate sutures; the first one is a subcutaneous suture usually put with absorbable sutures, and the second one is the skin suture usually put with a nonabsorbable suture [10]. 8CTS

technique has the ability to close the superficial and deep layers of the wound together in one suture. Furthermore, absorbable suture materials usually used for subcutaneous suturing loose their strength in time. Another advantage of the presented technique comes forward at this point; 8CTS is performed using nonabsorbable suture materials and hold in place for 3 wk; therefore, 8CTS keeps its maximum strength until the suture removal. The results of maximum scar enlargement measurements evaluated at the postoperative sixth month demonstrated a maximum scar tissue enlargement of 7 mm. This result proves the effectiveness of full-strength subcutaneous support applied by using nonabsorbable suture materials for 3 wk.

All the sutures that support both the skin and soft tissue layers are removed in 8CTS technique at the end of 3 wk. The removal of absorbable suture materials reduces the risk of foreign body granuloma, which may result in false positive tumor diagnosis [11–14]. However, in 8CTS technique, all stitches are removed from both skin and subcutaneous tissue after the third week to prevent any subcutaneous granuloma formation. In the presented series of patients, no foreign body granuloma or granuloma-related complications was encountered.

In pilonidal sinus or cyst surgery, the basic treatments before the flap closure include primary closure or secondary intention that may be with or without vacuum-assisted closure [15]. As a general opinion, secondary intention is the method with lower rates of recurrence. However, Doll *et al.* [16] reviewed recurrences encountered after pilonidal sinus surgery and concluded that recurrence rates are nearly the same in secondary intention cases compared with primary closure [16]. In our country, wide defects secondary to pilonidal sinus surgery are usually operated by plastic surgeons by transposing skin flaps to the area as they provide tension-free repair [3]. However, this is the last weapon to close such a defect if it recurs. 8CTS provides another chance before a skin flap transfer. Our recurred case was thought to be secondary to under-resection of the sinus tract and healed successfully after the revision operation. Furthermore suture placement extending to the presacral fascia also provides depression resembling a natural intergluteal fold.

In wide defects, if primary skin repair is not possible, the next step of the reconstructive ladder is placing split-thickness skin grafts to the area [1]. The 8CTS technique provides many advantages for the patient comparing with skin grafting. First of all, skin grafting creates a new donor area, which is another source of possible complications such as delayed healing, wound infection, and scarring [4]. Another disadvantage of skin grafting is the potential of unfavorable healing at the recipient site and possible risk of graft failure [2,4]. The presented technique provides a single straight line closure, which is almost always cosmetically more acceptable for the patients. Maximum scar enlargement of 7 mm measured at the postoperative sixth month is cosmetically highly acceptable comparing with skin grafting.

In our case series, the 8CTS technique was only performed in acute wounds. This technique requires healthy and mobile subcutaneous tissues to approximate large wounds with sufficient strength. Subacute or chronic wounds with fibrotic subcutaneous tissues may be unsuitable for the 8TS technique that usually requires other steps of the reconstructive ladder. Patients with severely inflamed tissues are also not candidates for 8CTS technique unless the tissue edema is resolved. Also, if there is a doubt on both wound edges and the base of the defect for residual tumor, primary closure is not recommended.

Although we performed the 8CTS technique in patients with an age range of 14 to 65 y, this easy and versatile technique may safely be performed in all age groups such as the pediatric and geriatric patients. Sixteen obese patients presented in this case series were successfully treated with 8CTS, especially by using the deeper type, which indicates that the technique is also suitable for obese patients. However, a close follow-up is essential, especially in the early postoperative period against the risk of fat necrosis.

5. Conclusions

The presented 8CTS technique combines subcutaneous and cutaneous suturation creating a single powerful suture, which provides primary closure of fairly large defects. In selected cases, 8CTS eliminates the need of more complex methods such as skin grafting or flap coverage and possible complications related to a new donor area and elongated hospitalization period is prevented. In our opinion, the 8CTS technique is a useful addition to the surgical armamentarium for all surgical specialties.

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Authors' contributions: N.Y. contributed to conception and design; H.S. wrote the article; K.Y. and A.Ö.A. collected the data; G.T. made the critical revision of the article.

Disclosure

The authors reported no proprietary or commercial interest in any product mentioned or concept discussed in the article.

Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jss.2014.09.003.

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