

Comparison of Outcomes of Velopharyngeal Surgery between the Inferiorly and Superiorly Based Pharyngeal Flaps

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Background: Pharyngeal flaps have been widely used for the correction of velopharyngeal incompetence. The aim of this study was to compare the outcomes of velopharyngeal surgery between those who received the superiorly and inferiorly based pharyngeal flaps.

Methods: A retrospective review of medical records of patients with cleft palates who received pharyngeal flap surgery for the correction of velopharyngeal incompetence at one craniofacial center was performed. The superiorly based flaps were elevated and inset using the fish-mouth method. The inferiorly based flaps were sutured to the soft palate where a distally based mucosa flap was turned over to cover the raw surface of the flap pedicle. The velopharyngeal functions were categorized as adequate, marginal, or inadequate. Complications associated with the operation were documented. Statistical comparisons between the two groups were made.

Results: There were 65 patients in each group. No statistically significant differences were found for sex distribution and age at operation. The outcomes of the velopharyngeal surgery were better in the group of patients who received the inferiorly based pharyngeal flaps ($p = 0.030$). The complications were not significantly different between the two groups, and were all relatively mild.

Conclusion: The inferiorly based pharyngeal flap was more effective than the superiorly based pharyngeal flap for the correction of velopharyngeal incompetence. A probable explanation may be the fibrotic changes and scar contracture occurring in the pedicle of the superiorly based pharyngeal flap that may have impaired the velopharyngeal closure.

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Key words: pharyngeal flap, inferior base, superior base, velopharyngeal insufficiency, cleft palate

Since its introduction more than 100 years ago, the pharyngeal flap has been accepted as a simple and effective technique for the correction of velopharyngeal incompetence.⁽¹⁾ Among the varieties, the

most popular types are the superiorly and inferiorly based flaps, and their effectiveness have been reported to be comparable.^(2,3) However, the pedicle of both flaps have traditionally been located below the C1

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level and the raw surfaces have also been left open.⁽²⁾ Although the same purpose is to narrow the velopharyngeal space, the superiorly based flap and inferiorly based flap are different in terms of operative techniques and postoperative appearances. The superiorly based pharyngeal flap is more commonly employed, possibly because of its technical ease. Both types of pharyngeal flaps have been used at this center for the correction of velopharyngeal incompetences, and were hence evaluated for their relative effectiveness and associated complications.

METHODS

A retrospective review of the medical records of patients with cleft lips/palates or cleft palates who had previously undergone palate repair and subsequently received pharyngeal flap operations for the correction of velopharyngeal incompetence from 1990 through 2005 was performed (Fig. 1). All of the patients were from the Craniofacial Center, Chang Gung Memorial Hospital. Data including each patient's general information, type of operation, velopharyngeal outcome and complications were collected. Those with mental retardation, multiple anomalies with poor speech development, inadequate medical records, and inadequate speech evaluation were excluded. All patients were followed up for a minimum of 6 months postoperatively for documentation of their speech outcome.

Preoperative speech evaluation was done primarily using perceptual assessment. Patients with

any degree of velopharyngeal insufficiency then underwent further instrumental tests, including nasopharyngoscope and videofluoroscope. Based on the objective findings, the method of surgical interventions for correction of the velopharyngeal closure dysfunctions were suggested by the speech pathologists. At our center, pharyngeal flaps are usually recommended for patients with moderate to severe velopharyngeal incompetence. The widths of the pharyngeal flaps were determined by the severity of the closure defects. Furlow's double opposing z plasty was recommended for the treatment of those with marginal velopharyngeal incompetence, i.e., a gap of 5 mm or less or a closure ratio of 0.7 or more. Once a decision has been made to use the pharyngeal flap, the surgeon made the decision about the use of either the superiorly or inferiorly based flap, based on his own preference. All operations were performed by experienced staff at the center.

The superiorly based pharyngeal flap was raised from the posterior pharyngeal wall above the prevertebral fascia using the standard fashion until the base of the pedicle reaches a point 5 mm or more above the first cervical spine level. The donor site was closed. The soft palate was split horizontally into a fish-mouth fashion up to the junction of the soft and hard palate. The pharyngeal flap was transposed and inset into the fish-mouth and fixed; the tip of uvular was sutured backward to partially cover the raw surface of the flap pedicle (Fig. 2). The inferiorly based pharyngeal flap was raised from the adenoid area of nasopharynx with the pedicle at 5 to 10 mm

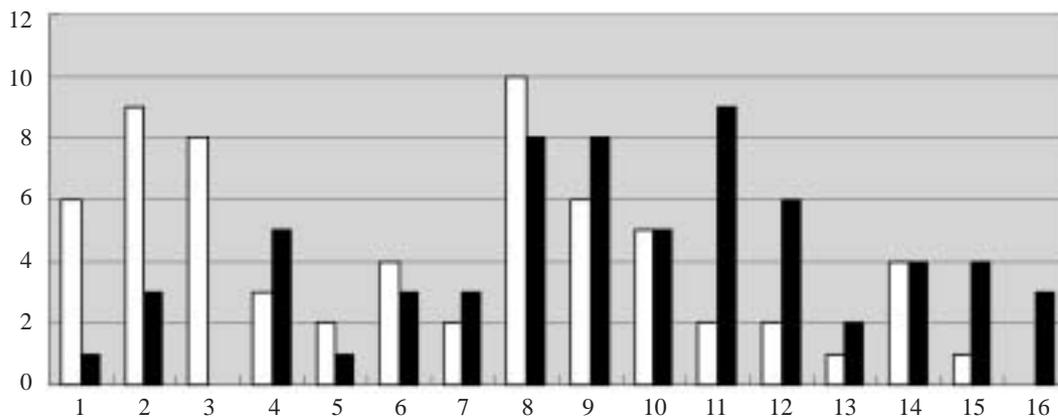


Fig. 1 The number of patients (Y axis) in the year from 1990 to 2005 (X axis). The white bar indicates inferiorly based pharyngeal flap, and the black bar indicates superiorly based pharyngeal flap.



Fig. 2 The superiorly based pharyngeal flap using the fish-mouth method.

above the level of the first cervical spine. The plane at this level was not apparent, and the dissection had to be carried out through the muscle and tendinous part underlying the mucosa. The donor site was left open. The pharyngeal flap was turned anteriorly over the soft palate. A distally based palatal mucosal flap of a similar size as the pharyngeal flap was raised and turned over to cover the raw surface of the pharyngeal flap pedicle (Fig. 3). Usually the superiorly based pharyngeal flap required more length than that of the inferiorly based pharyngeal flap. In both methods, no effort was made to control the size of the portals. Silicone tubes passing from the nostrils to oropharynx were sometimes used to maintain the airway post-operatively.

After the velopharyngeal operation, the patients were seen by speech pathologists at 3 months, and then every 6 months for evaluation of the velopharyngeal function. During that time the patients received speech therapy as indicated. Further objective instrumental evaluations were performed to detect any sign of velopharyngeal insufficiency. The velopharyngeal functions were categorized as adequate, marginal, or inadequate.⁽⁴⁾ The status of

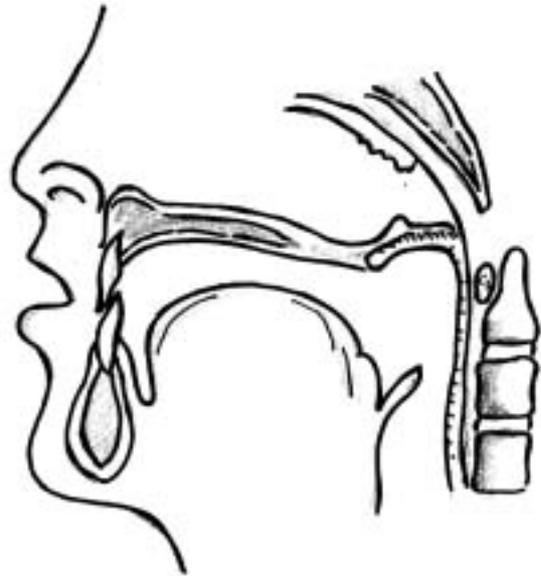


Fig. 3 The inferiorly based pharyngeal flap.

velopharyngeal function at the latest follow-up was used for outcome assessment. Comparisons of the outcomes of the velopharyngeal surgery between the two groups were performed using chi-square test, with $p = 0.05$ as the level of significance.

RESULTS

There were 65 subjects in each group that met the inclusion criteria. The profiles of each group are shown in Table 1. They were comparable in terms of age and sex distribution (Student's *t* test and chi-square test, $p > 0.05$).

The outcomes of the velopharyngeal surgery were better in the group that received inferiorly based pharyngeal flaps with a significant difference between the two groups, as shown in Table 2. The incidence of inadequate velopharyngeal function was higher in the group that received superiorly based pharyngeal flaps (18.5%) than those who received inferiorly based flaps (6.2%), with $p = 0.030$, chi-square test. No serious complications occurred in the patients in this study. However, the pharyngeal flaps had to be divided due to the portal stenosis, severe nasal obstruction and sleep disturbance in two cases with the superiorly based flap and 1 case with the

Table 1. Clinical Information for Patients Receiving Inferiorly Based and Superiorly Based Pharyngeal Flap

	Inferiorly based	Superiorly based
Number of patients	65	65
male	41	31
female	24	34
Age at operation		
range (years)	4 – 29	4 – 31
mean (years)	10.4	10.3
Follow-up		
range (years)	0.5 – 9	0.5 – 11
mean (years)	1.8	2.8

Table 2. Comparison of Velopharyngeal Outcome between Inferiorly and Superiorly Based Pharyngeal Flap

Velopharyngeal outcome	Inferiorly based	Superiorly based
Adequate	43 (66.1%)	44 (67.7%)
Marginal	18 (27.7%)	9 (13.8%)
Inadequate	4 (6.2%)	12 (18.5%)
Total	65 (100%)	65 (100%)

Chi-Square Test, $p = 0.030$

inferiorly based flap. The hyponasality rate was similar in both groups, without significant differences between the two groups (Table 3).

DISCUSSION

Flaps from the pharyngeal wall have been designed to narrow the velopharyngeal spaces in patients with velopharyngeal insufficiencies. Cadaveric studies revealed that the pharyngeal wall receives blood supply from segmental perforating branches of the ascending pharyngeal artery; vertical flaps from the posterior wall of the pharynx have no axial blood supply and are hence random flaps.^(5,6) Flaps used from the median portion of the posterior pharyngeal wall are preferred since they have higher success rates, which have been reported to be between 60% and 90%, and lower complication rates of about 6%.⁽⁷⁻¹⁰⁾ The pedicle of the pharyngeal flap is designed to be above the level of the first cervical spine to facilitate velopharyngeal closure, as the cleft

Table 3. Complications after Inferiorly Based and Superiorly Based Pharyngeal Flap Surgery

Complications	Inferiorly based	Superiorly based
Postoperative bleeding	0	0
Hyponasality and/or nasal airway obstruction	14 (21.5%)	15 (23.1%)
Airway obstruction requiring division of flap	1 (1.5%)	2 (3.1%)
Cervical spine subluxation	0	0
Flap dehiscence	0	0
Infection	0	0
Death	0	0

Chi-Square Test, $p > 0.05$

muscles contract and move the soft palate in the posterior and superior direction. The velopharyngeal function outcomes and complication rates in this series are comparable to those reported previously.⁽⁷⁻¹²⁾

The fish-mouth method for transverse splitting of the soft palate for the superiorly based pharyngeal flap was reported to be no different from the midline split of the soft palate with regards to outcomes of the velopharyngeal function.⁽¹³⁾ It was also reported that the group which underwent the fish-mouth technique had a bulge that appeared to assist velopharyngeal closure in some patients.⁽¹³⁾ The superiorly based pharyngeal flap is technically easier to raise, and a longer flap is available. Using the fish-mouth method, raw surface of the pharyngeal flap in the pedicle area remains exposed, and consequently a “tubing phenomenon” may occur. The post-operative “tubing” or shrinkage may impair the velopharyngeal closure function.⁽¹⁴⁾ The tubing phenomenon may also be caused by inadequate blood perfusion or denervation, and biopsy of the flaps showed only scar tissue and no viable muscle component.⁽¹⁾ Scar contracture of the raw surface area in the superiorly based flap tends to bring the pedicle and soft palate in a downward direction, which may also perturb the velopharyngeal closure. Prevention of the tubing phenomenon or scar contracture should improve the velopharyngeal outcome. To achieve this, the raw surface of pharyngeal flap should be completely covered, allowing primary healing. In the superiorly based flap, a distally based mucosa flap from the

nasal side of the soft palate could cover the raw surface, but this is not possible using the fish-mouth technique.

Our results showed that the inferiorly based pharyngeal flap provided better outcomes after velopharyngeal surgery. This is possibly because: (1) it has a lower length to breadth ratio (the inferiorly based flap is shorter); (2) the adenoid tissue is more vascular; (3) the scar healing of the inferiorly based flap pedicle brings it to a upward and more ideal position; or (4) the raw surface of the inferiorly based flap may be completely covered by turning over the uvular based palatal mucosa flap. Because of the technical difficulties in flap elevation and concern of postoperative bleeding, the inferiorly based pharyngeal flap has not become as widely used as the superiorly based one. A comparison between the two pharyngeal flaps is shown in Table 4. In this study, however, complications associated with the inferiorly based flap were not higher than those experienced by the recipients of the superiorly based flap. A meticulous dissection and careful hemostasis are mandatory to minimize complications.

In this retrospective study, the pharyngeal flaps were all performed by experienced cleft surgeons. The surgeons did both the superiorly based and inferiorly based flaps. One senior surgeon particularly preferred doing inferiorly based pharyngeal flaps. Other surgeons did mainly the superiorly based and some inferiorly based pharyngeal flaps. The surgical procedures were the same among the surgeons, and the surgical techniques were well established in the surgeons. Therefore the learning curve effect was not an issue in this study. It would be difficult to determine and it was not the intension of this study to distinguish the differences between the inferiorly and

superiorly based flaps within the surgeons. That would be a critical study and would require a prospective and controlled study.

In conclusion, the inferiorly based pharyngeal flap provided better outcomes in the velopharyngeal surgery. Complications associated of those who received the inferiorly based flaps were comparable to those who received the superiorly based flap. When a superiorly based pharyngeal flap is to be performed for the correction of velopharyngeal insufficiency, the raw surface should be well covered in order to prevent tubing or shrinkage of the pedicle, but this cannot be achieved using the fish-mouth method.

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Table 4. Comparisons between the Inferiorly Based and Superiorly Based Pharyngeal Flaps

	Inferiorly based	Superiorly based (fish-mouth method)
Technique	Difficult	Easier
Bleeding	More likely	Less likely
Length	Short	Long
Raw surface	No	Yes
Donor site closure	No	Yes
Position of attachment	Palatal side	Nasal side

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以蒂在上或蒂在下的咽瓣治療顎咽閉鎖不全的比較研究

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背景：咽瓣常被用來治療顎咽閉鎖不全，本研究是比較應用蒂在上和蒂在下不同咽瓣的治療效果。

方法：這項回顧性研究，收集一所顏面中心的唇顎裂病人，接受咽瓣手術治療顎咽閉鎖不全。蒂在上的咽瓣是在軟顎做魚口型切開後縫進去，蒂在下的咽瓣則是縫在軟顎上，而軟顎上的粘膜則後移覆蓋咽瓣的裸露部位。顎咽功能評估分成正常、邊緣或異常。手術併發症被收集分析，兩組的差別以統計方法做比較。

結果：兩組各有 65 位病人，兩組在性別和手術年齡上沒有明顯差別。顎咽功能評估顯示，接受蒂在下咽瓣的病人結果較佳。手術併發症在兩組間沒有顯著差異，而且都比較輕微。

結論：以治療顎咽閉鎖不全而言，蒂在下比蒂在上的咽瓣效果好。可能的解釋是，蒂在上的咽瓣，較容易有纖維性變化和疤痕攣縮，以致影響顎咽的閉合。

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