Techniques to Improve Reliability and Predictability of the Dorsal Pedicled Tongue Flap in Closure of Palatal Defects and Oronasal Fistulae

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Abstract

Introduction Despite the improvement in surgical techniques in cleft palate surgery, oronasal fistulas continue to remain a challenge, usually the result of residual palatal and alveolar clefts and post-palatoplasty defects. The tongue flap is an extremely versatile, sturdy, reliable and efficient means of closure of anterior as well as posterior, unilateral and bilateral palatal defects, effectively functionally obliterating the oronasal communication, owing much of its success to its highly vascular structure, good mobility, texture match, central location and low donor site morbidity. However, it has a few drawbacks. Flap dehiscence and detachment during the early postoperative period is a troublesome complication owing to tongue movements during normal activities such as speaking, swallowing, yawning and coughing.

Aim This article describes some of the methods which can be used to effectively alleviate these shortcomings.

Methods A protocol of immobilizing the tongue by tethering it to the maxillary teeth for the 3-week postoperative period, and also maintaining the patient on nasogastric feeding, until the patient is taken up for surgical separation the pedicle, was employed in all patients in this case series.

Results There was a successful and predictable take of the tongue flap at the donor site, namely the palatal/oronasal fistula with its successful closure, in all the patients.

Conclusion Treatment of the oronasal fistula using a two-layer closure using the nasal mucoperiosteum together with an anteriorly based dorsal tongue flap is an easy and efficient

method, whose reliability can be further increased by avoiding a common complication, namely tongue flap detachment in the postoperative period brought on by movements of the tongue, by immobilizing the tongue by tethering it to the maxillary teeth and also maintaining the patient on nasogastric feeding for the 3-week postoperative period.

Keywords Cleft palate · Palatoplasty · Oronasal fistula · Dorsal pedicled tongue flap · Flap dehiscence · Flap detachment

Introduction

Large palatal fistulae along the sites of palate closure in cleft lip/palate cases, representing failure of primary palatoplasty, often present a surgical challenge. Although these fistulae may occur anywhere along the site of the original cleft(s), they are more common on the hard palate and at the junction of the hard and soft palate [1]. Large fistulae cause significant functional problems, such as nasal regurgitation of fluid and food particles. Also, they lead to hypernasality of speech that may be accompanied by compensatory articulation disorders. Indications for closing palatal fistulae are both functional and esthetic. Closure will prevent food and liquids from entering the nose and reduce chronic rhinitis and malodor. Closure will also decrease nasal emission and improve speech and phonation [2]. Repair of the palatal fistula is technically difficult and challenging, most often due to paucity of local tissue for closure as well as excessive fibrosis and scarring in the palatal region as a result of previous surgeries. In view of a high recurrence rate of up to 34% following primary closure of these oronasal communications, surgeons are continuously searching for better solutions [2].

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Many surgical procedures have been described for repair of these fistulae either by using the local tissue or by importing new tissue from adjacent areas. The traditional use of local mucoperiosteal flaps is technically difficult, due to the scarcity of local tissue for closure or excessive scarring in the same area as a result of previous cleft repair. Moreover, it has a high recurrence rate up to 25% [3]. Nakakita et al. [4] used a buccinator myomucosal flap for fistula closure. Although it has a reliable blood supply with no donor site morbidity, it is a two-stage procedure, useful mainly for fistulas in the middle and posterior third of the palate and unreliable for anterior palatal fistulas [5]. Rintala et al. used the labiobuccal mucosal island flap with a hinge flap for anterior fistulae and residual clefts, but since it was a random mucosal flap with no specific vascular supply, its length is limited.

The large, mobile, vascular and centrally located tongue in the vicinity of a palatal fistula is a good choice for its closure. The anteriorly based dorsal tongue flap was introduced by Guerrero-Santos and Altamirano [6] in 1966 for the surgical closure of a large palatal fistula. In 1972, Cadenat et al. described the rich submucous vascular plexus in the tongue and demonstrated that tongue flaps could be raised safely in any direction, even when only 3 mm thick [7]. Because of its rich blood supply, flexibility and pliability, the tongue flap has become a versatile option for reconstructing the lip, cheek, oronasal fistulae and palatal defects [8, 9].

For palatal fistula closure, the procedure consists of reconstruction of the nasal lining, designing of the tongue flap; fixation of the flap to the palate, sectioning of the pedicle; and postoperative care. Moreover, the tongue flap can be successfully used for closure of large palatal fistulas or in severely scarred palates from prior surgery [10, 11]. Tongue flaps can be created from the ventral, dorsal or lateral parts of the tongue [12].

In this report of ten cases, the anterior palatal fistulae located at the premaxillary–maxillary junction were closed using two layers; the first one was a hinged oral mucoperiosteal flap that was elevated and inverted to close the nasal side, and the second was an anteriorly based, dorsal pedicled tongue flap, which formed the oral layer of the palatal defect.

Over the years, tongue flaps have been plagued with unpredictable outcomes resulting from flap detachment and dehiscence in the early postoperative period. Adequately securing and stabilizing the tongue flap to the palatal defect and ensuring its continued adaptation at the defect site throughout this entire period until it has completely vascularized has continued to pose a daunting challenge. This is primarily because of the tongue's inherent mobility during normal activities (i.e., speaking, coughing, yawning, eating and swallowing), which tend to tear the flap away from the palatal insertion.

The tongue consists mainly of muscle bundles and has continuous and often vigorous movements. Dehiscence of a tongue flap after a traditional procedure is often the result of such activity by the unbridled tongue or from the unrestrained opening of the mouth during yawning or involuntary gagging, which may tug on the pedicle and pull the flap from its attachment. For this reason, some fixation schemes have been previously proposed such as a wire sutured to the tongue tip, passed through and tied to the upper lip [13]; a Kirschner wire (K-wire) placed through the angles of the mandible, transfixing the lingual base and body of the tongue in between [14]; or intermaxillary fixation [15]. A “parachuting and anchoring” technique has also been advocated [12, 16], in which the tongue flap is parachuted upwards using a catheter drawn into the nose, and is then secured to the nasal septum, thus anchoring it for extra stability. However, all these methods are cumbersome, uncomfortable for and not well tolerated by the patient and not always successful.

In this article, a simple alternative technique is presented for tethering the tongue and maintaining the position of the tongue flap securely at the palatal defect site, until it is fully vascularized and the flap “takes.” In addition to this intraoperative procedure, a precautionary protocol in the postoperative period has been described as well, to prevent possible flap detachment. Both these measures are very well tolerated by the patients, pose practically no complications or difficulties and help in an assured and predictable take of the tongue flap at the defect site.

Case Series

Ten patients, 6 females and 4 males, of ages ranging from 10 to 27 years, reported with palatal fistulae of various sizes and locations (Fig. 1a). Their common complaints were escape of air into the mouth while breathing, nasal regurgitation of food and fluids, accumulation of orally ingested food in the nose which was later expectorated via the nostril on sneezing and halitosis. Six patients also complained of an unpleasant nasal twang and intonation of their voice. All the above complaints were of long standing, since childhood. All had been born with cleft lip and palate, for which they had been operated three to five times. Primary palatoplasty had been attempted, however, without success.

On examination, the patients had defects measuring approximately 1.5×2 cm to 2.5×3 cm, in the anterior part of the hard palate. The defect or palatal fistula was through and through, resulting in medium to large sized oronasal communications. The palatal mucosa around the defect appeared scarred owing to the repeated attempts at closure of the defect.

Fig. 1 **a, b** 17-year-old patient, an operated case of cleft palate, presenting with a residual palatal fistula. **c, d** A hinged oral mucoperiosteal flap elevated around the fistula and inverted to close the nasal side of the defect. **e** An anteriorly based, dorsal pedicled myomucosal tongue flap, marked and raised, the depth of which included the submucosal plexus as well as 3 mm of the underlying muscle. **f** Donor bed within the tongue closed primarily with 3-0 Vicryl sutures to eliminate dead space and to aid in hemostasis. **g** Flap

upturned and inset into the palatal defect and its edges sutured with the palatal mucosa at the margins, thus forming the oral layer of the defect. **h** Tongue tethered to the upper teeth using three silk interdental sling sutures, for added immobility in the postoperative period. **i, j** Sectioning of the flap pedicle after 3 weeks. **k, l** Four days after depedlicling, showing good take of the tongue flap at the recipient site and excellent healing of the donor site

The various surgical options considered in each patient included secondary palatoplasty, which, however, was ruled out due to the excessive fibrosis and scarring of the palatal mucosa, which in addition was inadequate and deficient owing to a narrow and constricted maxillary arch in most of the patients. Buccal mucosa transposition flap was considered, but there was no space or gap available between the teeth to bring the flap into the site of the defect at the anterior hard palate region. Use of a temporalis muscle flap was decided against as it was too extensive a procedure. The use of a tongue flap to close the palatal breach and seal the nasal cavity from the oral cavity appeared to be the ideal option. A two-layered closure using the palatal “turnover flap” for the nasal layer and an anteriorly based dorsal tongue flap for the oral layer was

planned. The patients (and parents in cases of children) were explained the procedure and the inconvenience of tongue immobilization as well as nasogastric tube feeding, which they would have to tolerate for the period of 3 weeks following surgery.

After routine workup, each patient was taken up for surgery under GA via a non-cleft sided nasoendotracheal intubation. A throat pack was carefully placed, leaving its outer end tucked in the right lower vestibule, for easy removal on completion of the surgery, just prior to extubation. A Davis mouth gag was applied, and the palatal mucosa surrounding the defect was infiltrated with adrenaline (1:80,000). An elliptical incision was made 5 mm away from all around the defect (Fig. 1c, d). This was carefully elevated mucoperiosteally and inverted, thus

creating a “turnover flap” and sutured using embedded/inverted sutures with Vicryl 4/0. This formed the nasal layer of the defect. The mouth gag was now removed and replaced with rubber mouth props for clear and unrestricted view of the tongue. A silk suture (2-0) was drawn through the tongue tip to pull the tongue forward into view and provide optimal access. A central, anteriorly based tongue flap was marked using methylene blue, taking care to create a long enough pedicle for a tension-free closure of the palatal defect using the flipped up tongue flap, which would also allow a limited amount of tongue mobility postoperatively. A surgical blade was used to make the initial incision on the tongue. The myomucosal flap was elevated anterior to the circumvallate papilla to spare the taste buds there (Fig. 1e). The tongue flap was raised carefully, the depth of which included the submucosal plexus as well as 3 mm of the underlying muscle (Fig. 1e) layer to maximize flap survival. The donor bed within the tongue was closed primarily with 3-0 Vicryl sutures to eliminate dead space and aid in hemostasis (Fig. 1f), care being taken to avoid strangulation of the flap during closure. Eleven blades are then used to circumferentially de-epithelialize the edges of donor site (dorsum of tongue flap) and the mucosal edges of the recipient site (palatal fistula), creating raw surfaces at these areas to ensure proper healing and “take” of the graft. The flap was then upturned and carefully inset into the defect, and its raw edges were sutured with the palatal mucosa at the margins of the defect

in a tension-free and watertight manner (Figs. 1g, 2c). The tongue was then lifted up, adapted against the anterior part of the hard palate and tethered in place using three silk interdental sling sutures, to ensure added immobility during the immediate postoperative period (Figs. 1h, 2d, e). These sutures were drawn through the tongue, one at its tip and one through each of its lateral borders, and each suture was slung around the nearest upper tooth/teeth and tied firmly, thus adapting the tongue to the anterior hard palate and reducing the traction on the attachment of the dorsal tongue flap, thereby preventing its detachment and further stabilizing the flap in place. GA was then reversed and the intraoral pack gently drawn out. A Ryles nasogastric tube was inserted as the patient recovered consciousness.

A precautionary protocol that was followed in the postoperative period in all the ten patients was that they were all maintained on nasogastric feeding for a period of 3 weeks until the second surgical session of separating the tongue pedicle. This was done in order to limit the necessity of excessive and frequent mouth opening while eating/drinking and swallowing, and to minimize movements of the tongue that would otherwise be inevitable and unavoidable during these activities. To keep the nasogastric tube in place, it was secured to the face with a piece of adhesive plaster or tape, so that it could be repositioned intermittently whenever the patient found it uncomfortable. Oral hygiene measures were undertaken using saline mouth rinses as well as gentle teeth cleaning using a small

Fig. 2 **a** A large residual palatal fistula in a 21-year-old patient previously operated for cleft palate. **b, c** Dorsal, anteriorly based pedicled tongue flap raised and inset into the palatal defect. **d, e** Tongue firmly adapted against the palate and tethered in place using sutures drawn through the tip and edges of the tongue and then slung

between and tied to the maxillary teeth. **f** Depedicling of the flap carried out. **g, h** Postoperative appearance a month later, showing the successful closure of the large residual palatal fistula, using a dorsal pedicled tongue flap

toothbrush with some toothpaste. After 21 days, the patients were taken up for the second stage of the procedure, and after removing the NG tube, the pedicle was severed under local anesthesia (Fig. 1i, j) and the residual tag on the tongue tissue was trimmed off.

The palatal fistulae in all the patients healed successfully, with no postoperative complications such as bleeding, hematoma formation, congestion, infection and partial or total flap necrosis or flap detachment. There were no respiratory problems due to lingual edema or retropharyngeal discharge. There was a complete resolution of the problem of nasal regurgitation of orally ingested fluids and food particles. The tongue flap at the recipient site remained healthy with no recurrence of the fistula in any of the patients in the 1–2-year follow-up period (Figs. 1k, 2g). There was observed no donor site morbidity or residual anatomic deformity in the tongue structure and morphology, and no restriction of any kind in its mobility and nil articulation defect caused by the flap harvested from the tongue dorsum, in any of the patients (Figs. 1l, 2h).

Articulation of all the patients improved following closure of the oronasal fistulae. This was tested using the standard Goldman–Fristoe test of articulation-2 (GFTA-2), which is a systematic means of assessing an individual's articulation of the consonant sounds of Standard English, by sampling both spontaneous and imitative sound production, including single words and conversational speech.

The phonation of all the patients improved dramatically as evaluated by listening for audible nasal air emissions (nasal rustle/snort/turbulence), and comparing the hypernasality and resonance of the voice prior to and two months after closure of the palatal defects. There was a perception of excessive nasality and nasal resonance during production of vowels especially i and u, glides such as w and j, and liquids such as l and r prior to surgery. Hypernasality and nasal air emission were both found to be much reduced following surgery, and speech quality was less muffled and more distinct.

Discussion

The pedicled tongue flap has gained a lot of popularity for its versatility and diverse clinical applications. It has been used for reconstruction following resection of oral structures, resurfacing of oral defects, oroantral fistula closure, alveolar clefts, hard palate defects, soft palate defects, tonsillar arch defect, tongue reconstruction, upper and lower lip reconstruction, etc. Its tissue bulk as well as excellent vascularity makes it especially useful in end stage palatal fistulae secondary to cleft palate as the patients often have scar tissue in the palate following multiple surgeries.

Advantages of the tongue flap include proximity to the intraoral recipient site, an excellent blood supply, large amount of tissue it can provide, low donor site morbidity and effective reinnervation of the flap from the adjacent host tissue. The flap can provide 9–10 mm of mucosal tissue for rotation and can be used confidently in patients' post-radiotherapy [12].

The dorsal tongue flap has a random vascular pattern and is supplied mainly by the perforating branches of the lingual arteries, which course through the substance of the tongue toward the dorsal surface [5, 17]. On reaching the dorsum of the tongue, they arborize to form a submucosal plexus. It is for this reason that the anteriorly based dorsal tongue flap should include 2–3 mm of the underlying muscle in order to protect the delicate submucosal plexus.

A vast number of satisfactory results of repairing palatal defects with tongue flaps have been reported in the literature. However, there are a few early and late complications that can develop. Early complications include hemorrhage, hematoma formation, infection and the risk of flap detachment. Late complications include partial or total flap necrosis. Inadequate flap design, wide mouth opening and inadvertent or excessive tongue movements contribute toward most of these complications. A mild narrowing of the tongue, temporary decrease in tongue sensation, taste and mobility, mild articulation defects in the early postoperative period are some minor drawbacks which are tolerated quite well by most patients. The mild narrowing of the donor site enlarges with time as the muscles of the tongue are well exercised. A few other drawbacks of using tongue flaps are the disadvantage of it being a two-stage procedure with anticipated intubation and extubation difficulties, and an esthetically unpleasant bulky tissue at the recipient site [5, 17]. Moreover, it may cause respiratory problems due to lingual edema and retropharyngeal discharge. The peroral appearance of the tongue tissue in the repaired area may seem bulky, rough and rather unnatural in the roof of the mouth.

A number of studies have brought out a high incidence of tongue flap detachment (as high as 25%), particularly in the early postoperative period [17, 18], when no modality to tether the tongue has been employed [19].

In this study, after suturing the tongue flap in place, the tongue itself was adapted against the anterior part of the hard palate and tethered to the upper teeth using three sling sutures drawn through the body of the tongue (Figs. 1l, 2d, e), thus restricting tongue movements till the patient was taken up for the pedicle separation 3 weeks later. This measure also had an indirect effect of limiting the interincisal mouth opening in the postoperative period which due to the mild discomfort experienced by the tugging of the sutured sites in the tongue. This further helped in stabilizing the tongue. Also, all the patients were kept on

Ryles nasogastric tube feeding for the entire period of 21 days till separation of the pedicle. This was done with the aim of obviating the necessity of opening the mouth wide to place food in and eliminate the need for chewing, swallowing, etc. which would indirectly help keep the tongue as immobile as possible, with the flap securely adapted at the defect site, to give it the best chance to “take” uninterrupted, and to reduce the chances of flap detachment in the postoperative period. Nasogastric feeding during this period allows a regular and adequate dietary intake without compromising on nutrition and nourishment of the patient. All the patients were found to quickly adapt to the use of the nasogastric tube and quite comfortably feed themselves with fluid and semifluid diets.

All the patients were able to accommodate well with both these procedures, and there was no issue at all with patient compliance. Although intermaxillary fixation (IMF) has been proposed to further restrict tongue movements [7, 8], it was considered redundant and unnecessary. In addition, surgeon can inspect and clean the oral cavity and the operative site better without the IMF.

Tethering of the tongue to the maxillary teeth did impose some restriction in speech, but this was not more than what is usually experienced in cases of tongue flaps. In fact, tethering the tongue protected and supported the tongue flap from peeling or tearing away from the recipient site, when the patient tried to verbalize. Within 2 to 3 days of surgery, the patients were able to adapt to the position of the tongue against the roof of the mouth and were even able to articulate in a limited fashion. The patients tolerated the restricted mobility of the tongue quite well and without any complaints other than this mild hampering of speech for the brief period of 3 weeks, which they readily did, looking forward to the complete elimination of the hitherto debilitating effects of the oronasal fistula.

It was also observed that the bulky and rough appearance of the reconstructed area changed in appearance with time, becoming much smaller and smoother, taking on an appearance closely similar to the adjacent tissues and blending quite well with them. In none of the cases, decrease in size of tongue, loss or change in taste sensation and difficulty in speech or difficulty in swallowing were observed.

Conclusion

Treatment of the oronasal fistula by a two-layered closure using the nasal mucoperiosteum together with an anteriorly based dorsal pedicled tongue flap is an efficient method with a high success rate. Its reliability can be further increased by avoiding a frequent complication in the early postoperative period, namely tongue flap detachment

brought on by unrestrained movements of the tongue. Temporarily immobilizing the tongue by stabilizing it against the anterior part of the hard palate and tethering it to the maxillary teeth using sling sutures for the 3 weeks postoperative period, until the patient is taken up for surgical separation the pedicle, can effectively prevent this complication. Further, obviating the need to chew and swallow food by maintaining the patient on nasogastric tube feeding during this period limits mouth opening as well as movements of the tongue, while ensuring adequate nourishment to the patient. These measures in the immediate postoperative period effectively reduce the incidence of flap detachment and dehiscence, ensuring a successful, reliable and predictable take of the flap at the donor site, thus making the procedure a failsafe and efficient one.

Compliance with Ethical Standards

Conflict of interest The author of this article has not received any research grant, remuneration or speaker honorarium from any company or committee whatsoever, and neither owns any stock in any company. The author declares that she does not have any conflict of interest.

Ethical Standards All procedures performed on the patients (human participants) involved were in accordance with the ethical standards of the institution and/or national research committee, as well as with the 1964 Helsinki Declaration and its later amendments and comparable ethical standards.

Human and Animals Rights This article does not contain any new studies with human participants or animals performed by the author.

Informed Consent Informed consent was obtained from all the individual participants in this study.

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