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THE SURGICAL ANATOMY OF SECONDARY CLEFT LIP AND PALATE DEFORMITY AND ITS SIGNIFICANCE IN RECONSTRUCTION

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Summary. This paper discusses the significance of the surgical anatomy of the adult cleft deformity in reconstruction. The essential asymmetry of the unilateral cleft is explained and methods suggested for reconstruction in three categories of cases; those with simple alveolar defects; those with additional retroposition of the maxillae; and those with vertical maxillary deficiency. The indications for two-stage osteotomies are presented. Finally a new surgical approach for osteotomy of the premaxilla in bilateral clefts is described and illustrated.

Introduction

During the past decade in particular there has been expanding interest in more effective and stable methods of correction of the adult residual deformity present in patients with clefts of the primary palate. Improved results have been achieved following the acceptance that the residual bony defect could be reconstructed (Henderson & Jackson, 1975) and that this reconstruction was an essential component in restoration of the soft tissue contour. Standard texts on maxillo-facial surgery now include relevant chapters based on these techniques (Jackson, 1978; Waite & Kersten, 1981). The correction of residual deformity is at present an expanding surgical field because of the large backlog of patients who were not previously offered treatment of this nature. From personal experience 62 cases of various complexity were subjected to maxillary osteotomy and bone grafting in the past 3 years and in the current year an average of three cases per month are presenting for surgery. It has become clear that previously described standard procedures are not easily applicable to all cases and the approach to the problem of residual deformity must take account of the individual surgical anatomy of each patient. This is because the adult deformity is related not only to the original embryological mesodermal deficiency and diminished growth potential, but also to the pattern of primary surgery, the degree of interceptive surgery during growth and the level of orthodontic skill practised within a particular treatment centre. The lack of consensus in these latter three areas means that the overall pattern of adult deformity is extremely varied.

A rational approach to the treatment of each case can be made from a study of the surgical anatomy, there being three components of the deformity at the end of the growth period.

(1) *Absent or hypoplastic tissue*
resulting from embryological deficiency and diminished growth potential.

(2) *Misplaced hard and soft tissue*
resulting from inadequate or incomplete primary and interceptive reconstruction.

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(3) *Deformity*
resulting from the effect of the scar tissue produced by necessary interceptive surgery during development.

Objectives in Reconstruction

In the fully grown patient the objectives of reconstruction relate to various components of deformity some or all of which may be present.

(1) *Nose and upper lip*:
Frequently it is only the nasal shape and upper lip appearance which offend and late reconstruction is confined to this area of the face.

(2) *Mid-facial hypoplasia*:
The facial form may be unsatisfactory because of both antero-posterior and vertical hypoplasia, correction of which will require some form of mid-facial osteotomy.

(3) *Occlusion*:
The functional occlusion varies from unsatisfactory to disastrous and it is important that it be re-established by orthodontics and surgery, as well as being provided with adequately restored teeth supplemented by cosmetically acceptable prostheses.

(4) *Oro-nasal fistulae and alveolar defects*:
Residual fistulae may themselves be an impediment because of air and fluid leakage and their affect on denture retention. However, the problem anteriorly is more usually related to deficient bone round the nasal sill in which the fistula is an incidental finding.

(5) *Speech*:
Improvement of speech at the adult level is an elusive objective but surgical treatments need to be designed to avoid causing any deterioration.

Nasal Reconstruction

It is important to remember that the shape of the nose and its relationship to the upper lip is frequently the most important complaint from the patients point of view. The superficial elements of the nasal skeleton are in general normal although some degree of hypoplasia of the alar cartilages may be present as a component of the original defect. It is now accepted that definitive rhinoplasty should logically only be undertaken after reconstruction of the maxillary base.

Closure of anterior fistulae and effective bony reconstruction of the nasal sill and septum are often more important to the appearance than correction of the occlusion. The alveolar defect has a fundamental affect on nasal shape particularly its symmetry. It is not good practice to devise maxillary osteotomies to advance and correct the occlusion which, after completion, still require obturation of an anterior fistula by means of a prosthesis, as the nasal base remains deficient and correction of asymmetry and airway obstruction is impossible, in spite of the improved profile.

The Unilateral Cleft

Residual deformity in unilateral cleft lip and palate is the commonest problem. In

most cases however good the primary correction the patient is left with asymmetry of the nasal base and nares. The bony deficiency allows the greater segment to tilt and the nasal septum deviates with it towards the non-cleft side and in a high percentage of cases it is displaced from its connection to the maxilla. (Fig. 1). The anterior extension of the vomer is bent and tilts in the coronal plane towards the cleft nostril forming a prominent ridge at its junction with the septum. This ridge is at the level of the inferior turbinate bone which on the cleft side is frequently hypertrophied. The approximation of these two structures obstructs the airway in spite of the fact that the general deviation of the nasal septum is to the opposite side. (Fig. 2).

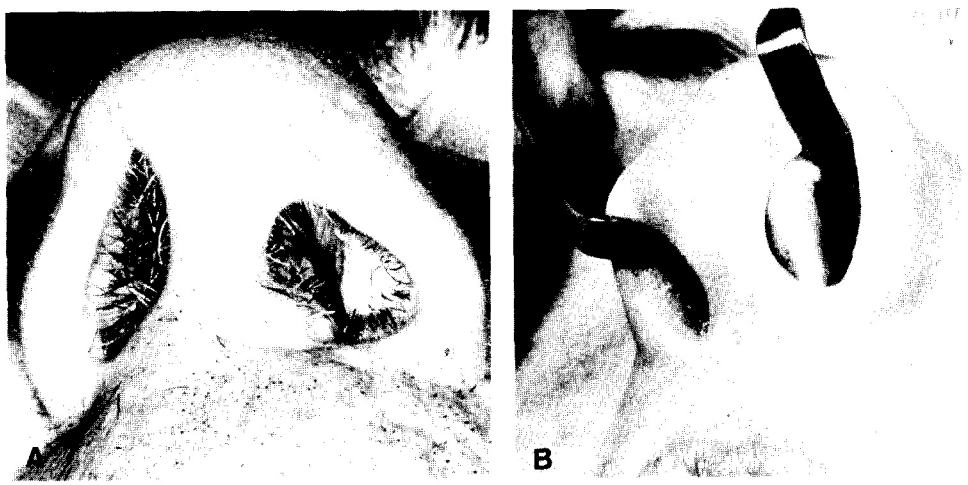

Fig. 1

Figure 1—(A). Asymmetry of the anterior nares in unilateral cleft lip and alveolus. The septal base deviates to the non-cleft side creating a ridge on the cleft side where it bends which partially obstructs the nostril on the side of the cleft. (B) Displacement of the base of the nasal septum from the maxillae in unilateral cleft.

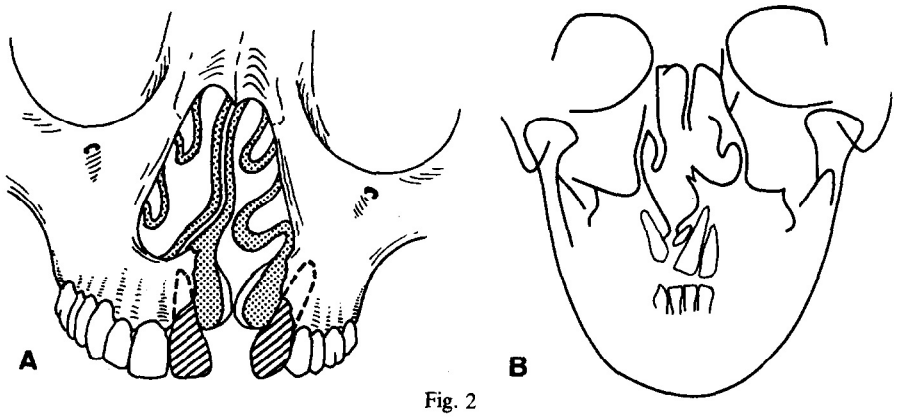

Fig. 2

Figure 2—(A). Diagrammatic representation of surgical anatomy in unilateral cleft of the alveolus. The nasal septum deviates to the non-cleft side creating a ridge which approximates with a hypertrophied inferior turbinate in the nostril on the side of the cleft. Teeth adjacent to the cleft are denuded of alveolar bone and are best removed at the time of alveolar bone grafting. (B) Tracing of P.A. radiograph in unilateral cleft patient which illustrates the deviation of the anterior part of the vomer which forms a ridge at its junction with the septum angled into the nasal space on the cleft side.

There is considerable variation in the final position of the two dento-alveolar segments depending on growth achieved both forward and vertically and the degree of orthodontic compensation achieved.

Cases fall into three general groups:—

(1) Adequate forward and vertical growth—residual alveolar defect and nasal asymmetry.

(2) Adequate forward growth of greater segment but vertical deficiency of lesser segment and arch collapse of varying degree.

(3) Inadequate forward and vertical growth of both segments with arch collapse of varying degree.

With each of these categories the surgical approach needs to be varied to produce the best result.

In all cases the lip may present as a separate but related problem. Lip morphology is very dependent on the standard of primary surgery. Lip closure has generally been of a high standard in major units for a sufficient number of years to minimise this problem. However, orbicularis reconstruction is not universally practised and many adult cases require the lip to be opened at least to reconstruct the muscle and often to correct lip length and irregularity and asymmetry of the vermillion.

Schendel and Delaire (1981) have recently drawn attention to the importance of muscle realignment in correcting the intrinsic asymmetry of the unilateral cleft in the adult. It is particularly important to undermine widely on the cleft side and to bring fibres of levator labii superioris and its nasal slip across the floor of the nostril to the septal base.

Surgical Reconstruction of the Unilateral Cleft Without Osteotomy

The objective in closing the alveolar defect is to achieve a symmetrical base for rhinoplasty.

As mentioned above it is often necessary to re-open the lip for muscle reconstruction and this facilitates the surgical approach. It is important to realign the nasal septum, if necessary by shortening and scoring of the cartilage. A hypertrophied inferior turbinate can be removed and the nasal floor re-established. There is always ample tissue for the nasal lining. The nasal sill is built up with cancellous bone and if necessary bone is packed behind the alar base.

The main difficulty is in establishing a healthy lining in the mouth. The oral mucosa repair usually requires an anteriorly based vestibular flap (Burian, 1963) from the sulcus overlying the lesser segment (Figs. 3 & 5A). If teeth are present adjacent to the cleft which are not covered by alveolar bone this prevents proper closure. If these teeth are retained, it results at worst in exposure and partial loss of the graft and at best in substantial resorption adjacent to the deficient tooth, thereby negating a large part of the objective of the reconstruction (Fig. 4). Teeth such as these are much better sacrificed along with any unerupted or supernumerary teeth within the cleft. They should, however, be retained up to the time of bone grafting since their presence preserves some important bone.

The mucosal flap used in the mouth is non-keratinised and provides a poor base particularly for a bridge. It is sometimes advantageous to replace the alveolar crest mucosa with a keratinised free palatal graft at a later date, at least 6 months after grafting.

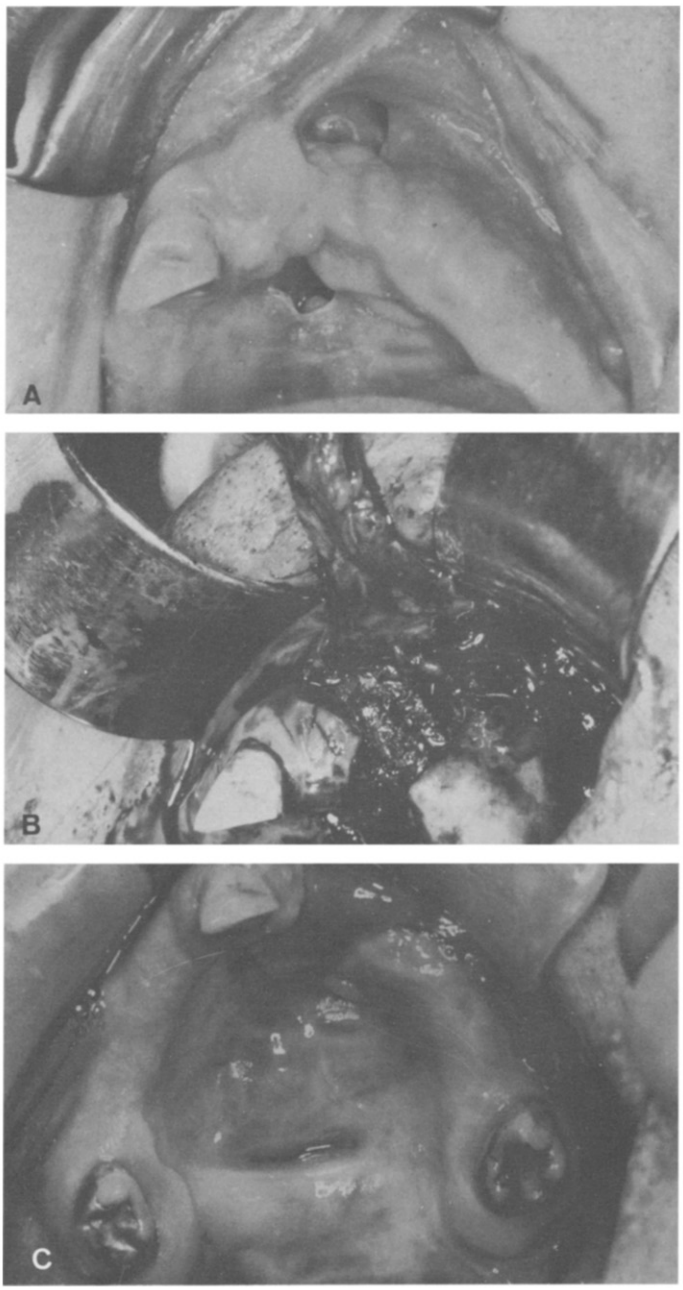

Fig. 3

Figure 3—(A). Residual anterior fistulae and alveolar defect. (B) The alveolar defect has been grafted but no osteotomy has been carried out. The oral defect can be safely repaired by an anteriorly based vestibular flap. (C) Completed closure of the anterior alveolus and fistula.

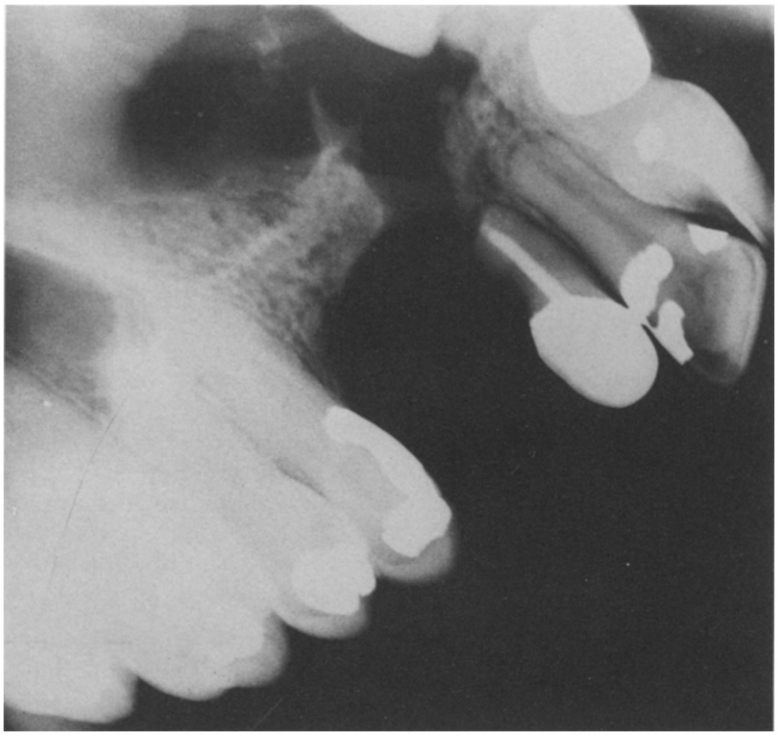

Fig. 4

Figure 4—Failure of alveolar graft in area adjacent to the lateral incisor. Failure resulted from retention of a tooth which lacked sufficient distal alveolar bone cover.

Unilateral Clefts Requiring Segmental Osteotomy

Frequently when there is a residual anterior fistula or alveolar defect the greater segment is well advanced but there is failure in the vertical growth of the lesser. This latter segment is often collapsed inwards to some extent as well. Vertical deficiency cannot be corrected orthodontically and an osteotomy is therefore required.

An osteotomy to reposition this lesser segment involves both buccal and palatal muco-periosteal stripping and it is frequently difficult to mobilise (Tideman *et al.*, 1980). An anteriorly based vestibular flap for closure of the oral mucosa over the cleft further denudes the segment. These lesser segments in cleft cases often have a deficient blood supply as Drommer (1980) has demonstrated by means of external carotid angiography. An anteriorly based vestibular flap taken off the side of the osteotomised lesser segment, while not preventing its overall survival, compromises the most distal tooth on the segment adjacent to the cleft and, with it, the incorporation of the bone graft in this area. It is better in these circumstances to use a posteriorly based vestibular flap taken from the labial vestibule in front of the greater segment (Fig. 5B). This technique is now used routinely without ever causing distortion of the vermillion of the lip. If a posteriorly based vestibular flap of this design is used, the osteotomy of the lesser segment can be achieved by a tunnelled approach on its buccal aspect thus maintaining buccal and palatal mucosal attachments (Fig. 6, C, D & E).

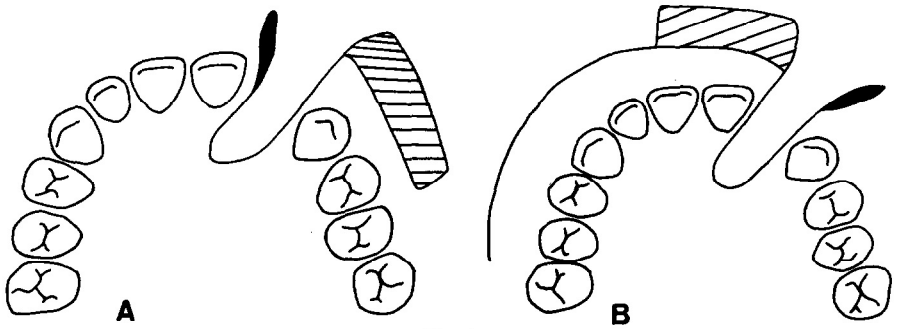

Fig. 5

Figure 5—(A). Diagrammatic illustration of anteriorly based vestibular flap. (B) Similar representation of posteriorly based vestibular flap designed to conserve the blood supply to the lesser segment when it requires surgical repositioning.

Breakdown of the oral wound is probably more common than the literature suggests. In unilateral clefts it has now become a very infrequent complication in this unit.

Consistency in oral closure has been achieved as a result of three measures:—

(1) Removal of any teeth adjacent to the cleft which are denuded of alveolar bone.

(2) The routine use of non-irritant fine suture material. 5/0 Prolene has proved to be extremely satisfactory and vastly superior to silk or resorbable materials which are never used in the mouth in these cases.

(3) Maintenance of a 'food-free' flap for 48 hours after operation. This is achieved by feeding the patient through an ultrafine flexible naso-enteric tube (Silk, 1980; Brown, 1981) together with intensive use of warm saline mouthwashes.

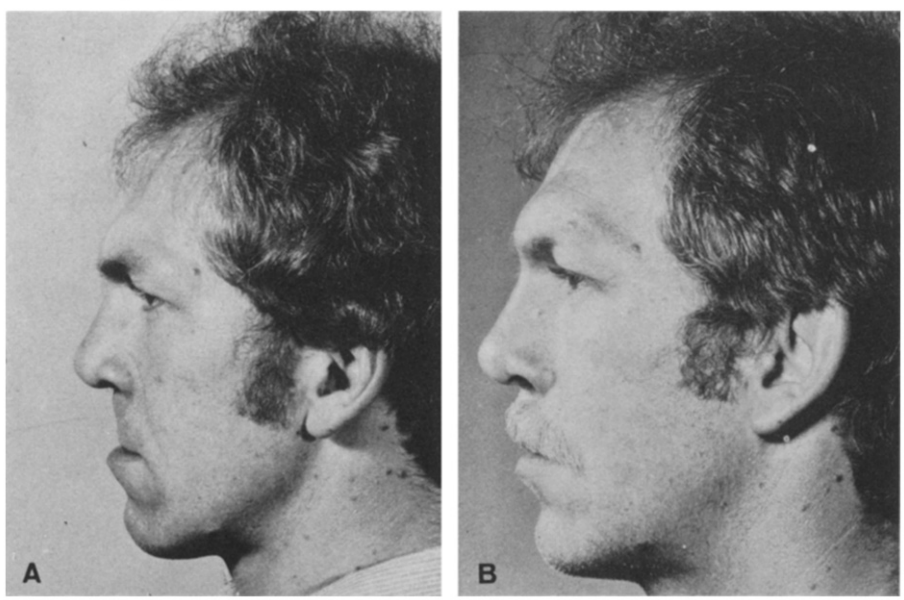

Fig. 6

Figure 6—(A). Profile of patient with unilateral cleft lip and palate. (B) Improved profile after Le Fort I osteotomy maxillary advance and vertical correction of lesser segment.

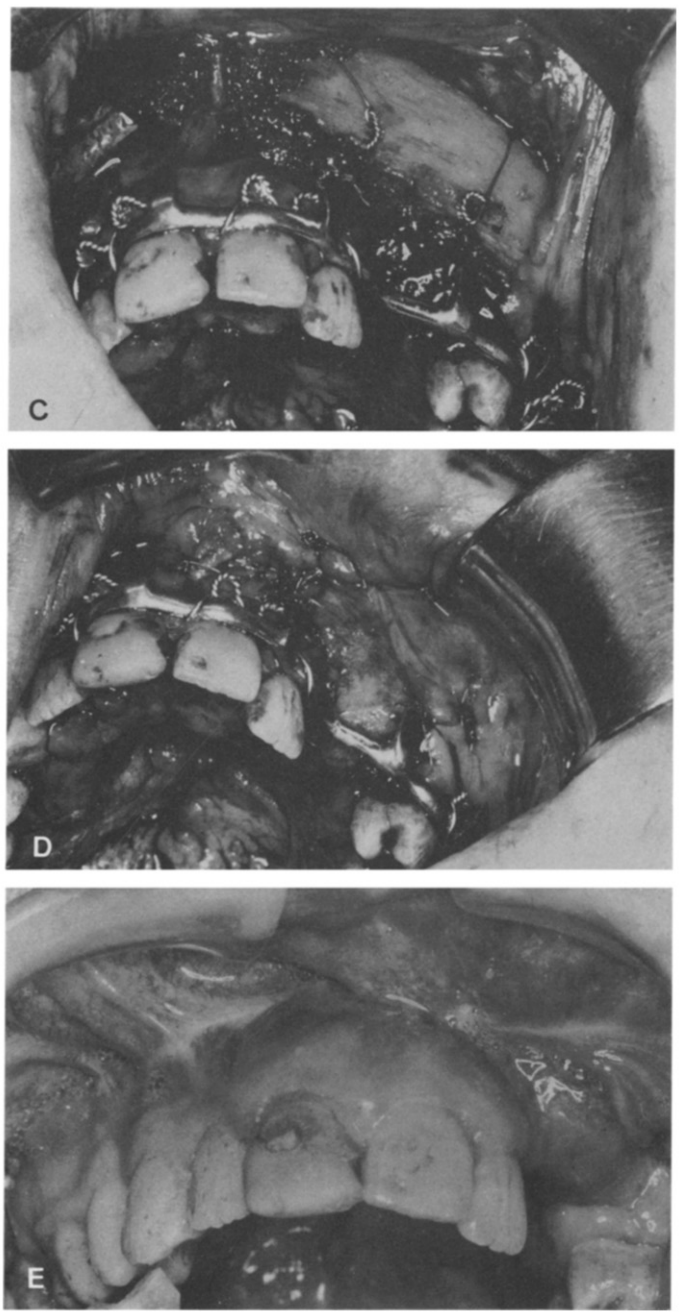

Figure 6

Figure 6—(C). Intra operative view showing bone graft for vertical correction of lesser segment and filling of alveolar defect. A tunnelled approach has been made for osteotomy of the lesser segment. (D) Same case after oral closure using a posteriorly based vestibular flap. The suture material is 5/0 Prolene. (E) Same case after healing showing satisfactory depth to the anterior vestibule from where the flap was transferred.

Unilateral Cleft–Retroposition of Maxilla with Adequate Upper Facial Height

This problem is dealt with by an extension of the techniques described above. Again the deficient nasal base and deviated septum are corrected and the lesser segment osteotomy carried out with great care via a buccal mucosal tunnel. The greater segment may be down-fractured via a circum-vestibular incision. It is sometimes necessary to raise a palatal flap from the greater segment in which case the vestibular incision should not be extended posteriorly further than the first molar.

No palatal flap is ever raised from the lesser segment. The pterygoid osteotomy is achieved through a small local incision at the maxilla-pterygoid junction. Oral closure over the cleft is again carried out with a posteriorly based vestibular flap which is, of course, raised easily after down fracture of the greater segment without affecting this surgical approach (Fig. 6).

There are a limited number of cases where the maxillary arch is grossly collapsed and retropositioned and in which the soft palate is already short. In such cases forward positioning and expansion will open the anterior fistula and palate to such an extent that closure by a vestibular flap becomes difficult.

This small group of cases is treated by utilising palatal flaps and tunnelled vestibular incisions. (James, 1978). The osteotomy cut can be made from the palate in front of the posterior bone edge and the segments advanced without too much soft palate distortion. This approach means that the large alveolar defect cannot be grafted nor the anterior fistula closed at the osteotomy stage. These are, however, cases in which the oral closure is best completed by a tongue flap as a secondary procedure. Lateral, posteriorly based tongue flaps are favoured as they can be inserted with much less restriction of tongue movement than that produced by a dorsal flap.

After separation and later trimming of the tongue flap, an alveolar bone graft may be considered but these patients are often satisfied with a prosthesis alone. It is not usually practical to insert a bone graft at the same time as the tongue flap is inset. However on rare occasions a good nasal lining can be formed by splitting the tongue flap. In these circumstances simultaneous bone grafting is permissible.

This is the only group of patients in which a palatal osteotomy approach has advantages. In general (vide infra) when multistage surgery is planned it is better to establish the dental arch prior to advancement.

Unilateral Cleft—Naso-maxillary Hypoplasia with Vertical Maxillary Deficiency

Not infrequently patients with cleft lip and palate exhibit considerable vertical maxillary deficiency. The resultant overclosure of the mandible produces pseudo-prognathism and gives the impression of more retroposition of the upper jaw than actually exists. Correction of the vertical deficiency is essential to the restoration of facial appearance. While this can sometimes be achieved by osteotomy at the Le Fort I level there are cases which benefit from osteotomy at the Le Fort II level.

One school of thought holds that Le Fort II osteotomies are never indicated in cleft patients because of the normal forward development of the nasal bridge. However, where vertical maxillary deficiency exists the Le Fort II osteotomy produces lengthening of the nose and a better forward positioning of the nasal tip without altering the upper nasal profile and naso-glabella angle. It is important in such cases for the osteotomy cut to pass in front of and below the medial canthal ligament, so that this structure is not depressed with the repositioned midface (Fig. 7).

If a Le Fort II osteotomy or vertical repositioning at the Le Fort I level is indicated it is much easier if the upper arch is reconstructed as a first stage. Alignment of the

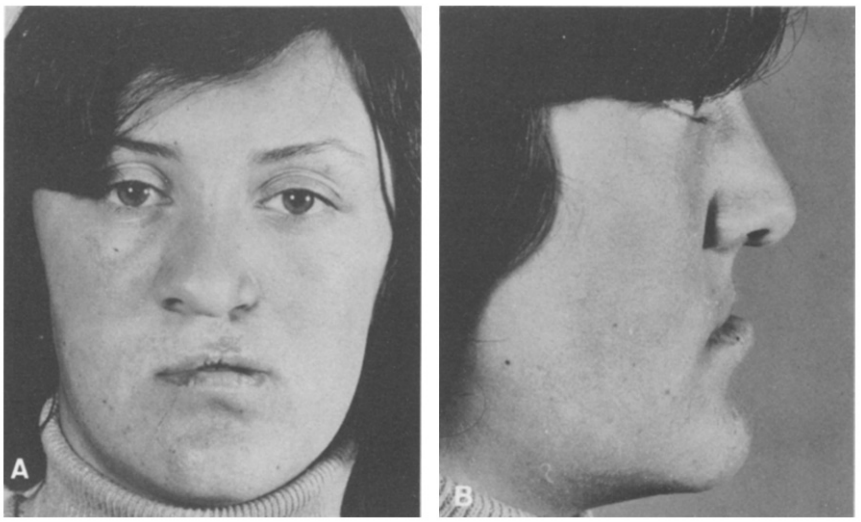

Fig. 7

Figure 7—(A). Full face and profile of adult unilateral cleft patient exhibiting naso-maxillary hypoplasia suitable for correction by Le Fort II osteotomy. (B) The deficiency in vertical dimension is evident in the profile view.

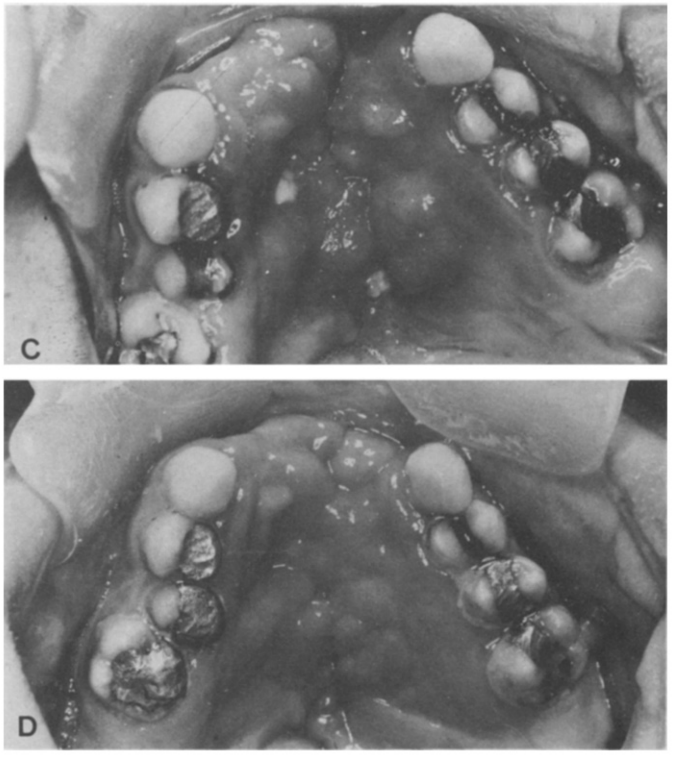

Fig. 7

Figure 7—(C). Pre-operative appearance of palate with residual anterior fistula and substantial alveolar defect. (D) Result of first stage of reconstruction. The alveolar defect has been successfully grafted establishing continuity of the upper arch.

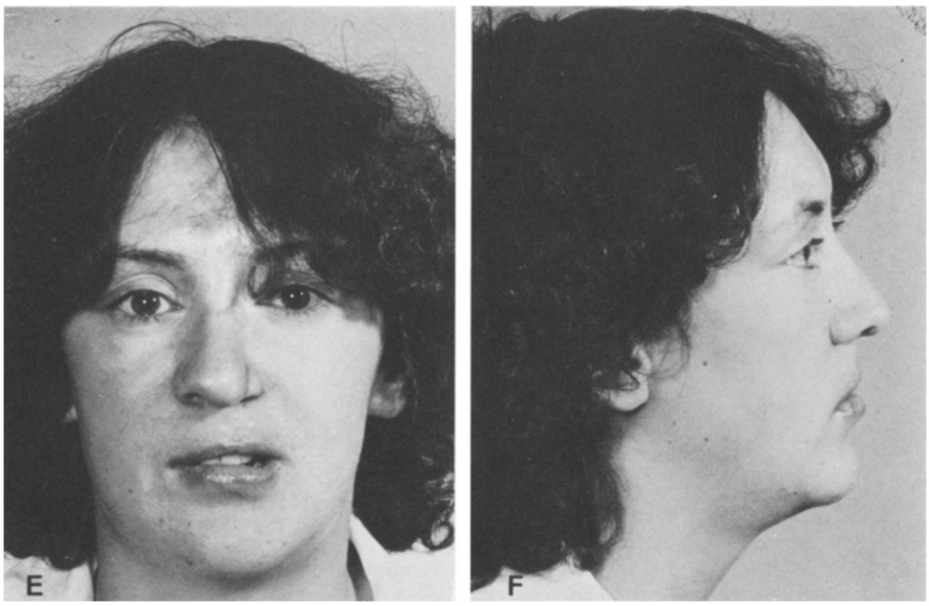

Fig. 7

Figure 7—(E). Full face and (F) profile views of same patient three years after Le Fort II osteotomy. The Mid-facial lengthening as well as advancement has produced a better naso-labial profile than would have been achieved by Le Fort I osteotomy. The para-nasal skin incisions are cosmetically acceptable but some degree of asymmetry of the anterior nares remains.

upper arch is best achieved by fixed appliance orthodontics assisted, if necessary, by segmental surgery. The alveolar defect is grafted to complete the reconstruction of the upper arch and the nasal sill.

The definitive osteotomy is carried out at least 6 months and preferably 1 year after alveolar grafting. In all these cases extra-oral cranio maxillary fixation is maintained for a 3 month period. This can be achieved using a halo-frame or supra orbital pins. Supra-orbital pins joined to the maxilla by three separate connecting bars have proved satisfactory for maxillary osteotomies in cleft cases. They remain completely firm during the 12 week period of fixation if the coarse 'wood screw' pattern of bone pin is used. After the extra-oral fixation is removed intermaxillary Class III elastics are used, if tolerated, for a further 3 months. This prolonged period of fixation is very tedious for the patient, but unless skeletal fixation is maintained until the bone grafts are consolidated relapse is inevitable. Preliminary experience with 13 cases treated in this way suggests that the repositioned maxilla does not relapse significantly.

Bilateral Clefts

The residual deformity in bilateral clefts is symmetrical (Fig. 8). This means that the problems associated with deviation and bending of the nasal septum do not exist. The chief difficulty encountered in reconstruction of the nose stems from the broadening of the tip, retroposition of the alar cartilages and shortening of the columella.

Extreme retroposition of the premaxilla may exist, particularly as there are still some patients left who were subjected to pre-vomerine resection in infancy. This

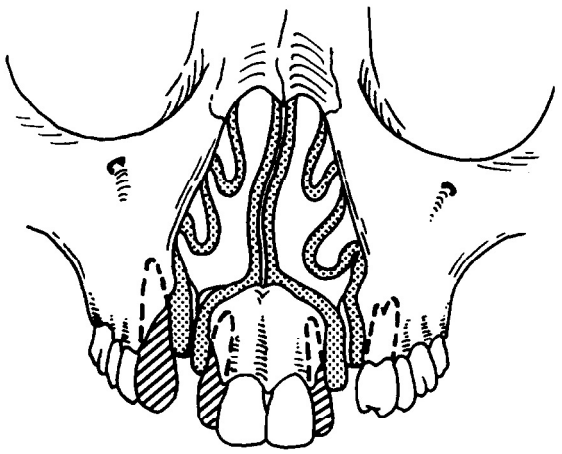

Fig. 8

Figure 8—Diagrammatic representation of the surgical anatomy in adult bilateral cleft. The deformity is symmetrical. The deficiency of alveolar bone adjacent to the cleft creates particular difficulties in reconstruction particularly as regards the small premaxilla.

particular operation, apart from leading to extreme malposition of the premaxilla, often ensured that the permanent tooth germs in the premaxilla were irreparably damaged.

In all bilateral clefts arch alignment and alveolar grafting precedes total maxillary osteotomy. The best conditions for reconstruction of the alveolar defect are present at the beginning of the final adult reconstruction. If these small segments are moved forward or vertically prior to alveolar grafting new scar tissue is created, their blood supply is easily compromised and final alveolar reconstruction made more difficult. If arch alignment and alveolar reconstruction are achieved prior to advancement the situation is akin to the unilateral case and an appropriately designed total maxillary osteotomy can be carried out as a later procedure.

The most difficult objective to achieve in the bilateral case is upper arch alignment and alveolar reconstruction. Collapse of the two lateral segments is usually corrected

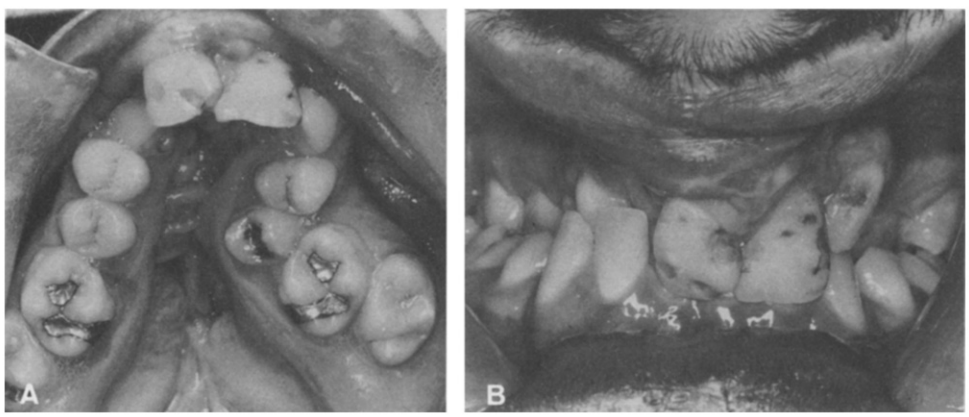

Fig. 9

Figure 9—(A) Typical arch collapse in adult bilateral cleft case—palatal view. (B) Same case illustrating the particularly unfavourable malalignment of the premaxillary segment.

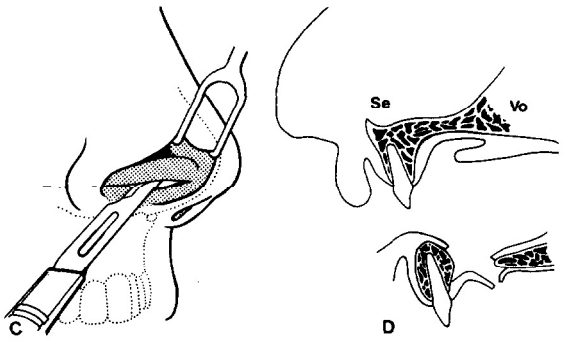

Fig. 9

Figure 9—(C). Diagram illustrating the nasal incision used by the author to approach the vomerine-premaxillary spur of bone. The osteotomy of this spur is carried out through this incision. (D) Diagrammatic representation of sagittal sections of the premaxilla in the midline and paramedian planes (Se–septum Vo–Vomer). The midline section illustrates the substantial vomerine-premaxillary spur which must be sectioned. The paramedian section illustrates how the essential apron of mucosa can be raised from the palatal aspect following a nasal approach.

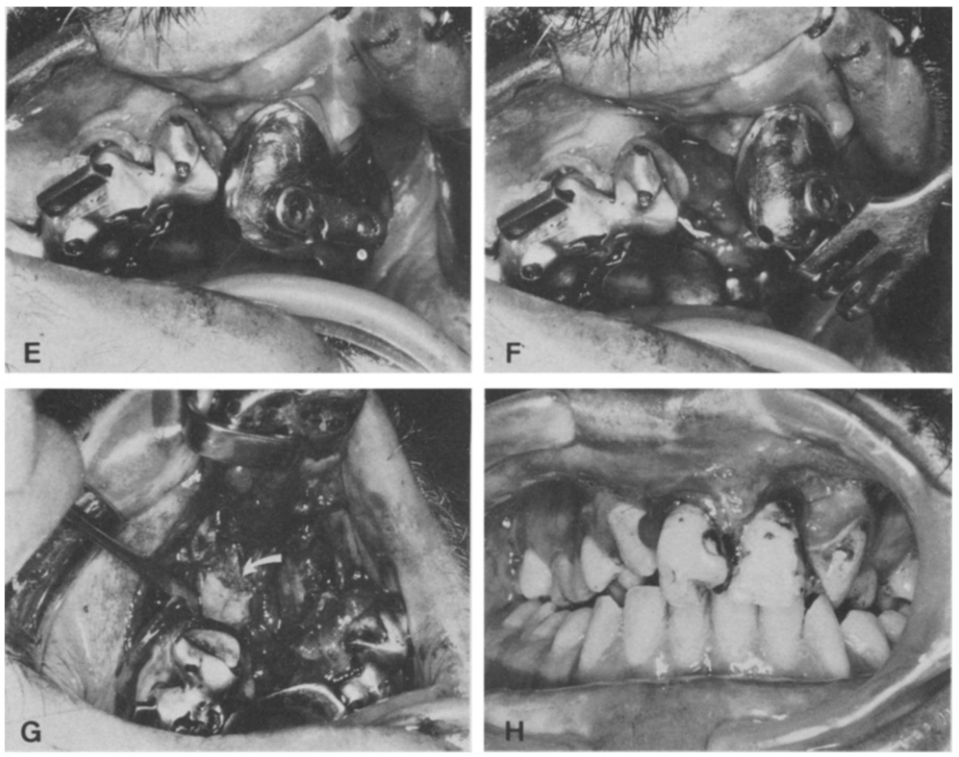

Fig. 9

Figure 9—(E). Case shown in 9A and 9B prior to premaxillary osteotomy. The difficulties associated with an intra oral dissection of the anterior fistula can be appreciated. (F) Same case after premaxillary osteotomy via an intranasal incision. The premaxilla has been mobilised without transgressing the oral mucosa at any point. (G) Same case after completion of the oral dissection. The premaxilla has been reflected forward on a vestibular mucosal pedicle. A healthy apron of palatal mucosa has been preserved behind the premaxilla. The white arrow indicates the cut vomerine-premaxillary spur of bone. (H) Final appearance of case shortly after removal of splints. The buccal segments were expanded orthodontically prior to premaxillary osteotomy and bone grafting of the alveolar defect.

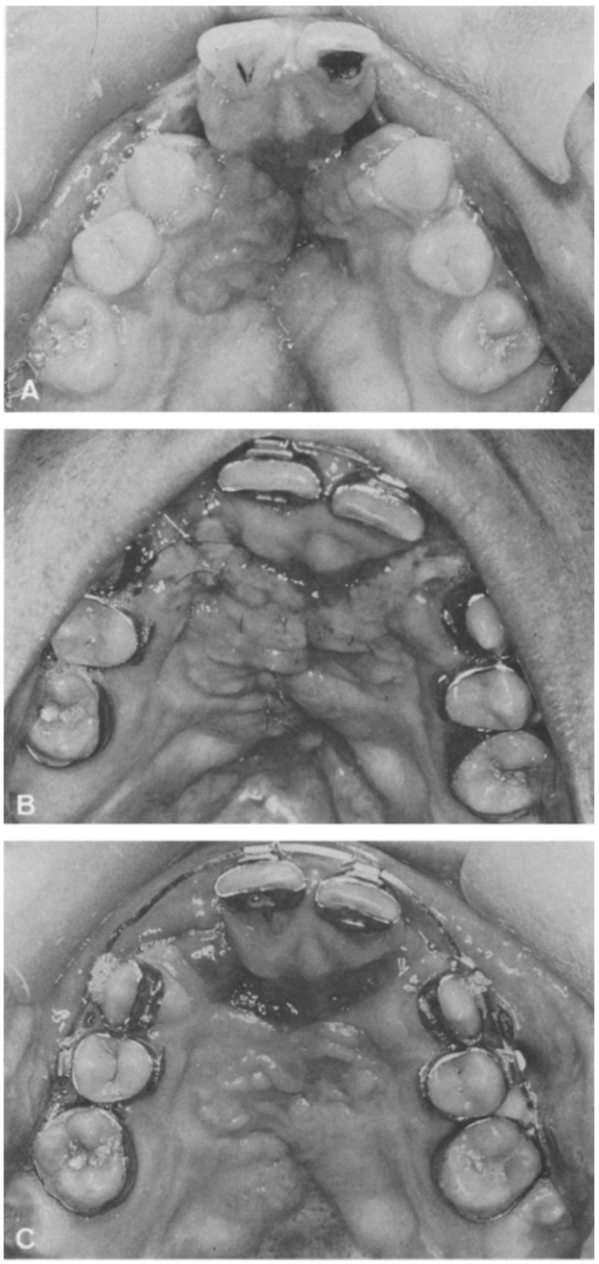

Fig. 10

Figure 10—(A). Adult bilateral cleft prior to reconstruction of alveolar defects. (B) Same case a few days after reconstruction by the method illustrated in Figure 9. Bilateral anteriorly based vestibular flaps have been sutured into the oral mucosal defect after bone grafting. The lack of inflammation associated with 5/0 Prolene is clearly illustrated. (C) Same case showing the appearance of the oral mucosa shortly after suture removal. Complete oral mucosal closure has been achieved including the problem area immediately behind the premaxilla.

orthodontically often by rapid maxillary expansion and this technique may also be used to achieve some forward correction of the premaxilla. However, the premaxilla frequently requires alignment in the vertical plane and it is this which presents the biggest problem, (Brouns & Egyedi, 1980).

It is extremely difficult to mobilise the premaxilla while still preserving both a good blood supply and a healthy apron of palatal mucosa behind. The premaxilla is usually united to the vomer by a substantial spur of bone. In order to preserve the oral mucosa this spur of bone is approached via incisions in the nasal mucosa on each side of the lower anterior part of the cartilaginous septum. The muco-periosteum overlying the back of the premaxilla can then be raised from above and behind prior to cutting the vomerine-premaxillary bony spur (Fig. 9).

After mobilisation of the premaxilla the cleft on each side can be dissected from the usual intra oral approach. It is frequently necessary to sacrifice the lateral incisors (if present) where these teeth are totally denuded of bone on their distal aspect. If the lateral segments have been aligned orthodontically this allows the premaxilla to be repositioned, bone grafts inserted in the alveolar defects and bilateral anteriorly based vestibular flaps rotated in to connect with the palatal flaps. The blood supply to the premaxilla is adequately preserved via the substantial labial pedicle.

It must be emphasised that it is difficult to achieve 100 per cent success in these bilateral cases, but unless alveolar continuity is established, further definitive osteotomy will be unsatisfactory (Fig. 10). Small residual fistulae behind the premaxilla are undesirable but acceptable.

Teeth and Alveolar Defects

The considerable problems inherent in grafting alveolar defects in the adult cleft patients are compounded by lack of bone covering the adjacent teeth. If the dental arches could be completed by earlier interceptive bone grafting these problems would recede. Dental arch alignment would then be possible in every case by orthodontics, and surgery would be confined to the correction of naso-maxillary hypoplasia.

Although, in general, interceptive surgery during growth is counter-productive there is now evidence that cancellous bone grafting to alveolar defects just prior to eruption of the canine tooth is justified. Waite & Kersten (1980) report successful eruption of the whole permanent dentition in 70 per cent of cases treated in this way.

Cleft lip and palate is a basic mesodermal defect in which anatomical reconstruction would best take place after completion of growth. Earlier surgery is always a compromise necessitated by the essentials of facial appearance, lip function and speech. A complete dento-alveolar component should be a further aim. It represents the only excuse for interceptive bone grafting and would greatly facilitate the correction of the residual defect in the adult. The planning of the final reconstruction must be based on a sound understanding of the surgical anatomy and techniques must be modified to suit individual circumstances in each case presenting for treatment.

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