Oral Endoscopic Comparison of Velopharyngeal Closure Before and After Pharyngeal Flap Surgery

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Velopharyngeal dynamics of a sample of patients with lateral pharyngeal walls that approximated were examined endoscopically before and after pharyngeal flap surgery. These patients generally appeared to have less movement after surgery, and possible anatomical and physiological reasons for this are hypothesized. Prescribing a “narrow” flap for patients with considerable lateral wall movement should be avoided because there is the possibility that surgery might reduce the amount of lateral wall motion observed.

KEY WORDS: Velopharyngeal physiology, pharyngeal flap

Mesial movement of the lateral pharyngeal walls appears to be principally responsible for lateral port occlusion subsequent to pharyngeal flap surgery. Skolnick and McCall (1972) examined 33 patients after pharyngeal flap surgery, of which approximately two-thirds (22) evidenced velopharyngeal incompetence. They found that 14 of these 22 patients had insufficient movement of both lateral pharyngeal walls and eight had incompetence in one portal. In seven of these patients incompetence was attributed either to incorrect vertical positioning of the flap relative to maximum lateral wall excursion or to asymmetrical positioning of the flap. Since nearly two-thirds of the group seemingly had reduced and limited lateral wall motion after surgery, a much higher percentage than generally seen in a cleft palate or normal population (Zwitman et al., 1976), a question may be raised concerning the degree of lateral wall motion that occurred preoperatively.

Shprintzen et al. (1979) concluded that flap width or the type of surgical procedure might be selected on the basis of the degree of mesial lateral wall movement prior to surgery. Although this would be an advance in surgical planning, it assumes that a person who has significant lateral wall motion before surgery will continue to retain the same degree of motion post-surgery.

LATERAL WALL MOTION PRIOR TO SURGERY

In a prior study, lateral wall movement in normal subjects was classified into four categories based upon the degree of medial excursion (Zwitman et al., 1974).

Category 1: Lateral walls move slightly or not at all. Velum touches the posterior wall at midline, and lateral openings are observed during phonation. (Figure 1)

Category 2: Lateral walls move medially, filling the lateral pharyngeal gutters and fusing with the raised velum as it contacts the posterior wall. (Figure 2)

Category 3: Lateral walls almost approximate each other with the velum contacting the lateral walls and partly occluding the space between them. A small medial opening is observed in some cases. (Figure 3)

Category 4: Lateral walls move medially and contact each other, resulting in a purse-string closure as the velum touches the approximated lateral walls. (Figure 4)

In a subsequent study utilizing an endoscope, variation in the degree of lateral pharyngeal wall movement seen in normal indi-

FIGURE 2. Category 2 lateral wall motion (l-lateral wall, v- velum, p- posterior pharyngeal wall).

FIGURE 3. Category 3 lateral wall motion (l-lateral wall, v- velum, p- posterior pharyngeal wall).


either directly or indirectly impede the function of the muscles responsible for pharyngeal constriction.

Whether based superiorly or inferiorly, the flap is usually constructed by first making two parallel incisions anterior to the pre-vertebral fascia. These incisions extend generally from the level of the torus tubarius to the middle constrictor muscle. Therefore, the flap is likely to contain superior constrictor and palatopharyngeal muscle fibers. Moreover, we do not know what effect a permanently elevated velum has upon levator palatini function, or

individuals was also observable in those who had velar inadequacy (Zwitman et al., 1976). Variations in lateral wall movement have also been found by other researchers (Skolnick et al., 1973; Iglesias et al., 1980; Croft et al., 1981).

Since lateral wall movement appears to vary across normal and cleft palate subjects, patients with Category 3 and Category 4 lateral wall motion might conceivably be candidates for a narrower pharyngeal flap. Data is required, however, concerning the possible effect that a pharyngeal flap may have upon lateral wall motion, since the pharyngeal flap donor site is created in an area that may
whether closing the flap donor site as recommended by Barsky et al. (1964) and May (1971) affects pharyngeal contraction. It is the purpose of this paper to study patients with considerable lateral pharyngeal wall motion prior to and then after surgery to determine if mobility of the lateral walls is affected.

Method

Fourteen patients with pharyngeal flaps who pre-operatively had evidenced lateral wall movement past the sides of the velum (Category 3) were examined. They ranged in age from seven to thirty-six years with a mean age of twelve years. Prior to surgery, combined posterolateral and lateral pharyngeal wall movement was observed in nine patients, while lateral wall motion only occurred in five patients.

The Berci/Ward oral endoscope (Storz 8700D or 8702D) attached to a Beaulieu R16 camera was used to record pharyngeal wall movement before and after surgery. Patients with pharyngeal flaps were observed at least six months post-operatively to allow for the dissipation of edema. Each patient pronounced repetitively the words “a papa pup” to allow for visualization of sustained closure. Each port was necessarily studied individually because of the scope’s limited viewing area. It was usually a simple process, however, to move right and left to visualize both ports.

Surgical Protocol

Two surgeons each performed seven of fourteen operations. Although both raised equal wide-based superior flaps, one surgeon sutured the pharyngeal flap to the nasal surface of the velum, lining it with a nasal velar flap, and partially closed the donor site of the pharyngeal flap. The other surgeon brought the flap through the velum after making a coronal incision through the soft palate about 1½ cm. from the free margin, suturing the flap to the oral surface of the palate. He did not close the donor site. The two surgical procedures were compared, especially with regard to the possible effect of donor site closure on lateral wall movement.

Results

Lateral pharyngeal wall motion was reduced after surgery from Category 3 to Category 1 or 2 in thirteen of the fourteen patients. Lateral wall motion that occluded or nearly occluded the ports was noted in ten patients (Figures 5, 6, 7), and in three others no lateral wall motion was evident (Figures 8, 9 and 10).

Lateral wall motion alone or in combina-
FIGURE 7. Port occluded by the lateral pharyngeal wall but movement is limited and just occludes the port (L- lateral wall, V- velum, P- posterior pharyngeal wall).

FIGURE 8. Inadequate velopharyngeal closure during phonation (prior to pharyngeal flap surgery). Posterior aspect of the velum (v) is partially visible. Lateral walls (l) move medially and posterolateral walls (p) move anteriorly forming separate segments of the v/p sphincter.

FIGURE 9. Right port of patient’s pharynx in Figure 8 post pharyngeal flap surgery during rest. (v-velum; p- posterolateral wall).

FIGURE 10. Closed port during phonation. Lateral wall motion is absent, and closure results from velar and posterolateral wall contact.

Port while lateral wall motion occluded the other, or lateral wall motion could totally occlude one port and partially close the other. In two cases where lateral wall motion was absent, posterolateral wall motion and velar elevation combined to occlude or nearly occlude the pharyngeal ports.

Only one of the fourteen patients had Category 3 motion, but on one side only. He had a narrow pharyngeal flap with a large right
port and a smaller left one. The right lateral wall was observed to move past the sides of the velum and occlude the port completely. Lateral wall motion appeared to be more limited on the left, but also occluded the port.

Two of the fourteen patients were hypernasal after surgery. One had no pharyngeal wall movement and had large pharyngeal ports, and in the other, partial port constriction was accomplished by posterolateral wall motion and velar ascent.

Another three patients also had incomplete port closure, but were not hypernasal. However, two of them evidenced very slight apertures during phonation since one had some lateral pharyngeal wall motion, while in the other patient posterolateral and velar elevation totally occluded the port on one side and partially closed it on the other side. Thus, only one of the three patients was left with partially open ports during phonation yet normal speech.

Since lateral wall motion had been significantly affected during surgery in both groups, it could not be determined whether closing the donor site further impeded lateral wall motion.

Posterolateral wall motion was also reduced significantly in all patients. It seemed likely that the middle posterior section of the posterolateral wall now composed part of the pharyngeal flap, and that it was the lateral aspect of the posterolateral wall that continued to move anteriorly and medially to limited degrees, closing the pharyngeal ports.

Discussion

The information obtained in this study fails to support a general hypothesis that patients with Category 3 lateral wall motion are candidates for a "narrow flap" because lateral wall approximation will occlude the large pharyngeal apertures remaining after pharyngeal flap surgery. Instead, our study indicates that marked lateral pharyngeal wall motion may be reduced or eliminated during the surgical process.

This finding seems to contradict the data reported by Shprintzen et al. (1979) who found no severe reduction in lateral wall motion. Nine of sixty patients in their study had excellent lateral wall motion, and therefore were provided with a pharyngeal flap anticipated to narrow after surgery. The reason for this contradiction might be the differing surgical approaches, but this is unlikely since wide pharyngeal flaps were elevated in their cases as well. Shprintzen et al. (1979) did not actually advocate using a narrow flap for their patients, but chose a surgical procedure where narrowing of the flap was anticipated over the post-surgical period. Therefore, it would be interesting to know at present whether the pharyngeal flaps narrowed to the degree anticipated and whether the lateral walls continued to compensate for the narrowing flaps.

The finding that pharyngeal flap surgery may curtail lateral wall motion raises the question why it has this effect. One possibility is that port size may have reduced lateral wall motion as the lateral walls adjusted to the confining ports. However, this hypothesis does not explain why a number of subjects had only a near occlusion of the ports or complete loss of lateral wall motion. If the ports actually "confine" lateral wall movement, such confinement would have been visualized as overextention of the lateral walls below the ports. This was not observed.

It is more advantageous to examine velopharyngeal anatomy and physiology for possible reasons for post-surgical reduction of lateral wall movement. Controversy continues to exist as to whether lateral pharyngeal wall motion results from levator palatini muscle contraction and its displacement of the torus tubarius and attached salpingopharyngeal folds (Dickson, 1972), or from the contraction of the superior constrictor (Iglesias et al., 1980), or palatopharyngeus muscles (Last, 1978) at the level of the palatine plane.

In the present study, pharyngeal movement at and above the hard palate into the nasopharynx could frequently be observed because of limited velar elevation which did not obstruct the visual field. Our findings agreed with Hollinshead's (1968), who after extensive cadaver dissections, found large variation in the number of salpingopharyngeal fibers. The number of fibers ranged from none to large vertical bundles. We have also observed marked variation in the size of the salpingopharyngeal folds. The folds were usually larger for subjects with Category 3 closure than for subjects that had been previously observed with Category 2 closure.

At rest, the salpingopharyngeal folds were observed to either be partially recessed in the pharynx especially at the level of the palatine plane, or they protruded from the pharynx
along their vertical length up to the torus tubarius. During phonation, maximum displacement of the salpingopharyngeal folds always occurred at the level of the hard palate. Salpingopharyngeal fold movement appeared to be a passive action resulting from the contraction of the pharyngeal musculature behind it. Less medial displacement of the folds was also frequently present above the hard palate extending upward and outward to the torus tubarius.

Whether salpingopharyngeal fold movement was limited to a restricted level at the hard palate or encompassed the entire fold appeared to be related to the constitution of the folds (firm and straight muscle fibers). That is, passive medial movement of the salpingopharyngeal folds either was restricted to the area at the velum, which resulted in a shelf-like contraction of the lateral pharynx, or with increased fold "stiffness", there was broader passive movement of the folds extending above the palate to the torus. After radiographic analysis of three patients, Honjo (1976) concluded that maximum lateral wall displacement occurred at the level of the torus tubarius decreasing quickly to no movement at lower levels. We did not observe significant torus tubarius movement. However, if this movement is present in some people, Honjo's data indicates its effect on salpingopharyngeal fold displacement at the palatine plane appears to be minimal.

The above observations and anatomical information can help clarify the possible effect pharyngeal flap surgery may have on pharyngeal port closure. The sphincteric continuity of the velopharyngeal musculature at the level of the palatine plane appears vulnerable to disruption during construction of a pharyngeal flap as deep incisions are made into both the palatopharyngeus and superior constrictor muscles. Since the torus tubarius was not observed to actively move with the salpingopharyngeal folds prior to surgery, the possible limiting effect on levator function resulting from a less mobile velum after surgery seems irrelevant to port closure. In contrast, the size of the salpingopharyngeal folds appears to be a significant factor in port occlusion. Large salpingopharyngeal folds can provide muscular bulk that may partially occlude the pharyngeal ports at rest. When the subject phonates, these projected folds require less pharyngeal contraction behind them to move the necessary distance to occlude the ports. Since it appears from our observations and the study by Skolnick and McCall (1972) that pharyngeal contraction is reduced significantly by pharyngeal flap surgery, larger folds will likely better utilize residual pharyngeal contraction. Considering the small ports that remain after pharyngeal flap surgery, large folds plus limited pharyngeal contraction may be sufficient for adequate port closure and normal speech. However, if the ports increase in diameter or the flap is purposely constructed to narrow (tube), neither the mass of the folds nor their limited movement may prevent velopharyngeal insufficiency.

Although the salpingopharyngeal folds provide a primary source of pharyngeal mass used in port occlusion, the additional bulging of pharyngeal mucosa and underlying tissue during contraction of the superior constrictor and palatopharyngeus muscles and anterior medial movement of adenoid tissue, primarily displaced by posterolateral wall contraction, were observed to be two other sources of pharyngeal bulk that might assist in occluding the ports in some patients.

Since the pharyngeal flap is constructed by making incisions through the posterior pharynx to the prevertebral fascia, it may be questioned why all lateral wall motion is not eliminated in all subjects by such a major disruption of the continuity of the pharyngeal musculature. Pharyngeal motion after surgery might be explained by looking at the findings of Iglesias et al. (1980) who measured considerable lateral pharyngeal wall movement at the level of the inferior tip of the maxillary incisor, an approximate level at which the flap is transected and raised. Since the salpingopharyngeal folds insert into the middle pharyngeal constrictor below this level, it is possible that pharyngeal contraction below the flap may now be the primary source of medial salpingopharyngeal fold movement. However, there will likely be reduced movement since pharyngeal contraction at the level of the maxillary incisor as measured by Iglesias et al. (1980) was never as great as it was at the level of the palatine plane.

Subjects with extensive pharyngeal movement and greater pharyngeal mass are likely to be better candidates for pharyngeal flap surgery, not so much because of the extensive movement, since that will likely decrease after flap surgery, but because of the greater pha-
ryngeal mass that can be moved by residual pharyngeal contraction. We suggest that pharyngeal flap procedures be modified according to a single division depending upon whether the patient has none or very limited lateral wall motion compared to movement that at least occludes the pharyngeal recesses. Patients who have no motion might be candidates for surgical procedures designed to curtail all flap reduction, such as the sandwich flap described by Shprintzen (1979); however, patients with significant pharyngeal mass (especially salpingopharyngeal fold mass) with significant pharyngeal contraction that may at least partially remain after surgery, and/or presence of posterolateral wall motion, would not be selected for a procedure to prevent all flap reduction since there is a good possibility that the ports will be or nearly entirely occluded during phonation by residual pharyngeal contraction.

The construction of a pharyngeal flap that will likely tube to a narrow band, which can be expected if the flap is not properly secured or lined, should not be prescribed for patients who demonstrate lateral wall approximation (Category 3). At present, there is conflicting evidence as to the effect surgery has on pharyngeal contraction and this study suggests it can significantly reduce this movement.

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References