A knowledge of nasal plastic surgery is necessary for otolaryngologists as variations in the external nasal shape are frequently linked with septal deformities. Correction of the airway associated with rhinoplasty forms a considerable part of nasal surgery.

In recent decades, a standard technique for rhinoplasty has evolved. The surgical steps present little technical difficulty, but their correct application is far from easy and rhinoplasty is a branch of surgery where errors related to lack of judgement are very obvious. Septoplasty aims to reposition the septum to the midline with minimal excision of the cartilaginous and bony components.

In almost all cases, correction of the septum can be combined with rhinoplasty in one operation. When the septal or external nasal deformity is gross, however, the patient should be warned that two steps may be necessary. A surgical anachronism is a standard submucosal resection to be followed at a later date by a rhinoplasty. A standard surgical step in rhinoplasty involves some degree of separation of the upper lateral cartilages from the septum. With inadequate support in the midline following removal of the septal cartilage, the division of the upper laterals from the remaining septum is likely to result in collapse of the nasal dorsum with saddling of the nose. A rhinoplasty after a standard submucosal resection is, therefore, compromised and a satisfactory result may not be achieved.

Analysis and selection of patients

A sense of aesthetics and common sense are necessary qualities to combine with sound surgical technique if satisfactory rhinoplasty results are to be achieved with minimal postoperative problems. The main cause of patient dissatisfaction following rhinoplasty is a failure of the surgeon to understand the patient's wishes. It is important for the patient to have a clear and realistic idea of the limitations of surgery. Good preoperative photographs are essential and the changes possible with surgery can be demonstrated to the patient on the photographs. Photographs also give the surgeon an excellent concept of the changes which can be achieved and the correct surgical steps which must be applied. In postoperative analysis photographs once again are extremely helpful.

The surgical approach to rhinoplasty should be influenced by the sex of the patient. In the female, one is operating for 'beauty'; in the male, the common complaint about the nose is that it gives rise to ridicule and comment and the operation is to eliminate these unsettling factors. Also, in the male, rhinoplasty may be carried out if a change in a particular racial appearance is required. Occasions, however, in which 'beauty' is involved for males are obviously less common.

In a male, particularly, a complaint about nasal deformity may be the presenting symptom of a profound psychiatric disturbance. It is important to detect these disturbed personalities in the preoperative assessment. Eight surgeons have been killed by disenchanted and mentally disturbed patients after rhinoplasty. The well-adjusted patient is invariably specific in the dislike about the shape of the nose. A complaint that the nose is too large,
deviated or has a hump, which links with the examination findings, is usually a clearcut case for rhinoplasty without psychological problems. The disturbed patient, however, is non-specific and evasive in the complaints about the nasal shape. A preoperative psychiatric assessment is necessary for those in whom the surgeon is doubtful about the patient's exact wishes and motives.

Care must be taken not to 'over-operate': the changes with rhinoplasty should be definite but subtle in most cases, and over-dramatic change may well predispose to a surgical or 'operated' appearance.

The age of the patient also has specific relevance for rhinoplasty. It is usually not advisable to operate under the age of 15 or 16 years, for the septum and the nasal bones may continue to grow or the shape continue to change. In older patients, a less radical alteration should be the aim. A gross nasal reduction in the more elderly not only tends to appear unnatural, but the elasticity of the skin is less and may not 'take up', leaving folds over the dorsum of the nose.

The height of the patient is another factor to be considered before rhinoplasty, in that a small nose may well be suitable for a small patient but frequently, and particularly in the male, a small nose on a tall patient - especially if the nasal tip is over-rotated - looks unnatural.

The moderate nasal deformity is probably the easiest to correct. In correcting a minimal deformity, extreme accuracy is necessary to achieve the desired result. Gross nasal deformity, which appears to present as an easy surgical challenge, may also be difficult. A natural-looking nose following a gross nasal reduction is not easy to achieve.

Finally, it is important to assess the nasal skin texture before rhinoplasty. With thick skin, changes or reductions made in the underlying cartilage and bone are not so obvious when the thick 'blanket' of skin is redraped. In thin skin, however, minimal change is apparent and any irregularity or asymmetry in reduction may present an obvious deformity. Telangiectasia of the skin may also be more obvious after a rhinoplasty and tethering of the skin to the bone or cartilage is more common with thin, ageing or atrophic skin.

**Surgical anatomy of the nose**

Approximately one-third of the supporting structure of the nose is made up of bone, the remaining two-thirds being cartilaginous. This may, however, vary considerably.

**The bony skeleton**

The two nasal bones project from the nasal process of the frontal bone superiorly and from the frontal process of the maxilla laterally. These bones are supported in the midline by bony nasal septum - the perpendicular plate of the ethmoid which is continuous with the vomer inferiorly and the cartilaginous septum anteriorly. The nasion is the depression of the profile at the root of the nose where the nasal bones meet the bossed glabella of the frontal bones.
The floor of the nose is formed posteriorly by the palatine bone and anteriorly by the maxilla. These paired structures both fuse in the midline to form a crest which supports the bony and cartilaginous septum. Anteriorly, the crest of the maxilla protrudes forwards as the nasal spine. If this projects too far, it can make the nasolabial angle more obtuse and give the appearance of a tethered and short upper lip.

**Cartilages of the nose**

The mid-third of the nose is formed by the cartilaginous septum and the paired upper lateral nasal cartilages. The upper laterals are triangular in shape and are overlapped superiorly by the nasal bones and frontal process of the maxilla and overlapped inferiorly by the lower lateral nasal cartilages; the groove thus formed is known as the limen nasi and is the landmark for the 'intercartilaginous incision'. It is important to note that the upper laterals lie below the nasal bones superiorly, and it is easy to disarticulate these structures when attempting to elevate the skin and periosteum overlying the nasal bones, leading to an unsightly deformity.

The lower lateral nasal cartilages are also known as the alar cartilages and form the lower third of the nose. These two cartilages are made up of a medial crus, which forms the columella, and a lateral crus, which provides the framework for the tip of the nose, preventing alar collapse on inspiration.

The lower margin of the lateral crus does not follow up the margin of the nostril but ascends away from it as it travels laterally, that is the margin of the lower lateral cartilages may be 1 cm from the margin of the nostril laterally, but only 1 mm distance medially. The fact that these two margins do not run parallel is of utmost importance surgically, whether attempting to follow the rim of the cartilage for a 'rim incision' or perhaps, even more significantly, when leaving 3-4 mm of cartilage undisturbed in a 'cartilage-splitting incision'.

The highest point of the lower lateral cartilage is referred to as the dome. This is usually at the junction of the medial and lateral crus but may, on occasions, be at a variable distance along the lateral crus. A 'facet' is found in most patients lying between the columella and lateral rim of the nostril. This facet is also referred to as the 'soft triangle'; it is not backed by cartilage and surgical interference at this point should be avoided as postoperative notching may occur which is impossible to correct.

Lying between the upper and lower lateral cartilages are several variable cartilages referred to collectively as the sesamoid cartilages.

The columella is formed by the caudal end of the septum, the nasal spine and the medial crura of the lower lateral cartilages. The nasolabial angle is that angle formed between the lip and the columella and is normally about 90° in males and a little greater in females.

**Muscles of the nose**

The procerus can be considered as a continuation of the frontalis muscle. Contraction of this muscle shortens the nose, pulling it upwards. Many surgeons in the past have removed a small portion of the procerus in an attempt to deepen the frontonasal angle. Since this is
usually replaced by scar tissue, it is seldom helpful. Laterally, the alar fibres of the nasalis and levator labii superioris shorten the nose and dilate the nostrils while the transverse fibres of the nasalis muscle compresses and contracts the nostril. Inferiorly, the paired depressor septi nasi muscles pass from the bone of the maxilla above the incisor teeth to the septum and alar cartilages and depresses the tip of the nose. In some patients, excessive activity of this muscle can cause the tip of the nose to move excessively while talking and division of this muscle may prevent this. Other facial muscles have an indirect effect on movement of the nose. All these muscles are innervated by the seventh cranial nerve.

**Anaesthesia**

In the majority of cases, the authors prefer to undertake surgery under general anaesthesia with the airway protected by a cuffed endotracheal tube and bleeding controlled by both topical application and infiltration with a vasoconstrictor. If this is undertaken in a careful and thorough manner as described below, bleeding is minimal. Controlled hypotensive anaesthesia results in excellent operating conditions, but involves risks over and above a standard anaesthetic.

If a general anaesthetic is to be given, the patient will need to be admitted a reasonable period prior to surgery. A full history must be taken and thorough general examination undertaken, together with any relevant preoperative investigations to ensure that there are no contraindications to general anaesthesia.

The patient must have nothing to eat or drink for a minimum of 4 hours preoperatively and is premedicated in the usual way. As the nose is to be infiltrated with vasoconstrictors, the anaesthetists may wish to avoid halothane and use a beta-blocking agent, provided this is not contraindicated, for example by asthma. The patient is intubated with a cuffed endotracheal tube which is inflated and the pharynx then packed with moist ribbon gauze. It is important to ensure that the tube is firmly fixed in the midline with strapping to avoid any asymmetry of the face. The patient should be monitored with an electrocardiographic (ECG) recorder throughout.

The patient should be placed on the operating table in the supine position with the head on a head-ring and the table rotated to about 15-30° in the head-up position. The operating lights are then arranged with one directly above and a satellite directed at the nose from the foot of the table. A headlight or fibreoptically illuminated instruments will also be required, particularly if any septal work is required.

In addition to topical application of vasoconstrictors to the nasal mucous membranes, the nose may be injected with 1% lignocaine containing 1:80,000 adrenaline. Care must be exercised while undertaking this, with a small bleb injected at a time, using a maximum of 6 mL. The following sites should be injected:

1. between the upper and lower lateral cartilages
2. along the nasal septum
3. laterally, towards the infraorbital nerve
4. along the site of the lateral osteotomy
5. the columella
6. the lower margin of the lower lateral cartilages.
It is important to wait about 10 minutes for the vasoconstrictors to have maximum effect.

**The osteocartilaginous vault**

A prominent dorsal nasal hump is the commonest cause of patient dissatisfaction with the appearance of their nose. In theory, the steps taken to 'dehump' and 'infracture' the nose are not difficult; nonetheless, it is all too easy for the final result to be 'unfavourable'.

A secondary hump or 'pollybeak' will result from inadequate removal of cartilage in the supratip region, while excessive removal of bony hump, particularly in males, can produce a most unsatisfactory appearance and incomplete lateral osteotomies may prevent proper infracture of the nasal bones, leading to an 'open-roof' deformity.

How much hump to remove? This is a question which cannot easily be answered as it will depend on the thickness of the skin, the amount of cartilaginous hump relative to bony hump, the width of the hump and angulation of the tip of the nose, as well as the inclination of the nasofrontal angle. The aim, however, should be to reduce the nose in harmony with the remaining facial features, remembering that it is always better to remove too little than too much.

There is much debate as to whether it is better to reduce the hump before the tip or remodel the tip before the hump. Those in favour of undertaking tip-plasty first will argue that one cannot judge how far to reduce the hump until the tip has been corrected; on the other hand, it can be argued that the degree of tip modification will depend on the new profile following correction of the osteocartilaginous vault. Another point in favour of the profile alignment first, is that this requires the introduction of relatively large and cumbersome saws and osteotomies which may more easily damage the lower lateral cartilage or tear the delicate flaps in the vestibular skin following tip-plasty. Those in favour of leaving the bony work until last will also argue that this causes most bleeding and should not be done until all the finer work is complete. The authors have no special preference, although they tend to undertake profile correction first, followed by tip-plasty except possibly in those cases with a short columella, where projection of the tip can be seen to be the main aim following which little, if any, hump reduction is required.

The first step after suitably arranging the patient in the head-up position, cleaning the nose and infiltrating with vasoconstrictors, will be to trim the vibrissae of the nasal vestibule as these not only get in the way of surgery but also tend to cake with blood clot afterwards, causing discomfort.

An incision is made along the sulcus formed by the lower lateral cartilage overlapping the upper lateral cartilage - the limen nasi. This intercartilaginous incision is continued medially to become continuous with the transfixion incision which separates the columella from the caudal border of the septum. Some surgeons will include a small sliver of cartilage in the columella (high transfixion incision) to prevent contracture of the scar pulling the tip of the nose downwards, contributing to a 'pollybeak'.
A 'hemitransfixion incision' is a contradiction in terms and may relate to two quite separate procedures: either a short incision which completely transfixes the columella but extends only a short distance down towards the nasal spine, or an incision which does not completely transfix the columella since the incision may be made on the right but not extend through to the left, while still being complete because it exposes the whole of the caudal end of the septum. The former incision is thought by some to reduce the likelihood of a pollybeak deformity due to scar contracture pulling down on the tip of the nose. The latter is particularly useful where extensive septal work is to be undertaken, and the surgeon will find it easier to elevate the mucosa if one side remains intact to act as a retractor.

The skin overlying the upper lateral cartilages is then elevated up to and a little beyond the osteocartilaginous junction of the nasal bones and upper lateral nasal cartilages. One then attempts to elevate the skin and periosteum overlying the nasal bones, being careful not to disarticulate the upper laterals from the undersurface of the pyriform aperture. The elevation is continued up towards the glabella. Lateral elevations should not be continued too far, particularly if multiple osteotomies are to be undertaken when the comminuted fractured bones will rely on the overlying skin and underlying mucosa to splint them in position. If multiple osteotomies are not required, the elevation may be continued a little more laterally; wider elevation may be helpful in 'redraping' the skin if a radical reduction is to be undertaken.

The upper lateral nasal cartilages are then divided from the nasal septum, keeping as close as possible to the nasal septum to prevent the formation of a 'T-shaped' structure which may be difficult to lower at a later stage. Occasionally patients may have a 'V-shaped' deformity where the upper lateral nasal cartilages and nasal septum join, which can be confusing unless the problem is recognized.

The upper lateral nasal cartilages and septum are then lowered, each by the same amount, up to the nasal bones using Foman scissors and the hump reduction completed with an osteotome or chisel. The bony and cartilaginous hump can then be removed with a large artery forceps, but should always be pushed further into the nose prior to withdrawal to detach any adhesions remaining between mucous membrane, periosteum and bone.

An alternative method is to lower the osteocartilaginous hump using a Bull's nasal saw which has a single fine blade, allowing the operator to remove even a small hump and a rounded blunt end to prevent damage to the overlying skin.

The nasal bones can be reduced further with a rasp although cartilage must be removed with a scalpel or scissors. Once a satisfactory profile has been achieved, the lateral walls of the nose will need to be infractured to close the flat 'open' bridge. In order to achieve this, lateral and medial osteotomies will be required. If these are curved in towards each other, these may suffice; if not, a superior osteotomy may be additionally required.

The techniques for undertaking the lateral osteotomy differ greatly. Few surgeons now use the saw as this requires elevation of a tunnel of skin and periosteum laterally along the line of the proposed osteotomy, which leads to marked swelling postoperatively, is laborious, and may cause bone dust which can become infected. A small 2-3 mm osteotome may be introduced intranasally at the lateral aspect of the pyriform aperture, via sublabial incision or
through a tiny stab incision directly through the skin. Whichever method is used, it is important that this osteotomy should be as low as possible to prevent a 'step' deformity which can often be felt and may be seen postoperatively. Once the osteotomies have been performed, the nasal bones can be infractured.

The height of the septum and lower lateral cartilages should then be rechecked. Ideally, the upper laterals and septum should be lowered equally. It is preferable to remove a little too much cartilage from the supratip region rather than too little as a secondary hump or 'pollybeak' deformity is the commonest cause of secondary revision although, in some cases, this may well result from hypertrophic scar tissue rather than inadequate removal of cartilage.

Reducing the caudal end of the septum will not, in itself, shorten the nose - to achieve this will require surgery to the lower lateral cartilages or tip-plasty in addition to often minimal reduction of the septum. Excessive removal of caudal septal cartilage simply results in columellar retraction or an excessively obtuse nasolabial angle.

**Nasal tip rhinoplasty**

In the early days of rhinoplasty, the finer surgery of the nasal tip was relatively ignored and more attention was given to the steps of hump removal and nasal bone infracture with lowering of the septum and upper lateral cartilages. In the last two decades, more thought and more elaborate techniques for the alar cartilages have been developed. Finer, more subtle and predictable changes in nasal tip anatomy can be achieved. Nonetheless, the more elaborate tip techniques have the disadvantages of producing more problems with tip asymmetries and deformities if wrongly applied or incorrectly carried out. Nasal tip deformities, furthermore, are probably more conspicuous than any other site on the nose or face.

One of the more common problems in the nasal tip is a bulbosity or fullness over the upper or cephalic aspect of the alar cartilages. Excision of the cephalic aspect of the alar cartilage not only achieves narrowing of this area, but makes some rotation of the nasal tip possible by a 'visoring' of the caudal rim of the alar cartilage into the cephalic defect.

Access to the cephalic portion of the alar cartilage is commonly achieved by a retrograde dissection via the intercartilaginous incision. With this approach, however, it is not easy to achieve an accurate and symmetrical excision of cartilage and a cartilage-splitting incision and delivery of the cephalic portion of the cartilage is preferred. Whichever approach or technique is applied to the cartilage, it is important to preserve the underlying vestibular skin. If an excess of vestibular skin is excised, pinching and alar collapse may follow. This problem, unsatisfactory from the point of view of both airway and cosmesis, is also probable if there is a failure to preserve a sufficient rim of alar cartilage to support the lateral wall of the nose. About 3-4 mm of cartilage is necessary to maintain the alae in a lateral position and prevent this collapse, but in a thin-walled nose with thin skin and rather lax cartilage, more lateral crus may be necessary. The texture of the skin and cartilage, therefore, may well determine the probability of this lateral alar collapse; with relatively thick skin and strong cartilage, a rim of 2 mm will suffice for support. If, however, skin and cartilage are removed from the lateral wall of the vestibule and removed to excess, then the pinching or 'knock-
kneel'd tip deformity will result. It is also important to excise equal portions of alar cartilage from each side to preserve tip symmetry and this is particularly necessary when the overlying skin is thin and the underlying cartilage is relatively strong and resilient.

Although the cartilage-splitting incision allows delivery of the upper aspect of the alar cartilage, this approach will not suffice when more radical changes are needed in tip anatomy. A rim incision with complete delivery of cartilage is necessary in these cases.

The rim of alar cartilage does not follow the margin of the nasal vestibule. The alar cartilage is placed obliquely and although, medially, the medial crus forms the rim of the vestibule, the lateral crus is up to 5 mm or more above the margin of the nostril. The rim incision and full delivery of the alar cartilage is necessary to correct bifid of flat nasal tip deformities. It is also necessary if lengthening of the columella is needed, and may be required to reduce a marked tip projection. Any radical change in tip anatomy which may be needed in such gross deformities as the cleft-nose nasal tip, also require a full delivery of the nasal cartilages. The rim incision and delivery of the alar cartilage gives an almost complete exposure of the lateral crus, the dome and the medial crus of the cartilage. If the cephalic half or two-thirds of the alar cartilage is removed (with preservation of vestibular skin), rotation or visoring of the remaining rim of cartilage achieves marked tip rotation. In most instances, it is better to avoid dividing the lower lateral cartilage at the dome or elsewhere for, although incision of cartilage in itself will alter tip anatomy as the crura spring apart, irregularity or sharp edges will result. This problem is particularly likely with resilient cartilage underlying thin skin. Symmetry of any cartilage incision or excision and the avoidance of any sharp edges is, therefore, important in these cases. It may be necessary however, to divide the alar cartilages separating the lateral and medial crus completely from one another to increase tip projection. In the technique described by Goldman (1965) - which is one of the better established techniques for increasing tip projection - the alar cartilages are divided lateral to the dome; the medial crura, plus the medial portion of the lateral crura are then sutured back-to-back. Cartilage grafts and struts are also advocated for insertion between the medial crura and are another way to increase tip projection and lengthen the columella. Recently, Sheen (1978) has advocated the use of cartilage grafts to give increased tip projection and a more pleasing tip anatomy. These grafts certainly have a proven place in revision rhinoplasty. In these cases, an excess of cartilage has almost certainly been excised at a previous operation or operations and replaced with fibrous tissue. Cartilage replacement is often clearly needed. In primary standard rhinoplasty, however, the use of nasal tip grafts or adjunct grafts is not usually necessary.

The saddle nose

The cartilaginous septum and maxillary bony crest form the main supports of the lower two-thirds of the nasal dorsum. If there is insufficient cartilage to give support, either due to absence or fibrosis of the cartilaginous part of the septum, nasal saddling to various degrees will result. Nasal saddling is, therefore, commonly seen after septal haematomata, following septal surgery or injury and, if the haematomata becomes infected, nasal collapse is almost inevitable. Patients should of course be warned prior to drainage of a septal abscess or haematoma that some degree of nasal saddling may occur. Immediate grafting is advocated by some (Huizing, 1986) but, in most instances, grafting of the dorsum is deferred until the degree of saddling is evident. Loss of septal support for the nasal dorsum, although resulting
mainly from trauma, may follow many of the chronic inflammatory conditions which involve cartilage such as sarcoidosis, tuberculosis, polychondritis and syphilis. Malignant granuloma may also damage septal cartilage and lead to nasal to nasal dorsum collapse; some degree of saddling may also be a familial or racial characteristic.

When considering management of a nasal saddle, one's first thought tends to be of a suitable graft material. It should be remembered, however, that many small saddles are accentuated by a nasal hump and simple removal of the hump suffices to solve the saddle defect resulting in a smaller nose which may be a bonus, particularly in the female patient. In some instances, it may be possible to remove a dorsal hump and use this to graft the saddle. With more severe saddling, however, an implant is required to restore an acceptable nasal contour. The problem is to select from the great number of alternatives the most acceptable and reliable long-term graft. When the saddle is due to loss of cartilaginous support, a 'soft' cartilaginous graft is preferable to the harder implants such as bone and synthetics. When the saddle defect involves the entire dorsum, that is both bone and cartilage, one of the harder implants is probably to be preferred.

Iliac crest bone grafts are still widely used and advocated in many standard texts, although their long-term survival is doubtful. When the saddling involves the bony skeleton of the nose, iliac crest grafts have a place but they are usually unsatisfactory for the cartilaginous saddle, producing a rather rigid and wide unnatural appearance. The donor site gives some considerable pain initially and produces a scar.

Autografts are probably the most useful graft material for the majority of nasal saddle defects. For the small saddles, sufficient cartilage may be obtained from the nasal septum. Usually, however, the cause of the saddle defect makes the likelihood of sufficient residual septal cartilage being available improbable. The bone of the septum from the vomer and ethmoid are thin and less satisfactory to fashion than the cartilage. Rib cartilage may be needed for the large saddle defects, but the harvesting risks of pneumothorax, postoperative pain and scar are among other disadvantages. Rib cartilages may twist, whatever manoeuvres are taken to avoid this troublesome long-term possibility.

Aural conchal cartilage is the most useful graft for the majority of saddle defects and can be obtained with minimal deformity, if necessary, from both ears. The shape of the conchal cartilage lends itself well to restoring good contour to saddle deformity. Although this cartilage gives many good results, it is a viable graft and change in shape and bulk may occur, so, as with all implants, it is not totally reliable. It is arguable whether this graft should be used for saddling related to chronic inflammatory diseases such as sarcoid, relapsing polychondritis or with malignant granuloma. It is not always possible to be certain that the disease is quiescent and the implanted graft may become involved in the inflammatory process and cause a complex deformity with the cartilage involved in the chronic inflammatory process.

Irradiated preserved cartilage is also advocated and impressive reports are available (McGlynn and Sharpe, 1981). Synthetic implants have a place in the management of nasal saddling although there are those who oppose their use with almost religious fervor. It is curious that, for chin augmentation, synthetic implants are almost universally used with little in the way of criticism. The thick overlying soft tissue present over the chin implant,
however, makes extrusion unlikely and conceals minor displacement. Synthetic implants underlying the nasal dorsal skin are close to the nasal cavity and to the exterior. Even with minimal infection, therefore, extrusion of the graft either externally or through a sinus inside the nose is possible. The firm synthetic implants may also move and their asymmetry of outline is obvious and aesthetically unacceptable. It is not true, however, to say that most synthetic nasal implants extrude. Long-term follow-up of cases show that this is not evident if certain precautions are taken (Mackay and Bull, 1983). An implant inserted through a midline vertical columella incision into a pocket underlying the dorsum of the nose with few or no other rhinoplasty steps undertaken concurrently will almost certainly remain in situ. Telangiectasia of the skin may occur and displacement from the midline position gives rise to asymmetry. The synthetic meshes, such as Supramid, also act as a satisfactory filling material in the nose and good results have been demonstrated (Beekhuis, 1975). These materials, however, cannot easily be fashioned or shaped. If infection does occur, the extrusion of solid implants results in a return to the status quo and surgical removal is also simple. With the mesh implants, however, complete removal may be difficult or impossible. The same problem of surgical removal arises with an infected bone or cartilage graft.

Firm synthetic implants are useful in saddling involving the nasal bones and cartilage and are particularly acceptable in some cases where a saddle appearance is an unwanted racial characteristic. With thin or scarred skin, synthetic implants are better avoided and any skin blanching overlying the implant at the time of insertion is to be avoided for the skin may later break down at this site.

There is probably no single ideal implant for all saddle deformities, but conchal cartilage grafts suffice and are possibly the most suitable graft at present to select for the moderate cartilaginous saddles. However, there is insufficient ear cartilage for gross saddle defects and, in this situation, a synthetic, rib or iliac crest graft is required.

The deviated nose

Correcting a deviated nose is one of the more difficult procedures in rhinoplasty. This is in part due to the fact that two-thirds of the nose is made up of cartilage which, unlike bone, does not 'stay put' but tends to spring back to its former position. In many cases, extensive septal surgery will be required which can considerably complicate any rhinoplasty procedure; lastly any inequality or asymmetry of the bony side walls may not be corrected by the usual medial and lateral osteotomies. Regrettably, although the procedures required to correct a deviation may be complex, this is seldom fully appreciated by the patient, whose attitude can often be summarized by the statement: "I don't want the shape changed, just straighten it!" As with all rhinoplasty surgery, it is well worth spending more time explaining the limitations than the expectations of any proposed surgery and this is particularly true of the deviated nose, when it should be carefully explained that no guarantee can be given that the nose will be perfectly straight but that certainly one hopes to achieve an improvement.

As long ago as 1845, Dieffenbach advocated division of the upper lateral nasal cartilages from the septum, the nose being held in its new position with bandages. In 1889, Trendelenburg was performing sophisticated procedures to correct the deviated nose by undertaking endonasal lateral osteotomies, percutaneous superior osteotomies and dividing the septum from the nasal crest using a fine osteotome. Joseph described a technique in 1907
whereby bilateral lateral osteotomies were undertaken in addition to removing a triangular wedge of bone from the 'long side'. A similar 'wedge-technique' together with an asymmetrical hump reduction was described by Foman in 1936 and later modified in 1960 (Foman, 1936, 1960). Cottle's description in 1960 of a high lateral osteotomy on the broad side and low osteotomy on the short side, together with a septoplasty and 'push down', although apparently effective, was criticized on the basis that it could lead to a 'step deformity'.

The techniques required to correct a deviated nose may be considered under four headings:

1. correction of the septum and upper lateral cartilages
2. dealing with deviation and asymmetry of the nasal bones
3. the nasal tip
4. augmentation, that is filling a depression to give an appearance of straightening the nose.

The last of these would not be suitable on its own if there is any functional element, but is a useful supplementary technique used in conjunction with the former three and may occasionally be all that is required to correct a purely aesthetic deformity.

The nasal septum and upper lateral cartilages

The septum is dealt with more fully in Chapter 10. When the septum, although deviated, is itself reasonably straight, that it, it may bend at one particular point only or it is straight within the nose but both nose and septum deviate to one side of the face, then the so-called 'septoplasty technique' can be usefully employed. A mucoperichondrial flap is elevated from both sides of the nasal septum or completely on one side with superior and inferior tunnels on the other. If mucoperichondrium is left attached to one side, it may reduce the chance of resorption of cartilage at a later date although, in practice, this seems rarely to occur. Leaving the flaps attached one side but not on the other, however, may lead to unequal scarring and later contracture which it is felt by some could lead to further deviation of the nose and septum at a later date. The septum is then separated from each upper lateral nasal cartilage above, divided at the 'bend' posteriorly, repositioned into the maxillary crest below, or the crest itself repositioned following an osteotomy if it is not in the midline and, finally, the septum repocketed anteriorly into a slot incised behind the columella.

Skin overlying the upper lateral nasal cartilages and nasal bones is elevated in the normal way via an intercartilaginous incision and, following detachment of the upper laterals from the septum, any inequality can be corrected by lowering the 'long' side and possibly even augmenting the 'short' side with a cartilage graft.

Septoplasty techniques are less satisfactory for dealing with deviations which are maximal at the valve area, where there is generalized 'ballooning' of the septum towards one side or where there is gross buckling and distortion of the nasal septum. In these cases, it may be necessary to undertake a submucosal resection of as large a portion of septal cartilage as possible which can then be repositioned and replaced as a free graft, or it may need to be completely replaced with an autograft from the ear or a homograft of banked septal cartilage. In these cases, there is a serious risk of supratip depression and saddling developing at a later
date and, when possible, it is better not to separate the upper lateral cartilage attachment to
the septum. This will, however, make it impossible to correct any inequality of the upper
lateral sides and more difficult to correct any deviation of the middle third of the nose. Very
occasionally, it may be necessary to stage the procedure in these circumstances.

The septum may, in some instances, be dislocated to one side of the columella
anteriorly, but the remaining septum may be in a satisfactory position. Providing there is
adequate support for the columella, which can readily be checked by pressing a finger in the
columella, then any displaced cartilage must be surplus to requirement and may be excised
together with its covering mucous membranes, provided this is excised parallel with the
septum to ensure that no useful cartilage is removed. If the cartilage is excised at a right-angle
to the septum, too much caudal border may be removed leading to unsightly columella
retraction.

**Deviation of the upper third - nasal bones**

Correction of the bony upper third should not in theory present too much of a
problem, as it should be possible to refracture, manipulate and immobilize the nasal bones
into any desired position. In practice, however, residual deviation in this area is not
uncommon and this may, in many cases, be due to the fact that medial, lateral and superior
osteotomies will not correct the deformity.

Trauma to one side of the nose will often result in a curved deformity and, if one
considers the nasal bones individually, each can be considered as 'canoe-shaped' or 'banana-
shaped' - medial, lateral and superior osteotomies will simply result in two fragments, each
still with the same curved shape.

Tardy and Denneny (1984) describe the use of vertical intermediate osteotomies using
a 2 or 3 mm osteotome endonasally. While this certainly results in greater mobilization of the
fragments, it may still not be ideal because a transverse or horizontal intermediate osteotomy
is more logical. This is difficult to perform endonasally, but can easily be performed using
a percutaneous technique.

The nose is prepared in the normal way; a small stab incision is then made in the
midpoint of the desired osteotomy. Through this single incision, the osteotome is then moved
up and down along the proposed line scoring the periosteum, and then tapped through in three
or four positions to complete the osteotomy. The same technique can be used for the lateral
and superior osteotomies. A medial osteotomy is undertaken in the normal manner. Following
this, the nasal bones are infractured or outfractured into the desired position. It is important
to note that skin and mucoperiosteum must not be widely elevated as these are required to
splint the relatively small fragments of nasal bones. Intermediate osteotomies, whether
longitudinal or transverse, must be completed before any other osteotomies. There may be
further comminution of the nasal bones, but this need not be a disadvantage and, indeed, was
the basis of a technique described by Kazanjian and Converse (1972) who advocated covering
the nose with cottonwool, protecting the eye with wadding and refracturing the nose with a
strong blow from a mallet.
**Nasal tip**

The cartilage-splitting technique describe above can at times be used to correct a tip deformity by an asymmetrical reduction, either removing more cartilage from one side than the other or reducing the tip only on the side to which the nose deviates. Occasionally, a tip can be reduced and the cartilage removed used to augment the other side.

Where the tip not only deviates to one side but also requires projection, the technique described by Goldman may be useful. A rim incision is performed and the overlying skin elevated. Skin and cartilage are then incised at a point some 2 mm lateral to the dome; the two sides are then sutured to each other in such a way that they can not only project the tip but also twist it back to the midline.

**Augmentation**

In addition to augmentation of the tip, as described above, it may at times also be useful to consider augmentation on the concave side of the nose over the upper lateral cartilage and nasal bones. It is always wise to consider the need for this carefully at the preoperative planning stage as, following infiltration and elevation of the skin together with a certain amount of inevitable oedema of the tissues during surgery, the need for augmentation after undertaking various other manoeuvres can be difficult to visualize. One can frequently be disappointed with long-term results in a case where a graft was considered preoperatively, but deemed to be unnecessary at the time of surgery.

Autografts are preferable to homografts and it is usually not difficult to find a suitable piece of cartilage. It is often necessary to remove cartilage from the nasal septum while correcting a deviated nose, and this makes ideal graft material. Where this is not available, however, conchal cartilage from the ear is equally suitable.

Whenever possible, these grafts should be positioned into a pocket which has been fashioned to exact size of the graft to prevent the latter being displaced. While this is highly desirable, it is not always practical; for example, if it has been necessary to elevate the skin over the dorsum to remove a hump, it is then impossible to fashion any pocket in the supratip region. In these circumstances, it is possible to secure the graft with 4-0 plain catgut sutured through the skin and secured with Steri-strip.

**Deviation associated with gross deformity of the nose**

Where there is gross deviation, particularly if this is associated with severe septal deformity, as with the cleft-lip nose, an external rhinoplasty approach should be considered. This allows excellent exposure of the septum, together with direct visualization of the nasal anatomy. It is, however, simply an approach and does not in itself offer an advantage other than improved exposure and access. The principles outlined above will still need to be followed in order to correct the deformity.
**Alar collapse**

Alar collapse is the phenomenon whereby the alae nasi collapse inwards on inspiration in a valve-like manner, causing nasal obstruction. It is most common in elderly patients with a drooping tip, loss of elasticity of the cartilage and atrophy of the dilator muscles. It may occur after rhinoplasty, if too much lower lateral nasal cartilage has been excised. Loss of vestibular skin may result in gross scarring and contracture in the valve area.

Conductance is proportional to the fourth power of the diameter of a vessel and a very small change in the width of the nostril will markedly affect the flow. As air passes inwards through the nose, it will produce a Venturi effect, tending to draw the nostril inwards, as this occurs, the resistance will increase tending to cause further indrawing until the nostrils eventually close off completely. In the normal subject, this will occur if inspiration through the nose is sufficiently forceful and a diagnosis of alar collapse should be reserved for those patients unable to achieve inspiration at physiological flow rates.

While a relatively small decrease in the diameter of the airway may greatly increase resistance, the converse is also true and a relatively minor alteration of the nasal septum in the valve area or narrowing of the columella may be sufficient to prevent the initiation of this phenomenon. One can test the relative significance of a wide columella by gently squeezing it between the two limbs of a Thudicum speculum. If this improves situation, it is a simple matter to excise an ellipse of skin to include the herniating portion of the medial crus of the lower lateral cartilage. The skin is then gently undermined and closed with sutures.

In addition to narrowing caused by the medial crus, the lateral crus may at times herniate inwards, causing obstruction; this cannot be corrected by simple excision, however, but needs to be dissected free and repositioned into a new pocket slightly more lateral and superior to its former position.

Apart from these supplementary techniques, the methods used to correct this problem fall into three groups:

1. prostheses
2. modification of existing cartilage
3. grafting additional material.

**Prosthetic devices**

Many prostheses have been tried over the years from quills and reeds to the silver wire alae nasi dilator used by Clement Francis at The Metropolitan Ear, Nose and Throat Hospital. Not one of them has, however, found lasting favour. More recently, Davenport, Brain and Hunt (1981) have reported greater success using acrylic materials. A mould is made with silicone putty which is then cast in clear acrylic resin through which a hole is drilled to provide an airway.
Modification of existing cartilage

In some cases, alar collapse is due to slit-like narrowness between the septum and the upper lateral nasal cartilages. Walter (1976b) has described a technique whereby the valve can be enlarged by dividing the upper laterals from the septum and covering the defect with a flap from the upper border of the lower lateral cartilage.

The skin is elevated over the upper lateral nasal cartilages which are then divided, together with the underlying mucosa, from the septum on both sides. A flap of cartilage and vestibular skin is then fashioned, based on the dome and retaining a 2-3 mm strip of cartilage along the lower border undisturbed. This flap is then rotated upwards to fill the defect between the septum and lower lateral cartilages.

Rettinger and Masing (1981) noted that the medial crus and lateral crus of the lower lateral cartilages lie in the same plane, in many patients with alar collapse, and this is particularly true in the elderly patient with a drooping tip. They also observed the tension lines in a plastic model under polarized light. By rotating the two limbs of the model in opposite directions, they noticed that these tension lines were distributed over a larger surface increasing the stability of the system. These principles were applied to the problem and the lateral border of the lower lateral cartilage was rotated upwards into a more cephalic position.

A rim incision is performed and the lateral crus dissected free of both overlying skin and underlying vestibular skin until the whole of the lateral crus remains attached only at the dome. A pocket is developed above the upper lateral and sesamoid cartilages and the lateral crus rotated upwards by means of a traction suture. The cartilage can then be maintained in its new position either with a mattress suture tied over Teflon foil or with fibrin glue.

Rettinger and Masing reported an initial success rate of 18 out of 19 patients with a minimum follow-up period of 6 months and pre- and postoperative rhinomanometry confirmed this improvement in the four patients in whom this was performed.

Cartilage grafts

In some cases, there is insufficient cartilage to reposition; this is particularly true following excessive excision of cartilage during rhinoplasty. In other cases, although present, the cartilage appears to have atrophied and lost all its elasticity such that repositioning is unlikely to be beneficial. In these cases, it is necessary graft new cartilage either from the septum or from the conchal cartilage of the ear, which is probably better as the latter is suitably curved and elastic. Where support alone is needed, a cartilage graft will suffice; if vestibular lining is needed in addition to support, a composite graft will be required.

Cartilage graft

An ellipse of cartilage is taken from the concha of the ear and inserted into a pocket prepared at the site where support is lacking. A small incision is made in the vestibular skin and a pocket fashioned with curved pointed scissors - the size of which should exactly match that of the graft to prevent the graft wandering into the wrong position. The pocket is then closed with a few fine sutures.
Composite cartilage graft

Alar collapse with stenosis may follow rhinoplasty, although it should not occur if the principles outlined here are followed; in particular, vestibular skin should not be excised. In addition to surgery, other trauma and in particular burns, sometimes following cautery for epistaxis, may result in this deformity.

Aural conchal composite grafts offer the most effective method to correct this difficult problem. Although composite grafts were described many years ago (Konig, 1902), it is due to Claus Walter's more recent innovative work that the wider application of these grafts has been developed (Walter, 1976a).

For the more minimal stenosis involving the apex of the vestibule alone, two separate elliptical composite grafts may be used. The vestibular skin is incised and undermined, on either side, but no skin is removed; the composite graft is then sutured into the defect. When stenosis is associated with saddling, a large composite graft can be used, with a small strip of skin removed from the midline of the graft where it 'bridges' the septum. This can provide cartilage to fill the saddle, cartilage to prevent alar collapse and skin to replace the stenosed vestibule as a simple procedure. The external rhinoplasty approach may facilitate the securing of these grafts.

External rhinoplasty

The standard rhinoplasty techniques, evolved from Joseph's and Roes' original operations, involve no external incisions on the nose or face. The technique is, however, to some extent blind and certainly placing intranasal sutures or accurate securing of grafts is not always easy via the standard intranasal incisions of rhinoplasty.

Rethi (1956) demonstrated that an excellent exposure and access to all the nasal structures could be achieved with elevation of the nasal skin via a transverse columella incision linking the cartilage rim incisions. The transverse incision across the columella is, however, invariably ugly and conspicuous and almost impossible to revise effectively. In 1974, Goodman of Toronto demonstrated that an inverted 'V'-shaped incision resulted in an almost imperceptible scar. Vertical columellar incisions are barely perceptible whereas transverse incisions are very obvious.

This small change in the incision led to a resurgence of interest in the external or 'open' rhinoplasty operation particularly in the USA, where it is now widely practised. It is not possible at present to say how acceptable this technique will become for routine rhinoplasty, for the standard technique is so well tried and proven that it will be difficult to displace. In certain gross deformities, marked deviations and revision techniques, the external rhinoplasty has the advantage of demonstrating the anatomy clearly so that correction can be better controlled and sutures accurately placed. For the insertion of composite or intranasal grafts and possibly access for repair of a septal perforation, the external rhinoplasty approach should be considered. It also forms an excellent access for excision, with minimal scarring, for lesions and swellings under the nasal dorsum which may hitherto have been approached by a direct incision through nasal skin.
Dressings, splints and plasters

Prior to the application of any dressings, one should ensure that any cartilage-splitting incisions have been sutured and that mucoperichondrial flaps are replaced and secured. It is not usually necessary to suture the intercartilaginous incisions.

Splints

Silastic splints may be required to immobilize the nasal septum and help to maintain this in the midline. These should be thick enough to provide rigid support, of sufficient length to support the entire length of the septum, but should not be too wide as they may otherwise cause pain due to pressure between the septum and the middle turbinate. Splints must be secured with a transfixion suture securing the two sides and not sutured one to the other across the front of the columella, as this is not only annoying to the patient but may cut into their skin leading to a permanent scar which is difficult to correct.

It is normally an easy matter to cut the suture and slide the splints out approximately one week later.

Packs

The nose will normally need to be lightly packed with a double layer of Telfa dressing, or a small vaseline pack, although the latter should be applied carefully as any vaseline entering the wound may cause a granuloma. Packing is removed at 12-24 hours.

The nose is strapped with 0.5 inch (13 mm) Steri-strips, moulding the nose in the desired position ensuring that the tip is held well up, approximating the transfixion incision and keeping the tip of the nose suitably pinched in. It is important to keep the supratip well strapped down to prevent any haematoma forming which may contribute to a pollybeak. One should avoid leaving any small area of skin unstrapped as it is possible for this to herniate through, leading to skin necrosis and ugly scarring.

External fixation

Many different materials have been used; plastics have the advantage that they are light and easy to keep clean; various designs of metal splints are available which are easy to apply but may expand with swelling of the nose, leading to a loose fit unless they are squeezed tight again a few days postoperatively. Plaster of Paris, although one of the oldest, remains popular with many surgeons and the authors use a splint cut from 6-8 layers of plaster of Paris bandages. This is dipped into warm water, squeezed out in gauze, applied over the nose and secured with a further layer of strapping.

Whether or not this external splint should cross the nasion up onto the forehead, remains debatable. Some feel that, as there may be postoperative oedema and swelling at the root of the nose, the plaster can be lifted up in such a way that there is no longer adequate support of the nasal bones where it is most needed. Conversely, it can be difficult to secure the upper end of a splint which is applied to the nose alone, and continuing the plaster onto the forehead not only facilitates this but may help to keep the nose in the midline. One
compromise is to apply a half-moon-shaped splint of 6-8 layers of plaster to the nose with an additional spur of 6-8 layers placed along the dorsum onto the forehead leaving a small gap under the splint at the nasion.

**Bolster**

Half a gauze eye-pad strapped under the nose makes a suitable bolster; this can be changed as necessary until the internal packing is removed the following day, whereafter bolster should be discouraged and as much air as possible should be allowed to get to and, if possible, up the nose.

**Postoperative care**

**Recovery**

If surgery is performed under general anaesthesia, a great deal is asked of the anaesthetist. Not only should the patient remain totally unconscious throughout the period of surgery but no sooner is the surgeon finished, the patient is required to be completely awake, conscious and cooperative. If too drowsy, they may well inhale blood, particularly when nursed in the optimal head-up position, itself aimed at reducing bleeding and swelling. If confused or thrashing about, the patients may displace the dressing and splints or this may occur as a result of attempting to restrain them. Fortunately, this surgery is not associated with much pain, this being particularly true if the nose is infiltrated with vasoconstrictors combined with local anaesthetic agents (for example lignocaine). Large doses of postoperative analgesia are therefore not required and, combined with careful preoperative medication and modern general anaesthetic agents, the ideal requirements can be achieved. Normal recovery procedures should be observed and, once fully conscious, the patient is transferred to the ward.

**Ward**

On the ward, the patient should be nursed in the sitting position for as much time as possible. Temperature, blood pressure and pulse should be observed as well as other signs of bleeding, that is swallowing, although severe bleeding at this stage is very rare.

**Antibiotics**

Routine prophylactic antibiotics are not required; they should be considered, however, in patients with splints which are to be left *in situ* for one week and in any case in which implants have been used, whether these be allografts, autografts or homografts. The commonest infecting organism is *Staphylococcus* sp. and, since this is very often penicillin resistant, an antibiotic which is specific for this should be prescribed.

**Complications of rhinoplasty**

Complications and problems arise with rhinoplasty when the standard techniques are carried out to excess or incorrectly. Excess removal of tissue or over-correction at the time of rhinoplasty is the commonest cause of the now well-recognized unnatural postoperative
rhinoplasty appearance. A nose with a natural non-operated appearance is the aim of rhinoplasty; surgical judgement along with a clear understanding of what the patient wants and expects are essential preoperative requisites.

A small removal of bony hump is usually all that is required and either a saw with a narrow single (rather than wide double-cutting) edge or an osteotome is the correct instrument. The wide saw encourages the surgical removal of an excess of tissue and this, coupled with too little excision of the lower cartilaginous portion, is the commonest cause of the pollybeak appearance. If an excessive portion of nasal bone is removed, and then to achieve alignment an equally large portion of septal or upper lateral cartilage is removed from the nasal dorsum, a ski-slope appearance of the nose results. These excessive changes are particularly unsatisfactory in the more elderly patient where the skin may not take up, and where gross change in nasal contour is to be avoided as it frequently appears unnatural.

Excision of the caudal angle of the septum is a standard step in rhinoplasty but it is unnecessary if the nasolabial angle is preoperatively over 90-100°. An excessively 'open' nasolabial angle produces a 'pig-snout' appearance and many potential rhinoplasty patients are now aware of this surgical appearance and will make a specific request for this to be avoided.

Excessive removal of lateral crus of the alar cartilage has already been mentioned as a step predisposing to pinching with collapse of the lateral wall of the nasal vestibule, resulting in a 'knock-kneed' nasal tip appearance.

Failure to obtain a good lateral osteotomy of the nasal bones with infracture results in a wide nasal bridge which is sometimes termed the 'open-roofed' deformity. The saw is the most ineffective and traumatic instrument for the lateral osteotomy and its use predisposes to this deformity: an osteotome is to be preferred.

If asymmetrical excision of the alar cartilage is carried out and the rim of the cartilage remaining is too narrow, particularly near the dome, 'bossing' or asymmetry of the nasal tip becomes obvious. If the medial and lateral crura are divided when the overlying nasal tip skin is thin, irregularities or highlights will show. Asymmetrical division of the cartilages, or division on one side only, is particularly likely to predispose to this unsatisfactory appearance. Morcelizing techniques of the tip cartilages are also at risk of producing tip irregularities with thin overlying skin.

Intranasal complications of rhinoplasty also occur. The standard rhinoplasty technique correctly carried out does not prejudice the nasal airway. Over 500 patients assessed postoperatively at The Royal National Throat, Nose and Ear Hospital had no complaint of nasal obstruction following rhinoplasty. Nonetheless, vestibular stenosis following revision rhinoplasty or excessive incisions inside the nasal vestibule, particularly if coupled with excision of vestibular skin, will lead to stenosis and narrowing of the airway which may be very severe.

Failure to excise the caudal portion of the upper lateral cartilage may result in a projection of this cartilage into the vestibule with an area of vestibulitis.
Synechiae should not occur but trauma to the lateral nasal wall skin and mucosa, if coupled with damage to the septal mucosa, may predispose to this and careful use of instruments is a relevant factor. Excessive lowering of the upper lateral cartilage along its dorsal margin also predisposes to webbing of the nasal valve with nasal obstruction.

Rhinoplasty and septoplasty, however, are operations which, if correctly applied, give excellent results achieving both an improvement in nasal airway and an acceptable and natural improvement in the external nasal shape.