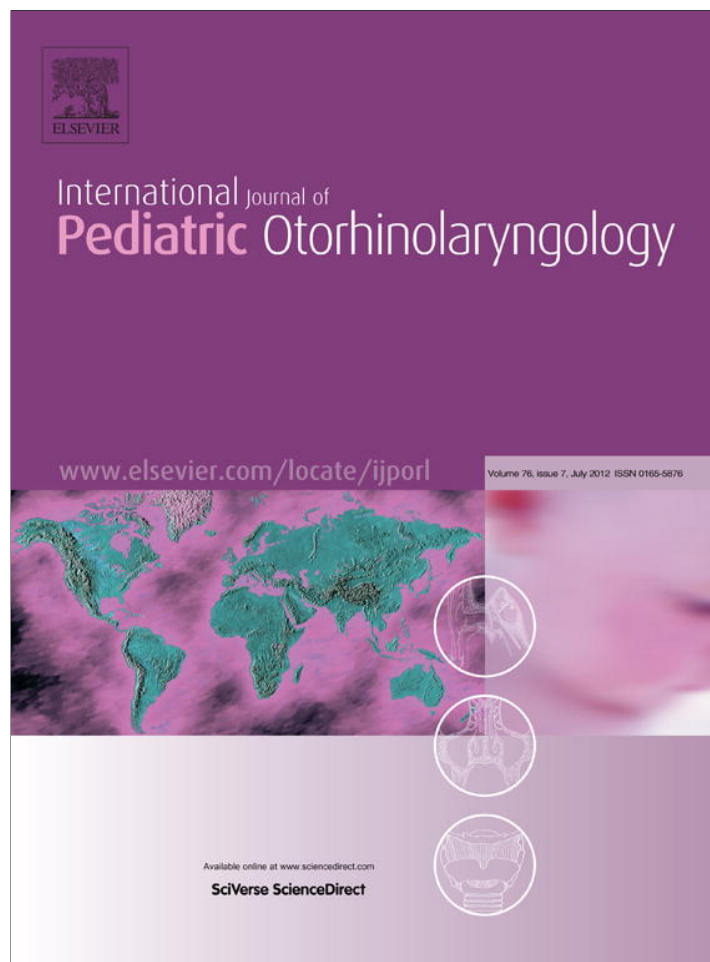


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journal homepage: www.elsevier.com/locate/ijporlRepair of submucous cleft palate with Furlow palatoplasty[☆]Mosaad Abdel-Aziz^{a,*}, Hassan El-Hoshy^a, Nader Naguib^b, Nassim Talaat^a^a Department of Otolaryngology, Faculty of Medicine, Cairo University, Cairo, Egypt^b Department of Otolaryngology, Faculty of Medicine, Beni Suif University, Egypt

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ABSTRACT

Objective: Submucous cleft palate is a congenital anomaly caused by abnormal insertion of the levator veli palatini muscles to the posterior border of the hard palate, normally these muscles unite together to form the levator sling. Velopharyngeal insufficiency (VPI) may occur in about 10% of cases, our previous treatment protocol was pharyngeal flap that may result in obstructive breathing. Furlow technique seems to be a more physiologic solution as it reconstructs the levator sling. The aim of this study was to determine the efficacy of Furlow palatoplasty in treatment of submucous cleft palate cases presented with VPI.

Methods: This prospective study was conducted on 15 children with symptomatic submucous cleft palate. All cases were treated by Furlow double opposing Z-plasty technique for repositioning of levator muscles, preoperative and postoperative speech evaluation was done using auditory perceptual assessment and nasometry, while velopharyngeal closure was assessed with flexible nasopharyngoscopy.

Results: Significant improvement of speech and overall nasalance score were achieved. Flexible nasopharyngoscopy showed complete velopharyngeal closure of 13 cases (86.7%), while one case needed secondary pharyngoplasty for correction of residual VPI and the parents of the other case refused secondary surgery as the speech improvement of their child was satisfactory.

Conclusions: Furlow palatoplasty technique is an effective method in treatment of VPI in cases of submucous cleft palate as it has high success rate with no morbidity.

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1. Introduction

Submucous cleft palate (SMCP) is a condition characterized by bifid uvula, notching of the posterior border of the hard palate, and deficiency of muscles in the midline of soft palate that appear as a bluish mucosa (zona pellucida) [1]. Its incidence is about 1:1250–1:6000, it may occur as either an isolated deformity or part of syndromal malformations [2,3]. However, most cases are usually asymptomatic and only about 10% of cases may present with symptoms [3]. Ear troubles are common presentation due to eustachian tube dysfunction, feeding problem in the form of regurgitation of food and fluids through the nose is usually the early presenting feature and should alarm the pediatrician to the possibility of palatal deficit, hypernasal speech may be a late presentation as long as child's speech is not still fully developed and also the presence of adenoid may compensate the palatal

defect till adenoidal involution occur; even children with minimal hypernasality due to SMCP can develop severe hypernasality following adenoidectomy [4,5].

The structural presentation of SMCP indicates that the levator veli palatini muscles have been shifted from their normal transverse orientation to a sagittal position. The muscles, presumably important for normal speech, insert aberrantly on the bony free edge of the hard palate instead of forming a complete muscular sling leading to inability of the posterior margin of the soft palate to fully contact the pharyngeal wall. The degree of velopharyngeal insufficiency (VPI) that can exist is based on the anterior displacement of the muscles [6–8].

Velopharyngeal insufficiency caused by SMCP has been treated by a variety of techniques. Sometimes, palatal repair may give poor results, and many have advised pharyngoplasty or pharyngeal flap, with or without velar surgery, as the first option [5,7,9]. However, pharyngoplasty and pharyngeal flap may have upper airway obstructive problems including snoring and sleep apnea [5,10]. Also, velar surgery may adversely affect maxillary growth caused by dissection on the hard palate and excessive fibrosis, Furlow technique is supposed to have a less harmful effect compared with other procedures because of less scarring with no raw surface on the hard palate [8]. It has been reported that patients with a cleft

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palate treated with Furlow palatoplasty had superior results on measures of hypernasality, articulation, and total speech scores compared with patients treated with other surgical techniques [8,11].

Despite the good results that we achieved previously with the treatment of SMCP with pharyngeal flap, some patients developed obstructive breathing [5]. So, we decided to use a less obstructive and more anatomical method as Furlow technique; it repositions the levator muscle fibers to obtain a better velar function. The aim of our study was to determine the efficacy of Furlow palatoplasty in correction of velopharyngeal insufficiency of submucous cleft palate cases.

2. Methods

This prospective study was conducted on 15 patients who were referred to our institute with the diagnosis of submucous cleft palate (Fig. 1). All cases presented with hypernasal speech after failure of speech therapy that was received for at least 6 months. They were treated with Furlow double opposing Z-plasty technique in the period from January 2008 to July 2010. There were 9 females and 6 males and their ages ranged from 4 to 9 years at the time of surgery, with a mean of 5.5 years. Informed consents were obtained from the parents of the patients and the principles outlined in the Declaration of Helsinki were followed. Also, the research protocol was approved by the local Ethical Committee of our institute.

All cases were subjected to the following:

- Preoperative assessment

- General medical examination for detection of any associated anomalies.
- ENT, head and neck examination with particular emphasis on ears (for possibility of middle ear effusion), and conditions that may affect the airway such as glossoptosis and micrognathia.
- Tympanometry as a routine preoperative evaluation for cleft palate patients.
- Auditory perceptual assessment (APA) of speech: hypernasality, nasal emission of air, weak pressure consonants were analyzed for every individual patient. Each of these parameters is 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 Nasometry (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 flexible nasopharyngoscope, which is 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 introduced through the nostril, superior to the inferior turbinate, to the choana. Velopharyngeal sphincter was assessed while the patients were repeating Arabic sentences loaded with high oral pressure consonants. The diagnosis of SMCP was confirmed by the presence of a central notch on the nasal surface of the soft palate [2,8,12]. Velopharyngeal insufficiency was considered in the presence of velopharyngeal gap and/or bubbles [5,12].

- Operative technique

Under general anesthesia with oral endotracheal intubation, incisions were marked (Fig. 2) 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 zona pellucida converting the patient as to have overt cleft soft palate, and incision of the medial edges of the bifid uvula was done to create raw surfaces. Elevation of the flaps in the usual fashion of Furlow technique (Fig. 3) [13], closure of the nasal layer with nasal mucosal flap anteriorly and nasal myomucosal flap posteriorly (Fig. 4), and closure of oral layer with oral mucosal flap anteriorly and oral myomucosal flap posteriorly (Fig. 5) was performed. Finally, both myomucosal flaps are overlapping each other posteriorly, all suture material used in closure was 4-0 Vicryl. After completion of palatal repair, myringotomy with T-tubes insertion was performed for cases that showed middle ear effusion.

- Postoperative follow up and evaluation

All cases received oral antibiotics and paracetamol for one week, and oral steroids for 2 days, the patients were discharged from hospital in the 3rd post-operative day. Cases were seen postoperatively at one week interval for three weeks, with follow-up appointments bimonthly for 12 months. Closure of clefts and wound healing were assessed. All cases started to



Fig. 1. Submucous cleft palate with appearance of the bifid uvula and translucent zona pellucida.

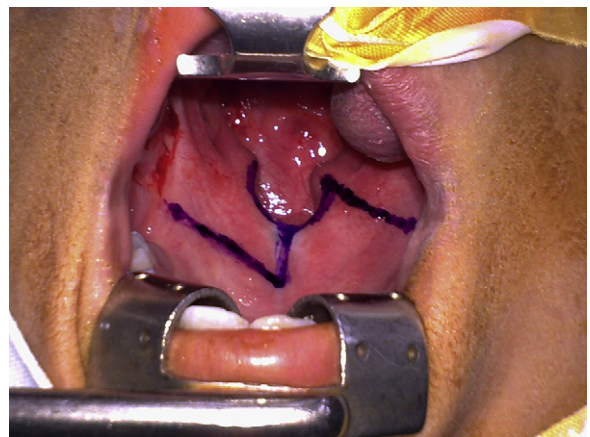


Fig. 2. Incision marking in a Z-shape passing through the medial edges of the bifid uvula.

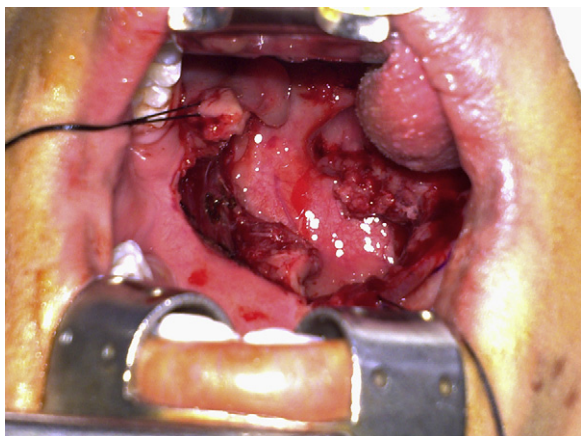


Fig. 3. Creation of 4 flaps with 2 oral flaps being suspended with sutures.

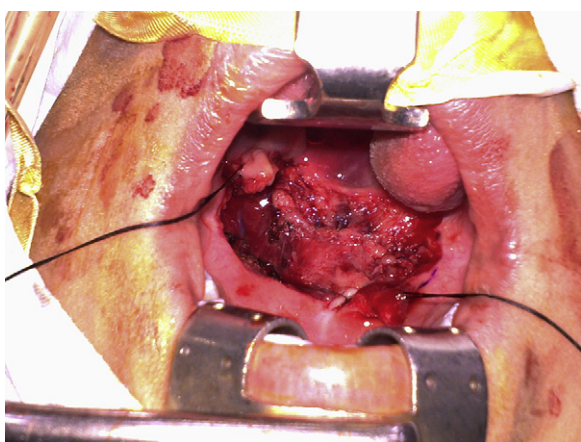


Fig. 4. Closure of the nasal layer with nasal mucosal flap anteriorly, and nasal myomucosal flap posteriorly, with suturing of both flaps together. A Z-shape suture line was created.

receive speech therapy at one month postoperatively. 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 preoperatively. Comparison of the pre-operative and post-operative data was done.

- Statistical method

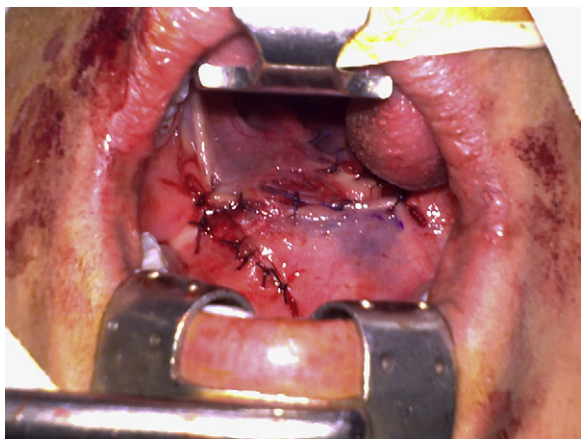


Fig. 5. Closure of the oral layer with oral mucosal flap anteriorly, and oral myomucosal flap posteriorly, with suturing of both flaps together. A Z-shape suture line was created that is reversed to that of the nasal layer.

Data were coded and summarized using Statistical Package for Social Sciences version 17.0 for Windows. Quantitative variables were described using mean \pm standard deviation and categorical data by using frequency and percentage. Comparison of preoperative and postoperative results of APA, nasometric assessment, and velopharyngeal closure was done using Paired sample *t* test and Pearson Chi-square. $P < 0.05$ is considered statistically significant.

3. Results

Fifteen children with submucous cleft palate were enrolled in this study, all cases were referred to our institute because of hypernasal speech after failure of speech therapy. Furlow double opposing Z-plasty was selected as the technique of palatal repair, all cases demonstrated the disease as an isolated deformity with no other congenital anomalies. No intraoperative complications were encountered, 6 cases developed postoperative snoring that was improved over days (1–5 days); it was attributed to the development of postoperative edema, all patients showed complete wound healing with no dehiscence or fistulae. Myringotomy with T-tubes insertion was carried out bilaterally for 12 cases who demonstrated middle ear effusion.

Regarding assessment of speech, no cases developed hyponasal speech. The mean preoperative baseline of APA was $8.98 (\pm 1.85)$ that improved to $1.82 (\pm 1.22)$. The difference between preoperative and postoperative scores was significant, with $P < .05$.

The overall preoperative nasalance score was 39 ± 7.6 for the nasal sentences and 15 ± 1.5 for the oral sentences, improved to 32 ± 9.9 for the nasal sentences and 13.2 ± 2.7 for the oral sentences. The changes were statistically significant for both nasal and oral sentences.

Preoperative flexible nasopharyngoscopy showed the characteristic central notch on the nasal surface of the soft palate that was obliterated postoperatively in all cases. Velopharyngeal insufficiency was detected preoperatively in all cases, 13 (86.7%) out of 15 patients showed complete velopharyngeal closure with no gap or bubbles postoperatively. Two cases showed residual postoperative VPI, but comparison of pre and postoperative video records for each individual case showed partial improvement with smaller gap. However, sphincter pharyngoplasty was done for treatment of residual VPI in 1 case, while the parents of the other case refused secondary surgery as the speech of their child was satisfied to them.

4. Discussion

SMCP is a congenital deformity in which there is imperfect union of muscles across the velum. It was first described by Roux in 1825 [14]. In 1910, Kelly coined the term “submucous cleft palate”, and characterized the notch or gap of the posterior nasal spine and imperfect midline union of the palatal muscles [15]. In 1954, Calnan reported the three classic anatomical characteristics of this condition; a bifid uvula, midline muscular diastasis, and notching of the posterior border of the bony palate [1]. However, not all individuals with the features of SMCP are symptomatic. For those patients who are symptomatic, several operations have been described; some authors of earlier reports advocated pushback palatoplasty and some recommended the von Langenbeck procedure [1,16]. However, Porterfield et al. [17] reported that 70% of patients with SMCP had poor speech after pushback or von Langenbeck palatoplasty, or both. The speech that developed after both these procedures has generally been less satisfactory than that achieved after a pharyngeal flap procedure [9], and many surgeons have gradually come to favour primary creation of a

pharyngeal flap for treatment of VPI associated with SMCP [5,18,19]. Also, some authors have advocated pharyngoplasty, perhaps combined with velar repair, on the basis that velar repair alone is likely to be inadequate [2].

Our preferred method for treatment of SMCP was pharyngeal flap as a primary procedure [5]. Although the results were promising and satisfactory, some children developed snoring and obstructive sleep breathing, a complication of pharyngeal flap that was reported by many authors [10,12,20]. Also, a late complication which is a foetor oris may develop in some cases that could be caused by accumulation of postnasal discharge in the nasopharynx above the pharyngeal flap which is difficult for the child to extrude it [21]. With persistence of snoring and foetor oris of our cases for long periods of follow up, we decided to treat SMCP with a less hazardous operation. Furlow technique was designed to lengthen the palate and for reorientation of the levator veli palatini muscles from sagittal to horizontal fashion which permits reconstruction of levator sling [13].

In this study, we performed Furlow palatoplasty for treatment of VPI in 15 children with SMCP. Thirteen cases achieved complete velopharyngeal closure, the overall APA and nasalance score showed significant postoperative improvement. Chen et al. [20] treated 30 patients of SMCP with Furlow palatoplasty, 29 of them (96.7%) achieved competent velopharyngeal function and the age of the only patient who developed failure was above 20. Although some of their patients were relatively old, the results were optimistic; however, they carefully selected their patients according to different criteria including velopharyngeal gap size, and they commented that patients of velopharyngeal gap less than 5 mm were considered to be the best candidates for a Furlow palatoplasty. In a 10-year series, Seagle et al. [22] reported a successful outcome of 83% for cases of SMCP treated with Furlow palatoplasty, they advised the technique for patients with velopharyngeal gaps of 8 mm or less. Perkins et al. [12] have managed VPI of 148 consecutive patients, they found that Furlow palatoplasty resulted in speech improvement in 72% of the cases, they confirmed that the preoperative velopharyngeal gap size is a predictive factor for speech outcome as the achieved success rate of 86.8% for patients with a small gap and 33% for patients with large gap. However, the authors have designed a treatment algorithm that showed recommendation of Furlow technique for all cases presented with sagittal orientation of levator veli palatini muscles with sagittal diastasis of the palate; a condition that describe SMCP. Sie et al. [23] used Furlow palatoplasty for treatment of VPI of 48 patients with sagittally positioned levator veli palatini muscles; 17 of them had SMCP while 31 cases had undergone previous cleft palate repair, they categorized postoperative VPI as complete resolution, minimal, mild, moderate, and severe which was 39.6%, 16.7%, 12.5%, 18.74%, and 12.5% respectively. The authors detected that there was no significant relation between the preoperative velopharyngeal gap size and the postoperative improvement.

Sullivan et al. [24] treated 58 SMCP patients with 3 different techniques, 24 cases underwent two-flap palatoplasty with muscular retropositioning, 19 cases underwent Furlow palatoplasty, and 15 cases underwent pharyngeal flap as a primary procedure. The success rate that had been achieved postoperatively was 30% for the two-flap palatoplasty, 67% for the Furlow technique, and 92% for the pharyngeal flap. Despite the superiority of the pharyngeal flap results, the authors recommended Furlow palatoplasty for children with SMCP as a primary treatment, with pharyngeal flap can be reserved if necessary as a secondary procedure. Also, comparison of four techniques for treatment of SMCP had been carried out by Park et al. [9], pushback palatoplasty (18 patients), pharyngeal flap (21 patients), pushback palatoplasty combined with a pharyngeal flap (8 patients), and Furlow

palatoplasty (3 patients), they found pharyngeal flap or pushback with pharyngeal flap are appropriate methods for the surgical correction of VPI in patients with SMCP; however, the sample of patients who were subjected to Furlow palatoplasty was small for judgment.

Recently, Reiter et al. [25] have performed a new technique for correction of VPI of SMCP patients; in which they suture the 2 levator veli palatini muscles together in a butterfly manner without division of the muscle attachment from its abnormal insertion to the posterior edge of hard palate and without redirection of muscle fibers from sagittal to horizontal orientation like in Furlow technique. Although the operative duration was short, and the results were encouraging for cases with mild form of VPI, about 50% of their patients showed no speech improvement.

The advantages of Furlow palatoplasty may include; it is designed to reconstruct the levator sling through horizontal realignment of the muscle fibers in the posterior part of the soft palate, also it lengthens the palate in anterior-posterior plane on the expense of the width by Z-plasty effect [13,20,26]. The operation -unlike pharyngeal procedures- has no adverse effect on the airway, and unlike pushback palatoplasty it does not need dissection on the hard palate with the consequent effect on maxillary growth [8,26].

In conclusion, Furlow palatoplasty technique is an effective method in treatment of velopharyngeal insufficiency in submucous cleft palate patients as it has high success rate with no morbidity.

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There are no financial disclosures.

Conflict of interest

None.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ijporl.2012.03.021.

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