

SURGICAL MANAGEMENT OF VELOPHARYNGEAL INCOMPETENCE USING SUPERIORLY BASED PHARYNGEAL FLAP

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Velopharyngeal incompetence (VPI) is a condition of inadequate functional valving between the oral and nasal cavities that results in hypernasal speech and nasal air escape. VPI is caused by the following factors ; cleft palate, soft palate defect, pharyngomegaly, velopharyngeal sphincter muscle anomaly and maxillary advancement surgery, etc. Velopharyngeal function is assessed by a variety of measures that include speech evaluation, cephalogram, airflow study, videofluoroscopy and nasoendoscopy. The management of VPI is classified into four main groups ; prosthesis, insertion of implant, palatoplasty and pharyngoplasty. Pharyngeal flap is the most common surgical procedure for correcting VPI since Schoenborn's report in 1875. We report seven cases of VPI which were treated by modified superiorly based pharyngeal flap with good results.

I . INTRODUCTION

Velopharyngeal incompetence (VPI) is a condition in which there is inadequate functional valving between the oral and nasal cavities, which results in hypernasal speech. VPI can occur as a result of ; cleft palate, soft palate defect, pharyngomegaly, velopharyngeal sphincter muscle anomaly and maxillary advancement surgery, etc¹⁻³. Velopharyngeal function is assessed by a variety of measures that include clinically specialized speech evaluation, multiview videofluoroscopy, resting and phonating cephalometric films, airflow study, sound cinefluorography, laminography, ultrasonography, sonograms, and nasoendoscopy²⁻⁴. Nasoendoscopy permits observation of the essential elements of velopharyngeal sphincter as they move⁴.

The management of VPI may be classified into four main groups ; prosthesis, insertion of implant, palatoplasty, and pharyngoplasty³. The use of va-

rious flaps of pharyngeal tissue to narrow the pharynx and/or produce a forward projection of the posterior pharyngeal wall is known as a pharyngoplasty¹⁻⁸. A pharyngeal flap is the most common surgical technique for correcting velopharyngeal incompetence since Schoenborn's report in 1875. Currently most surgeons prefer a superiorly based pharyngeal flap rather than an inferiorly based pharyngeal flap¹⁻³. Significant improvements in the surgical construction of pharyngeal flaps include the creation of as wide a based flap as possible, mucosal coverage of the raw surface of the flap to minimize flap contracture during healing, control of the surgically constructed lateral pharyngeal port size, and variable port size based on the degree of lateral pharyngeal wall motion³. We report 7 cases of VPI that were treated by a modified superiorly based pharyngeal flap with surgical procedures accentuating the lateral port control technique introduced by Hogan.

II. CASE PRESENTATION AND SURGICAL PROCEDURE

The objective of this presentation is to examine 7 patients who had been diagnosed VPI and surgically managed with modified superiorly based pharyngeal flap at our service for 5 years. The surgical technique used in our patients will be described with the actual operating photographs of a 20 year-old male patient. The basic preoperative examination relative to this study was composed of three parts; speech evaluation, audiometric evaluation, and nasoendoscopy. The nasoendoscopy was used to evaluate lateral pharyngeal wall and velum movement. The size and shape of the velopharyngeal defect was then recorded. The width of the pharyngeal flap for each case was determined presurgically on the review of these records.

He was seen at our service complaining of incorrect, hypernasal speech. Repair of cleft lip was done at the age of 2 and palatorrhaphy was done at the age of 14. The movement of the lateral pharyngeal wall was good. Physical status showed a normal healthy patient (Fig. 1).

With the patient under general anesthesia via transoral endotracheal intubation he is placed in supine position with the head hyperextended. A special mouth prop (Dingman's) is placed to depress the midline positioned tracheal tube and the tongue, retract the cheeks, and expose the oral pharyngeal walls. A small, moist throat pack is placed inferiorly and tucked out of the surgical field. The lips are lubricated with ointment. Injection of local anesthetic solution is done into the midline of the soft palate and posterior pharyngeal wall along the lines of the proposed pharyngeal flap incisions, about 7 to 10 minutes before the incisions are made. From the tip of uvula to a point about 5mm short of the posterior extent of the hard palate, the soft palate is then surgically divided. Each half of the velum is retracted anterolaterally with the silk sutures in order to expose the posterior pharyngeal

wall. Vertical incision in the posterior pharyngeal wall should be made just medial to the junction of the lateral and posterior pharyngeal wall to create as wide a flap as possible. The flap width, which is to be elevated from the posterior pharyngeal wall is critical in determining the lateral port control. It is based superiorly, and the base of the pharyngeal flap is 10 to 15mm below the eustachian tubes. The level of the pharyngeal flap base is placed where the palatopharyngeal muscle joins the lateral pharyngeal wall, at about the level of the anterior tubercle of the first cervical vertebrae⁶⁾ (Fig. 2, 3, 4).

These incisions extend through the superior constrictor muscle to the prevertebral fascia, on which blunt and sharp dissection is used to elevate a su-



Fig 1. Preoperative view of a 20 year-old male patient with VPI.

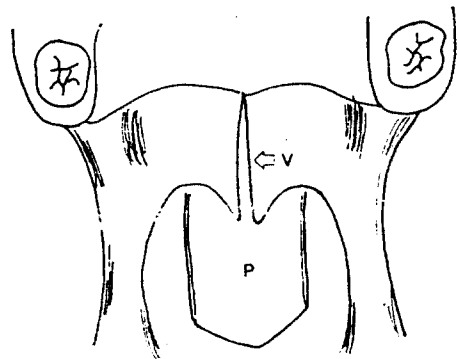


Fig 2. Velum splitting and raising pharyngeal flap

V : Split velum

P : Design of pharyngeal flap

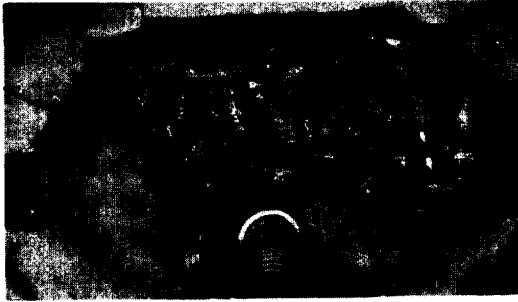


Fig 3. Velum is divided, retracted anterolaterally and pharyngeal flap is made.



Fig 4. Pharyngeal flap is raised and glistening prevertebral fascia is seen.

periorly based pharyngeal flap. Trapdoor flap is then formed including both the mucosa and the pharyngeal musculature, and dissected free from the underlying prevertebral fascia. The posterior pharyngeal vein, located in the midline of the posterior wall is just beneath the submucosal layer and just above the investing prevertebral fascia, bleeding from that is generally easily controlled by electrocoagulation. The flap donor site in the posterior pharyngeal wall may be left open to heal spontaneously or closely approximated. But generally closure of the posterior pharyngeal wall is considered important for two reasons ; it reestablishes the sphincteric action of the pharyngeal wall by reconstituting the superior constrictor muscle, it appreciably decreases postoperative morbidity.

Lining flaps are constructed from the nasal surface of the soft palate. With a No. 15 blade, the nasal mucosa of the velum is separated from the submucosal plane along the entire extent of the

palate. The nasal mucosa is undermined, and blunt dissection is carried posterolaterally into the lateral pharyngeal wall to about the location of the palatopharyngeal muscle. A description showing the midline incision through the soft palate and a beginning incision of the lining flap is in Fig. 5.

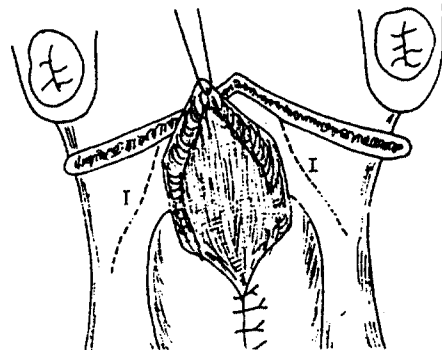


Fig 5. Closure of the posterior pharyngeal donor site

I : Incision for triangular lining flap

This technique use the mucosa of the nasal surface of the palate as a turnover flap based on the posterior margin of the palate to provide mucosal coverage of the raw surface of the superiorly based pharyngeal flap. The posterolateral extent of this triangular lining flap of nasal side is important in the control of the lateral port size and accordingly the effectiveness of this operation. The edge of the nasal mucosa of the soft palate most laterally adjacent to the bed of the elevated lining flap is sutured to the lateral margin of the pharyngeal flap to control the size of lateral port. The maximal velopharyngeal port opening during clinically normal speech is known to be less than 20mm^{2,3)}. When lateral wall movement is good, the dimension of the lateral port is left relatively large, and when lateral wall movement is absent, it is made small as 5mm² or so¹⁻³⁾. This subject proved to have good lateral pharyngeal wall movement and the size of lateral port was decided to be 20mm². This is accomplished by suturing the lateral margin of a superiorly based pharyngeal flap to an incision in the lateral phary-

ngeal wall so that it is snug around a No. 14 French catheter, which is inserted through the nose and secured with ligature (Fig. 7, 8).

After construction of the port on each side, the remaining margin of the pharyngeal flap is sutured to the nasal mucosa of the soft palate. The lining flaps are brought over the raw surface of the pharyngeal flap and sutured to each other in the midline with 4-0 Vicryl sutures. The suturing of the pharyngeal flap into the entire width of the palate is done. Final stage of the operation is presented in Fig. 9, 10.

Immediate postoperative management of the airway is critical because the nasopharyngeal airway has been significantly compromised by the pharyngeal flap operation and its associated edema. A silk suture is placed through the tongue for anterior retraction after removal of the orotracheal tube, if necessary, to prevent the airway obstruction^{1,3)}. After extubation, an oropharyngeal airway is placed between the teeth laterally and taped to the face so as to avoid damage to the repaired palate^{1,5)}. Suctioning of the oropharynx is carefully done with a soft catheter so as not to injure the donor site or the pharyngeal flap, and masking with an oropharyngeal airway is recommended.

Retention of the nasal tubes controlling the size of the lateral ports for 24 hours should be done so they can suction secretions from the pharynx and occasionally even provide an airway¹⁾.

Records of 7 patients treated with the modified superiorly based pharyngeal flap for VPI are reviewed in Table 1. All patients underwent physical management of their VPI via a modified superiorly based pharyngeal flap. Physical status, age, gender of the patients were examined. Three patients underwent modified superiorly based pharyngeal flap operation plus primary palatoplasty. Among them two patients turned out oroantral fistula, therefore tongue flap and turnover flap operation was done and finally closed without problem.



Fig 6. Closure of the posterior pharyngeal donor site

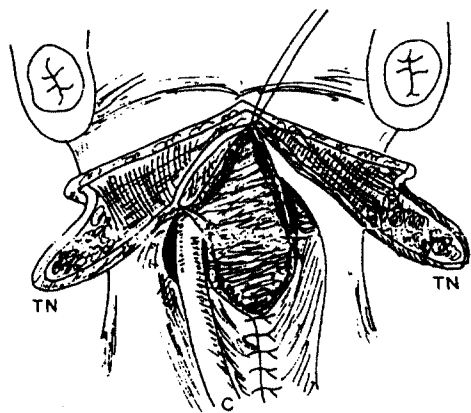


Fig 7. Triangular lining flap and lateral port control

TN : Triangular lining flap of nasal side of the velum

C : Catheter for lateral port control

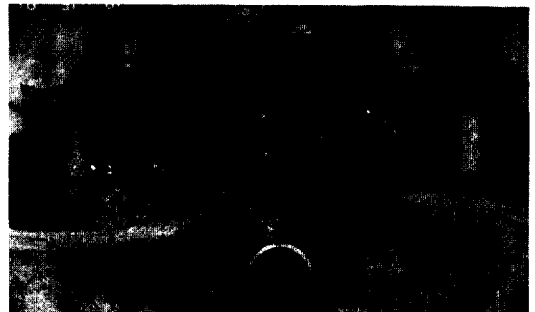


Fig 8. Triangular lining flap is taken and retracted, 14 French catheter is inserted for lateral port control

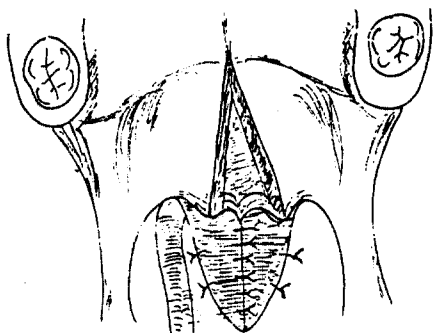


Fig 9. Mucosal coverage of the raw surface of the pharyngeal flap with triangular lining flap



Fig 10. Immediate postoperative view of the modified superiorly based pharyngeal flap operation

Table 1. Seven cases of VPI treated with the modified superiorly based pharyngeal flap operation

Pt.	Age	Sex	Op. date	Diagnosis	Operation	Complication	Speech result
1	5	M	87. 1. 16	VPI	SBPF	—	Good
2	12	F	88. 1. 18	VPI cleft palate	SBPF palatoplasty	—	Good
3	13	F	89. 1. 17	VPI	SBPF	—	Good
4	23	F	89. 12. 21	cleft palate VPI	palatoplasty + SBPF	Oroantral fistula	Good
5	13	F	90. 8. 14	VPI	SBPF	—	Excellent
6	21	M	91. 3. 18	cleft palate VPI	palatoplasty + SBPF	Oroantral fistula	Fair
7	20	M	91. 10. 18	VPI	SBPF	—	Good

III. DISCUSSION

The objective of surgery performed on VPI is to provide an apparatus which will permit the development of normal speech. Cleft palate speech consists of the primary precipitating components; hypernasality and nasal air escape, and the secondary compensating components; tongue positioning, glottal stops, pharyngeal fricatives, nasal grimacing^{1,2)}. The patient with hypernasal speech or demonstrable nasal air escape may be caused by as followings; idiopathic insufficiency of the musculature, congenital palatal insufficiency, submucous cleft palate, result from repair of the palate, after pharyngeal flap or pharyngoplasty, after adenoidectomy, enlarged tonsil, after midface advancement, neurogenic conditions affecting the pattern of closure, lack of velopharyngeal sphincter movement and functional hysteric hypernasality^{2,3)}. Evaluation of velopharyngeal function is being currently approached by the use of the fiberoptic nasoendoscopy which enables the continuous monitoring of velopharyngeal patencies as a time-varying function so permits the analysis of timing relationship between the velopharyngeal orifice size and speech production^{2,4)}.

The origin of pharyngeal flap surgery could be traced to the techniques of Passavant. The first

true transfer of tissue flap from the pharynx was described by Schoenborn which was inferiorly based²⁻⁴). The superiorly based flap was first introduced by Bardenheure in 1892, and its popularization was generally credited to Sanvanero-Rosselli in 1935²). Although studies have failed to show any significant difference in the two techniques, the advantages of the superiorly based flap include the ability to construct a flap of any length, a more normal situation because the flap tends to elevate rather than depress the soft palate, and postoperatively the raw surface is accessible if bleeding occurs³).

In 1973 Hogan designed lateral port control technique, that is to control the surgically constructed lateral port for appropriate speech and nasal air escape¹⁻³). And different lateral port size according to the movement of lateral pharyngeal wall was suggested by Johns and Salyer in 1977³). This provided high success rate in obtaining velopharyngeal competence, but this high rate of success is also associated with a high incidence of significant nasal airway obstruction. In addition closure of the pharyngeal donor site does narrow the pharynx and provides a pharyngoplasty effect, it occasionally results in sleep apnea³). The width of the pharyngeal flap which is important in the size of lateral port is determined by the amount of lateral wall movement noted during the preoperative evaluation^{1,3,7}). If there is minimal lateral wall movement, the flap is made at least 75% of the width of the posterior pharyngeal wall. Conversely, if there is adequate lateral wall movement, the flap is made approximately 50% of the width of that⁷).

The most commonly reported postoperative complication is obstructive sleep apnea so following measures should be considered; apnea monitors, a nasopharyngeal airway, the use of silk sutures through the tongue and overnight observation in the intensive care unit^{1-3,9,10}). Postoperative hemorrhage is another reported major complication status after pharyngeal flap surgery. The most common

culprits causing hemorrhage are the posterior pharyngeal vein, ascending pharyngeal artery and internal carotid artery, but the mean value of the distance of the internal carotid sheath to the lateral pharyngeal wall was reported to be 10.06 ± 1.84 mm⁶). The indication for a prepharyngeal flap adenoidectomy include vary large adenoid mass that may partially occlude the lateral ports or make creation of the pharyngeal flap difficult, chronic eustachian tube dysfunction, recurrent respiratory infections or chronic nasal drainage, chronic sinus disease, and should be performed at least 6 weeks before³). Dehiscence of the pharyngeal flap may occur as a result of postoperative infection or when the flap is of inadequate length, causing too much tension. In our case presentation, two patients who underwent modified superiorly based pharyngeal flap plus palatoplasty simultaneously turned out oroantral fistula. These two patients had wide gap cleft. In such a wide gap, the surgical procedure would rather have been done in two stages³). Unsatisfactory postoperative speech at early period of follow-up improves after 1 year, so success rate is known to be 95% statistically⁷). The determining criterion for success with pharyngeal flap surgery is the degree of the symmetry and vertical level of the lateral pharyngeal wall motion in relation to flap placement⁷). The timing for flap operation seems to be very important in the prognosis^{2,3}). When to close the palate surgically is controversial. Studies tend to indicate that the earlier the palate is repaired and velopharyngeal competence is established, the better the resultant speech will be. But early surgical repair increases abnormalities in facial growth, increases maxillary arch collapse and exacerbates orthodontic problems. The current philosophy is that secondary correction of speech disorder is usually easier than secondary correction of disorders of facial growth and occlusion³). In general the optimal timing for correction of VPI is known as between 3 and 6 years of age. At this age children can easily adapt to their new velopharyngeal me-

chanisms and enter school with normal speech¹⁾. Therefore long span programmed therapy should be performed by a team approach including speech therapist, orthodontist and surgeon for an optimal overall management of cleft disorders.

IV. SUMMARY

The cases of 7 patients who had been diagnosed VPI and surgically managed with the modified superiorly based pharyngeal flap was presented. Although we have got the limited cases and short period of follow-up, the following findings and conclusions can be drawn from clinical experiences and review of articles.

1. We could get the good speech result in the patients of VPI using modified superiorly based pharyngeal flap operation.
2. The surgical management of VPI is best performed at between 3 and 6 years of age.
3. Preoperative assessment, diagnostic protocol, surgical technique and patient care are very important in the management of VPI.

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상부기저형 인두피판을 이용한 구개인두 부전증의 외과적 처치

대구 파티마 병원 치과·구강악안면외과
안재진·장세홍·우성도·박지희

선천성 혹은 수술성 기형으로 발생하는 구개인두 부전증은 구강과 비강사이의 부적절한 폐쇄기능으로 인해 파비움 등의 발음장애를 초래한다. 그 원인으로는 구개파열, 인두비대증, 편도선절제술후의 구개와 인두의 비율 부조화, 구개인두 팔약근의 기형, 구개부전마비, 연구개 결손, 상악골 전진 절단술 등이 있다. 구개인두 부전증의 진단에는 임상적, 방사선학적 검사와 더불어 섬유광학 비내시경을 이용한 구개인두의 기능검사가 강조된다. 수술방법으로는 구개성형술, 인두증강술, 인두성형술, 인두피판술 등이 있다. 근자에는 상부기저형 인두피판술이 널리 사용되고 있는데, Hogan등이 개선시킨 술식에 의하면, 넓고 긴 피판을 얻을 수 있고 피판의 Raw surface를 연구개의 비강측 점막으로 덮을 수 있으며 측방 통로를 조절할 수 있다는 장점이 있다.

이에 저자들은 본원에 내원한 구개인두 부전증 환자 7례에서 상부기저형 인두피판을 이용하여 구강과 비강 사이의 측방 통로를 적절히 조절함으로써 발음을 개선시켜 본 바 양호한 임상성적을 얻었기에 보고하는 바이다.