OPEN STRUCTURE RHINOPLASTY
A Manual of Surgical Skills Training

2nd Edition

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Section 1 **Introduction: The Place of Open Structure Rhinoplasty**

The aim of modern rhinoplasty is to gain the greatest benefit for the patient in improvement of nasal function and aesthetics. Standard closed techniques usually offer a satisfactory approach for simple deformities such as dorsal humps and bony deviation. This form of traditional closed rhinoplasty technique is essentially a reductive process where cartilaginous and bony elements of the nasal skeleton are resected, with little effort being made to recreate structural integrity of the nose other than re-positioning the nasal septum and nasal bones. While for many patients this reduction and mobilisation approach is appropriate, others who have complex deformities of the nasal tip, septum, middle third and who require augmentation are often better served using an open approach.

This manual is designed for surgeons wishing to learn or improve their open approach skills. The specific exercises included have been developed as a result of our 18 years of experience with the Dundee Rhinoplasty Course and are the product of the combined views of the tutors and delegate feedback. The open structure technique is most readily justified for patients who require nasal skeleton augmentation or who have a complex cartilaginous deformity. Examples include those who have suffered major nasal deformity with tissue loss and have saddling of the nose and/or nasal tip deformity.

Our philosophy embraces an atraumatic surgical technique using carefully placed incisions and gentle flap elevation using subperichondrial and subperiosteal tissue planes to expose as much of the nasal skeleton as is necessary. While more time consuming, this technique gives the best exposure of any approach to the nasal tip. In addition, it enables the surgeon to perform bimanual surgery making the judgment of specific deformities much easier. It is indicated in cases of:

- Extensive revision surgery.
- Severe deformity of the external nose and/or septum.
- Congenital cleft lip nose deformities.
- Tip rhinoplasty, especially where graft augmentation is deemed necessary or complex suturing is required.
- Deformities of the middle third of the nose including saddle deformity.
- Certain cases of nasal valve collapse.

In the best interest of the patient, the surgeon should balance the surgical trauma of the chosen approach with the likelihood of achievement of a satisfactory outcome. In open structure rhinoplasty, since a greater weight is placed on re-shaping and rebuilding the nasal contours rather than
reducing them, it is best to do the minimum necessary for that individual, reducing or adding tissue only where indicated. Given that the exposure is good, it is important for the surgeon to resist the temptation to do more surgery than is necessary as each individual manipulation carries a risk of failure. Tip and supra-tip projection can be maintained or increased through the generous use of cartilage autografts sutured into strategic positions. Tip rotation can be controlled in a similar way and by careful sculpturing of the lower lateral cartilages.

It is also worth emphasising the wonderful opportunity open structure rhinoplasty offers as a less hidden means of teaching re-constructive nasal surgery. It is hoped that as the practice becomes more widespread, surgeons who learn the open structure technique, will not only have a better understanding of rhinoplasty and nasal anatomy, but will also be able to achieve better results, especially for patients with severe and moderately severe nasal deformity.

Section 2 Facial Aesthetics

Effective nasal aesthetic assessment requires an understanding of nasal anatomy, patient aspirations, available techniques, and cultural and race-specific facial aesthetics. The face can be analysed with respect to measurable parameters. If a line is drawn from the upper limit of the external auditory meatus to the lower orbital rim, the line perpendicular to this passing through the root of the nose is the facial plane. The nose projects forward from this, and is separated into thirds: the bony dorsum, the middle third and the tip. The aesthetics of the nose should not be judged in isolation but rather seen in the context of the overall facial structure for that individual. This analysis should include:

- Assessment of facial aesthetic and symmetry including:
  - Vertical fifths,
  - Horizontal thirds and
  - Alignment.
- Projection of nasion, bony dorsum, middle third and tip.
- Width; bony base, bony dorsum, middle third and tip.
- Rotation of columella with philtrum (naso-labial angle).
  and of dorsum with forehead (fronto-nasal angle).
- Analysis of symmetry and shape of the tip viewed form the base.
There are universally accepted differences between the male and female nose. Both should be symmetrical. The bony dorsum should be very slightly projected anterior to the nasion. The tip should be projected slightly anterior to the middle third. The tip defining points (the caudal maximum convexity of the tip) should be readily defined and not bulbous. The nasolabial angle should be 90–95 degrees in the male, and 95 to 100 degrees in the female. The tip should be rotated upwards at the second columnella break. The facial plane should be visualised in profile and the projection of the nose in relation to forehead and chin analysed. The malar arch projection should be assessed. It is important that attention be given to the skin type, colour, thickness, and age. In anterior view, the alignment should be assessed; looking at the bony and cartilaginous dorsum separately, noting any angulation between them. In basal view, the base should approximate the form of an equilateral triangle with nostril comprising two-thirds of the height, oval in shape and in an oblique position.

Facial proportions: Horizontal Thirds and Vertical Fifths

1. Horizontal third aesthetic divisions of the face.
2. Vertical fifth aesthetic divisions of the face.
3. Aesthetic facial angles for assessing nasal projection and tip rotation.
Introduction

The operation of open septorhinoplasty in the United Kingdom is generally performed under general per-oral endotracheal or laryngeal mask anaesthesia with the tube/mask fixed in the midline to prevent distortion of the upper lip. The operating table is placed in 15° of head up tilt to reduce bleeding. We advise applying xylometazoline spray as a nasal vasoconstrictor premedication. Further vasoconstriction is achieved following induction, when the nasal cavities are packed lightly with 1/1000 adrenaline soaked pledgets, and the septum and proposed skin wound lines are injected lightly with 1/80000 adrenaline with 2% lidocaine. Care is taken not to distort the soft tissue by over-injection. The nasal vibrissae are trimmed with fine blunt pointed scissors.

Planning and correct placement of incisions is of paramount importance and the skin flap should be raised in the sub-SMAS* layer as close to the cartilage and bone layer as is possible. This maximises the thickness of the overlying skin envelope and reduces bleeding. Elevation of the skin flap is normally straightforward but in secondary revision procedures with extensive scarring of the columella, foreshortened columella and deformed columella this can be extremely challenging.

Surgical Technique

There are 4 parts to the incision

- A Transcolumellar
- B Medial marginal
- C Domal
- D Alar crural

* superficial musculoaponeurotic system
It is better to out the incision first before injecting the local anaesthetic, so that there is no tissue distortion. The trans-columellar incision can be an inverted ‘V’ or ‘W’. Make this at the middle of the columella anterior to the feet of the medial crura. Our preference is a ‘W’ incision in primary rhinoplasties as it offers a wider area to redistribute the forces of contraction. However, in revision procedures, an inverted ‘V’ incision may be preferable. Sometimes, the columella is so distorted that you need to imagine the final shape of the columella and plan your incision accordingly (Fig. 5).

The **medial marginal columella** incision is made 1–2 mm from the columella edge and begins from the transcolumellar incision where it forms a right angle and extends about 10 mm up into the domal recess of the vestibule but avoiding the soft triangle (Fig. 5). The domal incision is made using three point retraction as described later in Exercise 1, and the plane of dissection to the domes is made by elevating the soft tissue off the medial surface of the medial crura as far as the intermediate crus. Palpation of the margins of the lower lateral cartilage at this point will offer a guide to the position of the alar crural incision which hugs the caudal edge of the lateral crura.

The skin flap is elevated with fine scissors using the technique of **small snips and big spreads**, staying just deep to the SMAS layer and within the perichondrium of the cartilage. The skin edge must be treated with respect by using skin hooks and never grasped with forceps. Once the flap is sufficiently mobile, then a blunt retractor such as Aufricht’s may be used to facilitate access to the anterior septal angle and the dorsum.

The extent of skin elevation in the dorsum depends on the extent of surgery and re-draping needed. If access to the septum is needed, then dissection is carried on between the medial crura identifying the anterior septal angle and then following the caudal border of the septum towards the nasal spine.
Section 4 Osseo-cartilaginous Vault Surgery

This section concerns the surgery to alter and refine both the profile and the line of the nasal dorsum. Procedures vary in their extent. The aim is to return the naso-facial angle to the ‘normal’ range of 30–40° (Fig. 3), and then achieve appropriate alignment, width and a normal dorsal aesthetic line. Various factors including the effects of trauma, differential growth and previous surgery mean that the surgical application can be unpredictable, so when considering osteotomies it must be appreciated that ‘one size does not fit all’. The decision on which pattern of osteotomies to use comes with knowledge, experience and training.

Assessment begins with the skin and soft tissue envelope. Careful inspection will demonstrate potential pitfalls including post-traumatic scars and skin discolouration. A gentle stretch of the skin of the bridge of the nose will highlight thin skin and demonstrate any sharp prominences of cartilage and bone. In this situation, it is wise to caution the patient of the possibility of surgically altered bone and cartilage ‘showing through’, and of scar persistence after surgery.

The bone-cartilage skeleton has three components:

- Lateral – gives height.
- Central – gives the width.
- Intermediate – at junction of lateral and central components defines dorsal aesthetic line.

Subsequently, the deformity will be assessed, photography taken, and surgery planned. In general, deformity of the osseo-cartilagenous vault will require osteotomies and should be considered to correct the following situations:

- Hump reduction / close open roof.
- Broad dorsum / broad bony base.
- Deviation.
- Infracture / outfracture.
- Concavity / convexity.
- Combinations of the above.

In cross-section, the bony dorsum has lateral, central and junctional components.
Hump Reduction

The previously described open approach facilitates excellent access to the nasal dorsum. The hump can be reduced using a composite or component technique.

In **composite reduction** complete resection of the bone-cartilage hump as single entity is performed. The cartilage is incised with a blade or scissors and an osteotome or chisel to separate the bone (**Fig. 11**). The resection includes incision of the upper lateral cartilage on each side and the dorsal septum in the mid-line. The open approach simplifies this procedure and facilitates accurate incision placement under direct vision. The bony hump is then reduced with a chisel, engaging the bones through the ‘fish mouth’ of the incised cartilage.

10 Composite hump reduction, when the hump is removed as a single entity creating an open roof deformity.

11 First the cartilaginous hump is incised with a scalpel, then a chisel engages the ‘fish’s mouth’ of the incised upper lateral cartilage.
Our preference is to use a wide osteotome or chisel to remove the hump in a smooth and even manner. It is sometimes possible to slightly angle the osteotome during the hump removal in order to help compensate for mild deviations of the nasal bone. Slightly more bone is removed from the side of the maximum deviation. Removal of the mobilised composite nasal hump is completed with heavy artery forceps. It is often sensible to advance the bony fragment further into the nose prior to its removal. With the hump removed, any uneven edges should be smoothed with a diamond rasp. This technique facilitates retention of the resected hump as a composite graft available for augmentation, if needed.

A component reduction differs in that the upper laterals are separated from the septum, the septum reduced as required with a scalpel, and the bone hump with a chisel. The upper laterals are reduced finally as required. This technique allows for asymmetry of the upper laterals and deviation of the septum to be managed individually rather than en bloc. This reduces the risk of over-reduction of the upper laterals causing an inverted ‘V’ deformity, which is seen after an overly aggressive composite reduction.

Care should be taken with large humps that removal is not associated with tearing of the dorsal nasal mucosa. In this situation, it is advisable to elevate the mucosa from the area at risk under the nasal bones prior to resection. Following resection of the hump, lateral osteotomies are performed to prevent an open roof deformity and excessive width of the dorsum. In both techniques, the area often found to be problematic is the dorsal edge of the septal cartilage at the rhinion. A defect with persisting prominence of the dorsal edge of the cartilaginous septum will require further reduction with a scalpel.

Osteotomies
Managing bony deformities with osteotomies requires careful planning at the preoperative stage, as the techniques necessary are fairly predictable.

Medial (Paramedian)
A 4–6 mm osteotome is used on either side of the nasal septum for the osteotomies either via the septoplasty or the dorsal wound after hump reduction. The aim is to separate the nasal bones in the midline. The osteotome is engaged at the root of the nasal bones flat onto the septum, and driven cephalad with a ‘tap-tap’ of the Cottle’s hammer by the assistant. Some surgeons ‘fade’ or angle outward from the septum at the superior end of the cut, in the belief that this improves the post-operative appearance of the root of the nose. The change in sound as the osteotome reaches the frontal bone defines the length of the osteotomy. This corresponds approximately to the level of the intercanthal line.
Lateral Osteotomies

The lateral osteotomy technique completes the bony incisions to allow the mobilisation and movement of the nasal bones. The path the bone cut is dictated by lie of the deformity, and the amount of movement of the lateral wall required. Additional intermediate osteotomies can be used to address complex fracture patterns and deformities. Although we define the osteotomies by their location, it is better to consider them by intended outcome when planning the procedure. In open rhinoplasty, the dorsum is well accessed, although inferior lateral aspects of the nasal bones are deliberately not exposed to reduce soft tissue trauma and maintain the periosteum. Either an internal or a percutaneous approach the lateral osteotomies is used. The percutaneous route and the technique is discussed in Exercise II facilitates execution of lateral, superior and intermediate osteotomies.

The path of the lateral osteotomies is normally ‘Low to high’ (Fig. 12) but can be ‘Low to low’ if needed. The more lateral the osteotomy, the greater the movement of the nasal bones and potential for step deformity. The low to high osteotomy, mobilises a relatively small area of the lateral wall, with greatest effect inferiorly. This osteotomy does not join the medial osteotomy until a greenstick fracture occurs at nasal bone manipulation. When more bone requires to be mobilised, a low to low osteotomy is used, and to reduce width, the osteotomies should be placed below the widest point of the bony base. To complete the mobilisation, a cephalic transverse or superior osteotomy is often necessary. Double level osteotomies employ an intermediate osteotomy before the transverse and lateral osteotomies are performed. Intermediate osteotomies are useful for decreasing the curvature of an excessively convex or concave nasal bone. The intermediate osteotomy allows the deformity to be reconfigured for correction of the severely deviated bony vault.

Manipulations of Nasal Bones

Manipulation of the nasal bones is necessary to close the open roof defect of the hump reduction and realign the dorsal super-structure. If the nasal bones have not been made fully mobile by the osteotomies, then the tip of the Cottles or Killians nasal speculum placed under the nasal bones can be used to provide outward pressure and fracture the nasal bones, otherwise the osteotomy line needs to be revised. The nasal bones are manipulated to the closed position and one should be careful not to ‘over correct’ the manipulation as this may result in an unsightly depression in the lateral contour.

Splintage

The aim of splint age is to maintain the desired reduction of the mobilised nasal bones, as well as minimise swelling and movement for patient comfort. It is accepted that the effectiveness of the splint decreases with time following the surgery. As the swelling reduces, the fit of the also reduces as it becomes proportionally too large for the nose.

There are a variety of different methods to splint the nose. All use a tape based under layer to adhere to the skin and control swelling. Traditionally plaster of paris has been used, though brittle and inflexible it is readily customised. Thermoform plastic gives a similar level of variation but with more flexibility. Malleable splints are not easy to customise but allow for adjustment as the swelling reduces. No matter what method is employed, the surgeon must be knowledgeable with the application technique.
Section 5 Tip Modification Techniques Without Grafting

Three terms commonly used in rhinoplasty need to be understood when discussing modification of the nasal tip.

**Tip projection** refers to the P-A distance, the nasal tip extends from the facial plane at the alar crease.

**Tip rotation** refers to the movement of the tip along an arc whose radius extends from the naso-labial angle to the tip defining point.

**Tip volume** refers to the width and size of the nasal tip. The alar cartilages provide structure and shape to the nasal tip and are the major contributors of tensile strength to the external nasal valve. Together they form a ‘floating tripod’ attached by fibrous ligaments to the underlying support structure of the nasal septum and upper lateral cartilages. Bulbosity of the nasal tip is usually the result of widening of the domes and/or the lateral crura of the lower lateral cartilages. This section aims to cover some specific suture and cartilage cutting techniques available to correct the various deformities of the nasal tip.

The **aims of nasal tip reconstruction** are to achieve:

- Good definition, symmetry and appropriate soft tissue Volume.
- Adequate projection.
- Adequate rotation of the tip in relation to the dorsum and upper lip.

The primary tip support mechanisms are; the intrinsic size, strength, and shape of the lower lateral cartilages, the inter-domal ligaments, the ligamentous attachment of the conjoined medial crura to the caudal septum, and the ligamentous attachment at the scroll region.

13 Bulbous ‘boxy tip’ caused by hypertrophy of the intermediate and lateral crura.
Surgical Principles

The nasal tip can be accessed by the open approach or closed approach techniques. We prefer the open approach as it allows good exposure and accurate direct assessment. The surgical steps of primary tip-plasty include:

- Maintenance of symmetry and definition of the lower lateral cartilages by cephalic trim of the lateral crus.
- Shaping and unification of the two medial crura, and creating symmetry in dome height and projection.
- Shaping of the domes and the two lateral crura.

The various techniques which help us to execute each of the above four steps with sutures and cartilage cutting manoeuvres are outlined:

**Step 1: Cephalic Rim Strip**

Excision of the cephalic border not only helps to reduce the width of the tip, but also corrects any asymmetry between the two sides (Fig. 14). In the healing phase, the scar contraction in the scroll area will also result in a degree of cephalic rotation and elevation of the alar rim. The cephalic strip excision is performed with preservation of the underlying vestibular skin. It is also essential to preserve an adequate width (6–8 mm) of the remaining caudal strip, this is important for integrity of the alar and avoidance of alar collapse.

**Step 2: Shaping and Unification of the Medial Crura**

This creates symmetry in domal height and projection and is achieved by the use of medial crural fixation sutures and if needed medial crural flare control suture.

**Medial Crural Fixation Suture (MCFS)**

This suture gives structural support to the medial crura and is often the first 'basement' suture performed in tip-plasty. It is indicated in most tip deformities where the two medial crura have moved away from each other (Fig. 51 in Exercise 5) or simply to reconstitute the interdomal ligament. After mobilizing the medial crura, the posterior superior free border of the

![Cephalic rime strip, excision of the cephalic border of the lateral crus.](image)

![Slight tip bulbosity (a) and appearance of the lateral crus at surgery (b).](image)
medial crura are sutured together with a 5-0 or 6-0 ethilon non-absorbable suture. This suture; prevents the two medial crura moving away from each other, addresses asymmetry of tip height and helps to prevent posterior migration of the columellar strut grafts.

**Medial Crural Flare Control Suture (MCFCs)**

This is a vertical mattress suture that is placed along the length of the medial crus to control the flare of the medial crus, thus narrowing the width of the columella. Care should be taken not to over-tighten these sutures close to the free border of the medial crus which results in complete loss of the flare and can give rise to a cosmetically unacceptable pencil thin columella. The aim of this suture is to narrow the width of the columella, change the direction of the medial crura as necessary (Fig. 16). This can be used to stabilise a damaged medial crural footplate, and can smooth out medial crural crinkles which have caused loss of projection (Fig. 17).

**Step 3: Shaping of the Domes and the Lateral Crura**

This can be achieved by a variety of measures including; interdomal sutures, trans-domal sutures, lateral crural steal and vertical dome division.

**Inter-Domal Suture (IDS)**

This is a dome suture joining suture indicated when there is domal divergence such as with a wide **bifid tip** (Fig. 13). It is a simple horizontal mattress suture passing through the medial aspect of each dome. Here, care must be taken not to introduce a ‘Unified Unicorn Nasal Tip’, which will give an unsightly pointed ‘single’ tip. This suture helps to narrow a bifid tip and to increase tip definition and projection.
Transdomal Suture (TDS)
This dome suture (Fig. 18) is indicated when there is a need to improve dome definition such as in a broad bulbous tip. It helps to narrow the tip, increasing the definition and projection. This is a unilateral horizontal mattress suture between each ipsilateral medial and lateral crus. It is usually applied as two separate sutures on either side although it can be executed as a single figure-of-eight suture but this is more complex and difficult to control. There is no need to dissect the vestibular skin on the undersurface of the dome but care should be taken not to pick it up with the suture. This suture helps to unify and bring together medial and lateral crura, which narrows the tip and increases the tip projection.

Lateral Crural Flare Control Suture (LCFCS)
This suture is a horizontal mattress suture between the two lateral crura to reduce lateral alar ballooning (Fig. 19). This suture helps in the medial and upward movement of the lateral crus, thus reducing the lateral alar ballooning. The suture is placed between the two lateral crura at the maximum point of lateral alar ballooning. Here care must be taken to prevent too much tightening, as this may cause alar pinching and unwanted under rotation of the tip with de-projection. This suture helps to narrow the lateral alar flare and ballooning and to restore the dorsal aesthetic line and achieve mild caudal rotation of the tip.
Lateral Crural Division Techniques

These techniques should be used with great care as they are not reversible and can cause significant alar weakening and collapse. Collectively, vertical dome division (VDD) refers to one of many methods of vertically dividing the alar cartilage at or near the dome to increase tip projection. The classic ‘Goldman tip’ is an incisional technique (not to be confused with any excisional techniques) that involved complete division of the lateral crus from the intermediate crus with the underlying mucosa and the intermediate crura being turned towards each other, to achieve tip projection. This was an ‘interrupted strip technique’ and fell into disrepute due to shape irregularities and lateral alar collapse. The principle of VDD has seen a resurgence, using an open technique with preservation of the underlying mucosa, but indications are rare and the technique should be used with caution.

Lateral Crural Overlap

This is an incisional technique performed to de-project the nose and rotate the tip in a cephalic direction. It is used for deformities such as a long overprojected ptotic tip. An incision is made across the mid portion of the lateral crus on each side, preserving the underlying mucosa. Between 2–4 mm of the medial segment of the lateral crus can be overlapped onto the lateral segment and approximated with a vertical mattress suture. The excess mucosal folds underneath will settle over time. This technique helps to de-project and increase rotation of the tip, when performed alone. When achieved in conjunction with bilateral medial crural overlap, global de-projection results without any element of rotation.

When the tip is severely deviated as a result of linear asymmetry of the lateral crura, then unilateral division and repair of the elongated lateral crus can be done to centralize the tip (Fig. 20).

![Figure 20](image-url) Tip straightening by shortening an elongated lateral crus.
Section 6  Septoplasty

Indications

- Nasal obstruction in which the fundamental cause is deviation of the nasal septum.
- As an adjunct to correction of external deviation.
- Harvesting of cartilage for grafting purposes.
- Septal perforation repair.
- As adjunct to aesthetic profile change in cosmetic rhinoplasty.

Aims of Septoplasty

- Straight, midline nasal septum.
- Maintain dorsal and tip support.

Structural Principle of Septoplasty

The septal cartilage together with the conjoined upper laterals forms the foundation tripod, which provides the primary structural support for the nasal lobule.

The integrity of this foundation tripod is dependent upon adequate tensile strength of these cartilages and rigid fixation at the ‘keystone’ area and the nasal spine. In septoplasty, it is necessary to preserve the dorsal and the caudal / inferior strips of the quadrangular cartilage so that the foundation tripod remains intact. Without this, nasal valve function and support to the tip and supra-tip areas will be compromised.

While it may be possible to refashion or disarticulate these structural elements, it is essential that in the end they are reconstituted or otherwise a poor result with nasal collapse will follow. So long as integrity of the anterior region of the quadrangular cartilage incorporating the struts is preserved, then the remaining posterior area of the quadrangular cartilage is available as a source of donor cartilage for grafting.

![Diagram](image)

21 The three limbs of the foundation tripod meet at their apex (red dot) – the anterior septal angle.
Approaches to the Nasal Septum

The two commonly used approaches to the nasal septum are the closed approach, through a hemitransfixion incision incising down onto the caudal end of the septal cartilage; and the open approach, achieved by gaining access between the separated the lower lateral cartilages (Fig. 23). If extended access is needed then the upper laterals can be separated from the dorsal septum. This will be necessary if spreader grafts are to be used, but should not be performed as a routine as it makes reconstruction of the foundation tripod necessary. Mucoperichondrial flaps are elevated either unilaterally or bilaterally depending on the surgical requirement. In all but the most minor of deformities, the next step is mobilisation of the cartilaginous septum from the vomer and the perpendicular plate of the ethmoid, while preserving the attachment at the keystone area. This separation is accompanied by a localised removal of bone from the perpendicular plate to ensure there are no deforming stresses transmitted to the cartilage. Once this is achieved, an assessment can then be made of the resting position of the cartilage, and a decision made about what further interventions may be required to further improve septal position.

22 The caudal and dorsal struts, essential elements for maintenance of septal support.

23 Display of the anterior septal angle.

24 Fracture of septal cartilage at the anterior septal angle.
Methods of Correcting Deformity

- **Removal of the deformed section.** This is useful for a localized spur or fracture line.
- **Correcting the curve** (see section on biomechanics).
- **Detachment and reattachment to nasal spine / vomer.** This can be useful if the septum is sitting to one side of the nasal spine or vomer. Mobilizing it to the opposite side and reattaching is known as the ‘doorstep technique’.
- **Removal and replacement of structurally sensitive area of cartilage.** This involves grafting of either the dorsal or caudal struts of the nasal septum (sometimes both). It is essential that these areas are reattached at completion (see above).
- **Septal extension graft.** Used if the existing septum is deficient caudally and/or anteriorly.
- **Extracorporeal septoplasty.**

Extracorporeal Septoplasty

This is a progression of the removal and replacement principle. In cases of severe quadrangular cartilage deformity, the anatomical correction may be too difficult to achieve in situ. Having identified this, the cartilaginous septum can be removed as a single block (Fig. 25). The decision to do this should be made early in the operation before any fragments of the cartilage have been resected. Once the cartilage is removed extra-corporeal ‘on the table’, evaluation of the cartilage is made and suitable elements can be selected to reconstruct the structural area. These are then secured to the nasal spine and keystone area. This technique is easier using an open approach. If a closed approach is used, preservation of a small dorsal strip of cartilage at the keystone area can facilitate reattachment. In these cases, a degree of overcorrection at the time of surgery is beneficial as the soft tissues also have ‘memory’ of the original deformity.
Biomechanics of Cartilage

Cartilage is a specialised connective tissue made up of a matrix of collagen and elastic fibres in a ground substance of proteoglycans. Variation in the respective proportion of these gives the different types of cartilage their elastic and structural properties. Since cartilage has no discrete blood supply, it can be readily transplanted from one area of the body to another without losing integrity. The nasal septum in common with costal cartilage, tracheal rings and articular surfaces is made up of hyaline cartilage. It is stronger and more rigid than elastic cartilage, and functions well both in tension and compression situations but is more prone to fracture than elastic cartilage.

The alar, auricular, auditory tubes and epiglottis are made of elastic cartilage. Whilst having less tensile strength than hyaline cartilage, elastic cartilage is more compliant. It functions well under tension and rather like the guy rope of a tent, less well under compressive forces.

Within cartilage matrix there are areas under tension and compression similar to that seen in a wood laminate such as plywood. All forms of cartilage retain a ‘memory’ of their original shape and although they can be “forced” into different shape, reversion to the original shape will occur unless steps are taken to prevent this. In open structure rhinoplasty, the surgeon can use a number of techniques to augment, strengthen and straighten deficient and/or deviated aspects of the nasal skeleton.

Structural Application of Cartilage Surgery

Cartilage and bone make up the fundamental framework of the nose. As such, cartilage can be used to replace damaged or absent structural components in the following ways:

- **Translocation.** For example, in septal surgery where severe deviations are replaced with an extra-corporeal graft of straight cartilage.
- **Reversal.** Reversal grafts are used to deal with inappropriate curvature such as the concave lateral crus which is treated by flipping so the concave area is reversed and becomes convex. This can also be useful in some areas of the nasal septum.
- **Structural Augmentation.** In this situation, cartilage can be used to strengthen the existing structure of the nose often using the inherent curved memory of the cartilage to good effect, e.g., butterfly grafting for valve collapse when the upper lateral cartilages are collapsing.

Cosmetic Application

Conchal and alar cartilage can be used as camouflage grafts, the soft elastic cartilage is ideal for augmenting the supra-tip and other superficial concave deformities about the nose. Septal cartilage can also be used in this situation, but as it is a little firmer in this area, it has more of a tendency to be palpable and show through the skin, especially in thin skinned northern Europeans. If septal cartilage is used for this purpose, many surgeons will ‘morselise’ it to reduce its structural integrity.
Methods of Aligning Cartilage

Cartilage Scoring
In a curved surface, as a result of either congenital growth or trauma, there is more tension on the concave surface than on the convex, and so releasing this tension can correct minor curves (Fig. 26).

In clinical use, however, this is of dubious long-term benefit without using an additional support.

Laminating
By laminating two oppositely curved structures together a straight structure can be obtained with the forces evened off (Fig. 27). This has the disadvantage of thickening the cartilage but this is rarely a problem in the nasal septum.

Suturing
Normally done in combination with a scoring technique sutures can be used to hold the shape of cartilage (e.g., in Mustardé-type pinnaplasty)

Splinting
Using a piece of cartilage across a divided fracture line to hold the cartilage straight (Fig. 28).
Section 7 Cartilage Harvesting

Given the risks of rejection associated with the use of synthetics and allografts in nasal reconstruction, our philosophy is that auto-graft material is by far the safest. Exogenous sources of cartilage are not favoured because of the potential risk of transmission of infective agents. Auto-graft cartilage may be harvested from various sites, and the decision on the donor site depends on availability and structural requirements. Other factors to consider are ease of access to the donor site, donor site morbidity, tissue volume requirement and any specific tissue requirements such as for a composite graft. Nasal septal cartilage is readily accessible, and if undamaged, offers suitable tensile strength for septal and columella strut grafts, but may not provide enough volume for adequate dorsal augmentation. It remains the largest single donor site in most rhinoplasty cases. Septal bone, if harvested in large fragments can be used successfully for dorsal augmentation. Auricular cartilage is readily accessible and can be accessed via an anterior (Fig. 29) or a posterior (Fig. 31) approach to the conchal cartilage. Much of this cartilage can be harvested without affecting pinna support. Costal cartilage is less accessible, and rib grafts have a reputation for twisting due to tension within the cartilage layers. However, this is a suitable tissue source when large volumes are needed or if auricular cartilage is unavailable. The underlying pleural cavity makes donor site morbidity greater. Small amounts of cartilage are available from the lower lateral cartilages, which along with the tragal cartilage make good filler grafts. For example the resected lateral crus from a cephalic rim strip may be used as a filler for small tip or supra-tip defects.

29 Incision line for the anterior approach in harvesting the conchal cartilage, perichondrium may also be harvested and can be useful as a soft tissue underlay.

30 Incision for composite grafts of skin and cartilage taken from the inferior crus of use in reconstruction of nasal alar defects and alar rim grafts.

31 Alternative post-auricular approach for harvesting conchal cartilage where the scar is less obvious.
Section 8 Spreader Grafts and Surgery for the Middle Third of the Nose

The middle third of the nose is an area sometimes underappreciated in rhinoplasty. Deformity here can have significant effects on both form and function, and is rarely corrected by septoplasty alone. The middle third is the meeting point of the solid (bony) and soft (cartilaginous) nasal structures and incorporates the structural tripod of the upper laterals, nasal septum and the union of these cartilages with the nasal bones, bony septum and frontal process of the maxilla. As discussed previously, this structurally vital union of bone and cartilage is known as the keystone area. Deformity of the cartilage occurs readily. Since it is fixed to bone at either end, the multi-directional tensions occurring as a result of growth and trauma can give rise to warping. Functionally, the middle third forms a major contribution to the internal valve, which has the narrowest cross-sectional area within the nasal cavity. As the valve walls are not rigid, the contribution of the upper laterals to the valve is affected by changes in airflow and lateral pressure. Surgery on the cartilage and bone of the middle third should aim not only for the ideal aesthetic structure but also the best nasal valve function.

Common Deformities of the Middle Third

- Those with nasal bone deviation.
- Those without nasal bone deviation:
  - Vertical tension leading to ‘C’ or ‘S’ profiles to the cartilage – upper laterals will need release and septum trimmed or replaced to fit to the bony aperture.
  - Total septal deviation – often has deviation of the keystone area internally.
- Lateral view deformities – these are dealt with in the dorsal grafting section.
- Narrow middle third or inverted ‘V’ deformity – a pinched appearance to the dorsum, reduces function. Spreader grafts required.
- Polly beak / tension nose from overly strong and long septum / upper lateral complex – leads to tall, thin internal valve. Septal and upper lateral reduction, possibly with spreader grafts, will be required.

Assessment and Management of Valve Collapse

Valve collapse on inspiration occurs when there is an increase air flow velocity through the internal or external valve. This causes a decrease in mural pressure, and subsequent lateral wall collapse by the mismatch with atmospheric pressure. In fluid dynamics, this is referred to as Bernoulli’s principle. Relevant deformities include global narrowing of the valve cross-sectional area, a narrow valve angle (less than 10°), the intrinsically weak lateral wall, and the unilateral wide valve when there is a reduction in the contralateral valve angle. Evaluation should include assessment of septal position, and evaluation of the integrity and position of the upper laterals.
Spreader Grafts

In the management of the narrow internal valve, middle third asymmetry and the narrow middle third, spreader grafts should be considered. The spreader graft is an internal spacer graft of cartilage up to 2 mm wide positioned between the dorsal septum and the upper lateral at its dorsal edge. Graft placement opens the internal valve angle and moves the lateral wall outward, increasing valve cross-sectional width. It will also widen the middle third of the nose cosmetically. If this is likely to give an unfavourable cosmetic result, then placement can be made at a slightly deeper level (Fig. 32).

Butterfly Grafts

These grafts sit over the upper laterals, but under the lower laterals, providing support by elevating the scroll area (Fig. 33). They are of benefit when the collapse is secondary to both upper and lower lateral deficiencies, when there is a narrow middle third, or an overly concave scroll area. The cartilage used needs to be flexible and not too thick so as not to fracture when under stresses. Conchal cartilage is ideal for this. Cosmetically, the graft leads to a widening at the middle third lower third junction and there is potential for over projection and pollybeak deformity. The dorsal septal projection may need to be adjusted to manage this and patients need to be counselled over this change.
Dealing with Deficiencies in the Dorsum – Dorsal Grafting

Management of these deformities can be complex and technically challenging, and one must appreciate that grafting the dorsum alone may not be adequate especially if septal support is weak. Dorsal grafts are potentially powerful grafts, which can dramatically change the aesthetics. Their role is therefore primarily cosmetic. When employed, a careful balance between best definition of the dorsal lines and avoidance of irregularities is necessary. Factors out with the control of the surgeon, such as thin skin, skin scars and vascularity need to be controlled for. Cartilage remains the graft material of choice, though bone can be used in some situations. Alloplastic material is frequently reported as a viable option, but the high complication rate in such a key area means that its use is best avoided.

Types of Deformity

Total Dorsal Under-projection (Fig. 34)
This nasal deformity represents a loss of height of both the nasal bones and cartilagenous lower two-thirds, as a result of congenital under-development, trauma, and over-resection at rhinoplasty. As the tip is unaffected, the deformity gives rise to a ‘peg nose’ appearance.

Upper Third Under-projection
When there has been poor development of the nasal bones, or more commonly over-resection of the bony hump with under-resection of the cartilagenous hump at primary rhinoplasty, this deformity is seen. When measured, the naso-facial angle will be near normal, however the patient may complain still of having of ‘too large a nose’.

Saddle Deformity (Fig. 35)
The description ‘saddle nose’ is a fairly imprecise term for depression of the supra-tip area. This easily recognisable deformity is usually associated with other abnormalities such as widening of the bony and cartilaginous dorsum, and widening of the alar base. This is most often due to septal cartilage loss giving rise to loss of support to the cartilaginous dorsum and nasal tip.
If the projection of the bony dorsum is preserved, invariably a pseudo hump will result. Practically, it can be difficult to decide whether apparent over-projection of the nasal bony dorsum is a true hump or pseudo hump (Fig. 37). Pseudo hump occurs when the naso-facial angle is less than 30° and the dorsum projects above this line between the nasion and the tip of the nose. Classically, in lateral view one sees decreased projection of the tip and supra-tip areas and there may be reduced projection of the bony dorsum as well. The columella is retracted and the naso-labial angle is acute (i.e., less than 90°). Significant changes are also seen in basal view of the saddle nose. As the cartilaginous dorsum saddles and the tip falls back, the angle of the lower lateral cartilages opens (see above), reducing tip projection and changing the shape of the nostrils from oval to near circular. The columella is shortened and the alar base widens. As the angle of the lower lateral cartilages opens and the tip drops back, a rounded bulbous appearance results. All of these abnormalities described very often result from destruction and displacement of the cartilaginous nasal septum alone. Reconstitution of the nose in such cases of deformity requires reconstruction of the caudal nasal septum (discussed elsewhere) as well as other interventions such as spreader grafts to improve the lateral projection of the upper laterals, and subsequent, internal nasal valve function.

Augmentation in the supra-tip area is usually undertaken using a partial dorsal cartilage graft. If the bony dorsum is adequately projected, only the upper lateral cartilages need to be grafted. The graft is bevelled and trimmed so the undersurface of the graft fits snugly on the outline of the cartilaginous dorsum. The cephalic edge of the graft should be thinned to avoid any visible or palpable ‘steps’. This graft can then be secured to the upper laterals, and under the lower laterals. If the nasal bones are more projected than the upper laterals, it can be possible to create a pocket for the cephalic end of the graft under the nasal bones lying on the bed of the upper lateral cartilages.

**Soft Tissue Grafting of the Dorsum**

This is mentioned because of the great value soft tissues can have in grafting the dorsum. They are rarely used in isolation, but come into their own when a patient has thin or scarred skin, or additional soft tissue is required such as to improve nasion or glabella projection. Perichondrium, harvested with conchal cartilage, or temporalis fascia are both low morbidity graft materials. They are also materials that will be familiar to surgeons undertaking rhinoplasty. They can be placed as a sheet, overlying cartilage grafts, as a wrap, encasing cartilage grafts, or as a roll or pad. When being used for bulk, there will be contracture and fibrosis of the material, so overcorrection is required in anticipation of this reduction in volume.
Section 9  Tip Grafts

In the primary rhinoplasty procedure, major and minor support mechanisms are often weakened by surgical manoeuvres. In this situation, the tip cartilage grafts can be used to provide additional support to the nasal tip. Various graft material, as discussed previously, are available for use in primary and revision rhinoplasty cases. Due to the dynamic nature of the nasal tip, it is preferable to use autogenous graft tissue. The various tip grafts employed for this purpose are the columellar strut, the shield graft, the batten graft, the alar rim graft, the lateral crural graft, plumping grafts and camouflage grafts.

Columellar Strut

The aim of the columellar strut is to provide structural support to the nasal tip and help to improve the projection. This is achieved by providing additional tensile strength to the medial crura. The ideal donor tissue is a straight fragment of posterior septal cartilage harvested as a narrow strip. If there is insufficient septal cartilage available, two strips of conchal cartilage sutured back to back to form a bilaminate graft can be used instead. The graft is placed between the medial crura and secured with horizontal mattress sutures. It can also be used for buckled medial or intermediate crura to increase the columellar show and reduce irregularity. Care must be taken to get the domes at the same height. It is important that the strut is not in contact with the nasal spine as it should float with the medial crura.

Shield Graft

Shield-shaped tip grafts are used to increase tip projection and nasal length and to reconfigure tip contour. The graft is positioned over the domes,
Cap or Buttr ess Graft

The cap or buttress graft is used along with the shield graft in thick skin and the under-projected tip. Typically, the shield graft should be projected 1–2 mm above the existing domes and the cap graft will support the shield graft to prevent its excessive cephalic rotation.

This graft is about 6 x 4 mm, with edges bevelled and placed transversely behind the shield graft. The graft is sutured to the tip graft and both domes with a fine monofilament suture.

Alar Batten Graft

Alar batten grafts are used to support the external nasal valve area. The external nasal valve is composed of cutaneous and skeletal components and provides support for the mobile nasal side wall. Alar batten grafts are placed in a pocket that extends from the piriform aperture to the midpoint of the lateral crus, although the exact position of the graft is determined by the site of the maximal collapse and marked out on the alar skin preoperatively. The graft is best harvested from conchal cartilage due to its curvature and it is sutured to the existing middle and lateral part of the alar cartilage with a fine monofilament suture in a convex out position.

Alar Rim Graft

Alar rim or alar contour grafts are used to prevent or correct the alar retraction and alar contour irregularities. These grafts can be used both endonasally and by external rhinoplasty approach.

The graft measures approximately 10–14 mm in length and 2–4 mm in width with the tapered end and placed through a stab incision, just 2–3 mm inside the alar cartilage running parallel to the alar rim. The graft is pushed into the pocket with a tapered end first and the incision is closed. When there is excessive alar edge elevation, a composite graft may be needed.

Plumping Graft

The plumping grafts are used to augment the columella base and help correct the retracted columella. The grafts consist of diced and morselised cartilage 1–2 mm in diameter, and is placed at the posterior aspect of the columella in the region between the nasal spine and medial crura. This provides a support to the base of the columella strut when the columella has been retracted.
Section 10 Pre and Post-Operative Care

Preoperative Care

The focus of this manual is the surgical techniques required for open rhinoplasty. These techniques are equally applicable to the post-trauma patient as they are to the patient seeking aesthetic rhinoplasty. The most valuable ‘skills’ to attain are those, which enable appropriate assessment and selection of those patients likely to benefit most from this operative intervention.

These skills include:

- Assessing the patient’s complaint.
- Understand the patient’s motivations, misconceptions and expectations.
- Exacting / detailed analysis and diagnosis of existing deformity.
- Conceptualise the ultimate intended outcome.
- Balancing the patient’s expectations against what is realistically achievable.
- Establishing a relationship where both the patient and surgeon are satisfied and informed with the decision.
- Recognising potential problem patients.
- Managing the dissatisfied patient.
- Not proceeding if uncertain or uncomfortable.

Assessment should include

- Detailed history and examination
- History not given by patient and information from other specialities
- Previous cosmetic interventions
- History of trauma and / or previous surgery

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Anaesthetic Considerations

Rhinoplasty around the world is practised under both general and local anaesthetic. The decision as to which method to employ is dictated by surgeon and patient preference, as well as facilities and expertise available. Pure local anaesthetic rhinoplasty is often unpleasant for the patient, and sedation is routinely given in most cases. This should only be done with adequate experience and training. In most UK centres, general anaesthesia is given. This allows for pharmacological control of the patients haemodynamic status and facilitates low normotensive state. Elevation of blood pressure and heart rate leads to increased bleeding in the operative field, complicating the procedure. A well-planned general anaesthetic enables day case surgery, which is popular with patients. This begins with premedication using analgesics such as paracetamol and ibuprofen (if tolerated), and is continued with short acting anaesthetic agents during the case. Morphine is best avoided if possible to reduce nausea and sedation, and alternatives, such as fentanyl, should be considered. Steroids are routinely given intraoperatively to reduce postoperative nausea, pain and swelling.

Postoperative Care

Postoperative care begins before the patient has left the operating theatre. Documentation of the findings and procedure undertaken, plus any difficulties or complications ensures adequate record in case of the need for revision surgery. Postoperative instructions should include a plan for follow-up care and management of:

- Suture removal
- Splint removal
- Ointments / creams
- Saline douching
- Antibiotics / Steroids
- Follow-up appointments

Beyond the surgery, the expectations and concerns of the patient are revisited. Hopefully, most patients will be happy with their results, however, inevitably some will not. Their concerns and worries should be addressed as soon as possible, and reassurance given when appropriate. If there is an unsatisfactory outcome, be honest with the patient, and discuss the options with them. Do not discharge the unsatisfied patient, if need be, get a second independent opinion from a colleague.

A lasting record of the outcome is important. Photography should be repeated at the stage when the majority of your patients are willing to attend. Visual analogue scales, satisfaction rates and quality-of-life scores, all give patient-reported outcome measures on the procedure, and with complication / revision rates, give a good basis for long-term personal audit of your results.
Exercise 1 Incisions and Skin Flap Elevation

N. Balaji

Educational Aims

- Achieve mid-columella inverted-V incision through the skin and subcutaneous tissue avoiding wound bevelling and trauma to the medial crura.
- Achieve extension of the above incision into marginal incisions at the correct level avoiding trauma to the alar rim and lower lateral cartilage.
- Achieve full skin flap elevation over the lower lateral cartilages without buttonholing or tearing the dorsal flap.

Transcolumellar Incision

Make the ‘W’ or inverted ‘V’ trans-columellar incision. Apply traction with a double hook at the infratip lobule as shown in (Fig. 38). With a finger apply counter traction at the alar base. Now, with the columella stretched, start making the incision with a No. 11 or No. 15 blade starting at the apex of the ‘W’ in the middle and extending it laterally on both sides, taking care not to go too deep and damage the medial crus.

Medial Marginal Columellar Incisions

This incision extends vertically from the edge of the trans-columellar incision inferiorly to the apex of the sub-domal recess superiorly hugging the caudal border of the medial crus and is cephalic to the soft triangle. The key to this incision is keeping it truly marginal.

After this STOP before you proceed to the third part of the incision. It is better not to make the lateral alar incision at this stage until the columellar flap is lifted till the tip as making all the incisions together can be messy due to bleeding.

Columella Flap Elevation

Now deepen the trans-columellar incision (Fig. 39) and start raising the columellar flap by applying superior traction with an alar double hook on the columellar skin. The trans-columellar vessels in the midline should be

38 Columellar incision marked.  39 Raising columellar skin flap.
coagulated and incised to release the tension in the flap. The rest of the
columellar flap is raised with fine scissors using the technique of small
snips and big spreads, staying just deep to the SMAS layer and superficial
to the perichondrium of the cartilage.

**Domal and Crural Incisions**

Once the flap is raised up to the alar margin, apply three-point traction to
facilitate access to the sub-domal skin (**Fig. 40**). Then make the third part of
the incision along the lateral alar margin to join the medial marginal incision
at the angle of the nostril using a double alar hook for traction. Care must
be taken to avoid damage to the soft triangle and the alar cartilages as this
may result in alar notching.

**Tip Skin Elevation**

Elevate the flap further to expose the cephalic border of the lower lateral
cartilage (**Fig. 41**), dissecting in an intraperichondrial plane over the lateral
crus. Finally, release the tension on the flap by releasing the soft tissues all
along the cephalic border of the lateral crus.

**Dorsal Skin Elevation**

Now, with an Aufricht's elevator under the flap, continue elevating the flap
deep to the SMAS plane. Then continue the dissection along the dorsum
of the nose till the nasion in an intra-perichondrial layer, converting to a
sub-periosteal over the nasal bones (**Fig. 42**). The extent of skin elevation in
the dorsum depends on the extent of surgery and re-draping needed.

If access to the septum is needed (**Fig. 43**), then dissect between the
two medial crura going through the inter-domal ligaments and identifying
the anterior septal angle. You can then dissect along the caudal border
of the septum going inferiorly towards the nasal spine area and created
muco-perichondrial tunnels on both sides.

At the end of the procedure, the trans-columellar incision is closed with two
5-0 or 6-0 monofilament sutures and marginal incisions closed with 5-0
Vicryl sutures. The final scar should be aesthetically pleasing.
Exercise 2 **Septoplasty – Stage 1 (Mobilisation)**

**O. Hilmi**

**Educational Aims**

- Elevation of bilateral mucoperichondrial flaps in correct plane.
- Perform inferior and posterior chondromoties.
- Harvest septal bone for grafting.
- Decide to separate the dorsal septum from the upper lateral cartilages.

Once the upper lateral cartilages are defined, using a blade, cut down directly onto the exposed dorsal and caudal edge of the septal cartilage to get into the subperichondrial plane. The subperichondrial plane is developed off each side using a Cottle elevator or sharp-tipped iris scissors to expose the septal cartilage. Elevation of the mucoperichondrium continues with the insertion of a Killian speculum and progressive elevation using a Freer or Cottle elevator. A posterior chondrotomy is performed by separating the quadrangular cartilage from its posterior attachment to the bony septum. Elevation of the muco-periosteum of the bony septum should be completed so that septal bone can be harvested as graft material. This can be done by making a bone cut with heavy scissors along the attachment of the bony septum to the nasal floor, then make a second bone cut through the perpendicular plate of the ethmoid well below the cribriform plate. The posterior septal bone can now be mobilised and removed as a single entity suitable for grafting. The mobilisation exercise is complete but we now have to make a decision as to whether the septum is to be detached from the upper laterals or not. This should not be performed routinely, but as we will be needing to insert spreader grafts, you should do this now as it will enable easy access for the medial osteotomies (next exercise). The attachment of the dorsal septum to the upper lateral cartilage should be divided as far as the caudal edge of the nasal bones. This can be achieved with scissors or a No. 15 blade. Depending on the surgical requirement, the cartilage can then be either completely mobilised and removed, or the non-structural segment can be harvested as “L-shaped” strut (Fig. 44). Leave the septal cartilage in-situ for the moment.

![Donor cartilage](image)

Donor cartilage

‘L-shaped’ strut

---

**Fig. 44** Preservation of the structural L-shaped strut.
Exercise 3  Osseo-cartilaginous Vault Surgery

P. D. Ross

Educational Aims

- Achieve osseo-cartilagenous hump reduction.
- Achieve lateral and medial osteotomies with closure of the open roof deformity.

Procedure

**Instruments:** blade No. 15, Parks nasal retractor, Aufricht retractor, curved sharp (10 cm) and Killner type dissection scissors, Addson-Brown tissue forceps, periosteal elevator, hump osteotome (10 mm), nasal rasp (tungsten carbide).

**Osteotomy Instruments:** Micro-osteotome (2 mm and 3 mm), Cottle hammer and No. 15 blade (for those surgeons wishing to carry out percutaneous osteotomies). Osteotomies are required to mobilise the bony pyramid for infracture, outfracture and re-alignment. Internal osteotomies performed using a narrow 3-mm osteotome create less surgical trauma and leave more periosteum intact. External percutaneous lateral osteotomies similarly are associated with minimum trauma to the periosteum, but very often will create short-term postoperative soft tissue swelling.

**Option 1: Composite Reduction (Fig. 45)**

Assuming the skin flap has been elevated adequately, it should be possible to see the whole dorsum from the anterior septal angle to the nasion. An Aufricht retractor assists with this. For the purposes of this simulation we will assume that the cadaver has a small osseo-cartilaginous hump which requires removal. Following this, medial and lateral osteotomies will be necessary to close the open roof defect. Reduction of the cartilaginous hump is performed with a scalpel under direct vision (Fig. 11).
Skin flap retraction at this point can be achieved either with a blunt nasal retractor or an Aufricht retractor in place. The cartilaginous vault should be incised by a through-and-through incision (No. 15 blade) along the planned resection line of the hump (composite reduction). Using this cartilage incision as a guideline, the osteotome is introduced into the opening created rather like a fish’s mouth, then mobilisation of the bony part of the hump is completed with an osteotome (Fig. 46).

Depending on the length of the hump, the upper laterals may have been separated from the septum by the composite hump reduction and should be reattached to the septum with a 6-0 prolene suture.

**Option 2: Component Reduction**

Alternatively, the cartilaginous hump can be removed as a component reduction. This is achieved by separating the upper laterals from the nasal septum, and reducing the septal dorsum with the scalpel blade or scissors. The bony hump can then be reduced with an osteotome. Finally, the upper laterals are trimmed with the scalpel to the desired height, or placed over the dorsal septum to prevent internal valve collapse. The septum generally needs to be lower if the upper laterals are going to be placed over the dorsum. 6-0 prolene is then used to secure the upper laterals to the septum. A (medium fine) tungsten carbine or diamond rasp is now used to smooth the bony surface and edges of the osteotomy if they are irregular. If necessary, some extra shaving of the cartilage with a scalpel is performed under direct vision to obtain the desired supra-tip height. In the case of the very small hump, it may be better to perform a series of cartilage shavings with a scalpel followed by rasping to avoid over reduction of the hump. On occasion, this may negate the need for osteotomies.
Internal Medial Osteotomy
The osteotome can be placed under direct vision taking care not to traumatise the skin flap as the osteotome is inserted. It is safer to use a large osteotome (8 mm) to reduce the risk of skull base penetration, should the osteotome slip posteriorly. It is accepted that with the larger osteotome, the internal mucosal trauma may be greater. Care must be taken not to penetrate the dorsal skin envelope. On nearing the nasofrontal suture, the osteotomy should be curved laterally (faded) taking care that the bone cut does not extend more cephalic than the inter-canthal line. In this way, the thick bone of the radix nasi is avoided. The use of a slightly curved osteotome will facilitate this lateral curvature.

Internal Lateral Osteotomy
A narrow 3- or 4-mm guarded curved osteotome is inserted through a mini-incision made in the soft tissue of the lateral wall of the pyriform aperture. A good landmark for the appropriate level is the superior margin of the inferior turbinate. A notch is created in the pyriform aperture at the ascending process of the maxilla. Position of the osteotomy will depend on the deformity, but in general terms it should start low, slowly bending from lateral to medial as far as the inter-canthal line where the medial osteotomy was carried out.

Percutaneous Lateral Osteotomy
This is performed using a narrow 2-mm osteotome introduced through two or three 2-mm skin incisions over the planned osteotomy line. Stab incision points for percutaneous lateral osteotomy are such that the superior incision is placed half way between the medial canthus and the dorsum, and the lateral incision is placed halfway between the medial canthus and the pyriform aperture at the junction of the face and the lateral edge of the lateral dorsal nasal aesthetic segment (Fig. 48).

A series of small ‘postage stamp’ osteotomies is made along the osteotomy line weakening the bone so that infracture can be performed. If an intermediate osteotomy is planned, the inferior incision can be placed 3 mm more dorsal to allow both the intermediate and lateral osteotomy to be performed through the same incision.

Fig. 47 Showing the lines of the internal and lateral osteotomy in red compared with the intermediate osteotomy in black.
Fig. 48 Stab incision points for percutaneous lateral osteotomy.
Exercise 4  **Septoplasty – Stage 2**  
(Extracorporeal Septoplasty)

O. Hilmi

**Educational Aims**

- Remove the mobilised quadrangular cartilage intact.
- Replace the modified septal cartilage as a septal strut graft.
- Anchor the graft with a nasal spine suture inferiorly.
- Anchor the graft dorsally by suture to the upper laterals.

The caudal septum between the nasal spine and the cartilaginous dorsum must be stable and straight to provide adequate support for the surrounding structures such as the columella, tip and cartilaginous dorsum. Ideally enough autogenous septal cartilage has been harvested for the fashioning of such a strut. If there is not sufficient septal cartilage then cartilage grafting, with either rib or laminated conchal cartilage is a good substitute.

To provide adequate support and adequate reconstruction of the foundation tripod, this graft must be fixed to bone at each end. The upper end can be secured with sutures through the graft and the lower part of the upper lateral cartilages and or periosteum of the nasal bones. At the nasal spine the caudal strut should be secured either to the soft tissues around the spine or, by drilling a hole through the spine, to the spine itself. You can achieve the drill hole by using a 21-gauge hypodermic needle as a hand drill. Once the hole is ready, a 4-0 prolene suture is passed through the hole and serves a rigid anchor point onto which the inferior edge of the septal strut can be sutured. This solid fixation to the keystone area and the nasal spine ensures a strong, stable structure on which the other nasal components can rest. Failure to achieve sufficient stability here will result in saddle deformity and nasal lobule collapse.

Septal cartilage is removed, flipped so the posterior margin becomes the anterior edge, trimmed, replaced and sutured to the nasal spine and the upper laterals.
Exercise 5 Tip Modification Techniques and Suturing

N. Balaji

Educational Aims

- Correct tip height asymmetry with medial crural fixation sutures.
- Narrow the tip and increase tip projection with domal and interdomal sutures.
- Reduce tip volume by cephalic trim of lateral crus of the alar cartilages.
- To decrease the projection increase cephalic rotation with lateral crural overlap.

Carry out the following suture techniques first, when completed undo the sutures and execute the cartilage cutting techniques.

Tip Suturing Techniques

Medial Crural Fixation Suture (MCFS)
Expose the lower lateral cartilages by dissecting in the SMAS and remove any overlying scar tissues. Any asymmetry in tip height is addressed with skin hooks and the position of the new tip secured with a small hypodermic needle. The posterior superior free border of both the medial crus is then sutured with a simple 5-0 ethilon suture. The suture goes ‘outside in’ starting at the posterior-superior margin of the medial crus starting from one side staying just below the intermediate segment and going through the other side from ‘inside out’ at the posterior-superior margin of the medial crus. A single knot is tied and is buried between the two crura (Fig. 50). The knot brings the two medial crura together and also establishes symmetrical tip height.

![Medial crural fixation suture.](image)
Medial Crural Flare Control Suture (MCFCS)

This is a vertical mattress suture that is placed along the length of the medial crus to control the flare of the medial crus, thus narrowing the width of the columella. This suture begins at the lower end of the medial crural footplate on the medial surface and comes out superiorly and goes similarly on the other side starting superiorly and coming out inferiorly and the knot buried in between (Fig. 51). The tightness and the location of the suture determines the width of the columella. Beware using the suture close to the free border of the medial crus which will give a cosmetically unacceptable pencil-thin columella.

Inter-Domal Suture (IDS)

Practise this bilateral dome suture with a 5-0 ethilon suture. This suture brings the two domes together, thus narrowing the width and controlling the bifidity of the tip. This can be either a simple suture (Fig. 52) or a horizontal mattress suture passing through both the domes around 2 mm above the caudal / medial border of the intermediate crura at the most divergent point, thus helping to approximate the domes. Take care to cut the knots very close and not to narrow the tip and give an unsightly ‘unicorn’ tip.

Trans-Domal Suture or Dome Spanning (TDS)

Expose the domes adequately, dissect all the scar tissue away, so that the bare cartilage is seen. Practise a unilateral trans-domal suture first. This is a unilateral horizontal mattress suture starting in the axial plane with a 5-0 ethilon suture entering the medial crus about 2 mm below the intermediate crus and coming out into the lateral crus at the desired point. Now, take the needle out and follow the path back from outside in and exiting the medial crus (Fig. 53) and secure the knot medial to the medial crus. Keep the entry point and exit points in the medial and lateral crus between 2–3 mm. This suture can also be done bilaterally with a figure-of-8 suture going through both domes and securing the knot between the domes. There is no need to dissect the underlying vestibular mucosa at the tip region.
Lateral Crural Flare Control Suture
Expose the alar cartilages, dissect the scar tissue away. Practice this horizontal mattress suture between the two lateral crura to reduce lateral alar ballooning. This suture helps in the medial and upward movement of the lateral crus, thus reducing the lateral alar ballooning. The suture should be placed in the lateral crus at the level of the alar ballooning as far laterally as possible, starting from ‘inside out/outside in on the right side’ and goes ‘inside out and outside in on the left side’. The knot is placed internally in the middle between the two domes (Fig. 54). Always replace the overlying skin flap and check for alar pinching and unwanted under-rotation of the tip before tightening the knot.

Cartilage Cutting Techniques
Cephalic Rim Excision of Lateral Crus
Adequately expose both lateral crus including the cephalic border through an open approach. Remove any overlying scar tissue. The amount of the lateral crus to remain (5–7 mm) is measured from the caudal edge of the cartilage. Then, with a No. 15 blade knife, the cartilage is incised taking care not to include underlying vestibular skin. Next, with a sharp curved scissors using a technique of ‘small snips and big spreads’, the cephalic portion of the cartilage is separated from the underlying mucosa and excised (Fig. 55).
The cephalic excision line should be parallel to the caudal border with a gentle convexity leading to the intermediate segment staying 2 mm lateral to the dome. When nearing the dome, it is advisable to gently curve the line of excision to prevent unwanted alteration in the tip dynamics. *Remember to leave a minimum of 5 mm in females and 7 mm in males of lateral crural cartilage to prevent external nasal valve collapse and alar pinching.* Sometimes, the cephalic border is readily definable due to rolling scrolling of the cephalic border. Care must be taken to excise this ‘rolled in’ cephalic border to achieve tip definition and symmetry.

**Lateral Crural Overlap**

After adequate exposure an incision is made across the mid portion of the lateral crus, after separating the vestibular mucosa (Fig. 56). Then, the medial segment is elevated and overlapped on the lateral segment with vertical mattress sutures up to a maximum of 4 mm. The excess vestibular skin underneath will settle over time. Where to incise and how much to overlap depends on individual patient need, but as a general rule of thumb, the maximum advancement should be no more than 4 mm to avoid distortion.
Exercise 6  
**Cartilage Harvesting**

*P. S. White*

**Educational Aims**

- Achieve harvesting of septal cartilage.
- Achieve harvesting of intact conchal cartilage for grafting.
- Option harvesting of costal cartilage.

**Procedure**

**Septal Cartilage**

This is achieved as in the extra-corporeal septoplasty exercise.

**Harvesting – Conchal Cartilage**

This may be harvested from one or both ears. One can use an anterior or post-auricular approach. Here, we describe an anterior approach. The flat areas of the cavum and cymba concha cartilage are excellent for cartilaginous dorsal grafting, columella struts, septal struts and shield grafts if insufficient septal cartilage is available. Begin by making a semi-circular incision through the skin and perichondrium, but not through the cartilage at the lateral edge of the conchal bowl. This incision should lie at the junction of the cavum concha and the antihelix. The antihelix eminence should hide any resultant scar. Elevate the skin/perichondrial flap anteriorly by blunt and sharp dissection in a subperichondrial plane. Take care not to incise the cartilage beneath. Elevate the flap forward as far as the external meatus, inferiorly and the fossa triangularis, superiorly. Now, carry the semi-circular incision down through the cartilage, and through this incision elevate the posterior skin off the posterior surface of the cavum concha. A large C-shaped block of cartilage attached anteriorly will result from this manoeuvre. Take care to preserve the crus helix so as to maintain pinna stability. Divide the anterior attachment using a No. 15 blade and with sharp scissors. Re-suture the skin flap in place using 6-0 nylon.

**Harvesting – Costal Cartilage**

Begin by counting down the ribs from the 1st rib in the mid-clavicular line, down to the 6th costal cartilage. Make a submammary (for female) or an anterior chest wall incision 2 cm in length over the body of the 6th costal cartilage. This incision is taken through the rectus muscle. The 6th rib is exposed and the costochondral junction is identified. The perichondrium is elevated. The dissection is continued medially and circumferentially using a periosteal elevator with a great deal of care to avoid an injury to the pleura. Bear in mind that the neurovascular bundle lying along the inferior edge of the rib must not be traumatised. Maintenance of dissection in a subperichondrial plane will facilitate this. Harvest a section of cartilage approximately 6 cm in length. In life, a Valsalva manoeuvre is conducted to assure the integrity of the pleura has been maintained. The wound is irrigated copiously. Meticulous repair is performed using a combination of 3-0 and 5-0 vicryl sutures.
Exercise 7  **Spreader and Butterfly Grafts**

*P. D. Ross*

**Educational Aims**

- Achieve placement of spreader grafts.
- Achieve placement of butterfly graft.

**Instruments:** No. 11 or No. 15 blade; dorsal retractor – KARL STORZ blade or other; Adson-Brown multi-toothed tissue forceps, atraumatic; needle holder; blue (23-gauge) hypodermic needles, 5-0 nylon suture.

**Spreader Grafts**

For this exercise, the assumption is the need for bilateral spreader grafts to correct a narrow middle third and bilateral internal valve collapse. Access is via the open approach, and if it is proving difficult, extending the incisions and dissection more laterally will allow for better access. Elevate the soft tissue from the upper laterals, identifying their attachment to the septum. Separate them from the septum, taking care not to open the mucosa into the nasal cavity. In most circumstances, the septal perichondrium has already been elevated, and the attachment to the septum can be incised using a blade or scissors cutting along the dorsal edge starting at the anterior septal angle. Now, assess the size of the spreader graft needed. The profile of the graft depends on the required level of lateralisation of the upper laterals. Ideally, harvest two identical lengths of septal cartilage, corresponding to the length of the upper laterals, and 2–3 mm in width. The width can be tapered superiorly, and the graft is usually at its widest inferiorly *(Fig. 57).*
Placing and securing the grafts can be tricky. Place a graft on one side first, and temporally secure it to the upper lateral and septum with two 23-gauge hypodermic needles. Do not go through to the other side yet. Now, place the other graft on the other side securing by further advancing the needles. If the position is satisfactory, the grafts should be secured to the septum and upper laterals, using horizontal mattress sutures which pass through all five layers of cartilage. Make sure the knot is hidden below the upper laterals so it is not palpable under the skin.

**Butterfly Grafts (Functional Onlay Graft of the Middle Third)**

(Fig. 33)

Fashion an oval or butterfly piece of cartilage to place under the lower laterals, sitting over the upper laterals. This is usually approximately 2 cm long, by 1 cm wide and is best fashioned from conchal cartilage. Carefully dissect the scroll area between the upper and lower laterals. This creates a pocket into which the graft can be placed. Use hypodermic needles to obtain temporary fixation. Once the position is satisfactory, the graft should be secured to the lower laterals with a 6-0 prolene suture. If a polly beak deformity is created, the septum can be trimmed under the graft so it sits less proud, and morcellised cartilage may need to be placed along the cephalic margin to soften the superior contour.

**Advanced / Optional Techniques**

- Spreader flaps – upper laterals used as own spreader graft.
- ‘Tuning fork’ technique – extracorporeal septal reconstruction with spreader grafts.
Exercise 8  **Supra-tip and Dorsal Grafting**

*P. D. Ross*

**Educational Aims**

- Fashion laminated dorsal graft.
- Place and stabilise dorsal graft.

**Instruments:** No. 11 or 15 blade; silastic block, dorsal retractor – KARL STORZ blade or other, Adson-Brown multi-toothed tissue forceps, atraumatic; needle holder; blue (23-gauge) hypodermic needles; 5-0 nylon suture, 4-0 undyed vicryl suture.

**Dorsal Grafting**

When in the situation where the projection of the entire middle and upper thirds of the dorsum is inadequate, grafting is required. This often needs to be more than a single layer of cartilage to give the required improvement. Using one of residual septal cartilage, costal cartilage, septal bone, fashion a laminate of grafts. It should be suitable to run the length of the dorsum from the nasium to the anterior septal angle and be as is appropriate to create dorsal aesthetic lines. The graft should be smooth, bevelled to reflect the dorsal profile, and have the suture knots buried (*Figs. 58, 59*).

The graft should then be placed in the dorsal pocket, and reduced as necessary if still too long. Refinements should be made and the profile checked by replacing the skin and applying some posterior traction on the dorsal skin. If extra soft tissue thickness is needed perichondrium or temporalis fascia can be placed as an overlay to prevent irregularities in the cartilage showing. Stabilisation of the grafts is often advisable, and is achieved either by suturing the graft to the septum and upper laterals, or by using a percutaneous vicryl suture.

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58 Dorsal grafting.

59 Dorsal graft fashioned from septal cartilage. Cuts are made at an angle ensuring a bevelled edge.
Exercise 9  Tip Grafts

S. Sheikh

Educational Aims
- Fashion a shield graft from septal cartilage and perform tip grafting.
- Construct and place a columella strut.

Procedure

Columellar Strut
The columellar strut is a rectangular graft that provides structural support to the nasal tip and improves nasal projection.

- Fashion a graft from a straight part of cartilaginous septum, 1 mm wide and 15 mm long.
- If there is insufficient septal cartilage available, then conchal cartilage can be used.
- The double-layered conchal cartilage sutured back to back will provide sufficient strength (Fig. 59).
- The graft should be about 10–15 mm in length and 3–4 mm in width.

Placement
- Dissect an area vertically between medial crura, following the path of medial crura to create a pocket towards the nasal spine.
- The strut should be placed 1–2 mm posterior to the domes of lower lateral cartilages to avoid excessive prominence and just 2 mm above the nasal spine to prevent clicking and displacement of graft with tip movement.
- The strut is secured with hypodermic needle and sutured with fine monofilament mattress suture including medial crura, strut and opposite medial crura (Fig. 60).
**Shield Graft**

A shield graft is a shield shape graft that is positioned over the medial and intermediate crura and can extend from medial crura footplate to the nasal tip.

**Placement**

- The shield graft is fashioned from cartilaginous septum or conchal cartilage and carved to the required size, usually about 8–15 mm in length and a width at the top of about 8–10 mm.
- Ensure that edges of graft are bevelled, so its contour merges with the surrounding nasal tip area.
- The inferior margin of the graft is trimmed down and bevelled up at the corners (Fig. 62).
- The graft is placed in a required position, usually in a slightly over-projected position, which can be trimmed if required (Fig. 63).
- The graft is stabilised with the hypodermic needle and suture with 5-0 or 6-0 PDS / Prolene to the underlying domes and medial crura. This would require about 4–6 sutures (Fig. 64).

**Overlay or Buttress Graft**

- This graft is used to camouflage over the domes at the nasal tip area.
- Softened auricular or cephalic trim graft is used.
- Use 6-0 PDS or Prolene suture and secure on caudal margin of domes.

**Batten Grafts**

- The alar batten grafts are curved septal or auricular cartilage grafts which are used for a thin alar side wall which collapses on breathing.
- Create a pocket caudal to the lateral crus towards the piriform aperture.
- Secure the graft with 5-0 PDS suture to the alar cartilage.
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Specifications:

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It is recommended to check the suitability of the product for the intended procedure prior to use.
Instruments for Rhinoplasty

403340 KILLIAN-STRUYCKEN Nasal Speculum, with set screw, blade length 40 mm, length 15 cm
403355 Same, blade length 55 mm
403375 Same, blade length 75 mm
496400 MASING Surgical Handle, length 14 cm, for Blades 208010 – 15, 208210 – 15
506400 AUFRICHT Nasal Retractor, width of retractor blade 8 mm, length of retractor blade 40 mm, length 16.5 cm
530910 Tissue Forceps, delicate, straight, 1x 2 teeth, length 10 cm
533012 ADSON Dressing Forceps, serrated, length 12 cm
533212 ADSON-BROWN Tissue Forceps, atraumatic, fine side grasping teeth, length 12 cm
Instruments for Rhinoplasty

479000  Masing Elevator, double-ended, graduated, sharp and blunt, length 22.5 cm
489031  Cottle Knife Guide and Retractor, one side with two-pronged retractor, 13 mm wide, other side with retractor with duct for guide of cut, length 20 cm
499101  Hook, one prong, sharp curve, length 16.5 cm
499202  Joseph Double Hook, sharp, width 2 mm, length 15 cm
505210  Kilner Ala Retractor, two prongs, sharp, width 10 mm, length 8.5 cm
523856  Nasal Rasp, tungsten carbide, double-ended, rasp blades Fig. 5 and 6, medium, length 20.5 cm
Instruments for Rhinoplasty

- **511210** Scissors, extra delicate, curved, length 10 cm
- **511514** METZENBAUM Scissors, curved, length 14 cm
- **513410 DS** COTTLE Scissors, curved, length 10.5 cm, color code: one gold-plated handle ring
- **513612** FOMON Lower Lateral Scissors, strongly curved, length 12 cm
- **516013** Needle Holder, tungsten carbide inserts, length 13 cm
- **535012** HALSTEAD "Mosquito" Artery Forceps, straight, length 12.5 cm
Instruments for Rhinoplasty

170602      TRAUTMANN Mastoid Chisel, width 2 mm, length 14 cm
484004      COTTLE Chisel, flat, graduated, straight, width 4 mm, length 18.5 cm
484007      Same, width 7 mm
484009      Same, width 9 mm
484600      MASING Chisel, slightly curved, with rounded guard right side, length 18 cm
484700      Same, on left
484800      Same, straight
Instruments for Rhinoplasty

BLAKESLEY Nasal Forceps, straight, size 2, working length 11 cm

ZÖLLNER Suction Tube, Luer-Lock, outer diameter 2.5 mm, length 15 cm

JOSEPH Elevator, slightly curved, length 17.5 cm

SENN Retractor, double-ended, blunt, length 15 cm

COTTLE Metal Mallet, length 18 cm
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System Overview

Exoscope

Camera System, Monitor and Illumination

Mechanical Holding System

Equipment Cart

Documentation System

VITOM® System Overview
VITOM®
System Components

Exoscope and Illumination – 2nd Generation VITOM® Telescopes
Length 11 cm

8100 AA

VITOM® Telescope 0° with Integrated Illuminator,
VITOM® HOPKINS® Straight Forward Telescope 0°,
working distance 25 – 75 cm, length 11 cm,
autoclavable, with fiber optic light transmission
incorporated and condensor lenses,
color code: green

Fiber Optic Light Cables 495 TIP or 495 NVC recommended

495 TIP
Fiber Optic Light Cable,
highly heat resistant,
diameter 4.8 mm, length 300 cm

495 NVC
Fiber Optic Light Cable,
with 90° deflection to the instrument,
very narrow radius of curvature,
diameter 4.8 mm, length 300 cm
VITOM®

System Components

Exoscope and Illumination – 2nd Generation VITOM® Telescopes

Length 11 cm

8100 DA

VITOM® Telescope 90° with Integrated Illuminator,
VITOM® HOPKINS® telescope 90°,
working distance 25 – 75 cm, length 11 cm,
autoclavable, with fiber optic light transmission
incorporated and condensor lenses,
color code: blue

Fiber Optic Light Cable 495 TIP recommended

495 TIP

Fiber Optic Light Cable,
highly heat resistant,
diameter 4.8 mm, length 300 cm
VITOM®
System Components

VITOM® 25 Distance Rod, length 25 cm

Wire Tray for Cleaning, Sterilization and Storage
of two rigid endoscopes and one light guide cable, including holder for light post adaptors, silicone telescope holders and lid, external dimensions (w x d x h): 352 x 125 x 54 mm, for rigid endoscopes up to diameter 10 mm and working length 20 cm
### VITOM® Specifications

<table>
<thead>
<tr>
<th>Working distance:</th>
<th>25 – 75 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of view at working distance of:</td>
<td>25 cm</td>
</tr>
<tr>
<td>Depth of view:</td>
<td>approx. 3.5 cm</td>
</tr>
<tr>
<td>Field of view at working distance of:</td>
<td>25 cm</td>
</tr>
<tr>
<td>H3-Z camera zoom 1x</td>
<td>5 cm</td>
</tr>
<tr>
<td>H3-Z camera zoom 2x</td>
<td>3.5 cm</td>
</tr>
<tr>
<td>Reproduction scale at working distance of:</td>
<td>25 cm</td>
</tr>
<tr>
<td>26&quot; Monitor:</td>
<td></td>
</tr>
<tr>
<td>H3-Z camera zoom 1x</td>
<td>approx. 8x</td>
</tr>
<tr>
<td>H3-Z camera zoom 2x</td>
<td>approx. 16x</td>
</tr>
<tr>
<td>42&quot; Monitor:</td>
<td></td>
</tr>
<tr>
<td>H3-Z camera zoom 1x</td>
<td>approx. 14x</td>
</tr>
<tr>
<td>H3-Z camera zoom 2x</td>
<td>approx. 28x</td>
</tr>
<tr>
<td>52&quot; Monitor:</td>
<td></td>
</tr>
<tr>
<td>H3-Z camera zoom 1x</td>
<td>approx. 17x</td>
</tr>
<tr>
<td>H3-Z camera zoom 2x</td>
<td>approx. 34x</td>
</tr>
</tbody>
</table>

Technical specifications are subject to change.
VITOM®

System Components

Cold Light Fountain XENON 300 SCB

Special Features:
- Extremely high light intensity due to 300 Watt Xenon lamp
- Built-in antifog pump
- With integrated KARL STORZ Communication Bus (KARL STORZ-SCB)

![VITOM® System Components](image)

20 1331 01-1  
Cold Light Fountain XENON 300 SCB

power supply 100 – 125/220 – 240 VAC, 50/60 Hz
including:
Mains Cord
Silicone Tubing Set, length 250 cm
SCB Connecting Cable, length 100 cm

Specifications:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamp type</td>
<td>XENON 15 V, 300 Watt</td>
</tr>
<tr>
<td>Color temperature</td>
<td>6000 K</td>
</tr>
<tr>
<td>Light outlets</td>
<td>1</td>
</tr>
<tr>
<td>Light intensity adjustment</td>
<td>continuously adjustable via a membrane keyboard or KARL STORZ Communication Bus Signal</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 165 x 335 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>7.96 kg</td>
</tr>
<tr>
<td>Certified to:</td>
<td>IEC 601-1 and UL 544, protection class 1/CF</td>
</tr>
</tbody>
</table>
**IMAGE1 S Camera System**

**Economical and future-proof**
- Modular concept for flexible, rigid and 3D endoscopy as well as new technologies
- Forward and backward compatibility with video endoscopes and FULL HD camera heads

**Sustainable investment**
- Compatible with all light sources

**Innovative Design**
- Dashboard: Complete overview with intuitive menu guidance
- Live menu: User-friendly and customizable
- Intelligent icons: Graphic representation changes when settings of connected devices or the entire system are adjusted

- Automatic light source control
- Side-by-side view: Parallel display of standard image and the Visualization mode
- Multiple source control: IMAGE1 S allows the simultaneous display, processing and documentation of image information from two connected image sources, e.g., for hybrid operations

**Dashboard**

**Live menu**

**Intelligent icons**

**Side-by-side view: Parallel display of standard image and Visualization mode**
IMAGE1 S Camera System

Brilliant Imaging
- Clear and razor-sharp endoscopic images in FULL HD
- Natural color rendition

- Reflection is minimized
- Multiple IMAGE1 S technologies for homogeneous illumination, contrast enhancement and color shifting

FULL HD image

CLARA

FULL HD image

CHROMA

FULL HD image

SPECTRA A*

FULL HD image

SPECTRA B**

* SPECTRA A: Not for sale in the U.S.
** SPECTRA B: Not for sale in the U.S.
**IMAGE1 S Camera System**

**TC 200EN**

**TC 200EN**

**IMAGE1 S CONNECT**, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:

- **Mains Cord**, length 300 cm
- **DVI-D Connecting Cable**, length 300 cm
- **SCB Connecting Cable**, length 100 cm
- **USB Flash Drive**, 32 GB, USB silicone keyboard, with touchpad, US

*Available in the following languages: DE, ES, FR, IT, PT, RU

**Specifications:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>TC 200EN (H3-Link)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD video outputs</td>
<td></td>
</tr>
<tr>
<td>Format signal outputs</td>
<td>1920 x 1080p, 50/60 Hz</td>
</tr>
<tr>
<td>LINK video inputs</td>
<td>3x</td>
</tr>
<tr>
<td>USB interface</td>
<td>4x USB, (2x front, 2x rear)</td>
</tr>
<tr>
<td>SCB interface</td>
<td>2x 6-pin mini-DIN</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>2.1 kg</td>
</tr>
</tbody>
</table>

**For use with IMAGE1 S**

**IMAGE1 S CONNECT Module TC 200EN**

**TC 300**

**TC 300**

**IMAGE1 S H3-LINK**, link module, for use with IMAGE1 FULL HD three-chip camera heads, power supply 100–120 VAC/200–240 VAC, 50/60 Hz,

*for use with IMAGE1 S CONNECT TC 200EN* including:

- **Mains Cord**, length 300 cm
- **Link Cable**, length 20 cm

**Specifications:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>TC 300 (H3-Link)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported camera heads/video endoscopes</td>
<td>TH 100, TH 101, TH 102, TH 103, TH 104, TH 106 (fully compatible with IMAGE1 S)</td>
</tr>
<tr>
<td>LINK video outputs</td>
<td>1x</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1.86 kg</td>
</tr>
</tbody>
</table>

* **SPECTRA A**: Not for sale in the U.S.

**SPECTRA B**: Not for sale in the U.S.
## IMAGE1 S Camera Heads

For use with IMAGE1 S Camera System
IMAGE1 S CONNECT Module TC 200EN, IMAGE1 S H3-LINK Module TC 300
and with all IMAGE1 HUB™ HD Camera Control Units

### Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH 100</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 114 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>270 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>

### Specifications:

<table>
<thead>
<tr>
<th>IMAGE1 FULL HD Camera Heads</th>
<th>IMAGE1 S H3-ZA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>TH 104</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x 1/3&quot; CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 100 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>299 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, f = 15–31 mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>
Monitors

9619 NB

19" HD Monitor, color systems PAL/NTSC, max. screen resolution 1280 x 1024, image format 4:3, power supply 100–240 VAC, 50/60 Hz, wall-mounted with VESA 100 adaption, including:

External 24 VDC Power Supply
Mains Cord

9826 NB

26" FULL HD Monitor, wall-mounted with VESA 100 adaption, color systems PAL/NTSC, max. screen resolution 1920 x 1080, image format 16:9, power supply 100–240 VAC, 50/60 Hz including:

External 24 VDC Power Supply
Mains Cord
## Monitors

### KARL STORZ HD and FULL HD Monitors

<table>
<thead>
<tr>
<th></th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall-mounted with VESA 100 adaption</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
</tbody>
</table>

**Inputs:**
- DVI-D
- Fibre Optic
- 3G-SDI
- RGBS (VGA)
- S-Video
- Composite/FBAS

**Outputs:**
- DVI-D
- S-Video
- Composite/FBAS
- RGBS (VGA)
- 3G-SDI

**Signal Format Display:**
- 4:3
- 5:4
- 16:9
- Picture-in-Picture
- PAL/NTSC compatible

**Optional accessories:**
- 9826 SF Pedestal, for monitor 9826 NB
- 9626 SF Pedestal, for monitor 9619 NB

### Specifications:

<table>
<thead>
<tr>
<th></th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
<tr>
<td>Brightness</td>
<td>200 cd/m² (typ)</td>
<td>500 cd/m² (typ)</td>
</tr>
<tr>
<td>Max. viewing angle</td>
<td>178° vertical</td>
<td>178° vertical</td>
</tr>
<tr>
<td>Pixel distance</td>
<td>0.29 mm</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Reaction time</td>
<td>5 ms</td>
<td>8 ms</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>700:1</td>
<td>1400:1</td>
</tr>
<tr>
<td>Mount</td>
<td>100 mm VESA</td>
<td>100 mm VESA</td>
</tr>
<tr>
<td>Weight</td>
<td>7.6 kg</td>
<td>7.7 kg</td>
</tr>
<tr>
<td>Rated power</td>
<td>28 W</td>
<td>72 W</td>
</tr>
<tr>
<td>Operating conditions</td>
<td>0–40°C</td>
<td>5–35°C</td>
</tr>
<tr>
<td>Storage</td>
<td>-20–60°C</td>
<td>-20–60°C</td>
</tr>
<tr>
<td>Rel. humidity</td>
<td>max. 85%</td>
<td>max. 85%</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>469.5 x 416 x 75.5 mm</td>
<td>643 x 396 x 87 mm</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC</td>
<td>100–240 VAC</td>
</tr>
<tr>
<td>Certified to</td>
<td>EN 60601-1, protection class IPX0</td>
<td>EN 60601-1, UL 60601-1, MDD93/42/EEC, protection class IPX2</td>
</tr>
</tbody>
</table>
VITOM®
System Components

Mechanical Holding System

28272 HC  **Articulated Stand**, L-shaped, long, reinforced version, only, especially large swivel range, with one mechanical central clamp for all five joint functions, height 48 cm, swivel range 66 cm, with quick release coupling KSLOCK (female)

28172 HR  **Rotation Socket**, to clamp to the operating table, with one mounted Butterfly Nut 28172 HRS, for European and US standard rails, with lateral clamp for height and angle adjustment of the articulated stand

28172 HM  **Extension Rod**, 50 cm, with lateral clamp for height adjustment of the articulated stand, for use with articulated stands 28272 HA, 28272 HB or 28272 HC and socket 28172 HK or 28172 HR

28272 UGN  **Clamping Jaw**, metal, clamping range 16.5 up to 23 mm, with quick release coupling KSLOCK (male), for use with all square-headed KARL STORZ HOPKINS® telescopes

28272 UGK  **Clamping Jaw**, with ball joint, large, clamping range 16.5 to 23 mm, with quick release coupling KSLOCK (male), for use with all square-headed KARL STORZ HOPKINS® telescopes

28272 CN  **Clamping Cylinder**, folding, for flexible mounting of 10 mm telescopes on the telescope sheath, **autoclavable**. The clamping cylinder allows vertical movement and rotation of the telescope.
Data Management and Documentation

KARL STORZ AIDA® – Exceptional documentation

The name AIDA stands for the comprehensive implementation of all documentation requirements arising in surgical procedures: A tailored solution that flexibly adapts to the needs of every specialty and thereby allows for the greatest degree of customization.

This customization is achieved in accordance with existing clinical standards to guarantee a reliable and safe solution. Proven functionalities merge with the latest trends and developments in medicine to create a fully new documentation experience – AIDA.

AIDA seamlessly integrates into existing infrastructures and exchanges data with other systems using common standard interfaces.

WD 200-XX*  **AIDA Documentation System**, for recording still images and videos, dual channel up to FULL HD, 2D/3D, power supply 100-240 VAC, 50/60 Hz

including:
- **USB Silicone Keyboard**, with touchpad
- **ACC Connecting Cable**
- **DVI Connecting Cable**, length 200 cm
- **HDMI-DVI Cable**, length 200 cm
- **Mains Cord**, length 300 cm

WD 250-XX*  **AIDA Documentation System**, for recording still images and videos, dual channel up to FULL HD, 2D/3D, including **SMARTSCREEN® (touch screen)**, power supply 100-240 VAC, 50/60 Hz

including:
- **USB Silicone Keyboard**, with touchpad
- **ACC Connecting Cable**
- **DVI Connecting Cable**, length 200 cm
- **HDMI-DVI Cable**, length 200 cm
- **Mains Cord**, length 300 cm

*XX Please indicate the relevant country code (DE, EN, ES, FR, IT, PT, RU) when placing your order.
Workflow-oriented use

**Patient**
Entering patient data has never been this easy. AIDA seamlessly integrates into the existing infrastructure such as HIS and PACS. Data can be entered manually or via a DICOM worklist. All important patient information is just a click away.

**Checklist**
Central administration and documentation of time-out. The checklist simplifies the documentation of all critical steps in accordance with clinical standards. All checklists can be adapted to individual needs for sustainably increasing patient safety.

**Record**
High-quality documentation, with still images and videos being recorded in FULL HD and 3D. The Dual Capture function allows for the parallel (synchronous or independent) recording of two sources. All recorded media can be marked for further processing with just one click.

**Edit**
With the Edit module, simple adjustments to recorded still images and videos can be very rapidly completed. Recordings can be quickly optimized and then directly placed in the report. In addition, freeze frames can be cut out of videos and edited and saved. Existing markings from the Record module can be used for quick selection.

**Complete**
Completing a procedure has never been easier. AIDA offers a large selection of storage locations. The data exported to each storage location can be defined. The Intelligent Export Manager (IEM) then carries out the export in the background. To prevent data loss, the system keeps the data until they have been successfully exported.

**Reference**
All important patient information is always available and easy to access. Completed procedures including all information, still images, videos, and the checklist report can be easily retrieved from the Reference module.
VITOM®
System Components

Documentation System

**19” KARL STORZ Touch Screen**, 24V, wall mounting, RS 232, VGA, resolution max. 1280 x 1024 (SXGA mode), including RS 232 cable, SVGA cable, mains cord and external power supply 24 VDC, power supply 100 – 240 VAC, 50/60 Hz

**041265-20** *Sterile Cover*, for 19” KARL STORZ touch screen

* mtp medical technical promotion gmbh,
  Take-Off GewerbePark 46, D-78579 Neuhausen ob Eck, Germany

Equipment Cart

**Equipment Cart**
wide, high, rides on 4 antistatic dual wheels equipped with locking brakes 3 shelves, mains switch on top cover, central beam with integrated electrical subdistributors with 12 sockets, holder for power supplies, potential earth connectors and cable winding on the outside,

Dimensions:
Equipment cart: 830 x 1474 x 730 mm (w x h x d), shelf: 630 x 510 mm (w x d), caster diameter: 150 mm

including:
Base module equipment cart, wide
Cover equipment, equipment cart wide
Beam package equipment, equipment cart high
3x Shelf, wide
Drawer unit with lock, wide
2x Equipment rail, long
Camera holder
Recommended Accessories for Equipment Cart

**Monitor Swivel Arm,**
- height and side adjustable,
- can be turned to the left or the right side,
- swivel range 180°, overhang 780 mm,
- overhang from centre 1170 mm,
- load capacity max. 15 kg,
- with monitor fixation VESA 5/100,
- for usage with equipment carts UG xxx

**Isolation Transformer,**
- 200 V–240 V; 2000 VA with 3 special mains socket,
- expulsion fuses, 3 grounding plugs,
- dimensions: 330 x 90 x 495 mm (w x h x d),
- for usage with equipment carts UG xxx

**Earth Leakage Monitor,**
- 200 V–240 V, for mounting at equipment cart,
- control panel dimensions: 44 x 80 x 29 mm (w x h x d),
- for usage with isolation transformer UG 310

**Monitor Holding Arm,**
- height adjustable, inclinable,
- mountable on left or right,
- turning radius approx. 320°, overhang 530 mm,
- load capacity max. 15 kg,
- monitor fixation VESA 75/100,
- for usage with equipment carts UG xxx