

Original Article

Modified O-T advancement flap for reconstruction of skin defects

Zhuo-Ran Li¹, Yong Jiang¹, Jun-Yan Zhang², Yun-Wei Su², Jian-Zhong Hu²

¹Department of Dermatology, Tianjin Medical University Second Hospital, Tianjin 300211, China; ²Department of Dermatology, Tianjin Medical University General Hospital, Tianjin 300052, China

Received May 12, 2017; Accepted July 26, 2017; Epub September 1, 2017; Published September 15, 2017

Abstract: Background: Round or oval defects are common in skin surgery. Functional and cosmetical reconstruction of defects in reparative process is critical for patients. Various flaps have been described, however, these flaps often result in longer scar or tip necrosis. To overcome these shortcomings, we modified O-T advancement flap on the basis of conventional O-T flap and observed the validity and complications during defect closure. Materials and methods: Defect transverse diameter was marked along the direction of minimum tension at the circular center. Extended line was drawn along defect transverse diameter with the same length of circular diameter. The skin was cut apart, and the flap was separated under the skin. Then the flap tips were sutured and fixed with the opposite center. After drainage, the defects were bandaged under compression. Results: This study includes a total number of 48 patients. We examined the location and size of defect and postoperative clinical courses. The follow-up period was from 3 months to 1 year. Overall, 41 of 48 patients achieved the satisfactory postoperative effect. Recurrence and limb dysfunction complication was not observed, except 2 cases of wound scar, 3 cases of wound infect and 2 cases of flap tip necrosis. Conclusion: Modified O-T advancement flap is practical and safety. It overcomes the shortcomings of traditional O-T flap. Reconstruction of modified O-T flap is aesthetically acceptable.

Keywords: Skin defect, O-T advancement flap, complication, reconstruction

Introduction

Conventional fusiform incision is the most common defect in surgery (**Figure 1A**). During the operation, the closure of fusiform incision usually results in longer postoperative scar in order to prevent “cat’s ear” [1]. In addition, round or oval defects commonly occur in the skin surgery, especially during the tumor radial surgery [2]. Circular or oval wound healing demands enough blood supply of donor flap and suitable tension [3]. Thus, reconstruction is very important for patients. The application of flaps aims to improve the surgical success rate and achieve the functionally and cosmetically good results [4]. In clinical operation, the application of flap has some flexibilities and limitations. If the defect is close to the important organ, the design of the flap should take into account the appearance and the function of the organ. If the defect is the organ with stronger tension, such as the scalp [5] or ankle flap [6], the application of flap is required to fully meet the needs of tension nearby. A classical advancement flap, A-T flap, also named O-T flap, is wide-

ly used in various skin surgery [7]. The shape of the letter “A” is similar to the triangular skin defect. And the shape of the letter “T” is formed by closing the triangular defect with two advancement flaps (**Figure 1B** and **1C**). However, the special design of O-T advancement flap often causes the excision of adjacent normal tissues and relatively long surgical scars. To overcome these limitations, we designed a modified O-T flap on the basis of conventional O-T flap. The modified O-T flap distributed the circular defect equally, made the long axis as the transverse incision of T shaped flap, and made the defect center as tension center. In this study, we explained the detailed operative techniques by presenting the related cases and addressing our experience with the modified O-T flap.

Materials and methods

Patients

In our experiments, we collected skin surgical patients from the Department of Dermatology

Modified O-T flap for defects

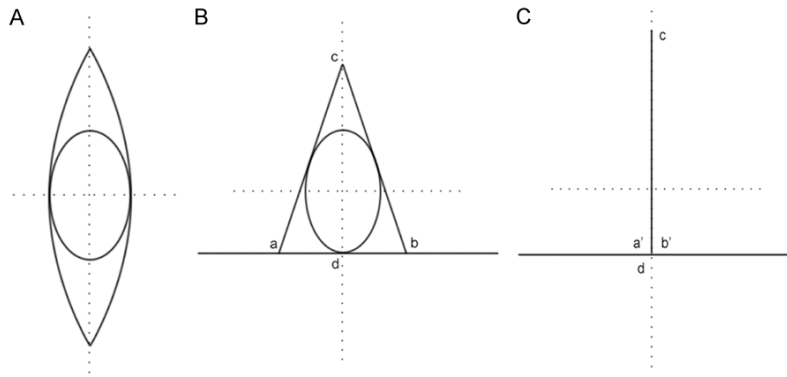


Figure 1. Schematic diagram of conventional fusiform incision (A) and O-T flap (B and C).

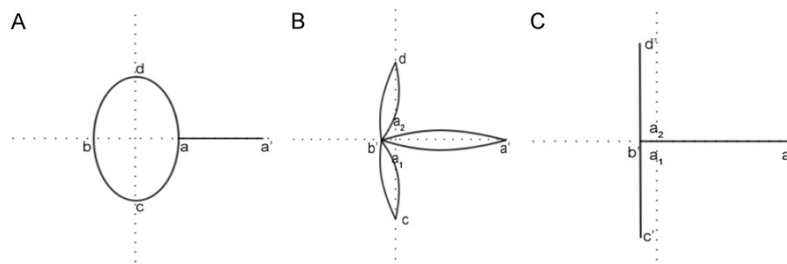


Figure 2. Schematic diagram of modified O-T flap. A. The extension of the line with the same length of the circular diameter was done along the extension of the defect transverse diameter, and the endpoint was set as point a'. B. Points a1 and a2 were produced after aa' was cut apart. C. Points c and d moved to c' and d' respectively following flap arrangement to prevent "cat's ear".

of Tianjin Medical University General Hospital and Tianjin Medical University Second Hospital from 2010 to 2016. A total of 48 patients were studied in the experiments, including 1 malignant melanoma case, 2 trichoblastoma cases, 15 basal cell carcinoma cases, 3 bowen disease cases, 25 pigmented nevus cases and 2 sebaceous nevus. The age of the patients ranged from 9 to 87 years. The defect diameter was from 0.9 cm to 11 cm. Before surgery, the urine routine, coagulation function, liver and kidney function, blood sugar level, chest X-ray and abdominal ultrasonography were performed. The risk of surgery was informed, and informed consent was signed before surgery. This study was approved by the ethics institution of our hospital.

Modified O-T flap design

Before surgery, we marked the scope of surgical defect and defect diameter in the center of circular extension of skin tension minimum. The incision edge intersection was set as point

a, and the opposite side was point b. Their vertical axis and the intersection of the incision were marked as point c and point d, respectively. The extension of the line with the same length of the circular diameter was done along the extension of the defect transverse diameter, and the endpoint was set as point a' (Figure 2A). If the surgical defect was elliptical, the short axis was employed as far as possible. Points a1 and a2 were produced after aa' was cut apart (Figure 2B). Point c and d were moved to c' and d' respectively following flap arrangement to prevent "cat's ear" (Figure 2C).

Surgical process

Routine preoperative skin preparation, operation field sterilization and towel show single were carried out. Surgical defect range and

points a, b, c, d and a' were marked at the lesion edge. The flap was separated under the skin. Point b was sewed with separated a1 and a2 after flushing the wound and squeezing the residual fluid as shown in Figure 2B. And then we arranged the flap according to Figure 2C, put the rubber strip drainage, banded under compression. After the absolute limit of operation area for 48 h, we pulled out the drainage, performed pressure bandage and removed the stitches according to the defect situation (Figures 3 and 4).

Results

The age of the patients ranged from 9 to 87 years old. The follow-up period was from 3 months to 1 year. We observed the wound infect, tip necrosis degree, complications, the scar size and incision aesthetic extent during follow-up period to monitor the outcome of modified O-T flap. Overall, no recurrence and limb dysfunction complication was observed and donor-site scar was aesthetically acceptable in 41 of

Modified O-T flap for defects

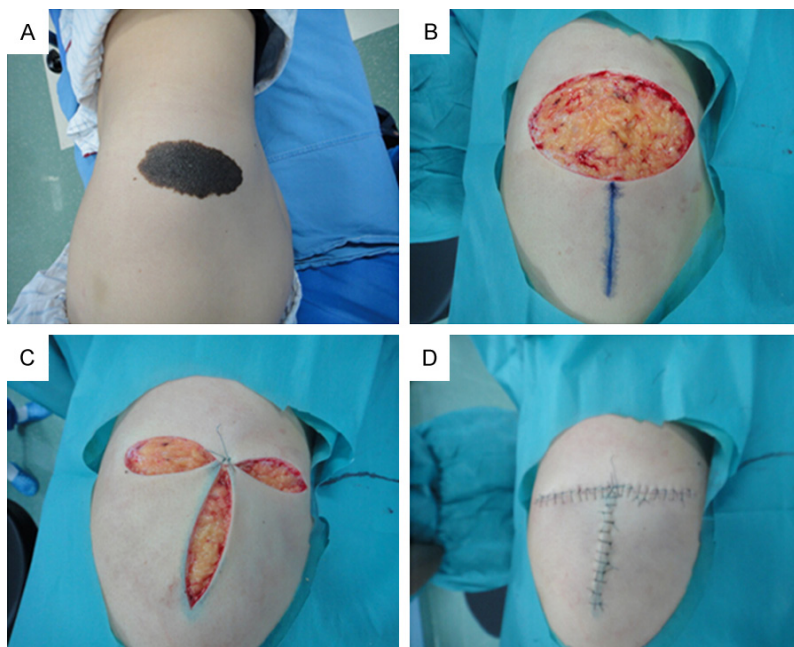


Figure 3. The case with Becker nevus in thigh underwent modified O-T flap surgery. A. Preoperative view. B. The modified O-T flap. C. Suture of four flap tips. D. Repair of the suture.

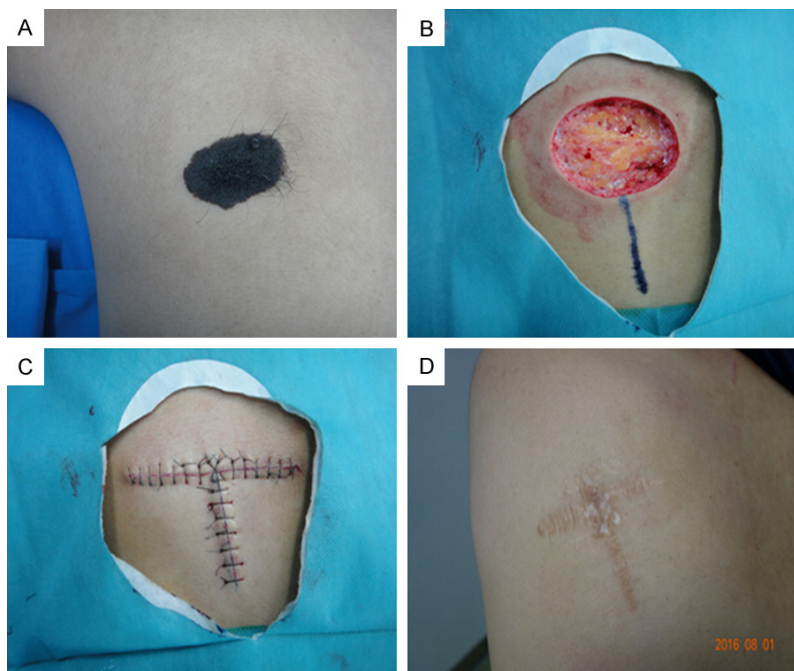


Figure 4. The case with Becker nevus in the back underwent modified O-T flap surgery. A. Preoperative view. B. The modified O-T flap design. C. Repair of the suture. D. Photograph after 1 year of the operation.

48 patients, except wound scar in 2 cases, wound infect in 3 cases and flap tip necrosis in 2 cases. The summary of patients was listed in **Table 1**.

Case reports

Case 1

A 48-year-old woman was diagnosed with Becker nevus on the left side of iliac by pathology diagnosis. The Becker nevus existed since she was born. No obvious expansion was found after adulthood. Recently, the patient required Becker nevus resection because of itchiness. Modified O-T advancement flap was employed for reconstruction. The reconstruction result was satisfactory without major complications. The donor-site scar was small and aesthetically acceptable (**Figure 3**).

Case 2

A 36-year-old man was diagnosed with Becker nevus on the left side of scapula by pathology diagnosis. We designed modified O-T advancement flap for incision repair. One year postoperatively, a good aesthetic result was noted without major complications (**Figure 4**).

Case 3

A 12-year-old boy was diagnosed with compound nevus on plantar by pathology diagnosis. The nevus grew older with the growth of age. The modified double O-T advancement flap was designed for reconstruction. Three years postoperatively, a good aesthetic result was observed without major complications (**Figure 6**).

Case 4

A 21-year-old woman was diagnosed with epidermal nevus on the right upper arm by pathol-

Modified O-T flap for defects

Table 1. Summary of patients information

| Diagnosis | Patients number | Age | Defect size (cm) | Defect position | Complication (case number) |
|----------------------|-----------------|-------|------------------|-------------------------------|---|
| Malignant melanoma | 1 | 47 | 2.5*2.5 | Crus | None |
| Trichoblastoma | 2 | 15/56 | 3*3/1.2*1.2 | Arm, face | None |
| Basal cell carcinoma | 15 | 42-87 | 0.8*1.1-9*10 | Face, scrotum, chest, abdomen | Wound infection (1) |
| Bowen disease | 3 | 67-78 | 3*3-6.2*6.5 | Chest, abdomen, crus | None |
| Pigmented nevus | 25 | 9-62 | 1.5*1.5-13*8 | Trunks, limbs, face | Wound infection (2), scar (2), flap tip retraction (1), flap tip necrosis (1) |
| Sebaceous nevus | 2 | 18-25 | 1.0*1.5-11*8 | Limbs, face | None |

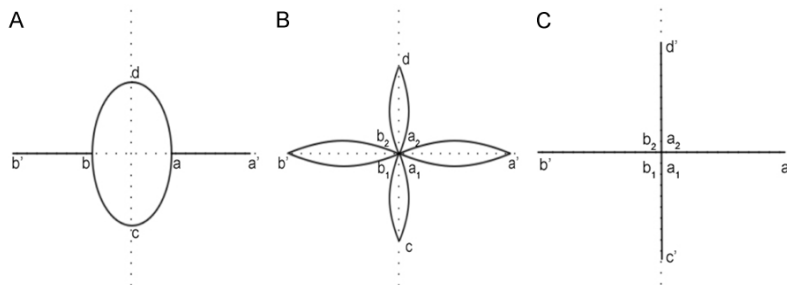


Figure 5. Schematic diagram of modified double O-T flap when the tension is stronger. A. bb' incision on the opposite side of aa' was designed to relieve the tension. B. The four separated flap tips were suture. C. The defects were sutured and repaired.



Figure 6. The case with Becker nevus in foot underwent modified double O-T flap surgery. A. Preoperative view. B. The design of modified double O-T flap. C. Suture of the defects. D. Postoperative view of the defect after 3 years of operation.

ogy diagnosis. Because tension lines were not consistent with the horizontal and vertical axis

of ellipse, the modified O-T advancement flap in special operation was designed and employed for surgery. Reconstruction result was satisfactory, with no major complications. The donor-site scar was small and aesthetically acceptable (Figure 7).

Discussion

Round or oval postoperative wound is the most common defect in skin surgery. Various classical flaps are developed for clinical surgery to protect the function of surgical area, reduce the tension and postoperative complications and beautify the appearance. Rotation and transposition flaps are widely used for round or round-like defects [8]. However, to keep as little tension as possible after wound closure, the arc length of rotation flap is required to be 3-4 fold of the length of defect, and the size of flap is more larger than that of defect [9]. Rhomboid and bilobed flaps, as classic rhomboid flaps are limited in the design of flap position, incision diameter, rotation angle, which require the rich experiment and great skill of the operators [10].

Advancement flap is widely used for skin reconstruction surgery, which transfers to the

Modified O-T flap for defects



Figure 7. The modified O-T flap in special operation (When tension lines are not consistent with the horizontal and vertical axis of ellipse, or there are some important organs in the neighborhood). A. Preoperative view of the case. B. Suture of the three flap tips. C. Suture of the defects.

defects along a straight line without rotatory movement [11], such as O-T flap. As classical advanced flap, O-T flap is broadly applied for surgical trace hide [7]. However, the special design of O-T flap results in the excision of adjacent normal tissues and relatively longer surgical scars [12]. To overcome these shortcomings, we designed and employed the modified O-T flap on the basis of traditional O-T flap. The traditional O-T flap sets the tangent of circular defect as the incision, and the tension center is localized in the edge of adjacent circular defect. However, the modified O-T flap distributes the circular defect equally, makes the long axis as the transverse incision of T shaped flap, and makes the defect center as tension center, which effectively distributes the tension to relieve the tension of each advancement flap. Compared with the traditional O-T flap, the damage on the surrounding tissues of modified O-T flap is lighter, and the surgery operation is at an appropriate difficulty level. In addition, good blood supply ensures the survival of flap. In the surgical practice, we found that the operation technology is focused on its tension center: the suture and fixation of two flaps with point b intersection. The strongest tension point is on the position of flaps intersection, so it is crucial for fixation method. According to our experience, it is viable to apply eight or cross-over suture method for the intersection [13]. What's more, removal of this suture is necessary to delay 2-4 d, or the event of flap tip retraction occurs to union delay. In our experiments, the modified time of suture and stitches avoided flap tip retraction or necrosis caused by traditional O-T flap.

During surgery, the operation of modified O-T flap depends on the character of surgical site.

For example, if the tension is stronger, we design bb' incision on the opposite side of aa' to relieve the tension and obtain ideal aesthetic results (double O-T flap, **Figures 5 and 6**). When tension lines are not consistent with the horizontal and vertical axis of ellipse, or there are some important organs in the neighborhood, the horizontal side could be at some angle with the vertical side of T flap (**Figure 7**). Modified O-T flap is very useful for the repair of larger defect. Because of the specificity and tractability of facial reconstruction, it is hard to employ modified O-T flap for facial reconstruction. So more work needs to be done for facial reconstruction.

Taken together, the application of modified O-T flap could effectively reduce the closure tension, maintain the operative area function and improve aesthetic appearance. Modified O-T flap is practical and safety, which is worthy of clinical application.

Disclosure of conflict of interest

None.

Address correspondence to: Jian-Zhong Hu, Department of Dermatology, Tianjin Medical University General Hospital, No. 154, Anshan Road, Heping District, Tianjin 300211, China. Tel: (+86) 022-60363959; Fax: (+86)-022-88329119; E-mail: hujianzhong88@yeah.net

References

- [1] Brown MD. Skin surgery: a practical guide. *Arch Dermatol* 1999; 135.
- [2] Costelloe CM and Madewell JE. Radiography in the initial diagnosis of primary bone tumors. *AJR Am J Roentgenol* 2013; 200: 3-7.

Modified O-T flap for defects

- [3] Kim YH, Kim SW, Kim JT and Kim CY. Tensor fascia lata flap versus tensor fascia lata perforator-based island flap for the coverage of extensive trochanteric pressure sores. *Ann Plast Surg* 2013; 70: 684-690.
- [4] Fischer JP, Wink JD, Nelson JA, Cleveland E, Grover R, Wu LC, Levin LS and Kovach SJ. A retrospective review of outcomes and flap selection in free tissue transfers for complex lower extremity reconstruction. *J Reconstr Microsurg* 2013; 29: 407-416.
- [5] Cho YK, Ryu DW, Chung HY, O TM, Blei F and Waner M. Surgical management of scalp infantile hemangiomas. *J Craniofac Surg* 2015; 26: 1169-1172.
- [6] Ring A, Kirchoff P, Goertz O, Behr B, Daigeler A, Lehnhardt M and Harati K. Reconstruction of soft-tissue defects at the foot and ankle after oncological resection. *Front Surg* 2016; 3: 15.
- [7] Ying B. Adjacent flaps for lower lip reconstruction after mucocele resection. *J Craniofac Surg* 2012; 23: 556-557.
- [8] Bovill ES, Macadam SA and Lennox PA. Repairing the high-riding nipple with reciprocal transposition flaps; and classification and management of the postoperative, high-riding nipple. *Plast Reconstr Surg* 2014; 133: 57e-58e.
- [9] Rovira-Lopez R, Pujol RM and Toll A. Repair of a defect of the lateral suprabrow. *Dermatol Surg* 2016; 42: 543-546.
- [10] Sari E, Tellioglu AT, Altuntas N, Seven E and Ozakpinar HR. Combination of rhomboid flap and double Z-plasty technique for reconstruction of palmar and dorsal web space burn contractures. *Burns* 2015; 41: 408-412.
- [11] Zhao LX, Schmidt PC, Sciallis AP, Breed CA and Haefner HK. Resection and advancement flap closure of a combined vascular malformation of the mons pubis. *Obstet Gynecol* 2016; 127: 269-272.
- [12] Krishnan R, Garman M, Nunez-Gussman J and Orengo I. Advancement flaps: a basic theme with many variations. *Dermatol Surg* 2005; 31: 986-994.
- [13] Hussain W, Salmon PJ and Mortimer NJ. The 'crossover' tip-stitch in O-T flap repair. *Br J Dermatol* 2010; 162: 219-220.