

Surgery of the Nose and Other Aesthetic Surgery

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INTRODUCTION

Facial appearance is often important in social contacts in creating a good first impression. Many patients with a facial impairment will be aware that a facial impairment will make them look different. This could count against them in social acceptance. Many would want or request for aesthetic surgery to minimise or restore their facial impairment. Even if the surgeon is not able to completely correct the impairment, any reduction will be an advantage and may enable society and the patient to change their perception. In the case of leprosy the loss of eyebrows and presence of nasal deformities are often a real problem for social acceptance by the community. The scarred slack redundant skin of the face that follows marked lepromatous leprosy makes a young man look much

older than his calendar years. Deformity of the pinna may indicate old lepra reaction or infection to the clinician but to the patient may mean possible rejection. Large ear lobes are often unacceptable to the patient trying to get on with life. In some patients the provision of a pair of glasses (even plain glass) with ornate or attractive frames (Fig. 20-1), or a new attractive "hairdo" may be enough to hide the impairment and deflect unwanted attention. However, in the younger age group surgical intervention may provide a much better permanent alternative. There are many surgical textbooks that describe facial operations. It is impractical to include all the possible procedures in this chapter. Those selected for inclusion are the most commonly used and applicable in leprosy affected persons and yet are sim-



FIGURE 20-1a This degree of deformity of his nose was enough to stigmatise this patient.



FIGURE 20-1b When he acquired a pair of fancy rimmed glasses the stigma was no longer a problem.

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ple enough for most surgeons to perform. Consideration is also given to the time required for each procedure and the expenses involved. Most centres treating large numbers of leprosy patients cannot afford to use the expensive modern alternatives to the patient's own tissues, especially when these are available virtually free of charge. Any surgeon wishing to regularly do this type of surgery should read widely to understand the reasons for the many variations and possibilities.^{6,11,17} It is recommended that at least one of the more recent text books is studied.

It must be remembered that lepromatous leprosy involves the skin and subcutaneous tissues and that lesions may heal with marked fibrosis. Lepromatous patients may have large areas of scarred skin in which there is considerable fibrosis that results in disruption of the normal blood supply so that rotation flaps and pedicle grafts may not survive a transfer. Hence some procedures regarded as "routine" in other situations are not applicable. Extra care needs to be taken when doing face-lifts, nose reconstruction, or flaps of any kind on the face, to avoid tissue loss and increased scars.

REGULAR RECONSTRUCTIVE PROCEDURES

The most common procedures used for facial deformities due to leprosy are procedures for:

1) facial paralysis, 2) nose and 3) eyebrow reconstruction, 4) ear reconstruction and 5) face lifts.

1. Improvement of appearance and function after facial palsy

Marked loss of symmetry and asymmetrical movement is frequently the first thing noticed when someone is met for the first time. It is important to remember that no one's face is completely symmetrical.

Facial paralysis can involve:

- a. The eyelids- lagophthalmos, one or both lids,
- b. The lower face and
- c. The eyebrow, sometimes in isolation.

Improvement in basic appearance may be achieved either by static slings or muscle transfers. There are also more complicated nerve and/or muscle grafting procedures available (Chapter 19).

2. Reconstruction of the Nose

Various methods are available. Simple insertion of bone or cartilage may be adequate. However, it may be better combined with reconstruction of soft tissues by various methods. In leprosy the most common nose deformity is the so called "saddle nose" due to destruction of the septal cartilage and the contraction of the lining of the nose. If the nasal lining is released the external skin is usually adequate so that no or minimal external scars are produced in reconstructing a cosmetically acceptable nose. In planning nose reconstruction it is important to consider the ethnicity of the patient, his family characteristics and to study any photographs of the patient prior to the development of the deformity. Some patients require high nasal tips and bridges but some dislike this height. Most leprosy patients are satisfied if the obvious stigma of leprosy is removed. It is better to use the more simple techniques and succeed than to attempt the more difficult operations and increase the scars on the patient's face.

3. Eyebrow Replacement or Supplementation

Eyebrow reconstruction could consist of:

- a. Individual hair follicles replacement. This is ideal to correct thin eyebrows without leaving scars, or for ethnic groups with

normally thin eyebrows.^{4,14} Larger punch grafts may also be used.²²

- b. Free graft of hair bearing skin; usually post auricular skin.⁹
- c. Pedicle graft. This is usually based on the superficial temporal artery and is advisable in ethnic groups where very thick eyebrows are desirable.¹¹

4. Ear Trims

Usually it is only the lobes, which may become very large and floppy after lepromatous leprosy. Patients may also benefit from excision of nodules and scars on the pinna. The whole edge of the pinna may be destroyed or it may present a moth eaten appearance after severe lepra reaction. Occasionally long tube pedicle grafts to repair damage to the helix and/or lobe are applicable.

5. Face-lift

After severe lepromatous leprosy the skin is often left redundant, especially the midface, including the upper lip. This may make a young man look prematurely old. In many cases of facial palsy a midface face-lift combined with fascial slings can result in a very acceptable face.

1. PARALYTIC IMPAIRMENTS (See Chapter 19)

2. NASAL DEFORMITY

In leprosy the mucous membrane of the septum of the nose is very prone to ulceration, either as a result of rupture of a lepromatous nodule, or from ulceration of lepra reaction lesions. Defects in the mucous membranes allow secondary infection to destroy the septal cartilage. As the main support of the dorsum of the nose is destroyed there is a tendency for the

nose to collapse. Initially the bridge is usually unaffected while there may be a complete collapse of the mid-third and retraction of the lower nose. In leprosy, the nasal bones are usually destroyed by sepsis, not directly by the leprosy process. Hence the pathology and anatomical changes are different to those occurring in syphilis where the primary involvement is in the nasal bones although the external appearance may be similar.⁶ Millard and Mejia state that the deformities of the nose caused by cocaine use are similar to those caused by leprosy.¹⁹ Irrespective of the cause of the collapse the methods of correction described here are relevant.

In leprosy, the nasal bones are usually spared until very late. Many leprosy patients do not require any surgery to increase the height of the bridge of the nose. However, they usually are not averse to having the bridge heightened as is necessary if a bone graft is going to be arthrodesed to the bridge. Once the cartilage support has been destroyed the damaged mucous membrane, now without support, tends to scar and contract, and this contraction pulls down the external skin of the nose towards the maxilla, resulting in the characteristic depression of the dorsum of the nose and flaring of the nostrils. When the nostrils flare there may be an accompanying increase in the depth of the creases separating the ala from the cheek. The result is that when one stands eye to eye with the patient one can look into the nostril, and that is not normal (Fig. 20-2).

It is most important to study the nasal contours of the racial group as a whole before embarking on nasal reconstruction. For social acceptance it is necessary that the nose does conform to the norm for that racial group. In some races the nose is basically flat and a "saddle nose" may not be a big problem if the nasal bones are intact and normal.

In leprosy, in cases of mild nasal collapse, the appearance is similar to that found in



FIGURE 20-2 This patient shows the typical flaring of the nostrils, that are almost vertical due to some soft tissue contraction.

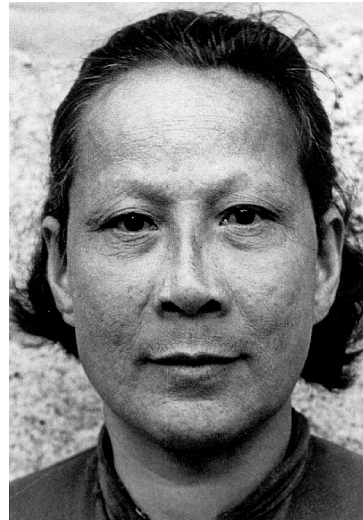


FIGURE 20-3 The same patient as in Fig. 20.2 after insertion of bone graft without need of lining release.

patients who have undergone nasal trauma or overzealous septo-plasty. If the patient is seen early when the nasal ridge is just beginning to collapse, he should be encouraged to pull the nasal skin out at the site where the depression may occur so that the skin is not allowed to contract. This may be enough to prevent an obvious collapse occurring. Figure 20-3 shows the effect of a bone graft in the patient in Figure 20-2 who did not require a lining release. Ointments may also be used to reduce the infection and inflammation of the septal lesions. Do not attempt inserting cartilage or bone grafts or synthetic material until the active phase of the leprosy is controlled and skin smears are negative as the risk of infection or ongoing destruction would be high. In some situations it is urgent that something be done to compensate for the collapsed nose, while the patient is highly positive. Then a reconstruction using naso-labial flaps, or a post-nasal epithelial inlay, will probably be best. Perhaps the bone graft can be added, if needed, once the active phase of the disease is completely controlled.

Nasal collapse due to leprosy seldom causes airway obstruction. In fact the nasal cavity is literally that- just a big cavity! Leprosy can cause airway obstruction if the mucosa contracts circularly. But if a patient *complains* of obstruction to breathing it is usually due to some other pathology or active leprous rhinitis.

Nasal Collapse: Grading

a. Mild

There is a slight depression or dip in the nose ridge, with mobile skin (Fig. 20-4). This can usually be corrected by bone or cartilage grafting, or the insertion of a synthetic prosthesis. The whole of the septal cartilage has not been destroyed and the skin not tightly tethered. To check for this, pull the skin of the nose at the site of the depression and see if it is possible to elevate it as much as is required without too much force. If the skin over the dorsum is unduly stretched and is under too much tension it may breakdown after the graft is inserted! These are the noses that are relatively



FIGURE 20-4 Mild nasal deformity due to loss of septum.

easy to correct by a standard bone, cartilage or synthetic graft, leaving no obvious external scars.

b. Moderate

This is usually associated with some flaring and moderate to major destruction of the cartilage. Usually there is some contraction of the nasal lining so that the nose cannot be easily mobilised. Initially, at least, the nasal bones and nasal spine are not destroyed. However, as the contraction of the mucous membranes increases the tissues around the nasal edge of the maxilla contract and the skin becomes tightly tethered until flaring of the alae is evident. The tip of the nose is pulled back and the nostrils appear to be wider and more vertical than normal (Fig. 20-2). Any degree of flaring implies that there is a definite contracture of the lining of the nose and that it is probably necessary to replace the lining after primary release of the scar tissue in the septal and alar areas. With these patients there is usually enough skin after release of the lining to cover the reshaped nose.

This is the group that does well with a post-nasal epithelial inlay skin graft (PNEI) This operation was first described by Gilles who developed it for correction of syphilitic saddle nose, in which the external appearance is similar to that of leprosy deformities.¹³ After freeing up the internal scars a split skin graft is applied over a stent to maintain external skin stretch for 3-6 months till contraction ceases. Then a support of the nasal ridge may be inserted if needed. A big advantage of the PNEI technique is that there are no external scars to show where the surgery has been done. Patients like it, and many would prefer it, even if the final nose is smaller than what could have been achieved by some other procedure that would leave more scars.

There are other flaps, such as naso-labial, forehead or from a distance that can be utilised. Each has their own special indications. Some races (Chinese, Koreans and many of the Asian tribal patients) normally do not have a high bridge and are happy if the nose is low and straight as long as the bridge has not been destroyed. In these people a simple post-nasal epithelial inlay as a single procedure may be adequate without any permanent support such as a bone graft. In these racial groups one needs to do the more complicated flaps and grafts less often than for those who desire a high pointed nose and a tall columella.

Figure 20-5 shows the shape of a normal nose and Figure 20-6 the cavity of the nose as altered by typical collapse.

c. Severe

In late stages, complicated by infection, the nasal bones and maxillary spine may be partly destroyed. Usually the nasal bones are still, at least partially, present. But there may be loss, usually from trauma or infection of alae, tip of nose or columella. This may require some type of flap reconstruction, to provide a new lining and external nasal skin. These may be forehead

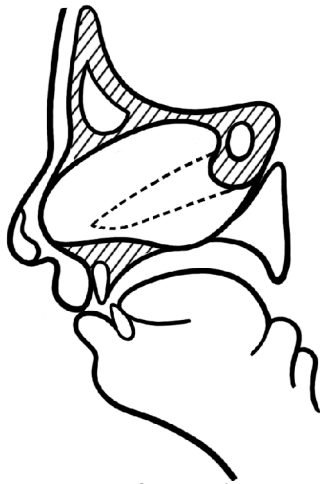


FIGURE 20-5 Diagram of vertical section through the normal nose.

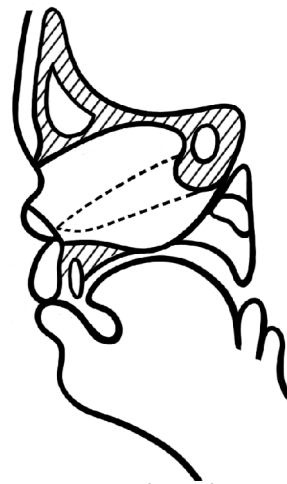


FIGURE 20-6 Diagram through typical collapsed nose showing distortion of anterior portion and cartilage.

flaps, naso-labial flaps, or other more distant flaps, or a combination of these. They usually need a structural support. Fortunately these severe deformities are relatively rare in leprosy. Many leprosy patients seeing other patients who have had the older forehead and scalp flaps that have left unsightly residual scars, request procedures with fewer scars. The "gull wing" forehead flap, in experienced hands, leaves minimal scars on the forehead and may be acceptable to the appearance conscious patient. The main need in most patients is to remove the leprosy stigma.

Do not attempt any major nasal reconstruction, especially using bone or cartilage grafting for any patient with dental caries or any infection of the head and neck.

SURGICAL PROCEDURES FOR NASAL COLLAPSE

i. Structural Replacement - Grafting

1. MATERIAL FOR GRAFT

When there is a definite "saddle-nose" or collapse of the ridge of the nose without marked flaring of the nostrils it may be possible to

insert a simple graft of bone, cartilage or synthetic material. Bone was the material of choice till the mid-1960s when cartilage came more into use. Later more synthetic materials were developed. Initially synthetic materials were frequently rejected but it appears that some of the more recent ones are better accepted. The authors do not recommend them as a routine for leprosy patients, due to high costs.

A. Cartilage grafts

Cartilage grafts can be harvested from the ear or a rib. Some consider them easier to obtain than a bone graft. It has been suggested that cartilage grafts are more frequently absorbed in children and that they do not grow with the child. Nasal collapse in children is rare but is seen in pre-teenagers. The best age to reconstruct the nose in these instances is open to controversy.

It is well documented that rib cartilage grafts can warp if not cut carefully. This particularly affects the costal cartilages of the lower ribs, which have a tendency to curl upon themselves. Gibson and Davis described a technique of cutting the rib graft so that the cartilage is less likely to curl.¹²

Technique of harvesting rib cartilage: The cartilage is often harvested from the lower ribs. The curve of the ribs needs to be carefully considered in order to obtain a piece that is long enough. Any remaining curves are acceptable in the finished nose. To prevent the twisting of a cartilage graft when in situ it is desirable that the graft should be cut uniformly. Hence it is not practical to take a straight graft out of the curve of a rib. Rib cartilage can usually be carved with a No. 10 or No. 20-scalpel blade. For a graft to extend from bridge to tip a straight length of cartilage, which can only be obtained from a larger rib, is often required. It can be cantilevered as described above and if necessary fixed as above. It will not arthrodese. The best one can hope for is marked fibrosis. Therefore make sure there is a good flat area of graft against a flattened nasal bones. Carving it to the required shape often means breaking of the usual rules to maintain the normal tension that prevents the curling of the graft after insertion.¹² If cartilage grafts are boiled or formalin sterilised they do not warp but are more likely to be absorbed.

Technique of harvesting ear cartilage: Usually cartilage of one ear will suffice but for a large collapse of the nose both may be required. To harvest the cartilage, an incision is made just inside the anti-helix and a skin flap raised with scissors towards the external meatus. The con-

chal cartilage is then removed with the cymba, giving a butterfly-shaped graft with a maximum size of 3.0×2.5 cm. For minor collapse a single layer of cartilage is used but usually sandwiching several layers will give better results (Fig. 20-7b). A small piece to place in the columella for tip support is also shaped. The grafts are cut to shape. To help the graft conform to the desired shape cross-hatching at 1-mm intervals on the concave surface is performed (Fig. 20-7a). The layers are then sutured together with chromic sutures and inserted into the dorsal defect through one of the access incisions as described below (Fig. 20-7c).

B. Cartilage and Bone

Celik states that if the nasal bones are reabsorbed it is advisable to use bone to replace them. He recommends the use of calvarium bone and cartilage grafts to provide bone for the bridge and cartilage on the nasal dorsum.⁵ Lee et al¹⁶ and Neu²¹ report using osteochondral grafts to provide bone to replace the ridge defect and combines this with conchal cartilage grafts to provide a flexible tip.

Bone graft can be used to increase the height of the nasal bones, or replace them, and to provide for the bridge at the same time. However, it is reported to have a higher rate of absorption than cartilage especially if the arthrodese is not complete. There may also be a higher rate of infection. Reabsorption of bone takes place

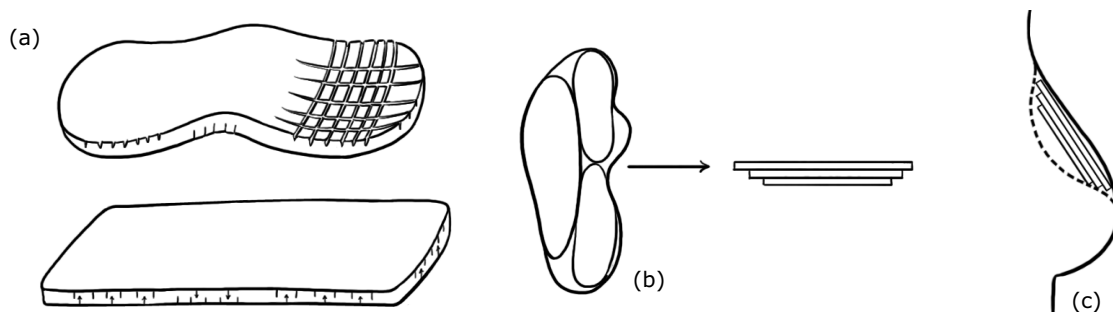


FIGURE 20-7 Chonchal cartilage grafting for reconstruction of mild nasal collapse. **a.** Cross-hatching technique to flatten the concave graft. **b.** Method of dividing cartilage to create three-layer sandwich graft. **c.** Placement of graft to fill dorsal defect.

slowly and even after it is complete there is often enough residual scar tissue to provide adequate support for the patient not to ask for further surgery. This is especially so in races with a basically low or flat nose. Some workers do not like the rigidity of the nose tip that is produced by a bone graft but we have not had any major complaints from the patients about this, and found that long-term the cosmetic results of bone grafts are good.

C. Bone Graft

Bone grafts may be taken from the top of ulna, front of tibia or calverium. The anterior part of the iliac crest provides a good graft that is a mixture of cancellous and cortical bone and is easily carved to shape in situ. It can be taken under local anaesthetic with general sedation. Once the path for the graft is opened and the length of graft is determined it is possible to select a section of the anterior half of the iliac crest which has an appropriate shape for the dorsum. Unfortunately, a bone graft can be fractured during trauma and a different deformity result. However such a deformity will not usually carry the stigma of a leprosy nose. If a columella strut is added, it increases tip rigidity, but breaks easily. I prefer to cantilever a bone graft off the nasal bone carefully shaping both surfaces so that no columella strut is required.

D. Synthetics

There is now a trend to using synthetic materials for nose reconstruction. Boyce and Toriumi discussed various synthetics and compared results obtained by their use with those obtained by autologous materials.² Motoki also discussed the pros and cons of various materials and the rate of absorption.²⁰ Early synthetic grafting materials were frequently rejected and hence the tendency to use autologous materials. Silicone rubber has had extensive use with good results.²³ It is non-porous and there is

therefore a tendency to capsule formation and risk of migration infection and extrusion. Good results have been reported using polyethylene implants in saddle nose reconstruction.²⁶ It is porous and has a low rate of extrusion or infection. However given the risks and costs with synthetics, autologous materials are still strongly preferred by these authors.

2. THE TECHNIQUES FOR SURGERY

A. Preparation of nose for grafting

The whole nose area must be well infiltrated with local anaesthetic, containing adrenaline. The nostrils are packed to prevent contamination of the surgical area, and prevent any blood from tracking down into the throat. This is especially important if the surgery is being done under local anaesthetic. The authors do all nose reconstruction under local anaesthesia with sedation. It is much easier to ensure correct positioning in relation to the rest of the face, when there is no need of anaesthetic tubes obstructing the view or distorting the mouth or nose. It is advised to give broad-spectrum antibiotics preoperative and to continue for 5-10 days post operation.

B. Approach for insertion of graft

Many incisions have been devised:

(1) *Through the columella, midline.* We prefer this approach. The midline incision is made along the whole length of the columella and the edges are retracted using fine skin hooks. The suturing can be done from side to side so that there are no suture scars on the columella itself.

(2) *Through one nostril.* Use an inter-cartilaginous incision, so that the scar is not external as it would be on the columella. The incision is made on the septum about 4-5 mm inside the nose. The tissues are dissected care-

fully to make a track that goes midline to the tip of the nose and then up the ridge as for the standard method. It is less convenient if a columella strut is required. Beware of suturing under tension.

(3) *Through the mouth.* This requires tunnelling up the columella and then angling to get into the nose. Hence this is a less easy approach for inserting the graft and it is difficult to maintain sterility as the work is through the mouth cavity. This is not recommended for regular use.

(4) *Over the root of the nose.* This makes it easier to achieve bone fixation of the graft to the nasal bone to ensure arthrodesis.

Technique: Make a large inverted V incision over the glabella so the point is midline mid-forehead and the arms of the incision extend well down on each side of the nose bridge. The incision ought to almost reach the eyebrows laterally and terminate distal to the medial canthal ligament and well out towards the cheek. The flap is elevated at periosteal level and the nasal bones can be flattened under vision. The Metzenbaum scissors are passed down towards the tip till all the area to be elevated is freed. The bone graft can be fairly large over the bridge of the nose and slimming down towards the tip for ease of insertion. The nasal bones are chiselled flat and then the graft fixed as described later. The forehead skin flap can be used as an advancement flap to allow the skin over the bridge to be stretched laterally to fill any defect on the lateral sides of the nose. Because of the easy vision it is possible to remove more of the nasal bones to flatten them so that the graft is not so prominent and the final bridge may be no higher than the original. However, if the patient has a prominent forehead the insertion of the graft could be very difficult.

C. Surgical procedure for insertion of bone graft

Nasal Dissection: Using Metzenbaum long thin curved scissors, a track is carefully prepared from the tip of the nose up to the root of the nose. Do not tunnel through the skin itself. Make sure there is enough skin above the scissors so that the graft will be adequately covered, but on the other hand, try not to puncture the mucous membrane into the nose. If this happens infection of the graft is very likely to occur. An infected bone graft in the nose is a tragedy, as it will usually need removal. At the best it will result in a reduced cosmetic result. At the root of the nose the scissors are directed onto the nasal bones, which are rarely involved in leprosy. A small chisel (3-4 mm size) is inserted and used to elevate the dorsal periosteum and to break up the upper table of the nasal bones to encourage arthrodesis. It is sometimes possible to elevate the whole of the upper table in one piece with the periosteum intact so that the graft can be driven between the two pieces. If this can be done it provides excellent stability. Otherwise strip the periosteum off the bone until the frontal bone is reached and then chisel a notch in the frontal bone where the graft can be wedged. Widen the soft tissue track to make it large enough to take a Kockers opened so that the space is about 1 cm wide and 1 cm deep. Measure the length of bone required and allow an extra cm. for handling when cutting the bone. Pack the space in the nose with ribbon gauze to obtain haemostasis, while the bone graft is taken from the iliac crest.

Technique for taking Iliac crest: The iliac crest is prepared as usual, with a sandbag beneath the side to be operated upon to make the crest more prominent. The iliac crest needs to be carefully examined to determine the site from the best shape of bone graft can be obtained. This is usually on the anterior half, but preferably not touching the anterior iliac spine. At the selected site a curved incision is made, on

the soft skin just above the iliac crest with the concave side to the crest. The ends of the incision are 1-2 cm above the iliac crest so the scar will not be irritated by the belt rubbing it against the iliac crest. The incision will be about 10-15 cm long starting on or just lateral to the anterior superior iliac spine, depending on the site chosen to take the graft (Fig. 20-8).

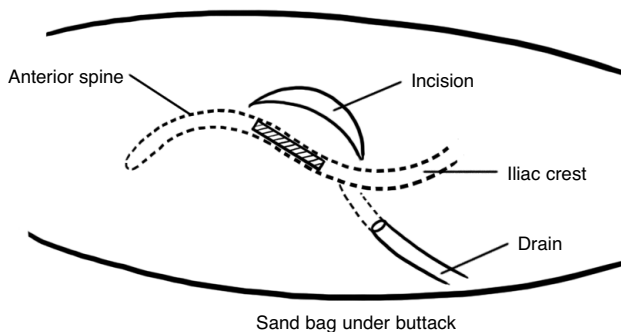


FIGURE 20-8 Diagram of where to take the graft from the Iliac crest. Note that the hip is elevated on a sand bag to make the crest more prominent. The iliac crest is marked as broken line and graft to be removed is hatched. Avoid area directly adjacent to Anterior Iliac spine- incision curved concave to the crest behind the spine will cause less long term discomfort. Exit the drain well below the suture line.

A piece of bone at least the required length of the nose, preferably 1 cm longer about 8-10 mm in width and 3-5 mm in depth, is cut out of the hip. It is necessary to ensure that the right shape is selected to give the nose a natural contour. Some workers like to use a piece of periosteal covered iliac crest but it is not always possible to get it straight enough or with a suitable curve. It is highly desirable to be familiar with the local ethnic variations in nose shape! It is easiest to achieve the basic shape of the bone in situ, and while still on the hip it is relatively easy to straighten the sides and smooth off any irregularity on the dorsal ridge that may otherwise end up as a bump on the dorsum. Once removed "fine tuning" can be done.

If the crest is very curved and it is not practical to obtain a relatively straight piece, while in situ, cut the upper edge of the graft flat without including periosteum. A certain degree of shaping can be done with the bone nibblers and a large flat rasp after the removal of the graft from the donor site. The rough edges need to be filed away so the graft can be slid into the cavity already prepared (Fig. 20-9).

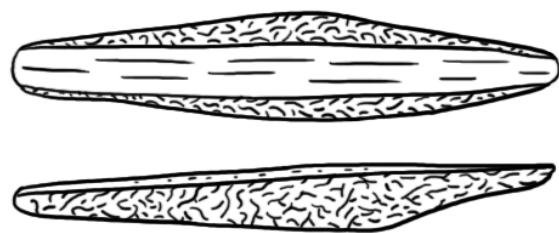


FIGURE 20-9 Diagram of bone graft ready for insertion, (Permission by Fritschi).¹¹

If the patient requires a nose with a very high tip, it may be advisable to use a columella strut. This can be cut in one piece so that an L shaped block of bone is removed from the hip, this is more difficult, or a separate columella strut can be cut, preferably from at least partly cortical bone. It is more difficult to stabilise a separate columella strut and many people prefer to use an "L" shaped block. However, the authors find that with an adequate cantilever a columella strut is not necessary. This then leaves the columella more supple than when a strut is inserted into it. Even for those needing a long columella it is usually possible to achieve a high tip by an adequately angled cantilever. To assist in holding it in position the nasal passages are packed, not so tightly that ischemia of the nasal mucosa will occur, and the packing is not changed for seven to ten days.

The iliac crest wound is closed, paying special attention to closure of the periosteum and/or muscle in layers over the bone deficit and draining the bone cavity. It is advisable to

use a drain for the first two days to prevent a haematoma. A dressing in the form of an abdominal binder makes the patient more comfortable and the knee of the operated side should be flexed, with the leg on an elevated pillow, during the first few postoperative days.

Insertion of bone: The bone graft is trimmed to size and the upper end is bevelled so there is cancellous bone to arthrodese to the nasal bones. Also the upper edges, that will lie along the ridge, are rounded off so the final nose in twelve months time will not continue to look like a rectangular block. If the bone has been cut longer than is needed, the lower centimetre can be used for holding it in a Kockers or large toothed dressing forceps, while inserting. It can easily be nibbled off when the graft is in situ and final length determined. A pair of nasal packing forceps, long armed nasal speculum or the kidney clamp mentioned above, are extremely useful to separate the edges of the track while the graft is slipped up between their blades. Once the graft is in situ, smooth the skin down as far distally along the graft as possible to make the nose as long as possible. At the same time, push the graft as far proximal as possible to jam the bevelled end under the bone flap or into the hole in the frontal bone, whichever is used (Fig. 20-10).

The length of the graft should be adjusted so that there is no real pressure on the tip of the nose, and so that the columella incision can easily be closed over the bone to minimise the risk of infection entering by that route. If the graft is well bevelled and the nasal bones have been flattened and denuded of periosteum the graft should be stable without special fixation.

A *columella strut* may be inserted if the bone feels unstable over the nasal bones, and/or the patient asks for a high tip. For this a track is prepared directly down through the columella to the maxilla and a notch cut out of the maxilla into which to slip the graft. If the bone graft is an L shaped piece this can be a little more diffi-

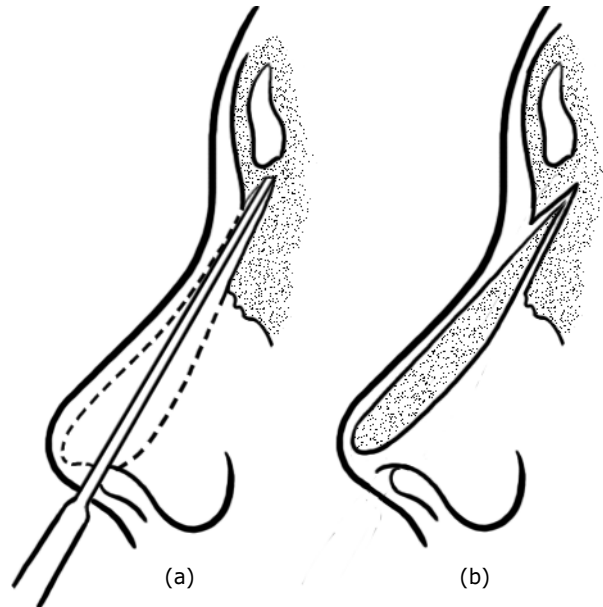


FIGURE 20-10 Diagram of nose grafting **a.** a small chisel has been driven up into the frontal bone so the graft can be wedged into the space. **b.** The bone inserted the wedge on the top of the graft cantilevers the bone off the nasal bones (Permission from Fritschi).¹¹

cult getting it into place, but once in situ it will be more stable. If it is a separate piece, it is easier to insert, but needs to be wedged in to an indentation made on the under side of the long piece of bone that forms the ridge of the nose, near the point of the nose to hold it firm.

Fixation of graft: If the cantilever is well shaped it should be stable and no other means of fixation is needed. However, fixation may be provided by:

a) A piece of 2x0 braided nylon. This can be utilised to stabilise the graft.

A piece of thread is anchored to the medial end of the canthal ligament on one side of the nose, and passed across the nose above the bone graft but under the skin then anchored on the canthal ligament on the other side similarly and then passed back lying parallel to the first thread, to be tied at the initial bite of canthal ligament. This provides a loop over the new

nose bone that should stabilise it, at least till fibrous union or ankylosis occurs. If carefully inserted the knot can be buried and it never needs to be removed, unless it causes problems later. The intranasal pack is still used, post operatively.

b) If there are good quality nasal bones, a small drill hole can be passed from side to side through them and a nylon thread passed through that and then tied over the top of the graft, similar to that just described, to fix it firmly to the nasal bones. The thread does not need to be removed.

c) It is possible to thread a *Kirschner wire* the full length of the bone graft from the tip and drive it about 5 mm into the frontal bone. It is usually cut off short at the tip so never removed.

d) A *short Kirschner wire* can be driven at right angles to the graft through the graft into the remains of the nasal bone. If this can be cut flush with the nose that is good but if it is not cut flush it can be removed in about 10-14 days when all swelling has settled. It may be better to expect to remove it especially if there is any doubt about the depth to which it was inserted and any risk of infection ascending from the sinuses or postnasal space.

e) With the forehead nasal base incision is may be possible to drill holes into the nasal bones and wire the graft onto the bones, as described in "a" above, or to use a *Kirschner wire* that is driven the whole length of the graft so it protrudes distally and then when the graft is in place reverse drive it in so a known length is in the frontal bone. Make sure it is cut short distally, but this may require an incision at the tip to cut it.

D. Post operative care

After insertion of the bone, the columella is closed using mattress sutures that go from

inside one nostril across to the other nostril, and back, everting the cut edges, so no suture marks are made on the skin. If an intra-nares incision is used the edges need to be accurately approximated to ensure no tension. The packing that was initially inserted in the nostril is removed and inspected. If there is evidence of the mucosa being broken the nose should be packed with a layer of Vaseline gauze first and then routine saline soaked gauze to fill the nasal cavity, in all cases. The saline-soaked gauze is basically to prevent the development of a haematoma and to stabilise the bone graft so it is not displaced during the postoperative swelling. Do not pack so tight that it will cause necrosis of the mucosa. Use a spray on dressing over the columella incision- or Tincture Benzoin Compound to seal the wound. A plaster of Paris shield is made to protect the nose from trauma (Fig. 20-11), and a piece of gauze

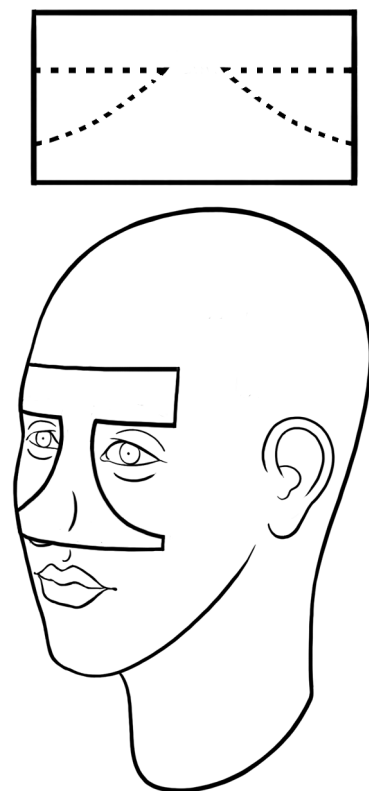


FIGURE 20-11 Pattern for plaster of Paris nose shield, and diagram to show its placement.

used to cover the incision on the columella. The plaster shield should be designed so the eyes are not covered. Initial attachment of this shield can be made using adhesive plaster, which will stick to the wet plaster if the plaster is first painted with Tinc Benz Co. Tinc Benz Co will also help stick the adhesive plaster onto the skin. Then a good firm bandage (cotton crepe or gauze not elastic) is placed around the head to keep a firm pressure on the whole nose, and reduce the swelling that could displace the graft.

The face and eyes will be very swollen for 3-4 days. It is advisable to use antibiotics for 5-10 days to cover this procedure. The longer duration is for patients in whom it is thought that there may have been a breach in the nasal mucosa. Antibiotic eye drops such as Chloramphenicol, should be inserted 4 times daily even if the lids will hardly open. The firm bandage is not changed for 3-4 days, by which time the worst of the swelling has subsided after which the plaster protector is held into place by adhesive plaster, and worn all the time for 6 weeks. The small skin sutures can be removed after 5-7 days. The plaster shield is worn at night or if out in crowds or other situation where trauma could occur, for 3 months to prevent accidental displacement of the graft from pressure or trauma. About 10 days after surgery, the plaster shield can be remade with tapes or elastic to tie it round the head. Keep a close check on the face for signs of postoperative infection and, if in doubt, continue antibiotics, or preferably change the antibiotic.

After cartilage grafts it is advisable to pack the nares and use the nose guard, and give antibiotics as described above. Cartilage will not break as bone does when impacted during direct trauma, but in the early stages can still be displaced by a blow.

ii. Post Nasal Epithelial Inlay (PNEI)

For the patient with marked scarring of the mucous lining of the nose, it is necessary to

replace the whole lining. The basic surgery is still the same. The Post Nasal Epithelial Inlay provides adequate lining for the patients with normally low noses who do not require a high columella, especially if they are happy with the height of their nasal bones. However, as the split skin graft is placed on minimal subcutaneous tissue it is difficult to get a bone graft between the skin graft and the dorsal skin if a straight ridge is desired. There are other methods of providing lining to the nose but I (GW) find that this inlay is simple and effective for selected patients.

Technique of PNEI

The whole face must be prepared including the inside of the mouth. We paint the gums, lips and teeth with Gentian Violet before the incision is made. Gentian Violet does not taste as bad as cetrimide and helps to define the mucosa edge during suturing. The nose cavity is packed as far back into the postnasal space as possible so that blood will not trickle down the throat but also so the cavity itself can be worked upon and grafted. The whole area is infiltrated with local anaesthetic. Most patients do not require a general anaesthetic if well sedated initially. The incision is in the upper sulcus of the mouth extending to just beyond the fourth tooth on each side (Fig. 20-12). Using a curved dissecting scissors, dissect straight down to the periosteum of the maxilla and keep at that level for the whole of the dissection. The muscle fibres are then elevated off the bone with minimum bleeding. A diathermy is used for haemostasis. When the tissues from the maxilla have been elevated it will be possible to open into the nose itself. Try and cut the mucosa as far back from the external nares as possible. It is best to leave normal skin in the nares where grafting would be very difficult. After that, the septum, if present, can be split well back, so that a small part of it remains in the posterior aspect of the nasal space, but the

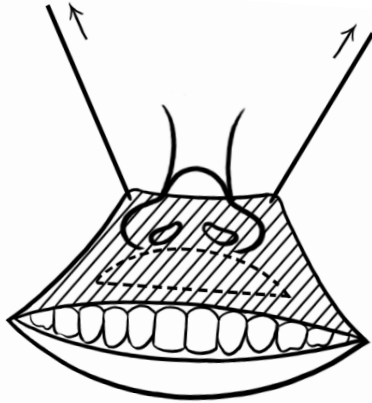


FIGURE 20-12 This diagram shows the naso-oral fistula extending to level of 4th tooth on each side and the upper lip elevated by a black thread on each side.

back of the columella is still complete. This helps to maintain the stent in position. The dissection is continued until the whole of the nose is freed from the maxilla up to the nasal bones. The area that is elevated from the face is shown in Fig. 20-13. However, stay beneath the nasal bones, not above them, especially if they are basically normal. This will make it easier to elevate the tissues off the nasal bones if a bone graft is required at a later date. The mucosa must be cut right round the nasal cavity, distal to the end of the nasal bones, and connection with the incisions along the maxilla, to completely free the dorsal skin and lining from the maxilla. The periosteum is not removed from the maxilla.

When adequate haemostasis is achieved a stent is made from guttae percha. The stent needs to over-stretch the skin of the nose as far as possible and extends into the mouth to keep open the full width of the naso-oral incision so that the stent can be removed via this route at a later date. The black guttae percha is the ideal material (see later). Once the cavity is prepared the guttae percha is moulded into a roughly pear shaped mass that will over-fill the space created, and is forced into the cavity. It is

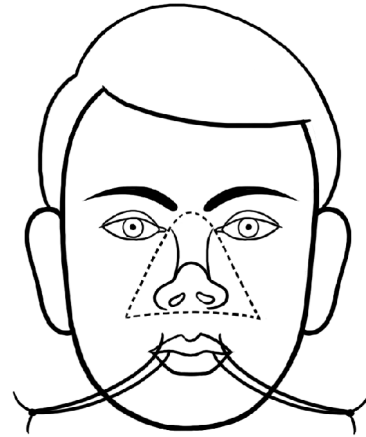


FIGURE 20-13 The hatched area indicates the area of the face to be elevated for the PNEI. The two silk threads through the upper lip, one on each side, serve as retractors and provide counter traction, during dissection.

moulded with the fingers so that it overlaps the maxilla on each side of the nasal cavity and stretches the dorsal ridge as long as possible to make the tip as high as possible. To achieve this, use a blunt hook or small bladed retractor through the nares and an assistant pulls the nasal dorsum as long as possible while the surgeon moulds the guttae percha into the desired shape (Figs. 14a and 14b). It is only by making the nasal ridge as long as possible i.e. stretching the nose to its maximum length, to make the tip as high as possible, that the final angle in (6 months time) between the columella and the upper lip will be adequately small. A large angle may produce a nose, the lower end of which appears almost like a snout. Once the stent is made use sterile ice, on the outside of the nose, to set it firm. While it is setting obtain a large piece of split skin graft, preferably from a non-hairy donor site such as the thigh. Then practice inserting and removing the piece of guttae percha. The stent is then draped with the piece of split skin (Fig. 20-15) with the raw surface outside so that when the skin draped stent is replaced in the nose, the skin will grow

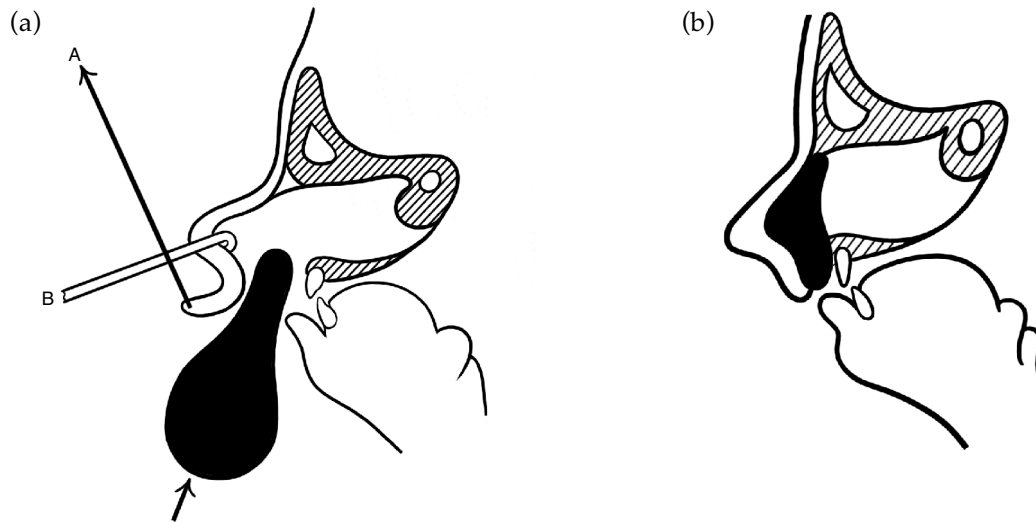


FIGURE 20-14 **a.** A vertical section through the nose during surgery for PNEI. The guttae percha (filled in-black) is being forced, as indicated by the arrow, into the cavity in order to fill it completely. The arrow "A" indicates the direction of pull of the two black silk threads elevating the upper lip. The arrow "B" is the direction of pull on a small flat bladed retractor under the top of the columella, used to stretch the nasal ridge to its maximum. The cranium and hard palate are marked with hatching. **b.** Shows the guttae percha in the nasal cavity. It reaches up till just under the nasal bones at the top and rests on the maxilla at the bottom protruding into the mouth, distending the upper lip. It should lie on the maxillary bones on each side and not protrude any further backwards.



FIGURE 20-15 The black guttae percha stent has been allowed to set with the assistance of ice. It is now being draped with SSG ready for insertion. Note the height of the lower end that will occupy the naso-oral fistula. It is being held by a large toothed forceps to make handling easier.

on the raw inner surface of the nose and become its new lining. Avoid hair-bearing skin, as it has been known to grow, and may then need removal.

Once the skin covered stent is placed into the nose the operation is finished and the only dressing necessary is a little Vaseline gauze in the external nares and a piece of dry gauze on the outside to prevent flies and secondary infection. The immediate post operation appearance appears very gross with a markedly stretched and elevated upper lip, pushed out by the stent. The stent must be kept as thick as possible between lip and maxilla, as shown in Fig. 20-15, to enable the stent to be inserted and removed. The donor site for the skin graft is dressed as usual. Swelling can be reduced post-operatively by the use of ice bags, over the face, around the nose, for the first 48 hours.

Use of Guttae Percha

When guttae percha is being used in the operation room, boiling water, sterile ice, and cold water are necessary. To make sterile ice water, sterilise a metal screw top container and fill it

with sterile boiled water and freeze the whole in an ordinary refrigerator. When it is needed the scout nurse can unscrew the top and tip the ice out of the tin into a sterile bowl on the scrub nurse's table, where a hammer and chisel will be needed to break it up! If sterile ice in a plastic bag is placed over the nose with the guttae percha in situ, while the skin graft is being taken, it will help to make the guttae percha firm and also control bleeding.

Gutta percha is the ideal material to use. It can be sterilised prior to use, by soaking. It is easy to soften with very hot water and sets again relatively quickly after which it can be carved with a knife if needed. It can be reheated and reshaped. It has an elasticity and will not break if dropped. The black guttae percha is more adaptable than the pink dental gutta percha. It is not the same as the easily available red type. Dental impression material is not so easily mouldable. It cannot be carved with a knife, so minor adjustments needed during use are difficult. The same guttae percha stent can be used for as long as a stent is needed. Either material can be replaced later by an acrylic or other material such as is used for dental plates. In some patients because of the difficult in

inserting bone between the nasal skin and the skin graft, it may be best if a PNEI is followed permanently by a nasal stent. This is recommended by Antia.¹ This can be attached to an upper denture utilising the naso-oral fistula created at the initial surgery.

Postoperative care

After the post nasal epithelial inlay has been completed, the stent is left in place for ten days to allow good healing of the graft. It is then removed via the mouth. It is best if the surgeon or his assistant is the one who initially changes the stent. The area inside the nose is cleaned with simple saline to remove any excess skin that will now be dead. It is usually well healed and the stent is replaced at once (Fig. 20-16). It is important that the stent not be left outside the mouth for more than a few minutes. The cavity can shrink at an amazing rate. Do not try and make a new stent at an early stage, as that will require too much time and contraction of the cavity may occur while it is being done. If there are any obvious rough areas or protruding areas that may traumatise during insertion and removal these can be removed with a scalpel and then smoothed off by a short soak

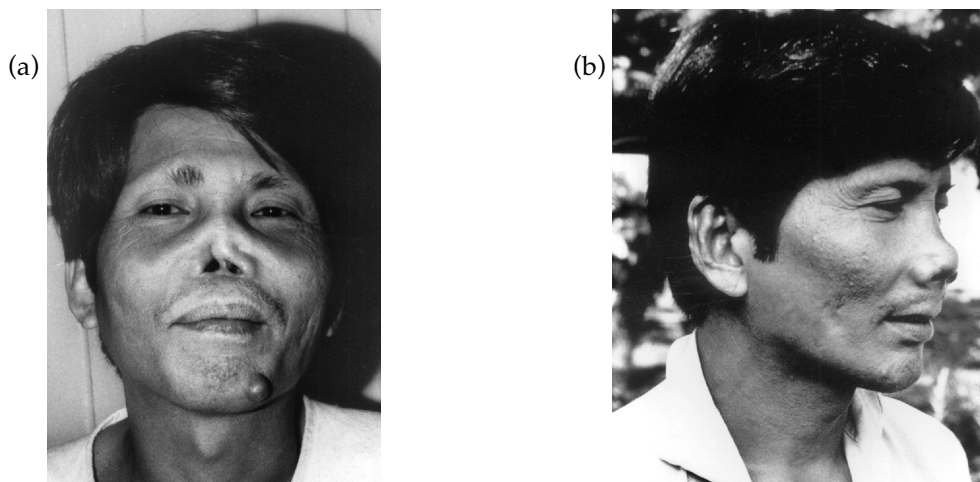


FIGURE 20-16 a. Marked deformity of the nose tip with average midnose contraction treated by PNEI. b. Same patient after 6 months. Note the nice curve of the nose and that the contracted nostril has been completely released.

in very hot water. Over the next few weeks it may be necessary to do this on many occasions if areas are taking excessive pressures. After 3-4 weeks holes can be drilled through the stent so the patient can breathe through the nose. The stent can now be replaced daily, initially checking for healing and to see if the stent needs to be modified, for ease of application. Do not make it too small or it will not do its job! Patients say it is uncomfortable but not really painful and becomes painless after the first few weeks. But later change twice weekly, or weekly as necessary, depending on the cleanliness of the nasal area. Many patients learn how to do it themselves. However, if the area is clean and well healed, then the patient can be taught to rinse his nose out by using saline sniffs daily instead of having the stent removed. This is very useful for patients with bad hands who are not able to handle the stent, and is safer when the patient goes home. It is not recommended that a removable PNEI stent be used in patients with very bad hands who will live at home where no one is available to help them.

The stent must be worn for at least three months until all contracture of the skin and soft tissue has ceased. By that time the stent will be considerably smaller and the upper lip will not need to protrude so much, and the nose will have quite an acceptable shape. Then it can be considered that the patient will be ready to have the bone graft inserted into his nose, as previously described or to have a permanent prosthesis made. If a bone graft is later inserted, about 3-6 months after the PNEI, the surgeon must be careful not to puncture the skin graft, which is rather thin, but it is usually quite possible to get a slim graft into position without damaging the skin graft. Some patients seeing the appearance of the nose about 3-4 months after surgery, with the stent in, decide that they will not have a bone graft added. Some patients prefer to use the permanent prosthesis, which may be fixed to an

upper denture to provide support to the stretched nasal skin. A dentist should be able to make this, inserting a thin nasal supporting prosthesis through the naso-oral fistula. Some patients decide that the nose is "good enough" without any support. If they are not going to have a graft or dental support they ought to wear the stent for a total of 6 months to be sure there will not be and significant skin contracture (Fig. 16 a & b).

Long-term patients have been seen who abandoned the stent after 6-12 months leaving the nose hypermobile, but in whom no further contraction occurred and the nasal shape remained satisfactory for up to five years! These would be patients who only require a low nose and in whom the original contractures were not very severe. They may ask for the naso-oral fistula to be closed which is a good idea.

iii. Crockett's Operation

A combined operation was devised by Crockett.^{11,17} The PNEI dissection is done in basically the same way but then is modified so that the bone graft is inserted at the same time and chips of cartilage are used to fill the space around the nasal bone/graft junction. The initial oral incision is made so that it is on the lip side of the sulcus leaving a flap of oral mucosa on the maxilla that can be used to close the naso-oral fistula at the end. The skin graft is still used but not draped over a stent, so is more difficult to insert. It is also more difficult to ensure the area is fully clothed with graft and all the graft is kept in contact with the recipient area.

Technique

The operation is commenced as for the PNEI with the difference in the raising of the flap of oral mucosa as mentioned above. Once the cavity is ready take a large piece of medium thick-

ness SSG and fold it over and sew the sides together with chromic cat gut to make a bag that is a little longer than the desired length of the finished nose and one cm wider than the nasal cavity in the maxilla. A slim bone graft is cut and used as described above, inserted above the nasal bones, preferably by driving a wedge into the frontal bone or under a flap of anterior nasal bone or periosteum as described previously. The graft must be narrow because a wide graft will not allow the growth of the skin across the bare bone. The graft needs to be cantilevered as described previously. The upper part of the nasal cavity, just behind and adjacent to the nasal bones, is packed with small cubes of cartilage (1mm cubes). Then the skin bag is filled with small pledgets of cotton wool soaked with Chloramphenicol 2% solution and well rung out. The bag is inserted into the nasal cavity with the open end towards the mouth. Further pledgets are added to ensure a firm packing that will give good contact between skin and bone and cartilage. This is a difficult stage as adequate packing is needed to obtain adhesion of skin but if excessive pressure is applied the SSG may slough. The bag is sutured closed and then the naso-oral fistula is closed in layers with vicryl making sure all sutures are buried (Fig. 20-17).

After the columella incision and the oral incisions are closed the nose is moulded by the surgeons hands into the desired shape and covered with several layers of gauze before a nose guard of plaster of Paris is made and moulded to maintain the desired position. The moulding of this plaster is important to prevent a changing of shape immediately post operative when swelling occurs. The nostrils are covered with a piece of gauze that will be removed daily to clean the external nares.

Antibiotics are given for 5-10 days. The face generally will be very swollen. Antibiotic eye-drops are given four times daily. At 10-12 days the skin bag at the anterior nares is ruptured and the pellets are carefully removed and the

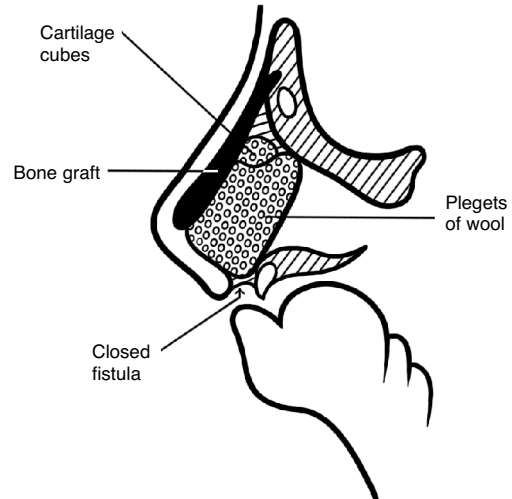


FIGURE 20-17 Diagram to show lateral view through a nose after a Crockett operation. The solid filled-in area is the bone graft wedged into the skull bones which are hatched. The small squares are the pieces of cartilage up under the graft and nasal bones and the small rings are the pledgets of cotton wool filling the bag made of SSG. The naso-oral fistula has been closed over the skin bag.

cavity cleaned, through the nares. If practical, open the posterior nares by puncturing the skin bag. Then repack the cavity with ribbon gauze soaked in Chloramphenicol and paraffin and leave in situ for another 3-4 days. After its removal the patient learns to hold saline in the cup of his hand and sniff it up, and spit it out, to wash the inside of the nose, to keep it clean. Tovey²⁵ recommends the plaster splint be discarded after 2 weeks but I prefer the patient to use a nose guard all the time for 6 weeks to 3 months as described above in the standard bone graft protocol.

This technique can be quite effective but is more likely to result in secondary complications if infection results. The fact that the skin grafts do basically take over cartilage and bone is of great interest. In a very severely contracted nose it is preferable to use the PNEI first and hence it becomes a two-stage procedure.

Certainly the novice should not attempt a one stage "Crockett's" until he has had some experience in dealing with the problems that may occur from each of the procedures used alone.

iv. Naso-labial Flaps for Nasal Lining

Nasolabial flaps depend on the nasolabial vessels and so can be made much longer in comparison to the width than is normally possible for direct transferred flaps. There are several techniques described.^{10,11,15} These flaps are used to create lining of the superior nasal cavity in the presence of moderate to severe contracture.

For lining the nose it is recommended that superior based nasolabial flaps be used. Because of the excellent blood supply they can be up to 2 cm wide. The surrounding skin can be undermined and the defect closed without tension or deformity, giving the effect of a mid-face face-lift. With careful surgery when lining the nose it is possible to completely close the area of deficiency so that the bone graft can be placed in situ at the same time as the new lining with less risk than with a Crockett proce-

dure. There should be no need for a free skin graft.

Technique of Naso-labial flap nose reconstruction

Carefully check the patients skin. If the patient has had severe Type 2 reaction and there is a lot of scar of the nasolabial skin it is possible that the blood supply will not be adequate and another method of reconstruction should be considered.

The classical method of doing a nasolabial flaps for full nasal reconstruction is to turn the flaps in to reline the nose without freeing the alae. This can be a little difficult but in many noses it is possible. The standard skin incisions are shown in Figure 20-18a. The nasolabial flaps are raised, from distal to medial, raising them at the level of deep fascia. They need to be long enough to go right across the nose to line the dorsum. Use a heavy silk thread through the tip of each flap, to hold and control and move the flaps. If the tissues are thin it is advisable to take muscle in the flap near the nasal end. These flaps are raised till they can be

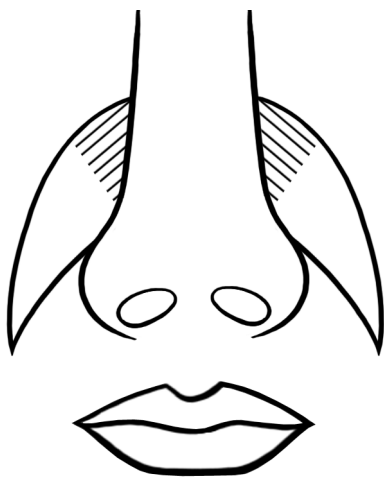


FIGURE 20-18a Diagram of Nasolabial flaps. Note that the hatched triangle near the nose on each side will be de-epithelised in order to obtain attachment for the flap which will be the new lining.

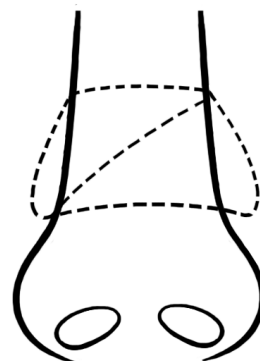


FIGURE 20-18b. Diagram to show how the flaps are folded beneath the skin. Suturing is difficult but can be done by using the two black threads to pull the graft out to one side and then the other during suturing. There is no need to suture the upper and lower incisions between the transplanted skin and the mucosa. As long as there is adequate width. The skin elevated during de-epithelisation can be sutured back to fill any gap beside the nose.

passed through an incision that opens, at the level of the maxillary periosteum, into the nasal cavity from the root of the flap so that the flap turns through 180 degrees to go into the nasal cavity. Through this small incision remove any septum that is directly in the line of view so that the cavity will not be blocked by the flaps when the two flaps are inside. The mucosa is cut from side to side across the bridge and freed as far as necessary to achieve a good external shape with a straight dorsal ridge. Estimate the triangle of epithelium on the flap, shown by hatching on the diagram, that will not be making the new cavity lining, usually about 1–1.5 cm. De-epithelise that, leaving it attached to the nose initially so that it can be used if necessary to close the nasolabial incision after the flaps are turned into the nose. The de-epithelised area will come to lie in the tunnel created into the nasal cavity. Then pass the two flaps through using the threads in their tips and line the flaps up so that they lie flat, side by side. Mark the point where the end of one flap lies against the other. Then pull first to one side and then to the other to suture the two flaps together to make a continuous lining for the mid-nose with absorbable sutures. Figure 20-18b shows the way the de-epithelised flaps turn under and the epithelium can fill the triangular gap beside the nose. The two flaps then cross inside to replace the lining, and are sutured. When the flaps are sutured together, centralise them and suture the incisions on the side of the nose. These flaps alone may give an adequate cosmetic result, especially in ethnic groups with a flat nose (Fig. 20-19). Bone can be inserted at the same time, but it is safer to leave the bone graft for at least 3 months or till fully healed.

The area where the flap turns under often tends to leave a widened area, spreading the bridge of the nose outwards onto the cheeks. The extra skin and fat can safely be removed at 3 months.



FIGURE 20-19 a. A typical depressed nose with flared nostrils, and marked nasolabial folds. He is still in his twenties but looks older. He still has a good nasal bridge.

b. Same patient after Nasolabial flap correction of depression. The flaps have achieved a mid-face face lift. The nose maintained a good contour without a bone graft. He looks years younger.

Modification of Farina's procedure

If the nose is badly contracted and/or a high tip is desired it may be better to do a full three-flap naso-labial flap reconstruction.

Technique: The skin incisions are shown in Figure 20-20, with three flaps to be raised. Note the third flap extends from the columella onto the filtrum and it will allow some lengthening of the columella.

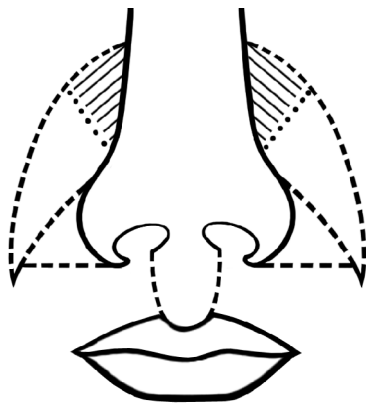


FIGURE 20-20 Skin incisions for a Modified Farina procedure. Note that the hatched portion will be de-epithelised. The alae are raised with good bases for easy reattachment. The whole nose can be turned back at midlevel to allow dissection and attachment of the bone graft under vision.

The lateral flaps are cut so that they can be crossed as described in the standard naso-labial flap reconstruction. The filtral flap is made about 1 cm beyond the columella removing a thick piece of upper lip that can be closed as a V-Y scar if the columella needs to be lengthened. The point of each flap should have a black silk thread for easy control and movement, without constantly being gripped by forceps. The whole of each alar is raised down to deep fascia with a triangle of skin attached to make it easy for reinsertion. All flaps are raised down to deep fascia and the mucosa is cut along the edge of the nasal cavity. If the septum is intact cut it about 0.5-1 cm inside the nose and leave adequate mucosa in the external

nares so it can be sutured back into place. Cut the mucosa across the midline from side to side, as the mucosa will be lengthened by the side flaps turning in. This will release the nose. The nose can then be turned back on its base and if bone is to be inserted the nasal bones can be prepared under vision to take a cantilevered bone graft of good size.

Turn the two lateral flaps over the raw area of the ridge of the nose and suture them with buried Vicryl (3x0 or 4x0) sutures. Then suture the flaps to the mucosa so that the lining is now complete. The bone can be inserted from the side and then the nose placed correctly and all the skin incisions closed carefully. By cutting the alae flaps large it should be easy to realign them and to close the flaps making sure the lining is closed before attempting to close the superficial tissue and skin.

The cavity is packed with gauze soaked in acriflavine emulsion or similar. A Plaster nasal protector is made as for other nose bone grafts. Antibiotics are given as usual. The packs are removed in about 7-10 days and the nose checked inside. If well healed there is no need to repack again. If there is any open area or an unhealed area it needs to be packed twice weekly with antibiotic ointment until healed.

The modified Farina's flaps do take more time to do than the PNEI but should give a better final result for the patient who requires a high tip and straight ridge to his nose, or when a badly contracted or deformed tip is present.

v. Forehead flap

With most nasal defects, the skin is sufficient in itself for nasal reconstruction. In some long-standing cases or where the infective process has destroyed part of the skin covering of the nose and the underlying bony/cartilage framework, some skin from a distant site is required. For this the ideal flap is a paramedian forehead flap. As described by Burget and Menick it can be used to cover the dorsum, tip, columella or

entire nose.^{3,18} It is used only for nasal cover. Mucosal cover must be obtained from elsewhere, either from nasolabial flaps, existing nasal skin, septal mucosa or a full-thickness skin graft. Using septal lining is usually not practical in leprosy due to the large septal defect. I find that turning down existing nasal skin is usually adequate for lining the inner surface of the nose and that nasolabial flaps are ideal for replacing a deficit of mucosa around the roof of the nasal cavity. The paramedian flap is advantageous as it leaves minimal scar, does not require grafting for closure, is reliable and gives skin of a good thickness and colour match. It is based on the supratrochlear artery, either left or right. The scar should be vertical, as the axial blood supply to the flap will thus be maintained. An oblique design will give greater length but may compromise the blood supply and may make thinning of the distal portion hazardous.¹⁸ The forehead flap described by Farina also appears to give good results although we have not used this technique.¹⁰

Technique: The location of the vessels may be checked by Doppler. They are approximately 1.5 cm from the midline of the forehead. A three-dimensional pattern is made of the skin defect. This must be exact. The graft is placed on the forehead near the hairline and the position checked to make sure that it will reach the intended site (Fig. 20-21). If the arc of rotation is too short, the distal part of the flap can be placed in hair-bearing skin, or the base may be extended through the eyebrow to give extra length. If the patient has adequate columella this can be used, thereby shortening the flap. The base is 1.2 to 1.5 cm wide. This allows easy primary closure and easy rotation. The flap is then raised and the distal part of the flap thinned, avoiding the axial vessels. Frontalis muscle is included in the base of the flap.

The recipient site should be prepared prior

to moving the flap. The skin from the tip of the nose can be turned down as lining. Otherwise nasolabial flaps are raised to rebuild the roof of the nose which allows the native lining of the tip of the nose to be moved down to a more normal position. The nasolabial flaps must be transferred via tunnels rather than detaching the alae as otherwise the lining of the tip would become avascular. In either case the entire tip and both alae must be replaced by the forehead flap to give a pleasing appearance. Usually in leprosy a bone graft will be necessary to support the nose. Otherwise chonchal cartilage grafts are harvested to rebuild the nasal tip structure as needed. These are sutured in position with absorbable sutures. The forehead flap is then rotated down without tension and sutured in position. If the dorsum of the nose is also being replaced no pedicle results. If only the tip and alae are being replaced then the raw undersurface of the pedicle is covered with paraffin gauze. The donor defect is closed by undermining and advancing frontalis muscle, then suturing in two layers. A gap will usually result near the hairline, which should not be grafted. It will be no larger than 2-cm in diameter. It should be left open and will contract and heal with minimal scar within four to five weeks.

In three weeks the pedicle can be divided, at which time the upper part of the flap can be thinned of frontalis fascia. The pedicle is not returned to the forehead but rather divided horizontally and discarded so that the resultant scar is parallel to the eyebrow. This will give a very aesthetically pleasing new nose and usually will not require further revisions.

Especially with severe loss of nasal structures the use of other flaps and tube pedicles may be required, which are described in plastic surgery textbooks. However the authors have found the above flaps to suffice for virtually all nasal deformities in leprosy.

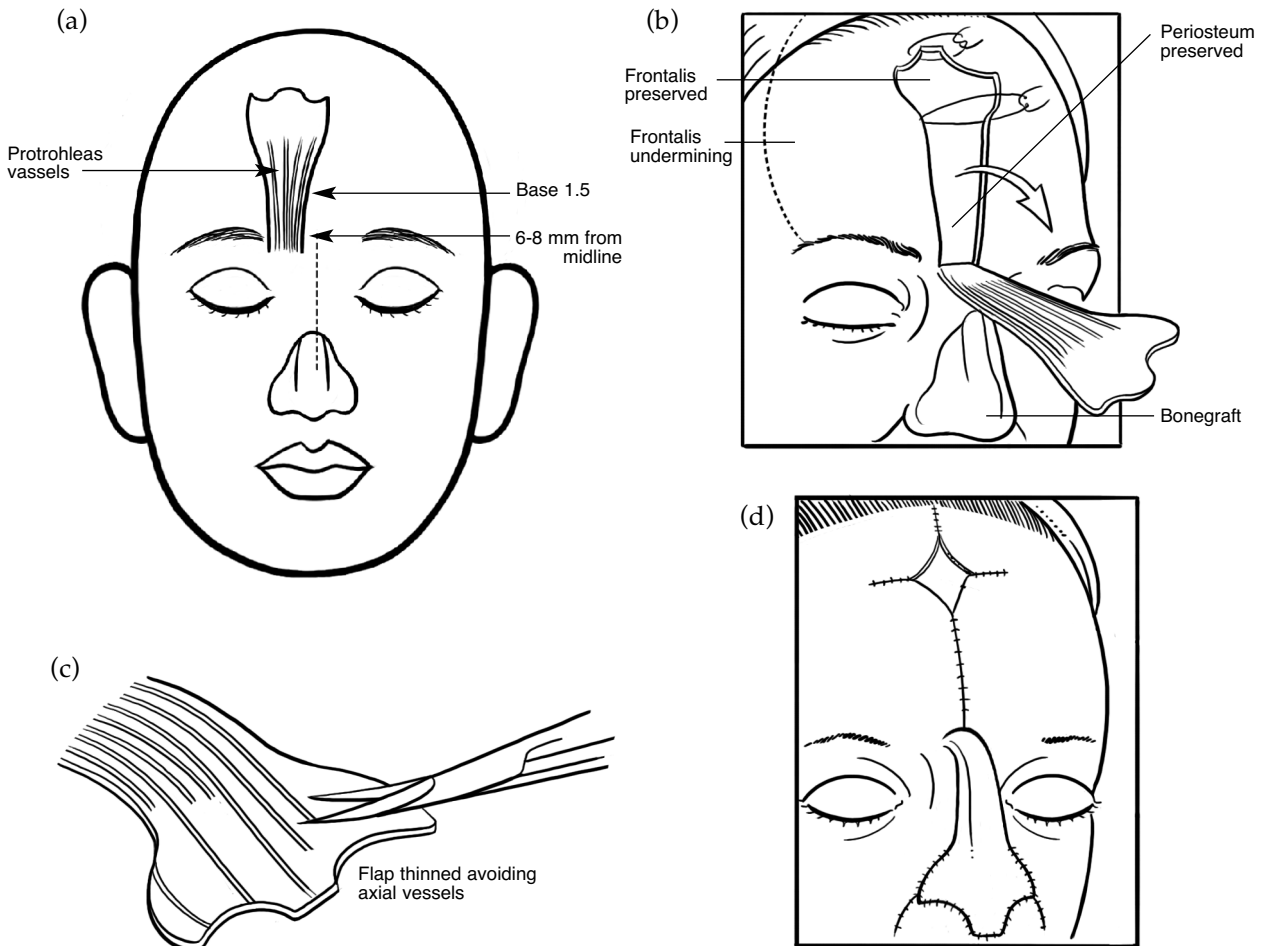


FIGURE 20-21 Gullwing forehead flap. **a.** Anatomy and outline of flap. **b.** Flap raised and lower part of donor defect and "tips" of wings closed by suture. **c.** Tip of flap thinned, avoiding axial vessels. **d.** Flap rotated down to cover nasal tip. Central portion of upper portion of donor defect left to close by secondary intention.

3. LOSS OF EYEBROWS

In lepromatous leprosy the loss of eyebrows may be complete or incomplete, due to destruction of the follicles. When incomplete, the smaller hairs often remain though the larger coarser hairs are lost. In borderline and reactional leprosy loss of eyebrows may be due to ulceration, infection and scarring. Only one eyebrow or even a part of one may be lost.

Eyebrow replacements should not be performed until the skin has returned to as nearly

normal as possible, the risk of reaction is passed and the infection is completely controlled. If a lepromatous patient is seen at the stage of acute inflammation of the eyebrow region and the eyebrows are still present but becoming scanty, it may be beneficial to rub in cortisone cream thrice daily into the eyebrow area till all inflammation has ceased.

If a patient comes and asks for eyebrow replacement it is essential to find out what he wants. There are many possibilities. If he re-

quires full eyebrows get him to draw them. The patient should do this before surgery is planned, while he is vertical and he and his friends can comment. Eyebrows designed on the operation table rarely give the desired expression. He can cut out various shapes in adhesive plaster coloured black and after cutting a pair, experiment with the different positions, angles and shapes. When he is satisfied, tattoo the outline using gentian violet or similar on a hypodermic needle to mark the skin. Cut the shapes in tinfoil e.g. inside lid of a milk tin. These can be sterilised and used as the pattern for cutting the actual grafts. Do not decide where to put the grafts when the patient is on the table. The result may not be satisfactory. Figure 20-22 shows the typical appearance before and after free graft eyebrow replacement.

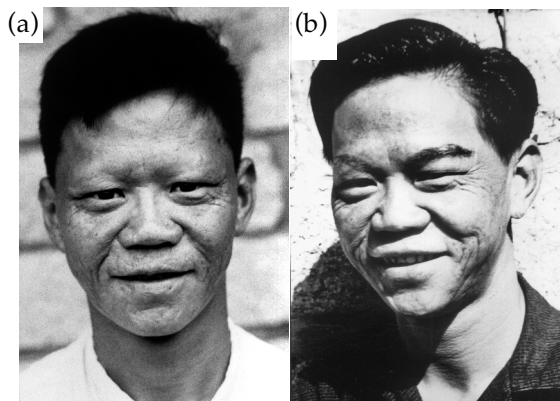


FIGURE 20-22 a & b Pre and post operative pictures of patient with free graft eyebrow replacements. He has also had a bone graft in his nose. He is now ready to face the world.

The site of the donor area needs to be selected at least the day before and the hair cut to about 3-5 mm length for easy cleaning and handling. Wash the hair thoroughly with cetrimide or similar, the day before to remove all oil and again immediately before coming to operation room. There is no need to shave the

whole head. The short hair helps one know the direction of growth of the hair to select the correct site for the grafts. It is essential to note the patterns of baldness in the community, the ethnic group and the family. It may be necessary to use occipital, post-auricular or crown hair. In many Asian patients, the postauricular hair is softer and more suitable than that of the crown and therefore makes “nicer” eyebrows.

There are four methods of eyebrow replacement. The free grafts are easiest and quickest, and in the author's hands, reasonably successful.

i. Individual follicle planting

In some endemic leprosy countries this technique is sometimes referred to as rice planting. This technique is most useful in partial loss of eyebrows as the grafted longer hairs can supplement the remaining short hairs.

Technique: A piece of scalp is removed, usually retro-auricular, as the hair is relatively soft and easy to handle. This is the preferred site because the direction of hair growth is more easily adapted to suit the recipient needs. It is carefully dissected into individual hair follicles making sure that the root bulb is not damaged when cutting it (Fig. 20-23). Sometimes two or three hairs make up one bundle. The dissected hairs are put in an antibiotic/saline solution.

After infiltration of the recipient area with a local anaesthetic containing adrenaline, the whole recipient area is punched with holes, using a No.18 or 16 hypodermic needle. It is wisest to punch all of one eyebrow at the beginning or the pressure of punching may force out hairs already planted. Be careful with the punching to ensure that the hair grows in the desired direction. For a full eyebrow 60-150 hairs are needed depending on whether there is partial or complete loss. Do not punch in straight rows and punch in the direction you wish the hair to grow. Patients have ended up

with eyebrows that stick up like the bristles on a toothbrush.

The hairs are then picked up in a fine non-toothed thumb forceps with the bulb at the point end. A straight non-toothed Iris forceps is ideal. Two or three hairs may be in one small bundle. The forceps is used to plant the hair into the punched hole using an injection needle to help prevent it being pulled out again as the forceps is withdrawn (Fig. 20-23). When enough hairs are planted, the area is covered with a piece of Vaseline gauze and a folded pile of saline gauze to make a pressure dressing just over the planted area. The pressure is exerted by adhesive plaster stuck to the local skin, and left on for ten days. Cover the plaster reinforcement with a firmly applied cotton bandage, not

true elastic, to provide a uniform pressure dressing for the first three days. Be careful not to put pressure on the ears or the rims may become gangrenous. After ten days, remove the dressings and keep the area dry and clean. Use spirit if necessary. Do not pull out hairs when washing or cleaning the area. The hairs will fall out and regrow over the next 3-6 months. We expect about 60% take if no infection occurs. Inform the patient that in 6-8 weeks time he may have no eyebrows but that they will re-grow after that period.

There is a Japanese hair holder for planting these follicles. However, I (GW) find it difficult to load and handle, and of no real advantage over the earlier described method. Ranney writes about the use of biopsy punch grafts as

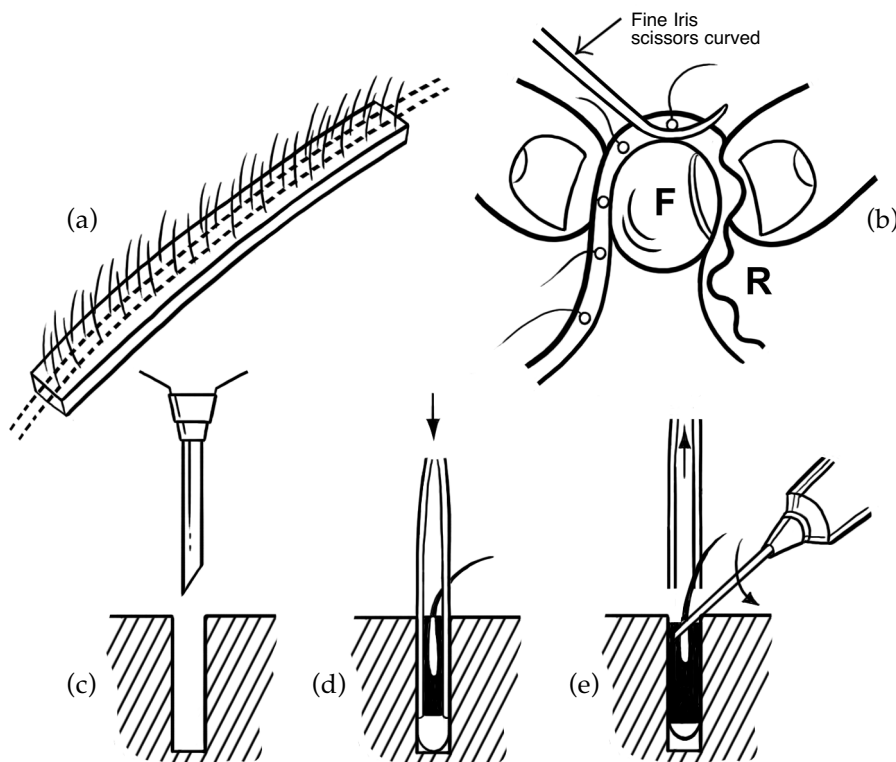


FIGURE 20-23 Planting technique. **a.** A piece of hairbearing skin is taken. **b.** Wrap it over a finger (labelled F) and with a scalpel cut parallel to the lines of the hair follicles. Then use a pair of fine curved scissors, such as iris scissors, to cut out the complete follicle. **c.** Punch the hole with a thick bored hypodermic needle. **d.** Pick up the follicle in fine straight non toothed forceps and plant it into the hole. **e.** Use a hypodermic needle to hold graft into hole as the forceps are withdrawn.

now used for bald heads.²² These would be similar, but being larger would leave a more definite scar pattern which would be more obvious if used on large areas.

The method described here leaves little or no scar where the hairs are planted and provided the hairs are planted so that they will grow in the correct direction those that do grow appear to be normal, even if the eyebrow is still thin.

ii. Full thickness grafts of hairbearing skin

If all the hairs have gone, or the patient wishes to change position of eyebrows, it is probably better to graft the whole eyebrow in one piece. Note that the free grafts should not be wide or the central section may not survive.

First cut the scalp hair to about 3-5mm length so that the direction of growth can be easily seen and the 3mm of hair will provide a handle to hold the grafts. The whole head is prepared as described above, for surgery.

Technique: The eyebrow recipient sites are prepared by removing the skin inside the tattoo lines, securing haemostasis. Then grafts are cut using either the removed pieces of skin or the tinfoil shapes previously cut.

The tinfoil patterns can be sterilised to achieve correct size and shape. Remember to cut a pair of eyebrows. Often the piece for the right eyebrow comes from behind the left ear (Fig. 20-24). It is usually best to take one from each side as this makes the lines of hair growth on each side similar. Be careful to note the direction of hair growth if natural eyebrows are desired. It is possible to bend the graft slightly and change the direction of growth as does occur at midline. Notice that the hairs in most eyebrows tend to grow up and out along the top. The central 1 cm of the hairs are often in a different direction. Examine carefully when preparing to cut the grafts to ensure that the final directions of growth will be satisfactory. It

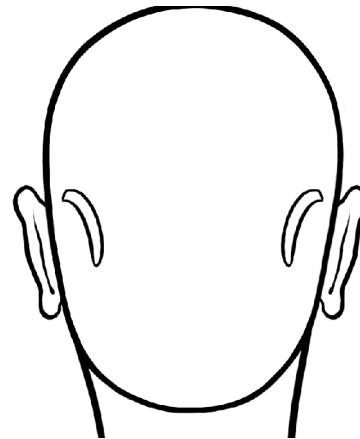


FIGURE 20-24 Shows the back of a head to indicate placement of the two sites for graft harvesting. For free grafting post – auricular hair usually gives the best results and the piece from behind the right ear goes to the left eyebrow, and from behind the left ear to the right eyebrow. The natural change in the direction of the hair follicles lends itself to making the new eyebrow more realistic as the hair follicles naturally lie in the direction in which they should grow in future. The growth patterns can sometimes be improved by slightly curving the piece of skin as it is sutured into place.

is usually possible to slightly rotate the medial end of the graft during suturing to get a subtle change in direction of growth that is needed.

The post auricular area is frequently the best donor site as the skin is supple and the hair soft, but occipital hair may be better. The crown may provide a better direction for hair growth unless there is familial baldness.

The graft is then cut. Try and keep the knife blade in the line of the hair growth so that each root has a complete follicle. Be sure to elevate the graft just above galea and be careful not to damage the base of the hair follicles. It may be safer to remove the galea initially and then carefully remove it from the graft to ensure that no damage is done to the follicles that lie very close to the galea. The scalp is sutured with fairly deep mattress sutures to ensure haemostasis. Usually one layer is adequate. The excess fat and any fascia are trimmed off

the graft so that the occasional hair follicles are seen. However, do not remove all the fat or the hair follicles will be damaged. All fascia must be removed to assist in the take.

The graft is then sutured into the recipient site, using tie over sutures, which need to be deep enough to provide pressure when tied over. They should not encroach far into either the non-hair-bearing recipient skin or the graft. When the suturing is complete, cover the graft with Vaseline gauze and then make a bolus of saline soaked gauze to about 1.5 cm diameter and 2cm longer than the eyebrow and tie over it with the multiple ties. This is then covered with dry gauze and then cover this with adhesive plaster to construct a pressure dressing over the whole sutured area. This is then reinforced with a firm cotton, not elastic, bandage to minimise movement and haematoma formation. Also make sure the ears are protected by cotton wool pads to prevent excessive pressure on the rims. The ears are often anaesthetic and pressure sores on them after the removal of extra firm bandages for eye, eyebrow and face surgery, are not uncommon. After 3 days the pressure bandage is taken off but the firm adhesive plaster dressing is left in place till the tenth day. Then the sutures are removed. After removal of sutures, keep the eyebrows dry and clean. The hairs will drop out in 2-3 weeks and will grow again in 3-6 months if the follicles have not been damaged and scarring from infection does not follow (Fig. 20-22b).

(iii) Pedicle or island artery grafts

It is usually recommended that no adrenaline be used in the local anaesthetic, on the scalp as adrenaline makes it more difficult to dissect the artery without damage. This often allows a lot of bleeding and a diathermy is desirable. Adrenaline may make it more difficult to find the vessels and so they get damaged. Ideally the superficial temporal artery should be traced out before surgery and tattooed in as a

guide, and the correct site for the grafts selected. Take into account the direction of hair growth, the thickness desired and the likelihood of baldness later (Fig. 20-25). The most common donor site is towards the crown as the superficial temporal artery is usually easy to find and the lines of hair growth suitable.

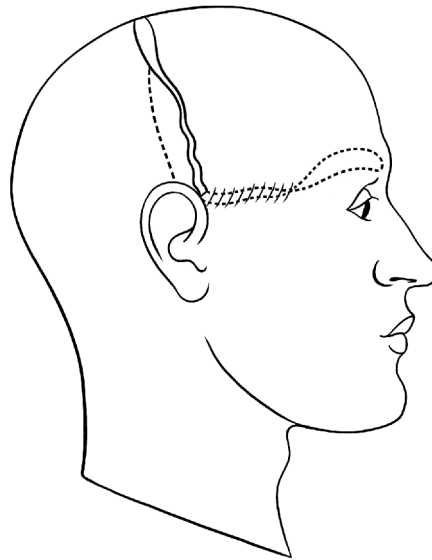


FIGURE 20-25 Diagram of technique for Pedicle Artery Grafts. Note incision is behind the artery and the incision is continuous with the graft to be moved for suture into recipient site.

Technique: An incision is made roughly concave to the artery and 1-2 cm behind it, extending up till it is continuous with the area for the graft. Dissect down to the deep fascia and cut that and elevate below the deep fascia so that the artery and vein can be seen, from the cranial side of the fascia. In this manner it is easier to get the vessels without damage than if the vessel is approached directly from the skin. The superficial fascia is cut with the neurovascular bundle intact. This can be difficult as the vessels meander especially if a direct approach is used. The vessels in the deep fascia need to be freed up from just above the ear till the pedicle is long enough to reach the outer end of the

eyebrow recipient. At the end the eyebrow shape is cut, attached to the vessels. A generous tunnel is made from the recipient site to in front of the ear and the eyebrow carefully tunnelled through. The graft is stitched into position as before with tie over sutures. Similar dressings are used, adhesive tape over the 'tie over bolus' and then a pressure bandage for three days.

The hairs do not usually fall out by this method. Therefore the eyebrows may be presentable soon after surgery. If they do fall out do not hurry to redo! They should grow back in 3-6 months. It is sometimes very difficult to dissect the artery to get it long enough. The hair of the crown may be very wiry and may grow in the wrong direction. These points need to be considered in planning. This is the best method of producing a thick luxuriant eyebrow such as many patients of the Indian subcontinent desire, but they are not appreciated by most Chinese patients.

(iv) Sometimes more complicated methods are used, such as swinging a bucket handle flap of scalp over from the back of the scalp and suturing into the eyebrow position and returning later to replace what is unused and trim it all up. These methods are no more successful and are more time consuming and more prone to infection. Also, it is difficult to achieve a suitable directional growth of the hairs that eventually form the eyebrow.

4. BAGGY EARS

It is usually only the ear lobe in a lepromatous leprosy patient that can become enlarged, 'baggy'.

Tanzer and Converse report about wedging to reshape large lobes and still maintain normal edges.²⁴ There have been many modifications published since. If one edge of the wedge is in the line where the ear joins the face the scar will be negligible as in the T-wedge (Fig. 20-26) A

second incision will be needed to fold the edge round. As far as possible keep the natural rolled edge of the ear to make it look more normal.

The most effective wedges are removal of a Single V, a W-shaped wedge and the T-wedge (Fig. 20-26). In suturing make sure the posterior points of the wedges are correctly placed.

The sutures can be removed on the fifth day and wounds are protected for another week or two, especially to protect the ear(s) in case the patient is pulling a shirt or sweater over his head. It is advisable to keep adhesive strapping to minimise such problems. Typical enlarged

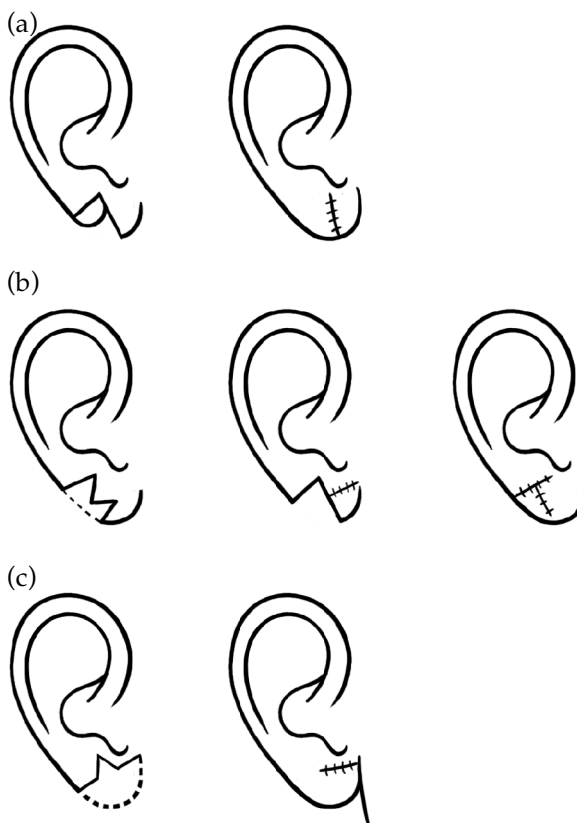


FIGURE 20-26 Diagrams of wedges to reshape ear lobes. **a.** the simple V wedge if the lobe is not excessively large., **b.** a long double wedge is of use if there are defects on the edge that need removal. **c.** The T wedge is excellent as the top of the T is in the skin crease and so less obvious than some of the other wedges.

lobes are shown in Fig. 20-27a and after wedging in Fig. 20-27b.

Occasionally the edge of the pinna may also need to be tidied up if reaction or infection has caused irregularities of the helix and a rat eaten appearance may have resulted. If a patient has a complete loss of the whole helix roll, it may be desirable to replace it with a local flap of post auricular skin or even a tubed pedicle graft from the sub auricular area of the neck or the acromio-clavicular area. Such a graft would need to be raised in say three sections, which could be joined to make one long tube. This can then be jumped on to the neck as a staging point. Three weeks later it can be sutured around the edge to provide a smooth rounded helix. A post-auricular flap with skin grafting is much simpler than this.

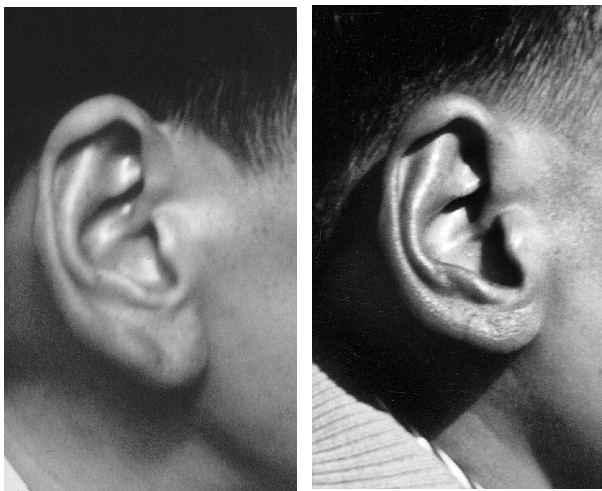


FIGURE 20-27a & b Pre and post operative views of a trimmed ear lobe.

5. EXCESSIVE WRINKLING

After recovery from severe lepromatous leprosy a patient may have very wrinkled skin of the face. His appearance can be improved, and often the appearance of youth restored by a face-lift. In leprosy the main looseness of skin occurs around the mouth- especially the upper

lip and in the nasolabial folds area. The pre-auricular skin and forehead are rarely badly affected. Most patients are not concerned about those areas.

The classical face-lift is a massive and time-consuming procedure whereby all scars are inside the hairline. The skin is elevated from that point to the lips and nose, then pulled tight and sutured firm with the excess skin excised. There is often a need to make extra incisions around the nose and mouth to eliminate the wrinkles that are the main problem. The classical face lift, done through the hairline, deals with large areas of skin that are usually unaffected in leprosy and it is usually not necessary to perform such extensive dissections.

By utilising the nasolabial face lift the amount of dissection is greatly reduced and the scars can be placed so that they appear to be the normal nasolabial creases. This can be done at the same time as the nasolabial flaps are taken out to reconstruct a collapsed nose. It is the patients with marked nasal collapse who often desire a face-lift.

Nasolabial Face Lift: Technique

A curved incision is made in the nasolabial fold, commencing at the nose and swinging about 1 cm lateral to the angle of the mouth, then back towards the point of the chin (Fig. 20-28). The two incisions can meet in a V about 1-3 cm below the chin point, allowing excessive skin of chin and neck to be excised at the same time though if that area is not badly affected they can be discontinued at a higher level. Through the incision the skin of the cheeks and lips is elevated far enough to achieve the desired smoothness. Care must be taken to peel the skin off the fat, because removal of the fat always leads to extra bleeding and possible haematoma formation. Haemostasis is secured and then 4-0 Vicryl or similar suture is used to secure the subcutaneous tissues in the desired position to remove as many wrinkles as possi-

ble and be sure that the scar will not stretch later. There should be no tension of the fine skin sutures. The excess skin is excised and then the incision closed.

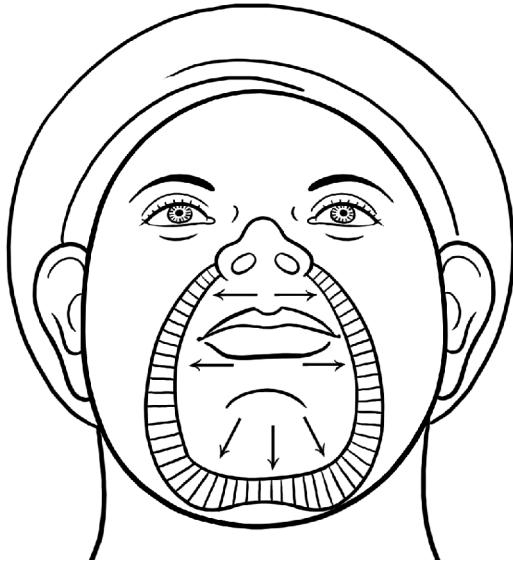


FIGURE 20-28 Diagram of a face to show the incision and the direction of pull of the skin before the first fixation with Vicryl. The incision does not need to go right under the chin but can if the skin there is also redundant.

Similar incisions can be made, on the upper eyelids and the forehead, if there is excessive skin that the patient wishes to have removed. Provided they follow normal crease lines, they should not be very obvious when healed. If adequate haemostasis is achieved it should not be necessary to use pressure dressings which are difficult to apply on the face. In six months the scar should be hardly detectable, as it should lie in the natural crease. If the surgeon is clever he can actually produce an artificial dimple beside the mouth.

Face lifting should not be done while there is any risk of a lepra reaction.

In patients who have a facial palsy of the lower half of the face a vast improvement in appearance can be achieved by a nasolabial face-lift. This is especially useful when the tem-

poral muscle is needed to protect the eyes that are affected by lagophthalmos.

6. SKIN SCARS

Skin scars may result from ulcerating lepra reaction. They may cause disfigurement, or may cause deformities due to contractures. Lepra reaction around the eyelids may produce scars that pre-dispose to exposure keratitis, or chronic infections. Routine plastic surgical measures may be employed. When contractures occur round the eyes it may be necessary to apply skin grafts to the lids to ensure future closure. Post auricular skin, full thickness, is the best, as it is very like eyelid skin. The graft should be large enough to allow the lids to overlap without being stretched, and preferably a "tie over" bolus of gauze used to prevent contractures and haematoma during early healing. It is advisable to do a temporary median tarsorrhaphy to hold the whole lid closed for 3 months to prevent the graft contracting again and causing recurrent ectropion. In the post-operative stage antibiotic drops should be dropped onto the medial canthus, when the patient is lying down, so that it will trickle into the eye as the lids are closed in the centre.

CONCLUSION

It is obvious that there are many procedures that will help improve the appearance and social acceptance of the leprosy patient whose disease is controlled. However, some patients have no interest in such management. They accept their deformities and disabilities and may even be accepted by the community. However, if there is a deformity such as lagophthalmos that may threaten the patient's welfare in the future we ought to try and persuade the patient to have something done to correct the impairment.

There are also individuals who may request things that are not discussed. Many of these people need counselling to deal with problems that are often much deeper than those that can be corrected by surgery. Do not neglect to try and meet these needs when considering surgery. If the emotional problems are deep seated, no amount of facial reconstruction will solve the problems. What we do should be aimed at improving quality of life, not just an improvement in appearance.

REFERENCES

1. Antia NH: Reconstructive Surgery of the Face. pp 497-509. In Cochrane R, Davey T (eds): Leprosy in Theory and Practice, 2nd edition. John Wright and Sons Ltd., Bristol, 1964
2. Boyce RG, Toriumi DM: Considerations in the use of biologic grafts and alloplastic implants in facial plastic and reconstructive surgery. *J Long Term Eff Med Implants* 2(4):199-220, 1992
3. Burget GC, Menick FJ: Nasal support and lining: the marriage of beauty and blood supply. *Plast Reconstr Surg* 84:189-203, 1989
4. Caputy GG, Flowers R: The pluck and sew technique of individual hair follicle placement. *Plast Reconstr Surg* 93(3): 615-620, 1994
5. Celik M, and Tuncer S: Nasal reconstruction using both cranial bone and ear cartilage. *Plast Reconstr Surg* 105: 1624-1627, 2000
6. Cochrane R, Davey T: Leprosy in Theory and Practice, 2nd edition. John Wright and Sons Ltd., Bristol, 1964
7. Cochrane RG. Lesions of the Nose, Ear Mouth and Throat. pp 322-330. In: Cochrane RG, Davey TF (eds): Leprosy in Theory and practice, 2nd Edition. John Wright and Sons Ltd, Bristol, 1964
8. Converse JH et al: Deformities of the Nose. pp 694-828. In: Converse JH (ed): Reconstructive Plastic Surgery. WB Saunders, Philadelphia, 1964
9. English FP, Forster TD: The eyebrow graft. *Ophthal Surg* 10(7):39-41, 1979
10. Farina, R: Total Rhinoplasty for the Destroyed Nose. pp 143-148. In: Enna CD, McDowell F (eds): Surgical Rehabilitation in Leprosy. The Williams and Wilkins Co, Baltimore, 1974
11. Fritschi EP: Reconstructive Surgery in Leprosy. The Leprosy Mission, Delhi, 1984
12. Gibson T, Davis WB: The distortion of autogenous cartilage grafts: its cause and prevention. *Brit J Plast Surg*, 10:257-274, 1958
13. Gilles HD: Deformities of the syphilitic nose. *Brit Med J* 2:977-979, 1923
14. Goldman GD: Eyebrow transplantation. *Dermatol Surg* 27: 352-354, 2001
15. Hari K: Reconstruction of the short nose with iliac bone graft and nasolabial flaps. *Plast Reconstr Surg* 69:863-870, 1982
16. Lee Y, Kim J, Lee E: Lengthening of the postoperative short nose. Combined use of a gull-wing and Concha composite graft and a rib costochondral dorsal onlay graft. *Plast Reconstr Surg* 105:2190-2199, 2000
17. McDowell F, Enna CD (eds): Surgical Rehabilitation in Leprosy. Williams and Wilkins Co, Baltimore, 1974
18. Menick FJ: Aesthetic refinements in use of forehead for nasal reconstruction: the paramedian forehead flap. *Clin Plast Surg* 17:607-622, 1990
19. Millard DR, Mejia AM: Reconstruction of the nose damaged by cocaine. *Plast Reconstr Surg* 107:419-424, 2001
20. Motoki DS, Mulliken JB: The healing of bone and cartilage. *Clin Plast Surg* 17:527-544, 1990
21. Neu BR: Segmental bone and cartilage reconstruction of major nasal dorsal defects. *Plast Reconstr Surg* 106:160-179, 2000
22. Ranney DA: The role of punch grafting in eyebrow replacement. *Lepr Rev* 45:153-157, 1974
23. Shirakabe Y, Shirakabe T, Takayanai S: The classification of complications after augmentation rhinoplasty. *Aesth Plast Surg* 9:185-192, 1985
24. Tanzer RC, Converse JM: Deformities of the auricle. pp 1084. In Converse JH (ed): Reconstructive Plastic Surgery. WB. Saunders, 1964
25. Tovey FH: Reconstruction of the nose in leprosy patients. *Lepr Rev* 36:215-220, 1965
26. Turegun H, Sengezer M, Guler M: Reconstruction of saddle nose deformity. *Aesth Plastic Surg* 22:38-41, 1998