Secondary Deformities of Cleft Lip, Cleft Lip and Nose, and Cleft Palate

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Secondary deformities of patients with cleft lip or cleft lip-cleft palate include defects and irregularities in the form of the lip, distortion and deformity of the nose, hypoplasia of the maxilla, and malocclusion. Cleft lip and palate is not infrequent in various craniofacial anomalies; these deformities are not discussed in this chapter.

The diversity of secondary deformities following repair of the cleft lip and nose is striking. The deformities reflect the wide variety of surgical techniques used to repair the cleft lip and the cleft lip nose. Secondary deformities of the repaired cleft lip and nose result from several distinct but related components: congenitally abnormal tissues; surgically modified tissues; the innate tendency of tissue to reflect its phenotype; the absence of diverse tissue elements such as ectoderm and mesoderm; and the effects of growth and development. Whereas primary repair of the cleft lip has become increasingly successful, repair of the cleft lip nose has continued to be a difficult problem. The three-dimensional nature of the abnormality and the presence of a mixed tissue matrix are responsible for the difficulty in finding an empirical solution to the nasal deformity.

Steffensen (1953) suggested the requirements for a satisfactory repair of the cleft lip and the associated nasal deformity. A slight expansion of Steffensen's list includes the following requirements: (1) accurate skin, muscle, and mucous membrane union; (2) rotation of the deflected lateral portion of the orbicularis oris muscle into a horizontal position with its medial component; (3) measures to obtain symmetrical alar bases and nostril floors, and a nasal tip with an adequate columella-labial angle and adequate columella length; (4) a symmetrical vermilion border with a reproduced Cupid's bow; (5) a slight eversion or pouting of the central portion of the upper lip; and (6) a minimal scar which in its contraction will not interfere with the achievement of the other stated objectives. If two or more of these objectives have not been met, it is generally necessary to perform a secondary operation involving both lip or nose rather than to attempt a limited correction.

Secondary Deformities of Cleft Lip

Secondary deformities of the unilateral and bilateral cleft lip are considered together, since many postsurgical deformities are common to both.

Incomplete Muscle Union. Failure to identify, rotate, and join the fibers of the orbicularis oris muscle from its laterally placed position results in a characteristic lateral muscle bulge beneath the ala. After the complete bilateral cleft lip repair, the prolabium may be flaccid.

The numerous techniques for bilateral cleft lip repair, including those of Schultz (1946), Glover and Newcomb (1961), Duffy (1971), and Millard (1971, 1974), advocate approximation of the muscle, but for many surgeons the emphasis on horizontal muscle closure has been a fairly recent concern. As a result, this deformity is often seen in older
patients operated upon years earlier (Converse, Hogan, and Dupuis, 1970). In the older child and adult, the shortened fibers of the quadratus labii superioris muscle can be seen as they enter the deeper portion of the orbicularis oris muscle. As emphasized by Hogan and Converse (1971), these fibers often must be partially divided in order to bring the muscle into an adequate horizontal relationship with its counterpart from the other side.

**Flattening of the Lip.** A generalized flattening of the repaired cleft lip on the cleft side may be due to several causes. The mesodermal deficiency (Veau, 1931; Stark, 1954, 1968, 1973) leaves the lip with deficient marginal tissue on the medial aspect of the cleft. Frequently, after mobilization of the orbicularis oris muscle from the alar base area, a soft tissue deficit remains. This deficiency can be filled by a dermis-fat graft (Cosman and Crikelair, 1965) or by the interdigitation of a small portion of the contralateral muscle, as advised in the primary repair by Millard (1974). The flattening is also caused by hypoplasia of the pyriform aperture of the maxilla, which should be corrected in the manner described later in this chapter.

**The Excessively Long Lip.** The length of the repaired lip depends to a large extent on the technique of the primary procedure. Among the techniques which have been popular for unilateral cleft lip repair, the LeMesurier operation (1949) is the most likely to result in a long lip, with excessive lengthening of the lateral portion of the lip. Excision of the previous scar, with the focus on removing an adequate amount of tissue in the horizontal limb of the incision, has been described by Converse (1975). A similar surgical approach can be applied in the bilateral cleft lip, though excessive length of the prolabial segment is rarely seen unless there has been extreme lengthening by an initial Z-plasty type repair, or an Abbé flap has been inserted previously.

**The Excessively Short Lip.** In the unilateral cleft lip, a short lip is more likely to result from the straight line or slightly curved incisions (Rose, 1891; Thompson, 1912) or, as is more commonly seen today, following the Millard (1955) technique. Excision of the scar and application of Z-plasty techniques such as the LeMesurier (Trusler and Glanz, 1952) have been suggested. These may be adequate if the deformity is minor or if the philtral crest has previously been violated by a lower lip Z-plasty technique. However, when a significant deformity exists, especially if the philtrum is intact (as after a Rose-Thompson or Millard repair), it is preferable to ignore the previous scarring and to repeat the initial repair with emphasis on the downward rotation. Extra lip length can often be obtained by further division of the vermilion from the cutaneous border of the lip.

Correction of the short bilateral cleft lip is doubly difficult. In minor deformities, scar excision and Z-plasty techniques may suffice. In the moderate deformity, if adequate horizontal width of the lip is present, it may be possible to approach the problem as though one were dealing with incomplete clefts, applying the Z-plasty techniques of the repairs of Tennison (1952), Randall (1959), Wynn (1960), Skoog (1965), Bauer, Trusler, and Tondra (1971), and Millard (1971). However, lengthening the lip without an unacceptable amount of compromise to the horizontal lip dimension is difficult, and in severe deformities an Abbé flap from the lower lip may be required.

**The Tight Upper Lip.** When a primary procedure has discarded significant amounts of upper lip tissue in order to achieve closure, there may be a tightness of the lip which may
progressively increase with growth. This deformity can be corrected by an Abbé cross-lip flap (see Chapter 32). Sabbatini (1838) is credited with originating this procedure, which was subsequently employed and modified by Stein (1848), Estlander (1872), and Abbé (1893). It is particularly useful when there is a deficiency of upper lip tissue and a disproportion between the upper and lower lips. Studies by De Palma, Leavitt, and Hardy (1958) and by Smith (1960, 1961) have confirmed that the Abbé flap becomes reinnervated and functions as an active part of the upper lip.

The Abbé flap is applicable to the secondary correction of both the unilateral and bilateral cleft lip deformity. Placement of the flap either in a new midline incision or in the line of the old scar releases the tightness. Proponents of placing the flap in a new midline incision in the unilateral lip deformity claim that it produces the most satisfactory results despite the presence of a thin island of residual skin between the midline flap and the scar of the repaired lip. At a later date, the old scar is excised together with its thin medial remnants, if necessary. Peet and Patterson (1963) and Millard (1964) stated that the placement of the Abbé flap in the midline gives the best results. The authors agree that central placement is probably preferable in secondary operations for unilateral and bilateral cleft lip deformities.

The central cross-lip flap is particularly useful, as it reproduces the central fullness or pout of the upper lip and there is a semblance of Cupid's bow when the Abbé flap is taken from the midportion of the lower lip. It should be designed to mimic the missing or deformed philtrum. The philtrum is fundamentally trapezoidal. The width of the adult philtrum ranges from 0.8 to 1.2 cm at the vermilion border and from 0.6 to 0.9 cm at the base of the columella. The Abbé flap should be designed to balance the upper and lower lines within these dimensions. An improvement in the technique of the Abbé insertion into the upper lip is the "shelving muscle flap" technique which staggers the suture lines at the base of the columella, decreasing scar formation and a tourniquet effect on the columella base (Hogan and Converse, 1971). "W" cross-lip flaps whose superior margins protrude laterally around the columella and into the nostril floor as described by Cannon (1941) are of limited usefulness in the unilateral cleft lip.

The flap must not be too long. It must not be longer than the shortest distance from the nostril floor to the apex of the Cupid's bow on the normal side in cases of unilateral cleft lip. According to Clifford and Pool (1959), the maximum length of the normal adult philtrum is 1.7 cm; therefore, in the secondary repair of the unilateral cleft lip, this dimension should be the approximate guideline.

The routine use of Abbé flaps for the repair of deficient upper lip tissue has been challenged by Obwegeser (1975). He believes that in most cases maxillary advancement restores the upper lip profile more satisfactorily than the Abbé flap. However, in many patients, the soft tissue deficiency is excessive, and the tight lip may exert pressure on the advanced maxilla and cause a lingual version of the maxillary teeth.

Reconstruction of the Philtrum. The philtrum is characteristic of the upper lip and gives it its identity; its absence is the telltale of the "operated" lip. Without the philtrum, even the most satisfactorily proportioned repaired lip hangs.
Following the observation of Cardoso (1952) that the major portion of the philtrum was preserved in the medial component of the unilateral cleft lip, the techniques of Tennison (1952), Randall (1959), and Millard (1955) have been designed to preserve its essential landmarks. Veau (1931, 1938) had emphasized the need to preserve the philtrum. The LeMesurier repair (1949) and most of the previous methods tended to obliterate the philtral remnants. Bilateral cleft lips pose a greater problem, since little of the anatomy of the philtrum is present.

Monie and Cacciatore (1962) studied the philtrum in detail and concluded that the philtral dimple is formed by central dense subcutaneous tissue bordered by zones of loose subcutaneous connective tissue, producing the philtral ridges laterally. This contour is augmented by the insertion of the decussated orbicularis oris fibers into the dermis lateral to each philtral ridge.

A number of attempts to reconstruct the philtrum have been reported. Millard (1971) has modified his primary bilateral cleft lip repair to include the formation of a prolabial dimple by a deep suture from the dermis to the premaxillary periosteum, in addition to tailoring the prolabium to mimic a philtrum.

When an extreme upper lip tissue defect is present, the secondary repair may be achieved by a carefully designed central Abbé flap, which may serve not only to remedy the deficit but also to mimic the philtrum. Nevertheless, philtral reconstruction alone, without the primary need for tissue augmentation, would not justify such a radical procedure. O'Connor and McGregor (1958) have described subcutaneous rotation flaps. Schmid (1963) transplanted a chondrocutaneous composite graft obtained from the ear, and Neuner (1967) used subcutaneously grafted auricular cartilage to reconstruct the philtrum. An overly emphasized and rigid Cupid's bow is a possible complication of these techniques.

Attempts to reconstruct the Cupid's bow by advancing the vermilion border of the lip have also been made. Gillies and Kilner (1932) described full-thickness skin excision and advancement of the vermilion border as double peaks. A similar method for vermilion advancement in which the skin is deepithelialized rather than excised in full-thickness fashion, in an attempt to retain the "pout" of the vermilion border (the "white line" of Veau), has been used by Converse (1964). V-Y mucosal advancement to evert the lip border has also been advocated by Neuner (1967). Onizuka (1975) has reported on various possibilities of forming philtral crests.

The Deficient Buccal Sulcus. Surgical increase in the depth of the labiogingival sulcus, after obliteration by trauma or ablative cancer surgery, is well established. Resurfacing of the surgically deepened sulcus has been achieved by oral mucosal grafts, split-thickness skin grafts, meshed palatine mucoperiosteum, or local rotation flaps. All undergo a variable amount of contraction; thus the depth of the sulcus must be maintained by a prosthesis (see Chapter 30). This technique is more difficult to use in the child, since successful retention of the obturator by a small child is difficult; Z-plasties and advancement flaps of mucosa can often be successful.

The problem of sulcus reconstruction in cleft lip surgery most commonly arises in the management of the prolabium-premaxilla. Schultz (1946) was the first to popularize separation
of the prolabium from the premaxilla, the posterior aspect of the prolabium being lined with lateral flaps. The premaxilla was allowed to epithelize secondarily. Similar management of the sulcus in primary repair has been described by Bauer, Trusler, and Tondra (1959) and Manchester (1965). Lining of the premaxilla with the "discarded" vermilion was added by Tondra, Bauer, and Trusler (1966). Horton and associates (1970) have advocated "V-Z advancement". Their method involves the combination of V-Y advancement and Z-plasty and is supplemented by a small mucosal graft if needed. It can be used at the time of the primary lip closure or as a secondary procedure. An alternate procedure is the prolabial hinge flap of Falcone (1966), supplemented by a mucosal graft from the cheek to cover the denuded premaxillary periosteum.

In small adhesions of the sulcus, a Z-plasty, as usually employed for the release of the frenulum, may suffice.

Minor Deformities of the Upper Lip

Malalignment. Irregularities involving only slight malalignment of the "white line" in the presence of normal lip length and normal contour can be corrected by excision and careful reapproximation. Greater degrees of malalignment require either Z-plasty or deepithelization and vermilion advancement. In the latter technique, half-buried mattress sutures are first placed on the vermilion side, then passed through the dermis on the skin side, then brought back to be tied on the vermilion side (Stark, 1968). This technique avoids suture marks on the skin side of the vermilion-cutaneous border. Both vermilion advancement and Z-plasty methods should generally be accompanied by V-Y advancement or Z-plasty from the oral side to increase the visible bulk of the vermilion portion of the lip.

Irregularities involving minor degrees of malalignment of the skin and "white line" as well as minor mucosal notching may be corrected by excision of the notch and part of the vertical scar. Secondary horizontal incisions on the oral side may be closed vertically (Erich, 1953) to increase the vertical dimensions of the vermilion borders. This method requires that the overall lip vertical length be adequate; otherwise, secondary repair of the entire lip is indicated.

The Whistle Deformity. Deformities involving only deficient visible mucosa and vermilion, known as "whistle deformities", are relatively common.

The classic surgical procedure for repair of a whistle deformity involves a flap with the blood supply generally coming from the cutaneous vermilion border. The flap is advanced toward the cutaneous vermilion border and closed in a V-Y fashion. The problem with this flap is that it often behaves in a fashion similar to other narrow single pedicle or trapdoor flaps in that it retracts from the surrounding adjacent tissues and becomes isolated from them. As an alternative to this approach, Hogan (1976) has employed two large rotation flaps of mucosa from the undersurface of the lip, rotating them toward the midline and advancing them toward the midline and advancing them toward the cutaneous vermilion border. The flaps are designed so that they meet in the midline of the whistle deformity and are formed from an upside-down V-incision, which is almost a straight line. This incision becomes an upside-down Y as the rotation flaps are advanced and elevated toward the midline. The flaps include a thick mucosal layer but do not involve lip musculature. If an obvious defect of the
muscle is present, it should be carefully sutured with 5-0 chromic catgut. Converse (1975) has employed Z-plasties with considerable success, using flaps of variable size according to the magnitude of the deformity incorporating a thin layer of muscle.

Guerrero-Santos, Ramirez, Castenada, and Torres (1971) have described a modification of the Millard repair using a denuded flap from the excess of lateral vermilion tissue tunneled into the medial position of the vermilion border to minimize secondary vermilion notching.

Vermilion notching in the central defect, seen after bilateral cleft lip repair, may require either a double later V-Y advancement (Robinson, Ketchum, and Masters, 1970) or double pendulum flaps which are island flaps with an orbicularis muscle displaced centrally (Kapetansky, 1971). Although this involves dividing both labial arteries, the soft tissue flaps have suffered no ischemic complications. Guerrero-Santos (1969) proposed the use of a tongue flap in this situation, but its interposition between the teeth for three weeks prior to division precludes its usefulness in children.

Scars. The problem of scarring in the upper lip may be improved by dermabrasion. In extreme cases, however, a full-thickness skin graft may be necessary (Broadbent, 1957).

Deformities of the Unilateral Cleft Lip Nose

Pathologic Anatomy. The theory that the alar cartilage of the cleft lip patient is normal in content but mechanically distorted in position and shape was postulated by Blair (1925), Gillies and Kilner (1932), McIndoe (1938), Huffman and Lierle (1949), and more recently Stenström and Oberg (161). This school of thought has emphasized the role of the nasal and adjacent facial muscles as active extrinsic forces in producing the nostril deformity.

Most of the current concepts concerning the origin of the cleft lip nose deformity, however, suggest the presence of an intrinsic disturbance of growth and development. It is now generally accepted that a failure of migration of neural crest cells (Johnson, 1965) results in a failure of mesodermal penetration of the soft tissues of the cleft region (Veau, 1937-1938; Stark, 1954, 1968, 1973). The growth disturbance results from an inherited tendency (Fogh-Andersen, 1942) or from an environmental influence (Fraser, 1963, 1971; Patton, 1968, 1971), with the degree of deformity related to how early in embryonic development the disturbance occurs. Avery in 1961 pointed out the striking differences in the nasal cartilaginous capsules of five cleft lip embryos when compared to those of unaffected embryos. There was delayed growth of the affected cartilage and septum, and the cartilage in the anterior part of the nasal capsule was deficient and malformed in the cleft lip embryos. Deficiencies of cartilage in the lateral crura of the alar cartilages and abnormalities of the vomer and contiguous maxillary bones were also present.

It is helpful to consider the pathologic anatomy under three categories: (1) the nasal tip (alae and columella), (2) the lateral bony platform (pyriform aperture of the maxilla), and (3) the midline supporting structures (cartilaginous septum and anterior nasal spine).

The Nasal Tip. The specific deformities of the cleft side of the nasal tip are the following:
1. The medial crus is displaced medially and downward, producing a shortened columella and a decreased projection of the dome of the alar cartilage on the affected side.

2. The alar dome is displaced laterally, resulting in a tendency to bifidity, and the angle between the medial and lateral crura is more obtuse.

3. The lateral crus is downwardly displaced, with a skin web veiling the soft triangle, and it is buckled lateral to the dome.

4. The alar base is displaced laterally, resulting in a flattened alar-facial angle and a widened nasal floor.

Lindsay and Farkas (1971) have applied anthropometric methods to the cleft lip nasal deformity to try to delineate the extent of each component defect. Takahashi and Yamazaki (1964), Brown (1964), and Boo-Chai and Tange (1968) have reported the occurrence of an isolated cleft nostril deformity without cleft lip or palate, illustrating the presence of formes frustes or microforms of this congenital anomaly (see Chapter 46).

The Lateral Bony Platform. Additional evidence, derived from the studies of Graber (1949) and Pruzansky and Osbourne (1968), of abnormalities of the tissues adjacent to the cleft lip and palate, such as those of the mandible, maxilla, and cervical spine, suggests the presence of a more pervasive embryonic disturbance, less localized than previously suspected. If there is disagreement concerning the presence or absence of hypoplasia of the cleft lip nostril, there is general agreement that hypoplasia of the maxilla in the region of the pyriform aperture is usually present. Gillies and Kilner (1932) and McIndoe (1938) were among the first to note the bony deficiency of the pyriform aperture, which provides a platform for the ala. Fomon, Bell, and Syracuse (1956), Farrior (1962), Longacre and associates (1966), and Hogan and Converse (1971) have also emphasized this abnormality. Longacre pointed out that, following bone grafting of the cleft maxillary arch, there is frequently an improvement in the contour of the overlying cleft lip nose and ala. In addition, Takahashi and Yamazaki (1964) noted that pyriform aperture hypoplasia is usually present in the microform cleft lip nasal deformity.

The Midline Supporting Structures. The midline supporting structures are usually distorted. Deviation of the caudal edge of the cartilaginous septum toward the noncleft side occurs, distorting the columella. Secondly, convex deviation of the midportion of the septum into the cleft airway is frequently present and may cause airway obstruction as well as malalignment of the nasal dorsum.

Hogan and Converse (1971) observed that virtually all of the unilateral cleft lip nasal deformities could be explained by considering the nose as a tripod. The nasal tip is supported by the center of a tripod, consisting of an arm for each ala and a third arm which includes the dorsal border of the septum. When one of the lateral bony platforms of the pyriform aperture is deficient, the tripod tilts and the ala collapses. Not only is the ala deformed, but also the septum suffers as well. The overlying tissues may limit, to a mild degree, the forward thrust of the developing septum, and when alar collapse occurs, the septum bends along a sagittal plane with the convex portion toward the cleft side.
If the tilt is particularly severe, or if, in addition, there is hypoplasia of the ala on the cleft side which adds to the degree of collapse, the septum may slip out of the vomer groove and protrude in the unaffected nostril. This particular abnormal anatomical configuration of the septum is very common, occurring in 70 to 80 per cent of cleft lip nose deformities. Avery's studies (1961) confirm that there are often abnormalities of the septum and vomer in cleft cases. The vomer may increase the displacement of the septum by being deformed itself and being unable to provide a stable base for the septal cartilage. The alar deformity, therefore, could represent a combination of abnormal shape and position due to a "tilted tripod", plus variable degrees of intrinsic hypoplasia of the involved soft tissue and cartilage.

Timing of Corrective Nasal Surgery. Considerable controversy still exists as to whether correction of the nasal deformity should be attempted in infancy at the time of the primary lip repair, or whether correction should be deferred until adolescence when growth of the nasal structures has been completed.

McIndoe (19380, Brown and McDowell (1941), Huffman and Lierle (1949), Berkeley (1959, 1969), and O'Connor, McGregor, and Tolleth (1968) have advocated attempting nasal correction at the time of primary lip repair, arguing that the future nasal configuration would be more satisfactory if the structures were in their anatomical position during the growth period. Millard (1964) has also indicated that in his more severe cases he is not averse to modifying to a slight degree the alar cartilage of the cleft side.

Direct surgical attack on the nasal tip or alar cartilages of the unilateral cleft lip nasal deformity in infancy may be overly presumptuous in view of the complexity of the problem. Operating on the adult nose offers the advantage of knowing that the anatomical result of surgery is definitive. Attempts to modify the alar cartilage in the cleft lip infant's nose in order to produce a subject suitable for photographing, as the patient leaves the hospital, has been decried. "It has been found that this excision of the alar cartilage may complicate a future rhinoplasty and, furthermore, the effect is not always maintained" (Peet and Patterson, 1963). Blair (1925), Veau (1931), Gillies and Kilner (1932), Marcks and associates (1964), and Matthews (1968) have also recommended a delayed nasal repair. They warned that successful early surgery is technically not feasible owing to the tiny size of the structures, and that violation of the cartilaginous framework will lead to growth disturbance and distortion.

In recent years, however, a rational compromise approach has developed. Improved primary lip repair utilizing Z-plasty techniques in the upper lip are now available. These lip repairs include primary closure of the cleft nostril floor and repositioning of the flared ala. By augmenting the cleft alar platform with bone grafts, one can favorably influence symmetrical nasal growth. Thus it seems that the use of a primary lip repair of the upper Z-plasty type, possibly supplemented by onlay bone grafting of the hypoplastic pyriform aperture, should be the full extent of the nasal repair undertaken primarily. Secondary rhinoplasty would then be deferred until nasal growth has been completed. According to the studies of Hajnisova (1967), nasal growth is complete in females by age 16 and in males by age 18.

Objectives of Corrective Nasal Surgery. The objectives of the nasal surgery are to restore the symmetry of the alar cartilages, to produce a cosmetically acceptable nasal tip, and to obtain a satisfactory relationship between the lip and the nose. To achieve this it is often
necessary to reduce the nose in size, and a complete rhinoplasty is frequently performed. The
unaffected naris may appear to be abnormally large because of the hypoplasia of the cleft
nostril, which is secondary either to the original deformity or to previous surgical intervention.
To restore symmetry, therefore, the unaffected nostril must be reduced in bulk. This can
usually be achieved by partial excision of the cephalic portion of the lateral crus. Both alar
cartilages must then be molded into a symmetrical form by various surgical procedures on the
alar cartilage of the cleft side.

Much of the nasal tip deformity may be due to the abnormality of the septum. The
form and shape of the cartilaginous septum are adversely affected by the defective maxillary
development. The inadequate septal support may result from either an intrinsic septal cartilage
abnormality or a malformed vomer. That these structures may be involved in the congenital
anomaly of the unilateral cleft lip and palate can no longer be doubted. Correction of the
septal deformity is essential if, as is often the case, the caudal portion of the septum
contributes to the asymmetry of the nasal tip. This is accomplished by the "swinging door"
method (Metzenbaum, 1929; Converse, 1950) (see Chapter 29).

**Corrective Surgery.** The majority of the patients will already have had primary lip
closure, and the individual components of the pathologic anatomy will have been altered by
the surgical procedure. This is especially true of the flared alar base. A deviated septum and
the presence of a previous lip repair are common to all patients seeking corrective surgery.

No single procedure which has been developed to date has given sufficiently good
results to provide a standard approach to the problem of the cleft lip nose deformity. Thus the
surgeon must be familiar with the wide range of available methods in order to choose the
appropriate procedure for each individual patient's deformity.

In general, the repairs fall into two categories: (1) correction of the ala as a unit, and
(2) correction of the alar soft tissue and the cartilaginous framework separately. The latter
category of repairs can be performed through either extranasal or intranasal incisions. The
cartilaginous framework may be adjusted by suture relocation, incision and suspension, or
graft augmentation. In addition, a number of minor "touch-up" procedures have been
developed to compensate for residual deformities not corrected by specific methods.

**Correction of the Ala as a Unit.** One of the earliest approaches was repositioning the
entire ala as a unit. Stimulated by Blair's initial impression that the lateral displacement of the
medial crus was the major characteristic of the deformity, a trend developed to "rerotate" the
ala. Since this procedure involved moving the soft tissues along with the cartilaginous
framework en bloc, it required external skin incisions.

The initial design by Blair (1925) involved correcting the downward displacement of
the medial crus by a mid-columella incision which extended under the alar base to allow
rotation. This procedure elevated the dome and narrowed the alar base, but it left the caudal
dislocation of the alar margin to be corrected by a rim excision. Techniques described by
Sheehan (1936), Padgett and Stephenson (1948), and Schjelderup (1963) are basically
modifications of the Blair prototype.
In 1931, Joseph described the technique of dorsal skin excision, which corrected the downward displacement of the ala and to a lesser extent brought the dome of the alar cartilage into a more correct position. Narrowing of the alar base was done in a separate procedure. Crikelair, Ju, and Symonds (1959) have reported their application of this technique.

Gillies and Kilner (1932) extended the Blair concept a step further by lengthening a mid-columella incision upward above the dome, as in Joseph's technique. Their repair was basically an alar rotation, with the columella and alar base rotated separately. The downward displacement of the ala was corrected by a rim excision. Young (1949), Morel-Fatio and Lalardrie (1966), and Velazquez and Ortiz-Monasterio (1974) have published variations of this technique.

Berkeley (1969) combined the Blair type of alar rotation with the Joseph technique of soft tissue excision, so that the entire ala was moved en bloc. This procedure combines the advantages of its predecessors, correcting the inward displacement of the medial crus, the downward displacement of the alar rim, and the flaring of the alar base. Wilkie (1969) published a correction of an artist's error in the original Gillies and Kilner paper and suggested that incorporation of a Joseph-type dorsal skin excision was also part of the Gillies and Kilner method.

Wynn (1972) has described a "round nostril" technique, which employs a triangular flap at the alar base.

Correction of the wide nostril floor resulting from alar base flaring has been corrected by Z-plasty transposition of the nostril floor to a position lateral to the alar base (Gillies and Kilner, 1932), or by excision and alar base rotation (Erich, 1953).

The advantages of the en bloc alar repositioning techniques are the control during the mobilization provided by the wide exposure and the long-term stability provided by moving the soft tissues along with the tip supporting sutures. However, most surgeons are reluctant to use them as standard procedures because of the visible external scarring. As suggested by Crikelair, Ju, and Symonds (1959), external incisions and excisions are indicated in the patient (1) with severe deformity, (2) with thick and excessive alar skin, or (3) after a previously unsuccessful intranasal procedure.

A number of small supplemental soft tissue procedures have been designed and are usually required. Correction of the web at the apex of the nostril has been achieved by rim excision (Blair, 1925; Gillies and Kilner, 1932; Millard, 1964) or by Z-plasty (Straith, 1946; Elsahy, 1974). The correction of the narrow nostril floor was described by Joseph in 1931.

Tension in the lateral vestibule has been relieved by a Z-plasty (O'Connor, McGregor, and Tolleth, 1968; Matthews, 1968), V-Y advancement (Stenström, 1966), or skin grafting (Rees, Guy, and Converse, 1966). The details of the Gillies-Kilner technique are illustrated in the figure.

Correction of the Soft Tissue Deformity and Cartilaginous Deformity Separately. A number of external nasal incisions have been designed in order to provide exposure of the medial crura and dome area. Most of the techniques employed through external incisions
focus on the medial crus and its fixation to its counterpart on the noncleft side. DeKleine (1955) and O'Connor, McGregor, and Tolleth (1968) advocated a mid-columella incision. The original Gillies and Kilner incision (1932) extended the columella incision into the cleft nasal floor; it can be used for exposure without rotating the entire ala as a unit. Erich (1953) advocated a "flying wing" incision at the nasal tip, and the Figi incision (1952) is a combination "flying wing" and mid-columella incision. Several authors have advocated intranasal rim incisions connected across the columella at different levels (Rethi, 1934; Potter, 1954; Spira, Hardy, and Gerow, 1970). A midline incision extending along the nasal dorsum to the tip of the nose gives good exposure and allows remodeling and repositioning of the structures under direct vision. A dermabrasion performed two to three months after the scar has healed leaves a relatively inconspicuous residual scar.

The various types of intranasal incisions are those routinely available in rhinoplastic surgery (see Chapter 29) and thus will not be illustrated. These approaches provide adequate exposure of the lateral and medial crura. The exposure is not as complete, however, as that afforded by the direct exposure through an external incision. The soft tissue redraping is also less stable than when done by an external incision. Nevertheless, most surgeons prefer the intranasal approach whenever possible, and most of the following procedures have been designed for use through an intranasal route.

Methods dealing with suture fixation of the alar cartilages have been described. In a severe deformity, the best exposure is obtained through an incision along the caudal rim of the alar cartilages; thus the domes and septal angle are approached from this dorsal aspect. McIndoe and Rees (1959) described a procedure which involves exposing both alar cartilages, then securing the two alar domes to each other and to the septal angle. The lateral cartilages were also sutured to the septum, and the position of the two lateral crura was secured by mattress sutures through the skin. The lateral vestibular defect was left open to epithelize by second intention, with the risk of a recurrence of the deformity.

Stenström (1966) described medial rotation of the lateral crus with suturing to the ipsilateral nasal dorsum near the edge of the nasal bone. The lateral vestibule was advanced according to the V-Y principle and the ala moved medially with a Z-plasty. Spina (1968) has described a similar procedure which places the excised noncleft lateral crus into the lateral vestibular defect.

Rees, Guy and Converse (1966) freed the misplaced lateral crus and approximated the alar domes to the contralateral upper lateral cartilage, and a full-thickness graft was placed in the lateral vestibular defect to minimize secondary contracture. A procedure attaching the cleft lateral alar crus to both the ipsilateral and contralateral upper lateral cartilages has been described by Reynolds and Horton (1965).

Relocation of portions of the alar cartilages was also proposed. Brown and McDowell (1941) described dividing the cleft lateral crus and advancing it across the midline over its own dome to be suspended to the contralateral dome through intranasal incisions. Erich (1953) divided the medial crus on the cleft side through an external incision and suspended the dome to the contralateral dome. Incision and reflection of the upper portion of the unaffected lateral crus across the midline to augment the lateral crus of the cleft side was proposed by Humby (1938). His repair was done through an intranasal route.
Barsky (1950) suspended the upper portion of the lateral crus on the cleft side to the dorsum of the septum through a Gillies-Kilner external incision. Whitlow and Constable (1973) used a Figi-type external incision to cross a bilateral winged alar flaps which were suspended through the skin by pull-out sutures over bolsters. These last three procedures depend for their success upon a very small portion of hinged cartilage in the dome. Since the cartilage of the alar dome is frequently thin and friable, construction of a durable hinge may not be possible in many cases.

Finally, a number of operative procedures have been devised based on graft augmentation of the cleft ala, frequently in combination with other procedures. Fomon, Bell, and Syracuse (1956) described a procedure which involved placing cartilage grafts over the lateral crus, at the anterior nasal spine, and in the columella. Lamont (1945) proposed using the unaffected lateral crus to augment the cleft alar dome, and Musgrave and Dupertuis (1960) developed this approach further with the use of cartilage to suture a multi-layered "lifeboat graft".

Application of a columella strut made from septal cartilage combined with rim excision and alar base resection was advocated by Millard (1954).

The placement of bone or septal cartilage grafts over the hypoplastic maxillary pyriform aperture was suggested by Farrior (1962). Takahashi and Yamazaki (1964), Longacre and associates (1966), and Hogan and Converse (1971) have used bone grafts and septal cartilage grafts. Elsahy (1974) modified the Straith dome Z-plasty to provide a buried dermal flap in the cleft dome.

Converse (1964) modified the Gillies-Kilner technique, which increases the projection of the defective alar dome by rebasing the medial crus. An intercartilaginous incision is made bilaterally, and the transfixion incision is extended to the septal angle and downward to the midpoint of the caudal border of the septal cartilage. The alar cartilages are exposed by means of rim incisions (see Chapter 29). An incision is then made along the caudal border of the medial crus on the affected side, freeing the medial crus and covering skin. The dome of the alar cartilage along with the medial crus is then raised, increasing the projection of the dome as much as possible in an attempt to restore the symmetry of the two domes. Partial thickness incisions are made through the defective alar cartilage to assist in shaping the dome. The medial crura are then sutured to each other. Cartilage is resected from the cephalic portion of the unaffected lateral crus; the excised cartilage is then placed over the affected dome, "capping" the dome, and maintained in position by fine plain catgut sutures. A gap remains at the base of the columella on its lateral aspect. A composite graft from the auricle repairs the defect.

Intranasal vestibular molds are essential in maintaining the projection of the dome (see Chapter 29). After completion of the surgical procedure, an impression of the vestibule on the repaired side of the nose is taken with softened dental compound. The compound must extend into the recess of the vestibule, supporting the dome. A second mold is made and will be duplicated in acrylic. The thin acrylic mold should be worn by the patient for many months if a satisfactory result is to be obtained. The importance of the prosthetic mold must be emphasized, since it provides support of the repositioned defective dome, maintenance of the
elongated columella, and prevention of secondary contracture of the vestibule, particularly if a skin graft is required to remedy a deficiency of the vestibular lining.

In the patients shown in the figures, prior to the repair of the nose, augmentation of the hypoplastic maxilla to correct the tilted tripod was essential. In addition to excision of the caudal border of the hanging defective ala, the septum was straightened and augmentation of the projection of the defective dome was done as illustrated in the figure. A modified version of the Straith technique was used to elongate the narial opening on the defective side.

**Deformities of the Bilateral Cleft Lip Nose**

In contrast to the technical difficulties encountered in attempting to correct the deformity of the unilateral cleft lip nose and the relatively mediocre results often obtained, more encouraging and occasionally dramatic improvement in appearance has been obtained in patients with the nasal deformity of the bilateral cleft lip.

**Pathologic Anatomy.** The bilateral cleft lip nose deformity is essentially a bilateral form of the unilateral cleft lip nose deformity.

1. The *medial crura* are displaced with their bases partially submerged in the prolabium, producing lowered domes and a shortened columella.

2. The *alar domes* are laterally displaced, causing a tendency to bifidity; the dome angle between the medial and lateral crura is more obtuse, resulting in a flattened tip.

3. The *lateral crura* are displaced downward, with a skin web veiling the apex of the nostril; the cartilage may be buckled lateral to the dome, producing a collapsed nostril contour.

4. The *alar bases* are displaced laterally, causing bilateral flattened alar-facial angles and a widened nasal floor.

5. Bilateral hypoplasia of the *pyriform aperture* is often present.

6. The position of the *nasal septum* is dependent upon the degree of symmetry of the deformed nose.

Pigott and Millard (1971) have pointed out that the normal infant nose is flatter and broader than the adult nose. They found the anterior nostril angle in the infant to be approximately 90 degrees; this decreases to 45 degrees in the adult. Furthermore, the ratio of columella height to nasal projection above the columella is less than 1:2 in the infant, but greater than 1:2 in the adult. Their measurements were based on studies in Caucasians; the figures vary with ethnic differences. The height of the normal columella usually coincides with the length of the philtrum. An understanding of the nasal tip proportions is necessary for accurate surgical planning.
Corrective Surgery. Under the influence of Axhausen (1932), bilateral cleft lip closure became based upon use of the prolabium as the entire central portion of the lip. In this technique, however, the columella tended to become shortened and drawn into the lip. In contrast, secondary nasal repairs have stressed the need to lengthen the shortened columella, often returning tissue to the columella from the previously repaired lip.

In order to correct the residual deformity of the bilateral cleft lip and nose deformity in adults in whom treatment had been inadequate or incomplete. McIndoe and Rees (1959) attempted to remove in a single stage the residual deformities that stigmatize the bilateral cleft lip patient. The operation consisted of resection of the scar tissue, repair of the lip, and total bilateral mobilization and realignment of the distorted alar cartilages and septum. Bilateral osteotomies were also performed, when indicated, to realign the bony framework of the nose.

Lindsay and Farkas (1971) measured the columella in normal individuals and in patients who had undergone bilateral cleft lip repair and concluded that in many cases the columella shortness in infancy was more apparent than real. They reasoned that avoiding dissecting and displacing the columella at the time of initial lip repair would allow columella growth and would preclude the need for further columella lengthening in many instances.

From a historical viewpoint, attention was primarily focused on the columella and the lack of tip projection, since the symmetry of the deformity tended to disguise its complexity. Classification of the techniques must therefore be centered around the management of the columella.

Upper lip tissue was first used for columella reconstruction by Dupuytren (1883). Gensoul (1833) originated the concept of V-Y advancement from the prolabium. Denecke and Meyer (1967) reported that Lexer and Joseph and modified the V-Y technique, as did Gillies and Kilner (1932), Blair and Lettermen (1950), and Potter (1954). A stellate flap was devised by Brown and McDowell in 1941. It combined a V-Y advancement of the central portion of the columella with bilateral wings from the nostril floors to lengthen the membranous septum. Erich and Kragh (1959) utilized a similar type of stellate flap but extended the incision onto the alar rims.

Converse, Horowitz, Guy, and Wood-Smith (1964) and Converse, Hogan, and Dupuis (1970) described the use of advancement of the prolabium into the columella combined with simultaneous reconstruction of the prolabium by a cross-lip (Abbé) flap. The technique has been most effective in patients in whom the lower portion of the prolabial segment was sacrificed at the primary lip closure operation, leaving a tight upper lip, often a hypoplastic maxilla, a lingually displaced premaxilla, a short columella, and a flat nasal tip. The technique is also applicable to bilateral complete clefts in which there is no muscle in the prolabial segment. The flaccid prolabial segment furnishes the missing tissue to the columella, thus lengthening it and restoring adequate tip projection.

The circumoral continuity of the orbicularis muscle is restored by an Abbé flap from the lower lip. In certain cases, the projection of the tip is maintained by a cantilever iliac bone graft (see Chapter 29). The scarred tight upper lip of the bilateral cleft lip may also result in a lingual displacement of the premaxilla and maxillary hypoplasia. Prior to restoring skeletal
contour, the tight lip must be relieved. In the patient shown in the figure, the premaxilla was realigned and fixation was maintained by bone grafting after the nose-lip repair.

Bilateral vertical flaps from the upper lip were rotated into the columella base as a secondary procedure by Marcks, Trevaskis, and Payne (1957) and by Trauner and Trauner (1967). A similar method is employed for columella lengthening in the primary lip repairs of Wynn (1960) and Skoog (1965). Millard (1958) used bilateral "forked" flaps in secondary procedures, moving them into the columella by V-Y advancement.

Columella lengthening by tissue from the nose was also described. Tissue from the nasal floor was used by Carter (1919), Kazanjian (1939), Converse (1957), and Cronin (1958). Millard (1971) described a two-stage "forked" flap procedure in which the lip flaps are "banked" in the nostril floors at the initial lip procedure, then shifted into the columella at a second stage (see Chapter 44).

A number of procedures have been devised which augment the columella by means of distant tissue. Brown and coworkers (1946), Dupertuis (1946), Pelliciari (1949), and Meade (1959) have recommended transplanting composite grafts from the auricle. Pegram (1954) elongated the columella by means of a graft from the alar base, and Champion (1960) transposed a nasolabial flap.

Tissue rearrangements in the columella and the nasal domes has also been suggested. Blair and Letterman (1950) described a diamond-shaped excision of tissue from the columella and also a V-Y advancement of the tip. A V-Y advancement from the nasal dorsum downward was described by Joseph (1931), Ombrédanne and Ombrédanne (1928), and Morel-Fatio and Lalardrie (1966). Denecke and Meyer (1967) gave credit to Dieffenbach as the originator of this technique. Another method, proposed by Brauer and Foerster (1966), adapted the double-wing flaps of Gillies (Gillies and Millard, 1957) to lengthen the columella in bilateral cleft patients. Ortizcochea (1975) used a hinged septal flap to provide a columella strut. Apparent though not true columella lengthening can be obtained by Z-plasties in the nostril apex, as described by Straith (1946) and Straith, Straith, and Lawson (1957).

If the nasal floor cannot provide adequate donor tissue, however, attention should be turned to the upper lip, where the forked flap technique can be used.

If the upper lip is deficient and cannot yield donor tissue, advancement of the prolabium into the columella combined with the use of an Abbé flap may be necessary.

In addition to columella lengthening, reapproximation of the alar domes to correct the bifidity is often necessary, as is maxillary advancement. Further modification of the nasal tip may be needed, but in the usual case, the symmetry of the deformity minimizes its abnormal appearance.

When flaring nostrils require correction, the technique illustrated in the figure, may be indicated. A wedge-shaped flap is raised from the floor of the nasal vestibule; the ala is freed by an incision at its base and rotated medially; the flap from the floor of the nasal vestibule is transposed laterally to the ala; and the remaining lateral defect is closed by the V-Y technique.
Deformities of the Maxilla in Cleft Palate Patients

Cleft palate patients have many associated deformities. The most frequent complication is maxillary hypoplasia. As mentioned earlier in the text, some degree of maxillary hypoplasia, especially near the pyriform aperture, is frequently present as part of the congenital cleft anomaly. There is increasing evidence incriminating early surgery as the causative factor in severe retardation of maxillary growth (see Chapter 42). The early clinical observations of Slaughter and Brodie (1949) and Kazanjian (1951), the observations by Ortiz-Monasterio and associates (1959, 1966) of nonoperated cleft lip patients, and numerous experimental studies demonstrate that the primary results of early lip and palate operations are followed by the disappointment of progressively increasing maxillary underdevelopment in later childhood.

As a result of the continued growth of the mandible, the rehabilitation of the cleft lip and palate patient may require a surgical procedure to correct the disparity between the maxilla and the mandible. The continued growth of the lower jaw in the presence of a hypoplastic maxilla results in a Class III malocclusion, which requires either a maxillary advancement (Le Fort I or Le Fort 1.5 osteotomies) for correction in the more severe cases, or a premolar segmental advancement osteotomy in less severe cases when the molar relationships are adequate (see Chapter 30). Other types of osteotomies are also indicated in patients with more severe deformities and gross disparity in size and form between the maxilla and mandible. A modified Le Fort III osteotomy is occasionally indicated. A combination of osteotomies may be required to achieve adequate facial contour and dentoalveolar arch form (see Chapter 30).

Maxillary advancement procedures in the cleft lip and palate patient differ from the operative procedures done in other types of maxillary hypoplasia (idiopathic or traumatic). Because of the frequent asymmetry of the deformity, the advancement involves segmental osteotomies with forward and often lateral movement of each palatal process. A new arch form is thus established; better balance between the two jaws is achieved; and dental occlusion is improved.

The tight and scarred soft tissues tend to restrict the forward movement of the maxilla at the time of surgery, and maxillary advancement is usually more difficult in cleft palate patients. The subperiosteal separation of the soft tissues from the skeletal framework should be meticulously performed, and the release of the soft tissues may have to be extended to the posterior pharyngeal wall.

The soft palate is advanced with the skeletal structures. Though the maxillary advancement could potentially uncover latent velopharyngeal incompetence or be the cause of recurrence of a preexisting velopharyngeal incompetence which has been corrected previously, postoperative assessments of the soft palate indicate that the changes are more in position than in the distance from the posterior pharyngeal wall (see Chapter 30). Thus speech is usually not critically impaired. When advancement of the maxilla occurs to an unusual degree, velopharyngeal incompetence may result and requires pharyngeal flap rehabilitation.

In the presence of a pharyngeal flap previously constructed to correct velopharyngeal incompetence in early childhood, the passage of a nasoendotracheal tube for the anesthesia
may be difficult or impossible. On occasion, the pharyngeal flap is diminished in size, and the lateral retraction of the flap will permit passage of the tube. If the flap is tethered and ineffective and the patient has velopharyngeal incompetence, the flap is severed and a secondary flap, either superiorly or inferiorly based, is constructed at a later date.

When the pharyngeal flap is functional, Ruberg, Randall, and Whitaker (1976) have described a technique of lengthening the flap to preserve its function at the time of maxillary advancement. Incisions are made along the lateral edges of the posterior pharyngeal wall on each side of the flap. The base of the flap is undermined in a superior and inferior direction. A horizontal incision then allows adequate lengthening of the intact flap. The donor site is left open to re-epithelize.

The patient shown in the figure is an example of the result that can be obtained by a Le Fort 1.5 maxillary advancement followed by improvement in the contour of the upper lip by an Abbé flap from the lower lip. The extent of the maxillary hypoplasia is shown; maxillary advancement combined with pre- and postsurgical orthodontic treatment improved the facial contour and dental occlusal relationships. The contour of the upper lip was further improved by an Abbé flap from the lower lip which restored the Cupid's bow. The Abbé flap was placed centrally in the lip, and the cleft scar was moved laterally.

Hypoplasia involving the major portion of the midfacial skeleton is evident in the cleft palate patient shown. A high maxillary advancement osteotomy (Le Fort III, see Chapter 56) was modified in order to avoid enophthalmos, which could be a risk of the classic Le Fort III osteotomy. Starting at the nasofrontal junction, the osteotomy was extended backward to the lamina papyracea, turned at a right angle downward, then again turned at a right angle forward along the base of the medial orbital wall, across the infraorbital rim, vertically downward over the maxilla to a level immediately below the infraorbital foramen. From the infraorbital foramen, the osteotomy continued its course through the upper portion of the body of the zygoma, immediately below the rim of the orbit. The zygoma could then be advanced after the zygomatic arch was sectioned at the zygomaticotemporal junction. A bone graft wired in place restored the continuity of the arch. The remainder of the procedure was similar to a Le Fort III osteotomy with pterygomaxillary disjunction, advancement, and bone grafting at the pterygomaxillary interface. The technique made possible an advancement of the midface without disturbing the orbits.

In a male patient who had undergone a bilateral cleft lip repair in infancy, multiple attempts to correct secondary deformities of the upper lip and nose had been made. The upper lip was badly scarred, with its central area completely devoid of muscle. The patient also had a hypoplasia of the premaxilla and anterior portion of the maxilla, although the molar relationships were adequate. The treatment proceeded as follows: in a first stage the tight scarred upper lip was repaired by an Abbé flap. The scarred, hairless central portion of the upper lip was used to lengthen the columella according to the technique in illustrated previously. A premolar segmental advancement osteotomy (see Chapter 30) was performed to restore adequate occlusion between the anterior dentoalveolar arches. The premolar advancement osteotomy also helped to improve the contour of the upper lip. The considerable improvement achieved can be seen when the preoperative appearance of the patient is compared to the postoperative appearance.
Palatal Defects: Oronasal Fistulas

Defects of the palate should be closed by surgical methods, if possible, to improve speech and to prevent the escape of fluid and food particles into the nasal cavity.

Successful closure of large or small palatal perforations depends on adequate vascularization of the surrounding mucoperiosteal flaps. Fortunately, the rich vascular supply to the mucoperiosteum of the palate and alveolar process and the mucosa of the lips and cheeks permits the mobilization of local tissue even after it has been scarred, provided that sufficient time has elapsed to allow softening and revascularization of the tissue. The hard palate donor site shows a remarkable propensity to regenerate, and the denuded area is rapidly and spontaneously resurfaced.

An essential principle to be observed in closing defects communicating between the oral cavity and the nasal or maxillary sinus cavities is the provision of a lining, as well as covering by a flap. The lining tissue is obtained from several sources: the nasal cavity (the vomer); the tissue immediately adjacent to the defect, raised, turned in, and sutured with a purse-string type of suture; a turnover flap of adjacent tissue on one side of the defect; a flap of adjacent alveolar, vestibular, or cheek tissue; or, as a last resort, a distant flap introduced into the oral cavity.

Use of an obturator made by a prosthodontist is an alternative solution in defects that cannot be closed by local tissue because of size or several unsuccessful surgical procedures. In such large defects, the patient can wear a denture with an attached obturator (see Chapter 52).

Closure in the majority of cases is accomplished by transposing flaps from the immediate vicinity of the defect. Only in rare cases is the use of a distant flap indicated, as a prosthetic obturator is usually a satisfactory and simple means of eliminating large palatal defects.

For the repair of median hard palate fistulas, anteroposterior incisions are made along the gingival margins of the teeth; the mucoperiosteum is undermined extensively. Mattress sutures are employed to obtain a wider surface of contact between the flap and the raw edges of the defect. In small palatal defects this technique is usually successful. If the mucoperiosteum around the defect is adequately vascularized, it is raised and hinged on the border of the bony defect, and sutured by a purse-string suture, thus furnishing a lining as illustrated.

There are many ingenious surgical techniques available which draw upon local tissue for the closure of larger palatal defects. The use of a vestibular flap, introduced subperiosteally into the floor of the nose to reconstruct the nasal lining of the defect, is illustrated. Mucoperiosteal flaps furnish the oral covering of the defect.

A lateral defect of the hard palate may be closed by two mucoperiosteal flaps: a lining flap and a covering flap. The covering flap extends along the margin of the alveolar process backward around the tuberosity of the maxilla and is elevated sufficiently to avoid tension and injury to the palatine vessels. The lining flap is a turnover flap hinged on the edge of the
defect. Use of such flaps with incisions in close proximity to the dentition should be restricted to patients in the secondary dentition stage because of the effect of the resulting scar on the developing dentoalveolar complex.

A defect in the posterior portion of the hard palate is repaired by raising the mucoperiosteum around the defect; it is hinged on the borders of the defect and sutured by a purse-string suture. The oral covering is provided by bipedicle Langenbeck flaps. The flaps also extend around the maxillary tuberosities, and the palatine vessels exiting from the greater palatine foramina are respected. As mentioned earlier, the denuded hard palate has a remarkable propensity for spontaneous re-epithelization.

**Bone Grafting Palatal and Alveolar Defects.** When conditions are favorable and well-vascularized flaps are available for both lining and covering tissue, bone grafts may be employed to complete the reconstruction by restoring the continuity of the alveolar arch. Judgment must be exercised in deciding whether to graft bone at the time of flap transfer - a procedure generally feasible.

Cancellous bone grafts wedged between the edges of the alveolar defect or packed into the defect as bone chips are employed. The indications for bone grafting in the cleft lip and palate patient are discussed in Chapter 48.

**Large Defects of the Palate.** In patients with wide clefts, and in those in whom an unsuccessful attempt at closure has been made, a pharyngeal flap combined with a cleft palate operation is indicated (see Chapter 45 and 52).

**Tongue Flaps.** Tongue flaps have been employed for the closure of palatal defects. Jackson (1972) has described a technique of closing large anterior palatal fistulas with anteriorly based flaps from the dorsum of the tongue. Nasal resurfacing is obtained by hinge flaps from the margins of the defect. The tongue donor defect is closed by direct approximation, and the pedicle is divided at 17 to 21 days.