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Case Report

Reconstruction of nose defects using external temporoparietal fascia prefabricated forehead flap - an innovative surgical approach

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Abstract: Nasal reconstruction remains one of the most complex challenges in reconstructive plastic surgery due to its intricate three-dimensional architecture and functional demands. While the forehead flap has emerged as the gold standard for nasal reconstruction, conventional techniques inevitably produce conspicuous longitudinal forehead scarring at the pedicle site. We present an innovative approach combining external temporoparietal fascia prefabrication (E-TPFF) with tissue expansion technology to address these limitations. This article aims to enhance the existing method to meet the demand for nasal defect repair while eliminating the operation's drawbacks. Our modified technique offers three significant advantages: (i) complete elimination of visible forehead scarring through an external temporoparietal fascia prefabricated forehead flap (E-TPFF); (ii) providing a flap with reliable vascular supply through temporoparietal fascia prefabrication, and (iii) generation of sufficient flap volume and pedicle length to accommodate even extensive maxillofacial defects. Preliminary results demonstrate that the E-TPFF technique maintains all benefits of traditional forehead flaps while overcoming their most notable aesthetic drawbacks, representing a substantial advancement in facial reconstructive surgery.

Keywords: Temporoparietal fascia flap, nasal reconstruction, forehead flap, prefabrication

Introduction

The nose is the most prominent facial feature and is often involved in skin malignancies or injuries. Due to its unique structural support, symmetry, three-dimensional (3D) contour, and skin color, reconstructing nasal defects can be complex and challenging [1]. Primary sutures, local flaps, or skin grafts are effective for repairing small nasal defects. However, for larger and more intricate defects that involve skin, cartilage, or nasal mucosa, the forehead flap has emerged as the reconstruction modality of choice for such cases due to its ideal color and texture match [2, 3]. However, the forehead flap technique requires a properly shaped flap on the forehead and a longitudinal pedicle between the brows, which inevitably results in a noticeable longitudinal frontal scarring - a persistent aesthetic concern even in experts.

First described by Golovine in 1898 [4], the temporoparietal fascia flap (TFF) has become a cornerstone in reconstructive surgery due to its rich vascular network and versatility. As a thin yet highly vascularized connective tissue layer, the TFF has been extensively utilized in facial and neck reconstruction, particularly in flap prefabrication procedures [5, 6]. Flap prefabrication represents a significant advancement in reconstructive surgery, enabling the creation of customized donor sites independent of anatomical vascular boundaries [7]. Building upon these principles, we innovatively combined the forehead flap and flap prefabrication method to perform nasal reconstructive procedures. This novel technique effectively addresses the persistent challenge of conspicuous frontal scarring associated with traditional forehead flap pedicles. To our knowledge, this represents the first reported application of external temporoparietal fascia-prefabricated forehead flaps (E-TPFF) in nasal reconstruction, with preliminary results demonstrating significant clinical promise.

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Figure 1. Preoperative view of the nasal wounded area including the nasal tip, right ala, right nasal alar cartilage, cornu cartilaginous alaris, and sulcus alaris.

Case presentation

A 32-year-old female presented to our hospital with acute nasal trauma sustained during an electric bicycle accident 4 hours before admission. Physical examination revealed a composite nasal defect measuring 2.6 cm × 2.2 cm involving the nasal tip, right ala, right nasal alar cartilage, cornu cartilaginous Alaris, and sulcus alaris (**Figure 1**).

Following a comprehensive evaluation that ruled out concomitant craniocerebral injury, initial wound management included standard antisepsis and sterile dressing application, prophylactic antibiotic administration and tetanus antitoxin (TAT) immunization was performed.

Definitive reconstruction was achieved through a four-stage procedure utilizing an external temporoparietal fascia-prefabricated (E-TPFF) forehead flap. The operation phases are as follows:

Stage I - E-TPFF prefabrication and tissue expansion

The operation was performed under local anesthesia with an incision extending from the root of the helix and vertically up to the superior temporal line. To ensure adequate pedicle length for flap transfer (from the root of the vascular pedicle to the nasal defect, 15 cm), the superficial temporal fascia was dissected along the flap pedicle to the cranial midline, incorporating a portion of the galea aponeurotica (**Figure 2A**). The pedicle's width was maintained at approximately 3.0 cm throughout its course, with the visible artery and vein preserved as much as possible. This design ensured both adequate blood supply to the distal fascial flap and optimal rotational capacity for flap positioning.

Subsequently, a paper template was contoured by directly tracing the nasal defect to replicate its size and three-dimensional shape accurately, ensuring precise flap design. The forehead flap was designed near the hairline and lifted from the surface of the frontal muscle. The flap was incised along three borders while maintaining continuity at the left-sided pedicle (**Figure 2B**). The distal portion of the temporoparietal fascial flap (TFF) was positioned under the forehead flap without tension. Then, a skin tissue expander (volume 50 ml) was implanted under the frontal muscle near the prefabricated flap (**Figure 2C** and **2D**). To minimize postoperative exudate, the external prefabricated TFF (E-TPFF) pedicle was covered with a free thin skin graft (**Figure 2C**). Intraoperative expansion was initiated with 10 mL sterile saline instillation into the tissue expander. Postoperative expansion commenced on postoperative day 3, employing a rapid dilation protocol of 1 mL daily saline injections.

Stage II - Flap exercise and transfer

Two weeks later, the second-stage procedures involving flap exercise and transfer were performed. The TFF-forehead flap composite was dissected from the frontal muscle's surface, with two strategic incisions created along the superior and inferior borders of the flap. The vascular pedicle on the left aspect of the prefabricated flap was secured with a rubber band tourniquet. The tightness of the ligation was determined by observing no obvious bruising at the distal end of the flap. The ligation was tightened for 30 minutes/time per day, 3 times daily, and continued for one week. The expansion procedure was continued with rapid dilation at 2 ml/d saline injections.

One week after the flap exercise, the vascular bundles of the prefabricated flap were dissected and separated for flap transfer. The healed nasal scar flap was turned inward to form an internal lining (**Figure 3A** and **3B**). The E-TPFF

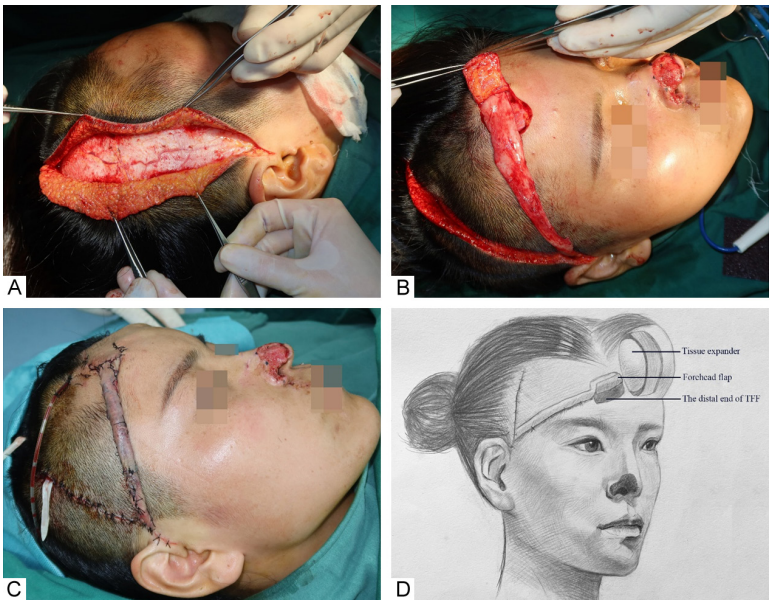

Figure 2. E-TPFF prefabrication and tissue expansion. A: Separation of the superficial temporal fascia. The visible vein is preserved as much as possible in the pedicle of the fascial flap. B: Transfer the TFF below the forehead flap. C: The external TFF pedicle was covered with a free thin skin graft. D: Schematic diagram of surgery.

successfully repaired the donor site with favorable aesthetic outcomes (**Figure 3C**).

Stage III - Flap ischemia experiment and pedicle division of TPFF

18 days after the second-stage procedure, the third surgical stage was performed, involving division of the E-TPFF pedicle. Before the pedicle was separated, an ischemia experiment was conducted. Rubber strips were clamped at the pedicle and TFFF junction for blood supply observation. When no significant changes were found in the flap's blood supply, the vascular pedicle was removed (**Figure 3D**). An appropriate flap revision was performed, making it more consistent with the recipient site (**Figure 3E**). Subsequent flap refinement was carefully performed to optimize contour and symmetry with the recipient site (**Figure 3E**). Postoperatively, the patient was fitted with custom nostril stents, which were maintained for one month to support the reconstruction.

Stage IV - Flap revision

At the three-month follow-up, minor revision procedures were performed, including flap margin refinement and thickness adjustment.

The flap demonstrated complete viability without significant scarring in the donor area. Both the patient and surgical team expressed high satisfaction with the aesthetic outcomes.

12 months postoperatively, the reconstructed site exhibited excellent color matching and contour symmetry (**Figure 4A** and **4B**). The scar on the frontal was minimally visible, while the TFF donor site remained completely concealed within the hair-bearing scalp (**Figure 4C** and **4D**).

During the 3-year follow-up period, through staged refinements, the nasal reconstruction achieved a remarkable natural appearance (**Figure 5A**, **5C-E**). Encouragingly, a tactile and pain sensitivity recovery was observed in the TPFF. The scar of the TFF donor site hidden in the hair-bearing scalp was insignificant (**Figure 5F**). There was still partial retraction of the nasal alar, and the nostril was smaller on the affected side than on the contralateral side (**Figure 5B**). Although cartilage grafting was proposed to address this discrepancy, the patient declined further intervention due to satisfactory functional and cosmetic outcomes.

Discussion

The nose serves as both an aesthetic focal point and a structural keystone of facial architecture, necessitating careful consideration of cosmetic outcomes when reconstructing nasal tip and dorsum defects. The forehead has historically been recognized as an ideal donor site for nasal reconstruction, dating back to ancient surgical practices because of its unmatched color and texture compatibility [8]. Despite these advantages, the ongoing challenge of noticeable donor-site scarring continues to significantly impact both patient satisfaction and clinical decision-making. In a study of nasal reconstruction using the forehead flap, diminished satisfaction was observed due to visible donor-site scarring, particularly in male pa-

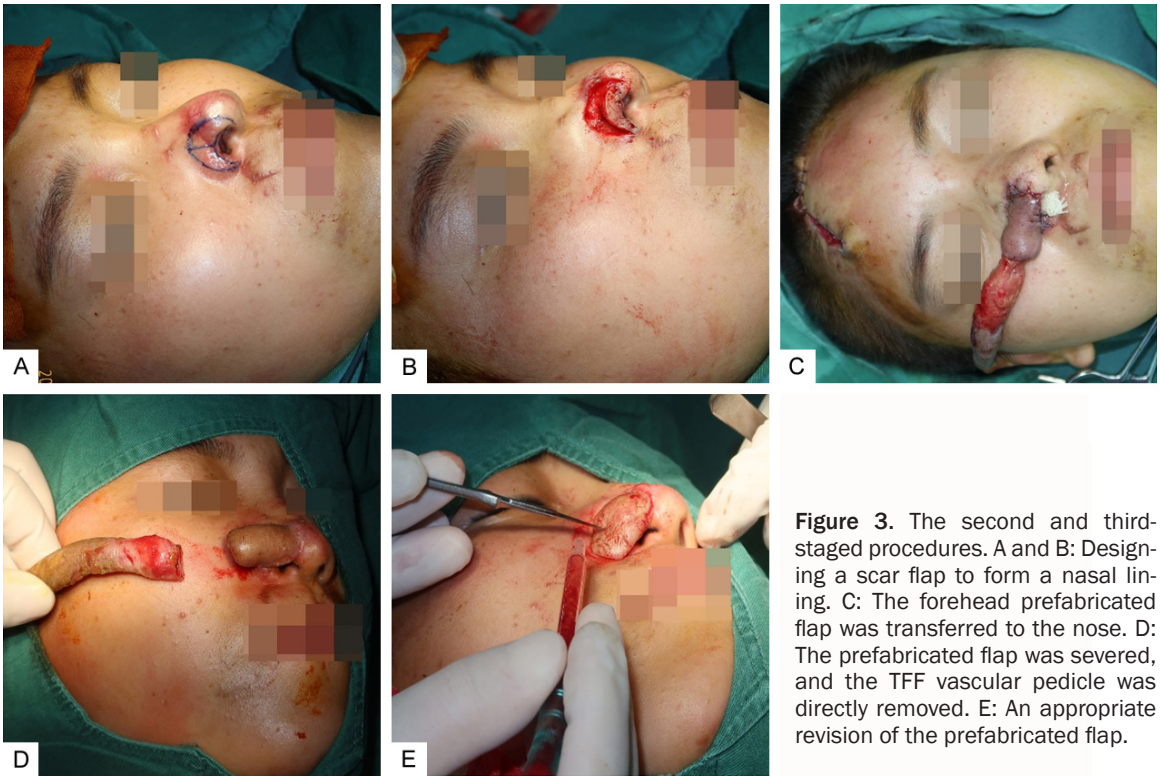

Figure 3. The second and third-staged procedures. A and B: Designing a scar flap to form a nasal lining. C: The forehead prefabricated flap was transferred to the nose. D: The prefabricated flap was severed, and the TFF vascular pedicle was directly removed. E: An appropriate revision of the prefabricated flap.

Figure 4. Postoperative view of the surgical region at 12 months. A and B: The repaired site showed a good color and texture match. C: The donor site of the TFF was invisible, with a light scar hidden in the hair-bearing scalp. D: The scar on the frontal by primary closure was insignificant.

tients whose scars could not be hidden by hair [9].

In this article, we describe an innovative E-TPFF approach for nasal reconstruction, which provides a reliable vascularity to support complex stabilized nasal reconstruction without the visible donor-site scarring associated with conventional forehead flaps.

The temporoparietal fascial flap (TFF) represents the thinnest pedicled fascial flap in human anatomy, characterized by its rich vascular network that provides an optimal scaffold for flap prefabrication. The TFF attaches to the occipitofrontalis and galea superiorly, extending into the superficial musculoaponeurotic system (SMAS) below the zygomatic arch and turns to the galea aponeurotica when beyond the temporal line [5, 10]. Superficial temporal arteries and veins run through this layer. The blood supply could cover the defect area of 14 × 17 cm centered on the pedicle [10].

While anatomical studies confirm the consistent course of the superficial temporal artery

Figure 5. Postoperative view of the surgical region at 36 months. The reconstructed nasal tip demonstrates excellent color match with surrounding tissues and highly natural contour (A, C-E), with the only observable asymmetry being a slightly smaller nostril on the affected side compared to the contralateral side when viewed in the head-up position (B). The scar of the TFF donor site hidden in the hair-bearing scalp was insignificant (F).

extending to the cranial midline with contralateral anastomoses, venous anatomy exhibits significant variability, sometimes coursing independently from the arterial system. In this case, there were no obvious accompanying veins. Therefore, it is necessary to retain as much of the vein network in the fascia as possible to ensure the survival of the galea aponeurotica.

Advantages of this TPFF operation: (1) elimination of visible frontal scarring; (2) customizable flap design for optimal defect matching, and (3) simplified surgical execution with direct visual monitoring compared to traditional buried flaps, reducing the dissection of the subcutaneous tunnel.

Deficiency of this TPFF operation: (1) risk of donor-site alopecia from follicular thermal injury or superficial dissection, necessitating cautious electrocautery use and tension-free closure; (2) the superficial temporal vascular pedicle has variation, which needs to be handled flexibly during the surgery; and (3) prolonged treatment duration with extended hospitalization.

Conclusions

The prefabricated vascular pedicle flap technique demonstrates significant advantages over the conventional approaches, offering a novel paradigm for the prefabricated flap. In the hands of an experienced and knowledgeable surgeon, this technique can also be applied to conduct prefabricated flaps in various areas of the human body. While requiring an extended treatment period, the long-term aesthetic and functional benefits outweigh the temporary inconvenience, particularly in avoiding permanent donor-site scarring.

Disclosure of conflict of interest

None.

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