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The Laterally Extended Paramedian Forehead Flap for Nasal Reconstruction: The Delay Technique Revisited

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Background: Problems with poor circulation often occur when a large defect or a distant region, such as the apex of the nose, is covered with a paramedian forehead flap. Delay technique increases the safety of reconstruction procedures, but it has been used less frequently because a 2-stage surgery is necessary, and various other flaps and techniques have been developed.
Method: We performed the delay technique of paramedian forehead flap at the same time as tumor resection. For the flap, a narrow pedicle of about 1-cm was prepared on the supratrochlear artery and vein, and the incision was extended toward the lateral side conforming to the defect morphology, and a paramedian forehead flap with a design consistent with the esthetic unit containing the defect was prepared. The region below the flap was dissected to create the flap bipedicle, and surgery was completed.
Result: This procedure was used in 4 patients with malignant tumor of the external nose, and the flap survived perfectly in all patients. The postoperative esthetic outcome was also found to be good.
Conclusions: This procedure does not increase the frequency of surgery, circulation in the flap is maintained, the flap pedicle on the supratrochlear artery can be made narrow, and flap thinning can be performed from the beginning. Coverage of an extensive defect is possible because a large flap can be excised, and satisfactory esthetic appearance can be obtained by matching with the esthetic unit. The delay technique for various flaps (not limited to forehead flap alone) should be considered an effective technique for the current treatment of malignant tumors.
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INTRODUCTION

Forehead flap is a representative pedicled flap, and it has long been used in the plastic surgery field. It is effective and may be used as the first choice for reconstruction of the external nose. However, when a large defect or a distant region, such as the apex of the nose, is covered with it, circulation is often poor and the flap may reach the hairy area. The use of the delay technique[1,2] and a tissue expander[3] increases the safety of the procedures, but 2 or more surgeries are necessary.

The delay technique for flaps has been performed as a technique to stabilize blood flow in the flap and to allow the flap to reach a site as distal as possible. The mechanism of the delay phenomenon has been elucidated, and it is an effective surgical procedure depending on the way of use. However, its application requires a 2-stage surgery, and its utility value decreased due to the development of various flaps. Recently, skin defects are covered with artificial dermis upon resection of malignant tumor without closing the wound in the first stage, and reconstruction is performed after confirming the presence or absence of the tumor margin via histopathological examination. Thus, we performed the delay technique to a paramedian forehead flap at the time of tumor resection, and the flap was removed after obtaining definite findings of pathological examination. This procedure facilitated a safe reconstruction without increasing the frequency of surgery.

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METHODS

The distributions of the supratrochlear artery and frontal branch of the superficial temporal artery were confirmed by Doppler ultrasound before surgery. In surgery, first, the tumor was resected and pathologically examined. Artificial dermis was applied to the skin defect after resection. For the flap design, a paramedian forehead flap was selected. A pedicle (about 1 cm or narrower) was prepared on the supratrochlear artery and vein, and the incision was extended toward the cranial side corresponding to the distance to the defect and then toward the lateral side matching to the defect morphology so as to prepare a paramedian forehead flap with a design consistent with the esthetic unit containing the defect. Incision and dissection was performed on both sides of the flap to the depth of the periosteum in parallel to the long axis of the flap, and a flap containing the frontalis muscle and superficial layer of the temporal fascia was prepared. No skin incision was made at the central or the peripheral side of the flap. The flap was dissected on the periosteum as a bipedicle flap, and surgery was completed by suturing (Fig. 1). The second surgery was performed after confirming the results of histopathological examination, but basically, it is better to perform the surgery within 10–14 days when the effect of the delay becomes marked. Granulation of the artificial dermis in the skin defect was removed, the paramedian forehead flap was elevated to match with the esthetic subunit, and the defect was covered. Thinning of the region around the flap was performed at the same time. For the flap donor region to which plication is not applicable, skin grafting was performed.

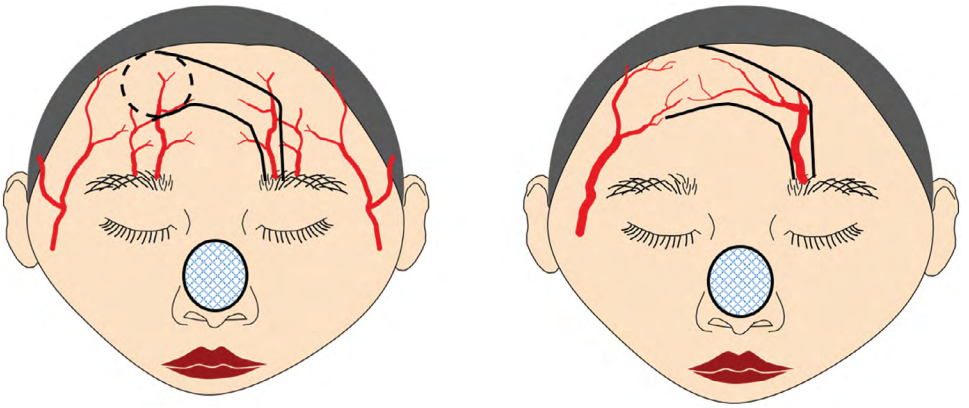

Fig. 1. Create delayed phenomenon by making an incision. An increase in blood flow from the supratrochlear artery and the superficial temporal artery is expected.

RESULTS

This procedure was performed in 4 patients with a malignant tumor of the external nose, and the flap survived perfectly in all patients. No postoperative complications, such as flap necrosis, wound infection, or hematoma, developed. The eyebrow in the resected region could be elevated by the conserved frontalis muscle other than the flap-donor region, although it was weaker than that on the healthy side, and no esthetic problem was observed.

Case Presentation

Case 1: 82-year-old Man with Malignant Melanoma of the Nose

A black tumor was present in the apex of the nose over the bilateral alae and diagnosed as malignant melanoma on dermoscopy (Fig. 2). In the first surgery, the tumor was resected with a 1-cm margin on the perichondrium, and artificial dermis was applied to the skin defect. The

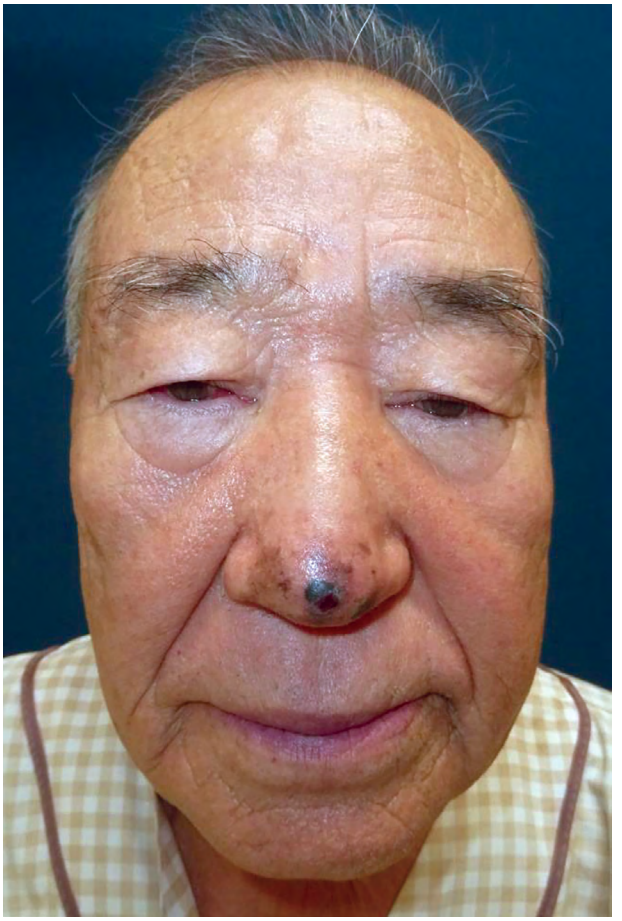

Fig. 2. Eighty-two-year-old man with malignant melanoma of the nose (T3N0M0).

Fig. 3. An incision in the forehead by the first surgery.

Fig. 4. The flap was cut off in the second surgery and sutured to the defect.

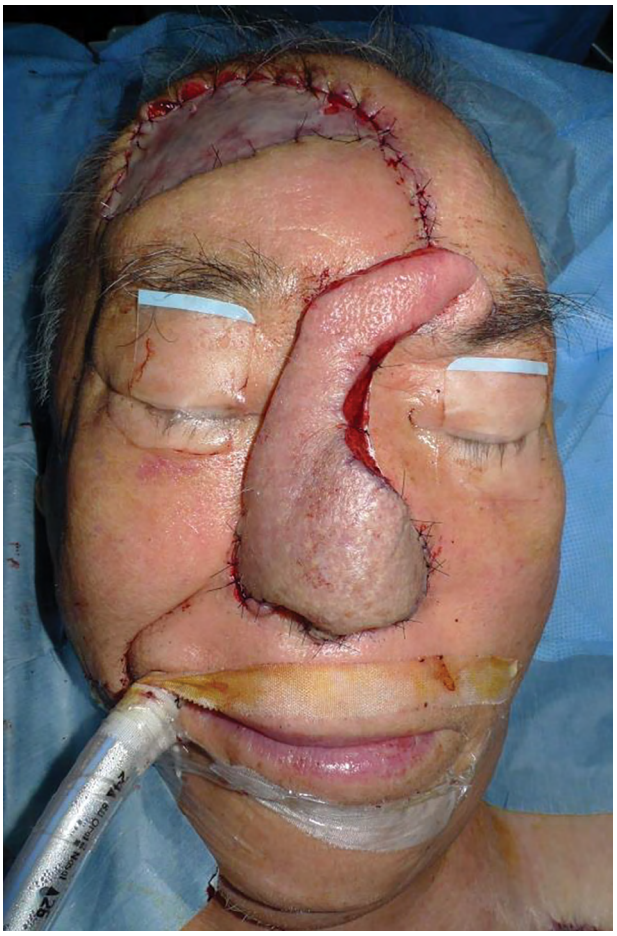

Fig. 5. Paramedian forehead flap reached the tip well.

second surgery, in which the delay technique (Fig. 3) was performed at the same time was performed after 2 weeks. The surrounding skin was resected so as to match with the esthetic unit of the dorsum of the nose and alae. The paramedian forehead flap was elevated, and the defect was covered. In the flap donor region, the flap base on the trochlear artery was sutured, and a full-thickness skin graft from the left clavicular region was applied to the residual skin defect (Figs. 4, 5). There was no problem with blood flow, and the flap was removed after 2 weeks. Flap engraftment was satisfactory. As of 6 years after surgery, the flap was found to be symmetric with good appearance, although thickness slightly remained (Figs. 6, 7).

Case 2: 77-year-old Man with Malignant Melanoma of the Right Ala

An extended resection with a 1 cm margin from the tumor margin was performed. Full-thickness defects formed in parts of the right dorsum and apex of the nose and right ala (Fig. 8). The delayed technique was performed at the same time (Fig. 9). After 2 weeks, the paramedian forehead flap was elevated. For lining of the right ala, a hinge flap was prepared by reversing the remaining skin of the right dorsum of the nose within the range consistent with the esthetic unit. The skin defect was

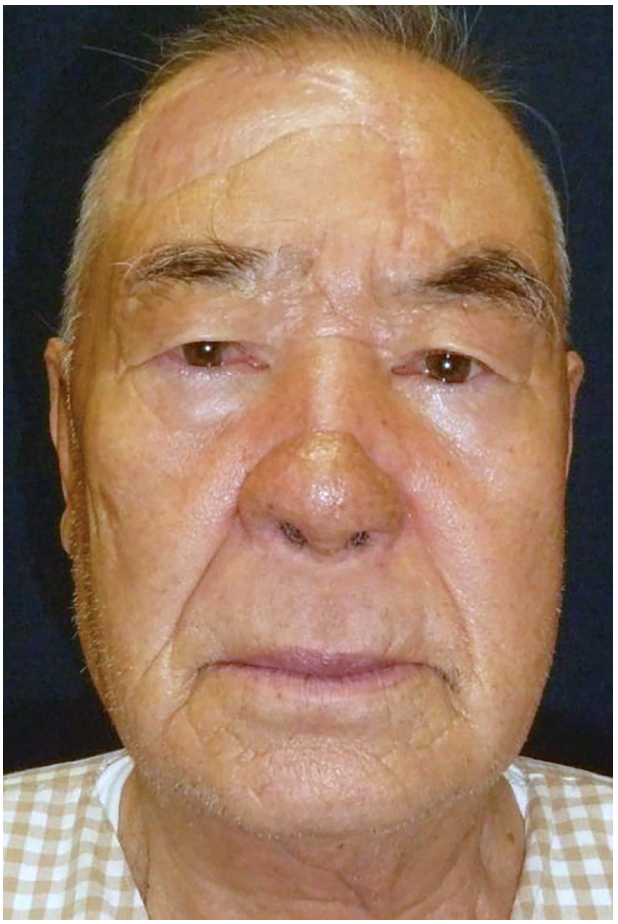

Fig. 6. Appearance of the patient 6 years after surgery.

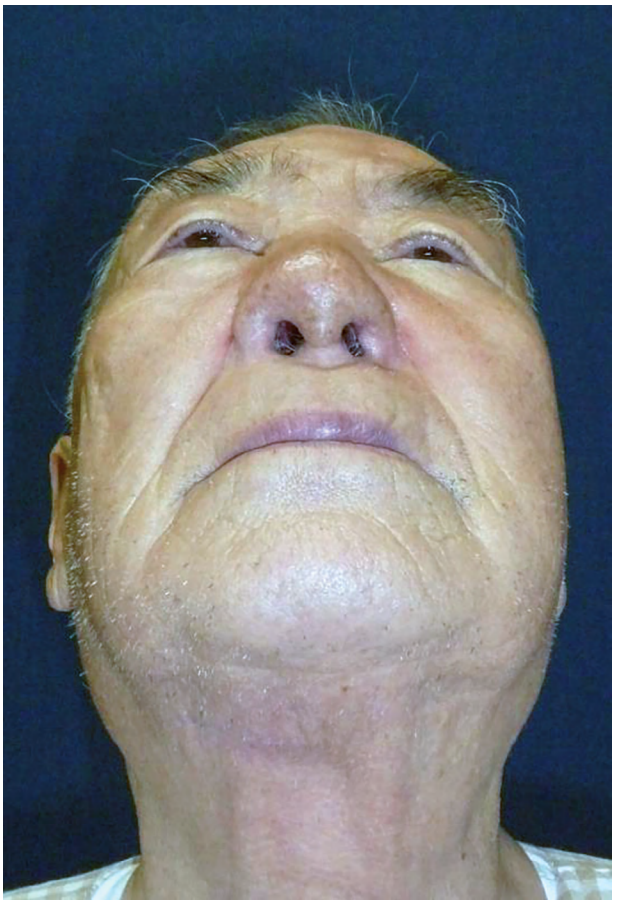

Fig. 7. Paramedian forehead flap was symmetric with good appearance.

covered with the paramedian forehead flap (Figs. 10, 11). The forehead was plicated as much as possible, and the defect region was subjected to open therapy. The flap was removed after another 2 weeks (Fig. 12).

DISCUSSION

Median forehead flap is useful for defects of the nose.[4] Various methods have been developed, and the frequency of surgery, lining method, and flap thinning method have recently been discussed.[5] Three arteries are distributed in the forehead: the frontal branch of the superficial temporal artery, which is the terminal branch of the external carotid artery; supraorbital artery, which is the terminal branch of the ophthalmic artery; and supratrochlear artery. The forehead skin tissue structure comprised the skin, subcutaneous superficial layer of adipofascia, frontalis muscle, galeal aponeurosis, loose fascial layer of galeal aponeurosis, and periosteum. The vascular network in this structure is different from those in other regions, and it comprises 3 layers: subdermal vascular plexus, subcutaneous adipofascial vascular plexus, and vascular plexus beneath the galeal aponeurosis. The subdermal vascular plexus is well developed, especially in the midline region, and closely communicates with the temporal artery.

A paramedian forehead flap prepared by extending a median forehead flap toward the lateral side using this vascular network has been reported. Reconstruction using a normal median forehead flap is difficult in patients with a narrow forehead and for distant defects, such as a defect of the apex of the nose, and extension to the scalp is necessary for some cases. Thus, this flap is useful for these patients.

However, a flap that has a narrow pedicle may be problematic with regard to blood flow. Congestion readily occurs in the tip of a flap. Atrophy due to flap necrosis and insufficiency in postoperative blood flow occurs after reconstruction of the nose, which is a large esthetic demerit in many cases.

To obtain the safe flap circulation, the delay technique and an expander[3,6] are used. It has been clarified that the delay phenomenon increases the diameter of the choke vessel as the early-phase change. This effect enables elevation of the flap crossing the perfused region.[1] In an animal experiment using rabbits, the effect most efficiently increased from 48 to 72 hours and gradually reached the plateau over the 7th day. Regarding the late-phase phenomenon, vascularization from the surrounding tissue has been clarified, but many points remain unclear with regard to the timing. This procedure has long been used as a very effective technique for flap circulation in

Fig. 8. A 77-year-old man with a malignant melanoma of the right ala (T4N0M0).

Fig. 9. Incision made in the forehead at the same time as resection.

Fig. 10. The nasal cavity was covered with a hinge flap in the second surgery.

Fig. 11. Blood flow at the flap tip was good.

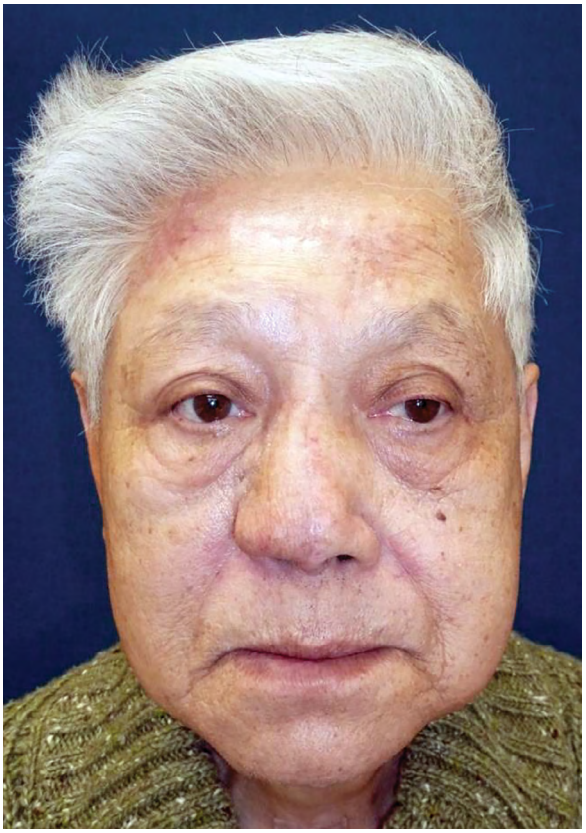

Fig. 12. Appearance of the patient 6 months after surgery.

the plastic surgery field, but the frequency of its use has decreased because it requires 2-stage surgery, and various flaps have been developed by studies on the circulatory system.[7,8]

Various diagnostic methods of malignant melanoma have recently been developed. Dermoscopy is one of these, and it has been reported that skilled dermatologists may diagnose malignant melanoma at 92% sensitivity and 99% specificity.[9,10] The general surgical treatment strategy for malignant melanoma in the nasal region is total tumor resection or biopsy followed by reconstruction after pathological examination of the tumor in many cases. We decided to perform the delay technique in the first surgery using the period of waiting normally for 1–2 weeks. The flap engrafted in all patients, and no deformity was noted after surgery.

The merit of a paramedian forehead flap using the delay technique designed by us is that it enables early reconstruction after tumor resection without increasing the frequency of surgery. Accordingly, it may become a good indication especially for malignant tumor of the external nose in the elderly. Flap circulation is maintained, the flap pedicle on the trochlear artery can be narrowed, and thinning of the flap can be performed from the beginning, which are the advantages of the technique. Since a large flap can be excised, an extensive defect can be covered and a good esthetic outcome can be achieved by conformity to the esthetic unit. In addition, healthy skin contained in the esthetic unit can be used for reconstruction, such as lining of the ala, which may also be advantageous.

It is necessary to determine the flap size before making a definite diagnosis of tumor, for which a slightly larger flap size should be selected. However, since an expanded defect size following the esthetic unit is generally covered, there is no problem if a flap is designed in conformity to the defective esthetic unit.[8] In the current treatment of malignant tumor, the delay technique should be considered effective for various flaps, not limited to forehead flaps alone.

CONCLUSIONS

We reconstructed an extensive defect of the external nose with a paramedian forehead flap using the delay technique and achieved good outcomes. The delay technique is an effective means to stabilize flap circulation, but it has recently been less frequently used because several surgeries are necessary. However, a 2-step surgery has recently been performed for malignant tumors: tumor resection and then reconstruction after confirming the results of pathological examination. Thus, performing the delay procedure in the first surgery enables a safe reconstruction.

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PATIENT CONSENT STATEMENT

Patients provided written consent for the use of their images.

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