



Medial femoral condyle free flap in combination with paramedian forehead flap for total/subtotal nasal reconstruction: Level of evidence: IV (therapeutic studies): Level of evidence: IV (therapeutic studies)

This is the peer reviewed (post-print) version of the following article:

Original

Medial femoral condyle free flap in combination with paramedian forehead flap for total/subtotal nasal reconstruction: Level of evidence: IV (therapeutic studies): Level of evidence: IV (therapeutic studies) / Cherubino, M., Stocco, C., Tamborini, F., Maggiulli, F., Sallam, D., Corno, M., Bignami, M., Battaglia, P., Valdatta, L.. - In: MICROSURGERY. - ISSN 0738-1085. - 40:3(2020), pp. 343-352. [10.1002/micr.30532]

Availability:

This version is available at: 11368/2967780 since: 2020-06-17T20:22:41Z

Publisher:

Published

DOI:10.1002/micr.30532

Terms of use:

Some rights reserved. More details in the PostPrint rights section below.

License:

Digital Rights Management not defined

Publisher copyright

--

(Article begins on next page)

Accepted: 25 October 2019

Medial femoral condyle free flap in combination with paramedian forehead flap for total/subtotal nasal reconstruction

Level of evidence: IV (therapeutic studies)

Mario Cherubino MD, FEBOPRAS^{1,2,3}  | Chiara Stocco MD⁴  |
Federico Tamborini MD³ | Francesca Maggiulli MD³ | Davide Sallam MD¹ |
Martina Corno MD¹ | Maurizio Bignami MD⁵ | Paolo Battaglia MD⁵ |
Luigi Valdatta MD, FACS^{1,2}

¹Division of Plastic and Reconstructive Surgery, Department of Biotechnology and Life Sciences, University of Insubria, Varese, Italy

²Microsurgery and Lymphatic Surgery Research Center, Department of Biotechnology and Life Sciences, University of Insubria, Varese, Italy

³Plastic Surgery Unit, Microsurgery and Hand Surgery Unit, ASST Settelaghi Varese, Varese, Italy

⁴Department of Medical, Surgical and Health Sciences, Plastic, and Reconstructive Surgery Unit, University of Trieste, Trieste, Italy

⁵Department of Otorhinolaryngology, University of Insubria, ASST Settelaghi Varese, Varese, Italy

Correspondence

Mario Cherubino, Plastic Surgery Unit, Microsurgery and Hand Surgery Unit, ASST Settelaghi Varese, Varese, Italy.
Email: mario.cherubino@gmail.com

Abstract

Background: The nose is a functionally complex organ with also a critical role in aesthetics. For reconstruction of full thickness nasal defects, multiple stages are needed and there is risk for resorption resulting in residual deformity. The aim of this report was to develop and evaluate a new method for full thickness total/subtotal nose reconstruction using the medial femoral condyle free flap (MFCFF) in combination with a paramedian forehead flap.

Methods: Between November 2015 and January 2018, eight patients (four males, four females) mean age 52 years (range 40–73 years) undergoing a total/subtotal nasal excision and subsequential reconstruction with MFCFF plus paramedian forehead flap were enrolled. Six cases were squamous cell carcinomas while two were basal cell carcinomas. The MFCFF was stabilized, with the periosteum as inner layer, with plates and a paramedian forehead flap was used as external skin coverage. All patients were evaluated for with postoperative nasal endoscopy and CT scan. A post-operative questionnaire was given 6 months after surgery.

Results: The mean MFCFF size was 2–3.8 cm × 2.25–2.5 cm with a mean pedicle length of 6.3 cm (range 4.1–9.4 cm). The postoperative period was uneventful. The mean follow-up was 16 months, no bone displacement or resorption was observed at the CT scan, no evidence of nasal stenosis occurred. All patients had a satisfying aesthetic evaluation and a good subjective nasal function.

Conclusions: In this series, the MFCFF in combination with the paramedian forehead flap appeared to provide a valid subtotal nose reconstruction, allowing for the recreation of all the three nasal layers and maintaining the nose projection and airway patency in the long term.

1 | INTRODUCTION

The nose plays a critical role in the equilibrium between the harmony and proportion of the face. In addition, it is of fundamental importance for its aesthetic structure, for breathing and for its functions as a sensory organ (Springer et al., 2007). For this reason, due to its properties, the total and subtotal nasal reconstruction represents an extremely challenging procedure (Rohrich, Griffin, Ansari, Beran, & Potter, 2004). In particular, when full-thickness defects are to be reconstructed, all the three layers (external skin coverage, rigid mid-layer, and internal lining) must be replaced with adequate tissue in order to gain the best possible result (Menick, 1999; Menick, 2002). Many techniques have been described for total or subtotal full thickness nose reconstruction including local flaps (Brodland, 2005), skin/cartilage/fascia lata single or composite grafts (Cherubino et al., 2014; Menick, 2010; Selçuk, Durgun, Özalp, & Bozkurt, 2013; Seth, Rev-enaugh, Scharpf, Shipchandler, & Fritz, 2013), mucosal flaps (Duffy, Rossi, & Pribaz, 1998), and free flaps (Burget & Walton, 2007; Cherubino et al., 2017) and the most common and undesirable complication is represented by unpredictable graft resorption, scar contractions, and nose distortion (Burget & Menick, 1989).

The aim of the present report was to develop and evaluate a new method for full thickness total/subtotal nose reconstruction with a two-staged procedure using the medial femoral condyle free flap (MFCFF) in combination with a paramedian forehead flap allowing a long lasting, functional, and cosmetic pleasing reconstruction.

2 | PATIENTS AND METHODS

Between November 2015 and November 2017, an observational longitudinal study was conducted at the Microsurgery and Hand Surgery unit, ASST "Sette Laghi," University of Insubria.

Eight patients (four males, four females) mean age 52 years (range 40–73 years; Valdatta et al., 2019) with diagnosis of invasive nose skin cancer treated with full thickness excision and reconstruction with MFCFF and paramedian forehead flap were treated. Six cases were squamous cell carcinomas (SCCs) while two were morphea-type basal cell carcinomas (BCCs). The full thickness nasal defects consisted in a variable loss of soft and hard tissue of the proximal two-thirds of the dorsum, both sidewalls of the nose, tip, columella, and nasal ala. In one case, due to the clinical situation and to the high motivation of the patient, the reconstruction was immediate, after intraoperative tumor frozen sections indicating clear margins, while in seven cases it was delayed. In one case, due a previous forehead flap, there was the need to pre-expand the frontal area in order to achieve enough skin to reconstruct the nasal pyramid and to avoid donor site heal by secondary intention.

2.1 | Surgical technique

All the surgeries were performed by the first author (M.C.) under general anesthesia (GA). A wide local tumor excision and all cases required a full

thickness excision; surgical margins were intraoperatively controlled and confirmed with frozen sections and the reconstructions were immediate in the first case, and delayed in the others.

A cortico-periosteal MFCFF was planned to replace and recreate the bony/cartilage missing support and the internal lining while, for the external skin coverage, a paramedian forehead flap was designed.

The patient was placed in supine position with the leg chosen as donor site abducted and flexed in a frog-like position to expose the medial surface of the knee (Bürger, Windhofer, Gaggli, & Higgins, 2013; Doi, Oda, Soo-Heong, & Nanda, 2000); the nose bony/cartilaginous defect size was measured, and the flap was designed and harvested as a rectangle. The flap harvesting was then completed, isolating the pedicle to the point where it pierced the roof of the adductor canal to yield a longer. The flap was then detached when the recipient area was ready and the donor site was packed with bone wax and then was closed in layers over a suction drain with the application of a compressive dressing. Intraoperative knee X-rays were taken before the end of surgery to ensure that no bony fractures accidentally occurred.

The cortical bony aspect of the flap was then trimmed using bone pliers and the flap was folded into an acute-angle vault to reproduce a tent-like shape (Del Piñal et al., 2007; Figure 1). The periosteal surface of the flap was used to replace the nose inner layer and sutured to



FIGURE 1 The cortical bony aspect of the medial femoral condyle free flap trimmed using bone pliers after harvesting (a) and folded into an acute-angle vault to reproduce a tent-like shape (b)

the remaining nasal mucosa and the bone was stabilized with either a linear plate or with modified titanium mesh (Matrix MIDFACE System, Synthes, Zuchwil, Switzerland), which was bent to recreate the natural projection and width of the nose and then fixated, or with two mini-plate for metacarpal synthesis from the remaining portion of the maxillary bone. The arterial and venous anastomoses were performed under the operating microscope as end-to-end (ETE) anastomoses to the angular or facial vessels.

A paramedian forehead flap was harvested and mobilized to cover the MFCFF and the forehead donor site closed by suture (Stocco, Berton, Papa, Bussani, & Arnež, 2016) or secondary healing and a soft dressing with a gentle internal nasal packing was applied. Standard postoperative monitoring was performed on ward (Arnež et al., 2019). The second-stage surgery to divide the pedicle of the forehead flap was planned 3–4 weeks later. Clinical follow-up was performed regularly at least once a week in the first month and then at 4, 12, and 24 weeks postoperatively.

A subjective postoperative questionnaire was given and completed 6 months after surgery; all patients were also assessed at the same time for an objective evaluation by a plastic surgeon not involved in the cases (Vaira et al., 2018).

All postoperative complications were documented, and nasal airway patency was recorded.

Internal layer postoperative nasal cell samples were collected from the mid-part of the internal vault of the MFCFF by brushing with interdental brushing, after spraying topical anesthetic on the nasal mucosa. Immunohistochemistry was performed to assess the type of the harvested cells.

All patients were also evaluated for alar collapse, nasal whistle, synechia, crusts, and postoperative nasal endoscopy and CT scan performed.

3 | RESULTS

The mean MFCFF flap size was 3 cm × 2 cm (range 2–3.8 cm × 2.25–2.5 cm) while the mean pedicle length 6.3 cm (range 4.1–9.4 cm; Table 1).

No intra- or postoperative complications were encountered both regarding the donor and the recipient sites; however, one patient reported a mild nasal obstruction in the first weeks after surgery because of the swelling and presence of some intranasally vegetating bulky tissue that was removed at the time of paramedian forehead flap pedicle autonomization. Three patients had minor revision surgeries, under local anesthesia aimed to improve the forehead aspect.

After a mean follow-up period of 16 months (range 6–30 months), no bone displacement or resorption were observed at the CT scan, no evidence of nasal stenosis, as a result of intranasal contracture, occurred nor tumor recurrence was registered. One patient, at the objective evaluation, had moderate while two had mild alar retraction.

In all cases, an internal lining cell brushing was performed after 6 months from the first surgery, showing MFCFF periosteal mucosalization: cell samples ranging from 1.04 × 10⁵ to 2.05 × 10⁵ cells/ per sample were collected. Of eight samples, five formed confluent

TABLE 1 Patients demographics, tumor, and reconstruction details

Patient	Age/ gender	Diagnosis	Defect	MFCFF dimension (length × width; cm)	Pedicle length (cm)	Receiving vessels (end to end anastomosis)	Postop complications/ surgeries	Flap success/ failure	Follow-up (months)
M.G.	50/M	SCC	Subtotal defect of the dorsum and lateral walls	2.25 × 2	6.2	Facial vessels	Forehead minor revision surgery	Success	30
P.P.	73/M	SCC	Subtotal defect of the tip and left ala	3.2 × 2.4	6	Angular nose vessels	None	Success	22
F.E.	40/F	SCC	Subtotal defect of the dorsum and right lateral wall and ala	2.25 × 2	6.4	Facial vessel	None	Success	8
G.T.	48/F	BCC	Subtotal defect of the tip and right ala	2 × 2.25	6.2	Facial vessel	Forehead minor revision surgery	Success	16
G.M.	50/M	SCC	Subtotal defect of the tip and right ala	3.1 × 2.2	9.4	Facial vessel	None	Success	18
L.T.	51/F	BCC	Subtotal defect of the dorsum and left lateral wall	2 × 2.2	4	Facial vessel	None	Success	20
P.R.	50/M	SCC	Subtotal defect of the dorsum and tip	2 × 2.2	6.0	Facial vessel	Forehead minor revision surgery	Success	10
S.F.	59/F	SCC	Subtotal defect of the dorsum, tip and bilateral alae	3.8 × 2.5	6.7	Facial vessel	None	Success	6

Abbreviations: BCC, basal cell carcinoma; F, female patient; M, male patient; SCC, squamous cell carcinoma.

cultures while the remaining three indicated only patches of epithelial cells; no fungal or bacteria contamination was present and the immunocytochemistry confirmed the presence of epithelial cells in the cultures.

Postoperative nasal endoscopies were performed after 2 weeks, and then every month up to 6 months follow-up showing mucosalization, absence of synechia, and crusts and documenting the adequate macroscopic appearance of the internal lining (Figure 2).

The CT scans were performed 3 months after surgery as part of the oncologic follow-up and then at 1 year as per oncologic follow-up and showed no recurrences, a stable bony reconstruction and no radiological signs of resorption.

All patients completed the self-aesthetic nose assessment (with score ranging from 1—poor to 10—excellent) showing an overall satisfying aesthetic evaluation rate regarding the appearance of the nose (showing a mean final score of 6.75 out of 10), the donor site scar on the forehead

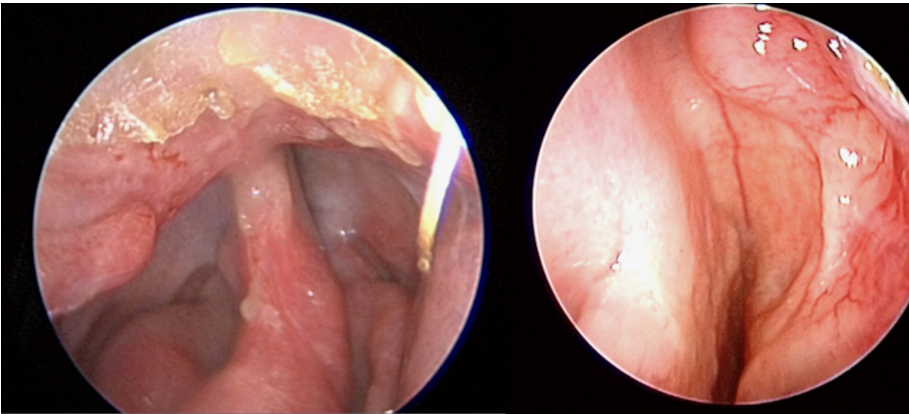


FIGURE 2 Endoscopies performed 6 months postoperatively; it can be noticed that the periosteum placed as inner layer is completely mucosalized

TABLE 2 Subjective evaluation

Patient	Subjective aesthetic evaluation (1–10)			
	Aesthetic evaluation	How do you rate the appearance of your nose?	How do you rate the appearance of your forehead?	How do you rate the appearance of your naso-labial groove?
1	8	8	9	10
2	7	7	9	9
3	9	9	8	10
4	6	6	8	8
5	5	5	6	10
6	7	7	7	9
7	5	5	6	9
8	7	7	8	9
Mean	6.75	6.75	7.625	9.25

Patients	Subjective functional evaluation (0–4)					
	Nasal air-flow decreased after surgery?	Do you snore more than before surgery?	Olfaction has worsened after surgery?	Do you think that nasal mucosa is drier after surgery?	Nasal bleeding occurs more often after surgery	The quality of your voice has worsened after surgery?
1	2	0	0	2	0	0
2	2	0	0	1	0	0
3	1	1	0	3	0	0
4	3	2	1	2	1	0
5	2	1	1	3	0	0
6	2	2	0	2	0	0
7	1	1	1	1	0	0
8	2	0	0	0	0	0

Note: None = 0, Not much = 1, Enough = 2, Mostly = 3, Absolutely = 4.

TABLE 3 Objective assessment

	Objective functional assessment (0–1)						
Patients	Alar collapse	Nasal whistle	Mucosal dryness	Nasal crusts	Nasal synechiae		
1	0	0	1	1	0		
2	0	0	1	0	1		
3	0	0	1	1	0		
4	0	0	1	0	1		
5	0	0	1	0	0		
6	0	0	1	0	0		
7	0	0	1	0	0		
8	0	0	1	0	0		
	Objective aesthetic assessment (0–4)						
Patients	Color matching	Hair growth	Flap thickness	Nostrils size	Alar thickness	Alar retraction	General appearance
1	4	4	4	4	4	4	4
2	3	4	4	4	4	2	3
3	4	4	4	4	4	3	4
4	3	4	4	4	4	4	3
5	4	4	4	4	4	4	3
6	4	4	4	4	4	4	2
7	4	4	3	4	4	3	4
8	4	3	4	4	4	4	4

Note: Absent = 0, Present = 1, Very poor = 0, Poor = 1, Moderate = 2, Good = 3, Excellent = 4.

**FIGURE 3** Preoperative views

(score 7.6 out of 10), and the appearance of the naso-labial groove (score 9.25 out of 10); similarly, the functional satisfaction rate considering nasal airway flow, snoring, olfaction, nasal bleeding, and voice quality showed overall a good subjective nasal function (Table 2). In addition, all patients were asked to rate the leg donor site discomfort that was recorded to be minimal (score 1.5 out of 10).

The objective functional evaluation showed good functional results regarding the absence of alar collapse or nasal whistle even

during forced inspiration and expiration, the rhinoscopy did not demonstrate the presence of crusts in any case but revealed the presence of synechiae in two patients, while mucosal dryness was detected in all the patients, probably related to the change of the internal structure of the nose due the surgical resection. The objective aesthetic evaluation revealed a satisfying score regarding color match, hair growth, flap thickness, nostrils size, and ala thickness, while one patient had substantial and two had moderate alar retraction, possibly

due to scar healing (Table 3). The overall appearance was rated excellent/good for all patients except for one that was considered to have a moderate satisfying results, even though the subjective evaluation reported by the same patient was valued as pleasing.

4 | CASE REPORTS

4.1 | Case 1

A 73-year-old man who suffered a subtotal tip/alar excision for a squamous cell carcinoma (Figure 3). The patient received a delayed reconstruction with a 3.2 cm × 2.4 cm MFCFF with 6 cm pedicle length that was harvested and fixated to reconstruct the bony/cartilage defect and the vascular anastomosis where performed as ETE to the facial vessels (Figure 4). A left paramedian forehead flap was then raised and used as external lining coverage, in a shape that could give an adequate dorsum, alar, and columella shape (Figure 5). The postoperative period was uneventful.

The final subjective aesthetic self-evaluation showed a score of 9 out of 10 (0—poor, 10—excellent), the subjective functional self-evaluation a score of 0.83 (0—no discomfort, 4—maximum discomfort) while the objective aesthetic evaluation showed a score 3.8 (0—poor, 4—excellent) and an objective functional evaluation of 0.4 (0—no functional impairment, 1—functional impairment).

Final aspect at 6 months after the reconstructive stage (Figure 6) and postop donor site (Figure 7).

4.2 | Case 2

A 59-year-old women that underwent a subtotal dorsum/tip/alar excision for a squamous cell carcinoma and had a delayed reconstruction with the combination of a 3.8 cm × 2.5 cm MFCFF, pedicle length

6.7 cm, and left paramedian forehead flap (Figures 8 and 9). No complications occurred in the postoperative period. The subjective aesthetic and functional evaluations showed scores of 7.75 (0—poor, 10—excellent) and 0.33 (0—no discomfort, 4—maximum discomfort), respectively, an objective aesthetic evaluation of 3.8 (0—poor, 4—excellent) and an objective functional evaluation of 0.2 (0—no functional impairment, 1—functional impairment).



FIGURE 5 Intraoperative detail at the end of the surgery. Columella view



FIGURE 4 Intraoperative detail with the medial femoral condyle free flap shaped and fixated, the vascular anastomosis performed to the facial vessels, and covered with the paramedian forehead flap



FIGURE 6 Postoperative follow-up at 6 months



FIGURE 7 Donor site scar at 6 months



FIGURE 8 Preoperative view

The final aspect at 6 months after surgery (Figure 10).

5 | DISCUSSION

Total or subtotal full thickness loss of nasal tissue is a clinical contingency that can be encountered while treating skin oncology, severe burns or traumas and it is widely known that demanding

reconstructive skills are required since the restoration of all the three layers (internal lining, rigid framework and skin cover) appears to be mandatory.

A careful analysis of the defect must take into consideration what will be required for restoration of the different structural elements and subunits. Since extensive loss of tissues cannot be managed with only local flaps the final reconstruction can be generally obtained with multistaged procedures, often involving the need for microvascular



FIGURE 9 Intraoperative detail with medial femoral condyle free flap in place and the paramedian forehead flap as external coverage



FIGURE 10 Postoperative follow-up at 6 months

free flaps (Antunes & Chalian, 2011; Kim, Boahene, Byrne, & Desai, 2017; Mathy & Pribaz, 2009).

The free flap reconstruction brings well vascularized tissue to an area that may need postoperative irradiation and generally offer a robust reconstruction also in countering wound contracture while, on the other hand, it is commonly burdened by skin color mismatch and tissue thickness that may become even a more significant concern (Menick, 2008; Menick & Salibian, 2011).

For the external nasal layer, the paramedian forehead flap traditionally represents the workhorse in extensive nasal defects reconstruction due to its unique color match, texture, and thickness (Jellinek, Nguyen, & Albertini, 2014); however, a rigid nasal scaffold needs to be provided in order to maintain the nasal three-dimensionality. Different options have been described such as a cartilage or bone graft or titanium mesh, but they experience additional morbidity of the donor site, high percentage of resorption or risk of implant exposure respectively; in addition, they are extremely sensitive to infection which is a well-established cause of graft/prosthetic implant reconstruction failure (Bakri, Shin, & Moran, 2008; Bikhazi, Chow, & Maas, 1997; Henry et al., 2010).

For this purpose, the MFCFF appears to fulfill most of the requirements needed for the internal and middle nasal layer reconstruction: the laminar and pliable cortical bone can be easily mold into a tent-like shape without compromising its vascular supply, it offers a stable and long-lasting bony support and the thin and highly vascularized periosteum (that will ultimately mucosalize) prevents the need for internal debulking procedures.

The MFCFF has been popularized by Bürger (Cherubino et al., 2017) and it constitutes an excellent source of vascularized bone, ideal for the treatment of complex defects necessitating vascularized osseous reconstruction with minimal donor site morbidity (Jones Jr, Moran, Bishop, & Shin, 2010). It was firstly described and mostly used in the orthopedic upper and lower limb reconstruction (Del Piñal et al., 2007; Doi & Hattori, 2009; Jones et al., 2010; Rao, Sexton, & Higgins, 2013) and later in oral and maxillofacial reconstruction of the mandible (Lee, Hackenberg, Halvorson, & Caterson, 2014).

The MCFF for nasal reconstruction has been recently exploited and developed by Bürger, who used a corticoperiosteal flap in combination with a skin paddle to reconstruct the bony scaffold and the internal lining with a single flap (Gaggl, Bürger, & Chiari, 2012). However, the thickness of the subcutaneous tissue of the medial knee

region generally requires immediately defatting to avoid bulkiness of the recipient area and to achieve a more pleasing aesthetic result (Borumandi, Bürger, Brandtner, & Gaggl, 2013).

To the best of our knowledge, this report represents a novel approach and the first case series description of total/subtotal nose reconstruction with the combination of the MFCFF and paramedian forehead.

This type of combined reconstruction, in our hand, demonstrated to be an effective and reliable solution for nasal extended full thickness defects (Cherubino et al., 2016). The subjective and objective evaluation of both aesthetic and functional outcomes showed an overall pleasing satisfaction rate with minimal donor site discomfort and the aesthetic alteration recorded did not seem to represent a distressing element in the physiologic facial harmony and the data obtained are in accordance with those present in literature (even though they evaluated smaller nose defects; Arden, Nawroz-Danish, Yoo, Meleca, & Burgio, 1999; Mureau, Moolenburgh, Levendag, & Hofer, 2007; Singh & Barlett, 2003).

Considering the cases herein reported, the main advantages are represented by the possibility to obtain a robust, reliable and pleasant total/subtotal nose reconstruction, with all the three nasal layers reconstructed and with minimal donor site discomfort (mild to no discomfort in the medial femoral region and no discomfort, except for the presence of a scare, in the forehead); among the disadvantages we can list the need for a two-stage procedure (necessary to cut the paramedian forehead pedicle) after 3 weeks from surgery, the need to perform a delicate MFCFF harvesting in order to recruit only the periosteum and a thin layer of cortical bone and the impossibility of a direct clinical monitoring, since the MFCFF is completely buried.

In addition, the small cohort of patients represent a limit of the report but, at the present time, these data seem to be encouraging while compared with those present in literature even though further cases and outcomes will need to be treated and assessed. Further study should be needed, in particular, to compare different types of total/subtotal nose reconstruction.

6 | CONCLUSIONS

When dealing with extensive full thickness nose defects, a meticulous evaluation and a subsequential correct planning of the three-dimensional defect (and reconstruction) are the starting point for a pleasant functional and aesthetic result, both for the patient and the surgeon. In our report, the MFCFF in combination with the paramedian forehead flap appeared to provide a valid full thickness nose reconstruction, allowing for the recreation of all the three nasal layers and maintaining the nose projection and airway patency in the long term with minimal donor site discomfort. This complex reconstruction will need further comparison to other total/subtotal nose techniques already described in order to compare the different techniques and outcomes.

CONFLICT OF INTERESTS

None of the authors has funding or conflicts of interest to declare. All patients filled an informed valid consent prior to the surgery. This

study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki as revised in 2000. The study was registered within the internal database of audits held in the Microsurgery and Hand Surgery unit, ASST "Sette Laghi," University of Insubria and the Hospital institution accepted the publication of the data obtained and previously presented in the clinical audit section. The paper is an observational longitudinal study, it follows the STROBE checklist for cohort studies.

ORCID

Mario Cherubino  <https://orcid.org/0000-0003-1196-3075>

Chiara Stocco  <https://orcid.org/0000-0003-0034-7533>

REFERENCES

- Antunes, M. B., & Chalian, A. A. (2011). Microvascular reconstruction of nasal defects. *Facial Plastic Surgery Clinics of North America*, 19(1), 157–162.
- Arden, R. L., Nawroz-Danish, M., Yoo, G. H., Meleca, R. J., & Burgio, D. L. (1999). Nasal alar reconstruction: A critical analysis using Melo-labial Island and paramedian forehead flaps. *Laryngoscope*, 109, 376–382.
- Arnez, Z. M., Ramella, V., Papa, G., Novati, F. C., Manca, E., & Leuzzi, S. (2019). Stocco C. is the LICOX® PtO2 system reliable for monitoring of free flaps? Comparison between two cohorts of patients. *Microsurgery*, 39(5), 423–427.
- Bakri, K., Shin, A. Y., & Moran, S. L. (2008). The vascularized medial femoral corticoperiosteal flap for reconstruction of bony defects within the upper and lower extremities. *Seminars in Plastic Surgery*, 22(3), 228–233.
- Bikhazi, N. B., Chow, A. W., & Maas, C. S. (1997). Nasal reconstruction using a combination of alloplastic materials and autogenous tissues: A surgical alternative. *Laryngoscope*, 107, 1086–1093.
- Borumandi, F., Bürger, H., Brandtner, C., & Gaggl, A. (2013). Osteocutaneous femur perforator flap for salvage reconstruction of the nasal septum and columella. *Plastic and Reconstructive Surgery*, 131(5), 854e–855e.
- Brodland, D. (2005). Paramedian forehead flap reconstruction for nasal defects. *Dermatologic Surgery*, 1, 1046–1052.
- Bürger, H. K., Windhofer, C., Gaggl, A. J., & Higgins, J. P. (2013). Vascularized medial femoral trochlea osteocartilaginous flap reconstruction of proximal pole scaphoid nonunions. *The Journal of Hand Surgery*, 38(4), 690–700.
- Burget, G. C., & Menick, F. J. (1989). Nasal support and lining: The marriage of beauty and blood supply. *Plastic and Reconstructive Surgery*, 84(2), 189–202.
- Burget, G. C., & Walton, R. L. (2007). Optimal use of microvascular free flaps, cartilage grafts, and a paramedian forehead flap for aesthetic reconstruction of the nose and adjacent facial units. *Plastic and Reconstructive Surgery*, 120(5), 1171–1207.
- Cherubino, M., Battaglia, P., Turri-Zanoni, M., Tamborini, F., Giudice, M., Sallam, D., ... Castelnovo, P. (2016). Medial femoral condyle free flap for nasal reconstruction: New technique for full-thickness nasal defects. *Plastic and Reconstructive Surgery*, 4(9), e855.
- Cherubino, M., Berli, J., Turri-Zanoni, M., Battaglia, P., Maggiulli, F., Corno, M., ... Valdatta, L. (2017). Sandwich fascial anterolateral thigh flap in head and neck reconstruction: Evolution or revolution? *Plastic and Reconstructive Surgery. Global Open*, 5(1), e1197.
- Cherubino, M., Pellegatta, I., Tamborini, F., Cerati, M., Sessa, F., & Valdatta, L. (2014). Evaluation of lymphangiogenesis in acellular dermal matrix. *JAMA Facial Plastic Surgery*, 47(3), 318–324.
- Del Piñal, F., García-Bernal, F. J., Regalado, J., Ayala, H., Cagigal, L., & Studer, A. (2007). Vascularised corticoperiosteal grafts from the medial femoral condyle for difficult non-unions of the upper limb. *The Journal of Hand Surgery, European Volume*, 32(2), 135–142.

- Doi, K., & Hattori, Y. (2009). Vascularized bone graft from the supracondylar region of the femur. *Microsurgery*, 29(5), 379–384.
- Doi, K., Oda, T., Soo-Heong, T., & Nanda, V. (2000). Free vascularized bone graft for nonunion of the scaphoid. *The Journal of Hand Surgery*, 25(3), 507–519.
- Duffy, F. J., Rossi, R. M., & Pribaz, J. J. (1998). Reconstruction of Wegener's nasal deformity using bilateral facial artery musculomucosal flaps. *Plastic and Reconstructive Surgery*, 101(5), 1330–1333.
- Gaggl, A. J., Bürger, H., & Chiari, F. M. (2012). Reconstruction of the nose with a new double flap technique: Microvascular osteocutaneous femur and microvascular chondrocutaneous ear flap—First clinical results. *International Journal of Oral and Maxillofacial Surgery*, 41(5), 581–586. <https://doi.org/10.1016/j.ijom.2012.02.001>
- Henry, E. L., Hart, R. D., Mark Taylor, S., Trites, J. R., Harris, J., O'Connell, D. A., & Seikaly, H. (2010). Total nasal reconstruction: Use of a radial forearm free flap, titanium mesh, and a paramedian forehead flap. *Journal of Otolaryngology—Head & Neck Surgery*, 39(6), 697–702.
- Jellinek, N. J., Nguyen, T. H., & Albertini, J. G. (2014). Paramedian forehead flap: Advances, procedural nuances, and variations in technique. *Dermatologic Surgery*, 40(Suppl 9), S30–S42.
- Jones, D. B., Jr., Moran, S. L., Bishop, A. T., & Shin, A. Y. (2010). Free-vascularized medial femoral condyle bone transfer in the treatment of scaphoid nonunions. *Plastic and Reconstructive Surgery*, 125(4), 1176–1184.
- Kim, I. A., Boahene, K. D., Byrne, P. J., & Desai, S. C. (2017). Microvascular flaps in nasal reconstruction. *Facial Plastic Surgery*, 33(1), 74F–81F.
- Lee, C. C., Hackenberg, B., Halvorson, E. G., & Caterson, E. J. (2014). Vascularized treatment options for reconstruction of the ascending mandible with introduction of the femoral medial epicondyle free flap. *The Journal of Craniofacial Surgery*, 25(5), 1690–1697.
- Mathy, J. A., & Pribaz, J. J. (2009). Prefabrication and prelamination applications in current aesthetic facial reconstruction. *Clinics in Plastic Surgery*, 36(3), 493–505.
- Menick, F. J. (2008). *Nasal reconstruction: Art and practice*. Arizona: Elsevier.
- Menick, F. J. (1999). Anatomic reconstruction of the nasal tip cartilages in secondary and reconstructive rhinoplasty. *Plastic and Reconstructive Surgery*, 104(7), 2187–2188.
- Menick, F. J. (2002). A 10-year experience in nasal reconstruction with the three-stage forehead flap. *Plastic and Reconstructive Surgery*, 109(6), 1839–1855.
- Menick, F. J. (2010). Nasal reconstruction. *Plastic and Reconstructive Surgery*, 125(4), 138e–150e.
- Menick, F. J., & Salibian, A. (2011). Microvascular repair of heminasal, subtotal, and total nasal defects with a folded radial forearm flap and a full-thickness forehead flap. *Plastic and Reconstructive Surgery*, 127(2), 637–651.
- Mureau, M. A. M., Moolenburgh, S. E., Levendag, P. C., & Hofer, S. O. P. (2007). Aesthetic and functional outcome following nasal reconstruction. *Plastic and Reconstructive Surgery*, 120, 1217–1227.
- Rao, S. S., Sexton, C. C., & Higgins, J. P. (2013). Medial femoral condyle flap donor-site morbidity: A radiographic assessment. *Plastic and Reconstructive Surgery*, 131(3), 357e–362e.
- Rohrich, R. J., Griffin, J. R., Ansari, M., Beran, S. J., & Potter, J. K. (2004). Nasal reconstruction beyond aesthetic subunits: A 15-year review of 1334 cases. *Plastic and Reconstructive Surgery*, 114(6), 1405–1416.
- Selçuk, C. T., Durgun, M., Özalp, B., & Bozkurt, M. (2013). Cartilage-supported paramedian forehead flaps for reconstruction of full-thickness nasal defects. *The Journal of Craniofacial Surgery*, 24(2), 425–427.
- Seth, R., Revenaugh, P. C., Scharpf, J., Shipchandler, T. Z., & Fritz, M. A. (2013). Free anterolateral thigh fascia lata flap for complex nasal lining defects. *JAMA Facial Plastic Surgery*, 15(1), 21–28.
- Singh, D. J., & Barlett, S. P. (2003). Aesthetic considerations in nasal reconstruction and the role of modified nasal subunits. *Plastic and Reconstructive Surgery*, 111, 639–648.
- Springer, I. N., Wannicke, B., Warnke, P. H., Zernial, O., Wiltfang, J., Russo, P. A. J., ... Wolfart, S. (2007). Facial attractiveness: Visual impact of symmetry increases significantly towards the midline. *Annals of Plastic Surgery*, 59(2), 156–162.
- Stocco, C., Berton, F., Papa, G., Bussani, R., & Arnež, Z. M. (2016). Vicryl hypersensitivity test with histological response. *Dermatitis*, 27(3), 145–146.
- Vaira, L. A., Massarelli, O., Deiana, G., Meloni, S. M., Dell'aversana Orabona, G., Piombino, P., & De Riu, G. (2018). Aesthetic and functional evaluation of total nasal reconstructions. *Indian Journal of Otolaryngology and Head & Neck Surgery*, 70(1), 71–78.
- Valdatta, L., Perletti, G., Maggiulli, F., Tamborini, F., Pellegatta, I., & Cherubino, M. (2019). FRAIL scale as a predictor of complications and mortality in older patients undergoing reconstructive surgery for non-melanoma skin cancer. *Oncology Letters*, 17(1), 263–269.