

Cerclage and sphincter pharyngoplasty techniques for management of velopharyngeal insufficiency: How I do it?

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The activities of swallowing and speaking depend upon the ability to achieve adequate closure of the velopharyngeal (VP) port. Swallowing and speaking are complex motor skills that involve the coordination of diverse groups of muscles between the nasopharynx and oropharynx. Various conditions can affect VP closure function including an adenoidectomy operation. Defects in the VP sphincter can affect the patient's speech in many ways – for example, induction of hypernasality, decreased speech intelligibility, and nasal emissions. Three main surgical approaches to VP corrective surgery can be used – namely, pharyngoplasty, pharyngeal flap, and posterior pharyngeal wall augmentation. The author of this study designed a new procedure called cerclage sphincter pharyngoplasty to be added for correction of VP insufficiency. Maximum benefit can be achieved when the surgical technique takes advantage of the remaining native VP closure. As pharyngeal flaps are not functional and have multiple drawbacks and because posterior pharyngeal wall augmentation is successful only in case of minor defects, the author focuses on functional techniques used for correction of different closure patterns and grades – namely, cerclage and sphincter pharyngoplasty.

Keywords:

cerclage sphincter pharyngoplasty, pharyngeal flap, pharyngoplasty, sphincter pharyngoplasty, velopharyngeal insufficiency

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Introduction

Velopharyngeal (VP) valve closure is a crucial function in every moment of our day-to-day activities including speech, swallowing, and straining. Six muscles are involved in the efficient dynamics of velar mechanism; these muscles can primarily be divided into palatal and pharyngeal muscles. The palatal muscles include the levator veli palatini, the tensor veli palatini, and the uvularis (musculus uvulae). These muscles work to raise the palate in a superior and cranial direction for velar competence. All these muscles together form a three-dimensional muscular valve known as the VP sphincter [1]. The patterns of VP closure; that is, coronal, sagittal, circular, and circular with passavant's ridge, depend on the degree to which each of these components of the sphincter is active during closure [2,3].

The inability of the VP sphincter to close completely during production of oral (non-nasal) sounds of speech can be referred as velopharyngeal insufficiency (VPI) [3]. The primary effects of VPI are nasal air escape and hypernasality. Secondary effects of VPI include speech articulation errors (distortions, substitutions, and omissions). These effects combine to reduce the intelligibility of speech [4]. Facial grimacing, nasal regurgitation, chronic rhinosinusitis, and otitis media are other conditions associated with the impairments in VP function [4].

In patients with an impaired VP function, speech analysis is usually performed by a speech/language pathologist trained in assessing speech in patients with VPI. Speech

variable assessment includes evaluation of hypernasality, hyponasality, weak pressure consonants, glottal stops, pharyngeal fricatives, nasal fricatives, velar for dental plosives, and palatal for dental plosives [5]. In addition, another crucial objective assessment must be carried out using nasopharyngeal [4] and oral endoscopy for VP valve closure (e.g. by the same speech/language pathologists who evaluated the speech and the surgeon who will perform the operation). In the latter assessment, the closing activity (according to a five-point scale, 0–4), asymmetry, and shape of closure can be determined [6].

When VPI exists, the treatment is often surgical. The treatment falls into two categories, prosthetic and surgical. Prosthetic management can be utilized in patients who do not have a structural cause for their VPI (e.g. neuromuscular etiology) or have contraindications to surgical intervention.

Partial obstruction, either temporary or permanent, of the VP gap is the unifying attribute of most existing operative management strategies for VPI. The choice of either of the two broad categories options for VPI depends on the patient's specific diagnosis. The first strategy involves lengthening the palate by retropositioning the velum, which can be achieved with a V-Y pushback procedure, an intravelar veloplasty [7] or a double-opposing Z-plasty [8], and a palatal re-repair [9]. The second strategy, which is the most commonly performed operation, is reduction of the static opening between the nasopharynx and the oropharynx [10,11] and is considered a VP narrowing procedure. It may be accomplished with a pharyngeal flap,

sphincter pharyngoplasty, or retropharyngeal and velar augmentations. The author of this study designed a new surgical technique for the treatment of VPI, namely, cerclage sphincter pharyngoplasty [12]. During the past 15 years, the surgical procedure for correction of VPI was tailored according to the defect exhibited by the patient and the manner of closure. In contrast to all the above-mentioned VP procedures, cerclage sphincter pharyngoplasty is not a passive narrowing procedure [12]. It is a dynamic procedure using the normal muscles in place with no disturbance to different surrounding structures [12].

The author uses the sphincter pharyngoplasty and cerclage sphincter pharyngoplasty as 'work horses' procedures for management of all patients with VPI.

Timing of surgery

Surgical management of the velopharynx should only be performed when the diagnosis of VPI has been firmly established. In such cases, speech therapy is not of value. There is diminutive value in delaying surgery once the diagnosis has been confirmed as long as there are no critical reasons (e.g. systemic anomalies and cardiovascular or airway instability) to prohibit the surgery.

Positioning

In the operating room, both procedures can be performed under general anesthesia. The patient is placed in the supine position with the neck extended. A Dingman mouth gag is used while the patient is in supine position, which allows wide visualization of the oral cavity as well as access to the oropharynx and nasopharynx [12–14].

Mapping and concept of the operations

Before the first incision is made, an inspection for aberrant carotid artery pulsations in the pharynx must be carried out. This is particularly important in children having medially displaced internal carotid arteries, as observed in those with velocardiofacial syndrome (deletion 2q11.2) [13]. Cautious planning of the site of VP sphincter closure is imperative in both procedures. Moreover, mapping the degree of its closure is essential before proceeding with the procedure to minimize the risk of underestimated or overestimated closures [12]. In cerclage sphincter pharyngoplasty [12], double-level circular sutures allow backward displacement and stretching of the velum posteriorly, the lateral pharyngeal walls (LPWs) medially, and the posterior pharyngeal wall (PPW) anteriorly. Thus, the cerclage permits stretching of the main velum closure muscles (the palatal tensor, the palatal levator, and the superior pharyngeal constrictor). At the same time, it decreases the needed gap for closure. In contrast, in sphincter pharyngoplasty, creation of bilateral superiorly based myomucosal flaps elevated from the LPWs will be the tissue for advancement of the designed sphincter. The components of the flaps include the palatopharyngeus (posterior tonsillar pillars) muscle, the superior constrictor (PPW) muscle, or both muscles [12–18]. The surgeon may shift the position of the flaps more medially depending on the amount of

desired augmentation, as determined on instrumental assessment.

Use of methylene blue allows marking of the proposed level of suturing in cerclage operation as well as the PPW closure site in sphincter pharyngoplasty, which can be performed with a curved needle preoperatively.

Field exposure

The soft palate is retracted into the nasopharynx through two small-sized catheters passing through both nasal cavities to the nasopharynx. Suturing of the oral surface of the base of the uvula to both catheters allows retraction of the caudal margin of the soft palate, including the uvula, into the nasopharynx [14]. After the surgical sites have been determined preoperatively with methylene blue, local anesthesia along with a vasoconstricting agent (mepivacaine HCL 2% and levonordefrin 1:20 000) is injected by means of a dental syringe while avoiding blood vessels.

In cerclage sphincter pharyngoplasty, the injection can be administered at the proposed sites of suture cerclage insertion, whereas in sphincter pharyngoplasty the injection is to be administered at the flaps sites and at the PPWs [12].

Operative procedure

Cerclage sphincter pharyngoplasty [12]

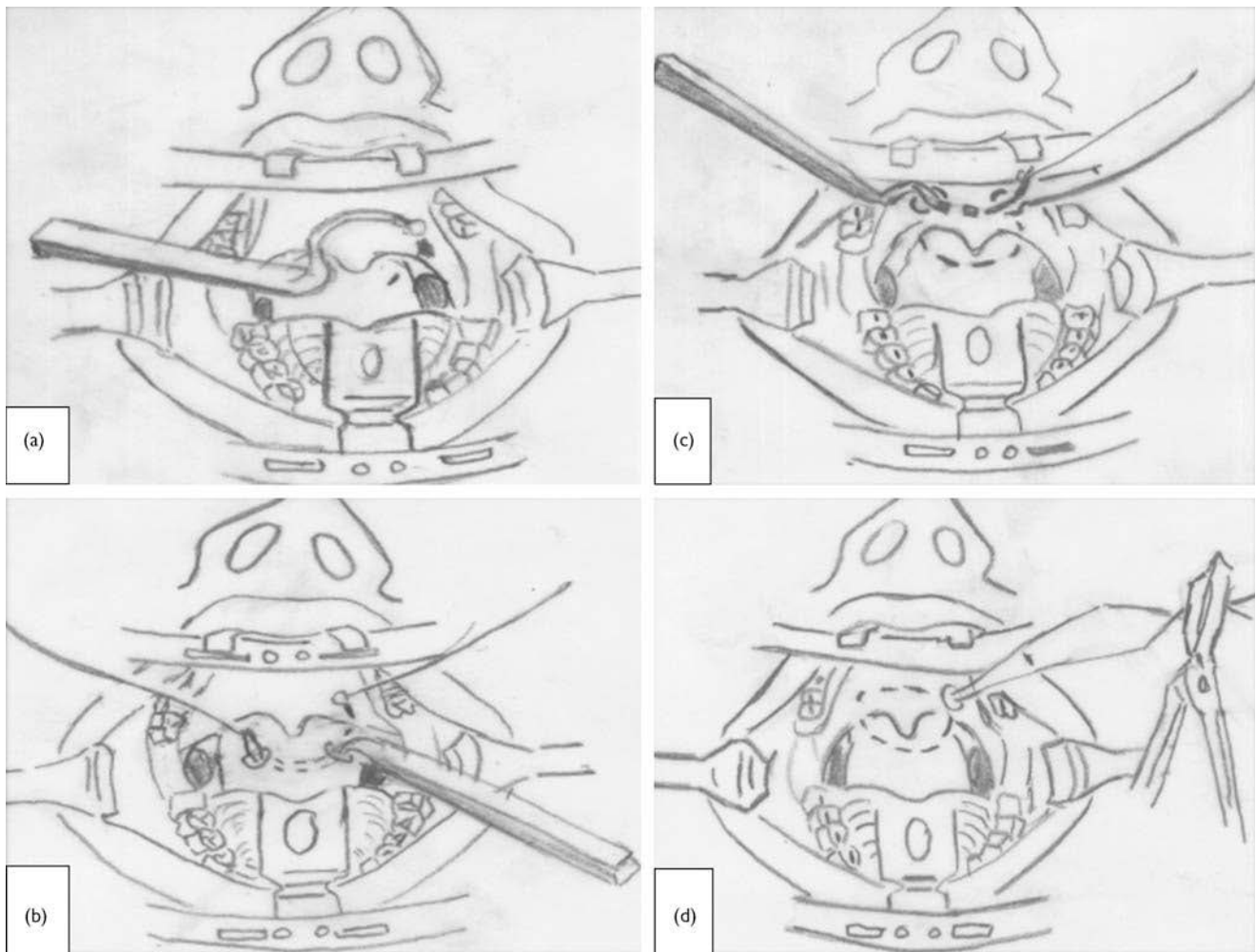
In these operations, two levels of cerclage can be designed: the first is at the level of the junction of the posterior and middle one-third of the soft palate passing through the left LPW of the soft palate, the PPW, the right LPW, and the soft palate; and the second level is at 3 mm in the front, below the first level (Fig. 1).

A special swan neck needle (long curved needle with a lengthy handle) designed for this purpose threaded with 1–0 polypropylene suture material can be used.

Starting from the left side of the soft palate, the needle can be inserted at the junction of the soft palate and the LPW (at the level of the junction between the posterior and middle one-third of the soft palate) (Fig. 1a). Selection of the cerclage site to be positioned between the middle and the posterior one-third of the soft palate facilitates the velum to close at the active site of closure. Moreover, it lends a handed traction of the levator veli palatini muscle (the major elevator of the velum), which occupies the intermediate 40% of the length of the soft palate. Passing behind the muscles of the lateral and PPWs, the needle comes out at the right corner of the PPW (Fig. 1b). Thereafter, passing behind the muscles of right LPW and the soft palate, the needle comes out at a point same as that of the insertion (Fig. 1c). A second cerclage suture will be repeated, starting 3 mm in front of the starting point of the first one. After adjusting the size of the VP valve closure, each suture end (in each ring) is tied together (Fig. 1d). The degree of tightness depends on the degree of preoperative closing activity.

Use of nasal endoscopy allows observation of the required degree of tightness. Each cerclage would bring the four walls near each other like a sphincter. The knots are

Figure 1



Cerclage sphincter pharyngoplasty technique with two cerclage rings: (a) Starting from one side of the soft palate, a special swan neck needle with a long handle threaded with 1-0 polypropylene suture material is inserted laterally at the level of the junction between the posterior and middle one-third of the soft palate, reaching behind the muscles of the lateral pharyngeal wall. (b) The needle passes behind the muscles of the lateral and posterior pharyngeal walls. (c) After passing from the other lateral pharyngeal wall, the needle passes through the soft palate and then comes out at a point same as that of the insertion. (d) One cerclage with two end sutures is formed, and the suture ends of each ring are tied together. The same procedure can be repeated at a distance of 3–5 mm for another cerclage ring.

secured and buried. The burial site is closed with absorbable sutures (coated vicryl 4-0).

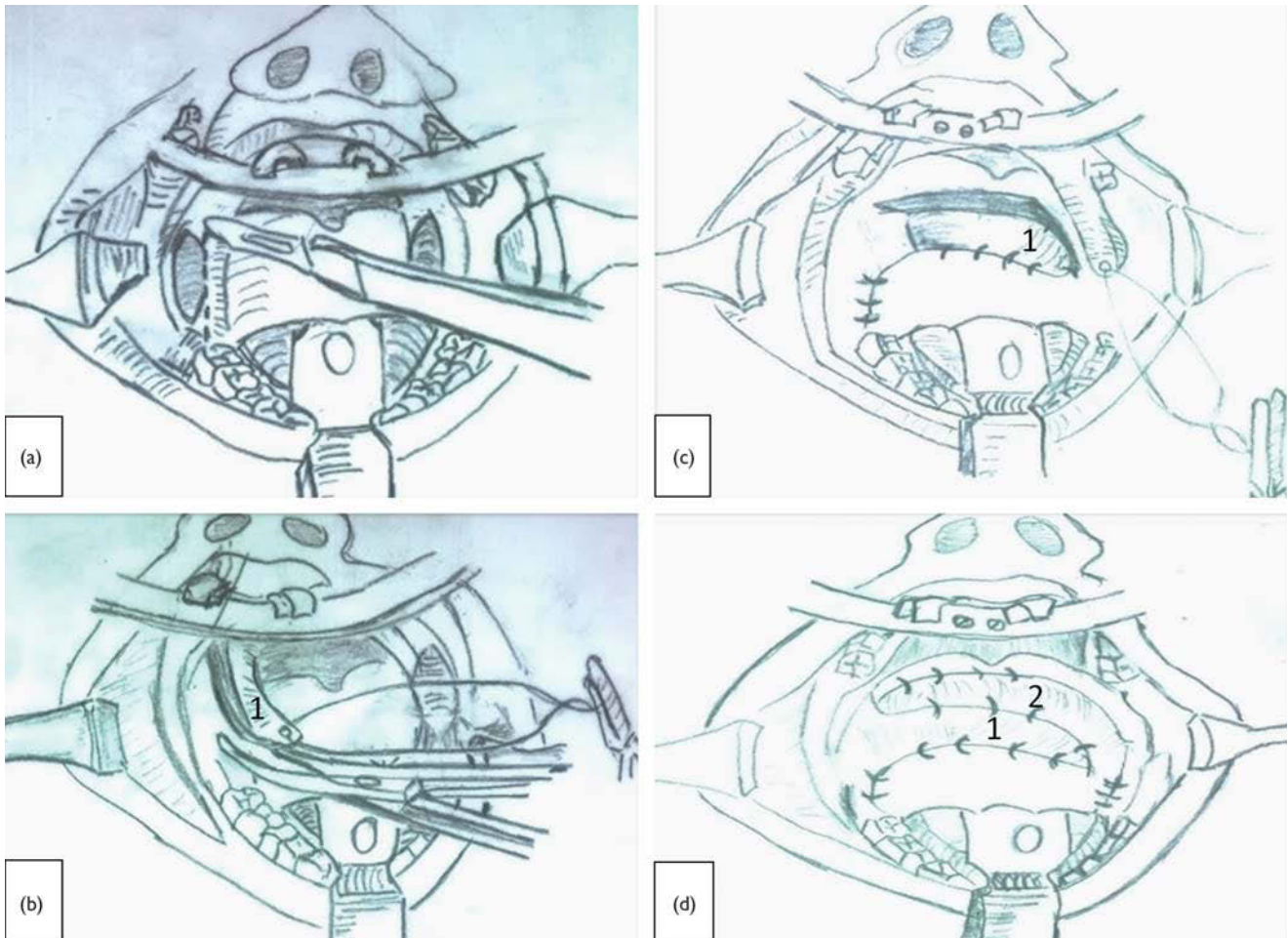
Sphincter pharyngoplasty [13–18]

Lateral flap design: After retraction of the tonsillar tissue laterally, an initial incision is made through the mucosa along the junction of the posterior pillar and the tonsillar fossa (Fig. 1b). While grasping the pillar with forceps and pulling it medially, a dissection is made with the ends of a pair of scissors that are pointed posteriorly and medially (Fig. 2a). The dissection of the muscle is progressed to incorporate the required amount of the palatopharyngeus within the flap. As the muscle is separated from the lateral wall, the underlying horizontally oriented fibers of the superior constrictor muscle can be seen, deep beneath which lies the ascending pharyngeal artery [14]. The motor nerve of the palatopharyngeus from the vagus enters the muscle at the base of the flap [14].

The medial incision is created, and the muscles are bluntly dissected to the level of the alar fascia. The muscles are then dissected from the alar fascia such that the distal aspect of the flap is completely elevated. A suture guide with vicryl 3/0 sutures at the distal tip of the flap can be inserted to pick up the flap before division of the distal tip of the flap with scissors (Fig. 2b). The length of the flap can be adjusted to achieve the desired amount of PPW augmentation. The contralateral flap is then created in a similar pattern.

Flap site inset: The flap site inset consists of a simple transverse incision from the superior end of one medial flap incision to the other. It is placed at the level of the body of the first cervical vertebra. The more cephalic the level of the inset incision, the better is the outcome. However, the adenoidal mucosa of the PPW is a limiting landmark. Avoidance of the adenoidal mucosa is mandatory. The friable adenoidal mucosa holds sutures poorly and is prone to profuse bleeding. A 5–10-mm strip of mucosa is excised

Figure 2



Sphincter pharyngoplasty technique: (a) Flap 1 design starting with a lateral limb incision. The palatopharyngius muscle with or without sector of the superior constrictor is dissected down to the alar fascia. (b) The medial incision is created for flap 1, and the muscles are dissected from the alar fascia. The distal tip of the flap (1) are retracted with sutures and divided with scissors. (c) A transverse recipient bed is created by excising a 5–10 mm of the mucosa between two transverse incisions. The superiorly based flaps (1) are transposed 90° over the demucosalized recipient bed and sutured with vicryl sutures to the inferior limb of the transverse incision. (d) The other side flap (2) is transposed superiorly to the other flap and sutured at its apex. Thereafter, suturing is performed through the superior margin of the flap with the transverse incision. This is followed by suturing of the two flaps (1 and 2) together.

between the limbs of the two incision sites creating the recipient bed. Care should be taken to excise only the mucosa such that projection of the neosphincter into the nasopharynx is maximized. A slight movement of the blunt tips of the scissors will separate the edges of the transverse incision, and the dissection is progressed posteriorly to the level of the prevertebral fascia.

Suturing: Interrupted 3–0 vicryl sutures are used for the entire closure. A needle with a decreasing radius of curvature should be used. The donor sites are closed with interrupted sutures after checking for hemostasis, especially caudally. One flap is rolled at a right angle, and its tip is sewn into the contrary corner (Fig. 2c). Its cephalic edge is then secured to the upper edge of the transverse incision. The other flap is transposed in an analogous manner, and its tip is fixed into the opposite corner of the transverse incision (Fig. 2d), crisscrossing the flaps. The inferior aspect of the inferior flap is secured to the inferior margin of the recipient bed. Finally, the inferior aspect of the

superior flap is sutured to the superior aspect of the inferior flap with interrupted vicryl sutures. The result is a central, lined, small port and a transverse mound created by the overlapping palatopharyngeal flaps, high across the PPW.

The size of port closure should be assessed with nasal endoscopy after extraction of the catheters to determine any undersized or oversized closure. The nasopharyngeal airway should be secured to ensure patent airways until the patient recovers.

Postoperative care

The cerclage sphincter pharyngoplasty sphincter pharyngoplasty procedure takes about 1½–2 h. The child will have to stay in the hospital for 1 day. In the first few days after the surgery, the child will have a sore throat, will snore, and will not sleep well. Therefore, a 45° sleeping position is advised. These symptoms will alleviate over the next 2 weeks. Although it is better to avoid hard foods after surgery, there are no particular foods that a child should avoid. Post-

operatively, patients are allowed to progress to a regular diet as tolerated. In general, patients are observed during a postoperative visit 1 month after surgery. A perceptual speech assessment is performed 3 months after surgery, and at this time speech therapy can be started.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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