

The Spider Procedure

A New Z-Plasty-Based Local Flap Procedure

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Background: Using neighboring similar skin, local flap procedures provide optimal aesthetic and functional results in reconstruction of skin defects. Therefore, a number of local flap procedures have been described. However, as skin defects present limitless variations in size and shape, new flap procedures are still needed. Here, we describe a new Z-plasty-based local flap technique, “the spider procedure,” for closure of the skin defects.

Methods: In this procedure, first, the existing defect is surgically converted to a triangle in shape. Then, using a modified 5-flap Z-plasty pattern, the flaps are outlined. By transposing the elevated flaps in a Z-plasty manner, a tension-free closure is achieved by means of tissue relaxation provided by opposing Z-plasties. Over 9 years, this technique has been used for closure of various skin defects in 42 patients (19 men and 23 women) aged 17 to 57 years. This procedure was used for facial defects in 20 patients, abdominal defects in 6, upper extremity defects in 7, and lower extremity defects in 9 other patients. The defect size ranged between 1.5 and 17 cm in diameter.

Results: A tension-free defect closure was obtained in all patients. Except 2 patients with minor flap tip necrosis who underwent secondary healing, all patients healed uneventfully and no patient required revision surgery in our series. There was no patient with dog-ear formation. A mean follow-up of 2 years (6 months–9 years) revealed an aesthetically acceptable scar formation in all patients.

Conclusions: On the basis of our clinical results, the spider procedure seems to be a useful alternative for the closure of various skin defects in all regions of the body. Using the advantage of extra tissue relaxation provided by opposing Z-plasties, it enables a surgeon to obtain tension-free closure of considerably large skin defects without dog-ear formation.

Key Words: defect closure, skin defects, triangular defects, local flaps, unequal Z-plasty

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In plastic surgical literature, local flap techniques for closure of skin defects are needed. However, limitless variations of skin defects in shape and size still make us search for new local flap procedures for defect closure with use of the neighboring tissue that is similar in appearance. An ideal local flap procedure for the closure of various skin defects should provide a tension-free closure with minimal additional healthy skin excision and scarring. Moreover, it should not cause so called dog-ear formation and distortion of the neighboring mobile anatomic landmarks. This requires a logical design which provides maximum tissue relaxation by borrowing the tissue from all directions. To achieve these goals, some authors have

reported the use of Z-plasty technique in local flap procedures.^{1–6} Here, we present a new Z-plasty-based local flap technique that we call “the spider procedure” for the closure of skin defects located in different regions of the body.

PATIENTS AND METHODS

Over 9 years, this technique has been used successfully for closure of various skin defects in 42 patients (19 men and 23 women) with ages ranging from 17 to 57 years in our clinic. This procedure was used for facial defects in 20 patients, abdominal defects in 6, upper extremity defects in 7, and lower extremity defects in 9 other patients. The defect size ranged from 1.5 and 17 cm in diameter. Skin defects were caused by excision of skin cancers in 18 patients, pilonidal sinus in 7 patients, hidradenitis suppurativa in 9 patients, and trauma and burn scar in 3 patients. In the remaining 5 patients, it was used for the closure of flap donor-site defects on the extremities. Operations were performed under general anesthesia in 32 patients and with local infiltration anesthesia in the remaining 10 patients. All patients were operated upon by Dr. Mutaf or under his supervision.

Technique

The spider procedure basically includes the use of a modified 5-flap Z-plasty technique to obtain maximum tissue relaxation for tension-free closure of skin defects. In this procedure, the defect is surgically converted to an either equilateral or isosceles triangle, and closed with 5 flaps harvested from the neighboring skin in a double-opposing Z-plasty manner. Here, the surgical technique is explained for an equilateral triangular defect (Fig. 1A). First, beginning from the vertices of the base of the triangular defect, 2 imaginary lines (Y) are drawn superolaterally. These lines are designed as the superolateral extensions of the baseline on both sides, with an angulation of 15 degrees. Their length is two-thirds of the base of the triangle. Then, beginning from the ends of the Y lines, other imaginary lines (Z) parallel to the lateral margins of the triangular defect are drawn downwardly on each side. The length of line Z is almost two-thirds of the neighboring margin of the triangle. The midpoint of the base of the triangular defect is determined, and beginning from that point, an imaginary line (X) is drawn superolaterally on both sides. The line Xs are designed to be parallel to the margin of the triangle on each side. Its length is equal to the line Z. The angle between the base and the line X is 60 degrees, whereas the angle between the lines Y and Z is 45 degrees. The lines Y and Z are constituted as 2 flaps on both sides of the triangular defect (Fig. 1B). By completion of this design, we obtain 2 opposing unequal Z-plasties delineating 5 flaps to be elevated. Then, the skin flaps are elevated and closure of the skin defect is accomplished by the transposing of these flaps in a routine manner, using the 5-flap Z-plasty technique (Fig. 1C). A suction drain is placed beneath the skin flaps as required and the skin closure is done in a 2-layered fashion. Resultant incision scars are seen in Figure 1D.

Illustrative Case Reports

Case 1

A 67-year-old man presented with an ulcerated basal-cell carcinoma located on the right side of nose (Fig. 2A). The lesion was

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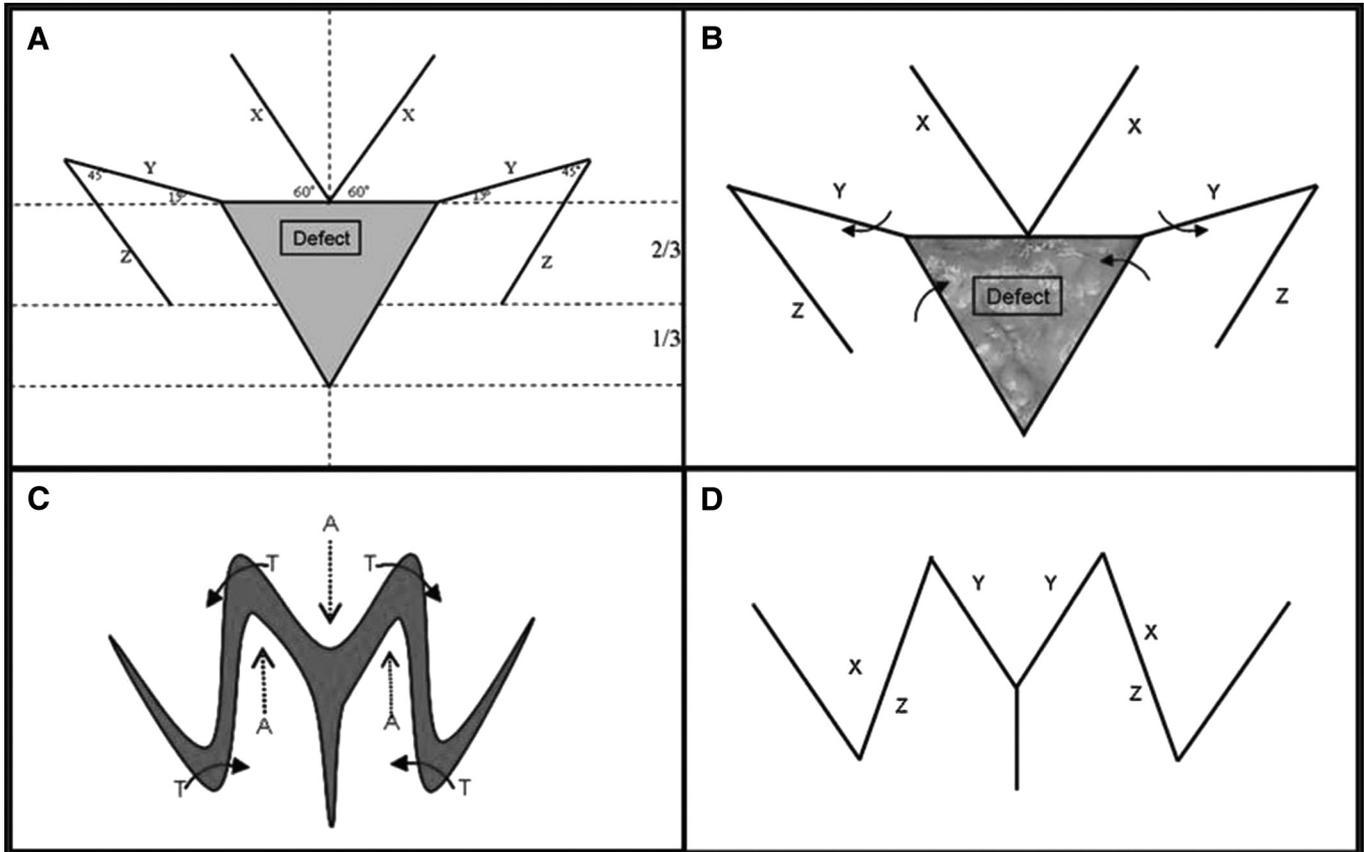


FIGURE 1. Illustrative drawing of the spider procedure.

excised with 5 mm of intact tissue surrounding the lesion. The resultant defect was in the shape of a triangle with 1.5 cm width (Fig. 2B). The use of a single local flap for closure of defects of the nose together with direct repair of the flap donor site is limited by the potential for tension and limited mobility of the nasal skin. The double-opposing Z-plasty technique is a useful alternative to minimize these drawbacks. The lesion was excised as an equilateral triangle, and the defect closed with 2 opposing Z-plasties (Figs. 2C, D). The technique allowed closure of both the primary defect as well as the 2 smaller defects of donor sites. The use of multiple flaps from opposite sides of the defect prevents excessive tension (Fig. 2E).

Case 2

A 57-year-old man presented with a dysplastic nevus located at the midparietal scalp. Under local infiltration anesthesia with 1% lidocaine solution, the lesion was excised with 1 cm of surgical margins (Fig. 3A). The resultant defect was measured to be 3 cm in dimension. Defect closure was accomplished with the spider procedure (Fig. 3B). The flaps were elevated at suprapariosteal plane and the defect was closed with transposition of the flaps in a Z-plasty manner. Despite a remarkably large defect on the vertex, a tension-free closure was achieved. Defect closure was done without dog-ear formation or trapdoor deformity. The flaps healed uneventfully. At 2 years after surgery, there was no recurrence and the final scar was almost invisible and aesthetically acceptable (Fig. 3C).

Case 3

A 47-year-old woman was admitted to our clinic with a malignant melanoma located superior to the posterior iliac crest. Under

general anesthesia, the tumor was excised with 5-cm margins and the resultant defect was 14 cm wide (Fig. 4A). The closure of the resultant defect was done with the spider procedure (Figs. 4B, C). There was no complication in the early or late term. Resultant scars were acceptable (Figs. 4D, E).

Case 4

A 48-year-old man was referred to our institution with a large squamous cell carcinoma on his sacral region (Fig. 5A). Under general anesthesia, the lesion was excised resulting in a 17-cm wide defect (Fig. 5B). We planned to close the defect with the spider technique. The flaps were elevated fasciocutaneously (Fig. 5C). By transposition and advancement of the flaps (Fig. 5D), a tension-free closure was achieved without any extra healthy skin excision and dog-ear formation (Fig. 5E). In 2 of the flaps, tip necrosis was observed at the second day. This was closed with secondary healing. An aesthetically acceptable and durable outcome was achieved in the early post-operative period (Fig. 5F).

RESULTS

In all patients, a successful tension-free closure of the defect was obtained. There were no patients with distortion of the mobile anatomic structures or dog-ear formation. This technique was found to be useful for closure of skin defects measuring up to 17 cm in diameter in this clinical series. Except 2 patients with minor flap tip necrosis who underwent secondary healing, all patients healed uneventfully and no patient required revision surgery in our series. Because the defects were closed with similar neighboring skin, an excellent skin match was obtained. A mean follow-up of 2 years

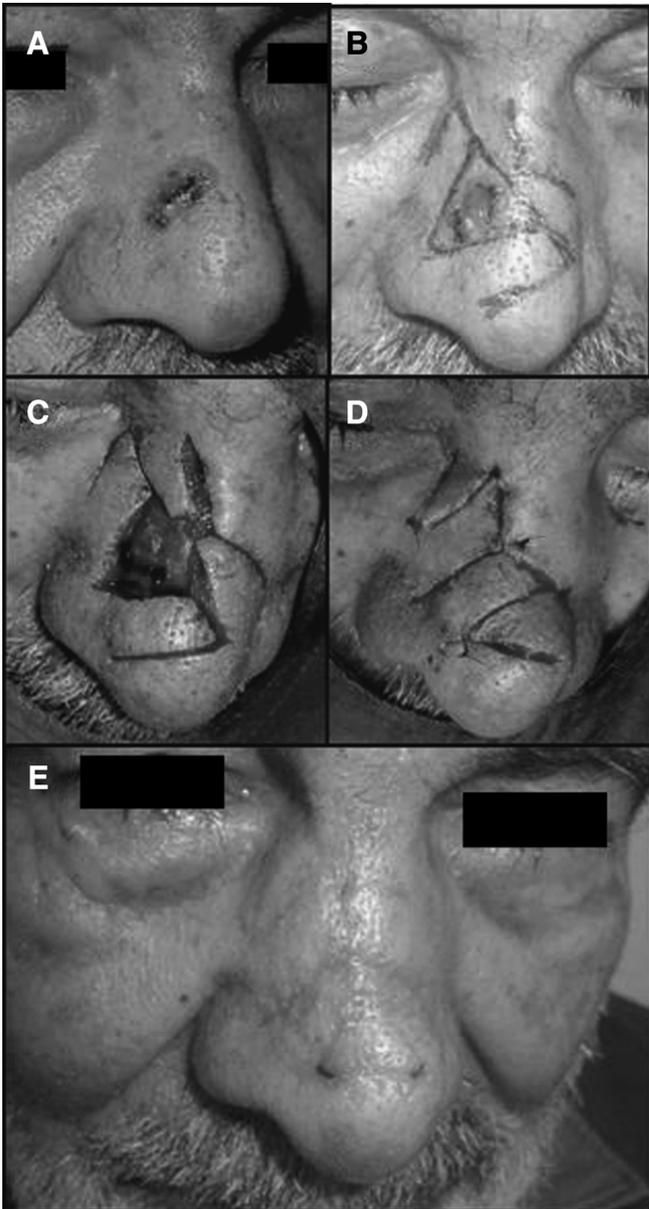


FIGURE 2. Case 1. A, A 67-year-old man with basal cell carcinoma on the right side of his nose. B, Surgical plan. C, Lesion excision and flap elevation. D, Transposition of the flaps with Z-plasty maneuvers and final appearance. E, Postoperative view at 2 months after surgery.

(6 months–9 years) revealed a durable skin coverage with acceptable scars in all patients.

DISCUSSION

Use of local flaps to repair excisional defects together with direct coverage of the flap donor site is limited, especially where the regional skin is not relaxed. By providing extra tissue relaxation, use of Z-plasty concept can provide an aid to our capability for the closure of skin defects. It also helps to avoid distortion of the surrounding anatomic structures because it distributes the tension evenly by borrowing the tissue from different directions. Use of the Z-plasty in defect closure is not new. To date, there have been several techniques

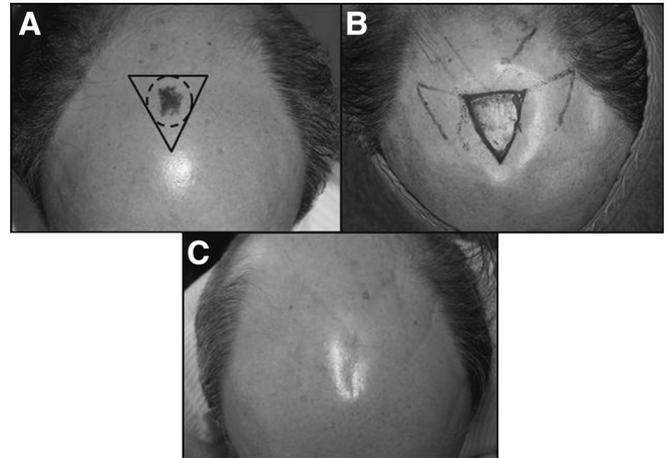


FIGURE 3. Case 2. A, A 57-year-old male presented with a dysplastic nevus located at the midparietal scalp. B, Surgical excision was performed with 1 cm of intact margin. View of excisional defect and surgical plan is shown. C, Postoperative view at 2 years after surgery.

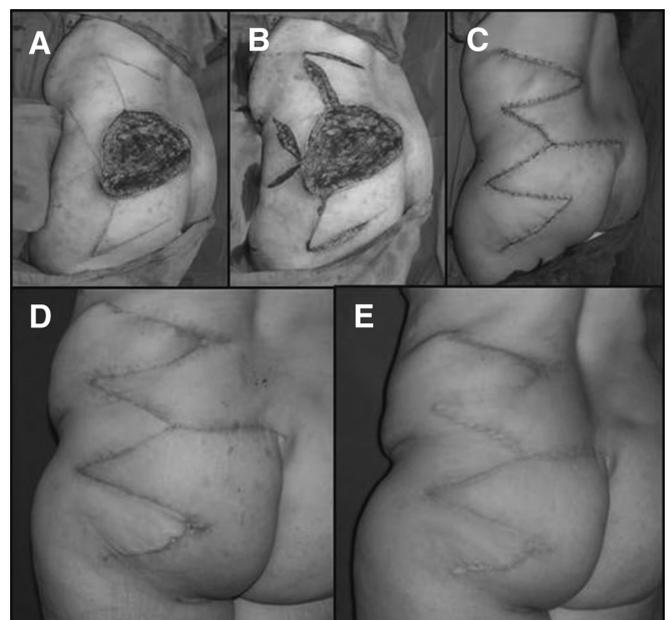


FIGURE 4. Case 3. A, A 47-year-old woman was admitted with a malignant melanoma located superior to the posterior iliac crest. Surgical plan and excisional defect of 14 cm wide is shown. B, Incisions and elevation of flaps. C, Z-plasty maneuvers and view after suturation. D, Postoperative 3 months view. E, Postoperative 2 years view.

using single or double Z-plasty procedures to provide extra tissue relaxation in favor of defect closure. Limberg was the first author who used Z-plasty for the closure of skin defects.¹ He developed his timeless flap design on the basis of an unequal Z-plasty concept. Recently, Becker, Cuono, and Keser et al^{2,3,4} used a double-equal Z-plasty concept, and Mutaf et al used unequal Z-plasty concepts in 2 different procedures, namely, the “reading man” and the triangular closure technique.^{5,6} To our knowledge, there has been no earlier report of the use of the 5-flap Z-plasty as a defect closure technique to date.

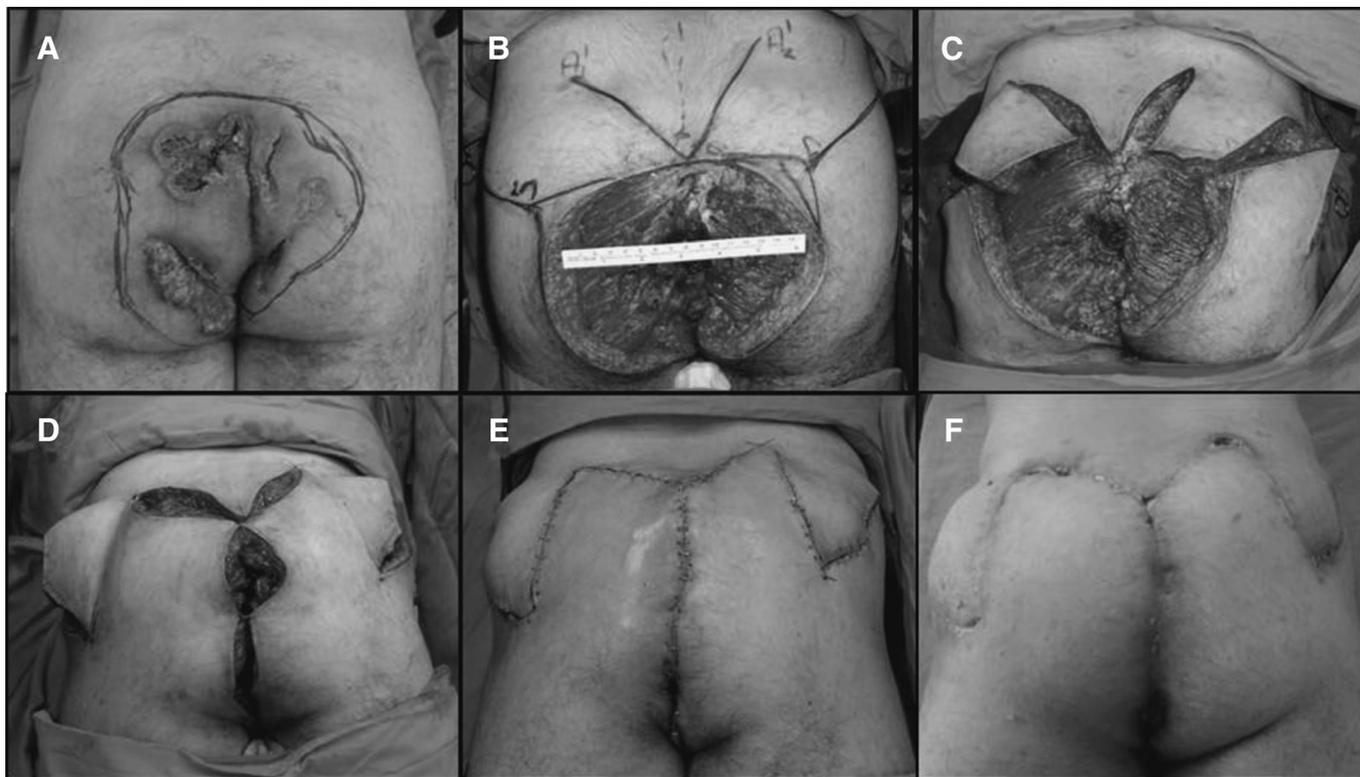


FIGURE 5. Case 4. A, A 48-year-old man was referred to our institution with a large squamous cell carcinoma on his sacral region. B, Lesion was excised with 1 cm of healthy tissue and the resultant defect was 17 cm in size. C, Flap elevations with supramuscular dissection. D, Transposition of flaps. E, Final appearance after suturation. F, Patient with minor flap tip necrosis who underwent secondary healing at 2 weeks postoperatively.

The 5-flap Z-plasty technique was originally described by Mustarde for correction of epicanthal folds in 1959.⁷ Since that time, this technique has been used worldwide for many reconstructive problems, including the release of scar contractures, strictures of the urethral meatus, cleft ear lobes, and correction of midline cervical web and umbilical stenosis.^{8–10} The 5-flap Z-plasty is also called “the jumping man procedure” because of its appearance. In 1964, Converse described another type of 5-flap Z-plasty, the double-opposing Z-plasty; he also used it for the correction of epicanthal folds.¹¹ It was later modified by Hirshowitz et al,¹² who called it the 5-flap procedure. In this article, we described for the first time a new use of this well-known technique as a defect closure procedure, and shared our 9 years of experience with this new local flap procedure based on the 5-flap procedure to achieve greater tissue relaxation for tension-free closure of the skin defects. To make it easy to remember, we named this new technique “the spider procedure” because the surgical design of the procedures resembles a sketched spider figure (Fig. 1).

Although this procedure has been developed on the basis of the 5-flap Z-plasty technique, there are several differences between the classic design and ours. As shown in Figure 1, the Z-plasties are designed in a slanted manner in our procedure. Moreover, the opposing Z-plasties used in our procedure are unequal, with 60/45 degrees of the angles. Using extra tissue relaxation provided by double Z-plasty maneuvers, the spider procedure provides tension-free closure of the primary defect as well as of the 2 smaller donor defects. By borrowing half of the required skin from opposite sides of the defect, excessive tension is avoided in repairing donor regions. In comparison with other flaps (Cuono, Becker, and Keser) using opposing Z-plasty technique, our procedure seems to have certain ad-

vantages. Our technique and Cuono’s double-opposing flap require different amounts of additional healthy tissue removal; 112 mm² in the spider procedure and 162 mm² in the Cuono’s procedure for a circular defect measuring 2 cm in diameter (Fig. 6). Although it also requires some additional healthy-tissue excision in the paper and sponge models, the amount of additional healthy-tissue excision in our technique is considerably less in comparison with those procedures, converting the defect in a rhomboid as documented with a metric analysis shown in the Figures 6 and 7. As a matter of fact, the results of these model studies cannot reflect the clinical circumstances properly. Due to elastic nature of the human skin, the defect closure was achieved with no additional healthy-tissue excision in most of our patients. However, as a major drawback, Cuono’s procedure borrows tissue only from 2 directions (Figs. 7A2, B2, C2, D2, E2). Using transposition and flap advancement maneuvers together (Fig. 1C), our procedure borrows tissue from all 4 directions and provides further tissue relaxation and an even distribution of the tension (Figs. 7A1, B1, C1, D1, E1). In practice, that means lesser tension and lesser risk for distortion of the surrounding anatomic structures. Moreover, it also provides a very critical advantage regarding elimination of dog-ear formation. Keser’s opposing semicircular flap procedure is also based on the opposing Z-plasty concept. However, the scar length is remarkably longer and, similar to Cuono technique, it borrows tissue from only 2 directions (Figs. 7A3, B3, C3, D3, E3). Moreover, curved incisions used in this technique are more likely to lead the trapdoor deformity. In our procedure, the circular defect is converted into a W-shaped scar, which is easier to conceal in the natural skin creases and less likely to develop trapdoor deformity. In the comparative sponge model analysis, the length of the resultant scar measured in the spider procedure is 29 cm; in the Cuono flap,

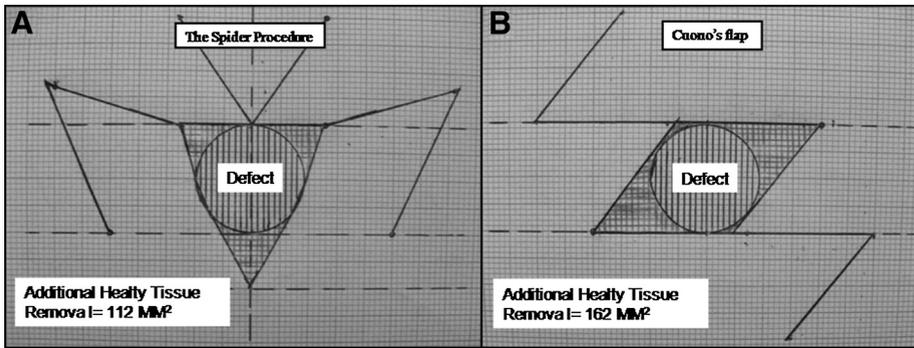


FIGURE 6. Comparative metric analysis of the Spider procedure and Cuono flap for a circular defect of 2 cm in diameter. The amount of additional healthy skin excision is $\sim 112 \text{ mm}^2$ in our technique (A), whereas it is $\sim 162 \text{ mm}^2$ in the Cuono flap (B).

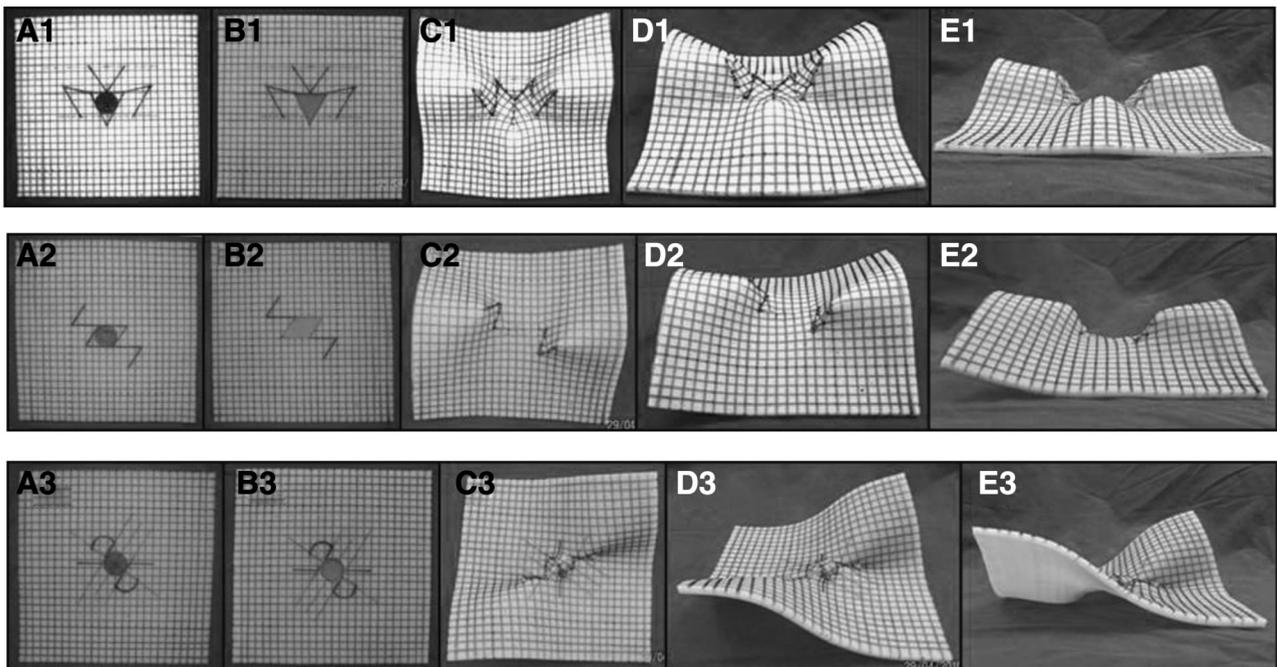


FIGURE 7. Comparative sponge model study of (Above) the Spider procedure, (Middle) Cuono flap, and (Below) Keser technique. Borrowing tissue from 4 directions, the spider procedure causes remarkably lesser dog-ear formation and reduces the risk of distortion of the neighboring regions in comparison with Cuono and Keser flap techniques. Note the severe distortion with the Keser technique.

23 cm; and in the Keser flap, 20 cm (Fig. 7). The larger resultant scar was the only disadvantage of our new technique.

In our series, there was no patient without dog-ear or trap door deformity. The resultant scars were found to be quite acceptable in all patients as a result of planning the Z-plasties properly according to the relaxed skin tension lines. To obtain better aesthetic results, the longitudinal axis of the triangle should be parallel to the relaxed skin tension lines. In this clinical study, it was concluded that the spider procedure has a great potential to be a useful alternative for the closure of various skin defects in all regions of the body. Using the advantage of extra tissue relaxation provided by opposing Z-plasties, it enables surgeons to achieve a tension-free closure of considerably large skin defects without dog-ear formation.

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