

Nasal Reconstruction With Two Stages Versus Three Stages Forehead Flap: What is Better for Patients With High Vascular Risk?

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Abstract: In nasal reconstruction, it is necessary to replace all anatomic layers in order to reinstate correct aesthetics. The most apt donor site to use in order to cover the nose has been recognized as forehead skin. Traditionally 2 phases are required to reconstruct the forehead flap; however, an intermediate third phase was described by Millard which is between transfer of the flap and division of the pedicle. These methods will be compared in this study with regard to both complication rates and aesthetic results in high vascular risk patients.

46 patients were enrolled in the study, all of whom were undergoing either total or subtotal nasal reconstruction from January 2001 to March 2018. The 2-step technique (2S Group) was performed on 30 patients and the 3-step technique (3S Group) was performed on 16. Evaluation questionnaires were completed by patients and a plastic surgeon who was extraneous to the study to evaluate aesthetic satisfaction. Complications other than flap necrosis such as infection, wound dehiscence and hematoma were recorded. VAS and Likert mean values, used to evaluate aesthetic satisfaction, were examined with a Student *t* test and were discovered to be relevant. Complication rates studied with Fisher exact test showed no statistically significant difference between the 2 groups. The 3-phase method for nose reconstruction using a forehead flap represents a better functional and aesthetic option for patients at high vascular risk.

Key Words: Nasal reconstruction, Forehead flap, high vascular risk patients

The forehead flap is one of the earliest recorded surgical procedures for nasal reconstruction.¹⁻⁵ The most apt donor site for nose reconstruction after oncological resection has been recognized

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as the forehead. The advantages of using the flap are its versatility, its color suitability, and its texture.^{6,7}

Traditionally, 2 phases (2S) are required to transfer the flap with later secondary revisions incorporated at intervals of between 6 and 12 months.⁸⁻¹¹ The first phase excises distally the frontalis muscle and the subcutaneous tissue and then insets partially thinned flap into the recipient site. As Frederick J. Menick¹² pointed out, this initial debulking is considered comparatively safe, especially in nonsmokers, as the flap has an abundant blood supply. Nevertheless, alar and columellar extensions could turn necrotic. After 3 weeks, a second phase divides the pedicle. However, "thinning" the soft tissue in this way is restricted, unfinished, and fragmentary. In smokers and major nasal reconstructions, flap necrosis and contour imperfections are particularly prevalent. The larger the flaps the more widespread soft-tissue thinning is required, putting the blood supply in danger. In 1974, in order to reduce these problems, Millard⁹ believed that thinning the flap would be less dangerous if the pedicle was intact so he described a midway operation between transfer of the flap and its division to model the ala and tip (3S). 13 years later, Burget and Menick¹⁰ recommended that it was possible to initially transfer a forehead flap with no distal thinning in large reconstructions. All contouring would then be performed during the second operation, which would create a thin cover flap and a sculpted underlying bed. The pedicle was sectioned at a third stage. This study compares these 2 techniques in terms of complication rates and aesthetic results. The objective of this study is to consider whether the 3ST procedure is a better functional and aesthetic option for high vascular risk patients.

METHODS

A retrospective medical chart review was performed for patients who had undergone nasal reconstruction by either a 2S or a 3S forehead flap. Approval from the internal review board was obtained before data collection. The study protocol was conformed to the ethical guidelines of the 1975 Declaration of Helsinki. Patient demographics, specific flap type used for repair and comorbidities, including diabetes mellitus, as well as smoking habits, were recorded. The criteria for including patients were defects larger than 1.5 cm, ASA <3, smoking habit (>20 cigarettes a day), diabetes, elderly patients (>65 years). The criteria for excluding patients were ASA >3, earlier surgery on the forehead and those under 18 years old. 56 patients were enrolled in the study, all of whom were undergoing either total or subtotal nasal reconstruction with a forehead flap between January 2001 and January 2017. Patients were split in Group 2S (30 patients received the 2-stage technique) and 3S (16 patients received the 3-stage technique). An evaluation questionnaire was completed by patients to evaluate aesthetic satisfaction (Visual Analogical Scale [VAS] = 1-10). The aesthetic outcome was assessed using the 5-point Likert scale as well. Both types of questionnaire were administered 6 months and 1 year postoperatively. The same questionnaires were administered to a plastic surgeon who was extraneous to the study (MM). The minimum follow-up was 1 year but the average follow-up was 6.1 years. Statistical analysis with chi-squared or Fisher exact test was performed to determine significance. Mean, *P* value, 95% confidence interval, level of freedom, normal error of difference were other statistical indicators which were evaluated. Complications other than partial or complete flap necrosis such as infection, wound dehiscence and hematoma were recorded.

SURGICAL TECHNIQUE

Each patient was put through blood tests, chest X-rays and cardiac assessment before the operation. A hand-held Doppler was used to evaluate and investigate the quality of the vessels before the

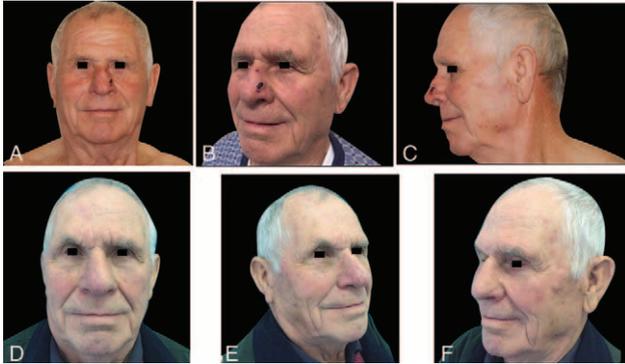


FIGURE 1. Two-phase nasal reconstruction with the forehead flap. A, Preoperative, frontal view. B, Preoperative, 3-quarter left side view. C, Preoperative, left side view. D, Postoperative, frontal view. E, Postoperative, 3-quarter right side view. F, Postoperative, left side view.

operation. General anesthesia or local analgesia using intravenous sedation was administered. In both techniques the first phase is identical; a forehead full-thickness flap is raised without being thinned (with the exception of columellar area). Three weeks later, during the second phase of the traditional technique (2S), the flap’s pedicle is divided without additional thinning or with minimal thinning. This 2-stage technique is considerably quicker, but in order to achieve a pleasing cosmetic result, subsequent operations are definitely required in the near future. (Fig. 1 A–F). In the 3-phase technique a second time is introduced, 3 weeks after initial surgery, which elevates and thins the skin and subcutaneous fat, with the exception of columellar area. Additionally, shape is added to the underlying muscle and cartilage so as to construct a solid rigid matrix for the thin skin to lie over. Three weeks later again, in the third stage a section of the pedicle is involved. (6 weeks after initial surgery) (Fig. 2 A–G).

RESULTS

In the study 52 patients were enrolled; 6 patients who had insufficient follow-up, were excluded. Therefore, a total of 46 patients were identified for inclusion in the study. Analysis of epidemiological data showed that of the 46 patients 17 were female and 29 were male and the average age was 68, with a range of between 37 and 87. In the 2S group, partial or complete necrosis of the flap developed in 4 patients. In the 3S group, a small dehiscence was suffered by 1 patient and there were no reports of functional problems. There were also no descriptions of complications, for example, dehiscence or necrosis dependent, on the donor site. Dehiscence and necrosis rates showed no statistically significant difference between the 3S and 2S groups (*P* value respectively of 0.6446 and 0.3478).



FIGURE 2. Three-phase nasal reconstruction with the forehead flap. A, Preoperative, right side view. B, Preoperative, 3-quarter right-side view. C, Preoperative, 3-quarter left side view. D, Preoperative marking. E, Postoperative, right side view. F, Postoperative, 3-quarter right-side view. G, Postoperative, 3 quarter left side view.

In group 3S aesthetic satisfaction in patients had average values (VAS) of 6.56 and 8.00 six months and 1 year postoperatively respectively. In the group 2S the values were 5.43 six months in the post-operative stage and 6.66 1-year postoperatively. The surgeon reported values of an average of 5.13 six months later and 6.23 1-year later in group 2S. In group 3S the mean value was 7 six months post-operatively and 8.125 after 1 year. VAS mean values were examined with *t* Student test and were discovered to be relevant. The average values of Likert scale were 2.63 in group 2S 6 months post-operatively and 3.37 1-year post-operatively. The values of the group 3S were 3.19 six months post-operatively and 3.94 1-year post-operatively.

In group 2S, the surgeon reported values of an average of 2.50 and 3.07 six months and 1-year post-operatively respectively. In group 3S 6 months post-operatively the mean value was 3.63 and 4.13 one-year post-operatively. Likert mean values were examined with the Student *t* test and were discovered to be relevant. (Supplemental Digital Content, Table 1, <http://links.lww.com/SCS/A833>).

DISCUSSION

This study aims to demonstrate that the 3- stage forehead flap procedure is a better functional and aesthetic option for patients at high vascular risk. In 2S group, partial necrosis of the flap developed in 4 patients; necrosis did not occur in the 3S group. In the 3S group, a small dehiscence was suffered by 1 patient. No dehiscence was noticed in the 2S group. Despite the difference between the 2 groups, the values studied with the Fisher test were found to be not significant.

The VAS and Likert mean values were analyzed with the Student *t* test and were discovered to be relevant. The 3S group was more satisfied in terms of aesthetic results.

Traditionally, it is necessary to transfer the forehead in 2 stages, with later secondary revisions incorporated at intervals of between 6 and 12 months. The first stage excises distally varying amounts of Frontalis muscle and subcutaneous tissue and arranges the partially thinned flap into the recipient site. This initial debulking is considered comparatively safe, especially in nonsmokers, as the flap has an abundant blood supply. Nevertheless, alar and columellar extensions could turn necrotic.

In smokers and large nose reconstructions, flap necrosis and contour imperfections are particularly prevalent in smokers. This is because the larger the flaps the more widespread soft-tissue thinning is required, putting the blood supply in danger.

It is frequently necessary to make several late secondary revisions once the soft tissues have evolved and become softer. At intervals of between 6 and 12 months, the flap has to be reelevated in part by means of the scarred, subdermal plane in the course of individual operative phases. Supplementary soft-tissue excisions are carried out and secondary cartilage grafts are put in place. However, the skin is not easily shaped because of subcutaneous fibrosis which makes it rigid, shrunken and refractory. The forehead is multilamellar because it consists of skin, subcutaneous tissue, frontalis muscle, and a thin, areolar layer. It is a flap which is completely thick based on a paramedian pedicle, its supratrochlear vessels pass deeply over the periosteum at the supraorbital rim and travel vertically upward through the muscle to lie at an almost subdermal position under the skin at the hairline. It is a well-perfused myofascial and axial flap. The myocutaneous component of its blood supply is removed during the initial transfer by the excision of the frontalis muscle and subcutaneous fat; a damaged, sore, bleeding subdermal surface is exposed with a tendency to fibrosis and shrinkage and a flap with less ability to endure the tension of closure is created¹². In 1974, to solve these problems, an intermediary phase was described by Millard⁹ between the transfer

of the flap and the division of the pedicle to model alae and tip, as he believed that thinning the flap would be less dangerous if the pedicle was intact.⁴ The 13 years later, Burget and Menick recommended that it was possible to initially transfer a forehead flap with no distal thinning in large reconstructions. All contouring would then be performed during the second phase, which would create a thin cover flap and a sculpted underlying bed. In accordance with this approach, the pedicle would be sectioned during a third phase.¹⁰

In a previous study, Ribuffo et al¹³ demonstrated that patients who underwent the 3-phase technique of nasal reconstruction were satisfied to a higher degree than patients who underwent the 2-phase technique. The authors concluded that for defects which include underlying structures, for example, bone or cartilage and in particular for all defects in the distal area (tip and nostrils) this approach was better suited. Furthermore, they recommended that for smokers using the 3-phase forehead flap technique reduces the risk of forehead flap complications.

Our objective is to demonstrate that 3S procedure is indicated not only in smokers and patients with large defects but in all patients at high vascular risk.

Stewart et al concluded that full-thickness defects were significantly associated with higher incidences of any major complication and had higher odds of flap necrosis and alar notching. Smokers had higher odds of developing flap necrosis. Neither the presence of diabetes, increased age, nor vascular disease were significantly associated with higher rates of major complications.¹⁴

Paddack et al compared nasal reconstruction with 2-stage paramedian forehead flap and nasolabial flap. Defect thickness, use of a cartilage graft, type of flap used, and presence of comorbidities did not affect outcome. Although the comparison was not statistically significant, flap failures were more commonly observed in smokers.¹⁵

Ebrahimi et al devised single-stage tunneled paramedian forehead flap for large nasal skin reconstruction. The Island paramedian forehead flap provides aesthetic and functional results in a single-stage reconstruction of large nasal skin defects. The most significant advantage of this flap is the ability to bury the pedicle, obviate the second stage, preservation of inter brow distance and limited scar length in the forehead donor site. In patients who smoke, in diabetics and patients with transverse forehead scars, this type of paramedian forehead flap is unsuitable and is at risk of necrosis.¹⁶

When locoregional flaps are not feasible a free flap may be required for soft tissue coverage. In selected patients, microvascular free flaps have shown good results in terms of safety and reliability in nasal reconstruction.^{17–20}

However free flaps are not comparable with the forehead flap in terms of aesthetic and functional results. The forehead flap remains the gold standard for extensive defects of the nose.^{21–23}

CONCLUSION

When the 2 methods are compared, it can be seen that the 3-phase method for nose reconstruction with a forehead flap, allows surgeons to provide a better 3-dimensional structure to the tissue which has been transposed which is as similar as possible to the real nose. A maximal blood supply, a thin covering flap, and controlled contouring are ensured with this technique.^{24–29} A disadvantage of this technique is the additional operative time but it is completely compensated for by an improved aesthetic outcome and by a reduced need for revisions at a later date. In fact, all patients who underwent nasal reconstruction using the 3-stage technique were satisfied to a higher degree than patients who underwent the 2-stage technique. This difference in the degree of satisfaction was statistically significant. Moreover, for smokers, elderly patients and diabetic patients the 3-phase forehead flap approach should be recommended as it reduces the risk of

forehead flap complications even though the difference was not found to be statistically significant.

REFERENCES

1. Converse JM. *Reconstructive Plastic Surgery*. Philadelphia, PA: WB Saunders; 1964
2. Conley JC, Price JC. The midline vertical forehead flap. *Otolaryngol Head Neck Surg* 1981;89:38–44
3. Antia NH, Daver BM. Reconstructive surgery for nasal defects. *Clin Plast Surg* 1981;8:535–563
4. Jackson IT. *Local Flaps in Head and Neck Reconstruction*. St Louis, MO: Mosby; 1985
5. Burget GC, Menick FJ. Nasal support and lining: the marriage of beauty and blood supply. *Plast Reconstr Surg* 1989;84:189–202
6. Athanasopoulos I, Peridis S, Parpounas K, et al. Unilateral choanal atresia in one monozygotic twin: a case report. *Eur Rev Med Pharmacol Sci* 2011;15:103–105
7. Gillies HD, Millard DR. *The Principles and Art of Plastic Surgery*. Boston, MA: Little and Brown; 1957
8. Gillies HD. *Plastic Surgery of The Face*. London: Frowde, Hodder & Stoughton, 1920: 270–273.
9. Millard DR. Reconstructive rhinoplasty for the lower half of a nose. *Plast Reconstr Surg* 1974;53:133–139
10. Burget GC, Menick FJ. *Aesthetic Reconstruction of the Nose*. St Louis, MO: Mosby; 1994
11. Menick FJ. Nasal reconstruction: forehead flap. *Plast Reconstr Surg* 2004;113:100–111
12. Menick FJ. Ten-year experience in nasal reconstruction with the three-stage forehead flap. *Plast Reconstr Surg* 2002;109:1839–1855
13. Ribuffo D, Serratore F, Cigna E. Nasal reconstruction with the two stages vs three stages forehead flap: a three centres experience over ten years. *Eur Rev Med Pharmacol Sci* 2012;16:1866–1872
14. Little SC, Hugley BB, Park SS. Complications with forehead flaps in nasal reconstruction. *Laryngoscope* 2009;109:3–1099
15. Paddack AC, Frank RW, Horace J. Outcomes of paramedian forehead and nasolabial interpolation flaps in nasal reconstruction. *Arch Otolaryngol Head Neck Surg* 2012;138:367–372
16. Ebrahimi A, Kalantar Motamedi MH, Nejadsharvari N, et al. Subcutaneous forehead island flap for nasal reconstruction. *Iran Red Crescent Med J* 2012;14:271–275
17. Stamatopoulos C, et al. Use of free flaps in aesthetic reconstruction of face and neck deformities. *Microsurgery* 1992;13:188–191
18. Pribaz JJ, Weiss DD, Mulliken JB, et al. Prelaminated free flap reconstruction of complex central facial defects. *Plast Reconstr Surg* 1999;104:357–365
19. Sinha M, Scott J, Watson SB. Prelaminated free radial forearm flap for a total nasal reconstruction. *J Plast Reconstr Aesth Suggest JPRAS* 2008;61:953–957
20. Hsiao YC, Huang J-J, Zelken JA, et al. The folded ulnar forearm flap for nasal reconstruction. *Plast Reconstr Surg* 2016;137:630–635
21. Correa BJ, Weathers WM. The forehead flap: the gold standard of nasal soft tissue reconstruction. *Semin Plast Surg* 2013;27:96–103
22. Tarallo M, Cigna E, Fino P, et al. Abrikossoff tumor does it origin in schwann cells. *Case report Ann Ital Chir* 2011;82:319–321
23. Tarallo M, Cigna E, Fino P, et al. Fibroepithelioma of Pinkus: variant of basal cell carcinoma or trichoblastoma. *Case report G Chir* 2011;32:326–328
24. Kroll SS. Forehead flap nasal reconstruction with tissue expansion and delayed pedicle separation. *Laryngoscope* 1989;99:448–452
25. Kroll SS, Rosenfield L. Delayed pedicle separation in forehead flap nasal reconstruction. *Ann Plast Surg* 1989;23:327–334
26. Boyd CM, Baker SR, Fader DJ, et al. The forehead flap for nasal reconstruction. *Arch Dermatol* 2000;136:1365–1370
27. Bucher S, Guerra M, Ribuffo D, et al. Basal cell carcinoma of the nose requiring amputation arising after irradiation for childhood hemangioma. *Anticancer Res* 2006;26:4747–4770
28. Fioramonti P, Sorvillo V, Maruccia M, et al. New application of purse string suture in skin cancer surgery. *Int Wound J* 2018;15:893–899
29. Lo Torto F, Losco L, Bernardini N, et al. Surgical treatment with locoregional flaps for the eyelid: a review. *Biomed Res Int* 2017;2017:6742537