Primary von Langenbeck* Palatoplasty with Levator Reconstruction: Rationale and Technique

WILLIAM C. TRIER, M.D.
THOMAS M. DREYER, M.D.
Chapel Hill, North Carolina

In the preceding article, patients undergoing von Langenbeck palatoplasty without reconstruction of the levator veli palatini muscles were compared to patients undergoing the identical procedure, but with intravelar veloplasty. Palatoplasty included repair of both hard and soft palate, tension-free approximation of mucoperiosteal and soft palate flaps, and everting suture of nasal mucous membrane and oral mucous membrane from the anterior extent of the palate cleft to the tip of the uvula. No attempt was made to repair an alveolar cleft, if present.

The authors concluded that intravelar veloplasty was of significant value in providing velopharyngeal competency, and in this companion article the rationale and technical details are presented.

Grabb (1971) has given as reasons for closing a cleft palate the provision of a mechanism for normal speech, hearing, dental occlusion, and swallowing and the separation of the oral and nasal cavities. Implicit in the attainment of these objectives in palate closure is the requirement for avoiding interference with facial bone growth. Although there seems to be general agreement on the reasons for cleft palate closure, there is very little agreement on almost all other aspects of cleft palate surgery. There is controversy about the proper time for cleft palate repair, whether the hard or soft palate should be repaired first or the entire palate repaired at one operation, the type of palatoplasty to be performed, and whether a pharyngeal flap should be performed at the time of palate closure.

A number of factors foster such controversy. One of the major problems is simply the definition of "normal speech" and identification of the specific effects on speech of the palate repair. When reports of the effects of palate repair describe speech merely as "normal," "acceptable," and "unintelligible," the authors may fail to differentiate between velopharyngeal incompetency and speech problems related to other factors. In addition, so-called "objective" measures of velopharyngeal competency such as lateral cephalometrograms, cineradiography, videofluoroscopy, oral and nasal endoscopy, and various aerodynamic studies have proponents and opponents, and there are inherent limitations to each of these several methods.

Regarding facial growth, some interesting animal experiments (Kremenak et al. 1970) suggest the possibility that stripping

---

Dr. Trier is affiliated with the Division of Plastic Surgery, Department of Surgery, School of Medicine, University of North Carolina, Chapel Hill, N. C. 27514. Dr. Dreyer is in practice in Eugene, Oregon. Address correspondence to: William C. Trier, M.D., Division of Plastic Surgery, Wing D, 208H, Medical School, University of North Carolina, Chapel Hill, N. C. 27514, Telephone (919) 966-3080.

* Blair and Brown (1934) acknowledged that palatoplasty performed by raising and suturing together mucoperiosteal flaps elevated through lateral incisions is commonly termed the von Langenbeck palatoplasty. They pointed out that it was Dieffenbach in 1828 who first described this technique. It should be stressed that the Dieffenbach bone flap method of cleft palate repair is an entirely different technique (Peer, et al, 1964).

of mucoperiosteum from the human maxilla may result in maxillary deformity. However, such studies are not entirely convincing because of differences in the surgical subjects, as well as the specific nature of the operation performed and the site at which stripping or elevation of mucoperiosteal flaps is performed. Even the evaluation of results of similar operations for palate closure by different surgeons, and by even one surgeon over a period of time, fail to take into account inter-operator and temporal same-operator differences in technical details of an operation, surgical finesse, and, perhaps very important, minute variations in the site of incisions, degree of tension in a wound, exact extent of undermining, and exact suture technique.

In summary, there is a real need for more precisely defining the standards by which the effect of palate repair on speech and facial growth can be judged so that more meaningful comparison can be made between various techniques of palate closure. However, it is quite possible that differences in operations are much less important than the total quality of the cleft palate rehabilitation program with its careful analysis of results and evaluation of particular surgeons' results by competent speech pathology and dental colleagues.

Time of Operation

It is generally agreed by speech pathologists and others with a particular interest in oropharyngeal physiology that oropharyngeal movements preparatory to speech efforts begin in intrauterine life and that these and the babbling and cooing of infants are a very important prelude to the normal development of speech (Bosma, 1967; Oller et al, 1976). Recognizable speech certainly becomes apparent at about the age of two years. For this reason, speech pathologists recommend palate closure at as early an age as possible (Dorf and Curtin, 1982; Trost, J.E., 1984). In addition, clinical reports suggest that restoration of a more normal palatopharyngeal mechanism with an incidental improved mechanism for Eustachian tube function and protection of the Eustachian tube orifice may lessen the degree and frequency of episodes of serous otitis media found almost universally in children with cleft palate although data indicates this may only be due to effects of age (LeWorthy and Schliesser, 1975; Bumsted and Lusk, 1984). For these reasons, as well as to provide a better mechanism for feeding, palate closure would ideally be carried out at the very earliest possible time.

Balanced against these important reasons for a very early palate closure, however, are the greater difficulties in surgical repair due to the small size of the oral cavity in an infant, a greater likelihood of airway obstruction in the post-operative period, a small blood volume in very small infants and children and commonly a relatively greater width of the cleft, little affected yet by closure of the lip cleft, when present, or by growth of the palatal shelves. Although admitting to a rather empiric judgment, therefore, but believing it to be a reasonable compromise, repair is planned for fourteen to sixteen months of age. Anemia and acute upper respiratory infection or other problems may make a delay of surgery necessary for a month or two or longer.

Choice of Operation

Rayner (1925), in writing of the operative treatment of cleft palate, emphasized adequate blood supply, wound closure without excessive tension, freedom from infection, and complete de-epithelialization and eversion of cleft edges. All these basic principles are important in achieving uncomplicated wound healing in any site but particularly within the mouth. One should find little disagreement with these technical demands.

Implicit in techniques that meet these requirements, however, are several important details. 1). Provision of adequate relaxation and suturing without excessive tension requires sufficient release of palate flaps. In order to achieve sufficient release, lateral incisions, elevation of mucoperiosteal flaps, and occasionally dissection of the greater palatine artery for some distance from the undersurface of the flap, may be required. Release of the soft palate from the tonsillar pillar may also be required. The lateral incision must be carried sufficiently anterior to prevent excessive tension in closure of the anterior extent of the palate. 2). No palatal tissue should be discarded. Nasal mucous membrane must be dissected from oral mucous membrane to permit closure of both layers of tissues; and closure of the oral layer, at least, must be accomplished with everting vertical mattress sutures. 3). Repair of a single wound between lateral palatal flaps is inherently more secure and less subject to healing problems than are two or more wounds converging to a single point, as in the four-flap or three-flap type of repair.

In addition to these three technical points, the choice of an operation for cleft palate closure is influenced by two other considerations: soft palate length and soft palate dynamic function. Estimates of soft palate length have generally been made by oral examination of the palate. Subscribing to the philosphy that "a palate cannot be too long" many surgeons routinely perform three-flap or four-flap palate closure with lengthening, elongation, or setback of the palate, depending upon whether or not the cleft of the secondary palate is complete or incomplete. Palate lengthening without epithelial covering of the resulting nasal mucosal defect may provide velopharyngeal competency in patients with borderline or minimal incompetency. However, it seems illogical that contraction of the secondarily healing wound on the nasal surface would not fail to shorten the effective length of the palate to the extent that lasting competency could not be maintained. Therefore, if lengthening is carried out, plans for persistence of this lengthening should include reconstruction of the nasal surface defect with an island palatal mucosal flap (Millard, 1962) or a buccal flap (Kaplan, 1975), or a retrodisplacement of nasal mucous membrane from the nasal surface of the hard palate (Cronin, 1957). We are not convinced of the need to lengthen the soft palate whether or not the nasal defect is resurfaced. Furthermore, if the work of Kremenak and associates is indeed applicable to humans, lengthening of the soft palate certainly results in exposed denuded maxillary bone on the oral hard palate surface with potentially deforming effects on the maxillary arch. However, we are convinced by the work of Veau (1931), Kriens (1969, a and b) and Fara and Dvorak (1970) and it does appear logical that a functioning velopharyngeal sphincter mechanism must be provided as well as simple closure of the palatal cleft. In every cleft palate, including submucous palatal clefts, both overt and occult, abnormal insertion of the levator veli palatini muscles into the posterior nasal spine and posteromedial hard palate can be demonstrated (Trier, 1983). It is unrealistic to expect separated segments of a muscle sling, tethered to bone, to provide any sort of sphincteric action. Reconstruction of the levator sling is thus an integral part of palate closure.

Brief mention should be made of recent enthusiasm by some surgeons for palate closure and construction of a primary pharyngeal flap. By such policy, unnecessary pharyngeal flaps would have been constructed in an least 70% of our present series of patients undergoing primary palatoplasty. An increase in immediate operative morbidity, the greater risk of operative mortality, increased nasal airway resistance, additional maxillary growth retardation and risks of hyponasality and denasality would have been needlessly added to the usual risks encountered by patients undergoing primary palatoplasty.

And finally, in choosing the procedure for palate closure, one must consider the relative merits of primary palatoplasty versus primary veloplasty. Proponents of primary veloplasty cite as major justification for this two-stage palate closure the prevention of maxillary deformity and prevention of retardation of maxillary growth. There are studies that indicate some measurable decrease in maxillary growth, but Robertson and Jolleys (1977) suggest that this decrease is not of clinical significance to the patient.

If one can achieve palate closure at an early stage and in one stage, is there a significant beneficial effect on the major reason for palate repair, provision of a mechanism for normal speech? Although the data are far from complete, long-term speech results in patients undergoing primary palatoplasty seem superior to patients undergoing delayed hard palate repair, even when fitted with a speech appliance to cover the temporary hard palate defect (Cosman and Falk, 1980; Bardach et al., 1984). We have not had many opportunities to examine patients in whom soft palate repair alone has been carried out and in whom a palatal appliance has been used as a fixed or removable speech appliance, but those patients observed have speech that is grossly hypernasal with nasal emission and greater impaired intelligibility. They have also had very poor oral hygiene secondary to the appliance. Cosman and Falk (1980) have called attention to the poor speech results in their patients with delayed hard palate repair and they, Fara and Brousilova (1969) and our personal observations also indicate technical difficulties in performing delayed hard palate repair. There is certainly an apparent and very likely actual increased shortening of the entire palate following a two-stage repair. In addition, the scarring and rigidity of the palatal soft tissue, with the decrease in length of palatal tissue, almost invariably led to the need for pharyngeal flap construction at the time of hard palate repair (Reidy, 1962). Fara and Brousilova (1969) have not been impressed by the supposed significant narrowing of the hard palate cleft as a result of soft palate repair with or without levator reconstruction, and we agree completely.

von Langenbeck Palatoplasty with Levator Reconstruction

Following is a brief description of a one-stage palatoplasty procedure, the von Langenbeck palatoplasty with levator reconstruction, that meets all the criteria reviewed above. The significance of levator reconstruction is emphasized because that aspect of the procedure is designed to yield a high incidence of velopharyngeal competency. The procedure has been followed at the University of North Carolina at Chapel Hill by the senior author (W. C. Trier) since 1976. Between 1967 and 1969 von Langenbeck palatoplasty without levator reconstruction had been carried out by the senior author so comparison between the two groups of patients could be made.

Preoperatively, all necessary examinations and procedures are followed to ensure satisfactory medical status of the patient who is undergoing major surgery. Children with serous otitis media unresponsive to decongestant treatment and with middle ear fluid and retracted tympanic membranes are scheduled for a myringotomy and insertion of ventilation tubes to be carried out immediately following induction of anesthesia. Prophylactic antibiotics (penicillin or a cephalosporin) are begun just prior to surgery and continued until the first post-operative day to minimize the possibility of wound complications secondary to infection. Anesthesia is enflurane, rather than halothane, to avoid cardiac irritability. The patient is properly positioned and prepared for surgery. Soft tissue infiltration of 1:200,000 units of epinephrine, with 0.5% lidocaine not to exceed 3 micrograms per kilogram of body weight, is used to enhance hemostatis.

SURGICAL TECHNIQUE. The initial incision is made transversely across the top of the tonsillar pillar just posterior to the maxillary tuberosity (Figure 1a, 1b). The incision then curves anteriorly where soft palate joins maxillary tuberosity and is carried forward exactly at the junction between palatal mucous membrane and gingival mucous membrane to approximately one centimeter anterior to the most anterior extent of the cleft in the incomplete cleft palate. This incision is carried to within one half centimeter from the cleft when an alveolar cleft is present. The incision is made at right angles to the underlying bone and is carried completely to bone along the entire length of the incision.

An L-shaped palate elevator is then introduced just anterior to the maxillary tuberosity and, being certain that the rounded end of the elevator is against bone, and using the bony shelf as a fulcrum, the blade of the elevator is used to elevate the mucoperiosteum from the underlying bone to the medial and anterior extent of the proposed flap. The elevator is then withdrawn from the initial wound and is reinserted in the transverse incision just posterior to the maxillary tuberosity and with the tip of the elevator directly posteromedially, the posterior palate tissue is elevated. The handle of the elevator is swung

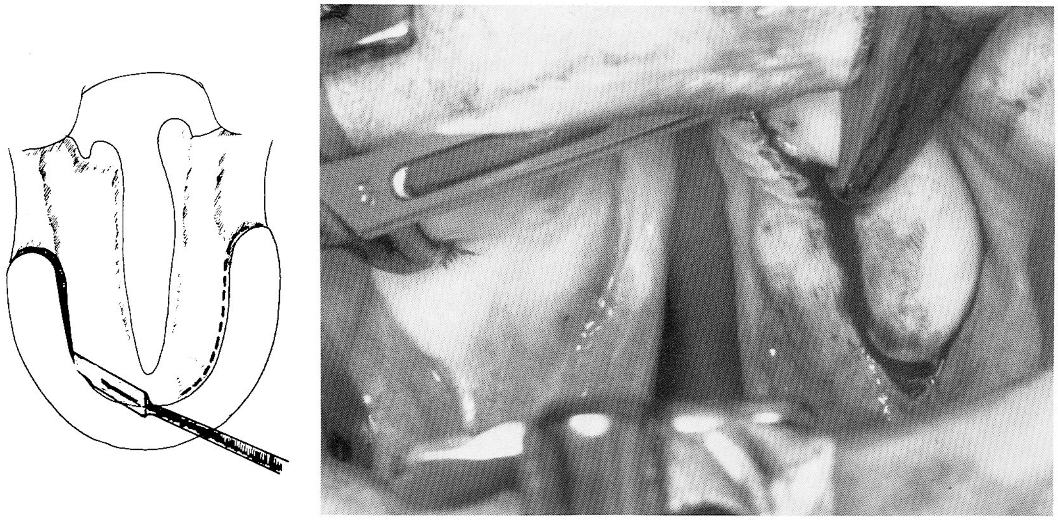

FIGURE 1a and 1b. Incisions are made transversely across top of tonsillar pillars posterior to maxillary tuberosities and divides palatal from alveolar mucous membrane. Incisions extend to 1 cm. anterior to anterior extent of cleft or within 0.5 cm. of alveolar cleft when present.

laterally to carry the tip of the elevator medial to the greater palatine artery until it reaches the posterior hard palate. (Care is taken to avoid any blind dissection or elevation of the mucoperiosteum medial to the maxillary tuberosity in order to avoid injury to the greater palatine artery where it emerges from the pterygo-palatine foramen.) The operator must be aware that the foramen, the maxillary tuberosity and the hamular process of the pterygoid form an equilateral triangle. With adequate elevation, bleeding will cease promptly and the same maneuver is repeated on the opposite side of the palate.

A number 11-bladed scalpel or pointed, double-edged and angled scalpel blade then incises the margins of the cleft at the junction between oral and nasal mucous membrane between the tip of the uvula and the anterior extent of the cleft. If an alveolar cleft is present, the incision is carried to the alveolar cleft. If an alveolar cleft is not present, or if the palatal cleft is incomplete, the medial incision is carried around the anterior end of the cleft.

Long single skin hooks are then used to elevate the oral mucous membrane just posterior to the posterior edge of the hard palate. Using curved and straight Joseph or Davis scissors, mucous membrane is dissected in the plane just deep to the visible mucous glands to expose the abnormally inserted levator muscles. The muscles are exposed anteriorly to their insertion into the hard palate. The skin hooks are then moved to retract the levator muscles and the muscles are freed from the thin nasal mucous membrane, again to the site of insertion of the levator into the hard palate. A multiple toothed (Brown-Cushing) forceps then grasps the muscle just posterior to the hard palate, the insertion of the muscle is divided with scissors, and with dissection on oral, nasal and lateral borders, the muscle bundles are dissected free until they can be drawn medially and posteriorly and lie without restriction in a clearly transverse direction (Figures 2a, 2b, 3a, 3b).

At the medial borders of mucous membrane at the medial edge of the hard palate the nasal mucous membrane and oral mucous membrane are separated with a Freer septal elevator and mucous membrane is dissected from the nasal surface of the hard palate. The angled scalpel blade, or a right angle palate knife is used to incise along the anterior edge of the cleft so that tears in the oral or nasal mucous membrane will not be produced by blind dissection.

Final dissection is carried out under di-

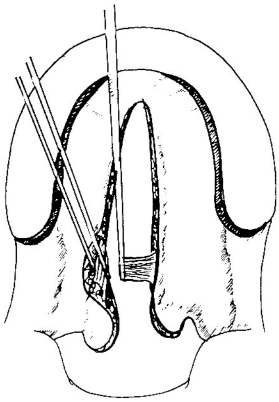

FIGURE 2a and 2b. After incisions divide oral from nasal mucous membrane, levator veli palatini muscles are identified, dissected from oral and nasal mucous membrane, and detached from hard palate insertions.

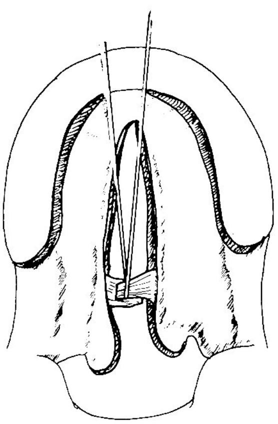

FIGURE 3a and 3b. Levator veli palatini muscles are drawn medially and are sutured so that they overlap each other.

rect vision through the lateral incisions by first raising the flap with the tip of the L-shaped elevator resting against the bony palatine shelf fulcrum and carefully stretching the greater palatine vascular bundle from the foramen. Fibrous attachments between the mucoperiosteal flap laterally and the maxillary tuberosity area are divided under direct vision. The only structure now restricting medial displacement of the mucoperiosteal flaps from the area of the maxillary tuberosity anteriorly is the greater palatine artery. If excessive lateral restriction of the mucoperiosteal flap still does not permit approximation of the flaps without excessive tension, the vascular bundle is dissected from the undersurface of the flap far enough anteriorly to allow unimpeded medial movement. If medial movement is restricted posterior to the maxillary tubercle, an elevator or the operator's finger can be used to separate soft palate from the tonsillar pillar.

Closure of the nasal mucous membrane is carried out with simple sutures of 4-0 chromic catgut tied on the nasal surface. Closure should be complete from tip of uvula to anterior end of cleft, except where an alveolar cleft is present. Closure stops at the alveolar cleft when an alveolar cleft exists.

Levator sling reconstruction is carried out by overlapping one levator muscle medially over the other. A mattress suture of 3-0 chromic catgut is inserted through the mucous membrane and incorporates the levator muscle bundle on the opposite side so that traction on these two sutures causes overlapping of the levator muscles. The mattress sutures are left untied until closure of the oral mucous membrane is completed (Figure 4a, 4b)

Everting interrupted verticle mattress sutures of 4-0 polydioxanone, alternated with simple interrupted sutures of the same material, are used to approximate the oral mucous membrane for the entire length of the palate. Again no effort is made at the time of primary palatoplasty to close an alveolar cleft.

Lateral packs are not used, and after blood and mucous have been aspirated from the pharynx, the mouth gag is removed. A heavy silk suture (0 or 1) is inserted transversely across the center of the thickness of the tongue for possible use as a traction suture for adequate suctioning or management of the airway in the early postoperative period. Arm restraints are applied.

Following post-anesthetic recovery, clear liquids are permitted orally and parenteral intravenous fluids are continued until oral fluid intake is adequate. A blenderized diet, or diet of similar consistency, is provided for four weeks from the time of operation. Patients are most commonly discharged from the hospital on the second post-operative day.

Note that no attempt is made to repair an alveolar cleft at the time of primary palatoplasty. Reliable closure of an alveolar cleft cannot be expected at the time of primary palatoplasty because of inherent technical problems associated with water-tight closure in two layers of a narrow, deep and irregular slit. Damage to tooth buds and periodontal ligaments with risks for resulting alveolar deformity seem almost certain, as is the need for later bone graft-

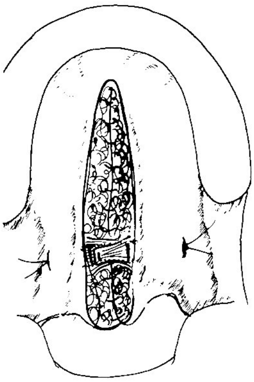

FIGURE 4a and 4b. After nasal mucous membrane is repaired, muscle sutures are placed, to be tied after everting closure of oral mucous membrane.

ing (Boyne and Sands, 1971, 1976). Our colleagues in speech pathology and dentistry support this position.

COMPLICATIONS AND RESULTS. There have been no deaths in this personal series, nor have there been any post-operative fistulas, wound infection or wound complications. As reported in the preceding article, in the series of 21 patients with von Langenbeck (no levator reconstruction) 62% had normal or acceptable speech, 52% had adequate palate function as determined by aerodynamic studies, and 38% had required secondary structural modification for velopharyngeal incompetency. A comparable series of 22 patients undergoing primary palatoplasty with levator reconstruction reported 89% of patients examined an average of four years and seven months following primary palatoplasty had acceptable or normal speech; 91% had adequate closure as demonstrated by aerodynamic studies; and 11% had required secondary structural modification for velopharyngeal incompetency (Dreyer and Trier, 1984). No patients are judged to have developed maxillary deformity attributable to the surgery.

Conclusions

Primary von Langenbeck palatoplasty with levator reconstruction is a safe and reliable operation for palate closure. It presently provides velopharyngeal competency in 89% of patients followed for an average of four years and seven months following primary palatoplasty.

References

BARDACH, J., MORRIS, H. L. AND OLIN, W. H. Late results of primary veloplasty: the Marburg project, *Plast. Reconstr. Surg., 73:* 207–215, 1984.

BLAIR, V. P. AND BROWN, J. B. The Dieffenbach-Warren operation for closure of congenitally cleft palate, *Surg. Gynec. Obstetr., 59:* 309–320, 1934.

BOYNE, P. AND SANDS, N. R. Secondary bone grafting of residual alveolar palatal defects, *J. Oral Surg.,* Vol. 3, Feb. 1972.

BOYNE, P. AND SANDS, N. R. Combined orthodontic-surgical management of residual palato-alveolar cleft defects, *Am. J. Ortho., 70:*20, 1976.

BOSMA, J. F. Human infant oral function, Chapter 4, Symposium on Oral Sensation, Charles C. Thomas, Springfield, 1967.

BUMSTED, R. M. AND LUSK, R. Palatoplasty and Eustachian tube function: a comparative study of primary veloplasty to conventional palatoplasty. Presented at Annual Meeting, American Cleft Palate Association, Seattle, May 21, 1984.

BYARS, L. T. Personal communication.

COSMAN, B. AND FALK, A. S. Dalayed hard palate repair and speech deficiencies: a cautionary report, *Cleft Palate J., 17:* 27–33, 1980.

CRONIN, T. D. Method of preventing raw area on nasal surface of soft palate in push-back surgery, *Plast. Reconstr. Surg., 20:* 474–484, 1957.

DORF, D. S. AND CURTIN, J. W. Early cleft palate repair and speech outcome, *Plast. Reconstr. Surg., 70:* 74–79, 1982.

DREYER, T. M. AND TRIER, W. C. A comparison of palatoplasty techniques. *Cleft Pal. J. 21:* 251–253, 1984.

FARA, M. AND BROUSILOVA, M. Experiences with early closure of velum and later closure of hard palate, *Plast. Reconstr. Surg., 44:* 134–141, 1969.

FARA, M. AND DVORAK, J. Abnormal anatomy of the muscles of palate: pharyngeal closure in cleft palates, *Plast. Reconstr. Surg., 46:* 488–497, 1970.

GRABB, W. C. General Aspects of Cleft Palate Surgery. In Cleft Lip and Palate. Edited by Grabb, W. C., Rosenstein, S. W. and Bzoch, K. R. Boston: Little, Brown and Company, p. 373, 1971.

KAPLAN, E. N. Soft palate repair by levator muscle reconstruction and a buccal mucosal flap, *Plast. Reconstr. Surg., 56:* 129–136, 1975.

KAPLAN, I., LABANDTER, H., BEN-BASSAT, M., DRESSNER, J. AND NACHMANI, A. A long-term followup of clefts of the secondary palate repaired by von Langenbeck's method, *Brit. J. Plast. Surg., 31:* 353–354, 1978.

KREMENAK, C. R., JR., HUFFMAN, W. C. AND OLIN, W. H. Maxillary growth inhibition by mucoperiosteal denudation of palatal shelf bone in non-cleft beagles, *Cleft Palate J., 7:* 817–825, 1970

KRIENS, O. B. Fundamental anatomic findings for an intravelar veloplasty, *Cleft Palate J., 7:* 27–36, 1970.

KRIENS, O. B. An anatomical approach to veloplasty, *Plast. Reconstr. Surg., 43:* 29–41, 1969.

LEWORTHY, G. W. AND SCHLIESSER, H. Hearing acuity before and after pharyngeal flap procedure, *Plast. Reconstr. Surg., 56:* 49–51, 1975.

MILLARD, D. R. Wide and/or short cleft palates, *Plast. Reconstr. Surg., 29:* 40–57, 1962.

MUSGRAVE, R. H. AND BREMMER, J. C. Complications of cleft palate surgery, *Plast. Reconstr. Surg., 26:* 180–189, 1960.

OLLER, D. K., WIEMAN, L. A., DOYLE, W. J. AND ROSS, C. J. Infant babbling and speech, *J. Child Lang., 3:* 1–11, 1976.

ONEAL, R. M. Oronasal Fistulas. In Cleft Lip and Palate. Edited by Grabb, W. C., Rosenstein, S. W. and Bzoch, K. R. Boston: Little, Brown and Company, pp. 490–498, 1971.

PEER, L. A., WALKER, J. C. AND MEIJER, R. The Dieffenbach bone-flap method of cleft palate repair, *Plast. Reconstr. Surg., 34:* 472–482, 1964.

RAYNER, H. H. The operative treatment of cleft-palate. Lancet, 816–817, 1925.

REIDY, J. P. The other 20 per cent: failures of cleft palate repair, *Brit. J. Plast. Surg., 15:* 261–270, 1962.

ROBERTSON, N. R. E. AND JOLLEYS, A. The timing of hard palate repair. Paper presented at Third International Congress on Cleft Palate and Related Craniofacial Anomalies. Toronto, June, 1977.

TRIER, W. C. Velopharyngeal incompetency in the absence of overt cleft palate: anatomic and surgical considerations, *Cleft Palate J., 20:* 209–217, 1983.

TROST, J. E. Compensatory articulations: error, types, patterns and treatment approaches. Presented at Annual Meeting, American Cleft Palate Association, Seattle, May 23, 1984.

VEAU, V. Division Palatine. Paris: Masson and Cie, 1931.