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Our Experience in Using the Paramedian Flap in Facial Reconstruction as A Workhorse Flap

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Abstract

Background and Objective: Maxillofacial defects demand reconstruction frequently as a result of the resection of benign or malignant cancers and traumatic injuries. The main objective of this work was to evaluate the versatility of the paramedian forehead flap as a workhorse flap in the reconstruction of facial defects from a clinical application view.

Patients and Methods: This prospective study has been carried out on 20 cases recruited from emergency rooms and outpatient clinics at Benha University and Nasser Institute from 1/4/2023 until 1/4/2024. The participants who agreed to participate in this clinical study signed an informed consent following being completely informed about the technique and its circumstances.

Results: The flap survival rate has been seen to be 100%. Regarding Satisfaction, 1 [5%] patient was dissatisfied, 7 [35%] patients were satisfied, and 12 [60%] patients were very satisfied. No patients were very dissatisfied. Function was preserved in all patients. Regarding complication, 1 [5%] patient had wound infection which was managed with antibiotics, debridement, and removal of diseased or threatened cartilage and 1 [5%] patient had hair on the nose which was later treated with a laser hair removal procedure.

Conclusion: Paramedian forehead flap have high versatility and efficacy as a workhorse flap in reconstruction of facial defects with lower complication and high patient satisfactions. Wound infection and hair on the nose were the most common complications.

Keywords: Forehead Flap; Reconstruction; Facial Defects.

INTRODUCTION

Traumatic injuries and the resection of malignant or benign tumors frequently lead to maxillofacial defects that demand reconstruction. Focusing on the regaining of both form and function is the optimal reconstructive technique [1].

Reconstructive choices should be weighed carefully while taking into account facial subunits as well as optimized functional and aesthetic outcomes. A comprehensive evaluation of the wound encompasses its size, depth, layers, location, function, and relationship to the surrounding facial tissues and subunits. Depending on the location, inherent cases characteristics, and surgeon preference, the available options may vary [2].

The Sushruta Samhita, an Indian medical document, is the 1st to describe forehead flap and how it was utilized, which dates back to 700 B.C. Even though the fundamental principles of the method have stood the test of time, the forehead flap has been developed into a strong and versatile reconstructive modality as a result of continuous refinements and enhancements made by several of surgical pioneers, including Carpue, Kazanjian, Millard, Burget, and Menick [3].

Supratrochlear vessels are the primary source of the paramedian forehead flap's rich vertical blood supply, especially the terminal branch of ophthalmic artery named the supratrochlear artery that is present in the orbit superficially at the corrugator supercilii muscle & deeply at the orbicularis oculi[4].

The paramedian forehead flap is a two- or three-stage technique, although it may be conducted as a single-stage procedure in certain situations. Consequently, the majority of patients who undergo forehead flaps would require at least one additional procedure to divide the vascular pedicle, and they may require additional operations to refine the inset site through skin grafting, dermabrasion, debridement, and other procedures. Additionally, cases might experience extensive operating periods due to the forehead flap's interpolated flap, which needs careful dissection and a complex inset [5].

The paramedian forehead flap is a dependable and versatile flap due to its superior color, size, good aesthetic outcome, low morbidity, and texture. The procedure may be completed in several stages, based on the health of the cases and desired result, as well as the type of the defect. The flap has a very low complication rate, and when complications happen, they are typically resolved with conservative operative treatments and antibiotics [6].

The goal of this investigation was to assess the versatility of the paramedian forehead flap as a workhorse flap in reconstruction of facial defects.

PATIENTS AND METHODS

This prospective study has been carried out on 20 cases recruited from emergency rooms and outpatient clinics at Benha University Hospital and Nasser Institute from 1/4/2023 until 1/4/2024. The participants who agreed to participate in this clinical investigation signed an informed consent following being completely informed about the technique and its circumstances. The work has been carried out with the permission of the ethics committee at the Faculty of Medicine at Benha University, the approval code is 53-1-2023.

Inclusion criteria: Participants must be at least 16 years old, male or female, and have facial defects that can be covered by a forehead flap of various etiologies.

Exclusion criteria: Patients who are under 16 years old, unfit for surgery, have a fractured bone in the forehead, have serious concomitant conditions, have a pathologic or congenital malformation of the face, refuse to participate in the study, or leave during the follow-up period are excluded.

All patients have been subjected to: Complete history taking, physical examinations and investigational studies

Operative procedures for nasal reconstruction: Lidocaine one percent with 1:100,000 epinephrine has been utilized alone or occasionally combined with bupivacaine 0.25percent in equal portions & injected deeply across the whole forehead. Furthermore, the base of flap and dorsum of nose have been injected. Using a scalpel, margins of defect of nose have been debrided as required & performed perpendicular to wound bed. If necessary, the remaining aesthetic subunit was removed.

Flap elevation and inset:

By combining the surface landmarks previously described and, if necessary, Doppler ultrasonography, the flap has been designed to incorporate supratrochlear vessels within its pedicle and base. A wound template was utilized in order to obtain the desired shape for the skin paddle that is located at distal end of the flap in superior forehead, which has been frequently made utilizing the foil of a suture packet or x-ray film for large defects. The flap could be designed with a lateral curve to prevent the usage of hair-bearing skin in cases who have low anterior hairlines or for those who have previously employed the flap for columellar reconstruction. This would be done in order to maintain the integrity of the flap. The use of dissection in a subcutaneous plane has been utilized on numerous occasions to expose terminal hair bulbs & eradicate them in the event that the flap extends into the hair-bearing scalp area. When compared to a donor site incision that extends down to periosteum or galea, elevation in a subcutaneous plane may also be helpful if the defect is big. This is because elevation in this plane has the ability to speed up the healing process by 2ry intention. Furthermore, elevating the flap in a subgaleal / submuscular plane would increase the bulk of the reconstruction if the defect was deep. In certain instances, the flap might be elevated in continuousness with a split-thickness graft if structural support is required. In a segment that was about 1.5 to 2 centimeters wide and centered on the supratrochlear vessels, the pedicle has typically been elevated in a subgaleal / submuscular plane. The possibility of failing to involve the supratrochlear vessels in their totality increased if the pedicle was too narrow, while the possibility of kinking it throughout rotation and compromising perfusion or venous drainage increased if the pedicle was too wide. To determine the length of the pedicle for flap design aim, the surgeon can secure a surgical sponge at the medial eyebrow and rotate it downward to the defect. This would provide the surgeon

with an indication of the amount of length that was lost through the 180-degree flap rotation. In generally, basing the flap contralateral to the larger part of the defect [if the wasn't perfectly symmetric and midline] reduced the possibility of kinking the pedicle and minimized the risk of flap compromise because of arterial insufficiency or venous congestion.

To make sure the incorporation of supratrochlear vessels, which were situated deep to frontalis muscle at this juncture, the plane of elevation is deepened to a subperiosteal level around three centimeters above the orbital rim. The supraorbital artery was additionally at risk of transection in this location, so it is important to exercise caution when dissecting inferiorly beyond the orbital margin to enhance flap mobility or length. This requires careful undermining with direct visualization. The skin of nose has been undermined around the periphery of the defect after the flap has been raised, and the flap has bene rotated into position.

The flap's thickness must be assessed and adjusted as essential to accommodate the defect before suturing. A rim graft of auricular cartilage or harvested septal might be positioned to mitigate the possibility of alar notching following surgery if the defect approaches the nasal ala's margin. Subsequently, the flap has bene sutured into position within the defect, with particular attention paid to the wound margins. The proximal aspect of flap wasn't sutured until pedicle division at a later date, after it has been affixed to the nasal dorsum.

Finally, the donor site of forehead has been closed using multilayer suturing and subgaleal/submuscular undermining. In order to prevent a headache following the surgery and/or a widened scar, the objective was to reduce tension and avoid forcing the donor site closed. Scar revision might be required at a later date if a portion of the wound has been closed through secondary intention. In order to prevent the cases from experiencing three weeks of drainage and promote hemostasis, some surgeons may apply a skin graft to the exposed subgaleal / submuscular surface of the pedicle. The pedicle may be wrapped in petrolatum gauze if a skin graft hasn't been placed.

Intermediate stage:

The skin flap might be gently raised out of the defect & additional thinned to enhance contour following three weeks. This recontouring was generally well tolerated, as the flap has already been delayed for 3 weeks. The pedicle might be separated 3 weeks following the intermediate stage.

Pedicle division:

Three weeks later, the final stage of reconstruction has been carried out. The pedicle of the flap has been separated throughout this stage, and any unused portions have been amputated and discarded. The exception was a triangle of skin that has been utilized to restore the medial aspect of the eyebrow from which the flap has been harvested. In order to optimize the aesthetic result of the procedure, it was essential to meticulously reposition the base of the pedicle into eyebrow. It was crucial to make sure that the triangle at the base of the flap did not exceed the eyebrow's height when it has been inset into the glabella; otherwise, it would appear as a peninsula within forehead. The brow has been closed following wide-undermining & suturing to prevent a trapdoor deformity.

Operative Technique:

Forehead Flap was performed in two stages. In step 1, the patient was given general anaesthesia and rigorous aseptic procedures were followed throughout the surgery. We performed a large local excision with suitable margins in cases of Squamous Cell Carcinoma [SCC] and Basal Cell Carcinoma [BCC]. For malformations brought on by traumatic injuries or Mucor Mycosis, the defect area was carefully reconstructed. We detected a paramedian flap based on the ipsilateral supratrochlear vascular, which is about 1.5 cm from the midline, after reconstructing the defect. Making sure the paramedian flap's base was at least 3 cm wide was essential. Where more length was required, the flap was stretched into the hair-bearing scalp. With the exception of the periosteum, all layers of the scalp—including the skin, subcutaneous tissue, and frontalis muscle—were preserved when the forehead flap was carefully elevated from proximal to distal. The flap has been used to conceal the defect and primary donor site closure has been completed. Stage 2: Following a 21-day healing period, the flap was delicately inset into its final place and separated. There were no issues throughout the post-operative healing phase. It may be necessary to postpone further procedures for several months in order to give the flap time to mature, contract, and scar. Dermabrasion, contouring, and depilation may be performed subsequently.

RESULTS

Regarding demographic data of the studied cases, age varied from 26 to 68 years with a mean of 50.6 ± 13.59 years. There were 16 [80%] men & 4 [20%] women. Regarding rresidence, 11 [55%] patients were from urban residency and 9 [45%] patients were from rural residency [Table 1].

Regarding facial defects reported in the studied patients, 11 [55%] cases had basal cell carcinoma, 6 [30%] cases had SCC, and 6 [30%] cases had post traumatic nose defect. Regarding site of defects, 10 [50%] patients had nose defect, 4 [20%] patients had orbital region defect, and 6 [30%] patients had cheek defect. Duration from trauma to presentation to ER varied from 11 to 50 days with a mean of 29 ± 14.36 days [Table 2]. Time of flap procedure varied from 32 to 59 minutes with a mean of 42.9 ± 7.95 min. The Mean flap sizes was from [2 ×10 centimeters] to [3 × 12]. The flap survival rate was seen to be 100%. [Table 3].

Regarding Satisfaction, 1 [5%] patient was dissatisfied, 7 [35%] patients were satisfied, and 12 [60%] patients were very satisfied. No patients were very dissatisfied. Function was preserved in all patients [Table 4].

Regarding complication, 1 [5%] patient had wound infection which was managed with antibiotics, debridement, and removal of diseased or threatened cartilage. A laser hair removal method was used to treat one patient [5%] who had nose hair [Table 5]. Hospital stays varied from three to twenty days with a mean of 11.4 ± 4.88 days. Monitoring varied from 2 to 3 months with a mean of 2.4 ± 0.5 months**. [Table 5]**

Table [1]: General characteristics of the cases under investigation

		number=20
Age [years]	Mean ± SD	50.6 ± 13.59
	Range	26 - 68
Sex	Male	16 [80%]
	Female	4 [20%]
Residence	Urban	11 [55%]
	Rural	9 [45%]

Table [2]: Facial defects, site of defects, and Duration from trauma to presentation to ER of the studied patients

		n=20
Facial defects	Basal cell carcinoma	11 [55%]
	Squamous Cell Carcinoma	6 [30%]
	Post Traumatic Defect Nose	6 [30%]
Site of defects	Nose	10 [50%]
	Orbital region	4 [20%]
	Cheek	6 [30%]
Duration from trauma to presentation to ER [Days]	Mean ± SD	29 ± 14.36
	Range	11 - 50

ER: Emergency room

Table [3]: Time of flap procedure and flap survival among the studied patients

		n=20
Time of flap procedure [min]	Mean ± SD	42.9 ± 7.95
	Range	32 - 59
Flap survival rate [n,%]	Yes	20 [100%]
	No	0 [0%]

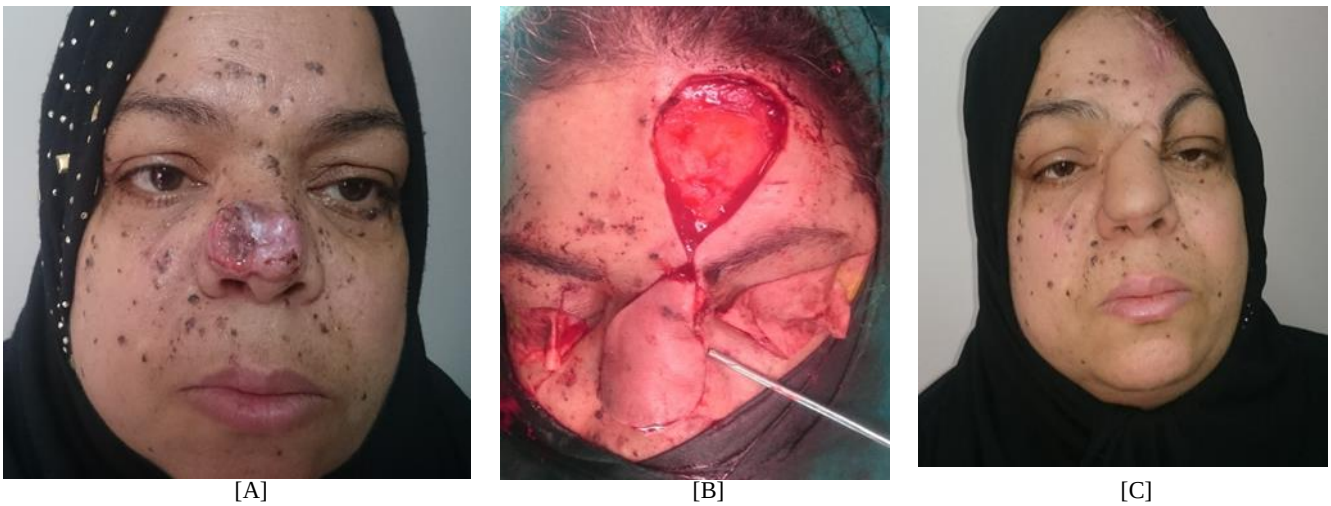
Table [4]: Satisfaction of the studied patients

		n=20
Satisfaction	Very Dissatisfied	0 [0%]
	Dissatisfied	1 [5%]
	Satisfied	7 [35%]
	Very satisfied	12 [60%]

Table [5]: Complications, hospital stay and duration of follow up of the studied patients

		n=20
Complications [n,%]	Wound infection	1 [5%]
	Hair on the nose	1 [5%]
	No	18 [90%]
Hospital stay [Days]	Mean ± SD	11.4 ± 4.88
	Range	3 - 20
Follow-up [Months]	Mean ± SD	2.4 ± 0.5
	Range	2 - 3

Figure [1]: [A, B]: Preoperative: the original injury degloving of cheek, upper lip and lower lip debridement and grafting at early stage, [C, D]: Sub mental flap for lower lip and forehead flap paramedian hair-bearing at its distal end was used to reconstruct cheek and upper lip and mustache, [E, F]: Intraoperative: the forehead flap was divided as two aesthetic units for cheek and upper lip with an incision simulating nasolabial groove and palmaris tendon was used to augment vermilion border of lip and treat lip ectropion, [G, H]: Postoperative: final results with good cheek, upper lip and mustache.



[A] [B] [C]

Figure [2]: [A]: Preoperative: basal cell carcinoma of nasal dorsum as one aesthetic unite, [B]: Intraoperative: excision of all nasal dorsal skin and applying paramedian forehead island flap as one aesthetic unite, [C]: Post-operative results the patient did not need neither debulking or refinement of the flap

[A] [B] [C]

Figure 3: [A] pre-operative [B] intra operative and [C]: post-operative

DISCUSSION

Regarding demographic data of the studied cases, age varied from 26 to 68 years with a mean of 50.6 ± 13.59 years. There were 16 [80%] men and 4 [20%] women. Regarding residence, 11 [55%] patients were from urban residency & 9 [45%] patients were from rural residency.

In variance with our demographics, an earlier retrospective investigation by **Price *et al.*** [7] has been carried out to assess functional and aesthetic outcomes of repair of periorbital defect utilizing forehead flaps. They encompassed cases who underwent repair of periorbital defect by three of us, either independently or in conjunction with other regional or local flaps, bone grafts, or cartilage. The age of the cases was eleven to eighty-five, with nine men and nine women cases [mean, 62.3 years].

Regarding facial defects reported in the studied patients, 11 [55%] cases had basal cell carcinoma, 6 [30%] cases had squamous cell carcinoma, and 6 [30%] cases had post traumatic defect nose.

In agreement with the previous findings, **Patel *et al.*** [8] carried out a retrospective, multi-institutional cohort investigation to assess the tumour type for Mohs micrographic surgery in cases undergoing delayed facial reconstruction among 415 patients, basal cell carcinoma was present in 323 [77.8] patient, squamous cell carcinoma was present in 64 [15.4] cases, and melanoma was present in 13 [3.1] cases

Regarding site of defects, 10 [50%] patients had nose defect, 4 [20%] patients had orbital region defect, and 6 [30%] patients had cheek defect.

This was in line with the outcomes of **Patel *et al.*** [8] who aimed to characterize the incidence of and predictors of complications in cases having delayed facial reconstruction following Mohs micrographic operations. They discovered that the nose was the most frequently referred location for defects requiring delayed repair [44.6 percent].

Duration from trauma to presentation to emergency room ranged from eleven to fifty days with a mean of 29 ± 14.36 days. However, **Patel *et al*.** [8] study results mentioned that the emergency department visit was within 48 hours in 31 [1.4%] of patients and within 30 days in 86 [4.0%] of patients.

Time of flap procedure varied from 32 to 59 min with a mean of 42.9 ± 7.95 min. The Mean flap sizes was from [2cm×10 cm] to [3cm × 12cm]. There was a 100% flap survival rate observed, which was in accordance with **Price *et al.*** [7] who found that no patients experienced flap failure, after monitoring ranged from one month to 7.8 years [mean, 1.5 years].

Regarding satisfaction, 1 [5%] patient was dissatisfied, 7 [35%] patients were satisfied, and 12 [60%] patients were very satisfied. No patients were very dissatisfied. Function was preserved in all patients. Regarding complication, 1 [5%] patient had wound infection which was

managed with antibiotics, debridement, and removal of diseased or threatened cartilage. A laser hair removal method was used to treat one patient [5%] who had nose hair.

Chen *et al.* [9] carried out a retrospective cohort investigation to determine the rate of complications following paramedian forehead flap reconstruction for defects caused by facial tumors resection, which is consistent with our findings. The authors determined that infection was the most prevalent complication of reconstruction of paramedian forehead flap. Their findings verified that deep venous thrombosis following surgery happened in ten or fewer cases [≤ 0.5%], postoperative hemorrhage in thirty [1.4%], and infection following surgery in sixty-three [2.9%].

In our outcomes, stay in hospital varied from 3 to 20 days with a mean of 11.4±4.88 days. Monitoring varied from 2 to 3 months with a mean of 2.4 ± 0.5 months.

Rudolph *et al.* [10] a retrospective investigation concluded that for large and complicated abnormalities, the cross-paramedian forehead flap is a reliable tool in a reconstructive surgeon's toolbox, as well as those with periorbital extension, in accordance with our hypothesis and research objective.

In addition, **Pawara and Kim** [11] carried out a review to examine the investigation defining the modern concepts and methods used in reconstruction of forehead flap of facial defects. The forehead flap remains a staple in armamentarium of facial plastic and reconstructive surgeons, they conclude from their review. Despite the fact that the fundamental principles of the forehead flap are still unaltered over the years, the refinement of specific methods and applications continues.

The retrospective cohort research carried out by **Chen *et al.*** [9] examined 2175 cases who had reconstruction of paramedian forehead flap for skin tumor reconstruction. The investigation aimed to assess the rates of complications following reconstruction of paramedian forehead flap for defects caused by resection of facial tumors and to identify cases factors and complications that related to readmission. The mean [SD] age of the cases was 70.3 [13.4] years, with 1153 [53.5 percent] of them being male.

Blázquez-Sánchez *et al.* [12] discussed the advantage of the paramedian forehead flap and demonstrated that it is adaptable and offers skin that is similar to the external nose in terms of texture and colour. It is equipped with a dependable vascular pedicle that ensures the viability of the flap and other tissues that might be utilized in conjunction, like chondromucosal or chondrocutaneous grafts. Occasionally, it might be necessary to revise the technique in a subsequent operation in order to obtain an optimal outcome**.**

Conclusion:

Paramedian forehead flap have high versatility and efficacy as a workhorse flap in reconstruction of facial defects with lower complication and high patient satisfactions. SCC and BCC were the most frequent tumor types, while nose was the most defected part in face. Wound infection and hair on the nose were the most common complications.

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