40. *Search for Dynamic Pharyngeal Flaps*

STANDARD pharyngeal flaps offer various passive advantages to an incompetent velopharyngeal sphincter. They act as a posterior velar tether and tractor, offer their substance as an obturator and, with donor area closure, reduce the size of the pharyngeal aperture.

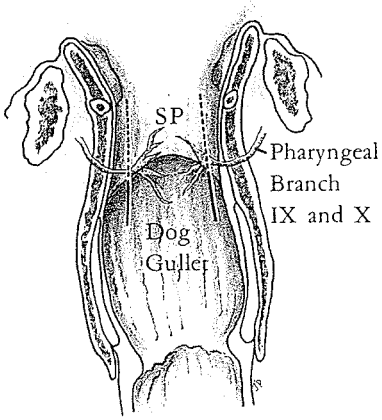
There were surgeons who were concerned about violating the posterior pharyngeal wall musculature. Randell Champion of Manchester, England, for instance, wrote in 1957:

> The pharyngeal muscles should be left undisturbed, as much as possible and if a pharyngoplasty operation is undertaken, the mucous membrane only should be used.

This, of course, removed any slight chance of flap contractile ability. Almost as long as pharyngeal flaps have been in use, surgeons have enjoyed wishful thinking that the constrictor muscle fibers, usually incorporated in these flaps, were capable of full cooperation and active contraction to lift the velum toward the pharyngeal wall during speech.

In 1959 Broadbent and Swinyard postulated that the pharyngeal flap is a dynamic structure, as demonstrated by electromyographic findings in patients in whom either superiorly or inferiorly based pharyngeal flaps had been used. By means of monopolar EMG needles inserted through the palate in the area of the flap, they observed normal motor unit potentials during swallowing. In 1972 Fára and Vele reported their EMG findings in a large series of inferiorly and superiorly based pharyngeal flaps.

Inferiorly based flaps tended to preserve their nerve supply and therefore their EMG activity, whereas superiorly based flaps were likely to become denervated.

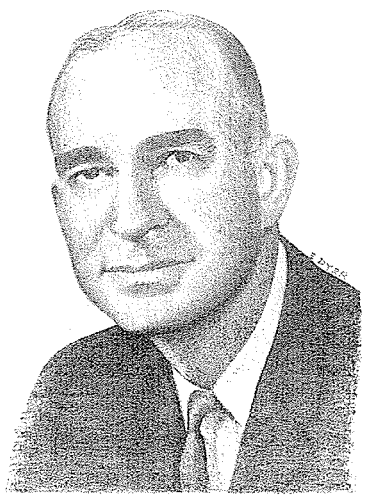


In 1971 Smith and Dedo, in dog dissections, found the nerve supply to the superior pharyngeal constrictor muscles. It enters at the midpoint of the lateral margin and thus would be divided during the development of any vertical pharyngeal flap whether the base was superior or inferior. In 1972 Owsley, Creech and Dedo performed clinical EMG studies in the operating room on anesthetized patients undergoing superiorly based pharyngeal flap operations. They concluded that the findings in humans and in dogs were similar:

> After both lateral incisions and division of the inferior end of the flap had been completed, the flap was elevated. Following this, we were unable to demonstrate any EMG potentials at any location in the flap.

Then there was the minor matter of muscle fiber direction. Weber, Jobe and Chase noted in 1970:

> Dynamic muscular contracture is also said to occur in pharyngeal flaps. . . . Since the muscle fibers are aligned transversely, it seems unlikely that contraction of the muscle would shorten the flap.



Fred McCoy

THE INNERVATED CHEVRON FLAP

Fred McCoy and Carroll Zahorsky of the University of Missouri School of Medicine, Kansas City, became interested in the possible dynamic action of the posterior pharyngeal flap. In an attempt to duplicate the 1959 electromyographic studies by Broadbent and Swinyard, which had indicated dynamic pharyngeal flaps with potentially functioning muscle, they tested their own pharyngeal flaps, taking elaborate precautions to avoid stimulation to any musculature adjacent to the flaps. They stated:

> Contractility was not demonstrated in any of the patients we tested.

Their subsequent dissection of five cadavers to determine the exact pathways of innervation led to their 1972 design of a new type of pharyngeal flap, presented in *Plastic and Reconstructive Surgery*. This is their anatomical report:

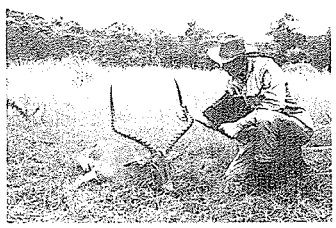
Entering the skull, the vagus and glossopharyngeal nerves were identified as they emerged from the medulla and passed through the jugular foramen, along with the internal carotid artery. At this point, small branches from IX and from the ganglion nodosum joined a single branch from the vagus to form a branch which descended first, then turned medially and upward, paralleling the oblique fibers of the constrictor muscle. The level at which this major recurrent branching consistently occurred was about one or two centimeters above the level of the greater cornu of the hyoid bone. This branch supplied the middle and superior constrictor muscles.

In their course, these paired nerves passed downward in an extremely lateral position deep to the musculature, then turned abruptly medially and upward in a recurrent pattern to enter the deep surface of the muscles.

They deduced:

It seems apparent that the incisions for *all* the conventional pharyngeal flaps would completely sever this nerve supply, particularly the incisions for those flaps based superiorly. There is a possibility that an inferiorly-based flap, placed high enough, might retain some functioning neuromuscular units.

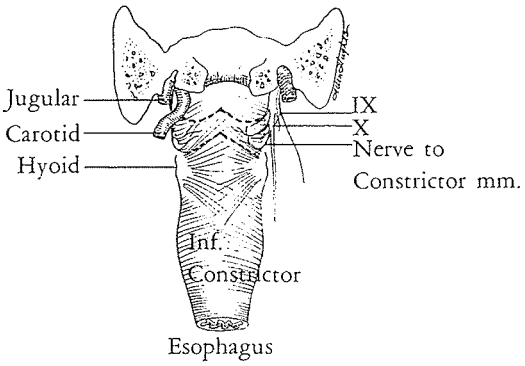
McCoy is a big-game hunter with trophies of polar bear from the Arctic, elk from the Rockies and elephant from Tanzania. He now feels that use of the dwindling numbers of fascinating species should be restricted to the shooting of specimens for museum collections, where the lessons of ethology can be best taught—possibly for the eventual survival of civilization. Here McCoy, with the shoulder patch insignia of the Kansas City Museum of History and Science, is preparing to measure an impala prior to mounting for the Museum.

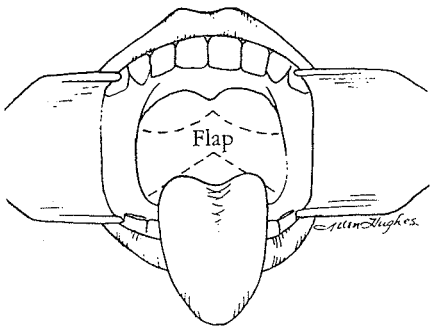


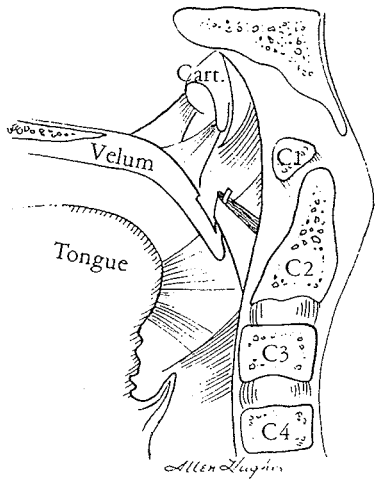
Whether he is hunting bobwhite or bobcat, the same instincts that prompt McCoy's charting of direction during a tracking, taking into account specific wind and terrain factors, must have led him, in his hunt for a dynamic pharyngeal flap, to shift the direction of its axis to a transverse chevron-shaped bipedicle flap:

The incisions are made through the mucosa and musculature, and the flap is elevated carefully from the prevertebral fascia to avoid damage to the nerve supply, just deep to the muscle.

An area of 8 to 10 mm. of the mucosa at the apex is denuded to allow its insertion under a flap on the nasal surface of the soft palate. This latter 1 cm. flap is based posteriorly and is raised just 1 cm. anterior to the posterior border of the soft palate.







The chevron flap is then pulled into position so that the two raw surfaces directly overlie one another. The 3 layers are then fixed with 5 through-and-through chromic catgut sutures. The donor defect can only be partially closed by undermining an advancement of the wound edges. The remaining defect heals secondarily without difficulty within 10 to 14 days.

At the time of the 1972 presentation, McCoy and Zahorsky had used this flap on five secondary cleft palate patients over a six-month period. All five showed an improvement, and one showed functional neurovascular components within the pedicles when tested electromyographically. In spite of the limited experience, these advantages were outlined:

1. A chevron-shaped, bipedicled flap, properly placed, can produce a dynamic neurovascular unit.
2. The two-directional pull, or "bridle effect," gives added effectiveness to the velopharyngeal closure.
3. The double pedicle fills twice the space filled by a single-pedicled flap.
4. There is a more natural central nasopharyngeal opening for mucous drainage.
5. There is no damage to that portion of the superior constrictor muscle involved in Passavant's ridge formation.
6. It may be possible to secondarily use this flap following the use of an inadequate superiorly-based flap.

In 1976 McCoy summarized his present stand:

Our development of this flap stemmed from our basic concern for the possible importance of a dynamically functioning pharyngeal flap. We shared Ray Broadbent's concept that dynamism is a highly desirable feature. We did not share his confidence that this was being obtained in his superiorly

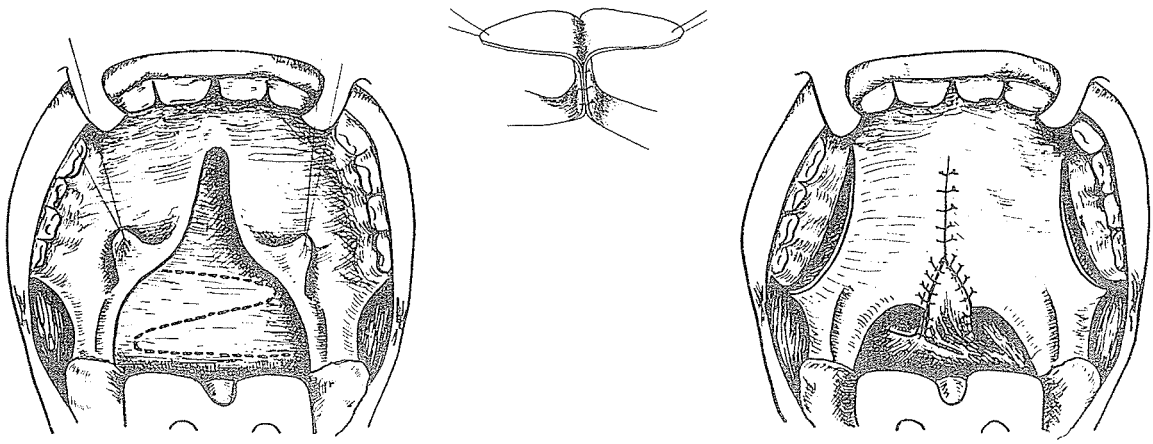
based flaps. The same objections applied to those based inferiorly. Our suspicion was confirmed by anatomical dissections. . . . Actually, once the anatomical distribution of the nerve supply had been identified, the chevron flap virtually designed itself. Since 1971, we have used the chevron flap almost exclusively, with only an occasional superiorly based flap being used for comparison. Our speech therapists have been enthusiastic from the outset about the improved results, which in many instances were dramatic.

We are currently engaged in a five-year re-evaluation, not only of the improvement of the quality in speech, but also of the question of dynamism on these flaps. We have now done approximately 60 chevron flaps and continue to do them exactly as originally described. The complications have been rare and the two technical failures were probably due to the inexperience of the resident operators. Like most other pharyngeal flaps, we feel they should be done at an early age, preferably under 6, and have been least effective in patients over 16.

Donald Kapetansky

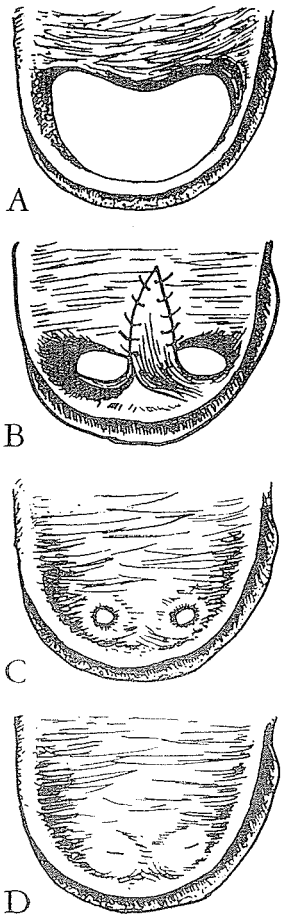
In 1973 in *Plastic and Reconstructive Surgery* Donald I. Kapetansky of Southfield, Michigan, reported his bilateral transverse pharyngeal flaps for velopharyngeal incompetence. This procedure, he explained, was developed to preserve the muscular function in healed pharyngeal flaps as he had noted gradual atrophy in "our series of 225 pharyngeal flaps during the past 14 years." The operation was designed to produce two smaller competent pharyngeal sphincters, in place of the single large incompetent sphincter. His description of the method is clear:

A wide S-shaped incision is made on the posterior pharyngeal wall to produce two flaps, each having a base of 15 to 20 mm with a length of 30 to 35 mm. The incisions are deepened to the prevertebral fascia (to preserve any nerve supply entering on the deep aspect of the muscle tissue [McCoy and Zahorsky]).



Usually the flaps can be inserted into the posterior 15 to 20 mm of the midportion of the soft palate. One flap is brought up to the nasal aspect—where it is turned on its long axis and fastened in place with interrupted, braided, non-absorbable sutures. The opposite flap is brought up to cover the oral aspect in the same position. A few interrupted sutures are used then to bring the two flaps together in the posterior midline area.

The residual defect in the posterior pharyngeal wall is closed with a few sutures which also pick up the deep fascia to avoid tenting of the tissues.



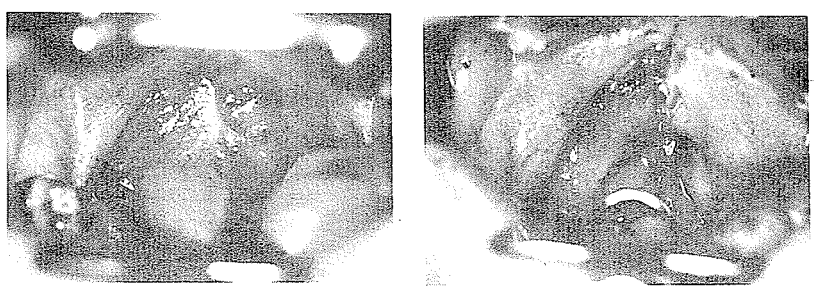
At the time of this first publication, Kapetansky had used double flaps on 21 patients over the preceding year.

By 1975 he had carried out 48 double-pedicle posterior pharyngeal flaps in patients ranging from 5 to 30 years. Thirty-nine had not had a pharyngeal flap before, but nine had had either an inferiorly or a superiorly based flap which failed to produce acceptable speech. One double flap separated, but dramatic improvement in speech was noted in the remaining 47 patients.

In his 1975 report in the *Cleft Palate Journal,* Kapetansky presented rough sketches showing (A) an incompetent palatopharyngeal sphincter, (B) the formation of two sphincters with his double-pedicle procedure, (C) partial sphincter functioning during speech and (D) complete sphincter functioning during speech and swallowing.

He emphasized that the preservation of the nerve supply not only maintained a larger flap mass for better obturator effect but enhanced the flap's contractile possibilities.

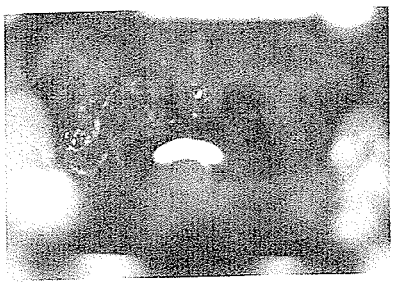
In 1975 Kapetansky forwarded to me three different problem cases of rhinolalia which had been completely corrected with his transverse pharyngeal flap operation:



A. Before A. After

A. W. M.—Nine-year-old male born with a cleft of the palate, postalveolar, with repair at eighteen months of age by another surgeon. In 1969, a vertical pharyngeal flap was performed by myself with incomplete im-

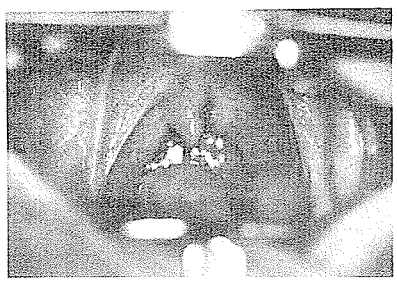
provement in speech. The patient then moved to Kentucky and the palate flap was transected by the plastic surgeon at St. Joseph's Hospital in Lexington, Kentucky, in 1970. Speech regressed completely. Tonsils and adenoids were removed in October of 1974. On January 30, 1975, bilateral pharyngeal flaps were performed without crossing the mid-line scarring of the posterior pharyngeal wall.



B. Before

B. After

B. S. A. S.—Seven-year-old male with a submucous cleft palate. The patient had undergone tonsillectomy and adenoidectomy, and nasality of speech was severe. On February 3, 1975, I performed bilateral transverse pharyngeal flaps.



C. Before

C. After

C. D. W.—Sixteen-year-old female born with a cleft palate, post-alveolar. At two years of age the entire palate was repaired in Ann Arbor. Examination showed a splitting of the uvula and a residual cleft at the junction of the soft and hard palate. There was marked nasality of the speech. On February 7, 1975, the palate was repaired with transverse pharyngeal flaps.

IS IT WORTH IT?

It is difficult to estimate how important dynamic action of the muscular portion of a pharyngeal flap is. Preservation of nerve supply is always ideal and will probably maintain better mass. Whether what muscle contractions persist will have any real effect on the complex and delicate speech mechanism is yet to be determined.