



## Results of speech improvement following simultaneous push-back together with velopharyngeal flap surgery in cleft palate patients



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### ABSTRACT

**Objective:** Velopharyngeal insufficiency (VPI) can be caused by a variety of disorders. The most common cause of VPI is the association with cleft palate. The aim of this study was to evaluate the effectiveness of different surgical techniques for cleft palate patients with VPI: 1) velopharyngoplasty with an inferiorly based posterior pharyngeal flap (VPP posterior, Schönborn–Rosenthal), and 2) combination of VPP posterior and push-back operation (Dorrance).

**Patients and methods:** 41 subjects (26 females, 15 males) with VPI were analysed. Hypernasality was judged subjectively and nasalance data were assessed objectively using the NasalView<sup>®</sup> system preoperative and 6 months postoperative.

**Results:** Subjective analysis showed improved speech results regarding hypernasality for all OP-techniques with good results for VPP posterior and VPP posterior combined with push-back with success rates of 94.4% and 87.7%, respectively. Objective analysis showed a statistically significant reduction of nasalance for both VPP posterior and VPP posterior combined with push-back ( $p < 0.01$ ). However, there were no statistically significant differences concerning measured nasalance values postoperatively between the VPP posterior and VPP posterior combined with push-back.

**Conclusion:** Based on our findings, both VPP posterior and VPP posterior combined with push-back showed good results in correction of hypernasality in cleft patients with velopharyngeal insufficiency.

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### 1. Introduction

Velopharyngeal insufficiency (VPI) can be caused by a variety of disorders (structural, genetic or functional, acquired) and very often there is an association with cleft palate (Schuster et al., 2013). Abnormal physiological separation of the oropharynx from the nasopharynx leads to VPI and hypernasality. Speech therapy or prosthetic management is recommended for patients with minimal VPI or for whom surgery is contraindicated. Surgery is the mainstay of effective treatment in patients with anatomic defects and results in elimination of hypernasal resonance in 62–98% of cases (Lendrum and Dhar, 1984; Argamaso et al., 1994; Sie et al., 1998; de Serres et al., 1999; Seagle et al., 2002; Meek et al., 2003; Armour et al., 2005; Pryor et al.,

2006; Chegar et al., 2007; Sie and Chen, 2007; Capra and Brigger, 2012). A study of two hundred and twenty-two patients demonstrated that pharyngeal flap surgery is a safe and reliable option for the surgical management of VPI (Cole et al., 2008). Pharyngoplasty and pharyngeal flap or combination procedures are most effective in cases of severe VPI with possible advantages for posterior pharyngeal flaps in cases of wider gap VPI (Saman and Tatum, 2012). This is in line with a recent meta-analysis showing that there are no statistically significant differences in speech improvement between sphincter pharyngoplasty and pharyngeal flap surgery. However, very recent work by Collins et al. suggested better speech results in VPI patients undergoing pharyngeal flap surgery (Ysunza et al., 2004; Abyholm et al., 2005; Collins et al., 2012). Recently several new techniques and modifications have been described (Saman and Tatum, 2012). In our study, we also performed the levatorplasty, a new technique developed by Sader and colleagues (Sader et al., 2001). Its effects have not been analysed in any other papers.

Of special importance in surgical correction of hypernasality is choosing an appropriate surgical technique. As described by

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Sommerlad (Sommerlad et al., 2002; Fisher and Sommerlad, 2011), in many cases simple re-operation alone with rearrangement and reconstruction of the palatal muscles is sufficient to correct hypernasality and this has to be considered as a first step before performing the techniques mentioned above, including flap pharyngoplasty. Recent articles have also emphasised the influence of patient selection and surgeons experience in cleft palate surgery in general (Al-Nawas et al., 2013; Schuster et al., 2013) and especially on the outcome of surgery in VPI patients (Saman and Tatum, 2012).

The aim of this study was to evaluate the effectiveness of different surgical techniques for patients with VPI: especially comparing velopharyngoplasty with an inferiorly based posterior pharyngeal flap (Schönborn, 1875; Rosenthal, 1924) with the combination of a velopharyngoplasty and simultaneous push-back (Dorrance, 1925, 1935).

## 2. Material and methods

### 2.1. Patients

Between January 2008 and April 2011 54 patients (35 females, 19 males) with velopharyngeal insufficiency and marked hypernasality were consecutively enrolled in this study. Among these, 8 had a unilateral cleft of the lip and palate diagnosed, 2 patients had a bilateral cleft of the lip and palate, 15 had a cleft of the palate and 16 patients had a submucosal cleft of the palate. 13 patients had VPI without clefting. Patients with syndromes were excluded from the study. Surgery was performed between the ages of 3.5–32.4 years (mean: 6.13 years, SD: 5.23 years) at the Department of Cranio-Maxillofacial Surgery at the University Hospital Münster.

Because of the known negative influence of age on the outcome of speech improving operations, 4 adult patients (suffering from VPI without clefting) were excluded from further analysis. The remaining 9 patients suffering from VPI without clefting were also excluded from further analysis, because it can be assumed that in these patients the aetiology of VPI may differ significantly from subjects with a cleft of the palate.

In the following only the data of the remaining 41 patients (26 females, 15 males; mean age 6.04 +/- 2.12 years, range 3.5–11.9 years) is presented and analysed. These patients were operated on by two experienced cleft surgeons (UJ and JK) of the same craniofacial team.

### 2.2. Assessment of hypernasality and velopharyngeal function

Subjective assessment of hypernasality was collected immediately preoperative and 6 months postoperative from samples of spontaneous speech by two special speech and language therapists using a four-point scale (0 = no, 1 = mild, 2 = moderate, 3 = severe hypernasality). Rating of hypernasality by both examiners was carried out independently from each other and blinded. In cases of differing decisions a third independent examiner rated hypernasality. Objective analysis was performed using the NasalView® system preoperatively and 6 months postoperatively (Joos et al., 2006; Wermker et al., 2012). The speech data were collected by a modified Heidelberg Rhinophonia Assessment Test (Table 1).

In addition, the velopharyngeal closure pattern was characterized by nasopharyngoscopy preoperatively.

### 2.3. Surgical technique

In our study we performed four different surgical techniques for patients with VPI:

- 1) The velopharyngoplasty (VPP) with an inferiorly based posterior pharyngeal flap (PPF) was introduced by Karl Schönborn in

**Table 1**  
Speech stimuli and test items for nasalance measurements.

Item (abbreviation)		Speech stimulus
Words	W1	“Ampel”
	W2	“Lampe”
	W3	“Papagei”
	W4	“Teetasse”
	W5	“Kakao”
	W6	“gut”
	W7	“Zug”
Mainly oral/nonnasal sentences	OS1	“Peter spielt auf der Straße”
	OS2	“Peter trinkt die Tasse Kakao”
	OS3	“Das Pferd steht auf der Weide”
	OS4	“Die Schokolade ist sehr lecker”
	OS5	“Die Klara hält die Tasse Kaffee”
	OS6	“Der Affe fährt Fahrrad”
	OS7	“Ich esse die salzige Suppe”
Mainly nasal sentences	NS1	“Nenne meine Mama Mimi”
	NS2	“Mama und Nina naschen Marmelade”
	NS3	“Die Mama trinkt die Milch”
Calculated values	NRAT	Nasalance Ratio (minimum/maximum nasalance)
	NDIST	Nasalance Distance (maximum–minimum nasalance)

1875 (Schönborn, 1875) and by Wolfgang Rosenthal in 1924 (Rosenthal, 1924) and is one of the most common techniques for surgical VPI-correction. A flap, which includes mucosa and superior pharyngeal constrictor muscle, is sutured from the posterior pharyngeal wall to the border of the soft palate. Patients with sufficient lateral pharyngeal wall movement are good candidates for this approach (Sie and Chen, 2007; Armour et al., 2005; Capra and Brigger, 2012).

- 2) The push-back operation was first described by Dorrance in 1925. He described the lengthening of the soft palate “in cases with congenital shortening of the palate, cleft velum, and cleft palate which extends as far forward as the junction of the anterior third with the middle third of the hard palate” (Dorrance, 1925, 1935).
- 3) One procedure comprised of the combination of push-back and PPF. All the patients with adequate lateral pharyngeal wall movement and a sagittal closure pattern were part of this group.
- 4) A new surgical approach was described by Sader et al., called levatorplasty. The musculus longus capitis is turned into a new muscular loop to augment the posterior pharyngeal wall, to create a medial shift of the lateral pharyngeal wall and to stretch the velum posteriorly (Sader et al., 2001).

A prerequisite for performing one of the above mentioned four techniques was the presence of adequately reconstructed muscles of the palate. As recommended by Sommerlad (Sommerlad et al., 2002), in cases of an inadequately reconstructed soft palate the first step was re-repair with only rearrangement of the palatal muscles. Cleft palate cases who showed no further need for surgical VPI-correction after re-operation are not part of this study. Indication and choice of the surgical technique was made individually for each case after logopaedic and clinical diagnostics by experienced speech therapist together with the surgeon and was therefore based also on personal experience and preference of the surgeon.

### 2.4. Statistical analysis

For subjective assessment of hypernasality interrater reliability was analysed by calculating Cohen's kappa. For objective measured nasalance, if a sentence was recorded more than once, the

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