

Outcomes of Facial Artery Musculomucosal Flap in Repair of Post-palatoplasty Fistula - A Retrospective Study

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Abstract

Introduction: Closure of palatal fistula is difficult due to excessive scarring of the palate after previous surgery. The facial artery musculomucosal (FAMM) flap is considered a better option for palatal fistula closure due to its axial blood supply and minimal donor site morbidity. The aim of this study was to evaluate the results of harvesting FAMM flap for closure of medium and large palatal fistulas in terms of its versatility, reliability, feeding and speech assessment. **Materials and Methods:** A retrospective analysis was performed on patients with post-palatoplasty fistula admitted to the outpatient clinics of the Department of Plastic Surgery and the Department of Maxillofacial Surgery of Assiut University Hospital from March 2022 to February 2024. **Results:** Twenty patients aged 3–11 years, with female:male = 3:2 ratio, were included in the study. Two flaps experienced venous congestion and then partial flap necrosis. In addition, two flaps had wound dehiscence with mild infection. One patient experienced complete flap loss and then a late recurrent fistula. Most patients were able to feed well, except one patient was unable to swallow and had nasal regurgitation of fluids, that was relieved after second surgery by dorsally based tongue flap. Most patients had intelligible speech during verbal communication, only one patient had nasal tone and hypernasality and two patients were unable to communicate verbally. **Conclusion:** The FAMM flap is suitable for closing medium and large fistulas due to its versatility and vascular reliability. It has fewer complications and sufficient functional and aesthetic results.

Keywords: Facial artery musculomucosal flap, palatal fistula, palatoplasty

INTRODUCTION

Palatal fistulas are common and challenging sequelae of cleft palate surgery. They account for approximately 0-45% of all cleft palate operations.^[1] The problem is compounded when 25-34% of palatal fistula surgeries result in recurrence.^[1] Closing a palatal fistula is difficult due to the lack of surrounding normal tissue and excessive scarring of the palate from previous surgery.^[2] The main objectives of the reconstruction of these fistulas are to separate the nasal from the oral cavity, restore the palatal mucosa, ensure proper feeding without nasal regurgitation, prevent nasal air escape during speech and achieve the best functional and aesthetic results.^[3] Different surgical procedures have been proposed to close palatal fistulas depending on their size and location. Fistulas were classified according to their location using the Pittsburgh Fistula Classification System (types I–VI), the most commonly used classification system.^[4] Based on their size, Richardson and Agni classified fistulas as small (<2 mm²), medium (2–5 mm²) and large (>5 mm²).^[5]

For small palatal fistulas, a local palatal flap is usually used. For midpalatal fistulas with sufficient surrounding soft tissue, redo palatoplasty is a good option. However, for medium and large fistulas, various regional flaps have been adopted, including buccal mucosal flap, tongue flap, facial artery musculomucosal (FAMM) flap and free tissue transfer as a radial forearm flap.^[6] The FAMM flap was first described by Pribaz *et al.* Because of its versatility and reliability, it was considered a possible solution for palatal fistula repair in 1992.^[7] Lahiri and Richard have already provided a detailed description of the vascular base of the facial artery flap.^[8] It is reliable both as a superiorly based

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or inferiorly based flap. For fistulas in the anterior half of the hard palate, superiorly based flaps are used. For fistulas in the remaining hard palate and soft palate, inferiorly based flaps are used.^[8,9] Our study aimed to assess the versatility and reliability of the flaps in the repair of palatal fistulas with assessment of feeding and speech outcomes.

MATERIALS AND METHODS

A retrospective case series study was conducted on patients with fistulas after palatoplasty who were admitted to the outpatient clinics of the Department of Plastic Surgery and the Department of Maxillofacial Surgery of Assiut University Hospital from March 2022 to February 2024. The ethical committee clearance and patient consent were waived due to the retrospective nature of the study.

Inclusion criteria: Patients with medium-sized (2-5mm) and large (>5 mm²) palatal fistulas and well-defined facial arteries by hand-held Doppler were included in the study. **Exclusion criteria:** Patients with small (<2 mm²) fistulas requiring a local palatal flap for closure, a near-complete or large palatal fistula requiring a free flap for closure and an unidentifiable facial artery on hand Doppler due to scarring from previous surgery were excluded from the study. Data was collected from medical records for each patient with the following parameters: age, gender, cleft type, technique of primary palatoplasty, location and size of fistula, type of flap and laterality, technique of nasal layer repair and second-stage operation (for division of flap pedicle or flap debulking). Outcomes included flap complications, any additional surgery and assessments of feeding and speech.

Patients were subjected to complete medical history, clinical examination and comprehensive pre-operative examinations. The local examination included assessment of the location of the palatal fistula according to the Pittsburgh classification: type I–type VI and the fistula size according to the Richardson classification: small (<2 mm²), medium (2–5 mm²) and large (>5 mm²). Assessment of the donor site included the buccal mucosa and the course of the facial artery. Pre-operative IV antibiotics and pain medications were administered. Patients were operated on under general anaesthesia with oral endotracheal intubation. Facial artery identification using hand-held Doppler was mandatory before surgery. The course of the facial artery was mapped from the lower edge of the mandible to the level of the nasal ala using a hand-held Doppler. A Dingman mouth gag was used to keep the mouth open. Identification and marking of the parotid duct were performed to avoid accidental injury. The flap was then marked medial to the duct, limiting the posterior extent of the flap [Figure 1].^[10]

First, an incision was made 1 cm behind the oral commissure to locate the superior labial artery, which could be traced to the facial artery. The incision was deepened into the buccal fat layer by cutting the buccal mucosa, submucosa and underlying muscles (buccinators and a small portion of the orbicularis oris around the commissure). The size of the flap was precisely tailored to the size of the defect. The width of the flap was

limited to approximately 2–2.5 cm to avoid tension when closing the donor site. Depending on the location of the fistula, the flap was prepared either retrograde or antegrade, leaving the vessels in the centre of the flap. The flap was then hung over a pivot at the base of the pedicle and used to cover the defect. The stem was carefully aligned to prevent kinking or twisting. For superiorly based flaps, the pedicle was inserted into the oral cavity either by hanging over the teeth or through a gap in the dentition, if present [Figure 2]. For inferiorly based flaps, the pedicle was placed to cover the defect through the retromolar fossa [Figures 3 and 4]. After complete elevation, the flap was placed and the donor site was closed primarily with 4-0 polyglactin (Vicryl) interrupted sutures. Postoperatively, a bite block was applied for one week in all cases.

Immediately after surgery, intravenous fluids were administered along with pain medications for three days until patients could tolerate the introduction of oral fluids and soft foods. Patients were discharged and placed on a soft diet for one week. Fluids and soft food were given. Patients were followed up for a period of 6-24 months, with an average follow-up period of eight months. Patients were evaluated for feeding (ability to swallow and nasal regurgitation of liquids) and speech (nasal tone, hypernasality and ability to communicate verbally).

RESULTS

Twenty patients were enrolled in the study [Table 1]. They aged from 3 to 11 years. Females were predominant than males (female: male = 3:2 ratio). Palatal fistulae occurred most commonly following Bardach palatoplasty (60%), then von Langenbeck repair (30%) and finally Furlow double-opposing Z-repair (10%). The most common sites were at the anterior palate (60%), then midpalatal (30%) and finally at the

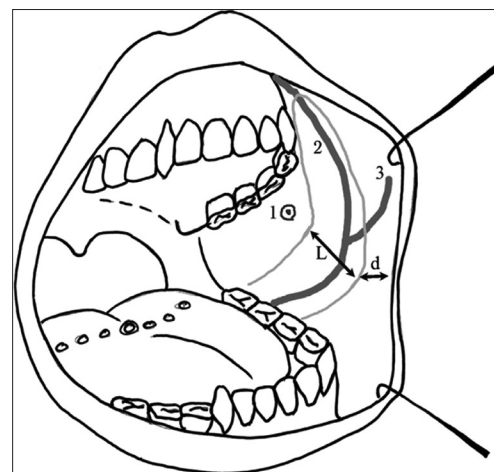


Figure 1: Landmarks for design of the inferiorly based facial artery musculomucosal flap. d: Distance of 1 cm from the labial commissure delaminates the anterior edge of the flap. L: Largest width possible determined by the position of the orifice of Stensen's duct. Inferiorly, the base of the flap is centred over the area of the second and third molar teeth with a 2 cm base. 1: Orifice of Stensen's duct; 2: Facial artery; 3: Superior labial artery^[16]

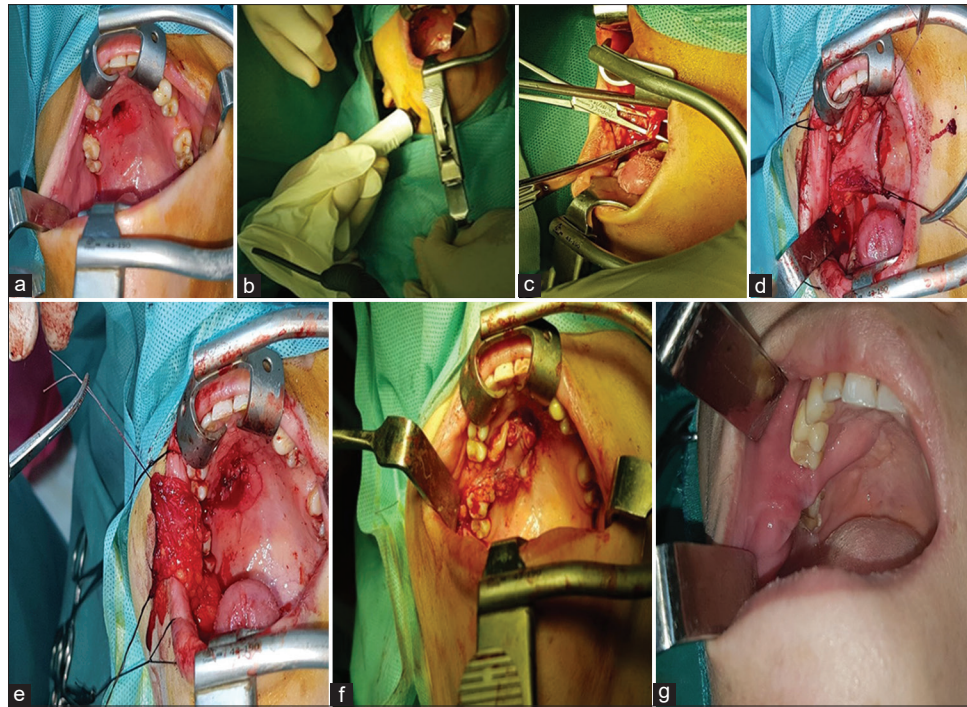


Figure 2: Anterior palatal fistula repaired by right superiorly based facial artery musculomucosal flap. (a) Anterior palatal fistula, (b) Detection of facial artery by handheld Doppler, (c) Dissection of vascular pedicle, (d) Flap harvesting, (e) Nasal layer closure by turnover palatal flaps, (f) Immediately after flap inset, (g) Late post-operative after 6 months

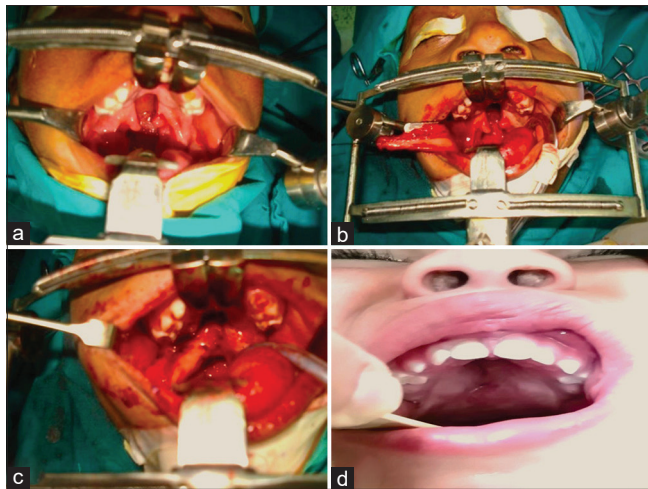


Figure 3: Posterior palatal fistula repaired by right inferiorly based facial artery musculomucosal flap. (a) Posterior palatal fistula, (b) Flap harvesting at the right side, (c) Flap inset, (d) Late post-operative after 7 months

posterior palate (10%). Large-sized fistulae (65%) were more common than medium-sized ones (35%). Superiorly based flaps were harvested more than inferiorly based flaps (3:2). Most flaps were harvested on one side except in four patients where flaps were harvested bilaterally (in large-sized, anterior palatal fistulas). Repair of nasal layer was performed by local palatal turnover flaps except in four patients where the nasal layer was covered by FAMM flap due to insufficient palatal tissue for nasal layer coverage. The second stage

for flap separation (when indicated) was performed after 3 weeks [Table 1].

Two flaps experienced venous congestion (mainly due to kinked pedicles) resulting in partial flap necrosis, which resolved after 3 days. Furthermore, two flaps had wound dehiscence (due to tension on the pedicle) which showed mild infection and was cured with medications. One patient experienced complete flap loss (due to severe congestion and ischaemia from a kinked pedicle) and later recurrent fistulas, which were reconstructed using a dorsally based tongue flap. Only two flaps needed debulking surgery (as they were initially rather bulky) [Table 2]. Upon feeding assessment, it was seen that most patients could feed well; only one patient with complete flap loss had inability to swallow and nasal regurgitation of fluids that was relieved after second surgery by a dorsally based tongue flap. Clinical assessment of speech by the speech therapist demonstrated that most patients developed intelligible speech. Only one patient experienced nasal tone of voice and hypernasality and two patients experienced speech difficulty and required speech therapy [Table 2].

DISCUSSION

The FAMM flap is considered a preferred option over other musculomucosal flaps due to its axial blood flow pattern and low donor site morbidity. However, harvesting the flap can be a technical challenge. It has no or limited aesthetic consequences due to the absence of external scars.^[10] Furthermore, facial nerve branches are more superficial than the facial artery

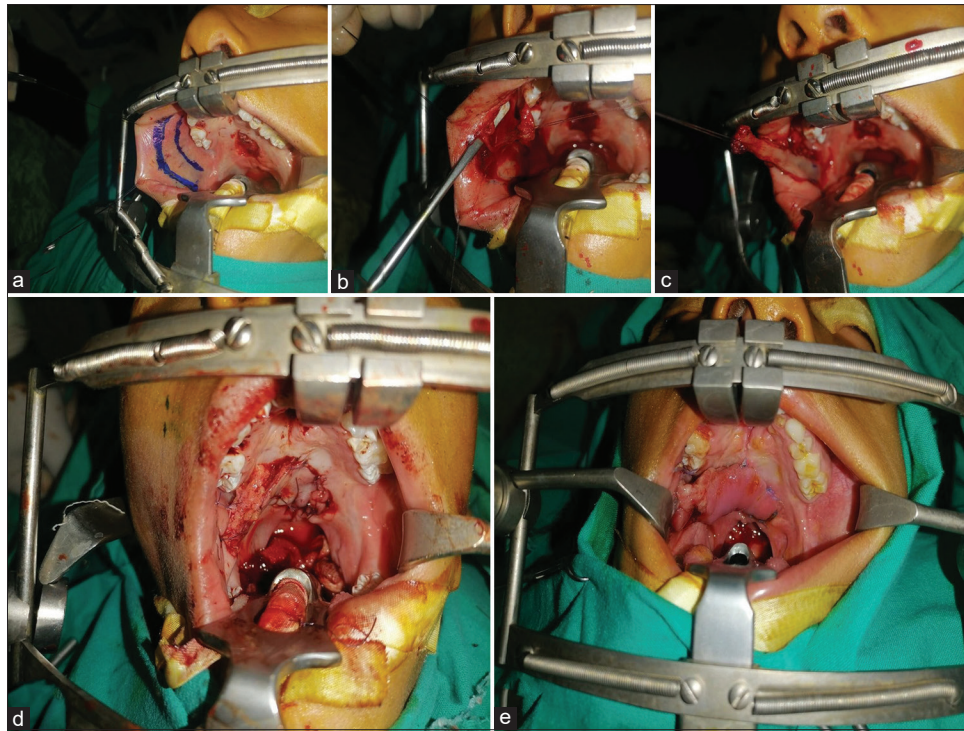


Figure 4: Midpalatal fistula repaired by right inferiorly based facial artery musculomucosal flap. (a) Nasal layer closure by turnover flap and flap marking on the right side, (b) Dissection of the vascular pedicle, (c) Flap elevation, (d) Immediate post-operative, (e) Late post-operative after 4 weeks (second stage for separation)

and are often not included in the plane of dissection, making them less susceptible to injury.^[11] Another advantage is that the possibility of harvesting facial vein along with the facial artery to allow adequate drainage in larger flaps.^[12]

A study by Durmus Kocaaslan *et al.*, concluded that the tongue flap offers several advantages such as the use of adjacent tissues, an abundance of tongue tissues, easy rotation, a rich and reliable vascular supply of the tongue in cases of scarred palatal tissue due to previous failed attempts and low morbidity to the donor site.^[13] However, the main disadvantages include the need for a two-staged procedure, difficulties in intubation and extubation, limited oral functions, risk of flap separation and the presence of bulky soft tissue on the surface of the palate after flap separation. Other serious complications include detachment, flap necrosis due to pressure from haematoma formation and airway obstruction.^[13] The design flexibility of the FAMM flap overcomes many problems. FAMM flaps are particularly useful for larger fistulas in the anterior portion of the hard palate or at the junction of the hard and soft palates, where the surrounding soft tissues are stiff, scarred and difficult to mobilise. The FAMM flap can be used to treat fistulas due to various conditions other than those occurring after cleft palate surgery.^[14]

Stein *et al.*, carried out a retrospective analysis measuring fistula size and velopharyngeal insufficiency (VPI) rates after cleft palate repair. They found that the Furlow repair had a lower probability of fistula formation than the von Langenbeck and Veau/Wardill/Kilner methods, as well as less VPI than the Bardach repair. One-stage repair is associated with a lower

likelihood of fistula formation and VPI than two-stage repair.^[15] Of our patients, 12 patients had superiorly based flaps and 8 had inferiorly based flaps according to the site of palatal fistulae. The nasal layer was repaired by turnover flaps in 16 patients and by FAMM flap in 4 patients. The second stage for flap separation was performed in eight patients after 3 weeks. Our patients had alveolar bone grafting from the iliac crest within 6 to 9 months after their fistula had repaired.

Rahpeyma and Khajehahmadi reported the versatility of FAMM flap in 10 patients with large anterior palatal fistulae. They concluded that a superiorly based FAMM flap is a good option when the fistula is continuous with an alveolar cleft.^[16] Nakakita *et al.*, described palatal fistula repair with buccal musculomucosal flaps. In that study, complete closure was achieved on the first attempt in 69% of cases, necessitating a second pedicle division procedure.^[17] In our study, venous congestion and partial flap loss occurred in two flaps and resolved in 3 days. Wound dehiscence with mild infection was reported in two flaps and cured with medications. Complete flap loss and late recurrent fistula occurred in one flap and reconstructed by dorsally based tongue flap.

Ashtiani *et al.*, used FAMM flaps to close large and complicated palatal fistulas in 22 cases. In one case, because of a very wide fistula, a bilateral FAMM flap was used. A second pedicle division surgery and a temporary bite block are necessary with this procedure. In addition, venous congestion is an issue when designing FAMM flaps.^[11] Shetty *et al.*, used FAMM flaps to repair post-palatoplasty fistulae in 11 patients. Two of the

Table 1: Patients' data

Parameter	Number of cases (%)
Total number of patients	20 (100)
Age: 3–11 years (mean: 7 years, SD: ±4)	-
Gender	
Male	8 (40)
Female	12 (60)
Cleft type (Veau)	
Soft palate only (Veau I)	2 (10)
Incomplete H + S CP (Veau II)	6 (30)
UCLP (Veau III)	4 (20)
BCLP (Veau IV)	8 (40)
Primary palatoplasty technique	
Furlow double-opposing Z-repair	2 (10)
von Langenbeck repair + IVV	6 (30)
Bardach Two-flap repair + IVV	12 (60)
Fistula site (Pittsburgh)	
Posterior palatal (type II)	2 (10)
Midpalatal junction (type III)	6 (30)
Anterior palatal (type IV)	12 (60)
Fistula size (Richardson)	
Medium sized (2–5 mm ²)	7 (35)
Large sized (>5 mm ²)	13 (65)
Flap type	
Superiorly based	12 (60)
Inferiorly based	8 (40)
Laterality	
Unilateral harvesting (6 RT, 10 LT)	16 (80)
Bilateral harvesting	4 (20)
Nasal layer repair	
Turnover palatal flap	16 (80)
FAMM flap	4 (20)
Second-stage operation for flap separation	8 (40)

SD: Standard deviation, H + S: Hard and soft, CP: Cleft palate, UCLP: Unilateral cleft lip and palate, BCLP: Bilateral cleft lip and palate, IVV: Intravelar veloplasty, RT: Right, LT: Left, FAMM: Facial artery musculomucosal flap

flaps showed venous congestion immediately post-operative and resolved spontaneously without any active intervention over the next 48 h.^[9] Other published papers on FAMM flaps also do not report any problems with donor sites.^[8–12] There have been no donor site morbidities reported during the study. Removal of a strip of muscle and mucosa from the buccal surface does not impact the mouth opening. Although reduced slightly postoperatively, it returned to normal within 3 months. Rabbani *et al.*,^[18] used FAMM flaps with low complication rates in many patients with palatal and oropharyngeal defects. They found that re-approximation of the buccinator muscle is not necessary and may contribute to increased scarring and commissure restriction. Patients were followed up for a period ranging from 6 months to 2 years. Satisfactory closure of the fistula was obtained in all patients. Patients could feed well; only one patient with complete flap loss had difficulty swallowing and nasal regurgitation of fluids that resolved after second surgery with a dorsally based tongue flap. Patients had intelligible speech with only one patient experiencing nasal

Table 2: Patients' outcomes after flap harvesting

Parameter	Number of cases (%)
Complication	
Wound dehiscence	2 (10)
Infection	2 (10)
Venous congestion	2 (10)
Partial flap necrosis	2 (10)
Total flap loss	1 (5)
Late recurrent fistula	1 (5)
Further surgery	
Flap revision (debulking)	2 (10)
Other flaps (tongue flap)	1 (5)
Feeding assessment	
Inability to swallowing	1 (5)
Nasal regurgitation of fluids	1 (5)
Speech assessment	
Nasal tone of voice	1 (5)
Hypernasality	1 (5)
Inability to communicate verbally	2 (10)

tone of voice and hypernasality and two patients who were unable to speak intelligibly.

Sohail *et al.*, compared the clinical outcomes of FAMM flap and tongue flap used for closure of large anterior palatal fistula. All patients in the tongue flap group experienced difficulty in speaking and eating, whereas in the FAMM flap group, two patients had eating problem and the other two experienced speech difficulty.^[19] Denadai *et al.*, conducted a retrospective study on 101 patients who underwent palatal fistula repair according to specific algorithms, through three approaches: local palatal flaps, buccinator myomucosal flaps and tongue flaps. Symptomatic and anatomical parameters (fistula-related symptoms and residual palatal fistula, respectively) were combined to stratify the clinical outcomes as 'good' (complete fistula closure with no symptoms), 'fair' (an asymptomatic narrow fistula remained) or 'poor' (failure to repair the fistula).^[20] They observed that most patients presented good clinical outcomes in buccinator flaps, tongue flaps and lastly local flaps. All fair and poor outcomes were observed in fistulae reconstructed by local flaps. All poor outcomes were observed in borderline fistulae (4–5 mm). No surgical-related complications (dehiscence, infections or necrosis) were observed, except for an episode of bleeding after the first stage of tongue flap-based reconstruction (1.0%).^[20]

A review of literature about outcomes of FAMM flap harvesting for palatal fistulae is presented in Table 3. One of the drawbacks of FAMM flap is that the greatest width gained is 2–2.5 cm to allow donor site closure and an open alveolar cleft is required for the flap to get access to the anterior palate when used in anterior hard palate fistulas. There is a need to insert a bite block in the immediate post-operative period to keep the pedicle from biting by patients' teeth.^[21–23] The other limitation of the flap is its vascular orientation. The facial artery has a very tortuous course in this region, so care must be taken to include the arterial axis in the flap.^[24,25] Another limitation

Table 3: Review literature about outcomes of facial artery musculomucosal flap harvesting for palatal fistulae

Author	Type of study	Number of patients	Surgical repair	Post-operative complications	Outcomes
Ashtiani <i>et al.</i> , 2005 ^[11]	Prospective case series	22 cases of wide, scarred, recurrent palatal fistulae were operated	8 cases repaired by superiorly based FAMM and 14 cases repaired by inferiorly based FAMM flap	2 cases had partial necrosis and one case had complete failure, repaired later by pharyngeal flap	The overall results have been very satisfactory The improvement in speech has also been good
Lahiri and Richard, 2007 ^[8]	Prospective case series	16 patients with large anterior palatal fistula after palatoplasty	Anterosuperiorly based FAMM flap	12 flaps were successful, but 2 suffered partial flap loss secondary to venous congestion, and 2 had complete flap failure; one of them had a small wound dehiscence that resulted in a small posterior fistula	Satisfactory outcome was obtained except in 4 patients
Shetty <i>et al.</i> , 2013 ^[9]	Retrospective analysis	11 patients (9 after cleft surgery and 2 cases after tumour excision)	8 cases repaired by superiorly based FAMM and 3 cases repaired by inferiorly based FAMM	2 flaps developed venous congestion (after 4–6 h), which resolved on its own without any active intervention (within 48 h) 2 flaps developed terminal marginal necrosis One flap developed suture line dehiscence	Satisfactory closure of the fistula was obtained in all patients
Sohail <i>et al.</i> , 2016 ^[19]	Retrospective cohort study	39 patients with anterior palatal fistulae	23 fistulae repaired by tongue flap and 16 fistulae repaired by superiorly based FAMM	All patients in tongue flap group experienced difficulty in speaking and eating, whereas in FAMM flap group, 2 of them had eating problem and 2 cases experienced speech difficulty. There was no difference for other complications and no recurrence at 1-year follow-up in both groups	More satisfactory outcomes with FAMM group than tongue flap group
Lee and Alizadeh, 2016 ^[21]	Retrospective review	14 patients with palatal fistula after cleft surgery and one patient after soft-tissue tumour	All cases had spacer facial artery musculomucosal flaps (FAMM modification) with mucosal hinge flap and intravelar veloplasty	All patients were free of recurrent oronasal fistula One patient had necrosis of the distal spacer facial artery musculomucosal flap (<1 cm ²) requiring a revision	Satisfactory closure of the fistula was obtained in all patients
Yehya <i>et al.</i> , 2017 ^[22]	Prospective study	24 patients with anterior palatal and junctional fistulae	14 cases repaired by superiorly based FAMM and 10 cases repaired by inferiorly based FAMM	3 flaps developed venous congestion 4–6 h after surgery and resolved – spontaneously without any active intervention after the next 48 h One flap developed suture line dehiscence	Satisfactory outcome was obtained except in one patient
Hasan <i>et al.</i> , 2021 ^[23]	Prospective study	17 patients with palatal fistula after cleft surgery and one patient after trauma	8 cases repaired by superiorly based FAMM and 9 cases repaired by inferiorly based FAMM	One case had flap complete necrosis (contralateral flap was harvested and one case had flap partial necrosis healed after debridement)	Satisfactory closure of the fistula was obtained in all patients
Roomi <i>et al.</i> , 2024 ^[24]	Randomised clinical trial	24 patients with recurrent small- and medium-sized fistula after cleft surgery	12 fistulae repaired by palatal pedicled flap and 12 fistulae repaired by inferiorly based FAMM	In one case in the FAMM group, there was a suture line dehiscence. However, the flap was successfully advanced and resutured	FAMM flap had more favourable satisfactory outcomes than pedicled palatal flap

FAMM: Facial artery musculomucosal flap

of the study is its retrospective nature which is subjected to bias and incorrect data collection from medical records. Recommendations for future research include incorporation of a third layer for proper closure of palatal fistula and improved healing such as acellular dermal matrix between the reconstructed nasal and oral layers.^[26]

CONCLUSION

The FAMM flap is suitable for closure of medium- and large-sized palatal fistula because of its reliability and versatility. It presents fewer complications and ensures adequate functional results after palatal fistula repair.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Yang AS, Richard BM, Wills AK, Mahmoud O, Sandy JR, Ness AR. Closer to the truth on national fistula prevalence after unilateral complete cleft lip and palate repair? The cleft care UK study. *Cleft Palate Craniofac J* 2020;57:5-13.
2. Garg R, Shah S, Uppal S, Mittal RK. A statistical analysis of incidence, etiology, and management of palatal fistula. *Natl J Maxillofac Surg* 2019;10:43-6.

3. Eberlinc A, Koželj V. Incidence of residual oronasal fistulas: A 20-year experience. *Cleft Palate Craniofac J* 2012;49:643-8.
4. Smith DM, Vecchione L, Jiang S, Ford M, Deleyiannis FW, Haralam MA, *et al*. The Pittsburgh fistula classification system: A standardized scheme for the description of palatal fistulas. *Cleft Palate Craniofac J* 2007;44:590-4.
5. Richardson S, Agni NA. Palatal fistulae: A comprehensive classification and difficulty index. *J Maxillofac Oral Surg* 2014;13:305-9.
6. Saralaya S, Desai AK, Kumar N. Difficulty index-based management of palatal fistula after primary cleft palate repair: An institutional experience. *J Oral Maxillofac Surg* 2019;77:851.e1-7.
7. Pribaz J, Stephens W, Crespo L, Gifford G. A new intraoral flap: Facial artery musculomucosal (FAMM) flap. *Plast Reconstr Surg* 1992;90:421-9.
8. Lahiri A, Richard B. Superiorly based facial artery musculomucosal flap for large anterior palatal fistulae in clefts. *Cleft Palate Craniofac J* 2007;44:523-7.
9. Shetty R, Lamba S, Gupta AK. Role of facial artery musculomucosal flap in large and recurrent palatal fistulae. *Cleft Palate Craniofac J* 2013;50:730-3.
10. Ayad T. Facial artery musculomucosal (FAMM) flap. *Oper Tech Otolaryngol Head Neck Surg* 2019;30:112-9.
11. Ashtiani AK, Emami SA, Rasti M. Closure of complicated palatal fistula with facial artery musculomucosal flap. *Plast Reconstr Surg* 2005;116:381-6.
12. Navarro Cuéllar C, Tousidonis Rial M, Antúnez-Conde R, Agea Martínez M, Navarro Cuéllar I, Salmerón Escobar JI, *et al*. Functional outcomes with facial artery musculo-mucosal (FAMM) Flap and dental implants for reconstruction of floor of the mouth and tongue defects in oncologic patients. *J Clin Med* 2021;10:3625.
13. Durmus Kocaaslan FN, Tuncer FB, Sendur S, Celebiler O. The tongue flap for large palatal fistulas, a success or a failure? Our 15-year experience. *J Plast Surg Hand Surg* 2020;54:151-5.
14. Fang L, Yang M, Wang C, Ma T, Zhao Z, Yin N, *et al*. A clinical study of various buccinator musculomucosal flaps for palatal fistulae closure after cleft palate surgery. *J Craniofac Surg* 2014;25:e197-202.
15. Stein MJ, Zhang Z, Fell M, Mercer N, Malic C. Determining postoperative outcomes after cleft palate repair: A systematic review and meta-analysis. *J Plast Reconstr Aesthet Surg* 2019;72:85-91.
16. Rahpeyma A, Khajehahmadi S. Facial artery musculomucosal flap in alveolar cleft surgery. *Iran J Otorhinolaryngol* 2021;33:347-53.
17. Nakakita N, Maeda K, Ando S, Ojimi H, Utsugi R. Use of a buccal musculomucosal flap to close palatal fistulae after cleft palate repair. *Br J Plast Surg* 1990;43:452-6.
18. Rabbani CC, Lee AH, Desai SC. Facial artery musculomucosal flap operative techniques. *Plast Reconstr Surg* 2022;149:511e-4e.
19. Sohail M, Bashir MM, Khan FA, Ashraf N. Comparison of clinical outcome of facial artery myomucosal flap and tongue flap for closure of large anterior palatal fistulas. *J Craniofac Surg* 2016;27:1465-8.
20. Denadai R, Zanco GL, Raposo-Amaral CA, Buzzo CL, Raposo-Amaral CE. Outcomes of surgical management of palatal fistulae in patients with repaired cleft palate. *J Craniofac Surg* 2020;31:e45-50.
21. Lee JY, Alizadeh K. Spacer facial artery musculomucosal flap: Simultaneous closure of oronasal fistulas and palatal lengthening. *Plast Reconstr Surg* 2016;137:240-3.
22. Yehya AA, Gamaan I, Abd El Monem M, Fathy A. Outcomes of facial artery musculomucosal flap for closure of small and medium sized fistula after clefts. *Egypt J Ear Nose Throat Allied Sci* 2017;18:231-5.
23. Hasan HA, Qader AR, Shakur AE, Rashid AH, Zorab SS. Role of the facial artery musculomucosal flap in the reconstruction of palatal defects. *Invest Clin* 2021;62:307-15.
24. Roomi DG, Askar NA, Khashaba M, Shaheen H. Patient satisfaction after using a reverse flow based facial artery musculomucosal flap (FAMM) versus a palatal pedicled flap for closure of recurrent small and medium-sized oronasal fistula: A randomized clinical trial. *Egypt Dent J* 2024;70:65-74.
25. Yara M, Mohamed M, Shady S. Palatal flap delay and facial artery musculomucosal (FAMM) flap for the closure of cocaine fistula. *J Plast Reconstr Surg Adv Publ* 2024;3:10-5.
26. Simpson A, Samargandi OA, Wong A, Graham ME, Bezuhly M. Repair of primary cleft palate and oronasal fistula with acellular dermal matrix: A systematic review and surgeon survey. *Cleft Palate Craniofac J* 2019;56:187-95.