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Furlow technique for treatment of soft palate fistula

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ABSTRACT

Objective: Fistula of the palate is a common complication of palatoplasty, it leads to nasal regurgitation of fluids and hypernasality of speech. Its treatment is technically difficult due to paucity and fibrosis of palatal tissues. The aim of this study was to evaluate the efficacy of closure of soft palate fistula by using Furlow double opposing Z-palatoplasty.

Methods: Nineteen patients were subjected for repair of their soft palate fistulas using Furlow Z-plasty. Pre and postoperative speech analysis using auditory perceptual assessment, measurement of nasalance score using nasometric assessment, and measurement of velar movement using flexible nasopharyngoscopy were done.

Results: All cases showed complete closure of their fistulas at first attempt, with no operative or postoperative complications. Recurrence was not recorded in any case after a follow up period of at least 12 months. Significant improvement of speech quality and nasalance score was achieved. Flexible nasopharyngoscopy showed postoperative increase in velar movement which was not significant relative to the preoperative records.

Conclusions: Treatment of soft palate fistula by using Furlow technique is an effective method as a primary treatment with a high success rate and a good functional outcome.

1. Introduction

Fistula of the palate is a common complication of palatoplasty, its incidence after primary cleft palate repair averages 10–20%. It can occur at any site; however it is common at the junction of the hard and soft palate posteriorly or at the premaxillary–maxillary junction anteriorly [1]. An anatomically based numerical palatal fistula classification system was proposed by Smith et al. [2] they classified the fistulas into seven types: type I referred to bifid uvula; type II means fistula in the soft palate; type III means fistula at junction of the soft and hard palate; type IV means fistula in the hard palate; type V indicates that the fistula at junction of the primary and secondary palates; type VI means lingual alveolar fistula; and type VII means labial alveolar fistula.

Fistula of the palate may lead to regurgitation of food and fluid to the nasal cavity, also it may cause escape of air during speech resulting in hypernasality [3]. Its development after cleft palate repair may be related to the type of cleft and the type of repair, it may occur as a result of wound tension, single-layer repair, infection and/or the presence of dead space deep to the mucoperiosteal flap [4,5].

Many techniques have been proposed for the repair of palatal fistulas. However, the incidence of recurrence after initial fistula closure is high. Faced with recurrence, the surgeon's options extend to flaps and/or grafts. Flaps may be in the form of tongue flap [6,7], Orbicularis oris musculomucosal flap [5,8] or free flaps [9], and grafts may be in the form of buccal mucosal graft [10], Conchal graft [11] or bone graft [12]. When speech disturbance occurs as a result of a fistula of significant size, prosthetic obturation of the fistula (even temporary) can be considered when weighed against repeated failed surgical procedures [13].

The aim of this study was to evaluate the efficacy of closure of soft palate fistula using Furlow double opposing Z-palatoplasty.

2. Methods

This study included 19 cases that were referred to our institute with palatal fistulas (types I and II) after repair of their clefts. The ages of the patients ranged from 3 years to 5 years and 8 months (with a mean of 3 years and 10 months), 11 females and 8 males. Patients were operated on between April 2006 and June 2010 in the Departments of Otolaryngology of Cairo University and of Beni Suif University. The original defects included 7 cases of bilateral complete cleft lip and palate, 6 cases of unilateral complete cleft lip and palate and 6 cases of cleft soft palate, complete clefts were repaired by 2 flap palatoplasty while incomplete clefts were repaired by Veau–Wardill–Killner technique. Patients who under-

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went Furlow Z-plasty for repair of their clefts were not included in the study. Informed consents were obtained from the parents of the patients and the principles outlined in the Declaration of Helsinki were followed. Also, we obtained approval for the study from our institutional review board. Patients who gave history of previous fistula repair were excluded; none of our patients were lost during the follow up.

All cases were subjected to the following:

2.1. Preoperative assessment

- Auditory perceptual assessment (APA) of speech: hypernasality, nasal emission of air, weak pressure consonants were analyzed for every individual patient. Each of these parameters were graded along a 5-point scale (0–4) in which 0: normal and 4: severe affection, with a total score of 12 on the 3 elements. The lower the score achieved on this rating scale, the less incompetence the patient demonstrates. The APA data were recorded for postoperative review.
- Nasometric assessment: Instrumental assessment of nasalance was done using Nasometery (Kay Elemetrics, model 6200) which provides an acoustic measure of movement of the vibrational energy through the vocal tract. Nasometric data were obtained while the patients read or repeated standardized Arabic nasal and oral sentences.
- Flexible nasopharyngoscopy: visualization of the velopharyngeal port by the use of fiberoptic "flexible" nasopharyngoscope, which was provided with a high-intensity cold light and a special endoscopic television system for videotape recording. This was accomplished using a high-resolution Karlheinz Hinze S/N 151385 endoscope (Karlheinz Hinze Optoengineering GmbH & Co, Hamburg, Germany), Storz endoscope video camera (Karl Storz GmbH & Co KG; Tuttlingen, Germany), and Panasonic SR 500 video recorder (Osaka, Japan). The nose was decongested and anesthetized with a mixture of 4% lidocaine and 0.05% oxymetazoline hydrochloride. The nasopharyngoscope was passed through the nostril, superior to the inferior turbinate, to the choana. Velopharyngeal sphincter was assessed while the patients repeating Arabic sentences loaded with high oral pressure consonants. As the velopharyngeal closure (VPC) could not be assessed in presence of oronasal fistula [14], the main parameter of analysis was the degree of velar movement, i.e. posterior–superior displacement relative to the resting position.

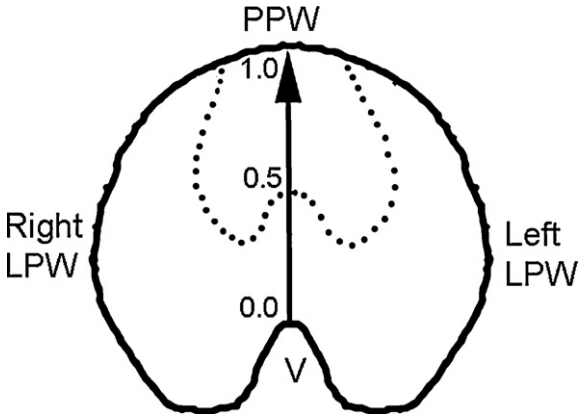

Fig. 1. Illustration for nasopharyngoscopic view demonstrating degree of velar movement as rated by standardized system; V is the velum, PPW is the posterior pharyngeal wall, and LPW is the lateral pharyngeal wall. The velum (0.0) moves half the distance to the posterior pharyngeal wall (1.0) that is scored as 0.5. Re-drawn after Golding-Kushner et al. [14].

According to Golding-Kushner et al. [14] velar movement can be measured by construction of a line from the midpoint of the velum to the posterior pharyngeal wall along the trajectory of the movement of the velar midpoint. The velar midpoint was defined as 0.0 (which is the rest position, during quite nasal inspiration) while the posterior pharyngeal wall was defined as 1.0 (Fig. 1). The point of maximum velar displacement was recorded and the records were analyzed individually for postoperative review and comparison.

2.2. Operative procedure

Under general anesthesia with oral endotracheal intubation, incisions were marked and the palate was injected with 0.5% Xylocaine in adrenaline (1:100,000). The soft palate was split into 2 halves from the midline passing through the fistula converting the patient as to have cleft soft palate with refreshing of the fistula edges by separation of oral from nasal mucosa. We used Furlow palatoplasty for repair (Fig. 2); the technique started with elevation of the myomucosal flap of the left side of the palate that was based posteriorly and formed of oral mucosa and muscle layer leaving about 2 mm posterior to hard palate to facilitate closure. Care should be taken not to injure the thin nasal mucosa; which was created as a left nasal mucosal flap by incising it near the posterior edge of the soft palate. The oral mucosa was elevated from the muscle layer on the right side of the palate so that the mucosal flap was based anteriorly with the incision has been made just anterior to the free edge of the soft palate. The right myomucosal flap was then created by incising the muscle layer and nasal mucosa about 2 mm behind the posterior edge of the right side of the hard palate; this left cuff of tissue could facilitate closure. Now, four flaps have been created; two myomucosal flaps based posteriorly and two mucosal flaps based anteriorly. The left nasal mucosal flap was rotated across the midline to be sutured to the right hard palate margin and the right nasal myomucosal flap was then rotated to the left to be inserted into the left hemi-palate. The contact line between both flaps was sutured. At this stage the nasal layer of the soft palate was established being formed of anterior nasal mucosal flap and posterior nasal myomucosal flap. The right oral mucosal flap was rotated across the midline to be sutured to left hard palate margin and the left oral myomucosal flap was then rotated to the right and sutured to the posterior soft palatal edge. The contact line between both flaps was then sutured, so the oral layer has been developed and was formed of anterior oral mucosal flap and posterior oral myomucosal flap. The uvula was re-approximated and sutured. All the suture material used in closure was 4–0 Vicryl.

2.3. Postoperative assessment

Cases were seen postoperatively at one week interval for three weeks, with follow up appointments at 3, 6, and 12 months. Healing of the palate and closure of palatal fistulas were assessed. All cases received speech therapy after complete wound healing. By the end of the follow up period; APA, nasometric assessment, and flexible nasopharyngoscopy were performed with recording of the same parameters that had been recorded pre-operatively. Comparison of the pre-operative and post-operative data was done.

2.3.1. Statistical method

Data were coded and summarized using Statistical Package for Social Sciences version 15.0 for Windows. Quantitative variables were described using mean ± standard deviation and categorical data by using frequency and percentage. Comparison of preoperative

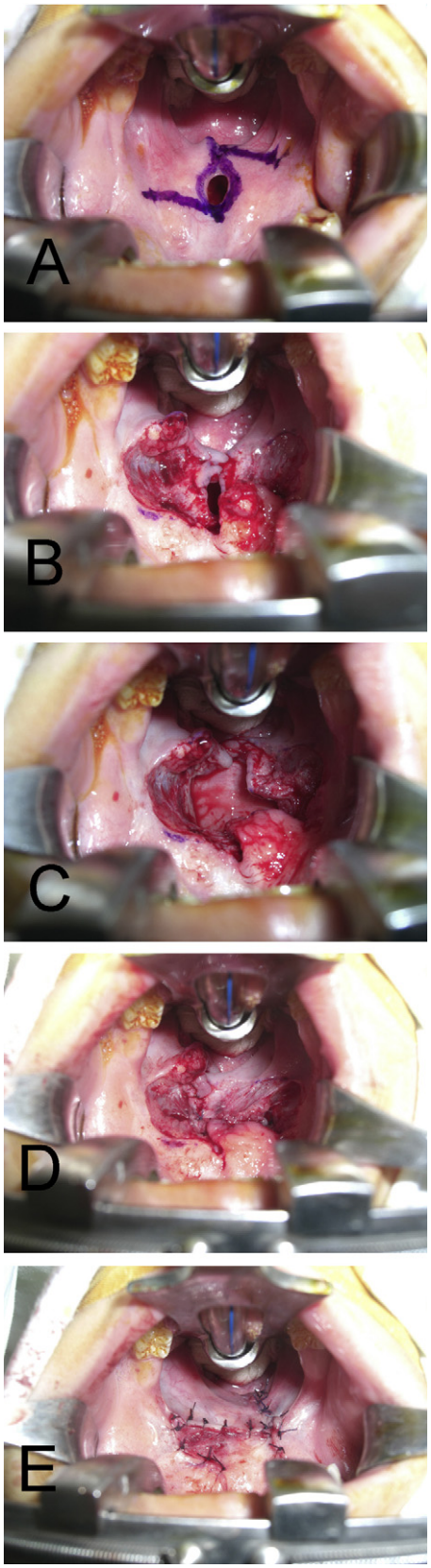

Fig. 2. Steps of the operation. (A) Incision marked on the oral surface of the soft palate, (B) the oral flaps elevated, (C) the soft palate converted into 4 flaps, 2 anterior mucosal flaps and 2 posterior myomucosal flaps, (D) closure of the nasal layer in Z-plasty, (E) closure of the oral layer in opposing Z-plasty.

and postoperative results of APA, nasometric assessment, and velar movement displacement was done using Paired sample t test, and Wilcoxon signed-rank test. $P \leq 0.05$ is considered statistically significant.

3. Results

The length of the fistulas ranged from 7 to 15 mm (mean of 10 mm) and their widths varied from 3 to 6 mm (with a mean of 5 mm). Fistulas were located in the midline of soft palate in 10 cases and in the posterior free margin in 9 cases, according to Smith et al. [2] the patients were described to have types I and II palatal fistulas (Fig. 3). All fistulas were closed by using Furlow double opposing Z-plasty. No cases developed operative or postoperative complications. In all cases, the fistula was completely closed at first attempt and there was no evidence of recurrence with a follow up of at least 12 months.

Regarding APA, the mean preoperative baseline was 9.54 ($\pm$1.94) that improved to 1.54 ($\pm$1.36). Correlation of the preoperative and postoperative scores was significant, with $P < 0.05$.

The overall pre-operative nasalance score was 45 ± 8.5 for the nasal sentences and 16 ± 2 for the oral sentences, improved to 33 ± 11.6 for the nasal sentences and 13.5 ± 3 for the oral sentences. Comparison between pre-operative and post-operative results was significant for nasal and oral sentences.

The mean preoperative baseline of velar movement seen by flexible nasopharyngoscopy was 0.6 ± 0.2, it improved to 0.8 ± 0.2. However, despite of velar movement improvement, the correlation of the preoperative and postoperative scores was insignificant.

4. Discussion

Palatal fistula represents a functional problem after cleft palate repair, as it may result in nasal regurgitation of food and fluids and it also leads to hypernasal speech. Although, its incidence is variable in the literature, however, it is a common problem [15]. In a previous study, we used a buccinator myomucosal flap from the inner side of the cheek in closure of posterior palatal fistulas at the junction between the hard and soft palate (palatal fistula type III), all fistulas had been closed successfully with no failure [16]. While in another study, we treated fistulas of the hard palate (palatal fistula type IV) using a V–Y mucoperiosteal flaps; with excellent results and no failures [17]. Also, we treated anterior palatal fistulas that were located at the premaxillary-maxillary junction (palatal fistula type V) with superior lip myomucosal flap including the orbicularis oris muscle, we achieved a success rate of 91% with partial necrosis of the distal part of the flap in 3 cases [8]. In all types of previously mentioned fistulas, the closure was in 2 layers with the nasal layer being formed of an inverted oral mucoperiosteal hinge flap from the area surrounding the fistula and the oral layer being formed of either buccinator myomucosal flap, V–Y mucoperiosteal flap, or superior lip myomucosal flap according to the location of the fistula.

In this study, we treated fistulas of the soft palate (types I and II) using Furlow double opposing Z-plasty: a technique that was originally described by Leonard Furlow [18] for repair of cleft palate. This technique is reported to improve the VPC by increasing the length of the soft palate approximating it from the posterior pharyngeal wall. Also by redirecting the levator muscle fibers from vertical to horizontal orientation, it seems to improve the palatal mobility [19–21]. Our study showed complete closure of all fistulas at first attempt with no recurrence.

The repair of palatal fistula is technically difficult, most often due to the paucity of local tissue for closure or excessive fibrosis in the same area as a result of previous surgeries. The recurrence rate is relatively high after its primary repair, it may constitute up to

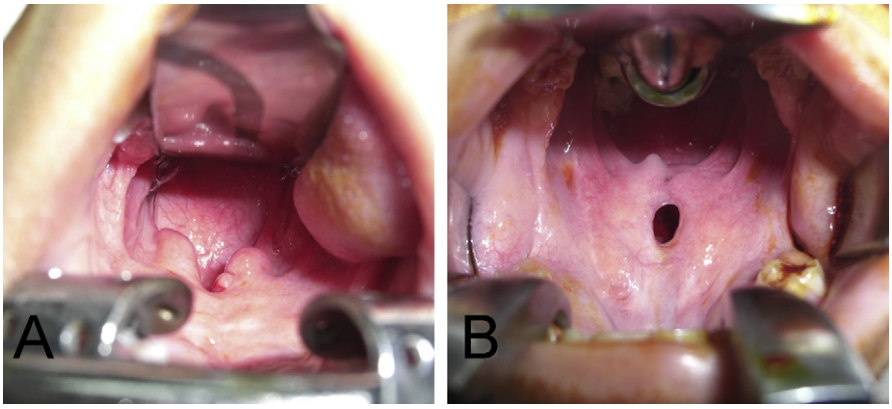

Fig. 3. Preoperative view of palatal fistulas type I (A) and type II (B).

34% [22]. In front of this high recurrence rate, surgeons are continuously searching for solutions. Several techniques have been described to circumvent these problems, Honnebier et al. [10] divided the methods currently employed for fistula repair into two groups: those that use mucoperiosteal flaps in one form or another, e.g., hinge flaps, and those that make use of additional tissue to close the defect. Sources of additional tissue are usually in the form of pedicled flaps from elsewhere in the mouth. They treated seven patients with oro-nasal fistula using a local mucoperiosteal flap lined with buccal mucosal grafts placed on the nasal side of the flap. The fistula was completely closed in all cases without complications. However their patients' sample was small, with a need for two donor areas; one located in the inner aspect of the cheek that had been closed primarily causing pain, and another on the hard palate that had been left to heal with granulation taking long time. Acellular dermal grafts have been used by some authors in the closure of oronasal fistulas, they achieved promising results with interposing the dermal graft between oral and nasal mucosa [23] however these dermal materials are quite expensive and may carry a little risk of infection as they are biological avascular foreign bodies.

Nakakita et al. [24] closed palatal fistula by the use of a buccal musculomucosal flap. Complete closure at the first attempt was obtained in 69% of the cases and they needed to divide the pedicle two weeks after the initial operation. Assunçao [25] used successfully tongue flap to close post-palatoplasty fistulas in 12 patients, all flaps survived but with partial recurrence only in one case. Also, Guzel and Altintas [26] used the same type of flap and they obtained complete closure of all fistulas but recurrence occurred in one out of ten during maxillary expansion. However, changes in articulation and resonance after tongue flap closure of palatal fistulas have been reported by Kummer and Neale [27].

Free flap closure for palatal fistula has been used by some authors with promising results. Ninkovic et al. [28] used the dorsalis pedis-first dorsal metatarsal artery free flap, Schwabegger et al. [29] used osseous angular scapular flaps and Krimmel et al. [30] used a mucosal prelaminated lateral upper arm flap, but these methods leave a wound in another part of the body adding to the cumbersome of the patient in the postoperative period.

In this study, we selected Furlow double opposing Z-plasty technique in closure of soft palatal fistula as it improves velar movement and consequently improves VPC through reconstruction of levator sling and palatal lengthening [19–21,31]. Auditory perceptual assessment and nasometric study showed a significant postoperative improvement of speech and nasalance score. Also, flexible nasopharyngoscopy showed improvement of velar movement, though it was not significant. These functional assessments could indicate improvement of the sphincteric mechanism of the velopharyngeal valve reflecting the major advantage of Furlow technique. So, our choice for this technique was not only to close the fistula, but also to improve the velopharyngeal valve function.

According to functional outcome, many authors ascertained the superiority of Furlow palatoplasty on other push-back techniques with regard to hypernasality, articulation, total speech scores, and pharyngeal flaps requirements [20,31,32]. Disadvantages of Furlow Z-plasty may include a relatively difficult dissection and increased operating time compared with other palatoplasty techniques [33,34].

The advantages of our method for closure of soft palate fistula is that it is a single stage operation, familiar to the cleft palate surgeons and causing no pain in another area of the body (if a flap or a graft was used), in addition to its glorious effect on improving VPC through reconstruction of levator sling and improvement of velar movement.

Finally, we can conclude that treatment of soft palate fistula that may develop after cleft palate repair by using Furlow technique is an effective method as a primary treatment with a high success rate and a good functional outcome.

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There are no financial disclosures

Conflicts of interest

There are no conflicts of interest

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ijporl.2011.09.030.

References

[1] A.M. Sadove, B.L. Eppley, Cleft lip and palate, in: J.L. Grosfeld, J.A. O'Neill, A.G. Coran, E.W. Fonkalsrud, A.A. Caldamone (Eds.), Pediatric Surgery, 6th ed., Mosby Elsevier, Philadelphia, 2006, pp. 803–812.
[2] D.M. Smith, L. Vecchione, S. Jiang, et al., The pittsburgh fistula classification system: a standardized scheme for the description of palatal fistulas, Cleft Palate. Craniofac. J. 44 (6) (2007) 590–594.

[3] D.S. Inman, P. Thomas, P.D. Hodgkinson, C.A. Reid, Oro-nasal fistula development and velopharyngeal insufficiency following primary cleft palate surgery-an audit of 148 children born between 1985 and 1997, Br. J. Plast. Surg. 58 (8) (2005) 1051–1054.
[4] B.J. Wilhelmi, E.A. Appelt, L. Hill, S.J. Blackwell, Palatal fistulas: rare with the two-flap palatoplasty repair, Plast. Reconstr. Surg. 107 (2) (2001) 315–318.
[5] V.K. Tiwari, S. Sujata, Orbicularis oris musculomucosal flap for anterior palatal fistula, Indian J. Plast. Surg. 39 (2006) 148–151.
[6] M.M. Al-Qattan, A modified technique of using the tongue tip for closure of large anterior palatal fistula, Ann. Plast. Surg. 47 (4) (2001) 458–460.
[7] C.M. Barone, R.V. Argamaso, Refinements of the tongue flap for closure of difficult palatal fistulas, J. Craniofac. Surg. 4 (1993) 109–111.
[8] M. Abdel-Aziz, W. Abdel-Nasser, H. El-Hoshy, A. Hisham, B. Khalifa, Closure of anterior post-palatoplasty fistula using superior lip myomucosal flap, Int. J. Pediatr. Otorhinolaryngol. 72 (2008) 571–574.
[9] N.D. Futran, J.R. Haller, Considerations for free-flap reconstruction of the hard palate, Arch. Otolaryngol. Head Neck Surg. 125 (1999) 665–669.
[10] M.B. Honnebier, D.S. Johnson, A.A. Parsa, A. Dorian, F.D. Parsa, Closure of palatal fistula with a local mucoperiosteal flap lined with buccal mucosal graft, Cleft Palate. Craniofac. J. 37 (2) (2000) 127–129.
[11] P.J. Skoll, C.H. Pienaar, Conchal grafts for closure of palatal fistulae, Ann. Plast. Surg. 56 (4) (2006) 467.
[12] R.C. Schultz, Management and timing of cleft palate fistula repair, Plast. Reconstr. Surg. 78 (6) (1986) 739–747.
[13] J. Pinborough-Zimmerman, C. Canady, D.K. Yamashiro, L. Morales Jr., Articulation and nasality changes resulting from sustained palatal fistula obturation, Cleft Palate. Craniofac. J. 35 (1) (1998) 81–87.
[14] K.J. Golding-Kushner, R. Argamaso, R. Cotton, et al., Standardization for the reporting of nasopharyngoscopy and multiview videofluoroscopy: a report from an international working group, Cleft Palate J. 27 (1990) 337–348.
[15] Y.S. Phua, T. de Chalain, Incidence of oronasal fistulae and velopharyngeal insufficiency after cleft palate repair: an audit of 211 children born between 1990 and 2004, Cleft Palate. Craniofac. J. 45 (2) (2008) 172–178.
[16] M. Abdel-Aziz, The use of buccal flap in the closure of posterior post-palatoplasty fistula, Int. J. Pediatr. Otorhinolaryngol. 72 (2008) 1657–1661.
[17] M. Abel-Aziz, V–Y two-layer repair for oronasal fistula of hard palate, Int. J. Pediatr. Otorhinolaryngol. 74 (2010) 1054–1057.
[18] L.T. Furlow Jr., Cleft palate repair by double opposing Z-plasty, Plast. Reconstr. Surg. 78 (1986) 724–736.
[19] W.H. Lindsey, P.T. Davis, Correction of velopharyngeal insufficiency with Furlow palatoplasty, Arch. Otolaryngol. Head Neck Surg. 122 (8) (1996) 881–884.
[20] E. Guneren, O.A. Uysal, The quantitative evaluation of palatal elongation after furlow palatoplasty, J. Oral Maxillofac. Surg. 462 (2004) 446–450.
[21] B.B. Horswel, Primary Palatoplasty:, Double-opposing Z-plasty (furlow technique), Atlas Oral Maxillofac. Surg. Clin. North Am. 17 (2009) 157–165.
[22] N.A. Amaratunga, Occurrence of oronasal fistulas in operated cleft palate patients, J. Oral Maxillofac. Surg. 46 (1988) 834–837.
[23] R.E. Kirschner, D.S. Cabiling, A.E. Slemp, F. Siddiqi, D.D. LaRossa, J.E. Losee, Repair of oronasal fistulae withacellulardermalmatrices, Plast. Reconstr. Surg. 118 (6) (2006) 1431–1440.
[24] N. Nakakita, K. Maeda, S. Ando, H. Ojimi, R. Utsugi, Use of a buccal musculomucosal flap to close palatal fistulae after cleft palate repair, Br. J. Plast. Surg. 43 (4) (1990) 452–456.
[25] A.G. Assunçao, The design of tongue flaps for the closure of palatal fistulas, Plast. Reconstr. Surg. 91 (1993) 806–810.
[26] M.Z. Guzel, F. Altintas, Repair of large, anterior palatal fistulas using thin tongue flaps: long-term follow-up of 10 patients, Ann. Plast. Surg. 45 (2000) 109–117.
[27] A.W. Kummer, H.W. Neale, Changes in articulation resonance after tongue flap closure of palatal fistulas: case reports, Cleft Palate J. 26 (1989) 51–55.
[28] M. Ninkovic, E.H. Hubli, A. Schwabegger, H. Anderl, Free flap closure of recurrent palatal fistula in the cleft lip and palate patient, J. Craniofac. Surg. 8 (6) (1997) 491–495.
[29] A.H. Schwabegger, E. Hubli, M. Rieger, R. Gassner, A. Schmidt, M. Ninkovic, Role of free-tissue transfer in the treatment of recalcitrant palatal fistulae among patients with cleft palates, Plast. Reconstr. Surg. 113 (4) (2004) 1131–1139.
[30] M. Krimmel, J. Hoffmann, S. Reinert, Cleft palate fistula closure with a mucosal prelaminated lateral upper arm flap, Plast. Reconstr. Surg. 116 (7) (2005) 1870–1872.
[31] L.L. D'Antonio, B.J. Eichenberg, G.J. Zimmerman, et al., Radiographic and aerodynamic measures of velopharyngeal anatomy and function following Furlow Z-plasty, Plast. Reconstr. Surg. 106 (3) (2000) 539–549.
[32] B.J. McWilliams, P. Randall, D. LaRossa, et al., Speech characteristics associated with the Furlow palatoplasty as compared with other surgical techniques, Plast. Reconstr. Surg. 98 (4) (1996) 610–619.
[33] D.B. Brothers, R.W. Daltson, H.D. Peterson, W.T. Lawrence, Comparison of the Furlow double-opposing Z-palatoplasty with the Wardill-Kilner procedure for isolated clefts of the soft palate, Plast. Reconstr. Surg. 95 (6) (1995) 969–977.
[34] R.J. Mann, D.M. Fisher, Bilateral buccal flaps with double opposing Z-plasty for wider palatal clefts, Plast. Reconstr. Surg. 100 (5) (1997) 1139–1143.