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L-Extension Deltopectoral Flap in Head and Neck Reconstruction

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Abstract

With more radical ablation for oral cancer, increasing difficulty was encounted in surgical reconstruction of the defect for good aesthetic appearance and function. The deltopectoral flap is a fasciocutaneous flap that is composed of fascia, subcutaneous tissue, and skin. Its blood supply is from the perforating branches of the internal mammary artery, especially the 2nd and 3rd perforators, and the venous drainage is reliable. The deltoid portion of the deltopectoral flap is usually not hair-bearing and the donor site can be concealed by clothing. In this analysis, we reported 10 cases of oral cancer using an L-extension deltopectoral flap technique for repairing the surgical defects without prior delayed procedure. The sites of reconstruction included cheek, mouth floor, lips, palate, and orbitomaxillary area. Only one flap was necessary to repair with forearm flap in second stage. Two minor complications were seen and healed after wound debridement. According to the analysis, we recommend the L-extension deltopectoral flap to be a reliable and versatile technique for head and neck reconstruction.

Key words: Deltopectoral flap, Oral cancer.

Introduction

Aymard[1] first described a deltopectoral flap used for nasal reconstruction in 1917. However, it was not until Bakamjian's[2] description of the medially based deltopectoral flap in 1965 that the widespread use of this versatile flap in head and neck reconstruction began. Before that forehead flap, the temporalis flap or the cervical flap was usually used for reconstruction. The forehead flap and the temporalis flap had the disadvantage of creating an expressionless scarred forehead or facial deformity. The cervical flap created from its natural covering of the neck. If there is a large defect, it may be necessary to raise another flap to cover the neck.

The pectoralis major myocutaneous flap

and free microvascular flap have gained the popularity in head and neck reconstruction since the 1980s. The following report described a modified technique, which may enhance and renew the application of the deltopectoral flap.

Patients and methods

From October 1998 to December 1999, 10 L-extension deltopectoral flaps (folded in 7 cases and greater length for 3 cases) were applied in reconstruction of the head and neck region without prior delayed procedures. The medical records were reviewed retrospectively. Data of age, sex, stage and site of the tumor, use of adjunctive chemotherapy or radiotherapy in combination and postoperative complications were analyzed. The age of patients ranged from 42 to 65 years old with a mean age of 54. There were 9 males (8 patients with untreated squamous cell carcinoma and 1 patient with recurrent squamous cell carcinoma) and 1 female (basal cell carcinoma). The sites of reconstruction included cheek in 5 cases, palate and cheek in one, lower lip in one, mouth floor in one, neck in one, and orbitomaxillary area in one case (Table 1). Among them, patient 8 had received 5000 rad of radiotherapy 2 years previously and patient 9 received radiotherapy a dose of 4500 rad 3 years previously. Five patients received a course of intravenous infusion chemotherapy (Cisplatin 60 mg, bleomycin 45 mg, 5-Fluorouracil 2500 mg) preoperatively. Patient 8 and patient 9 received chemotherapy 3 months and 14 months prior to operation respectively. Patient 1 and patient 7 received chemotherapy 7 days before the operation, and patient 10 received chemotherapy 7 days after deltopectoral flap division procedure (Table 2). Wide excision of the tumor was performed in all patients. Four patients required a marginal resection of the mandible, and 1 patient underwent a marginal resection of the maxilla.

After tumor removal with frozen examination control of the surgical margins, the length and extent of the flap was designed on the basis of the size of the postablative defect. The distance from the distal end of the L-extension

Table 1. Summary of the patients

Patient No.	Age/Sex	Diagnosis	Location	Size of Defect (cm)
1	51/M	Squamous cell carcinoma	R't buccal mucosa	12.5 × 7
2	53/M	Squamous cell carcinoma	L't buccal mucosa	12 × 6
3	65/F	Basal cell carcinoma	L't orbito-maxillo-facial area	5.5 × 5
4	54/M	Squamous cell carcinoma	Lower lip	8 × 6
5	65/M	Squamous cell carcinoma	R't submandibular area of neck	13 × 7
6	50/M	Squamous cell carcinoma	L't buccal mucosa	12 × 6
7	50/M	Squamous cell carcinoma	R't buccal mucosa	11 × 6.5
8	47/M	Squamous cell carcinoma	R't mouth floor, R't buccal mucosa	10 × 5
9	64/M	Squamous cell carcinoma	L't buccal mucosa and soft palate	10 × 5.5
10	42/M	Squamous cell carcinoma	L't buccal mucosa	10 × 5.5

R't, right; L't, left

Table 2. Summary of the outcomes and the adjunctive therapies

Patient No.	Preoperative Chemotherapy	Preoperative Radiotherapy	Folded Flap	Postoperative Chemotherapy	Follow-up (months)	Complication
1	+	-	+	-	14	None
2	-	-	+	-	14	None
3	-	-	-	-	13	None
4	-	-	+	-	13	None
5	-	-	-	-	3	None
6	-	-	+	-	9	None
7	+	-	+	-	12*	TN
8	+	+	+	-	6	PN
9	+	+	-	-	5	None
10	-	-	+	+	3	PN

PN: Partial Necrosis, TN: Total Necrosis *: Forearm flap used in second intention

deltopectoral flap to the medial base was measured with a long gauze and this was rotated to see if the flap length would be suitable. The superior border of the L-extension deltopectoral flap was located below the clavicle. The inferior border ran from the base encompassing four intercostal space and carried along a line above the nipple to the shoulder at the deltoid region. The distal end extended further down anterolaterally around the upper arm (Fig. 1a). After the flap was outlined, these incisions were then carried down through the skin and subcutaneous tissue to the fascia overlying the deltoid and pectoralis major muscles. Flap elevation was performed with sharp dissection from the deltoid region to pectoral region in the subfascial plane. As the dissection proceeded into the parasternal region, it should be stopped within 2 cm of the parasternal region to avoid injury to the perforating vessels which lay deep in the subcutaneous tissues. The elevated flap was then rotated to the surgical defect site (Fig. 1b). The base of this flap was tubed exterior to the cervical skin. The donor site was covered with a split thickness-skin graft harvested from the thight. The blood supply of the flap was examined 2 weeks later by ligating with a tourniquet for 10 minutes. If the distal side of the flap did not become cyanotic it was considered safe to divide the L-extension DP flap and the unused portion of the flap was returned to the chest wall in the second stage. Flap loss was categorized as partial necrosis to total necrosis (Table 2). The patients were followed up for a time ranged from 3 months to 14 months (Fig. 2).

Results

Among these 10 L-extension flaps, 7 flaps were successfully, 2 flaps experienced partial necrosis and 1 flap necrosed totally. The size of the flaps ranged form 5.5 to 13 cm in length and 5 to 7 cm in width. The average size of the L-extension deltopectoral flap was 10.4 × 6 cm, requiring a split-thickness skin graft to the donor site in the deltoid area. We found a greater number of minor and major complica-

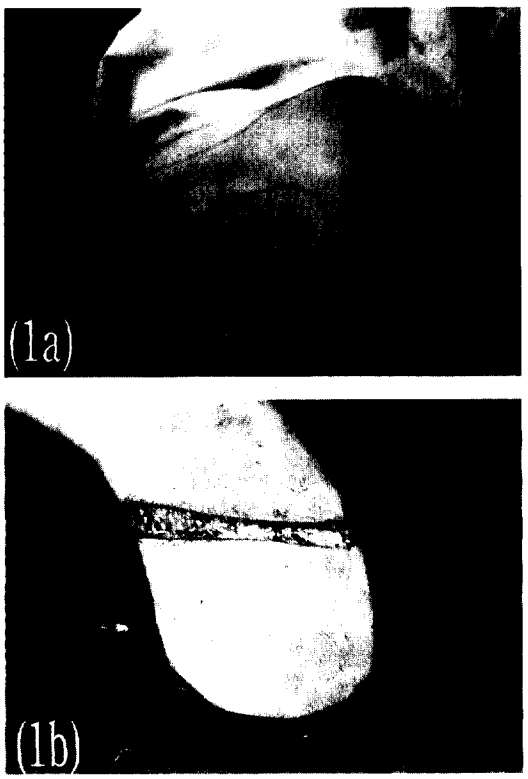

Fig (1a) Outline of L-extension deltopectoral flap to be raised.
(1b) The deltopectoral flap was elevated and de-epithelized.

Fig (2a) A case demonstrating a large full thickness cheek defect about 12 × 6 cm.
(2b, 2c) The L-extension deltopectoral flap was transferred into the surgical defect and satisfactory reconstruction was achieved at 6 months postoperatively.

tions in patients treated with chemotherapy, compared with those receiving no chemotherapy (Table 2). Patient 8 and patient 10 developed a partial necrosis of the flap which was healed by secondary intention. Patient 7 suffered from total necrosis of the flap after preoperative chemotherapy (Cisplatin 60 mg, bleomycin 45 mg, 5-Fluorouracil 2500 mg). Finally, the defect was reconstructed successfully using a free forearm flap. Patient 5 died at 3 months later because of severe weakness. There were no major donor site mobidities during the follow-up period.

Discussion

The pectoralis major myocutaneous flap is made of muscle and subcutaneous fat. Sometimes, the pectoralis major myocutaneous flap is too bulky and the nipple position becomes distorted to cause cosmetic problems. Schaller[3] encountered significant problems with flap bulky. He pointed out the undesirability of transfer of hair-bearing skin transferred into the mouth and pharynx in men, the distortion of the female breast, obliteration of the neck, and the shoulder deformity and disability. Shoulder complications arising from loss of the pectoralis major muscle may seriously compound shoulder disability resulting from the loss of the 11th cranial nerve.[4]

The deltopectoral flap forms in a better contour than the pectoralis major myocutaneous flap. The deltopectoral flap produces less distortion of the breast and there is no disruption to the pectoralis major muscle with no resultant shoulder dysfunction. There is relative lack of bulk and the operation is technically easy. The follow-up neck examination is not obscured, and the deltopectoral flap dose not require to violate the neck when no radical neck dissection is indicated.[4]

The free microvascular flap, with its rich vascularity, permitting a high degree of versatility and reliability in design, is a useful reconstruction method for postoperative defect. The free raidal forearm flap is more popularly used for reconstruction on the orofacial region. The complications of the radial forearm flap donor site include poor aesthetics, morbidity, reduced strength and sensation on the hand.[5] The deltopectoral flap continues to play a role in such situations and may obviate the need for the free microvascular flap.

In the deltopectoral flap, the anterior thoracic perforators terminate some 8 to 10 cm lateral to their point of entrance. Hemodynamically, the deltopectoral flap may be divided into (1) a cutaneous flap, lateral to the cephalic vein and (2) and arterial pedicle, medial to the cephalic vein.[6] Cutaneous flaps are supplied by the musculocutaneous arteries located in their base, which perpendicularly penetrate the flap to terminate directly in the dermal-subdermal plexi. Arterial flaps incorporate direct cutaneous arteries in their longitudinal axis, which thereby extend their vascular base beyond the anatomical base by perfusion pressure. Prior to isolation the lateral cutaneous flap is supplied by numerous musculocutaneous arteries, which are severed on elevation, thereby rendering it solely dependent upon a reduced and reoriented perfusion from the medial base.[6] Consequently, the arc of rotation and length of the flap are not compromised, and the blood supply is consistently preserved.

Although the 2nd perforating branch of the internal mammary artery is believed to be the main supply to the flap, this inferior limb

design assures the integrity of the third and fourth perforators, thus optimizing the blood flow. However, the flap with a narrower base and two vessels maybe in jeopardy. We maintained a wider base, including 3 intercostal vessels as Bakamjian[2] recommended to improve the vascularity.

Bakamjian[7] recommended a delayed deltopectoral flap because of healing problems in the patient who had malnutrition, diabetes, arteriosclerosis, or other complicating disorders, and those who required a longer flap. Greater length can be achieved when a delayed procedure is instituted as Bakamjian's recommendation, otherwise a significant distal flap necrosis will occur due to no prior delay.[7] The delayed procedure (2 weeks before main operation) was indicated when the length-breadth was increased beyond normal through the use of an extend flap (as L-extension flap).[8] Bakamjian's technique, of using L-extension deltopectoral flap from the upper arm with several delays, is advisable.[7] The delayed procedure apparently conditions the flap to a reduced, reoriented blood supply when paddles extending down the arm are used. Medial perfusion is even more essential and the cutaneous branches of the thoraco-acromial artery should be retained. In the initial delayed procedure, the deltoid component is folded or a skin graft is performed on the inner surface of the flap. In the second procedure (main operation), the two epithelial surfaces are transferred to the surgical defect. Our method appears to be safe and reliable and saving in time at of 10 to 14 days without a preliminary delayed procedure. The reduced time results in a significant decrease in the hospital course and cost.

The incidence of complications in previous reports[9] were not been diminished by delayed procedure. In occlusion, a delay in creating the deltopectoral flap had no influence upon the risk of complications and necrosis. No relationship was found between the delayed procedure and the successes of the flap. Gilas *et al*[9] reported an overall complication of 51%. The major flap necrosis rates were reported to range from 9.5% to 23%.[8,9,10] However, a review of the English language literature disclosed only a few reports[6,7,8,10] that used an L-extension deltopectoral flap with a preliminary delayed procedure. In our series, a overall complications developed in 30% (3 of 10) and the rate of major flap necrosis was 10%.

Flap necrosis may result from several factors.[8] Traction has been a very important factor. Hematoma under the flap likewise interferes with vascular ingrowth, and thus predisposes the flap to separation. Infection is frequently a sequel to separation or necrosis of the flap. Folding the flap to cover a through-and-through defect of the cheek may comprise the flap. Mendelson[8] reported that major complications developed in 23% of the flaps used for full thickness defects closures. In our series, a major complication developed in 14% (1 of 7) of the flap used for full-thickness defects closures. Thomas[11] claimed that previous radiotherapy to the recipient site did not affect flap viability and should not be a reason to delay the flap. In our experience, the result of patient 8 and patient 9 seemed to support this.

Vascular injury and complications associated with antineoplastic agents are being reported with increasing frequency.[12] This may increase the chance of complications in patients already having a decreased immunity

response and healing capacity, such as those treated by chemotherapy. It is well known that many chemotherapy agents cause significant chemical phlebitis or are associated with thrombolism. Microvascular thrombosis has been described in association with multidrug regimens containing bleomycin and cisplatin.[12,13] Bleomycin causes characteristic endothelial changes in capillaries and arterioles with cumulative administration. Fibrinous thrombi occur in small arteries, arterioles and capillaries throughout the body. The microthrombi, occluding the involved vessels to varying degrees, were adherent to the vascular walls and were accompanied by conspicuous endothelial hypertrophy. This process continued with progressive thickening of the dermis and narrowing of the vessels as the blood supply became critically compromised.[13] Hypoperfusion, resulting from thrombosis or arterial vasospasm, probably produces the acute ischemic vascular complications.[14] According to Cohen's[15] report, these unusual changes in hyperpigmentation, sclerosis, gangrene, and pulmonary fibrosis represent acute toxic manifestations of bleomycin therapy. In addition, cisplatin may enhance the vascular toxicity of bleomycin.[16] Therefore, we found more flap complications (3 of 5) in patients that had undergone chemotherapy. The skin changes of patient 7 occurred immediately after the chemotherapy was administered and hyperpigmentation appeared. After debridement and division of the flap, the obvious vascular thrombosis was noted in the fascial layer of the residual pedicle. It was evident that chemotherapy dramatically affected the incidence of flap necrosis. In summary, patients who had the tendency to suffer flap necrosis had received immediate treatment of pre-operative or post-operative chemotherapy.

Therefore, our protocol in the face of adjuvant therapy is as follows (1) Preoperative chemotherapy is not recommended. If preoperative chemotherapy is employed, surgical intervention must be postponed 4 weeks after last dose of chemotherapy. (2) The postoperative chemotherapy is not administered until 4 weeks after deltopectoral flap division. (3) Surgical intervention is performed at least 8 weeks after the last dose of preoperative radiotherapy. (4) The postoperative radiotherapy begins only after wound healing has completed, usually at an average of 4 weeks after deltopectoral flap division.

The L-extension deltopectoral flap is readily accessible, with a large length of versatile tissue available. In our experience, the L-extension deltopectoral flap can be folded to provide covering for through and through defects without a preliminary delayed procedure. The flap can be transferred without delay and is relatively hairless and non-bulky. The donor defect on the anterior shoulder does not appreciably hamper function or cause morbidity, and normal clothing easily masks the scar. The cosmetic appearance was acceptable in these patients.

Careful analysis of such factors as tension along the axis of the flap, vascular occlusion caused by extreme angulation or folding of the flap, and fastidious attention to detail during design, elevation, placement and donor site closure enhances this flap's reliability.[4]

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L-延伸型肩胸皮瓣在頭頸部重建手術的應用

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摘 要

口腔癌的病患經由根除性手術切除病灶區，其重建手術在美觀之要求及功能的恢復上，往往十分困難。肩胸皮瓣是由表皮、皮下組織以及筋膜所組成的；肩胸皮瓣的血流供應主要是來自內乳動脈之穿通枝，特別是第二及第三穿通枝，而且靜脈迴流系統是相當可靠。肩胸皮瓣之三角肌區通常並無毛髮附著，所以容易藉由衣著來覆蓋手術後缺損區，因此肩胸皮瓣是容易被病人接受的。

在報告的分析上，我們提出十個病例，是採用L延伸型肩胸皮瓣的手術來修補頭頸部的缺損，而且並無預先延遲性的手術步驟，重建的區域包括頰部、口底、唇部、上腭部以及上顎眼眶區域，其中一例因爲皮瓣壞死，而需要利用前臂皮瓣來做第二次的修補；另外二例有小部份的壞死，在傷口清創之後，復原情況很好。根據此份報告的顯示，利用L延伸型肩胸皮瓣的設計，乃是一種可靠且多樣性的方法，可用來重建頭頸部的缺損。

關鍵詞：肩胸皮瓣，口腔癌。

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