



## Important points for primary cleft palate repair for speech derived from speech outcome after three different types of palatoplasty



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### ABSTRACT

**Objective:** This study was performed to investigate speech outcomes after three different types of palatoplasty for the same cleft type. The objective of this study was to investigate the surgical techniques that are essential for normal speech on the basis of each surgical characteristic.

**Methods:** Thirty-eight consecutive nonsyndromic patients with unilateral complete cleft of the lip, alveolus, and palate were enrolled in this study. Speech outcomes, i.e., nasal emission, velopharyngeal insufficiency, and malarticulation after one-stage pushback (PB), one-stage modified Furlow (MF), or conventional two-stage MF palatoplasty, were evaluated at 4 (before intensive speech therapy) and 8 (after closure of oronasal fistula/unclosed hard palate) years of age.

**Results:** Velopharyngeal insufficiency at 4 (and 8) years of age was present in 5.9% (0.0%), 0.0% (0.0%), and 10.0% (10.0%) of patients who underwent one-stage PB, one-stage MF, or two-stage MF palatoplasty, respectively. No significant differences in velopharyngeal function were found among these three groups at 4 and 8 years of age. Malarticulation at 4 years of age was found in 35.3%, 10.0%, and 63.6% of patients who underwent one-stage PB, one-stage MF, and two-stage MF palatoplasty, respectively. Malarticulation at 4 years of age was significantly related to the presence of a fistula/unclosed hard palate ( $P < 0.01$ ). One-stage MF palatoplasty that was not associated with postoperative oronasal fistula (ONF) showed significantly better results than two-stage MF ( $P < 0.01$ ). Although the incidences of malarticulation at 8 years of age were decreased in each group compared to at 4 years of age, the incidence was still high in patients treated with two-stage MF (45.5%). On the whole, there was a significant correlation between ONF/unclosed hard palate at 4 years of age and malarticulation at 8 years of age ( $P < 0.05$ ).

**Conclusion:** Appropriate muscle sling formation can compensate for a lack of retropositioning of the palate for adequate velopharyngeal closure. Early closure of the whole palate and the absence of a palatal fistula were confirmed to be essential for normal speech. To avoid fistula formation, multilayer repair of the whole palate may be critical.

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### 1. Introduction

The ultimate goals of surgical palate repair are to restore normal anatomical relationships and reconstruct a velopharyngeal mechanism that permits normal speech without disturbing facial bony growth. Various palatal reconstructive procedures with specific

timing are utilized to achieve these goals. There are two protocols in terms of operation timing: one-stage and two-stage repair. In one-stage palatoplasty, both the soft and hard palate cleft are closed in one step. In two-stage palatoplasty, the palatal surgery is divided into two steps to delay surgical invasion of the hard palate until palatal development is almost complete [1]. The main palatoplasty techniques include Furlow's double-opposing Z-plasty [2], intravelar veloplasty [3], push-back (PB) palatoplasty [4], and two-flap palatoplasty [5–7]. The methods used for cleft palate repair have been changing over the last few decades

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[8–12]. Many studies have compared the speech outcomes of the two procedures [9–16], but sample extraction methods and evaluation criteria (cleft type or timing of evaluation) have varied among these studies. Therefore, it is difficult to directly compare these independent studies. Few studies have compared speech outcomes among several surgical procedures using the same evaluation protocol.

Since 2005, we have utilized one-stage modified Furlow (MF) instead of PB palatoplasty. In addition, by institutional integration, we had the opportunity to evaluate speech outcome with another cleft palate protocol, i.e., two-stage MF, performed by the same speech pathologist. In the present study, we compared speech outcomes in patients with unilateral complete cleft of the lip, alveolus, and palate (UCLP) after three types of palatoplasty: one-stage PB, one-stage MF, and conventional two-stage MF performed at the same institute between 2003 and 2006. All subjects were evaluated at 4 years of age (before intensive speech therapy intervention) and at 8 years of age (after completion of the whole palatoplasty). This study analyzed speech outcome from a surgical viewpoint based on each surgical characteristic.

## 2. Patients and methods

### 2.1. Patients

Thirty-eight consecutive nonsyndromic patients with UCLP treated at Hokkaido University Hospital from 2003 to 2006 were enrolled in this study. A total of 10 patients were treated with one-stage MF palatoplasty (2005–2006), 17 were treated with one-stage PB palatoplasty (2003–2005), and 11 were treated with two-stage MF palatoplasty (2003–2006). All patients underwent operations performed by experienced senior cleft surgeons. A routine ear check was performed in all patients, and pathological middle ear fluid, if present, was removed.

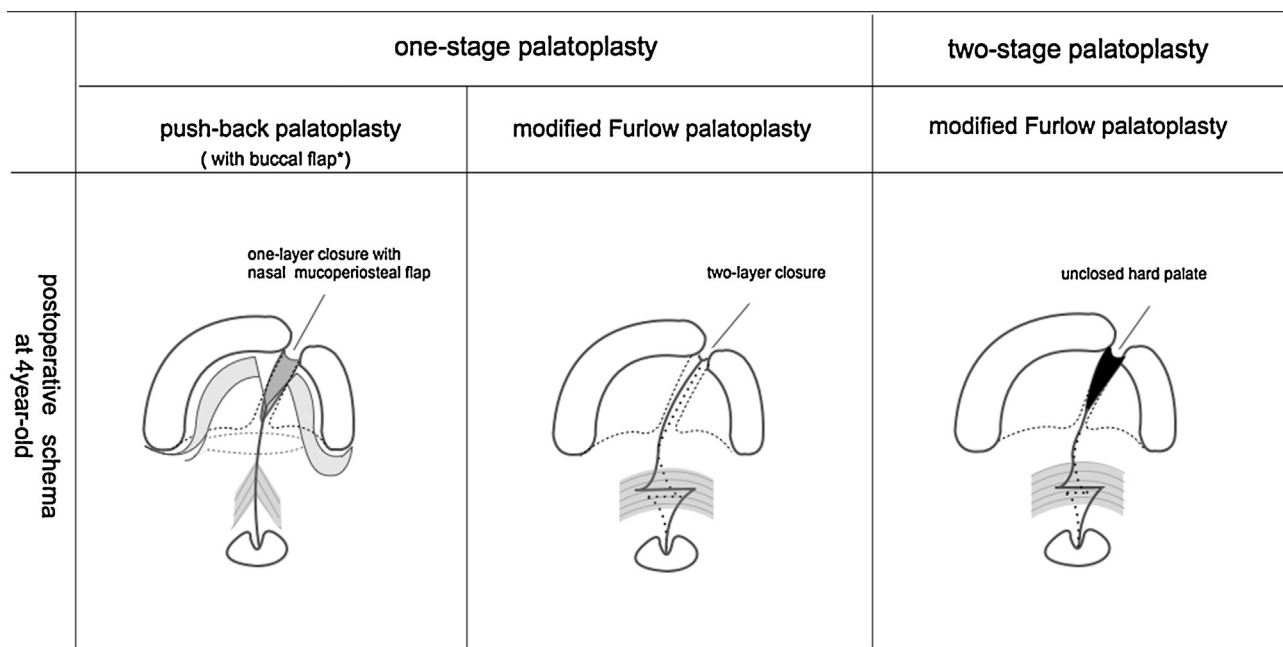
This research was performed with parental consent and followed the principles outlined in the Declaration of Helsinki.

### 2.2. Treatment protocol

Each patient in the one-stage group underwent palatoplasty at around 18 months of age. The PB concept focuses on retro-positioning in palatoplasty to reduce the velopharyngeal space, which results in a parallel muscle suture with a simple incision of the muscle and nasal mucosa transversely at the posterior edge of the hard palate [4]. The raw surface on the nasal side was covered with a buccal flap [17]. Consequently, the anterior hard palate in this group was reconstructed with a one-layer mucoperiosteal flap (Fig. 1). Each patient in the one-stage MF group underwent MF palatoplasty with double-opposing Z-plasty using oral and nasal mucosal flaps in addition to intravelar veloplasty (IVVP), which involved freeing the palatopharyngeus and levator veli palatine muscles from the posterior edge of the hard palate, isolating these muscles from the mucosa, and suturing muscles from both sides at the posterior region of the velum. The incisional length for Z-plasty was 10 mm or less. While Z-plasty also has a lengthening effect, this technique was focused more on myoplasty than retro-positioning. All patients in the one-stage MF group underwent presurgical infant orthodontic treatment until labioplasty was performed to narrow the cleft using a modified Grayson's presurgical nasoalveolar molding technique [18] followed by cleft palate repair. Hence, multilayer closure was also performed in the anterior hard palate (Fig. 1, and intraoperative views were shown in the supplementary file: Fig. S1). In the two-stage palatoplasty protocol, the soft palate was repaired at around 18 months of age using the same MF technique as described above. In patients who underwent the two-stage procedure, a Hotz-type plate was used to ameliorate feeding problems from the time of the first examination until soft palate closure, and the residual cleft in the hard palate was closed by 5–7 years of age. Hence, in this study, the anterior hard palate was not closed at the time of evaluation at 4 years of age in the patients who underwent the two-stage MF procedure.

Supplementary Fig. S1 related to this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ijporl.2014.09.021>.

All postoperative oronasal fistulas (ONFs)/unclosed hard palates were closed before examination at 8 years of age.



**Fig. 1.** Postoperative schemas at 4 years of age for each surgical protocol. Bold line shows incisional line. Schematic illustrating one-layer closure with nasal mucoperiosteal flap noted in gray, opening (fistula) in black. In two-stage palatoplasty, the anterior hard palate was left intentionally unclosed according to the protocol. \*The raw surface on the nasal side was covered with a Kaplan's buccal flap [17].

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