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Modified Dovetail-Plasty in Scar Revision

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Abstract: Scar revision is one of the fundamental techniques in the field of plastic and reconstructive surgery. Local flaps, such as a Z-plasty, W-plasty, or geometric broken-line closure, have been used for scar revision. Camouflaging a scar during scar revision for marginal scars from skin grafts and flaps, trapdoor scars, and linear scars is difficult. We describe our experience with the use of modified dovetail-plasty for scar revision in these difficult areas. Our study group consisted of 28 cases among 22 patients (9 males and 13 females) with a mean age of 33.6 years (range, 6–61 years). The conspicuous scars were located on the face (50%) and extremities (50%). The authors designed Y-shaped incision lines to relax the skin tension lines on one side of the excision line and trapezoid incision lines on the other side. There were 16 follow-up operations performed over 6 months after the initial operation among a total of 22 patients. There were scar depressions (2 patients) and a hypertrophic scar (1 patient) at the interval area between the dovetail flaps. A diffuse hypertrophic scar occurred in 1 patient with a dorsal foot scar. The overall success rates of the procedure as assessed by the surgeons were as follows: excellent (75%), good (12.4%), fair (6.3%), and poor (6.3%). This new local flap can achieve an inconspicuous scar using a blurred scar line and reducing tension. The authors recommend a modified dovetail-plasty for the revision of trapdoor scars and scars under excessive tension.

Key Words: Cicatrix, surgical flap, surface tension, scar revision
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Scar revision is a fundamental technique in the field of plastic and reconstructive surgery. There are many types of scars, such as linear, wide, smooth, uneven, depressed, and hypertrophic scars.¹ Surgeons have used many local flaps or inventive suture techniques

for scar camouflage. However, there is no unique solution for scar camouflage.

A Z-plasty lengthens a scar, releases a contracture, disperses a scar, or realigns a scar within a relaxed skin tension line. However, lengthening a scar in 1 direction will necessitate shortening in the perpendicular direction. In addition, 3 scars will result instead of the single preexisting scar.²

A W-plasty provides a regularly irregular scar, and the geometric broken-line closure (GBLC) provides an irregularly irregular scar. A W-plasty, unlike a Z-plasty, incorporates shorter limbs and does not result in an overall change in the scar length. A major disadvantage of the W-plasty and GBLC is that the removal of some normal tissue is necessary, which will increase the wound size and increase the tension on the closure.³

Pae et al⁴ used a local flap called a dovetail cheiloplasty to a correct cleft lip. The term *dovetail* was quoted from a joint technique most commonly used in woodworking. The dovetail joint consists of 2 trapezoidal blocks called a “pin” and “tail.” A wooden dovetail joint requires no mechanical fasteners. Thus, the idea for this flap is that once each flap has been locked, the scar does not widen with extensive tension (Fig. 1). However, this method requires the removal of the some normal tissue between the trapezoidal flaps.

We modified the design of the original dovetail flap to use the flap without normal tissue loss during the scar revision. This newly modified dovetail-plasty has the effect of absorbing perpendicular tension and releasing the scar contracture (Fig. 2B). When a rectangular-trapezoidal flap is required for a long scar, small parallel incisions from the base of the trapezoidal flap can be added (Fig. 3B). We describe our experience with the modified dovetail-plasty used for scar revision.

MATERIALS AND METHODS

This retrospective study reviewed 22 consecutive patients who underwent scar revision with a modified dovetail-plasty between November 2010 and August 2012. Our study group consisted of 28 cases in 22 patients (9 males and 13 females) with a mean age of 33.6 years (range, 6–61 years). Two patients had scars in 2 locations, and the other 2 patients had scars in 3 locations for the modified dovetail-plasty. The 28 procedures were for conspicuous scars on the face (n = 14) and extremities (n = 14) that was caused by trauma (8 patients), an operation (4 patients), burns (3 patients), full-thickness skin graft (3 patients), split-thickness skin graft (2 patients), and flaps (2 patients). Conspicuous scars occurred at the margin of the grafts and flaps. The defined scar locations on the face were the upper eyelid (n = 3), glabella (n = 3), upper lip (n = 3), philtrum (n = 2) (Fig. 2A), medial canthal area (n = 1), mandibular border (n = 1), and chin (n = 1). The defined scar locations on the extremities were the dorsal digital web (n = 4), dorsal foot (n = 3) (Fig. 3A), dorsal toe web (n = 2), axilla (n = 2), shoulder (n = 1), upper arm (n = 1), and thigh (n = 1). The conspicuous scars were classified as contracted (8 patients), depressed (7 patients), uneven (4 patients), or wide (3 patients). These types can lead to a combined appearance. The scar length measured less than 5 cm in 21 cases and greater than 5 cm in 7 cases. The long scars involved the extremity (Table 1).

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FIGURE 1. The design of the original dovetail cheiloplasty is the same as the wooden dovetail joint, which consists of 2 trapezoidal blocks named the "pin" and "tail." The cheiloplasty consisted of precut trapezoid flaps and its insertion.

There are surgical techniques for the modified dovetail-plasty, which are divided into serial (Fig. 3B) and alternative (Fig. 2B) types. A long, linear wide scar can be used as an alternative dovetail flap for diverting both lateral perpendicular tensions.

The design of the original dovetail-plasty is the same as the dovetail joint. The technique consisted of a precut trapezoid flap and its insertion and was intended for making a philtrum fold (Fig. 1).

Our design for the modified dovetail-plasty has a unique Y-shape incision, which can be opened into an M or inverted U shape for a releasing effect. Our design also was effective in wide and contracted scars by releasing, lengthening, and reducing the tension of the scars (Fig. 4).

Intraoperative marking of the fusiform excision line for the scar was performed before local anesthetic infiltration. The authors designed Y-shape incision lines along the relaxed skin tension lines on one side of the excision line and trapezoid incision lines on the other side. The length of each line was 2 to 3 mm for a facial scar (Fig. 2B) and 5 mm or more for an extremity scar (Fig. 3B). We determined the interval between each dovetail flap according to the size of the flap. Three patients had a combined Z-plasty.

The area of the scar revision was then infiltrated with 1% lidocaine with 1:100,000 units of epinephrine. The pattern of the design was incised after scar tissue excision. The Y-shape incision was opened, and a trapezoid flap on the other side of the excision line was inserted into opened space. We did excessively advance the dovetail flap. The small size for the trapezoid flap could lead to partial necrosis. We performed subcutaneous and dermal suturing with 5-0 Vicryl or 6-0 PDS and skin sutures with 6-0 or 7-0 nylon.

FIGURE 2. A 61-year-old woman complained of a depressed scar on the Weber-Ferguson incision site (A). The preoperative design of the modified dovetail-plasty notes an alternative type of small flap (B). The intraoperative view notes multiple stitches in the philtral ridge (C). The philtral scar was camouflaged 9 months after surgery (D).

FIGURE 3. A 10-year-old girl had a hypertrophic, contracted marginal scar of the full-thickness skin graft on the dorsal side of the right foot (A). This photograph shows 3 serial modified dovetail large flaps (B). The intraoperative view after wound repair shows an everted appearance in the interval area of flaps (C). In this postoperative view, note the narrow scar line with minimal immature scars 11 months after surgery.

The corners of these flaps were sutured with 6-0 nylon (Figs. 2C, 4C). Large dovetail flaps greater than 5 mm were used in the dorsal foot (2 patients) and axillary web (2 patients). The outcome over 6 months after surgery was characterized as excellent for inconspicuous scars, good for partially depressed scars, fair for partially hypertrophic scars, and poor for extensively hypertrophic scars.

RESULTS

The total number of dovetail flaps in 22 patients was 54 (mean, 2.45; range, 1–6). Dovetail flaps can be used as a combination of serial or alternative types. The serial type of dovetail flap was used for 25 of 28 procedures. The mean follow-up period after surgery was 8.4 months (range, 1–25 months).

Sixteen of 22 patients were evaluated over 6 months after the operation for their outcomes. There were scar depressions (2 patients) and hypertrophic scars (1 patient) in the interval area between the dovetail flaps. Diffuse hypertrophic scarring occurred in 1 patient on the dorsal foot scar, which she did not manage with a pressure garment. There was no wound dehiscence, necrosis, abscess, or cellulitis. Minimal tip abrasions on the dovetail flaps during the early stage after surgery were managed with conservative dressing. All of the patients except for one were satisfied with the result. However, there was a tendency for hypertrophic scarring on the extremities. Therefore, a postoperative pressure garment on the extremity may be helpful. The overall success rates for the procedure as assessed by the surgeons were as follows: excellent (12 patients, 75%), good (2 patients, 12.4%), fair (1 patient, 6.3%), and poor (1 patient, 6.3%) (Figs. 2D, 3D) (Table 1).

DISCUSSION

There are many types of scars, such as linear, wide, smooth, uneven, depressed, trapdoor, and hypertrophic scars. The ultimate goal of any operation in plastic surgery is to leave a linear scar. A linear scar is also the goal for scar revision. A scar in Asians is more conspicuous than in whites. Thus, every attempt should be made to leave a linear scar as inconspicuous as possible in Asian patients.¹

The success of scar revision, or camouflage, is dependent on many parameters. Some of these include scar location, patient age, nature of the initial injury, condition of the adjacent tissue, skin loss, ethnic background, skin type, patient expectations, and scar orientation.⁵

TABLE 1. Patient Summary

	Sex	Age, y	MOI	Location	Main Type of Scar	Scar Length, cm	Dovetail Flaps, n	Follow-up, mo	Outcome Score
1	M	47	Free flap	2 Sites on the upper lip	Uneven	1.5 × 2	2	22	4
2	F	55	Trauma	Glabella	Depressed	1.5	2	25	3
3	F	61	Op	Philtrum	Depressed	2	3	9	4
4	F	17	Trauma	Upper eyelid	Depressed	1.5	1	6	4
5	M	57	Trauma	Glabella	Depressed	2	2	6	4
6	F	54	Trauma	Chin	Depressed	3	2	1	—
7	F	45	FTGS	2 Sites on the upper eyelids	Uneven	1 × 2	4	18	4
8	F	41	Trauma	Philtrum	Depressed	1.5	2	6	4
9	M	27	Trauma	Medial canthal area	Contracted	4	2	7	4
10	F	10	FTSG	Foot dorsum	Contracted	7	2	11	4
11	F	12	Burn	Foot dorsum	Contracted	9	2	6	1
12	M	21	Local flap	Upper lip	Uneven	1	1	6	4
13	F	14	FTSG	Foot dorsum and dorsal toe in the 3rd and 4th webs	Contracted	10 and 1 × 2	5	1.5	—
14	M	54	STSG	Dorsal digit in the 1st web	Contracted	2	2	6	4
15	M	30	Burn	Axilla web	Contracted	8	1	1	—
16	F	6	Burn	Axilla web	Contracted	5	1	1	—
17	F	29	OP	Mandibular border	Wide	3	2	1	—
18	M	40	Trauma	Glabella	Uneven	2	1	23	3
19	F	29	OP	Upper arm	Wide	20	5	6	2
20	F	22	Trauma	Anterior thigh	Wide	18	6	14	4
21	M	32	STSG	Dorsal digit in the 2nd, 3rd, and 4th webs	Contracted	1 × 3	3	1	—
22	M	37	OP	Shoulder	Depressed	13	3	7	4

Outcome score (follow-up cases over 6 months): excellent, 4; good, 3; fair, 2; poor, 1.

MOI indicates mode of injury; OP, operation; STSG, split-thickness skin graft; FTSG, full-thickness skin graft.

One of the conditions is tension. The multidirectional tension may overstimulate the fibroblast, causing the production of excess collagen, which is the main constituent of a conspicuous scar.⁶

Mechanical conditions, such as flap immobilization and extensive tension, for example, induced by sutures, have a detrimental influence on the healing process.⁷ Local flaps, such as Z-plasty, W-plasty, or a geometric broken-line suture (GBLC), reduce the wound tension.^{2,3}

An important factor for the modified dovetail-plasty is wound tension. The tension between the concave and convex areas is higher than that for simple closure. However, as trapezoid flaps are being inserted to counter the insertion area, each face of the flap became packed. The idea of this technique is that flap packing weakens the lengthwise stress. Therefore, packing can prevent scar widening or hypertrophic scar formation. In addition, the interval areas between the flaps are tension-free because of excessive approximation during flap packing. The modified dovetail-plasty could free scar tension more than a simple Z-plasty. This technique also could insert many flaps in limited space without unnecessary tissue sacrifice compared with W-plasty. A modified dovetail-plasty can be used to camouflage scars located in areas with extensive tension.

This technique was used for scar revision of the glabella, chin, philtrum, upper lip (Fig. 2A), and upper eyelid. In addition, the technique can be used for scar revision of contracted and/or wide scars of the extremities on the joint areas, resulting in motion and/or excessive tension (Fig. 3A). However, the technique does not work for hypertrophic scars resulting from excessive sebum production and for genetic scars without excessive tension.

In addition to the revision of scars under extensive tension, this modified dovetail-plasty can be used to revise trapdoor and marginal scars from skin flaps and grafts (Fig. 3A). The sheet of the internal scar is primarily responsible for raising the skin inside of the semicircle. As a result of the contraction on the semicircular scar

surface, an uneven trapdoor deformity developed. The modified dovetail-plasty can release the contracted trapdoor part of the scar, and a trapezoid flap for the counterpart of the scar can be inserted into the empty place after releasing the contracted trapdoor part. The uneven scars can be revised to even, flat scars.

The sizes of the dovetail flaps were 2 to 3 mm for the face and 5 mm or greater for the extremities. In addition to the flap itself, the interval area between the flaps is an important factor in the modified dovetail-plasty. The interval area is a negative tension area; therefore, the wound tends to be inverted or everted, not flat. If the wound for the interval area is repaired with the usual suture technique, the wound will be depressed during scar maturation. Therefore, everted

FIGURE 4. When the Y-shape incision was opened, the grafted scar margin was adequately released. Large trapezoid flaps were progressively made and inserted into the releasing space from the proximal site of the scar.

sutures should be performed at the interval area (Fig. 3C). The interval area between the dovetail flaps is an important factor for a modified dovetail-plasty. If the interval length is too long, visible scar widening can occur in this area because of decreased absorption of the perpendicular tensions. We decided that the length of the interval area between the flaps was similar to the size of the flaps. Achieving an adequate interval length is difficult for long scars of the extremities.

The depression deformity can occur in the interval area of the dovetail flaps on the face postoperatively. However, this deformity can be prevented using an everted suture technique. Hypertrophic scarring can occur in a modified dovetail-plasty of the extremity postoperatively. This scarring will gradually improve over a long follow-up period and can also be prevented using a pressure garment.

This modified dovetail-plasty is a more complicated and time-consuming technique than other flaps for scar revision. However, this technique reduces perpendicular tension more than Z-plasty and sacrifices less tissue than W-plasty, GBLC, or the original dovetail

cheiloplasty. This technique is a new method for scar revision on the face and extremities.

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