The Versatility of the Tongue Flap in the Closure of Palatal Fistula

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Abstract

Aims Tongue flaps were introduced for intraoral reconstruction by Lexer in 1909. A retrospective study was performed in the Department of Oral and Maxillofacial Surgery, S.D.M. College of Dental Sciences (Dharwad, India), to assess the use of tongue flap in closure of palatal fistula.

Material and Methods A total of 40 patients treated for palatal fistulas were included in this study from the period of January 1, 2000, to January 1, 2007; fistulas present in anterior and midpalate were considered. Patients' preoperative photographs, clinical records, and preoperative speech analysis were recorded. Following completion of fistula closure, patients were assessed over 6 months to check flap viability, fistula closure, residual tongue function, aesthetics, and speech impediment.

Results A total of 40 (24 male and 16 female) patients with palatal fistulas were treated with tongue flap in our study. Six patients were 4 to 6 years old, three were 7 to 10 years old, and 22 were 11 to 20 years old, which accounts for 68% of study subjects. There were nine patients 21 to 30 years old. In the early postoperative period, we encountered bleeding in one patient and sloughing in one patient. There are three recurrences, and two flaps were detached; all remaining cases showed satisfactory healing, and donor site morbidity was minimal. No speech deficits were evident.

Conclusion Tongue flaps are used in cleft palate surgery because of their excellent vascularity, and the large amount of tissue that they provide has made tongue flaps particularly appropriate for the repair of large fistulas in palates scarred by previous surgery.

Keywords

- ▶ tongue flap
- ▶ palatal fistula
- ▶ speech intelligibility
- ▶ hyper nasality
- ▶ nasal emission
- ▶ complication

Primary treatment of cleft palate should result in an intact palate with separation of the oral and nasal cavities. However, the published reports of large series indicate that fistula is present in the secondary palate of a small but significant group of patients. The incident varies from 8.9 to 34%.¹ Even in the best of hands, an oronasal fistula of the secondary palate may occur postoperatively.

Etiology

Most often the palatal fistula is located at the junction of the hard and soft palate closure or between the premaxilla and secondary palate. The symptoms depend on size, position, and general velopharyngeal competence. A fistula may also be caused by trauma, tumor, irradiation, or a rare infectious disease, such as midline granuloma, syphilitic gumma,

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leprosy, noma, or leishmaniasis.² The most common complaint is uncontrolled regurgitation of fluid into the nose. A large fistula also causes obvious speech defects, whereas a small fistula may result in some speech impairment.

Breakdown of primary palatal repair is one of the major causes of palatal fistula, which is related to tension at the site of closure, necrosis, whether the greater palatine vessel was injured during elevation of the flaps or injection, hematoma, or mechanical trauma before flaps heal. Attempts at closure using only local transposition flaps may be successful, although frequently, closure is not achieved and a smaller oronasal fistula will recur.

Additional attempts to gain closure with local tissue alone often result in repeated failure as the thick and immobile, scarred palatal mucoperiosteum leads to closure under tension with subsequent flap necrosis and wound dehiscence.

Tissue from distant sites has been used including tubed pedicle and flaps from the abdomen, arm, neck, or cervicothoracic region. Others have used cheek and nasolabial flaps to close these palatal defects. Although staged distal tissue transfers may be effective, they require multiple operations, are always cumbersome, leave multiple scars, prevent chewing until final flap division, are bulky when inset, and finally transfer skin rather than mucosa to the roof of the mouth.

Tongue Flaps for Oronasal Fistula

Tongue flaps were introduced for intraoral reconstruction by Lexer in 1909.³ In the field of oncology, tongue flaps have been used for reconstruction of various sites including the lower lip, floor of the mouth, buccal mucosa, and palate. However, in cleft palate surgery their excellent vascularity and the large amount of tissue they provide have rendered tongue flaps particularly appropriate for the repair of large fistulas in palates scarred from previous surgery.⁴

This study was performed to quantitatively assess the possible benefits and advantages and the outcomes of tongue flap in closure of palatal fistula.

Objectives

The purpose of this study is to evaluate the versatility of tongue flap in closure of palatal fistula. Following completion of fistula closure, patients were assessed under following criteria over period of at least 6 months: (1) flap viability; (2) fistula closure; (3) residual tongue function and aesthetics; and (4) speech impediment.

Methods

Source of Data

We performed a retrospective study of 40 patients with palatal fistulas who were treated with anteriorly based tongue flap in the Department of Oral and Maxillofacial Surgery, S.D.M. College of Dental Sciences and Hospital (Sattur, Dharwad, India) from January 2000 to January 2007.

Patient Selection Criteria

Selection criteria consisted of the following: (1) fistulas present in anterior and midpalate were considered; (2) the size of the palatal fistula not amenable for local flap closure; (3) history of repeated attempts to achieve the closure of the palatal defect; (4) scarred palate and adjacent tissue.

Method of Study

Patients' preoperative photographs, clinical records, and preoperative speech analysis were recorded. Sizes of the fistulas were measured preoperatively.

Surgical Technique

The operation was performed with the patient receiving general anesthesia. The unaffected nasal side was used for nasotracheal intubation. After routine intra- and extraoral betadine preparation, sterile fistulas were injected with 2% lidocaine with 1:200,000 adrenaline for homeostasis and ballooning of the tissues for ease of dissection.

Incision was performed around the fistulous tract (►Figs. 1 and 2); mucosalized edges were excised (►Fig. 3). The nasal layer was identified and carefully dissected to mobilize the nasal layer, and the nasal floor was reconstructed using 4–0 Vicryl (►Fig. 4).

The length of the flap was designed such that 1 to 2 cm of additional tissue would span the posterior edge of the palatal defect; the approximate size of the tongue flap was designed using the coverage of the suture material as a template (►Figs. 5 and 6). Next, with the tongue in an unstrained position, a dorsal flap with an anteriorly based pedicle was designed using the suture material as a template (►Fig. 7). The width was dictated by the width of the defect plus 20%. The anteriorly based tongue flap was raised, including 2 to 3 mm of muscle thickness to allow for adequate vascularization (►Fig. 8). After mobilization of the lingual flap, the donor site was sutured with 4–0 resorbable interrupted sutures (►Fig. 9).

The tongue flap was then rotated forward and sutured to the raw edges of the palatal defect anteriorly and laterally using 4–0 Vicryl (►Figs. 10 and 11). No nasogastric tube was placed to assist in feeding.

After 2 weeks, the patient was taken back into the operation theater; under general anesthesia, the flap was divided and set into the posterior aspect of the palatal defect

Figure 1 Line of incision around the fistulous tract.

Figure 2 Line of incision around the fistulous tract.

Figure 5 Size of the tongue flap is designed using cover of suture material as a template based on the size of the defect.

Figure 3 Mucosalized edges were excised, nasal layers were identified and carefully dissected to mobilize the nasal layer.

Figure 6 Size of the tongue flap is designed using cover of the suture material as template based on the size of the defect.

Figure 4 Nasal floor reconstructed using 4-0 Vicryl sutures.

Figure 7 Design of the tongue flap with an anteriorly based pedicle.

Figure 8 Anteriorly based tongue flap is raised; flap should include 2 to 3 mm of muscle thickness to allow for adequate vascularization.

Figure 10 The tongue flap was then rotated forward and sutured to the raw edges of the palatal defect anteriorly and laterally.

Figure 9 After mobilization of the flap, the donor site is sutured with 4-0 resorbable interrupted sutures till lower edge of raised flap.

Figure 11 The tongue flap was then rotated forward and sutured to the raw edges of the palatal defect anteriorly and laterally.

(►Figs. 12 and 14). The donor site defect was closed using 4-0 Vicryl (►Figs. 13 and 14). Our experiences with tongue flaps in closure of palatal fistulas are shown in ►Figs. 15 to 22.

Following completion of fistula closure, the patient was assessed under the following criteria at 2 weeks, 1 month, 3 months, 6 months, and thereafter at 1-year intervals: (1) flap viability; (2) fistula closure; (3) residual tongue function and aesthetics; (4) assessment of speech impediment.

Length of follow-up period ranged from 2 weeks to 18 months, with an average length of 15 months.

Speech Assessment

A customized Performa for patients with palatal fistulas was used to document the findings of the speech pathologist. All

Figure 12 After 2 weeks, under general anesthesia the flap is divided and set into the posterior aspect of the palatal defect.

Figure 13 Donor site defect was closed using 4-0 Vicryl.

Figure 16 Result 1 week postoperatively.

Figure 14 Donor site defect was closed using 4-0 Vicryl.

Figure 17 Result 3 months following fistula closure.

Figure 15 Preoperative palatal fistula prior to closure.

Figure 18 Result 1 year after palatal fistula closure using anteriorly based tongue flap.

Figure 19 Preoperative palatal fistula prior to closure.

Figure 22 Result 1 year after palatal fistula closure using anteriorly based tongue flap.

Figure 20 Result 1 week postoperatively.

Figure 21 Result 3 months postoperatively.

40 patients with palatal fistula were evaluated by a speech pathologist preoperatively and at 1, 3, and 6 months and 1 year postoperatively, using the following parameters: (1) articulation and speech intelligibility; (2) nasal emission; (3) hypernasality.

All patients were advised to perform palatal muscular strengthening exercises for 8 weeks starting at 5 weeks

postoperatively, such as blowing (balloon, candle, etc.), sucking (using pipes and straws of varying length), and direct stimulation using finger or cotton ear buds. Patients were also given specific speech exercises as instructed by the speech pathologist to improve their articulation.

The degree of nasal emission, hypernasality, and speech intelligibility was recorded on a scale ranging from 0 to 3 (0, normal; 1, mild; 2, moderate; 3, severe). All assessments were done by single speech pathologist. The comparisons of the pre- and postoperative nasal emission, hypernasality, and speech intelligibility were done using the Wilcoxon matched pairs test.

Analysis of the Data

All the results of the study were subjected to statistical analysis.

Results

Sex and Age Groups

The group of 40 patients included 24 males (60%) and 16 females (40%) as shown in ►Fig. 23. Ages ranged from 4 to 30 years, with most patients 11 to 20 years old (22 patients), accounting for 68% of study participants. The mean age was 15.02 years. Age distribution is shown in ►Fig. 24.

Location of the Fistula

We used The Pittsburgh Fistula Classification System⁵ to describe the location of the fistula as follows: type I, bifid uvula; type II, soft palate; type III, junction of the soft and hard palate; type IV, hard palate; type V, junction of the primary and secondary palates; type VI, lingual alveolar; and type VII, labial alveolar.

In our study, most of the fistulas were seen at the junction of the primary and secondary palate. Of 40 patients, 31 (77%) had fistula at the junction of primary and secondary palate (type V), 3 (8%) had fistula in hard palate (type IV), and 6 (15%) had fistula at the junction of the soft and hard palate (type III) as shown in ►Table 1 and ►Fig. 25.

Distribution of study subjects by sex

Figure 23 Distribution of study subject by sex.

Location of the Fistula

Figure 25 Location of fistula.

Age Group Distribution

Figure 24 Age group distribution.

Size of the Fistulas

The largest fistula we encountered was 8×6 cm and the smallest, 10×8 mm; the mean size was 11.57×13.58 mm.

Size of the Tongue Flap

The length of the flap was designed such that 1 to 2 cm of additional tissue would span the posterior edge of the palatal defect; the width was dictated by the width of the defect plus 20%. In our study, we used tongue flaps from 14×18 mm to 8.5×6.5 cm.

Table 1 Location of the Fistula

	n	%
Junction of the primary and secondary palate (type V)	31	77
Hard palate (type IV)	3	8
Junction of hard and soft palate (type III)	6	15

Number of Previous Closure Attempts

In our study, 30 patients (75%) were operated for cleft palate previously; 7 (17%) were operated twice to close the fistula, primarily; and 3 (8%) were operated more than twice in attempts to close the fistula (►Table 2 and ►Fig. 26).

Presence of Scar Tissue

Of 40 patients, 38 (95%) had severely scarred palatal tissue adjacent to fistula due to previous surgery, and 2 (5%) had no scar tissue.

Speech Assessment

For all 40 patients, preoperative speech analysis was done by a speech pathologist, and degree of speech impediment (speech intelligibility, hypernasality, and nasal emission) was assessed. Results were compared with postoperative speech analysis at 1 month, 3 months, 6 months, and 1 year postoperatively. All three parameters showed significant improvement over 6 months to 1 year of follow-up.

Flap Viability

All flaps in 40 patients proved to be viable in the long term, although two flaps (5%) required resuturing, which showed satisfactory results over long-term follow-up.

Fistula Closure

In the initial stage, complete closure of the fistulas was achieved in all 40 patients; however, in three patients (8%), the fistula recurred and secondary closure was achieved by local advancement of the donated tongue tissue.

Table 2 Number of Previous Attempts at Closure

	n	%
1	30	75
2	07	17
>2	03	08
Total	40	100

NUMBER OF PREVIOUS ATTEMPTS AT CLOSURE

■ ONCE ■ TWICE ■ MULTIPLE ATTEMPTS

Figure 26 Previous attempts at closure.

Residual Tongue Function and Esthetics

In all cases postoperative aesthetics of the donor tongue site were found to be satisfactory.

Tongue aesthetics was assessed based on the symmetry on either side of the suture line after complete healing. There was no interference with speech as a consequence of use of the tongue as a donor site. Oral hygiene and mastication were unimpaired. No patient described sensory or gustatory disability following this procedure.

Complications

We encountered very few complications postoperatively. We noticed bleeding in one patient (2%), which was controlled with local hemostatic measures. In the early postoperative period, dehiscence was seen in two patients (5%) and sloughing in one patient (2%); two patients required resuturing of the flap. No complications were seen in remaining 31 patients (78%) as shown in ►Table 3 and ►Fig. 27.

Discussion

Primary treatment of cleft palate should result in an intact palate with separation of the oral and nasal cavities. However, the published reports of large series indicate fistula can recur in the secondary palate of a small but significant group of patients; the incidence varies from 8.9 to 34%.²

Table 3 Postoperative Complications

	n	%
Bleeding	1	2
Dehiscence	2	5
Sloughing	1	2
Detachment	2	5
Recurrence of fistula	3	8
No. of complications	31	78
Total	40	100

Post operative complications

■ Bleeding ■ Sloughing ■ Recurrence of fistula
■ Dehiscence ■ Detachment ■ No complication

Figure 27 Complications.

Even in the best of hands, an oronasal fistula of the secondary palate may occur postoperatively. A fistula may also be caused by trauma, tumor, irradiation, or a rare infectious disease, such as midline granuloma, syphilitic gumma, leprosy, noma, or leishmaniasis. Breakdown of the primary palatal repair is usually related to tension at the site of closure (often at the junction of the hard and soft palate); necrosis can occur if the greater palatine vessel is injured during elevation of the anterior tip of the push back flap.²

The severity of the original defect may also influence the incidence of fistula. Musgrave and Bremner reported a 4.6% incidence in the case of incomplete cleft palate, 7.7% in complete unilateral clefts, and 12.5% in complete bilateral clefts.⁶ In our study, we treated 40 patients with palatal fistula secondary to cleft palate surgery. We encountered 21 bilateral complete cleft lip, alveolus, and palate patients. This accounts for 52% of our study, and there were 11 unilateral complete cleft lip, alveolus, and palate patients (28%) and eight complete palate patients (20%). This is represented in the ►Table 4 and ►Fig. 28.

Fistulas may occur in the labial vestibule, the alveolus, the hard palate, and at the junction between the hard and soft palate. Symptoms of these fistulas may be hypernasality in speech, regurgitation of fluids into the nose, and food lodging in the defect. The symptoms depend to some extent on the

Table 4 Severity of Original Cleft as per Veau Classification

	<i>n</i>	%
Type IV	21	52
Type III	11	28
Type II	08	20
Total	40	100

Severity of original cleft

■ BILATERAL COMPLETE CLEFT LIP, ALVEOLUS AND PALATE
 ■ UNILATERAL COMPLETE CLEFT LIP, ALVEOLUS AND PALATE
 ■ COMPLETE PALATE

Figure 28 Severity of original cleft.

site of the fistula.⁷ In accordance with literature, most of the fistulas were located in anterior palate.⁸ In our study, The Pittsburgh Fistula Classification System was used to describe fistula.⁵ Most of the fistulas were seen at the junction of the primary and secondary palate (type V). Of 40 patients, 31 (77%) had fistula at the junction of primary and secondary palate, 3 (8%) had fistula in hard palate (type IV), and 6 (15%) had fistula at the junction of the soft and hard palate (type III), as shown in ►Table 1 and ►Fig. 25.

Attempts at closure using only local transposition flaps may be successful, although frequently this is not achieved and a smaller oronasal fistula will recur. Additional attempts to gain closure with local tissue alone often result in repeated failure as thick and immobile scarred palatal mucoperiosteum leads to closure under tension with subsequent flap necrosis and wound dehiscence.²

A variety of both surgical and prosthetic solutions to the problem of inadequate local tissue have been sought. Tissue from distant sites has been used including tubed pedicle flaps from the abdomen, arm, neck, or cervicothoracic region. Others have used cheek and nasolabial flaps to close these palatal defects. Although these staged techniques of distal tissue transfer may be effective, they require multiple operations, are always cumbersome, leave multiple scars, prevent chewing until final flap division, are bulky when inset, and finally transfer skin rather than mucosa to the roof of the mouth.²

Free nonvascularized grafts, such as dermis or conchal cartilage, may prove useful, though such grafts are limited to defects less than 5 mm in diameter.⁹

Jackson published his work on 68 patients for closure of secondary palatal fistulas with intraoral tissue and bone grafting. For narrow defects, a vomer flap was raised and closed after arch expansion was done and bone grafting followed the procedure. For wider fistulas, he used tongue flaps. In his study, he used the Veau flap and the buccal flap but found that the tongue flap was excellent for wider defects.¹⁰

Gordon and Brown provided a brief review of flap techniques for closure of defects of the palate including the Fickling-Inkwell technique, double-layer island flap, double-layer hinged flap, and tongue flap; the authors advise that local flaps be chosen for smaller defects (enough to be covered with a rotated flap) when adjacent healthy tissue is available. However, a larger defect may require reinforcement with tongue flaps.¹¹

The FAMM (facial artery musculomucosal) flap as introduced by Pribaz et al is a valuable option to reconstruct moderate-size defects of the anterior palate.¹² The FAMM flap has few minor drawbacks. First, the pedicle may be injured during mastication to the point that the pedicle gets severed. The patient must be aware that he or she will have to wear a bite block during the healing period. The incorporation of the flap for 3 weeks is a bothersome stage, and the mucosal paddle is somewhat bulky and requires resurfacing at a later date. The whole facial artery can also be missing, as reported in well-documented studies, and its presence should be ascertained by a laser Doppler examination. The procedure requires careful surgical planning for optimal results.¹³ Furthermore, speech therapists discourage the use of a flap that, with the inclusion of facial muscles, will likely interfere with further speech development.⁹

Given the limitations of local options for coverage, free tissue transfer may offer an attractive solution. Although the radial forearm flap has been described as the free tissue workhorse of the orofacial reconstructive surgeon, along with the dorsalis pedis flap, free tissue transfer methods are associated with significant donor site morbidity and oftentimes poor cosmesis.⁹

More recently, Cole et al used decellularized human dermal matrix for the repair of recurrent oronasal fistula. This study retrospectively analyzed five consecutive patients treated with interpositional AlloDerm (AlloDerm, Life-Cell Corporation, Branchburg, NJ) placement between nasal and oral mucosa for the repair of recurrent oronasal fistula; results were assessed, and the authors concluded that the adjunctive placement of intramucosal decellularized dermal graft is effective and reliable for use in the closure of recalcitrant oronasal fistulas.⁹ The main drawback of this study was small sample size and the average length of follow-up of only 7 months. The main disadvantage of AlloDerm is the associated cost.¹⁴ In this regard, further study is required to assess the efficacy of decellularized dermal matrix over the long term.

Tongue flaps have been used for the reconstruction of various sites including the lower lip, floor of mouth, buccal mucosa, and palate. However, in cleft palate surgery their excellent vascularity and the large amount of tissue they provide render tongue flaps particularly appropriate for the

repair of large fistulas in palates scarred by previous surgery.^{15–17}

Tongue flaps have been used to close intraoral defects following tumor surgery, severe infection,¹⁸ trauma, and cleft palate fistulas. According to DeSanto, tongue flaps are also useful after radiation therapy.¹⁹ Posteriorly based flaps are indicated when treating defects of soft palate, retromolar region, floor of the mouth, and posterior buccal mucosa.^{16,20} Anteriorly based flaps are useful in the treatment of defects of the hard palate, anterior buccal mucosa, lips, and anterior floor of the mouth.^{8,21}

Pigott et al²² presented their work on 20 patients with palatal fistulas, which were successfully closed with tongue flaps in 17 patients (85%); six required an additional minor procedure, several patients no longer had to wear obturator, speech was improved in nine patients due to reduction in hypernasality, and in eight patients, articulation was noticeably improved. No patient underwent intermaxillary fixation after the procedure. In addition, the authors also give indications for surgical repair of palatal fistula and for use of tongue flap. According to Pigott et al, in attempted palatal fistula with scarred regions, tongue flaps can be successful. The anteriorly based tongue flap has proved to be a reliable way of closing the difficult fistula where symptoms are sufficient to justify the attempt.

Contreras et al used tongue flap and forehead flap for closure of residual oronasal fistula, and they concluded that when all other surgical possibilities have failed, tongue, vestibular mucosa, pharynx, or forehead flap can be used to restore mucosal continuity.²³

Gamoletti et al studied the histological pattern of the reinnervation process of heterotopically transposed lingual flaps in the oral cavity. Two cases were reported: in the first, the tongue flap was used to repair the vermillion of the lower lip, and in the second, for the closure of a posttraumatic defect of the hard palate. The histological findings are similar in the two cases: myelinated and unmyelinated fibers, free nerve endings, and encapsulated receptors are present. The authors concluded that pedicled tongue flaps have proved to be an effective method of repairing defects due to tissue loss in the oral cavity.²⁴

Kim et al used tongue flaps in 16 cases; 13 patients were operated twice for closure of the fistulas.²⁵ In our study, 30 patients (75%) were operated for cleft palate previously, seven patients (7%) were operated twice to close the fistulas primarily, and three patients (3%) were operated more than twice in an attempting to close the fistula as shown in ►Table 2 and ►Fig. 26. In our study, fistula was present in anterior and midpalate; the size of the palatal fistulas was not amenable for local flap closure, and a history of repeated attempts to achieve closure of the palatal defect was considered.

Design of Tongue Flaps

The lingual artery is the main artery supplying the tongue. The dorsal lingual artery, a branch of the lingual artery, supplies the dorsum of the tongue, vallecula, epiglottis, tonsils, and adjacent soft palate. The ranine branch unites

both dorsal lingual arteries at the tip and provides a rich plexus. Once the lingual artery reaches the anterior edge of the hyoglossus muscle, it divides into its terminal branch: the sublingual and the deep lingual arteries. The sublingual artery travels along the genioglossus and the sublingual gland and has an extensive anastomotic network with the contralateral sublingual artery. The deep lingual artery courses anteriorly, deep to the ventral mucosa. It gives off multiple branches that ascend toward the dorsum of the tongue.²⁶ Cadenat et al have described the rich submucous vascular plexus found in the tongue.²⁷ This plexus allows for safe and predictable elevation of thin flaps.

Carlesso et al described a design for a tongue flap that utilizes the full thickness of the hemi-mobile tongue, which provides mucosal lining, muscle bulk, and a long, supple, nonrestricting pedicle. The flap uses the entire length of the hemi-mobile tongue, based on the midline of the anterior tongue and including the mucosa of the dorsal and ventral surfaces and the bulk of lingual muscle. The mobility of the flap is such that it can be moved in a wide arc in and around the oral cavity, suggesting the applications can be increased to include tissue losses as the result of trauma or the treatment of neoplastic diseases.²⁸

Busić et al used anteriorly based dorsal tongue flaps in 19 cleft patients for closing large palatal defects. The procedure was successful in 17 patients. One patient had partial marginal necrosis after division of the pedicle, another had complete necrosis after division of the pedicle, and another had complete necrosis of the distal part of the flap; the authors concluded that the anteriorly based dorsal tongue flap is a safe and effective method for closure of relatively large palatal defects. The parameters for success include sufficient length of the flap (5 to 6 cm), a flap width somewhat larger than the defect, and a flap thickness of ~0.5 cm.²⁹

Assunção presented his experience with thin (3-mm) tongue flaps used to close large anterior palatal fistulas. This technique was used successfully in 12 patients with fistula following surgery for cleft palate. One forked flap and one mushroom-shaped flap that were used to close irregularly shaped fistulas were described. All flaps survived, and there was a partial recurrence of one fistula in only one patient. The results of this series confirm that the thin tongue flap is a safe and reliable technique for the closure of large palatal fistula even when tailored to fit irregularly shaped defects.³⁰

Defect size is an important factor. The quality of the local tissue may be unsuitable. Repeated attempts to achieve closure of the palatal defect by transposition of local flaps result in tissue scarring, ischemia, and mucosal irregularity. This triad predisposes to chronic inflammatory changes in the palatal tissues, often compounded by the traumatic and unhygienic insults of orthodontic and obturating appliances.³¹

Kim et al encountered a maximum fistula size of 5×4 cm¹⁷; in our study, the maximum fistula size was 8×6 cm and minimum was 10×8 mm.

In our study, 38 patients (95%) had scar over the palate adjacent to fistula due to a previous surgery, and in two

patients (5%) not much scarring was present, which is one of the indications for the use of tongue flaps.³¹

In our study, a dorsal flap with an anteriorly based pedicle was designed. The length of the flap was designed such that 1 to 2 cm of additional tissue would span the posterior edge of the palatal defect; the approximate size of the tongue flap was designed using cover of the suture material as template. The width was dictated by the width of the defect plus 20%. The flap should include 2 mm of muscle thickness to allow for adequate vascularization.

Fistula Closure

For all 40 patients, we used anteriorly based tongue flaps. None of the flaps failed over the long-term follow-up, which indicates its versatility. In the initial stage, complete closure of the fistulas was achieved in all 40 patients; however, three patients (8%) experienced recurrences of the fistula. Fistulas in hard palate (type IV) recurred. These patients were 23, 27, and 28 years of age, and these fistulas were located in hard palate. Secondary fistula closure was achieved by local advancement of the donated tongue tissue. All the patients in whom defect closure was successful experienced complete resolution of nasal regurgitation and reduction in social embarrassment with improvement in their psychological attitude, which is in accordance with previous studies by Coghlan et al.³¹

Flap Viability

All flaps in 40 patients proved to be viable in the long term, although two flaps (5%) required resuturing, which showed satisfactory results over long-term follow-up.

Residual Tongue Function and Esthetics

In all cases postoperative aesthetics of the donor tongue site were found to be satisfactory. There was no interference with speech with the use of the tongue as a donor site. Oral hygiene and mastication were unimpaired. No patient described sensory or gustatory disability following this procedure.

Speech Assessment

Bradley and Stell treated eight patients who had carcinoma of the oral cavity with tongue flaps. Pre- and postoperative speech analysis (from 5 to 24 months after surgery) was done. None of the patients noticed speech problem postoperatively.³²

For all 40 patients, preoperative speech analysis was done by speech pathologist, and degree of speech impediment was assessed, including intelligibility, hypernasality, and nasal emission. These results were compared with 1-month, 3-month, 6-month, and 1-year postoperative speech analysis results. All three parameters showed significant improvement over a period of 6 months and 1 year.

Speech Intelligibility

In our study, degree of severity was graded as normal (0), mild (1), moderate (2), or severe (3). Of 40 patients, 10 (25%) were grade 3, 24 (60%) were grade 2, and 6 (15%) were grade 1 (►Table 5).

Following surgery at 1 month, there was no significant improvement in speech intelligibility but at 3 months, there was significant improvement; grade 3 severity disappeared, and 34 patients (85%) showed moderate severity (grade 2) with Z value of 2.254 (►Table 6), which is statistically

Table 5 Speech Intelligibility

Grade	Preoperatively		1 mo Postoperatively		3 mo Postoperatively		6 mo Postoperatively		1 y Postoperatively	
	Count	%	Count	%	Count	%	Count	%	Count	%
0.00							5	12.5	16	40.0
1.00	6	15.0	6	15.0	6	15.0	34	85.0	24	60.0
2.00	24	60.0	24	60.0	34	85.0	1	2.5		
3.00	10	25.0	10	25.0						

Table 6 Test of Significance for Proportions

Level	Comparison	Z-Value for Proportions	Significance at 5%
3	Pre vs. 1 mo post		
2	1 mo post vs. 3 mo post	2.254	Yes
	3 mo post vs. 6 mo post	7.217	Yes
1	1 mo post vs. 3 mo post	0.313	No
	3 mo post vs. 6 mo post	6.037	Yes
	6 mo post vs. 1 y post	2.254	Yes
0	6 mo post vs. 1 y post	2.541	Yes

Pre, preoperatively; post, postoperatively.

Figure 29 Speech intelligibility.

significant, and six patients (15%) had mild severity. At 6 months, severity showed further marked improvement. In five patients (12.5%), speech intelligibility reached normal level, and 34 patients (85%) had mild and only one patient (2.5%) had moderate score with the Z values of 7.217, which is statistically significant. At 1-year follow-up, there was drastic improvement in speech intelligibility: 16 patients (40%) reached normal level, and 24 patients (60%) had mild severity with Z values of 2.541, which is statistically significant. Improvement between pre- and postoperative regular fol-

low-up interval is represented in ►Tables 5 and 6 and ►Fig. 29.

Hypernasality

Degree of severity was graded as normal (0), mild (1), moderate (2), and severe (3). Of 40 patients, 9 (22.5%) had mild, 29 (72.5%) had moderate, and 2 (5.0%) had severe hypernasality preoperatively (►Table 7). By 1 month following surgery, there was no significant change in the degree of severity. At 3 months, 9 patients (22.5%) had normal, 29 (72.5%) had mild, and 2 (5.5%) patients had moderate hypernasality. At 6 months, 36 (90%) had reached normal level and only 4 (10%) patients had mild hypernasality. At 1 year, 37 patients (92.57%) had normal hypernasality and 3 (7.5%) had mild hypernasality. Improvement between pre- and postoperative levels is represented in ►Tables 7 and 8 and ►Fig. 30.

Nasal Emission

Nasal emission was assessed preoperatively and graded as normal (0), mild (1), moderate (2), or severe (3). Of 40 patients, 25 (62.5%) had moderate nasal emission, 12 (30.2%) had mild nasal emission, and 3 (7.5%) had severe nasal emission. At 1 month following surgery, there was significant improvement: 3 (7.5%) had normal nasal emission, 31 (77.5%) had mild nasal emission, 5 (12.5%) had moderate nasal emission, and 1 (2.5%) had severe nasal emission. At 3 months, there was further improvement: 14 (35%) had normal nasal emission, 23 (57.5%) had mild nasal emission, and 3 (7.5%) had moderate nasal emission. At 6 months and 1 year, 34 (85%) had normal nasal emission and 6 (15.0%) had

Table 7 Hypernasality

Grade	Preoperatively		1 mo Postopera-tively		3 mo Postopera-tively		6 mo Postopera-tively		1 y Postopera-tively	
	Count	%	Count	%	Count	%	Count	%	Count	%
0.0					9	22.5	36	90.0	37	92.5
1.00	9	22.5	9	22.5	29	72.5	4	10.0	3	7.5
2.00	29	72.5	29	72.5	2	5.0				
3.00	2	5.0	2	5.0						

Table 8 Tests of Significance for Proportion

Level	Comparison	Z-Value for Proportions	Significance at 5%
3	Pre vs. 1 mo post		
2	1 mo post vs. 3 mo post	5.967	Yes
	3 mo post vs. 6 mo post	0.716	No
1	1 mo post vs. 3 mo post	4.254	Yes
	3 mo post vs. 6 mo post	5.451	Yes
	6 mo post vs. 1 y post	0	No
0	6 mo post vs. 1 y post	0	No

Pre, preoperatively; post, postoperatively.

Figure 30 Hypernasality.

mild nasal emission, respectively, showing significant improvement (► **Tables 9 and 10** and ► **Fig. 31**).

Complications

Complications of the tongue flap procedure include hematoma formation^{33,34}; sloughing of the graft; epistaxis²²; dehiscence and temporary loss of tongue sensation^{22,34} and taste; and flap failure. Studies have shown no remarkable disturbances of speech, articulation, or lingual mobility following a reasonable postoperative period. The only residual defect of the procedure seems to be a slightly narrower tongue.^{8,31}

Steinhauser studied 10 patients with major palatal defects that were been treated with tongue flap; results were good, with only two complications. One patient had postoperative hematoma, and in other the tongue flap had to be repeated because of a poorly perfused flap; the author thought that failure was possibly due to constant tongue movements.³³ In accordance with literature, in our study we encountered very few complications, except for three recurrences (8%) of fistula; all other cases showed satisfactory results (► **Table 3** and ► **Fig. 27**).

Table 9 Nasal Emission

	Preoperatively		1 mo Postopera- tively		3 mo Postopera- tively		6 mo Postopera- tively		1 y Postopera- tively	
	Count	%	Count	%	Count	%	Count	%	Count	%
0.0			3	7.5	14	35.0	34	85.0	36	90.0
1.00	12	30.0	31	77.5	23	57.5	6	15.0	4	10.0
2.00	25	62.5	5	12.5	3	7.5				
3.00	3	7.5	1	2.5						

Table 10 Tests of Significance for Proportions

Level	Comparison	Z-Value for Proportions	Significance at 5%
3	Pre vs. 1 mo post	0.513	No
2	Pre vs. 1 mo post	4.388	Yes
	1 mo post vs. 3 mo post	0.373	No
	3 mo post vs. 6 mo post	1.177	No
1	Pre vs. 1 mo post	4.036	Yes
	1 mo post vs. 3 mo post	1.671	No
	3 mo post vs. 6 mo post	1.177	No
	6 mo post vs. 1 y post	0.338	No
0	Pre vs. 1 mo post	1.177	No
	1 mo post vs. 3 mo post	2.733	Yes
	3 mo post vs. 6 mo post	4.336	Yes
	6 mo post vs. 1 y post	0.338	No

Pre, preoperatively; post, postoperatively.

Figure 31 Nasal emission.

Summary and Conclusion

The tongue flap has proved to be a reliable and easily obtainable local flap. In cleft palate surgery, the excellent vascularity and the large amount of tissue that tongue flaps provide have rendered the flaps particularly appropriate for the repair of large fistulas in palates scarred by previous surgery. On the basis of our experience with 40 cases and on reviewing the experience of others, it is evident that the tongue flap is a useful and versatile option for closure of moderate to large palatal fistulas. In our study, we successfully used the tongue flap to close the fistula; the tongue flap was not only useful in closure of fistula but also there was marked improvement in the speech over long-term follow-up. Flap pliability, fistula closure, vascularization, along with the technical ease of its procurement, quality and quantity of tissue available, and minimal functional and esthetic sequelae make the flap suitable for closure of palatal fistulas. The study justifies the use of tongue flap for closure of palatal fistulas, as it provides abundant tissue with esthetic morbidity of the donor site. Hence, we would recommend this as a reliable surgical technique for the closure of palatal fistulas.

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