Tip Rhinoplasty in cleft Lip Nasal Deformity

Thesis submitted in fulfillment of the M.D. Degree in general surgery

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قالوا: سبكونك لإعلان لنا إلا ما علمتنا إنك أنت العلي العليم الحكيم

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Introduction

Rhinoplasty occupies a unique position in facial plastic surgery due to the central position of the nose in the face and the vital function of the nose (Helling et al., 2010).

Cleft lip nasal deformities are challenging problems in all aspects. The continued growth of the nasal septum on one hand and the arrested clef-side maxilla on the other, subjects the nasal cartilage to undue forces, splaying it apart. The resultant deformity possesses considerable psychological burden on children born with unilateral cleft lip (Millard., 1990).

The cleft lip nasal deformities include a group of facial defaults that may include depressed ala of the nose and the lower lateral cartilage on the cleft side. The nasal tip is deviated to the non-cleft side. The columella is shortened on the cleft side and becomes obliquely oriented (Lo, 2006).

It is important to identify the aim of the rhinoplasty in cleft lip nasal deformities as to restore the nasal symmetry, improvement of the naso-labial and naso-facial relationship with minimal evidence of surgical intervention as well as the functional objectives as patent air way, proper position of the maxilla and achievement of normal speech (Jackson, 2009).

Rhinoplasty in cleft lip nasal deformities could be performed either primary or secondary after repair of the cleft lip. Primary correction has been reappraised in the last two decades having particular advantages as more symmetrical nose and better appearance in the early life. Even when rhinoplasty is re-required after nasal growth is complete, the deformity is
less severe and more amenable final results (El-Bestar and Mansour, 2006).

The secondary surgery to further modify the nasal shape is often necessary in the teen years. The secondary deformities include depressed nasal tip with diastatic lower lateral cartilage, wide alae, large nostrils short columella, wide probantium with lack of philtral and Cupid's bow definition, shallow buccal sulcus, tight upper lip, irregular scars and central vermilion insufficiency (Lo and Chen, 2002).

If the nasal deformity is minimal, usually lobule rhinoplasty modified John potter rhinoplasty (closed approach), is enough. However, if the deformity is so significant with maxillary skeletal deficiency, alar base should be augmented first, usually with alveolar bone graft, then definitive septrhinoplasty is performed (Bentz et al., 2008).
Aim Of The Work

The aim of this study is to study the different surgical options for reconstruction of the nasal tip in cases of secondary cleft lip nasal deformity, evaluate of their esthetic and functional results and demonstrate the subjective satisfaction for each case.
EMBRYOLOGY

Morphogenesis of facial skeleton:

The fourth to eight weeks are a significant period during development. During this time rapid growth the brain expand significantly resulting in a prominent folding of the head and the cervical flexure become obvious and give the embryo its characteristic C appearance (Stephen and Vincent, 2006).

Development of craniofacial structures is the formation of five branchial arches. The arches are paired bulges on either side of the neck region that enlarge as neural crest cells migrate into the primordia and proliferate. Between each arch is a groove or cleft on the external surface of the embryo this clefts form a pouch of sorts that is lined by endoderm of the primitive pharynx (thus the ectoderm and endoderm are juxtaposed to one another at the opening of these pouches. The grooves disappear by week 7, giving the neck a smooth contour. Stated another way, the contents of each branchial arch—a cartilaginous core and muscular portion, and an artery destined to supply the resulting tissues—contribute to derivative structures of the arch (the first two branchial arches are most closely associated with development of the face and cranium) The first arch develops into the maxilla and mandible. The muscle of facial expression and mastication and other striated muscles in the head and neck are also derived from mesoderm in the first and second arches. The trigeminal and facial nerves originate from and supply structures derived from neural crest cells in the first and second arches (Fig. 1) (Moore and Persaud, 2001).
Organization of the facial primordial:

The three primary germ layers – *ectoderm*, mesoderm and endoderm – are the basis for tissue and organ formation. The ectoderm forms a neural plate with bilateral folds that conjoin into a neural tube. During closure of the neural tube, neural crest cells (mesenchyme) migrate into underlying tissue, forming pluripotential stem cells. The embryonic prominences of the face are formed by the migration of these neural crest cells. Segmental patterns of ventral migration of neural crest, termed rhombomeres, provide the precursors of cartilage, bone muscle, and connective tissue of the face and head (*Perris and Perissinotto, 2003*).

The face proper is composed of four primordia (*Fig. 2*): The midline frontonasal (median) process; which gives rise to the forehead, midline of the nose, philtrum, and primary palate, the maxillary process; which contribute to the sides of the face, the upper lip, and the secondary palates, the maxillary processes are paired mesodermal masses that lie cephalic to the mandibular arch and ventral to the optic neuroectoderm. These triangular masses enlarge, separate from the mandibular arch, and then migrate ventrally. The maxillary process ultimately coalesces with
the mesoderm of the globular processes (premaxillary prominence) to form the upper lip. Lateral nasal process; which gives rise to the nares, the mandibular process; which forms the lower jaw and lip. The paired median nasal processes coalesce during the sixth week and eventually form the premaxilla, philtrum of the upper lip, columella, and nasal tip. The lateral elements of the upper lip (from the philtral column laterally) are derived from the paired maxillary processes. The upper lip is therefore formed from both the median nasal and maxillary processes (Fig.1) (Sperber, 2004).

The upper lip is formed 1 week earlier than the palate (Alphonse, 2006).

Fig. (2): Face of a human embryo in a late somite period (30-32 days). The frontonasal prominence (FNP) projects the medial nasal (MNP) and lateral nasal (LNP) prominences on each side, surrounding the nasal placode. The eye (E) is seen in its lateral position. The maxillary prominence (Max) forms the superolateral boundary of the stomodeum (St), and the mandibular prominence (Man) forms the lower boundary (Sperber, 2004).
ANATOMY OF THE NOSE

The nose skeleton, projecting from the face, is largely cartilaginous. The nasal orifice is bounded above by the nasal bones and elsewhere by the two maxillae. The external nose consists of nasal bones and the upper and lower nasal cartilages, supported in the midline by the cartilaginous part of the nasal septum (Fig. 3). A smaller alar cartilage forms the lateral boundary of the nostril itself, this is made of elastic cartilage, and is moved by the compressor and dilator naris muscles. The other cartilages are of hyaline variety. The whole nose is covered by adherent skin that contains sebaceous glands; its inner is lined with respiratory mucous membrane. The skin extends into the vestibule within the nostrils and here it has a variable crop of stiff hairs. The muco-cutaneous junction lies beyond the hair bearing area (McMinn, 1995).

Fig. (3): Frontal view of the nose (O'Neal et al., 2000).
The nasal cavity is subdivided into the right and left halves by a septum which is approximately median in position. The septum reaches the posterior limit of the cavity, which communicates with the nasal part of the pharynx through a pair of posterior nasal apertures, placed immediately above the posterior border of the bony palate. The cavity communicates with the frontal, ethmoidal, maxillary and sphenoidal sinuses. Each half has a roof, floor, lateral and medial wall. The medial wall is formed by the corresponding side of the nasal septum (Davies and Coupland, 1976).

There are 3 nasal conchae (turbinate bones) each forming passages (or meatus) between the lateral nasal wall and the conchae. The space between the inferior turbinate and the floor of the nose is called the inferior meatus. The space between middle and inferior turbinate is the middle meatus and the space between middle and superior turbinate is the superior meatus (William and Dale, 1998).

The various paranasal sinuses open into the related meatus. The inferior concha is the longest and broadest of the three conchae. It is covered with mucous membranes. It can swell and block the nose. It overhangs the inferior meatus, which receives the nasolacrimal duct, draining excess tears from the eye (McMinn, 1995).

The superior concha is small extending posteriorly from its junction with the middle concha. Its lower edge is free and overlies the superior meatus into which drain the posterior ethmoidal air cells. The middle concha is midway in size and position between superior and inferior conchae. It extends horizontally backwards from its junction with the superior concha. Immediately behind the posterior end of the middle concha beneath the mucous membrane is the sphenopalatine foramen (Fig. 4) (McMinn, 1995).
Muscles of the Nose: (Guyuron, 2006)

The nose has a number of muscles which in man assumed an almost vestigial importance. All muscles of facial expression are supplied by branches of the facial nerve (Fig. 5&6).

- **Procerus**
  - It is the most cephalic muscle of the nose which arises from the glabellar area, extends caudally in a vertical fashion, and joins with the wing shaped nasalis transverse muscle covering the caudal portion of the nasal bones. The main function of the procerus is to move the eyebrows caudally. Removal of this muscle may elongate the.

- **Nasalis**
  - The nasalis muscle has 2 components: the *transverse nasalis muscle* and the *pars alaris* (alar nasalis). The transverse part of the muscle spans the dorsum of the nose, covering the upper lateral cartilages. This muscle arises from the lateral cephalic portion of the subpiriform crescent. The pars transversa joins with the procerus muscle and the opposite muscle in the midline to form the nasalis procerus aponeurosis. The pars transversa compresses and elongates the nose, contracts the nostrils, and narrows the vestibules. Although removal of the pars transversa may shorten the
nose, it is inadvisable since removal may cause skin dimpling. Removal of the pars transversa muscle may also expose any imperfections in the frame because it eliminates the blanket effect that this muscle lends the nose.

- The second component of the nasalis muscle, the *pars alaris* arises from the crescent origin of the maxilla and is more lateral and slightly caudal to the bony origin of the depressor septi nasi muscles. The alar portion partially covers the lateral crus of the lower lateral cartilages and assists in dilatation of the nares. Damage to this muscle may produce collapse of the external nasal valve.

  - **Depressor alae or myrtiforme.**
    - This muscle originates from the border of the pyriform crest and then rises vertically like a fan, up to the ala, acting as depressor and constrictor of the nostrils. Release of this muscle during alar base surgery has a beneficial effect on the external valve.

  - **Levator labii superior alaeque nasi.**
    - It extends lateral to the nose in a cephalocaudal direction and has fibers that are attached to the nostril, thus contributing to the dilatation of the nares. Paralysis of these muscles will also allow collapse of the external valve. Release of the muscles that dilate the nostrils, especially in African American patients and in those who have a very wide alar base, are crucial to avoiding postoperative widening of the alar base.

  - **Depressor septi nasi muscle.**
    - This muscle plays a cardinal role in the function of the nose. It arises from the maxilla just below the nasal spine, extends along the columella base, and attaches to the footplate. Occasionally, fibers of this muscle extend to the tip of the nose; some believe that these muscle fibers extend to the membranous septum. The depressor septi nasi muscle depresses the nasal tip on animation and alters air turbulence.
Additionally, it has aesthetic importance because its contraction would narrow the labi columellar angle.

- Release of this muscle would not only eliminate the depressor effect on the tip, but would also cause slight ptosis of the upper lip, which may or may not be beneficial depending on the patient’s tooth show. All of these muscles are innervated by the seventh cranial nerve. The understanding of the dynamic effects of these nasal muscles and the importance of their preservation is of paramount functional and aesthetic importance. Indiscriminate violation of the soft tissues will result in suboptimal nasal function and a displeasing aesthetic outcome. Planned release of a few of these muscles, on the other hand, may improve nasal function as well as nasal form.

Fig. (5): Soft tissue functional anatomy of the nose (Guyuron, 2006).
**Blood Supply of the Nose**

The superficial arterial supply is illustrated in Fig (7). The lower one-third of the nose is supplied by branches of the maxillary and facial arteries, which includes some collateral through the dorsal nasal and external branch of the anterior ethmoidal arteries. These vessels mostly run in the subdermal plexus superficial to the nasal superficial musculo-aponeurotic system (SMAS). Fresh cadaver dissections showed that the primary blood supply of the tip is from the lateral nasal artery branch of the superior labial artery with a contribution from the paired columellar arteries. In performing an open Rhinoplasty with a transcolumellar incision, blood supply to the tip is ensured by preservation of the lateral nasal arteries by proper dissection plane deep m the nasal SMAS and also limiting the depth and cephalic extension of the alar base incisions *(O'Neal et al., 2000)*.

The venous drainage of the external nose has the same named veins, which accompany the arteries. These veins drain via the facial vein and the pterygoid plexus and through the ophthalmic veins into the cavernous sinus *(Rohrich et al., 2001)*.
Fig. (7): Arterial supply of the external nose (O’Neal et al., 2000).

Nerve Supply of the Nose

The external nasal branch of the anterior ethmoidal nerve, which emerges between the nasal bone and the upper lateral cartilage, accompanying the same-named artery, supplies the skin over the dorsum of the distal nose down to and including the tip of the nose (Fig. 8). Injury to this nerve explains tip numbness commonly noted after rhinoplasty, because, this branch is vulnerable during intercartilaginous- or cartilage-splitting incisions. To minimize the chance of injury to this nerve, it is best to avoid going too deeply with endonasal incisions because the nerve is deep from the endonasal surface. Instead, maintain the dissection directly on the surface of the cartilage deep to the fibromuscular layer and extension of the periosteum Sensibility to the soft tissues on the side of the lower half of the nose is supplied through the infraorbital branches of the maxillary nerve, which also supplies portions of the columella and the lateral vestibule. Thus, an infraorbital block is important when relying on local anesthesia for pain control during rhinoplasty (O’Neal et al., 2000).
Skin of the Nose

Skin thickness is one of the most important features to assess preoperatively in planning rhinoplasty. The skin tends to be thinner and more mobile in the upper half of the nose and thicker and more adherent distally. The average skin thickness was noted to be greatest at the nasofrontal groove (1.25 mm) and least at the rhinion (0.6 mm). There are usually more sebaceous glands in the lower half of the nose, causing an oiliness and thickness in the skin that may limit tip definition. This is frequently true in the non-Caucasian nose, which may have a larger subcutaneous dense fibro-fatty layer than the Caucasian nose. Some of the nasal changes seen with aging (i.e., tip droop, nasal lengthening) may be caused by changes in skin character. The skin usually is thinner along the alar margin and in the columella, where the configuration of the alar cartilages may be visualized through a thin skin cover. The skin-to-skin approximation in the soft triangle area at the nostril apex makes it extremely vulnerable to notching and irregularities caused by scarring.
when intranasal incisions violate this delicate area (Fig. 9) (Lopez et al., 2012).

*Fig. (9): Thickness of the skin envelope over the nose (Byrd and Burt, 2002).*

**The Nasal Cartilages (Fig. 10&11)**

They are composed of hyaline cartilage which maybe ossified. They prevent collapse of the vestibule on inspiration. The upper cartilages are triangular flat expansions lying inferior to the nasal bones and are overlapped by them, by the adjacent frontal processes of the maxillae and the lower lateral cartilages in 70% of cases (Lang, 1993).

The groove between the upper and lower cartilages is known as the limen nasi which is the site for intercartilaginous incisions (Gunter, 1999).

The lower lateral or alar cartilages form the lower third of the nose. They are each composed of medial and lateral crus which meet at the dome of the tip. The part of the septum running between the tip of the nose and philtrum is called the columella (Lund, 1997).

The accessory cartilages connect each lateral crus to the pyriform aperture. These cartilages are bound together by a continuous perichondrium which gives stability to the cartilages and causes them to act a single structural and functional unit. This is referred to as the lateral crural complex.
The lateral crural complexes are supported by:

1. The suspensory ligament of the tip resting on the septal angle.
2. Fibrous connections to the upper lateral cartilages.
3. Abutment with the pyriform aperture.

The medial crura are supported by their elastic fibrous attachments to the caudal septum and the soft tissue interposed between their feet and the premaxillary area.

The elastic connective tissue fibers join the feet of the medial crura to the caudal septum and help maintain tip projection and resist backward movement of the tip. If this connection is interrupted with a transfixion incision, the only remaining support for the medial crura is the soft tissue interposed between the feet and the premaxilla. This tissue is compressible and the support they supply to the medial crura is dependent on its density (Benlier et al. 2009).

Fig. (10): Right lateral view of the nose (O'Neal et al., 2000).
ANATOMY OF THE NASAL TIP

The nasal tip is the mobile part of the nose and includes skin, subcutaneous tissue, superficial musculo-aponeurotic system, ligaments, and lower lateral cartilages (De la Fuente and Martin, 1998).

Skin:

The skin of the upper third of the nose is thin and mobile. The skin of the middle third is also thin but is not so mobile, while the skin of the lower third of the nose is thicker and not mobile. It is usually thick over the supratip area. The thickness of the skin is related to the number of sebaceous glands in the skin and the amount of subcutaneous tissue underneath, it is an important factor in surgical outcome because it determines whether minor asymmetries of the nose will be camouflaged after surgery. Thick sebaceous tissue may render fine tip refinements meaningless and may need to be addressed with laser surgery or dermabrasion. The immobility of the skin is due to its adherence to the underlying musulocartilaginous structures and the presence of trabeculae.
traveling from the dermis to the underlying fascia. The subcutaneous fatty tissue underneath the skin allows the skin to glide over it (Coskun et al., 2008).

Subcutaneous tissue:

a- Subcutaneous fat

b- Interdomal fat pad (IFP). It extends from the nasal tip to the supratip region. The amount of IFP affects the intermediate crura and the interdomal distance which is governed by the angle of the divergence of the intermediate crura. The IFP mass was found to be greater in bulbous noses and noses with divergent alar cartilages than the other noses. The location of the IFP and its relationship with cartilage tissues indicates that removal of this fat pad would be advantageous in the management of divergent alar cartilages. IFP is an important factor of shaping of the nasal tip that should be considered by surgeons who perform rhinoplasty (Copcu et al, 2010).

Superficial musculo–aponeurotic system (SMAS)

Five soft tissue layers are present beneath the dermis as following:

- A superficial fatty panniculus
- A fibromuscular layer (SMAS)
- A deep fatty layer
- A longitudinal fibrous sheet linking the upper lateral cartilages
- An interdomal ligament (Mendelson, 2003).

The SMAS functions as a layer that distributes the tensile forces of the nasal musculature and provides a sling against which the mimetic muscles may counteract (Lam and Williams, 2006).

The major arterioles, venous and lymphatics run in or above the nasal SMAS so the most desirable plane for dissection is under the nasal SMAS to preserve the vascularity of the overlying flap, minimize bleeding and edema, and to achieve a more favorable cosmetic result. The plane of dissection in an external or endonasal rhinoplasty should be therefore be under the nasal SMAS and above the perichondrium of the upper lateral cartilage and lower later cartilage (Lam and Williams, 2006).

Ligaments:
The interdomal ligament and the suspensory ligament of the tip are the main ligaments. The latter is a ligamentous connection between the cephalic margins of the lateral crura as they diverge from each other in the supratip area. The suspensory ligament crosses over the septal angle and is supported by it, lowering the dorsal septum, reducing its support (Copcu et al., 2010).

**Lower lateral cartilage (LLC):**

The nasal tip is composed principally of pair lower lateral or alar cartilages. Medially, the LLC begins anterior to the nasal spine as widened medial crural footplates and taper anteriorly as medial crura to the anterior nostril margin. The intermediate crura diverge and ascend from the anterior nostril margin to join with the lateral crura. On profile view, the junction of the medial and intermediate crura may be seen as double break in which the intermediate crura ascend slightly; this favorable aesthetic feature should be preserved by maintaining the divergence of the intermediate crura (Lam And Williams, 2006).

The intermediate crura span the infratip lobule, which is the soft tissue region of the nose extending from the anterior nostril margin to the nasal tip. The junction of the intermediate crura and the lateral crura is termed the angle or anatomic dome and is evident as a narrowed portion or isthmus. The clinical dome (vestibular or simple dome) lies lateral to the angle and is composed entirely of lateral crura and correlates with the deepest recess of the anterior nostril margin. The lateral crura extend superiorly and join the pyriform aperture at the so-called hinge, which is composed of either smaller accessory cartilages or represents the lateral extent of the lateral crus and which bends inwards upon upward rotation of the nose (Fig. 12) (Lam And Williams, 2006).
Nerve Supply of the Nasal Tip

The nasal tip receives its main sensory nerve supply from the external nasal branch of the anterior ethmoidal nerve, which is a terminal division of the nasociliary nerve, a branch of the ophthalmic division of the trigeminal nerve. After passing from the orbit through the anterior ethmoidal foramen and running in a groove in the cranial aspect of the nasal bones before emerging from their caudal edges as the external nasal nerve. The external nasal nerve emerges between the distal nasal bone and upper lateral cartilage and the point of exit is almost consistently located 6.5 to 8.5 mm lateral to the nasal midline regardless of the size of the nasal bone. The average diameter of the nerve at the point of exit is 0.35mm.it passes into the deep fatty layer directly under the nasal superficial musculo-aponeurotic layer and courses downwards almost straight alongside the midline toward the nasal apex. In 95% of people the nerve runs in the same deep fatty layer all the way down to the alar cartilages and in 5% it bends medially at the intercartilaginous level and is lying deeper between both medial crura (Han et al., 2008).
The nerve branching is classified as either:

1- Type I: having only one nerve without any branch (50%)
2- Type II: having one nerve proximally and then splitting into two main branches at the intercartilaginous junction (30%)
3- Type III: Having two main branches from the point of exit (20 %) (*Han et al., 2008*).

The following precautions are suggested during rhinoplasty to minimize the chance of injury of this nerve:

a- It is best to avoid deep intercartilaginous incisions so that the deep layer is not invaded and the dissection is maintained directly on the surface of the cartilage (deep to the nasal SMAS)

b- Dissection at the junction of the nasal bone and upper lateral cartilage area of one side should be limited to within 6.5mm from the midline.

c- When the nasal dorsum is augmented by an onlay graft or implants, graft less than 13 mm wide at the rhinion level should be used (*Han et al.,2008*).

**Nasal Tip Support Mechanisms:**

Nasal tip support and its influence on nasal tip projection should be clearly understood for the best results in rhinoplasty (*Adams et al., 2003*).

Appraisal of tip recoil is an easy method of determining the resilience and strength of the nasal tip by digitally depressing the nasal tip and observing the give of tissue under the pressure of one’s finger as well as the elastic recoil of the tip back to its native position, the integrity of tip support may be accurately assessed (*Echeverry et al.,2006*).

- Three constant tip support mechanisms of major importance can be identified. They operate in every patient to a greater or less degree. They include:
  1. The strength , thickness , size and contour of alar cartilages.
  2. The connective tissue attachment from the caudal margin of the upper lateral cartilage to the cephalic margin of the alar cartilage.
3. The intimate wrap-round relationship of the medial crural foot plates to the caudal cartilaginous septum (Echeverry et al., 2006).

- Six minor tip support exist including:
  - The interdomal ligament of Pitanguy
  - The sesamoid complex
  - The membranous septum
  - The cartilaginous dorsum
  - The nasal spine
  - The alar attachment of the skin and soft tissue (Beaty et al., 2002).

AESTHETIC ANATOMY OF THE NOSE
The greatest problem in performing corrective nasal surgery is found in attempting to apply aesthetic judgment to each individual case (Bernstein, 1971).

The main 4 components are:

1. Radix
2. Dorsum
3. Alar columellar complex
4. Tip

1- **Radix**

The nose should have no discernible beginning but should be a continuation of lines that are graceful extensions of the other facial parts. The root of the nose, or radix, should be part of an unbroken curve that begins in the superior orbital ridge and continues along the lateral nasal wall. The width of the radix is in good alignment with the supraorbital curve in most patients. With few exceptions, the use of surgical procedures designed to narrow the radix is unnecessary and contradicts a basic aesthetic premise, that is, that lines should flow uninterrupted (Fig. 13) (Janis And Rohrich, 2007).

![Fig. (13): Aesthetic of the nasal radix (Janis And Rohrich, 2007).](image)

2- **Dorsum**

- Dorsum on front view
- Viewed from the front, the dorsum connects the radix with the lateral projections of the crura of the lower lateral cartilages by two divergent concave lines that are unbroken extensions of the superciliary ridges. Though the dorsum is generally considered to be of greatest importance in profile, the impact of the frontal view of the dorsum on the appearance of the midface must be appreciated. The dorsum on front view should be of sufficient height to provide the appearance of an anatomic part separating the eyes. Over reduction of the dorsum causes change in the characteristic orbital-nasal relationship of each individual (Sheen, 1993).

- **Dorsum on lateral view**

- The relationship between the dorsum and the tip has a strong influence on the apparent shape of the tip. The dorsal line begins at the radix and descends in a relatively straight line to the tip, which is the highest point in the nasal profile. The oblique view of the dorsum can be omitted in evaluation of the nose (Sheen, 1993).

### 3- Alar Columellar Complex:

Although the alar- columellar relationships (ACR) is seen more directly from the lateral view, it is important to study it from the frontal view as well. On frontal view it is apparent in noses with good ACR that lines along the alar rims connecting at the columellar-lobular angle resemble the wings of a seagull in gentle flight as described by (Sheen, 1993) (Fig. 14).

In addition, it was found in aesthetically appearing noses that horizontal lines through the tip defining points, the highest point of the alar rims, and the columellar-lobular angle, divide this area into equal segments (Fig. 15). When this is not the case, an alar columellar distance is usually present. The same relationship is seen on lateral view (Fig. 15&16) (Gunter et al., 2004).
However; in nice appearing noses the outline of the nostril simulates an oval. The alar rim forms the upper half of the oval and the lower half is formed by the columellar rim at the junction of the external skin with the vestibular skin. This oval is occasionally interrupted by flaring feet of the medial crura but this doesn’t change the amount of exposure of the columella and should be disregarded when studying the relationship (Gunter et al., 2004).

In the ideal nose, the vertical distance between the columellar-lobular angle and the tip-defining points is divided in half by a horizontal line adjacent to the highest point of the alar rim (Gunter et al., 2004).

A line drawn through the most anterior and posterior points of the oval represents the long axis and divides the oval into and upper and lower half. By using the distance from the long axis to the alar rim superiorly (AB) and the columellar rim inferiorly (BC) (Fig. 17&18), the alar-columellar relationship are categorized into seven classes (Fig. 19). The significance of the ACR classification is that class II-VII requires different methods of treatment (Gunter et al, 2004).
**Fig. (17):** Posterioinferiorly, the ovoid shape of the nostril may be interrupted by the flaring feet of the medial crura. This does not alter the alar-columellar relationship and should be disregarded (Gunter et al, 2004).

**Fig. (18):** In a normal alar-columellar relationship, the greatest distance from the long axis of the nostril to either the alar rim or the columella should be 1 to 2 mm, or $AB = BC = 1$ to $2\text{ mm}$ (Gunter et al, 2004).

**Fig. (19):** Classification of alar-columellar relationships. Classes II to IV related to increased columellar show, whereas classes V and VI describe decreased columellar show (Gunter et al, 2004).
AESTHETIC ANATOMY OF THE NASAL TIP

There is no greater challenge in rhinoplasty than the predictable construction of a nasal tip that is elegant and distinct and there is no other problem in rhinoplasty that involves so many variables. The dorsal edge of the septum, the caudal septum, the nasal spine, the size, position and substance of the lower lateral cartilages, the position of the domes of the lower lateral cartilages, the character of the skin and the relationships and size of the nostrils all play a role in determining tip configuration. Through understanding of the influence of these various factors on the tip and a well-defined conception of the surface anatomy serve to guide the surgeon in the assessment and management of the nasal tip (Sheen, 1993).

Tip Defining Points (Fig. 20)

At the junction of the medial and lateral crura of each lower lateral nasal cartilage, a thick condensation of cartilage is often found that creates a sharp, localized impression in the skin of the nasal tip lobule. From this location at the apex of the tip lobule, these cartilaginous beads, the so called “tip points (TPS)”or “tip defining points” can be of paramount significance as a cosmetic structure because they draw attention to the nasal tip by both their influence on nasal shape and light reflection and their contribution to the tip projection at this critical spot (Burres, 1999).

Fig. (20): The nasal tip defining points are seen as two light-reflecting points of the nasal tip (Orten and Hilger, 2002).

Tip Point quality was graded into four categories based on the criteria of presence, interdomal crease, base width and distinction.
Tip Point grade (TPG) (Fig. 21)

- **Poor**: No TPs or present or minimal appreciable TPs; no columllar crease present in the tip region
- **Fair**: TPs appreciable but blunt, minor bifurcation between the TPs
- **Good**: TPs obvious with the distinct base but intermediate in diameter; clear bifurcation
- **Excellent**: TPs distinct, sharp and small with a discreet base: deep columellar crease (*Burres, 1999*).

![Fig. (21): TPG I = Poor  II= Fair  III=Good  IV= Excellent (*Burres, 1999*).](image)

The refined tip is characterized by four essential landmarks;

1. Lateral projection of the left dome
2. Lateral projection of the right dome
3. Point of tip differentiation from the dorsum
4. Columellar lobular junction

These four reference points are seen on any view of the nose and are manifest by either light reflexes or projections.

On oblique view, these points should form two equilateral geodesic triangles with a common base, the length of which is referred to as the intercrural distance (ICD). The apex of the superior triangle is the point of tip differentiation from the dorsum. The apex of the inferior triangle is the point of the columellar lobular junction. The apex of the curved line that connects the two domes of the lower lateral cartilages should be the
highest projecting part of the nose from whatever angle the nose is viewed (Sheen, 1993).

On front view the nasal tip must appear as a continuation of the lateral nasal walls. The end points of the diverging lines appear as light reflex the normal anatomy of a nasal tip produces a light reflex from three areas, the two lateral domes of the lower lateral cartilages and the central arch of the line that joins them. These reflections are ideal aesthetically if they follow the equilateral tip triangle that was previously mentioned (Rochrich and Sheen, 1998).

The ICD must be consistent with the rest of the nasal tip not too wide or too narrow. The significance of the placement of the domes equidistant from the midline becomes immediately apparent when shown schematically. Any change or loss of one or both of these important landmarks results in a tip that appears asymmetrical or of these distorted (Rochrich and Sheen, 1998).

On lateral view the character of the nose, its delicacy, inclination, length and width is influenced by the contour of the nasal tip. The four lateral views are identical except for the tip configuration. The dramatic changes that are illustrated underline the importance of the structure of the nasal tip to facial aesthetics. The influence of the nasal tip on the apparent length of the nose cannot be overstressed (Sheen, 1993).

**Tip Projection and Rotation**

Two specific measurements or illusion of measurements go hand to hand, that of tip rotation and that of tip projection. The understanding of one is required for understanding the other (Rochrich and Sheen, 1998).

**Tip Rotation**

Simon (1984), probably best delineated these when he used a nose enclosed within a half circle and radius to differentiate between actual tip projection and rotation. In tip rotation the radius lines moves upward or downward as the tip is raised or lowered an illusion of tip rotation may be gained by decreasing the height of the nasal dorsum.
**Tip Projection**

Tip projection is defined as the distance along a perpendicular line from the vertical facial plane to the most anterior projecting point of the nasal tip in quantitating nasal projection; one may use a specific angle or a ratio of horizontal to vertical distance. The nasofacial angle is of particular importance because it is the major angle used to assess projection of the nose. More than one method of assessment is always helpful (*Soliemanzadeh and Kridel, 2009*).

The nose-lip chin plane with ideal chin projection (in women) defined as 3 mm posterior to a plumb line drawn perpendicular to the natural horizontal Frankfort plane (Fig.22). The appearance of proper tip projection is dependent on this relationship, as an under projected chin will make the nasal tip seem over projected and vice versa (*Ghavami et al., 2008*).

![Image of nose-lip-chin balance relative to the natural horizontal Frankfort plane](image)

**Fig.(22):** *Evaluation of nose-lip-chin balance relative to the natural horizontal Frankfort plane* (*Ghavami et al., 2008*).

The nasal projection is approximately equal to the length of the upper lips; hence this ratio should be 1:1. The tip is measured from the mucocutaneous border to the base of the columella at the subnasale. The measurement of nasal projection is from the subnasale to the nasal tip. Approximately 50% to 60% of the tip should project anterior to the...
anterior most projecting point of the upper lip (Fig. 23) (Ghavami et al., 2008).

Fig. (23): Approximately 50% to 60% of the nasal tip should project anterior to the upper lip (Ghavami et al., 2008).

Good’s method uses a vertical line drawn from the nasion to the alar groove. This is the reference line. A horizontal line is then drawn from the nasal tip perpendicular to this vertical reference line. Then a line from the nasion to the nasal tip is drawn. A ratio comparing the length of the horizontal base line (ala to tip or A-T) with that of the dorsal line (nasion to tip or N-T) is made (Fig. 24). The equation is as follows

$$\frac{A-T}{N-T}=0.55 \text{ TO } 0.6$$

Fig. (24): Ideal nasal tip projection is equal to 0.67 times the ideal nasal length (Ghavami et al., 2008).

This ratio of base to dorsum reflects an increase or decrease in projection. The lower limit of 0.55 is more consistent with a female nasal
projection and the upper limit of 0.6 is more consistent with male nasal projection (Rohrich et al., 2001).

The supratip break (the supra lobular depression) is a depression just cephalic to the nasal tip where the lobule meets the dorsal portion at middle cartilaginous vault (Fig. 25). This very subtle break is considered extremely aesthetic in the nasal profile and is more pronounced in the female face than in the male face (Rohrich et al., 2001).

Fig. (25): An aesthetic nasal tip has 1 to 2 mm of supratip break (Ghavami et al., 2008).

Finally, an esthetically pleasing nose has certain characteristics. The proportions between alar and lobule should be approximately 1:1 in the lateral view. From the basal view the columella should be approximately twice the length of the lobule (Fig. 26) (Ghavami et al., 2008).

Fig. (26): The ideal nostril-tip relationship is 2:1 (Ghavami et al., 2008).
The nasolabial angle usually measures 90 to 115 degrees with a double break. From the frontal view there should a gentle curve from the superior orbital rim to the tip area. Powell and Humphries (1989), described their “aesthetic triangle” they believed that the following averages are ideal, nasofrontal angle 120 -135 degrees, nasofacial angle 30 to 36 degrees, nasomental angle 130 degrees and mentocervical angle 85 degrees (Fig. 27).

Fig.(27): Aesthetic triangle (Ghavami et al., 2008).

The nasolabial angle is often confused with the columellar labial angle, which is formed at the junction of the columella with the infratip lobule (Fig.28). This angle is normally between 30 and 45 degrees. A prominent caudal septum can cause increased fullness in this area, which can give the illusion of increased rotation, despite a normal nasolabial angle (Rohrich et al., 2001).

Fig.(28): The columellar-lobular angle should be 45 degrees (Ghavami et al., 2008).
PHYSIOLOGY OF THE NOSE

The nose contains the organ of smell as well of respiration. The nose warms, cleans and humidifies the inspired air. It adds quality to speech production (Darke-Lee, 1997).

The nasal passages are not static rigid structure; it is somewhat dynamic being able to change, increasing or decreasing the resistance to airflow. Resistance serves to slow and disperse air allowing the nasal mucosal to function effectively (William, 1999).

Four types of valves regulate airflow:

1. **The external nasal valve**: at the level of inner nostril. It is formed by the caudal edge of the lateral crus of the lower lateral cartilage, the soft tissue alae, the membranous septum, and the sill of the nostril. This is an occasional site of obstruction in the compromised nasal airway patient, particularly in the secondary rhinoplasty patient with the pinched alae deformity (Howard and Rohrich, 2008).

2. **The internal nasal valve**: a bottleneck exists at the level of the anterior head of the inferior turbinate. It accounts to half the total airway resistance (Anand and Isaacs, 1994).

   The junction between the septum and the upper lateral cartilage is normally 10 to 5 degrees). If the angel is less than 10 it produces a sense of nasal obstruction .Nasal surgery, especially nasal tip surgery is the most common cause of internal valve malfunction (Howard and Rohrich, 2008).

   When the angle is too narrow a spreader graft may be recommended (Sheen, 1993).

3. **The nasal turbinates**: exert a significant effect on the nasal airflow via their vasoconstriction and vasodilatation .Of the three turbinates, the inferior turbinates are the most significant functional component in nasal airway breathing. It is covered by ciliated epithelium. It has many venous channels with erectile capacity that controls the volume of air entering the lungs (Daniel, 2003).
4. **The nasal septum:** The nasal septum is rigid and therefore exerts a constant effect. Septal deviations and spurs can impair airflow (*El-Sahy, 2000*).

Eighty percent of adults have a normal nasal cycle. In the course of a cycle the inferior and middle turbinates on one side are resting and engorged with blood, while those on the other side are carrying out the nasal functions. Every 3 hours the process is reversed. Internal valve deformities, such as scarring, septal deviation, maxillary crest spurs, a hypertrophied inferior turbinate or weakened Upper Lateral Cartilage can cause an increase in airway resistance. The most common cause however, is enlargement of the inferior turbinate (*Howard and Rohrich, 2008*).
ETIOLOGY

Numerous substances have been identified that have teratogenic effects during craniofacial development (Shepard, 1995).

Both environmental teratogens and genetic factors are implicated in the genesis of cleft lip and palate. Intrauterine exposure to the anticonvulsant phenytoin is associated with a 10-fold increase in the incidence of cleft lip. Maternal smoking during pregnancy doubles the incidence of cleft lip. Other teratogens, such as alcohol, anticonvulsants, and retinoic acid, are associated with malformation patterns that include cleft lip and palate, but have not been directly related to isolated clefts percentage (Charles et al., 2007).

Both excess and deficiencies of retinoic acid can lead to facial anomalies and nervous system defects. Cleft lip appear especially if embryos are exposed to high doses at early stages of development (Helms et al., 2010).

The active component in the plant Veratrum californicum, which is a potent inducer of holoprosencephaly have been traced to cyclopamide and jervine. These molecules are steroidal alkaloids and may exert their teratogenic effect by perturbing cholesterol synthesis and transport which is required for proper processing of the shh protein (Beachy et al., 2002).

Disruptions in shh signaling at multiple time points during development can account for the range of holoprosencephaly-like defects (Charles et al., 2007).

Genetic abnormalities can result in syndromes that include clefts of the primary or secondary palates among the developmental fields affected. Less than 15% of cleft lip and palate cases are part of malformation syndromes. The most common syndrome associated with cleft lip and palate is van der Woude syndrome with or without lower lip pits or blind sinuses. Although there is a recognized genetic component to nonsyndromic cleft lip and/or palate, it appears to be multifactorial. Among other recent studies, a meta-analysis of 13 genome scans by Marazita and Mooney (2004), revealed multiple cleft lip/palate (CLP) genes on 16 chromosomal regions (Charles et al., 2007).
If the family has one affected child or parent with CLP, the risk of the child of the next pregnancy having CLP is 4%. If two previous children have CLP, the risk increases to 9%, and if one parent and one child were previously affected, the risk to children of subsequent pregnancies is 17% (Charles et al., 2007).

**PATHOGENESIS**

**Formation of primary palate:**

Despite in the difference in the shape of the median nasal and frontonasal process in avians, rodent s and humans, the expression of genes such as Fgf8, shh, Bmp2, and, Bmp4 is strikingly equivalent in these different species after initial establishment of these gene expression patterns, the outgrowth of the median nasal process begins to differ in the various species. In avians, the median nasal process begin to elongate, predicting the shape of the future beak. In rodent, the median nasal process develops as to lobes separated by a fissure, again predicting the shape of the future lip. In human, the development of the median nasal process more closely resembles that of the mouth although the fissure in the median nasal process is not as deep. In humans, this fissure is represented as philtrum of the lip (Stephen and Vincent, 2006).

*Failure of fusion theory*, proposed by His (1892), purported that the free edges of the facial processes unite in the central region of the face. As various processes fuse, the face gradually forms. When epithelial contact is established between the opposing facial processes, mesodermal penetration completes the fusion. Dursy suggested that the upper lip is formed when finger-like advancing ends of the maxillary process and the paired global process unite.

Stark and Ehrmann (1958), suggested that the central facial processes are composed of bilamellar sheets of ectoderm. This bilamellar membrane is bordered by epithelial seams, which delineate the principal processes. During development, the mesenchymal tissue migrates and penetrates this double-layered ectoderm, called the epithelial wall.
Caudal to the stomodeum, the lower face is formed by the branchial arches. The arches consist of a thin sheet of mesoderm, which lies between the ectodermal and endodermal layers. The neural crest cells of neuroectodermal origin, which arise from the dorsolateral surface of the neural tube, migrate under the ectoderm and supplement the mesoderm of the frontonasal process and branchial arches (Johnston, 1966).

If neuroectoderm migration and penetration do not occur, the epithelium breaks down to form a facial cleft. The severity of the cleft is proportional to the failure of penetration by the neuroectoderm (Johnston, 1966).

*Neuromeric theory* suggests that a direct relationship exists between the development of the nervous system and those structures to which its contents are dedicated. The neural tube is conceived of as a series of developmental zones within the central nervous system (Carstens, 2008).

Six prosomeres provide a Cartesian system to organize the tracts and nuclei of the prosencephalon (forebrain). The mesencephalon (midbrain) and rhombencephalon (hindbrain) are subdivided into 2 mesomeres and 12 rhombomere, respectively. Each of these neuromeres is defined by a unique overlap of several genetic coding zones along the axis of the embryo. In the hindbrain and caudally to the coccyx, these neuromeric units are defined by the homeobox series of genes (HOS genes). In the forebrain, a more complex series of genes is used, such as Sonic hedgehog (Shh), Wingless (Wnt), and Engrailed (En) (Carstens, 2008).

The unique "barcode" for each neuromeric zone is shared with all cells exiting a particular level to form the mesoderm and endoderm of the embryo. The migrating neural crest cells then provide the instructions for differentiation into the appropriate facial tissues. Thus, all the bones and soft tissues of the face can be thought of as genetically determined "fields" with defined cellular content and a fixed position in space. With the folding of the embryo, these fields are placed into their correct topologic positions, and a three-dimensional form results (Carstens, 2008).
This system permits the "mapping" of the face into developmental zones with distinct spatial origins in their precursor tissue units. The midline mesoderm of the nasal and ocular fields has an origin, innervation, and blood supply different from all surrounding mesodermal elements. When all the developmental zones are account for, the occurrence of craniofacial clefts is nothing more than an orderly progression of deficiency states in the precursor fields resulting in varying degrees of absence of soft tissue functional matrix or underlying bone (Carstens, 2008).

At the other end are the incomplete forms, including subtle labial clefts (Mulliken, 2011).

Three subgroups were defined at the far end of the incomplete spectrum, called lesser-form cleft lip, based on the extent of disruption at the vermilion-cutaneous junction. The minor-form cleft extends 3 mm or more above the normal Cupid’s bow peak, along with a depression of the intact orbicular muscle and the typical cleft lip nasal deformity. Microform cleft is characterized by a notched vermilion-cutaneous junction with the Cupid’s bow peak elevated less than 3 mm above the normal side. Other features include a glabrous strip in the lower portion of the cutaneous lip, a muscular furrow (accentuated by puckering), the cleft nasal deformity, and a small alveolar defect. Mini-microform cleft is distinguished by a discontinuous vermilion–white roll (without elevation of the Cupid’s bow peak), a hypoplastic mucosal free margin, and variable nasal deformity (Yuzuriha and Mulliken, 2008).

Midline cleft lip arises embryologically from incomplete fusion of medial nasal prominences (Mulliken, 2011).
MORBID ANATOMY

The nasal deformity in the cleft lip patient is produced by the lower lateral cartilage being subluxed inferiorly and laterally, which falsely lengthens the nose on the cleft side. The columella is not short. It simply extends laterally to a dipped area in the rim of the nostril. The cleft lip nasal deformity is correctable at the time of primary lip repair by advancing the lower lateral cartilage superiorly and medially. The correction will last with the cartilage fixed to the upper lateral cartilage-septal junction, its normal position. A deficient repair will not improve. A good repair will last, will not interfere with growth of the nose, and will free the patient from years of unnecessary embarrassment (Ira et al., 2002).

Primary Cleft Lip Nasal Deformity:

This means nasal deformities associated with original cleft lip/palate deformity

- Marked by obvious asymmetry
- Proportional to the severity of clefting
- Tip of nose and caudal septum are deviated toward non-cleft side
- Base of columella deviates toward non-cleft side
- Deviation of septum to normal side
- Obtuse angle between the medial and lateral crura
- Depressed dome of alar cartilage on cleft side
- Vestibular web
- Lateral and caudally displaced alar base
- M configuration of cleft side ala
- Smaller cartilage of cleft side
- Absent alar-facial groove on cleft side
- Hypoplastic maxilla
- Ill-proportioned nares
- Widened nostril floor on cleft side
- Retrodisplaced medial crus on cleft side
Primary Bilateral Cleft Lip Nasal Deformity

- Short columella
- Depressed, flat-appearing nasal tip, sometimes notched in the midline
- Lateral displacement of both alar domes with bilateral dislocation of the lateral crura from the septum
- Hooding of the alar rims
- Flaring of the alar bases
- Scarred vestibular floors
- Bilateral maxillary hypoplasia

Secondary Cleft Lip Nasal Deformity:
Develops after primary cleft lip/palate repair without simultaneous correction of the original nasal deformity.

Characterized by:

- Eversion of alar base
- Inadequate projection of nasal tip on cleft side
- Smaller alar cartilage of cleft side
- Webbing between ala and columella
- Shorter columella on cleft side
- Deflection of caudal end of the septum to normal side
- Previous surgical flaws:
  - Small and constricted nostril secondary to excision of lip and nose elements.

Secondary Bilateral Cleft Lip Nasal Deformity:

- Shortness of columella
- Snubbing of the nasal tip
- Eversion of the alar bases (Ira et al., 2002)
Timing of cleft lip nasal surgery

Traditional treatment protocol for correction of the unilateral cleft lip has been to repair the lip without correcting the nose (Millard, 1982).

The lip repair is performed before the infant reaches 6 months of age using the one-stage or two-stage method with an adhesion cheiloplasty ahead of the definitive lip repair. The lip is brought together using layer closure, with emphasis on the symmetry of the lip, vermilion, and Cupid’s bow. The nasal floor is reconstructed at the same time. The external nasal deformity is left untouched until the child is preschool age or after a growth spurt. The nasal deformity is improved to some extent after an approximation of the lip, but it remains the same morphological pattern as the presurgical one (Lo, 2006).

The ideas of doing primary lip repair without dissecting the nose is waiting the completion of the postpubertal growth spurt in the boney dorsum and anterior septum before proceeding with the definitive rhinoplasty. This occurs after the age of 14 years in female and 16 years in males. Also repetitive rhinoplasty during childhood should be avoided as it compromises the final long-term result (byrd et al., 2007).

McComb (1985) and Salyer (1986) are given the credit for popularizing primary repair in cleft lip nasal deformity. The aims of primary nasal repair on cleft patients are to achieve normalization of the nose, i.e., symmetry, by lengthening the cleft side columella, elevating the lower lateral cartilage, and shortening or lifting the cleft side hemi-nose (Fig. 29).

Fig. (29): Primary rhinoplasty in cleft lip nasal deformity (Liou et al., 2009).
**Trott and Mohan (1993)**, provided benefits of primary rhinoplasty as follow;

1- Restoring the anatomy of the alar cartilage from the earliest possible time in theory will allow growth to be vectored in an optimal way for as long as possible. This may have the benefits for the septal and upper lateral cartilages in terms of their future growth direction.

2- It has the potential to minimize the number and extent of subsequent revisional procedures.

3- Correcting the nostril at the earliest opportunity has the potential to minimize the psychological trauma from the cleft lip nasal stigma.

Although primary nasal correction is performed, this does not mean that an excellent nose has been obtained and that with growth there may not be changes that require a secondary correction. A tendency for the lifted alar cartilage to slump within a couple of months was observed (*Liou et al., 2009*).

It was reported that 10:20% of patients who underwent primary rhinoplasty, had moderate nasal deformities after adolescent growth spurts (*Boo-Chai, 1987*).

It was reported in a study involving a group of 76 patients with cleft lip that early nasal correction doesn’t lead to lasting results. On the contrary, a deformity recurs. Repeated interventions further reduce the blood supply and impair the tissue quality by subsequent scarring and their retraction making the later surgical correction much more difficult (*Duskova et al., 2011*).

### Planning and Preoperative Evaluation

Success in rhinoplasty surgery begins with a sound concept of beauty, symmetry, harmony, and proportion. The ability to accurately appreciate, interpret, and describe what one sees in a nose or face is seldom a gift of inheritance, but requires rehearsal, study, and refinement. Only through years of training and experience can a rhinoplasty surgeon refine the analytic and perceptive skills of diagnosis necessary to instantly appreciate disproportion and disharmony. With a clear and accurate understanding of the individual patient's expectations, a skilled rhinoplasty surgeon must develop the capacity to depict, predict, and foresee the
visualized final result long before surgical alterations commence. Analysis and planning are paramount to successful rhinoplasty surgery and a happy patient (Constantian, 2008).

Proper assessment should involve the following:

I. The initial impression
II. Aesthetic analysis
III. Anatomical analysis
IV. Technical analysis
V. Photographic analysis
VI. Laboratory and radiographic analysis
VII. Informed consent

I. **The initial impression and judgment:**

   This is formulated in a matter of seconds after meeting someone. For the most part, it is a subjective feeling as to whether the nose fits with a particular face. It is vitally important for the surgeon to listen to the patient's own analysis of the nose. The patient is the ultimate judge as to the success or failure of the procedure. Only by understanding the patient's concern can the surgeon make the necessary adjustments to achieve satisfaction. The patient, however, may have unrealistic expectations which cannot be achieved based on the anatomic features of the nose. These differences must be recognized and addressed prior to engaging into a relationship with the patient. Otherwise, any procedure will be a failure from the start (William et al., 2002).

II. **Aesthetic analysis:**

   It is based on universally accepted standards for “ideal” proportions. These proportions are just a reference point. During this analysis, the surgeon should systematically evaluate the various anatomical features of the nose in relation to each other as well as to the face as a whole. The goal is not to replicate “ideal” proportions for each nose because every face is different, and the “ideal” nose isn't appropriate for every face. A working knowledge of these proportions, however, help the surgeon create a nose which appears balanced in relation to the rest of the facial features (Sullivan, 2005).
The aesthetic analysis begins with an overall assessment of the size of the nose. The surgeon must know the patient height. He can then determine his general impression of the size of the nose whether it is too large or too small for the face and the body of the patient. A small shorter patient can tolerate smaller nose than a taller, heavier patient. Then the profile and the dorsum are examined beginning at the top of the nose at the nasofrontal angle. Next the projection of the nasal tip, that is the forward most projection of the lower lateral cartilages. The nasal projection is approximately equal to the length of the upper lip. The lip-chin complex suggest establishing a nose-lip chin plane with ideal chin projection (in women) defined as 3 mm posterior to a plumb line drawn perpendicular to the natural horizontal Frankfort plane (Fig. 30). The appearance of proper tip projection is dependent on this relationship as an underprojected chin will make the nasal tip seem overprojected and vice versa (Ghavami et al., 2008).

![Fig. (30): Evaluation of nose-lip-chin balance relative to the natural horizontal Frankfort plane (Ghavami et al, 2008).](image)

The next area to consider is the tip rotation; this involves how the tip of the nose rotates upwards along a certain arc in relation to the plane of the face. The last point to consider is the columella “the width and length of the columella and the medial crura” Then the nose is looked from frontal view to determine asymmetries (Ghavami et al., 2008).
It is to be noted that the sex, age, body built and general facial characteristic should influence the preoperative considerations in designing an ideal nose for any patient requesting a corrective rhinoplasty (Lopez et al., 2012).

a. Sex

Certain acceptable points of difference between the desired male and female noses are described in the following (table1) (Springer et al., 2009).

Table (1): Difference between the desired male and female noses (Springer et al., 2009).

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>Relatively larger</td>
<td>Relatively smaller</td>
</tr>
<tr>
<td><strong>Overlying skin</strong></td>
<td>Relatively thick and texture surface is acceptable</td>
<td>Relatively thin with a smooth surface</td>
</tr>
<tr>
<td><strong>Dorsum</strong></td>
<td>Wide dorsum is accepted</td>
<td>Narrow dorsum is desirable</td>
</tr>
<tr>
<td><strong>Dorsal projection</strong></td>
<td>Mild hump accepted</td>
<td>Retrousse acceptable</td>
</tr>
<tr>
<td><strong>Tip</strong></td>
<td>Wide tip</td>
<td>Narrow tip</td>
</tr>
<tr>
<td><strong>Nasolabial angle</strong></td>
<td>90-105</td>
<td>105-120</td>
</tr>
<tr>
<td><strong>Nares</strong></td>
<td>Wide nares acceptable</td>
<td>Narrow nares desirable</td>
</tr>
</tbody>
</table>

b. Age

The configuration of the nose in the newborn is a concave dorsum with an upturned tip. In early adult life, the dorsum is straight with nasolabial angle of 90 degree. In the aged person, the nose tends to elongate and the nasal dorsum becomes convex with downward rotation of
the lobule and retraction of the columella. The elongation of the nose is due to drooping of the tip (Vacher et al., 2006).

The supralobular depression becomes more pronounced. The nasolabial angle becomes more acute because of the dropped tip. The degenerative changes that take place in the alveolar process of the jaws during aging processes leads to an in-drawing of the lips, furthermore, attrition of the teeth lowers and the vertical height of the bite bringing the chin closer to the nose. The cumulative end result in a relatively larger appearance of the nose (Vacher et al., 2006).

c. **Body built**

As a general rule, the head of short individual is comparatively larger than that of a tall one. However, a tall person can tolerate a larger nose whereas a small nose is not so conspicuous on short individual. A greater up lift of the nasal tip may be acceptable for a short stature than for a tall one (Tardy, 2005).

d. **Facial characteristics**

The face is classified into square, round, oval or triangular in the frontal view. The ideal nose needs to be adjusted to the corresponding shape of the face, bearing in mind the greater the width of the square and round faces and the narrow configuration of the oval and triangular faces. Thus, the square and round faces require a slightly wider and shorter nose, whereas the oval and triangular faces are more harmonious with a narrow nose (Lopez et al., 2012).

### III. Anatomic Analysis:

In analyzing the cleft lip patient face, it is of cardinal importance to assess the entire face starting from the forehead and proceeding to the mid and lower face. Many of these patients may have asymmetry involving parts other than the nose and the lip. Disharmony of the orbits and palpebral fissures should be documented. The position of the lip cleft and the presence of clefs in other sites, such as the ala, palate and palpebral fissures of utmost importance (Tessier, 1976).

Lip symmetry and the height of the lip on both halves should be measured. Definition and symmetry of the mucocutaneous junction of the lip is important. The red lip should be evaluated for its volume and
symmetry on both the front and profile views. The lower face is then observed for any chin disharmony. Special attention is devoted to the midface area, because midface hypoplasia, especially maxillary retrognathia, is a common feature of a cleft lip nasal deformity. The oral cavity is evaluated for the presence of the alveolar cleft. Bone deficiency in the paranasal region plays an important role in successful cleft lip repair (Bardach et al., 1987).

A careful physical examination of the nose is important. The nose is inspected and this should be done with a headlight a nasal speculum and should include palpation (Tardy, 2005).

Rhinoscopy, with the aid of a head light, is indispensable during the examination, because if a septal deviation exists, it should be corrected in the same operative session as the aesthetic correction (Jang and Sinha, 2010).

In summary, analysis for rhinoplasty has looked for the following features of the nose:

- Lateral view
  I. Nasofrontal angle
  II. Nasal tip : projection, rotation and length
  III. The profile line of the dorsum “ created by connecting the tip defining point and nasofrontal point”
  IV. Lateral view of the columella

- Frontal view:
  I. Width of the nasal bone , width of the lobule , width of the alae
  II. Deviation of the nose

- Base view:
  I. Columella to lobule ration
  II. Position of the columella and caudal septum
  III. Shape of the lobule
  IV. Shape of the nostrils

The anatomic analysis shows:

1. Septal irregularities
2. Width and strength of the upper and lower cartilages

In cases of secondary rhinoplasty, there are 3 main questions should be answered:

1- Is tip projection adequate? Most often tip projection is inadequate in the cleft lip nasal deformity. A common mistake is to underestimate the degree to which this needs to be corrected.

2- Are the piriform aperture and maxilla hypoplastic? Hypoplasia can result from an alveolar cleft; however, even after successful bone grafting, the piriform aperture may need augmentation with cartilage or alloplastic material.

3- Is the projection of the boney dorsum deficient, normal or over projecting? This is an important assessment as the 3 variants are possible (Byrd et al., 2007).

A questionnaire with drawing has been published about the most annoying deformity in the cases of clefts, showing 10 typical deformities (Fig. 31) (Mombaerts and Nagy, 2008).
IV. Technical analysis:

Prior to any surgical intervention, the surgeon must be sure of the local situation and of the necessary steps for correction. There is no single standard procedure to restore the normal nasal appearance. Modern trends in rhinoplasty have allowed for great variations in the techniques according to the state of each individual nose. There are also a lot of acceptable techniques for carrying out the same operation (Daniel, 2003).

Fig. (31): Panel questionnaire for the most annoying nasal deformities in cleft patients (Mommaerts and Nagy, 2008).
V. **Photographic analysis:** *(Sullivan, 2005)*

A complete record should be made immediately following the initial consultation. The initial standardized uniform patient photographs should be a part of every patient record. Vivid, clear, and uniform preoperative and postoperative photographs allow a surgeon to plan surgery carefully and assess eventual outcomes accurately. Photographs, however, are no longer simply an adjunct to planning and treatment. They have become mandatory for medical/legal purposes and medical insurance reimbursement.

The key to quality medical photography is consistency which can only be achieved through a standard protocol. In the lateral view, the patient is positioned with the Frankfort line parallel to the horizontal floor. This view is helpful when evaluating nasal projection and tip rotation. The relationship of the nose to the chin and forehead can also be assessed.

On frontal and base views, the mid-sagittal plane becomes an important imaginary line so that the two sides of the face can be accurately compared. Nasal length, width, and shape are evident on the frontal view. In addition, any degree of deviation can be detected.

The basal view is important in evaluating caudal septal deflections, and nostril shape and size. The reverse basal view which is shot from a position over the forehead, will also demonstrate deviation of the dorsum. The oblique views, although most frequently missed, happen to be the most important aesthetic projection because the nose is most often seen at various angles between pure frontal and lateral views. These views provide the most information about the overall contour of the nose.

VI. **Laboratory and radiographic analysis:**

The extent of indicated laboratory evaluation performed in the preoperative period depends on the needs of the individual patient. It includes

- Complete blood picture
- Bleeding and coagulation survey
Routine sinus radiographs are requested only if nasal and sinus disease is suspected. However C.T. study may be more helpful (Daniel, 2003).

VII. Informed consent:

The selection of appropriate candidates involves an understanding of the patient's motivations for the procedure, expectations for the surgical outcome, and ego strength for tolerating the stress of operative intervention. The patient interview must be structured to give the surgeon ample information to determine the psychological and emotional stability of the candidate. Psychiatric consultation may be required if evidence is uncovered indicating psychiatric illness. Time spent informing the patient preoperatively will pay off great dividends in the postoperative period. If patient dissatisfaction does occur, validate and address the patient's concerns with a non defensive posture (Makdessian et al., 2004).

Pre-operative orthodontic management

Repair of cleft lip requires management by multidisciplinary team consisting of a plastic surgeon, pediatrician, orthodontic dentist and psychiatric support for both the child and his parents (McHeik et al., 2006).

The difference between the repair of cleft lip nasal deformity for infants and for adults can be summarized in two points one of them is that more aggressive correction is possible as maxillary growth is completed and the other point is that the correction of the anterior part of the nose is more difficult as the cartilage shows less elasticity and the deformity of the nasal cartilage is more severe (Morioka et al., 2007).

The nasal cartilages of the neonate have remarkable ability of remodeling by external forces this may be due to high level of estrogen in neonatal blood in the immediate postnatal period (Tan et al., 1997).

An external appliance, for remodeling of the nasal cartilage as well as minimizing the deformity associated with cleft lip, is used. Cutting et al. (1998), have used extension of the palatal appliance used in the presurgical period to remodel the nose in cases of cleft lip/ palate in the first months of life. This nasoalveolar molding helps to guide the nose and
palatal shelves into more normal position. The anterior extension of the appliance helps to stretch the nasal lining and giving more acute angle to the medial crus by direct pressure on it (Maull et al., 1999).

Analytical benefits of presurgical nasoalveolar molding technique have included easier lip surgery since the maxillary segments are repositioned, reduction of the width of the alveolar gap so that the antroposterior position of the gap is also improved prior to the primary surgical repair, and improvement in the nasal symmetry partly due to presurgical alignment of the maxillary skeletal but also due to nasal positioning and increase in nasal tip projection (Fig. 32&33) (Jaeger et al., 2007).

![Fig. (32): The use of pre-operative orthodontic appliance and post-operative outcome in bilateral cleft lip patient (Berkowitz, 2008).](image)

Grayson and Maull (2004), are accredited with the development of the technique of nasoalveolar molding by combining the intraoral molding plate with the nasal stent.

The only acceptable orthodontic treatment in the past was at the time of canine eruption, usually by the age of 9 to 11 years. Nowadays, we believe that it should be initiated earlier in life. For all intents and purposes, orthopedic appliances could be classified depending on pre-
surgical or postsurgical utilization, mechanism of action, active or passive, or regarding their position in relation to the cleft: extraoral or intraoral (Jaeger et al., 2007).

However the use of presurgical orthodontic appliance has encountered many difficulties. As the patient must be seen weekly to adjust this appliance also there must be a great cooperation by the parents as they should remove the appliance daily for cleaning. Other potential problems after utilization of presurgical orthodontic treatment of the cleft lip and nose deformity are nostril overexpansion, so-called mega-nostril, that occurs when the alar rim in the unilateral deformity becomes too large in comparison to the unaffected side, dermatitis due to excessive switching of the strips used to retain the device, localized tissue ulceration caused by excessive pressure, failure to retain the appliance during oronasal molding, failure to tape lip segments, and exposure of a primary tooth (Jaeger et al., 2007).

Although the initial results were good, the presence of these difficulties hinder the wide spread of nasoalveolar molding use. It is only practiced in few centers around the world (Mathes and Hentz, 2005).

Fig. (33): Orthodontic device used for nasoalveolar molding (Jaeger et al., 2007).
TIP RHINOPLASTY IN CLEFT LIP NASAL DEFORMITY

Repair of the cleft lip nasal deformity could be classified into 2 categories;

1- **Primary nasal repair**: This means an attempt to correct the nasal deformity early with the repair of the cleft lip.

2- **Secondary nasal repair**: This is performed on patients whom have no previous primary repair of the nasal deformity or in whom the nasal deformities remain after primary nasal repair (Byrd et al., 2007).

**I- Primary nasal repair:**

Primary rhinoplasty is performed at the time of lip repair, mostly at 3:6 months of age. The decision to perform a primary repair must take into account whether the benefits outweigh the risks of the procedure. Today some surgeons are performing some type of tip rhinoplasty during the primary lip repair (Shih and Sykes, 2002).

Primary nasal repair has been widely practiced owing to the popularity of Millard rotation advancement procedure (Fig. 34) as the incision used for this repair facilitate exposure and dissection of the nose. Other techniques, like Tennison triangular flap repair (Fig. 35), do not allow the same access thus requiring another incision for nasal deformity repair (Mathes and Hentz, 2005).
The fundamental components of the surgical correction of a cleft lip nasal deformity include repositioning the cleft lower lateral cartilage to a more normal anatomical position, achieving a symmetric projection of both alar domes, elongating the columella when necessary, moving the cleft alar base medially to obtain a symmetry of the nasal floor, and providing additional structural support by bone and/or cartilaginous grafts (Choo, 2007).

Millard later used tissues from the broad prolabium by a popular forked flap to lengthen the columella in cases of bilateral cleft lip (Fig.36) (Millard, 1971). One of the most recent techniques in the elongation of the columella is through the use of Turkish tulip method in cases of bilateral cleft lip (Fig. 37) (Atik et al., 2006).
Fig. (36): Millard forked flap to lengthen the columella in cases of bilateral cleft lip (Millard, 1971).

Fig. (37): Turkish tulip method in cases of bilateral cleft lip (Atik et al., 2006).

McComb also demonstrated another method for primary repair of the cleft lip nasal deformity via freeing the nasal skin from the nasal bone and cartilage from the incision in the upper buccal sulcus. The scissors were also passed up through the columella to free the skin from the medial crus and dome of the alar cartilage. The extent of the nasal dissection was from the alar rim over the nasal tip and up to the nasion on the cleft-side hemi-nose. No intranasal incisions were made. The nasal cartilage, with the attached vestibular lining, was now easily
lifted and fixed with one or two mattress suspension sutures tied over the small gauze bolsters at the nasion. One or more lateral mattress transfixion sutures are used to obliterate the dead space and secure the alar lift (McComb, 1985).

**Surgical technique:** (Byrd and Salomon, 2000)

- **Presurgical maxillary orthopedics:** In complete cleft of the lip and palate, trans-alveolar nasal extensions of the expansion device serve to mold and shape the lateral crus on the affected side.

- **To maintain adequate hemostasis:** a solution of 1% lidocaine with 1:100,000 epinephrine is infiltrated locally. In addition, the nose is packed with 1cm gauze soaked in the same solution.

- **External incisions:** The incision of Millard rotation advancement flap is also used for the concomitant nasal repair. The incision could be extended laterally into the alar-facial groove for better exposure and to permit mobility of the alar base.

- Deep to the skin, in the muscular plane, the incision around the alar base is performed at a 45 degree angle in relation to the facial plane, beveling outward from the nose. This maneuver preserves a tuft of muscular tissue, called the muscular roll, attached to the mobilized ala that can be used to span the nostril sill and build a new platform for the alar base (Fig. 38).

![Fig. (38): Incision for the primary nasal repair (Byrd and Salomon, 2000).](image)

- **Mucosal incision:** In addition to the standard buccal mucosal incision, the nasal mucosa at the level of piriform aperture is also
transected with release of the 2nd sesamoid cartilage attached to the piriform to achieve the desired mobility.

- **Subcutaneous nasal undermining:** Wide subcutaneous nasal dissection is performed to include the distal mid-vault and tip as well as the area between the medial crus of the lower lateral cartilages (Fig. 39).

![Fig. (39): Subcutaneous and nasal dissection during primary rhinoplasty (Byrd and Salomon, 2000)](image)

- From the base of the columella, the space between the two medial crura is dissected until the domes on both sides are released from the skin envelop. The attachment of the normal (non-cleft) medial crura footplates to the nasal spine and surrounding tissues are preserved. The cleft medial footplate attachments are released to allow anterior movement and lengthening of the columella as a part of the rotation step.
- From the alar base access, dissection is continued over the lower and upper lateral cartilages on both sides to join the dissection previously performed from the base of the columella.
- The abnormal medial and lateral crura can then be positioned to match the normal side.
- **Dome elevation:** After the separation of the two medial crura, the affected medial crura are free and move superiorly with the C flap as this flap is rotated into position.
- The cleft side columella can be lengthened and the affected medial crura elevated at the same time as part of the rotation step. The affected medial crura footplate may still be splayed laterally after the rotation flap is inset, it can be brought medially by
suturing it to the opposite stable footplate and the surrounding soft tissues close to the nasal spine.

- **Building the maxillary plateform:** The muscular roll is used to augment the cleft maxillary base. The alar base must be completely mobilized from the piriform area. The muscular roll is then folded underneath the cleft alar base to recreate its anterior projection and to correct the obliquity of the alar-to-cheek junction.

- Suturing the muscular tuft to the opposite stable footplate and nasal spine, maintaining its position under the nasal ala.

- The alar base itself is sutured in place as part of the lip repair to narrow the nostril-sill dimension. The ultimate positioning of the alar base is achieved by varying the tightness of these two sutures.

- If the cleft is incomplete, the intact nostril sill is usually preserved during the repair. They favor having medial sill excess rather than a scar across the sill (**Fig. 40**).

![Fig. (40): Building the maxillary plateform during primary rhinoplasty (Byrd and Salomon, 2000).](image)

- **Orbicularis dissection and repositioning:** The cleft side supraperiosteal plane is undermined up to the level of the infra-orbital nerve with transection of all abnormally inserted orbicularis fibers which is reoriented during lip repair.

- **Managing the vestibular web:** A 4-0 Vicryl mattress suture is used to correct the caudal bukling of the cleft lower lateral cartilage that causing the alar webbing. The suture includes the caudal portion of the lower lateral cartilage and accessory chain,
which are sutured to the pared facial musculature that is exposed during the supra-periosteal dissection.

- **Tajima suture:** If any cleft alar cartilage hooding persists at the end of the repair, a Tajima suture can be used to support the affected lower lateral cartilage. An infra-cartilaginous inverted U incision on the cleft side is necessary to complete this maneuver. This suture support the caudal border of the lower lateral cartilage by suturing it to the contra-lateral upper lateral cartilage (Fig. 41).

![Fig. (41): Tajima suture (Byrd and Salomon, 2000).](image)

**II- Secondary nasal repair:**

**Anesthesia & Preoperative Preparation:**

Either local anesthesia with intravenous (IV) sedation or general anesthesia may be used. After induction, the nasal vestibules are prepared by clipping and swabbing the entire nostril with Betadine solution. Before injecting local anesthetic, the line of the anticipated incision is marked (transcolumellar stairstep), if using an open approach) so as not to distort the anatomy. Approximately 10 mL of 1% lidocaine with 1:100,000 epinephrine is injected into the intranasal mucosa, along the septum, and into the soft-tissue envelope.

Additional local anesthetic is used on the inferior turbinates when an inferior turbinoplasty is anticipated. After injection, local vasoconstrictor solution is placed, to shrink the nasal mucosa, facilitate exposure, and minimize blood loss. Although oxymetazoline (Afrin) is preferred, 4% cocaine can be used. A throat pack is carefully placed in the posterior oropharynx to prevent inadvertent digestion of blood during
surgery, which helps prevent postoperative nausea and vomiting. (Echeverry et al., 2006).

After infiltration anesthesia, it is critical that the surgeon wait 10 to 15 minutes before proceeding with the operation, allowing vasoconstriction to reach its maximal effect. The goals of nasal anesthesia are:

a. A comfortable, relaxed and responsive patient
b. A bloodless operative field
c. Minimal distortion of the nasal tissues (Fig. 47) (Tardy, 2005).

**Patient Positioning:**

The patient is positioned towards the surgeon’s side and near end of the operating table. The patient’s neck is hyper extended so that the nasal cavity can be easily seen (Tardy, 2005).

**Algorithm (1): The principal components of a successful Rhinoplasty (Tardy, 2005)**

**Incision and approach:**

**Open Approach**
This is the main approach. A transcolumellar stairstep incision across the narrowest portion of the columella is generally preferred. The advantages of the stairstep include the provision of landmarks for accurate closure, the prevention of linear scar contracture, and its ability to camouflage the scar. Infracartilaginous extensions are then performed bilaterally, from lateral to medial, along the caudal border of the lower lateral cartilage. These incisions meet the transcolumellar incision to complete this approach (Raspall et al., 2010).

Exposure during this dissection is facilitated by double-hook alar eversion and digital counter pressure. It is important to take your time during this portion of the procedure, as most mistakes are made when trying to obtain exposure. Furthermore, the incisions should be kept superficial and the caudal border of the lower lateral cartilage should be identified prior to cutting to prevent injury to the underlying cartilages. (Rohrich et al., 2001).

However, the principal drawback of the open approach is the residual scars that are left on the columella. To avoid the transcolumellar incision, the bilateral paramarginal incisions close to the columella can be extended down to the nasal floors. Through this approach, it is possible to manage the nasal tip structures with large exposure (Sevin et al., 2007).

**Closed Approach**

Closed approach will be enough for those requiring minimal work on the tip. While in those with marked tip deformity open approach will be more reasonable (Mathes and Hentz, 2005).

**Protocol of management:**
**Algorithm (2): Protocol of management of secondary rhinoplasty (Byrd et al., 2007).**

**Tip Rhinoplasty**

*(Primary procedures)*

Techniques in rhinoplasty have evolved from Sanskrit teachings originating from Sushruta in 500 BC. Despite the advances in instrumentation and techniques through the years, Fomon’s statement in the early part of the 20th century, “He who masters the tip, masters rhinoplasty,” remains valid today. Indeed, nasal tip position, symmetry, contour, projection, and overall aesthetics are critical in achieving a favorable Rhinoplasty outcome. Effects of tip position and dynamics extend beyond the immediate tip region to affect the supratip, columellar, and lateral alar regions (Leach and Athré, 2006).

Tip sculpture cannot be successfully undertaken, until the major and minor tip support mechanisms are appreciated, respected and preserved. The tip unit composed of paired medial crura and posterosuperior flaring
of the lateral crura, forms a **Tripod** and is potentially a very stable structure (*Tardy, 2005*).

There have been many publications since the landmark article “*Studies on the support of the nasal tip*” by *Janeke and Wright (1971)* that classify the major and minor support elements of the nasal tip. The major support mechanisms can be identified as:-

1. Intrinsic shape and strength of lower lateral cartilages
2. Attachment of the medial crura to the caudal septum
3. Attachment of the upper and lower lateral cartilages

The minor tip support mechanism which in certain anatomic configurations may assume major tip support importance:-

1. Interdomal ligament
2. Ligament of Pitanguy
3. Septum
4. Sesamoid cartilages and their lateral pyriform attachment
5. Nasal skin and superficial musculoaponeurotic system
6. Nasal spine
7. Membranous septum (*Westreich et al., 2007*).

**The Tripod Concept**

*Anderson (1984)*, described the principle of the tripod in order to understand the dynamics of nasal tip surgery. With the patient upright, the Tripod lies on its side with one lower leg and two upper legs. The lower leg is represented by the medial crura, whereas each upper leg consists of a lateral crural complex based bilaterally on the pyriform aperture. The tip of the tripod corresponds to the nasal tip (*Fig. 42*) (*Ingels and Orhan, 2010*).
Fig. (42): The left and right lateral crura separately along with the united medial crura make up the tripod of the nasal tip (Ingels and Orhan, 2010).

In theory, shortening or removing the support of the lower leg of the tripod should move the tip downwards and backwards, (Fig. 43&44), and the same maneuvers on the upper legs should move the tip upward and backward (Fig. 45&46). Shortening or removing the support of all three legs should result in a backward and upward movement of the tip (Fig. 47& 48) (Ingels and Orhan, 2010).

Fig (43)

Fig (44)

Fig. (43) & Fig (44) Shortening or removing the support of the upper leg of the tripod should move the tip upwards and backwards (Tschopp, 1992).
Fig. (45) & Fig. (46): Shortening or removing the support of the lower legs of the tripod should move the tip downwards and backwards (Tschopp, 1992).

Fig. (47) & Fig. (48): Shortening or removing the support of all three legs should result in a backward and upward movement of the tip (Tschopp, 1992).

Lengthening the lower leg of the tripod should move the tip upwards and forwards (Fig. 49). Lengthening the lower leg and shortening the upper leg should accentuate upward movement of the tip (Ingels and Orhan, 2010).
Fig. (49): Lengthening the lower leg of the tripod should move the tip upwards and forwards (Tschopp, 1992).

These are theoretical considerations and the alterations described do not always result in the predicted movement because of other factors that influence tip support and stability. However, this concept is useful when planning nasal tip surgery, as the other factors are kept in mind (Anderson, 1984).

**Grafts in Rhinoplasty**

From a historical perspective, the achievement of adequate nasal tip projection has been addressed by many authors. Autologous overlay tip graft was advocated by Von Mangoldt (1970), to increase tip projection. Goldman (1961), advocated the use of cartilage button placed interdomally, but this method lost popularity because of the circumferential scarring and single point light reflex that is created.

Anderson (1971), popularized the use of cartilaginous columellar strut as a routine part of his open rhinoplasty technique. This basic maneuver is the most significant advance in rhinoplasty during the last 25 years and has formed the basis of open structure rhinoplasty technique. (Johnson et al., 1996).

In the last few decades, numerous grafting techniques have been developed to sculpt the nasal framework in primary and secondary rhinoplasty. These techniques have originated from the basic principle that maintenance of the major supporting structures of the nose is fundamental for aesthetic and functional purposes. Failure to maintain or furnish
needed support results in suboptimal results with deformities that are challenging to correct (*Gunter et al.*, 2004).

In the beginning, a vast variety of grafts were used for augmentation rhinoplasties and autologous cartilage (septum, pinna, and rib) seemed to be the preferred choice because of its low resorption and complication rates (*Bateman and Jones*, 2000).

Some authors have preferred synthetic materials over autologous grafts because of their immediate availability, lack of donor-site morbidity, better adaptability, good immediate results, and low costs. Among these materials, polyamide mesh (Supramid Mesh) first and expanded polytetrafluorethylene (Gore-Tex) later were considered “new miracles of modern chemistry”. Despite their recognized advantages, synthetic materials raise important concerns about infections, extrusions, displacements, and long-term results (*Lohuis et al.*, 2001).

The Properties of an ideal grafting material include:

1. Biocompatible physical properties
2. Resistance to infection
3. No inflammatory response
4. Cost effective
5. Easy removal
6. Non resorbable
7. No migration
8. No transmission of disease
9. Easy to modify or mold
10. Non carcinogenic
11. Easy to obtain

Grafting materials available for rhinoplasty can be summarized in the following table (2)

Advantages and disadvantages of each of the graft materials is listed in table (3)

**Table (3):** Advantages & disadvantages of graft materials (Lin and Lawson, 2007).

<table>
<thead>
<tr>
<th></th>
<th>Autografts</th>
<th>Homografts</th>
<th>Allografts</th>
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<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Biocompatibility</td>
<td>Biocompatibility</td>
<td>Strength</td>
</tr>
<tr>
<td></td>
<td>Strength (bone)</td>
<td>Strength (bone)</td>
<td>Elasticity</td>
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<tr>
<td></td>
<td>Ability to contour (cartilage)</td>
<td>Ability to contour (cartilage)</td>
<td>Durability</td>
</tr>
<tr>
<td></td>
<td>Ability to camouflage (fascia)</td>
<td>Ability to camouflage (fascia, alloderm)</td>
<td>No donor site morbidity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No donor site morbidity</td>
<td>Unlimited supply</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unlimited supply</td>
<td>Decreased surgical time</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>Donor site morbidity</td>
<td>Increased resorption</td>
<td>Higher extrusion rate</td>
</tr>
<tr>
<td></td>
<td>Memory (cartilage)</td>
<td>Warping (cartilage)</td>
<td>Higher infection rate</td>
</tr>
<tr>
<td></td>
<td>Resorption</td>
<td>Extrusion</td>
<td>Higher cost</td>
</tr>
<tr>
<td></td>
<td>Limited material</td>
<td>Higher infection rate</td>
<td>Patient confidence with implant safety</td>
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<tr>
<td></td>
<td>Warping</td>
<td>Higher cost</td>
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<tr>
<td></td>
<td>Displacement</td>
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<td></td>
<td>Increased surgical time</td>
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</table>

Autologous cartilage graft can also be classified into four groups according to graft origin:

1. Septal cartilage grafts
2. Auricular cartilage grafts
3. Bone graft (mainly Costal cartilage grafts)
4. Composite grafts (septal and auricular) (*Araco et al., 2006*).

**Cartilage grafts have many advantages over bone grafts**

- Cartilage has a much lower resorption rate than bone because cartilage survives without a vascular supply
- Cartilage is soft and pliable
- Cartilage graft gives a more natural feeling to the nose than bone graft. The chondrocytes survive by diffusion rather than by direct vascular in growth (*El-Sahy, 2000*).

**Septal cartilage graft:-**

Septal cartilage is the best choice for simple rhinoplasties, but quite often it is not sufficient when large amounts are necessary or when the nose has already undergone surgery.

Advantages of septal cartilage graft include :-

1. Easy harvest
2. Present in the surgical field (no separate donor-site morbidity)
3. Straight (good for certain purposes, such as a columellar strut)

Disadvantages of septal cartilage graft includes:-

1. May be deficient
2. Straight (less desirable as batten graft (*Araco et al., 2006*).)

**Auricular cartilage grafts:-**

It is the most frequent site for donor cartilage because it always provides sufficient amounts of graft material even for difficult aesthetic purposes.

Advantages of auricular cartilage graft include:-

1. Easy harvest
2. Relatively abundant
3. Curved nature ideal for certain purposes

Disadvantages of auricular cartilage graft include:-
1. Separate donor site
2. Curved (less desirable for some purposes) \textit{(Araco et al., 2006)}.

\textbf{Rib graft:-}

Costal cartilage (9th to 11th ribs) should be used only in selected cases in which a considerable amount of cartilage is required and septal or auricular cartilage is insufficient.

Advantages of rib graft include:-

1. Large volume (abundant, even for significant augmentation)
2. Distant donor site (2-team approach possible)
3. Reliable

Disadvantages of rib graft include:-

1. Donor-site morbidity
2. Warping possible \textit{(Araco et al., 2006)}.

The most commonly utilized grafts in modern rhinoplasty are divided by alphabetical order according to their intended location on the nose in \textbf{Table (4)}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Dorsum & Tip & Alar region & Base \\
\hline
 & & 2.Alar contour graft & 2.Columellar \\
\hline
\end{tabular}
\caption{\textit{Overview of rhinoplasty grafts by region (Gunter et al., 2004).}}
\end{table}
<table>
<thead>
<tr>
<th>Tip grafts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Anchor graft:</strong></td>
</tr>
</tbody>
</table>

| 2. Dorsal sidewall onlay graft   |
| (lateral nasal wall graft)       |
| 3. Radix graft                   |
| 4. Spreader grafts               |
| 5. Septal extension grafts       |

| 2. Cap graft                     |
| 3. Columellar strut (floating/fixed-floating) |
| 4. Columellar strut (fixed)      |
| 5. Extended columellar strut-tip graft |
| 6. Onlay tip graft               |
| 7. Shield graft                  |
| 8. Subdomal graft                |
| 9. Umbrella graft                |

| (alar rim graft)                 |
| 3. Alar spreader graft (lateral crural spanning graft) |
| 4. Composite alar rim graft      |
| 5. Lateral crural onlay graft    |
| 6. Lateral crural strut graft    |
| 7. Lateral crural turnover graft |

| plumping graft (s)               |
| 3. Premaxillary graft            |
The anchor graft is an anchor-shaped graft whose shaft is sutured to the caudal margin of the medial crura. The transverse components (wings) may replace the lateral crura or lie over their remnants and are sutured to them. Anchor grafts may be used to improve tip support and/or projection and collapse or deformation of the lateral crura. The graft is harvested from the auricular concha and is then designed according to the patient’s needs. Symmetrical carving of the wings may be difficult due to the asymmetries of the conchal bowl (Fig. 50) (Gunter et al., 2004).

![Anchor Graft](image)

**Fig. (50): Anchor Graft (Gunter et al., 2004).**

2. **Cap cartilage:**

   A cap graft is a small graft placed in the space between the tip-defining points and the middle crura (Fig. 51). It is a quadrangular cartilage graft, with the wider aspect of the graft overlying the domes and the narrower aspect tapered over the lower lateral crura. The graft edges are carefully beveled, and it is sutured in position overlying the domes to provide definition to the tip (Fig. 52) (Whitaker and Johnson, 2003).

   The graft is used to refine, soften, and fill in clefts of the nasal tip in patients with thin skin, to minimally enhance tip projection and occasionally refine the infratip lobule area. The preferred source of cartilage is from remnants obtained from the cephalic trim of the lower lateral cartilages, but septal, auricular, or rib cartilage may also be utilized. (Rohrich et al., 2001).
Fig. (51): Cap graft (Gunter et al., 2004).

Fig. (52): Cap graft. The graft is a quadrangular piece of cartilage with beveled edges. It is tapered posteriorly to blend with the underlying tip cartilages. It is sutured into position, overlying the domes (Whitaker and Johnson, 2003).

3. **Columellar Strut (Floating/Fixed Floating):**

A floating columellar strut is a graft placed in a tight pocket dissected between the medial crura through a small incision caudal to the feet of the medial crura (endonasal approach) (Fig. 53). It strengthens the central limb of the tripod. If there is any inherent buckling or weakening of the medial crura, the columellar strut provides a strong stable foundation. The fixed-floating columellar strut (open approach) is sutured to the medial crura for stabilization. A 2- to 3-mm pad of soft tissue is usually maintained between the graft and the nasal spine to keep the graft from moving back and forth over the spine with lip movements. The columellar strut helps in
maintaining tip support and increasing tip projection and aids in shaping the columellar-lobular angle (Gunter et al., 2004).

Septal cartilage is preferred, but costal cartilage is used when a stronger strut and more enhanced projection are desired. Auricular cartilage may be used, but a double layer should be used if strength is needed (Gunter et al., 2004).

![Fig. (53): Columellar strut (floating/fixed floating) (Gunter et al., 2004).](image)

4. **Columellar strut (Fixed):**

Columellar struts may be fixed to the nasal spine or premaxilla to give more stable support to the nasal tip (Fig. 54). A fixed columellar strut is the most effective way of increasing tip projection with a strut and can also aid in lengthening the nose. When using rib cartilage, more stabilization and control are obtained by using a 0.035-inch threaded Kirschner wire inserted longitudinally in the strut (a Kirschner wire cannot be placed in septal cartilage because it is too thin). The Kirschner wire should be inserted up to three-quarters of the length of the strut, with 10 mm left exposed at the base. This is then placed in a 12-mm drill hole just lateral to the maxillary midline, parallel and inferior to the nasal floor. When fixed with a Kirschner wire, the medial crura can be advanced and sutured to the strut to control projection, and rotation can be controlled by the angle made in the Kirschner wire at the base of the strut (Gunter et al., 2004).
5. **Extended Columellar Strut-Tip Graft (Extended Shield Graft):**

The extended columellar strut-tip graft is an elongated, shield-shaped graft that lies caudal to or between the medial crura and extends anteriorly to project beyond the domes and posteriorly toward the medial crural footplates (Fig. 55). The graft is used to provide tip support, projection, definition, and fullness caudal to the medial crura to aid in shaping the columella. *(Pastorek et al., 2005)*.

It is stabilized in a tight pocket in the precrural space (endonasal approach) or by placing it caudal to or between the medial crura and suturing it in place to the crura (open approach). The anterior end of the graft is rounded and shaved extremely thin to prevent visibility. The further the tip of the graft extends above the tip-defining points, the more it will tend to bend backward. If the bending is more than desired, a small rectangular block of cartilage may be sutured to the domes behind the graft *(Pastorek et al., 2005)*.

This results in increased stability and a barrier against bending upward with loss of tip projection and increased infratip lobular show *(Pastorek et al., 2005)*.
Fig. (55): Extended columellar strut-tip graft (extended shield graft) (Gunter et al., 2004).

6. **Onlay Tip Graft:**

An onlay tip graft is a single or multilayered graft placed horizontally over the alar domes (Fig. 56). It is placed in a tight pocket if the endonasal approach is used or sutured for stabilization in the open approach. The onlay tip graft is used to minimally increase tip projection but mainly to camouflage tip irregularities. The edges of the graft must be beveled or crushed to avoid postoperative visibility. This graft acts as the transverse component of the umbrella graft (Peck et al., 2002).

Fig. (56): Onlay tip graft (Gunter et al., 2004).
7. **Shield Graft (Sheen or Infralobular Graft):**

This shield-shaped graft is placed adjacent to the caudal edges of the anterior middle crura, extending into the tip (Fig. 57) *(Sheen, 1993)*. The shield graft is used to increase tip projection, define the tip, and improve contour of the infratip-lobule. Additional tip projection can be achieved by moving the graft more anteriorly above the tip. If used with the endonasal approach, it is stabilized by placing it in a tightly undermined pocket. If the open approach is used, it is sutured to the caudal margins of the cartilages. To avoid excessive cephalad tilting of the graft, a small “block” graft can be sutured to the alar domes to increase the stability. The shield graft is carved with a smooth curvature rather than a strong bidomal shape to provide softer definition to the tip. The graft edges should be beveled to make them softer and less visible (Fig. 58) *(Gunter et al., 2004)*.

The shield graft can be further camouflaged by placing a *Buttress graft* immediately behind the tip graft to smooth the transition. The buttress graft is a rectangular or quadrangular piece of either septal or conchal cartilage carved with beveled edges and sutured in place behind the shield graft. The buttress graft can also support and prevent retro displacement of the tip graft. This is particularly important when the tip graft projects significantly above the underlying nasal tip skeleton. The contour of the shield graft can be tailored to the desired effect *(Whitaker and Johnson, 2003)*.

Aggressive beveling to thin the leading edge allows the tip graft to bend slightly and more directly overlie the domal units. Suturing directly to the apex of the domes generally creates tension in the nasal tip and should not be done unless the graft abuts the domes, tension free. Less beveling and thinning should be used if significant projection of the shield graft above the domal units is required. A buttress graft is often used in this instance for support and contour *(Whitaker and Johnson, 2003)*.
8. **Subdomal Graft:**

A subdomal graft is a bar-shaped graft placed in a pocket under the domes (Fig. 59). The subdomal graft corrects dome asymmetry by controlling the horizontal and vertical orientation of the domes. It may also be used to correct the pinched nasal tip deformity. Septal cartilage is the preferred graft material (Guyuron, 2006).
Fig. (59): Subdomal graft (Gunter et al., 2004).

9. **Umbrella Graft:-**

The umbrella graft is composed of a vertical columellar strut combined with a horizontal onlay graft (Fig. 60). This graft is used in patients with both inadequate tip projection and inadequate support. The edges of the graft’s transverse component should be beveled or to avoid postoperative visibility. It is usually stabilized by placing the transverse component in a small tight pocket (endonasal approach) or by suturing it to the domes of the lateral crura (open approach) (Peck et al., 2002).

Fig. (60): Umbrella graft (Gunter et al., 2004).
Tip sutures

Rhinoplasty in the 20th century places more emphasis on surgery of the nose for aesthetic reasons than ever before. The increased use of cartilage excision techniques in aesthetic rhinoplasty often resulted in disruption of the nasal tip components, with inconsistent outcomes. Thus, sutures served to hold the disrupted tip components and then reposition them in place. In the 21st century, there was a rapid transition from disruptive cartilage altering techniques to procedures that made use of precision suture placement for reshaping of the nasal tip cartilages without serious disruption of the components. Surgical results are more predictable with increased reliance on sutures placed with precision and with an understanding of the dynamic that they induce when used singly or in combination. Currently, instead of excising and repositioning of the tip cartilages, the focus is on lateral crus preservation and tip cartilage modification through precise suture placement and tension control (Mao et al., 2008).

Evolution of suture placement in the nasal tip is elicited in (table 5):

Table (5): Evolution of suture placement in the nasal tip (Behmand et al., 2003).

<table>
<thead>
<tr>
<th>Surgeon</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joseph 1931</td>
<td>Orthopedic suture: columella septal suture (interdomal and medial crura anchor sutures).</td>
</tr>
<tr>
<td>Goldman 1954</td>
<td>Lateral crura divided just lateral to domes, medial crura sutured together (medial crural, middle crura, and interdomal sutures).</td>
</tr>
<tr>
<td>McIndoe and Rees 1959</td>
<td>Cleft nose repair: alar cartilage repositioned with medial crural and lateral crural sutures (medial crura anchor and medial crural sutures).</td>
</tr>
<tr>
<td>Author(s) and Year</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>McCollough and English 1985</td>
<td>Double-dome unit: morselization of domes; horizontal mattress through both medial and lateral crura under domes (early transdomal and interdomal sutures)</td>
</tr>
<tr>
<td>Tardy and Cheng 1987</td>
<td>Transdomal suture: horizontal mattress through both domes with knot placed interdomally.</td>
</tr>
<tr>
<td>Daniel 1987</td>
<td>Domal creation sutures: an individual horizontal mattress suture placed across each dome</td>
</tr>
<tr>
<td>Kridel et al. 1989</td>
<td>Lateral crural steal technique</td>
</tr>
<tr>
<td>Tebbets 1989,1994</td>
<td>Systematic nondestructive approach: specific sequence of suture placement; medial crura anchor suture, medial crura footplate suture, medial crura suture, lateral crura suture, tip rotation sutures</td>
</tr>
<tr>
<td>Gruber 1997</td>
<td>Lateral crura convexity control suture</td>
</tr>
<tr>
<td>Guyuron 1998</td>
<td>Medial crura footplate suture refinement</td>
</tr>
</tbody>
</table>

For many years it was believed that permanent sutures would be necessary to achieve a permanent effect on cartilage contour. That has simply not been proven true. Polydioxanone (PDS) sutures work just as well as permanent sutures and have the benefit of not causing stitch reactions (by protruding through the skin) or microabscesses that manifest as a bad odor noted by the patient. As for suture size, 5-0 PDS is empirically the size of choice for tip cartilages (*Gruber et al.*, 2002).

There are 5 basic suture techniques used in tip plasty:

1. Transdomal suture
2. Interdomal suture
3. The lateral crural Mattress suture
4. Columella-Septal Suture
1. **Transdomal suture:**

   The transdomal suture is perhaps the single most important suture technique for bringing the tip cartilages under control (Fig. 61). Standing at the head of the patient’s bed, one simply grasps the dome with a Brown-Adson forceps, squeezes it gently, and applies a mattress suture, beginning on the medial side of the dome. It is important that the transdomal suture is centered on the width of the cartilage; otherwise, it may result in unexpected and frequently undesirable changes in the lateral crus. To be certain that the vestibular skin has not been penetrated, it is helpful to temporarily leave the needle in place (as it passed through the dome cartilage) and then use the needle holder to palpate the underside of the dome to check for needle exposure. It is easy to see that the domes have an axis and orientation a cephalic and caudal end. The dome no longer looks like a small parachute as it did before resection of the cephalic lateral crus. The axes of the 2 domes form an angle of domal separation that is about 60 to 90 degrees. If for some reason the angle is abnormal, it can be altered by removing the suture, re-grasping the dome so that the axis angle is altered, and then reinserting the transdomal suture (Jang and Sinha, 2010).

2. **Interdomal suture:**

   The interdomal suture provides tip strength and symmetry (Fig. 62). This stitch is particularly important if the domes are weak and tend to splay apart; however, the purpose of the interdomal suture is not to bring the domes in contact with each other. There is usually about 3 mm between the cephalic ends of the domes, a distance that is not absolute, if
the domes are large and divergent, you might want less distance between the cephalic ends of the domes so that overall the tip is not too wide. To achieve that end, a 5-0 PDS suture is applied between the middle crura (on the cephalic side) and about 3 to 4 mm below (posterior) to the dome. The overall nasal tip width is controlled by the interdomal suture, as well as the transdomal sutures. In men, a wider tip width is planned for than in women, controlled by both the interdomal and transdomal sutures (Cardenas-Camarena and Guerrero, 2003).

Fig. (62): An interdomal suture brings the 2 tips together (Gruber et al., 2002).

3. The lateral crural Mattress suture:

The underside of the lateral crus is infiltrated with anesthesia and a horizontal mattress suture (5-0 PDS) is applied at the apex of the lateral crus convexity (Fig. 63). Standing at the head of the patient’s bed, the lateral crus is grasped with a Brown-Adson forceps, and the needle is passed on one side of the forceps perpendicular to the long axis of the lateral crus. The lateral crus should be slightly folded around with the forceps so that the smallest possible purchase can be made with the needle. A second purchase is made on the other side of the forceps at a distance of about 6 to 8 mm from the first purchase. The resulting knot is cinched until the convex crus flattens. Tying the knot too tightly may cause unwanted concavity of the lateral crus. There is frequently residual convexity in the posterior aspect of the lateral crus, which should, accordingly, receive a second mattress suture. Occasionally, a third mattress suture may be necessary to achieve a straight lateral crus. Each suture provides an approximately 30% increase in strength to the lateral crus (Nahai et al., 2011).
4. **Columellar-septal suture:**

The principle of the columella-septal suture is evident in similar suture techniques that also attempt to secure the tip cartilages to the caudal septum to effect both tip projection and rotation. With this suture technique, a large needle is passed between the leaves of the middle crura. (There are many fibers between the middle crura, allowing for very good purchase.) The needle is then passed through the anterior septal angle, which is usually at a more anterior level to the Columellar septal entry (Fig. 64) (Kuran et al., 2005).

In recent years, it is noted that 2 bites of the anterior septal angle are preferable because, occasionally, a single suture may pull out. The needle is then passed back between the leaves of the middle crura. If there is a transfixion incision, a clamp is placed between the tip cartilages and caudal septum to prevent over tightening of the knot (Kuran et al., 2005).

As the knot is slowly tightened, it pulls the tip cartilage up against the caudal septum, correcting any existing hanging columella and also providing a small amount of tip projection. “Small amount” is emphasized because the Columellar septal suture is not a replacement for the columellar strut. It should be thought of as a suture technique that fine tunes the position of the tip cartilages with respect to the caudal septum (Kuran et al., 2005).
5. **Intercrural suture:**

Not infrequently the middle crura splay at their caudal ends yielding what will undoubtedly be a wide columella. When inserting a columellar strut, the middle crura also tend to separate or splay. Consequently, an intercrural suture, which is simply a mattress suture, can be used to reduce the width of the cartilages in this location (Fig. 65). A 5-0 PDS is used to take a purchase of the inside of the middle crus (from posterior to anterior) on one side and then another purchase on the contralateral side. The knot will be located between the middle crura. Care is taken not to tie the knot too tightly to avoid overly narrowing the normal middle crus width. Again, use of a model helps to determine what is a normal width in this region. If a columellar strut has been placed between the middle crura the needle simply picks up the strut in its path from one middle crus to the other (Gruber et al., 2002).

*Fig. (64):* Columella-septal suture (Gruber et al., 2002).

*Fig. (65):* The intercrural suture (Gruber et al., 2002).
Secondary procedures used in tip rhinoplasty

1- Air way patency management:

Management of the air way could be therapeutic in symptomatic cases, or even prophylactic in patients with defective nasal valves. Airway obstruction is caused by multiple factors in the patient with a cleft nasal deformity. The septum is frequently dislocated off of the vomer on the non-cleft side, with subsequent curvature into the cleft side airway. External valve malfunction can also be a significant cause of an obstructed airway and related to a weak lower lateral cartilage, poor alar base position, and a non-anatomic relationship of the alar base with the cheek muscles (Byrd et al., 2007).

Correction of the external nasal valve:

Via dissection of the cheek muscles and repositioning of these muscles in their attachment to the ala together with strengthening of the LLC by tip grafts as anchor and columellar strut grafts (Byrd et al., 2007).

Correction of the internal nasal valve:

Spreader grafts are extraordinarily versatile and can be used to help stent open the internal valve. Recently a composite conchal chondro-cutaneous grafts is used to form the nasal tubercle, nostril sill, filling the deficiency of the vestibule, and supporting the upper lateral cartilages as well as to maintain better internal valve function (Ayhan et al., 2006).

Spreader grafts are rectangular strips of cartilage placed between the septum and the upper lateral cartilages. Spreader grafts are helpful in circumstances when widening of the middle third is needed, a relatively uncommon but obvious circumstance. Also, spreader grafts can provide important additional support of the middle third of the nose in certain types of patients.

Spreader grafts are matchstick-sized pieces of cartilage or vomerine bone that restore the normal dorsal width of the septum which has been lost during dorsal reduction (Fig. 66). They can correct asymmetries, prevent an inverted-V deformity, and avoid a pinched nose. Functionally,
they spread the upper lateral cartilages outward while restoring the 10-15° aperture of the internal valve and maintaining an aesthetic middle vault. They are easily cut to the desired length (20-25mm) and height (2.5-3.3.5mm), varies with the desired aesthetics of the middle vault. Most surgeons elevate the mucosa along the dorsal cartilaginous septum and create small pockets cephalically beneath the remaining intact dorsum (Beker, 2003).

![Figure 66: Spreader graft (Gunter et al., 2004).](image)

**2- Columellar lengthening:**

Short collumella is considered one of the most challenging deformities of the cleft lip nose. Different techniques have been described in literatures for columellar lengthening. Cronin was among the first to describe delayed columellar lengthening by the use of V-Y advancement of bipedicled nasal floor flap (Cronin et al., 2001).

Recently some authors prefer the use of composite cartilage-vestibular lining flap for correction the unilateral cleft lip nasal deformity with satisfactory results over 20 year experience (Lewis et al., 2007).

Another flap termed scar flap is used by some authors for secondary reconstruction of the nasal deformity. It is a skin flap having a pedicle based on the columellar base of the cleft side containing the original scar.
of the primary cleft repair. It is used to improve the columellar height together with the improvement of upper lip length. There are also other techniques which are used in columellar skin lengthening such as Bardach’s V to Y technique as well as Cutting & Grayson’s technique with chondro-mucosal flaps (Duskova et al., 2011).

3- Augmentation of the pyriform aperture:

Hypoplasia can result from an alveolar cleft; however, even after successful bone grafting, the pyriform aperture may need augmentation with cartilage or alloplastic materials. The base grafts include alar base grafts, columellar pluming grafts and premaxillary graft. Currently, there are available alloplastic grafts and bone substitutes used in augmentation of hypoplastic maxilla (Byrd et al., 2007).

4- Symmetrization and centralization:-

The nasal columellar as well as nasal tip deviation are common findings in cases of unilateral cleft lip nasal deformity. The deviation is caused by many factors as deviation of the midline of the maxilla, deviated septal cartilage due to growth discrepancy an both sides as well as distal and downward dislocation of LLC on the cleft side.

In order to correct these deformities, dissection around the anterior nasal spine is needed, then repositioning of the inferior base of the septal cartilage, freeing and repositioning of LLC by over-lapping on the ULC together with using of caudal septal extension graft (Nakamure, 2011).

Also, inter-domal suture provides more tip symmetry (Cardenas camarena and Guerreror, 2003).

5- Correction of the dorsum:

The dorsum in case of cleft lip nasal deformity may be deficient or over-projecting.

Deficient dorsum:

Reconstruction of a nose with a deficient dorsum requires a rib graft. The tenth-rib cartilage is preferentially to be harvested, which will provide a 33mm segment for use as a columellar strut and a 40mm segment to use for a dorsal spreader graft. Cleft noses will often have
thick soft tissues and require columellar strut projection of 8 to 12mm beyond the dorsum (Gunter and Friedman, 1997).

**Over projecting dorsum:**

In a cleft nose with an over-projecting dorsum, the septum and nasal bones must be reduced. The excess upper lateral cartilage is preferred to be used as a turn-in flap, which can be reinforced with a traditional spreader graft on the concave side. Once reduced, the nasal bones is narrowed with percutaneous J-osteotomies (Bryd et al., 2007).

**6- Nostril size:**

In order to maintain proper nostril size, the nasal sill and the alar rim should be managed.

Alar base and lateral crus are managed, specifically, if the accessory chain of the lateral crus remains attached to the pyriform aperture, it needs to be released by dissecting the peri-alar muscles from the cheek and lip muscles. This dissection goes up to the nasal lining and involves a release of the fibrous attachments to the pyriform aperture. The mobilization also extends across the nasal sill and the midline dissection of the columella.

Once completely released, the ala should be freely mobile across the cleft. The alar base is then sutured to the non-cleft side medial footplate. This rotates and repositions the alar base and brings muscle across the nasal sill. Finally, a suture is placed from the released portion of the lateral crus to the cheek muscles to create a functional cleft side external valve by attaching the released cheek muscles to the external valve.

If the nasal sill is not adequately reconstructed, not only will there be a soft tissue hollow, but the ala will not be adequately rotated inward and will remain lateralized (Byrd et al., 2007).

Then, it is necessary to deal with repositioning the malpositioned ala. In the definitive repair, the hypoplastic nature of the lower lateral cartilage must be also addressed. This is done with both alar strut graft and alar contour graft. Alar strut grafts will usually measure 3 to 4mm by 28 to 30mm and are placed in a pocket created by elevating the lining on the underside of the cartilage. The strut graft stabilizes external valve
incompetence that can be produced by the lateral release. An alar contour graft of residual septum is then fashioned to span from the dome out beyond the alar crease. These grafts essentially sandwich the abnormal alar cartilage (Rohrich et al., 2002).

Domal mattress sutures are added to further define the domes. The domes are sutured over the projecting rib columellar strut. A slight over-projection of the cleft lateral crus and domal segment is allowed to compensate for the tight soft tissue envelop on the cleft side (Byrd et al., 2007).

7- Alar web:

One of the problems encountered when correcting cleft lip nasal deformities is the alar web deformity on the medio-superior side of the nostril. Several methods have been introduced to correct this particular deformity, Straith performed alar-columellar web correction with a modified Z-plasty techniques (Cho, 2007).

Tajima and Maruyama described a reverse-U incision with the suture suspension of the repositioned cleft LLC, which produced a good nasal contour (Tajima and Maruyama, 1997).

Holt performed an excision of the skin above the rim margin and lifted the nostril roof into a new position (Holt, 1986).

However, when the cleft LLC is repositioned, a shortage of skin can be problematic, particularly in the alar web and vestibular area. Nakajima and colleagues modified the technique by adding Z-plasty in the lateral nasal vestibule to correct the alar-columellar web and prevent tightness in the vestibular area after rotation of the muco-chondrial flap (Nakajima et al., 1986).
Complications after management of cleft lip nasal deformity

Complications of rhinoplasty can be classified into hemorrhagic, infectious, traumatic, functional, or aesthetic problems. A thorough knowledge of the principles of postoperative management of these rhinoplasty complications can minimize their deleterious effects and preserve an aesthetic outcome. Nevertheless, both complications and suboptimal results do occur, even for experienced surgeons (Cochran and Landecker, 2011).

1. Hemorrhagic:
   a. Epistaxis

   Postoperative bleeding is one of the most common complications after nasal surgery. Epistaxis is most frequently mild. Fortunately, mild postoperative bleeding can generally be controlled with 60-degree head elevation, gentle nostril pressure for 15 minutes, and application of topical decongestant nasal sprays such as phenylephrine (Cochran and Landecker, 2011).

   b. Septal Hematoma

   A septal hematoma is a potentially serious complication of rhinoplasty. Patients may present with symptoms of nasal obstruction, pain, rhinorrhea, or fever. The typical finding on physical examination is an ecchymotic nasal septal mass. An untreated septal hematoma can have serious implications, as it may lead to cartilage necrosis with subsequent loss of dorsal support and a saddle-nose deformity (Canty and Berkowitz, 2003).

2. Infectious complications:

   Postoperative infections following rhinoplasty can range in severity from mild cellulitis of the soft tissue envelope to life-threatening systemic illness resulting from cavernous sinus thrombosis or toxic shock syndrome. Toxic shock syndrome, an acute, multisystem disease, has been described after nasal surgery with the use of both nasal packing and intranasal splints. Toxic shock syndrome is usually caused by the release
of an exotoxin, toxic shock syndrome toxin, created by *Staphylococcus aureus*. Treatment requires the immediate removal of the offending object, intensive care unit admission, intravenous antibiotics and supportive care (*Cochran and Landecker*, 2011).

Prior to surgery, it is important that the infant should be healthy and well nourished. This decreases the incidence of postoperative wound infection. Postoperatively, a dressing with an antibiotic ointment applied for only the first 24 hours to absorb serosanguinous drainage keeping it for longer time results in soiling from feeding. Systemic antibiotic are not routinely used (*Cronin et al.*, 2001).

Infection at the site of the premaxillary setback; this can be occurred in infant who received presurgical orthodontic manipulations. This may result in failure of bony union. A bone graft of the vomer might be of value (*Cronin et al.*, 2001).

3. **Traumatic complications:**

a. **L. Strut fractures**

When harvesting septal cartilage, most authors recommend preserving a 1-cm-wide septal L-strut that should remain attached to the perpendicular plate of the ethmoid and the nasal spine–maxillary crest area. When L-strut fractures occur, they should be repaired immediately to prevent significant deformity because the cartilaginous septal segment tends to rock posteriorly, resulting in a loss of dorsal support and a saddle-nose deformity (*Gunter and Cochran*, 2006).

b. **Intracranial Injury and Cerebrospinal Fluid Leak**

Intracranial injury and cerebrospinal fluid leaks are a major complication after Rhinoplasty. Violation of the cribiform plate by surgical instruments can result in a cerebrospinal fluid leak and potential intracranial injury or infection. Symptoms of a cerebrospinal fluid leak include clear rhinorrhea and positional headache. A cerebrospinal fluid leak necessitates hospitalization, bed rest, and prompt otolaryngologic and neurosurgical evaluations with potential placement of a lumbar drain (*Cochran and Landecker*, 2011).
c. Epiphora

Epiphora after rhinoplasty most commonly occurs due to compression of the lacrimal system by the characteristic soft-tissue edema. Fortunately, this normally resolves after 1 to 2 weeks. Treatment of these injuries may require early silicone intubation of the lacrimal system *(Cochran and Landecker, 2011)*.

d. Septal perforation

Septal perforations are most often caused by opposing tears in the elevated septal mucoperichondrial flaps with no intervening septal cartilage. However, perforations may also result from significant interruption of blood flow to the septal mucoperichondrial flaps from an unrecognized septal hematoma or tissue necrosis from septal stitches. Symptoms of a nasal septal perforation include crusting, bleeding, whistling, and nasal airway obstruction due to disruption of the normal laminar airflow through the nasal passages. Symptom severity should guide the decisions for treatment *(Cochran and Landecker, 2011)*.

4. Functional complications:

a. Intranasal adhesions

Synechiae are intranasal adhesions that result from cicatrical healing of opposed, abraded mucosal surfaces. Patients may present with nasal obstruction. Intranasal examination will reveal a “bridge” of mucosa from the septum to the inferior turbinate, middle turbinate, or lateral nasal wall Treatment requires division and placement of a barrier between the incised surfaces, such as a Silastic splint, until the surfaces undergo complete re-epithelialization *(Cochran and Landecker, 2011)*.

b. Postoperative septal deviation

Septal deviation, whether new or uncorrected, following septorhinoplasty is a source of frustration for both the patient and the surgeon Any significant septal deviation that persists and causes cosmetic or functional impairment should invite the discussion of revision surgery. There has been considerable debate over the need
and optimal means of internal splinting of the septum. While most surgeons do not routinely pack the nose, it was found that patients in whom nasal packs were used were less likely to develop recurrent or residual septal deviation and synechiae compared with patients in whom no packing was used (Malki et al., 2002).

c. Rhinitis

Over resection of intranasal structures such as the middle or inferior turbinate can lead to atrophy of the nasal mucosa, referred to as atrophic rhinitis. Patients may present with subsequent symptoms of dryness, crusting, and nasal obstruction. Nasal saline may provide symptomatic relief. More commonly, patients may report a spontaneous clear watery nasal discharge. This phenomenon most likely represents a variant of vasomotor rhinitis caused by abnormal parasympathetic tone to the intranasal mucosa. Topical anticholinergic preparations, such as 0.03% ipratropium bromide, act locally and are effective in decreasing watery rhinorrhea. Continued symptoms of watery nasal discharge despite appropriate topical therapy should raise the concern for an occult cerebrospinal fluid leak (Cochran and Marple, 2004).

5. Aesthetic complications:

a. Lip abnormality or asymmetry: lip scars, long lip, short lip, tight lip (whistle deformity), vermilion deficiency or deformity, loss of philtral definition and obliteration of cupid’s bow (Jackson and Fasching, 2004).

b. Whistle deformity

This deformity occurs when the prolabium is small or the lateral lip element is full. The resultant scar is usually tight with notched or depressed central vermilion. Whistle deformity can be prevented by using lateral muscle vermilion flaps to augment the thickness of the prolabium (Cronin et al., 2001).

c. Nasal deformity: the tip of the nose is deflected toward the non-cleft side, the dome in the cleft side is retrodisplaced, the angle between the medial and lateral crura on the cleft side is excessively obtuse, the ala buckles inward on the cleft side, the alar-facial groove on the cleft side is absent, the alar-facial attachment is at an obtuse angle, the
circumference of the naris is greater on the cleft side, the columella is shorter in the anteroposterior dimension on the cleft side, the medial crus is displaced on the cleft side, The columella is positioned obliquely, with dorsal ends slanted towards the non-cleft side (Jackson and Fasching, 2004)

6. **Soft tissue complications:**

   a. **Postrhinoplasty Nasal Cysts**

   Post rhinoplasty nasal cysts are a rare complication of Rhinoplasty. Lipo-granulomas and Mucous cysts are the most common. The most common site of occurrence for both types of cysts is the nasal dorsum. They are thought to arise from ectopic or displaced mucosa and ointment extravasation into osteotomy sites (Bassichis and Thomas, 2005).

   b. **Contact Dermatitis and Skin Necrosis**

   Contact dermatitis may result from irritation of the skin by the topical adhesives, tape, or dorsal splint. The treatment of contact dermatitis includes removal of the offending agent and application of topical and potentially systemic steroids, depending on the severity of the reaction. Fortunately, contact dermatitis usually resolves without any permanent sequelae. Superficial skin necrosis or epidermolysis can occur secondary to excessive compression of the skin by the taping and dressing. The treatment of minor skin necrosis should initially be conservative. Fortunately, major skin necrosis is extremely rare. In these cases, reconstruction should be performed using local or regional flaps (Cochran & Landecker, 2011).

   c. **Telangiectasia**

   Telangiectasia is small superficial vessels of the skin visible to the human eye and usually measure 0.1 to 1.0 mm in diameter. While telangiectasia of the nose has been reported to result from rhinoplasty, their incidence following surgery is unknown. (Scheepers and Quaba, 2003).

7. **Wound disruption or spreading of scar:**
This is always due to excessive tension, but infection could initiate or complicate the problem. Prevention is best by reducing the marked disparity between the premaxillary segment and tow maxillary segments before repairing the lip. If the wound does break down, efforts to support it with tapes (steri-strips) and no definitive repair should be attempted until the inflammation has subsided (*Cronin et al., 2001*).
Patients and methods

In our study, twenty five patients having cleft lip nasal deformity underwent rhinoplasty to correct the nasal deformity in which the definition and position of the nasal tip were the corner stones in evaluation of the net aesthetic result. These patients were managed in Kasr Eleni and Benha University hospitals during the period from January 2013 to June 2014.

All the patients who participated in this study had late cleft lip nasal deformities "either with no previous attempts was performed for cleft lip repair (4 patients) or repaired cleft lip (21 patients). The secondary nasal deformity resulted from either insufficient primary rhinoplasty during early repair of the cleft lip with residual secondary nasal deformity (5 patients) or not previously repaired cleft lip nasal deformity (20 patients). Out of the 25 patients, only 3 patients had bilateral cleft lip, while the other 22 patients had unilateral cleft lip.

The age of the patients ranged from thirteen years to thirty one years (average 17 years). There were fourteen females and eleven males.

Exclusion criteria:

1- Patients with medical diseases that cannot tolerate general anesthesia.
2- The patients with previous fracture of nasal bones or previous facial trauma to exclude presence of traumatic nasal deformity.
3- Patients with primary cleft lip nasal deformity to allow the study of secondary cleft lip nasal repair (except patients older than 12 years old with no previous attempts for previous repair).

Preoperative assessment
1- **Clinical parameters:**

All patients underwent complete history taking and clinical examination. The nasal deformities were recorded with pre-operative photos together with any residual deformity in the lip.

Out of the 25 patients, four patients had no previous attempts for repair of the cleft lip. Twelve cases had unpleasant scar from the previous operation. Five cases had short lip. Seven cases had notched vermilion. Ten of the patients had irregularities in the white line. Septal deviation was detected in nine patients. The nasal dorsum was deficient (saddle) in 16 patient, humpy (over projecting) in 6 cases and apparently normal in the rest 3 patients (Fig. 67).

![Fig. (67): Various lip deformities:](image)

(A) Male patient with unpleasant lip scar
(B) Female patient with irregular white line
(C) Male patient with unrepaired cleft lip
(D) Female patient with notched vermilion.

2- **Preoperative investigations:**
Operative technique

Anesthesia:

General anesthesia. A conformed oral endotracheal tube fixed on the chin in the midline. A throat pack was carefully placed in the posterior oropharynx to prevent inadvertent ingestion of blood during surgery, which helps to prevent postoperative nausea and vomiting. A low mean arterial pressure was maintained during surgery to maintain a dry surgical field.

Antibiotic prophylaxis

Prophylactic dose of 3rd generation cephalosporin was given I.V. upon induction of anesthesia.

Positioning:

The patient is placed in the supine position with the neck slightly extended using a small shoulder roll. The operating table is tilted into a slight reverse Trendelenburg position.

Prepping and draping:

The nasal vestibules are prepared by swabbing the entire nostril with Betadine solution. Sterile tapes were placed over the face and the closed eyelids.

Local hemostasis:
A solution of 1% lidocaine with 1:100,000 epinephrine is infiltrated locally.

**Lip revision:**

In the four cases of the unrepaired cleft lip, Millard repair were performed in the same set before the nasal repair (Fig. 68).

![Fig. (68): Millard repair for unilateral cleft lip before performing rhinoplasty.](image)

In the twelve cases having unsatisfactory scarring of previous cleft lip repair, excision of the old scar was performed, including skin, subcutaneous tissue, and minimal part of the underlying muscles. Closure was done in three layers (Fig. 69).

![Fig. (69): Excision of the old scar for patient with unpleasant lip scar.](image)

The five cases complaining of short lip following previous repair of cleft lip, Z plasty was done for elongation of the philtrum for one of them.
Among the seven cases with notched vermilion following previous cleft lip surgery, four cases with minimal notching were treated by horizontal incision in the vermilion at the center of the notch. Then this incision was closed vertically. The other three cases were treated by advancement flap similar to Millard advancement flap.

In the ten patients having irregularities in the white line, seven of them were treated by diamond shape excision of the protruding vermilion then careful approximation of the vermilion cutaneous junction preserving the continuity of the white line. The remaining three patients were treated by Z-plasty to reorient the tissues. Thus restoring the continuity of the white line.

Management of the nasal deformity:

**Primary procedures for tip rhinoplasty:**

Open rhinoplasty approach was applied to all cases. This was achieved by transverse columellar incision. An inverted U shaped incision along the nostril was done extending from the columellar incision laterally about 2 mm from the alar facial groove (Fig. 70).

![Transcolumellar incision for open rhinoplasty.](image)

**Fig. (70): Transcolumellar incision for open rhinoplasty.**
The cartilaginous framework was freed from the mucosa and the skin. The lower lateral cartilage was found to be deformed in all patients. In all patients the lower lateral cartilage was freed and the lateral crus was exposed (Fig. 71).

![Image](image.png)

**Fig. (71): Nasal dissection on the cartilaginous framework.**

Septoplasty was performed first to correct functional problems and obtain any cartilage that may be necessary for grafting. The anterior septal angle is easily identified, and soft tissue is removed from between the medial crura down to the premaxilla. This provides excellent exposure of the caudal septum and allows the columella to be narrowed.

The upper lateral cartilages are separated from the septum such that the nasal dorsum and septum are “ouvert au ciel” (open to the sky).

Then, the nasal tip is managed according to the intra-operative findings;

- All patients needed tip rhinoplasty by using both tip sutures as well as tip grafts.
- Tip grafts are indicated in all patients due to:
  1) A short infratip lobule segment that cannot be corrected by borrowing from the medial crus.
  2) To increase and maintain tip projection.
  3) To shape the nasal domes and the columella.
4) To add support to the dorsum.
5) To add support to the lateral crura.
6) Inability to achieve the desired look in the tip using non-destructive techniques and the normal anatomy.
7) To create visible angularity beneath extremely thick tip skin.

- Three sites were used to harvest the tip grafts; costal cartilage (14 patients), septal cartilage (7 patients) and auricular cartilage (4 patients) (Fig. 72).

![Fig. 72: Different types of tip grafts:](image)

(A) Costal cartilage. (B) Septal cartilage. (C) Auricular cartilage.

- The types of used tip sutures and tip grafts are demonstrated in (tables 6 and 7).

<table>
<thead>
<tr>
<th>Type of tip suture</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trans-domal suture.</td>
<td>15 patients</td>
</tr>
<tr>
<td>Inter-domal suture.</td>
<td>12 patients</td>
</tr>
<tr>
<td>Steal (Lateral crus suture).</td>
<td>8 patients</td>
</tr>
<tr>
<td>Spring suture.</td>
<td>5 patients</td>
</tr>
</tbody>
</table>

**Table (6):** Types of used nasal tip sutures.

<table>
<thead>
<tr>
<th>Types of tip graft</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columellar strut:</td>
<td>23 patients</td>
</tr>
<tr>
<td>Umbrella graft:</td>
<td>11 patients</td>
</tr>
<tr>
<td>Onlay tip graft:</td>
<td>10 patients</td>
</tr>
</tbody>
</table>
Secondary procedures for tip rhinoplasty:

As regards to the secondary procedures for correction of the nasal deformity, various procedures were used as tabled in (table 8).

<table>
<thead>
<tr>
<th>Secondary procedures</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air way patency:</strong></td>
<td></td>
</tr>
<tr>
<td>- Dissection and repositioning of the cheek muscles:</td>
<td>21 patients</td>
</tr>
<tr>
<td>- Strengthening of the LLC by tip grafts:</td>
<td>25 patients</td>
</tr>
<tr>
<td>- Spreader graft:</td>
<td>19 patients</td>
</tr>
<tr>
<td><strong>Columellar skin lengthening:</strong></td>
<td></td>
</tr>
<tr>
<td>- Bardach’s V to Y technique:</td>
<td>3 patients</td>
</tr>
<tr>
<td>- Scar flap:</td>
<td>1 patients</td>
</tr>
<tr>
<td>- Bipedicled nasal floor flap:</td>
<td>1 patients</td>
</tr>
<tr>
<td><strong>Augmentation of the pyriform aperture:</strong></td>
<td></td>
</tr>
<tr>
<td>- Premaxillary graft:</td>
<td>13 patients</td>
</tr>
<tr>
<td><strong>Symmetization:</strong></td>
<td></td>
</tr>
<tr>
<td>- Inter-domal suture:</td>
<td>12 patients</td>
</tr>
<tr>
<td>- Freeing and repositioning of LLC by over-lapping on the ULC:</td>
<td>6 patients</td>
</tr>
<tr>
<td>- Caudal septal extension graft:</td>
<td>6 patients</td>
</tr>
<tr>
<td><strong>Dorsum:</strong></td>
<td></td>
</tr>
<tr>
<td>- Dorsal on lay graft (in deficient dorsum):</td>
<td>16 patients</td>
</tr>
<tr>
<td>- Nasal bone reduction (in humpy nose):</td>
<td>6 patients</td>
</tr>
<tr>
<td><strong>Alar rim:</strong></td>
<td></td>
</tr>
<tr>
<td>- Alar contour graft:</td>
<td>17 patients</td>
</tr>
<tr>
<td>- Alar spreader graft:</td>
<td>8 patients</td>
</tr>
<tr>
<td>- Repositioning of the alar base:</td>
<td>8 patients</td>
</tr>
<tr>
<td><strong>Alar web:</strong></td>
<td></td>
</tr>
<tr>
<td>- Z-plasty:</td>
<td>4 patients</td>
</tr>
<tr>
<td><strong>Osteotomy</strong> for correction of wide nose:**</td>
<td>3 patients</td>
</tr>
</tbody>
</table>

Table (8): Secondary procedures used in repair of cleft lip nasal deformity.
Hemostasis and closure:

After meticulous hemostasis had been obtained, the skin envelope was redraped and closed. The transcolumnellar incision was closed in simple interrupted sutures (Fig. 73).

![Image of transcolumnellar incision after closure]

*Fig. (73): Transcolumnellar incision after closure.*

The nasal dorsum was covered with quarter-inch paper tape carefully layered into position ensuring that the skin is not wrinkled and that the tip is completely covered. A plastic splint is applied to the dressing and a small gauze pad is taped beneath the nostrils to collect mucus and blood.

**Postoperative care**

During the first 48 to 72 hours, the patient was instructed to keep the head of the bed elevated at 45 degrees. Cold packs were applied to the eyes for the first 12 hours postoperatively. Pain was usually not severe requiring only mild analgesics.

After one week, the dressing was removed and the patient resumed normal activities. During the first 2 weeks postoperatively nasal congestion was treated with the use of normal saline nasal spray and oxymetazoline nasal sprays (Afrin). The patient was encouraged to breathe through the mouth if there was difficulty with air passage through the intranasal splints.
The sutures and nasal splints were removed at the initial visit on postoperative day 5 to 7. The nose (especially the tip) may appear swollen and turned up and the tip may feel numb, but the patient was reassured that both are expected and that both will resolve with time. Normal sensation usually returns within 3 to 6 months.

**Evaluation of the outcome**

The patients underwent follow up in the outpatient clinic for 6 months and the post-operative outcomes were evaluated as follow:

- Subjective satisfaction: either excellent, good, fair or poor.
- Objective cosmetic appearance: via comparing the pre-and post-operative photos.
- Nasal tip shape and site.
- Development of secondary deformity.
- Post-operative complications: infection, disruption, and necrosis.
- Functional improvement of the pre-operative symptoms, as difficulty of breathing or change in the voice, if present.

**Statistical analysis**

Descriptive statistics such as frequency and percentages were used to summarize the collected data (qualitative data). Comparison between the different groups of patients was carried out using the test of proportion (z-test; to compare between two proportions). P-values for calculated test statistics were obtained. A P-value > 0.05 was considered Non Significant (NS), P-value <0.05 was considered statistically Significant (S) and a P-value <0.001 was considered Highly Significant (HS). All statistical analyses were carried out in STATA/SE version 11.0 for Windows.

**Ethical consideration**
An informed written consent was obtained from each patient before participation in this study.

An approval from the research ethics committee in Benha Faculty of Medicine was obtained
Results

This study included 25 patients coming for rhinoplasty. They were 14 females and 11 males.

The age of the patients ranged from thirteen years to thirty one years (average 17 years).

There were 4 patients having no previous attempts for cleft lip repair, while the rest of the patients (21 patients) had repaired cleft lip.

Only 5 patients had history of primary rhinoplasty during early repair of the cleft lip with residual secondary nasal deformity, while 20 patients had no previous attempts for repair the cleft lip nasal deformity.

Out of the 25 patients, only 3 patients had bilateral cleft lip, while the other 22 patients had unilateral cleft lip.

The operations took a duration range from 2 hours and 15 minutes up to 3 hours and 40 minutes, with the mean duration 2 hours and 55 minutes.

Evaluation of the outcome

1- Subjective satisfaction:
The general degree of subjective satisfaction regardless to the used method of tip rhinoplasty is illustrated in (Table 9) and (Fig. 74).

Table (9): Subjective satisfaction distribution among the operated patients.

<table>
<thead>
<tr>
<th></th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>11</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Percentage</td>
<td>44%</td>
<td>48%</td>
<td>8%</td>
</tr>
</tbody>
</table>
The type of graft used (the site of the taken graft) affected the net patient satisfaction. The study revealed that use of costal cartilage as a graft is the most superior results as it showed no patients with poor satisfaction among the operated patients. While the use of septal cartilage showed a statistically highly significant difference and auricular cartilage was the least satisfying among the patients (Table 10) and (Fig. 75).

Table (10): Subjective satisfaction distribution among the operated patients according to the type of graft (according to the taken site).

<table>
<thead>
<tr>
<th>Type of graft</th>
<th>No. of patients</th>
<th>Degree of satisfaction</th>
<th>Z</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Good/Fair</td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Costal cartilage:</td>
<td>14</td>
<td>14</td>
<td>100.0%</td>
<td>0</td>
</tr>
<tr>
<td>Septal cartilage:</td>
<td>7</td>
<td>6</td>
<td>85.7%</td>
<td>1</td>
</tr>
<tr>
<td>Auricular cartilage:</td>
<td>4</td>
<td>3</td>
<td>75.0%</td>
<td>1</td>
</tr>
</tbody>
</table>

P<0.001 Highly Significant (HS) difference; P=0.02 Significant (S) difference
The type of used tip graft affected the degree of patient satisfaction as tabled in (Table 11) (Fig. 76). Umbrella as well as onlay tip graft showed no recorded poor degree of satisfaction. Columellar strut, subdomal and cap grafts recorded statistically highly significant results. On the other hand, anchor graft failed to record a statistically significant relation with the degree of satisfaction.

Table (11): Subjective satisfaction distribution among the operated patients according to the type of graft.

<table>
<thead>
<tr>
<th>Type of tip graft</th>
<th>No. of patients</th>
<th>Degree of satisfaction</th>
<th>Z</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Good/Fair</td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>- Columellar strut:</td>
<td>23</td>
<td>22</td>
<td>95.6%</td>
<td>1</td>
</tr>
<tr>
<td>- Umbrella graft:</td>
<td>11</td>
<td>11</td>
<td>100.0%</td>
<td>0</td>
</tr>
<tr>
<td>- Onlay tip graft:</td>
<td>10</td>
<td>10</td>
<td>100.0%</td>
<td>0</td>
</tr>
<tr>
<td>- Sub-domal graft:</td>
<td>9</td>
<td>8</td>
<td>88.9%</td>
<td>1</td>
</tr>
<tr>
<td>- Anchor graft</td>
<td>6</td>
<td>4</td>
<td>66.7%</td>
<td>2</td>
</tr>
<tr>
<td>- Cap graft:</td>
<td>6</td>
<td>5</td>
<td>83.3%</td>
<td>1</td>
</tr>
</tbody>
</table>

P<0.001 HS difference; P=0.08 Non Significant (NS) difference
Fig. (76): Subjective satisfaction distribution among the operated patients according to the type of graft.

The subjective satisfaction seems to be more obvious in male more than females (Table 12) (Fig. 77).

Table (12): Subjective satisfaction distribution among the patients by the sex of the patient.

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. of patients</th>
<th>Degree of satisfaction</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>- Male:</td>
<td>11</td>
<td>6</td>
<td>54.5%</td>
<td>5</td>
<td>45.5%</td>
</tr>
<tr>
<td>- Female:</td>
<td>14</td>
<td>5</td>
<td>35.7%</td>
<td>7</td>
<td>50</td>
</tr>
</tbody>
</table>

Fig. (77): Subjective satisfaction distribution among the patients by the sex of the patient.
2- Objective evaluation of the nasal tip:
After the operation, the nasal tip was evaluated objectively regarding to its shape and site. Generally, most of the patients had accepted net nasal tip shape, site and pointing (20 patients) while the rest of the patients had residual deformity (Table 13) (Fig. 78).

Table (13): Distribution of the nasal tip shape and site among the operated patients.

<table>
<thead>
<tr>
<th>Shape and site of nasal tip</th>
<th>Accepted</th>
<th>Residual deformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Percentage</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Fig. (78): Distribution of the nasal tip shape and site among the operated patients.

The residual deformities after tip rhinoplasty were ranged from wide (flat) nasal tip, bulky nasal tip to deviated tip. The incidence of each residual deformity is tabled in (Table 14) and illustrated in (Fig. 79).

Table (14): Residual nasal tip deformity among the operated patients.

<table>
<thead>
<tr>
<th>Residual tip deformity</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Wide nasal tip:</td>
<td>2</td>
<td>8%</td>
</tr>
<tr>
<td>- Bulky nasal tip:</td>
<td>2</td>
<td>8%</td>
</tr>
<tr>
<td>- Deviated tip:</td>
<td>1</td>
<td>4%</td>
</tr>
</tbody>
</table>
It was found that the tip definition was greatly affected by the type of nasal tip graft (Table 15) (Fig. 80).

**Table (15):** Distribution of residual nasal tip deformity according to the used tip graft.

<table>
<thead>
<tr>
<th>Type of tip graft</th>
<th>No. of patients</th>
<th>Shape and site of nasal tip</th>
<th>Residual deformity</th>
<th>Z</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Accepted</td>
<td>Residual deformity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>- Columellar strut:</td>
<td>23</td>
<td>21</td>
<td>91.3%</td>
<td>2</td>
<td>8.7%</td>
</tr>
<tr>
<td>- Umbrella graft:</td>
<td>11</td>
<td>10</td>
<td>90.9%</td>
<td>1</td>
<td>9.1%</td>
</tr>
<tr>
<td>- Onlay tip graft:</td>
<td>10</td>
<td>9</td>
<td>90.0%</td>
<td>1</td>
<td>10.0%</td>
</tr>
<tr>
<td>- Sub-domal graft:</td>
<td>9</td>
<td>8</td>
<td>88.9%</td>
<td>1</td>
<td>11.1%</td>
</tr>
<tr>
<td>- Anchor graft</td>
<td>6</td>
<td>5</td>
<td>83.3%</td>
<td>1</td>
<td>16.7%</td>
</tr>
<tr>
<td>- Cap graft:</td>
<td>6</td>
<td>6</td>
<td>100.0%</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

P<0.001 Highly Significant (HS) difference
Also, it was found that the tip definition was greatly affected by the type of nasal tip graft according to the site taken from. The costal cartilage recorded a highly statistically significant results, the septal cartilage showed a statistically significant results. While, the auricular cartilage failed to achieve any statistical significance (Table 16) (Fig. 81).

**Table (16):** Distribution of residual nasal tip deformity according to the taken site of used graft.

<table>
<thead>
<tr>
<th>Type of graft</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costal cartilage</td>
<td>14</td>
</tr>
<tr>
<td>Septal cartilage</td>
<td>7</td>
</tr>
<tr>
<td>Auricular cartilage</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of graft</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Costal cartilage:</td>
<td>14</td>
</tr>
<tr>
<td>- Septal cartilage:</td>
<td>7</td>
</tr>
<tr>
<td>- Auricular cartilage:</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of graft</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Costal cartilage:</td>
<td>14</td>
</tr>
<tr>
<td>- Septal cartilage:</td>
<td>7</td>
</tr>
<tr>
<td>- Auricular cartilage:</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shape and site of nasal tip</th>
<th>Accepted</th>
<th>Residual deformity</th>
<th>Z</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accepted</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Costal cartilage</td>
<td>14</td>
<td>13</td>
<td>1</td>
<td>71.4%</td>
</tr>
<tr>
<td>Septal cartilage</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>83.3%</td>
</tr>
<tr>
<td>Auricular cartilage</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>83.3%</td>
</tr>
</tbody>
</table>

P<0.001 HS difference; P=0.01 Significant (S) difference; P=1.00 Non Significant (NS) difference
Fig. (81): Distribution of residual nasal tip deformity according to the taken site of used graft.

3- Development of secondary deformity:
The post-operative secondary deformities are listed in (Table 17) (Fig. 82).

Table (17): Post-operative secondary deformities.

<table>
<thead>
<tr>
<th>Secondary deformity</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Asymmetrical nostril:</td>
<td>2</td>
<td>8%</td>
</tr>
<tr>
<td>- Obtuse naso-facial angle:</td>
<td>2</td>
<td>8%</td>
</tr>
<tr>
<td>- Alar web:</td>
<td>2</td>
<td>8%</td>
</tr>
<tr>
<td>- Unpleasant lip scar:</td>
<td>1</td>
<td>4%</td>
</tr>
</tbody>
</table>

Fig. (82): Post-operative secondary deformities.
There was a statistically highly significant relation between the development of secondary deformities and each type of the used graft (Table 18) (Fig. 83).

**Table (18):** Distribution of Post-operative secondary deformities according to the used grafts.

<table>
<thead>
<tr>
<th>Type of tip graft</th>
<th>No. of patients</th>
<th>Secondary deformity</th>
<th>Z</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>- Columellar strut:</td>
<td>23</td>
<td>2</td>
<td>8.7%</td>
<td>21</td>
</tr>
<tr>
<td>- Umbrella graft:</td>
<td>11</td>
<td>1</td>
<td>9.1%</td>
<td>10</td>
</tr>
<tr>
<td>- Onlay tip graft:</td>
<td>10</td>
<td>2</td>
<td>20.0%</td>
<td>8</td>
</tr>
<tr>
<td>- Sub-domal graft:</td>
<td>9</td>
<td>1</td>
<td>11.1%</td>
<td>8</td>
</tr>
<tr>
<td>- Anchor graft:</td>
<td>6</td>
<td>1</td>
<td>16.7%</td>
<td>5</td>
</tr>
<tr>
<td>- Cap graft:</td>
<td>6</td>
<td>0</td>
<td>0.0%</td>
<td>6</td>
</tr>
</tbody>
</table>

P<0.001 HS difference

**Fig. (83):** Distribution of Post-operative secondary deformities according to the used grafts.

### 4- Post-operative complications:
During the course of the study, we were confronted with a number of complications, such as surgical site infection (SSI), epistaxis, contact dermatitis and wound disruption (Table 19) (Fig. 84).

**Table (19):** Post-operative non-aesthetic complications.
Post-operative complications

<table>
<thead>
<tr>
<th>Post-operative complications</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Epistaxis:</td>
<td>2</td>
<td>8%</td>
</tr>
<tr>
<td>- SSI:</td>
<td>1</td>
<td>4%</td>
</tr>
<tr>
<td>- Contact dermatitis:</td>
<td>1</td>
<td>4%</td>
</tr>
<tr>
<td>- Wound disruption:</td>
<td>1</td>
<td>4%</td>
</tr>
</tbody>
</table>

Fig. (84): Post-operative non-aesthetic complications.

5- Functional improvement of pre-operative complaints:
There were 5 patients complaining of difficulty in breathing, either due to defective internal or external nasal valve (differentiated by using tape test). All of them showed obvious improvement in their complaints. While there were 3 patients with abnormally nasal tone of the voice, only one of them noticed improvement in his complaint (Table 20) (Fig. 85).

Table (20): Post-operative improvement of functional symptoms.

<table>
<thead>
<tr>
<th>Functional symptom</th>
<th>No. of patients</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>- Difficult breathing:</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>- Nasal tone of the voice:</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
Fig. (85): Post-operative improvement of functional symptoms.
**Selected cases**

**Case (1)**

Fig. (88): Frontal, lateral and basal pre-operative views of the second selected case.

Fig. (89): Frontal, lateral and basal views 6 months post-operative of the second selected case.

- **Twenty years old female patient.**
- **Analysis of the nasal deformities:**
  - Frontal view: asymmetrical nostril.
  - Lateral view: ill-defined tip.
  - Basal view: flaring of the left nostril, central columella, C-shaped septum, under-developed pyriform aperture and cleft nasal sill.
- **She underwent:**
  - Revision of the cleft lip deformity to close the nasal sill cleft.
  - Tip sutures: as interdomal and lateral crural mattress sutures.
  - Nasal grafts:
    - Diced cartilage for augmentation of the pyriform aperture.
    - Columellar strut, spreader, alar rim and nasal tip (on lay) grafts using auricular cartilage graft.
Case (2)

Fig. (86): Frontal, lateral and basal pre-operative views of the first selected case.

Fig. (87): Frontal, lateral and basal views 6 months post-operative of the first selected case.

- Twenty two years old male patient.
- Analysis of the nasal deformities:
  - Frontal view: deviated columella with asymmetrical nostril.
  - Lateral view: humpy nose with plunging tip.
  - Basal view: flaring of the left nostril, deviated columella and septum as well as under-developed pyriform aperture.

- He underwent:
  - Humpectomy.
  - Tip sutures: as interdomal and lateral crural mattress sutures.
  - Nasal grafts:
    - Diced cartilage for augmentation of the pyriform aperture.
    - Columellar strut, alar rim and nasal tip grafts using costal cartilage graft.
Case (3)

Fig. (90): Frontal, lateral and basal pre-operative views of the third selected case.

Fig. (91): Frontal, lateral and basal views 3 months post-operative of the third selected case.

- Fourteen years old female patient (bilateral cleft).
- Analysis of the nasal deformities:
  - Frontal view: broad nose.
  - Lateral view: ill-defined tip.
  - Basal view: flaring and widening of both nostrils with short columella.

- She underwent:
  - Tie flap to lengthen the columellar skin.
  - Tip sutures: as transdomal, columella-septal suture and lateral crural mattress sutures.
  - Nasal grafts:
    - Columellar strut, bilateral spreader, alar rim and umbrella tip grafts using costal cartilage graft.
Case (4)

Fig. (92): Frontal, lateral and basal pre-operative views of the forth selected case.

Fig. (93): Frontal, lateral and basal views 1 week post-operative of the forth selected case.

- Twenty one years old female patient.
- Analysis of the nasal deformities:
  - Frontal view: long and broad nose with deviated tip.
  - Lateral view: ill-defined tip.
  - Basal view: asymmetrical nostrils with flaring of the left nasal rim and short columella.

- She underwent:
  - Tip rotation.
  - Tip sutures: as transdomal, columella-septal suture and lateral crural mattress sutures together with external spanning sutures.
  - Nasal grafts:
    - Columellar strut, spreader, alar rim and umbrella as well as subdomal tip grafts using costal cartilage graft.
Case (5)

Fig. (94): Frontal and basal pre-operative views of the fifth selected case.

Fig. (95): Frontal and basal views 2 weeks post-operative of the fifth selected case.

- Fourteen years old female patient.
- Analysis of the nasal deformities:
  - Frontal view: deviated nasal tip, asymmetrical nostrils as well as shortened lip scar causing notched white line.
  - Basal view: flaring and widening of the left nostril with short columella deviated tip, cleft nasal sill and under-developed pyriform aperture.

- She underwent:
  - Revision of the cleft lip deformity to close the nasal sill cleft.
  - Tip sutures: as transdomal, columella-septal suture and lateral crural mattress sutures.
  - Nasal grafts:
    - Diced cartilage for augmentation of the pyriform aperture.
    - Columellar strut, spreader, alar rim and anchor as well as subdomal tip grafts using costal cartilage graft.
Discussion

The nose is one of the most visible organs on the face and its appearance contributes enormously to facial aesthetics. Nasal deformity associated with cleft lip has been viewed as one of the most challenging reconstructive problems in rhinoplasty. The complexity of cleft lip rhinoplasty is demonstrated by the abundance of technique that is available for its correction. Yet, there is no conclusively superior technique among those that were described to date (Szychta et al., 2011).

Cleft lip nasal deformity present a major challenge in the management of cleft lip patients as the deformity presents a stigmata of cleft lip even with a properly and nicely repaired cleft lip (McHeik et al., 2006).

The universal goal of nasal tip surgery is to create a stable, symmetric, and aesthetically projected and rotated nasal tip that is triangular at base view and harmonious with the rest of the nose, improving its overall visual appeal. (Benlier et al., 2009)

This current study aimed at exploration the different surgical options for reconstruction of the nasal tip in cases of secondary cleft lip nasal deformity, evaluate of their esthetic and functional results and demonstrate the subjective satisfaction for each case.

A debate is going on whether to attempt immediate manipulation of alar cartilage to correct the deformity or to postpone the management until full growth of the nose. This was done on the assumption that early dissection of the alar and septal cartilage may interfere with the normal development of the nose (Lo, 2006).

Sykes (2010), stated that primary rhinoplasty at the time of cleft lip repair can improve the cleft lip nasal deformity by achieving better symmetry, which allow
the nose to grow in a symmetric fashion, and potentially improve long-term outcomes.

However, this study included 25 patients coming for rhinoplasty, all of them had delayed cleft lip nasal deformity, and any patient with early primary nasal deformity were excluded from the selected patients in the current study. Accordingly, this study cannot answer the question whether early repair of the nasal deformity could be attempted without jeopardizing the normal nasal growth.

The outcomes of the operations were evaluated subjectively as well as objectively regarding to aesthetic and functional perspectives.

In order to overcome the relatively limited number of patients, from the statistical point of view, good and fair degrees of satisfaction were merged into one item (accepted outcome) to be compared with poor degree of satisfaction in certain items.

In all cases involved in the current work, external approach was done. This had the advantage of exposing both sides of the nose so that the anatomy on the healthy side was used as reference for correction of the deformed side. In addition this adequate exposure had allowed accurate placement of the cartilage grafts and sutures used to correct deformities. This approach is the most universally accepted one in cleft lip nasal deformity (Raspall et al., 2010)

Regarding to the general degree of subjective satisfaction, 92% of the operated patients were accepting the aesthetic outcome (44% of the recorded good results, and 48% recorded fair results). On the other hand, only 8% of the operated patients recorded poor degree of satisfaction. These results are comparable and in agreement with (Ashoor, 2008).

Regarding to the type of the used grafts, we depended only on the autologous cartilaginous grafts. Although different types of other autologous grafts, as boney grafts, as well as allograft substitutes were mentioned in the
literatures, autologous cartilaginous grafts were preferred to avoid the undesirable
disadvantages of the other substitutes as resorption and difficult handling,
regarding to the bone graft, and the recorded universal long term complications
with unsatisfactory results in cases of allografts (Tosun et al., 2008) and (Bateman
and Jones, 2000). However, this concept does not agree with (Lohuis et al., 2001),
who preferred synthetic materials over autologous grafts because of their
immediate availability, lack of donor-site morbidity, better adaptability, good
immediate results, and low costs.

Although generally the use of tip grafts significantly affect the results
regardless to the donor site, the costal cartilage record the most satisfying outcome
regarding to patient's satisfaction as well as objective evaluation of the nasal tip
appearance, followed by the septal cartilage and then and lastly, the auricular
cartilage. This conclusion was also stated by (Araco et al., 2006) and (Gunter,
1999).

It was found that each type of tip graft significantly affect the ultimate nasal
tip appearance. Also it was concluded that using umbrella, onlay tip graft,
columellar strut, subdomal and cap grafts recorded the most significant affection of
the degree of patient's satisfaction. Relatively same results were obtained by (Park
et al., 1998).

Despite of the higher number of females involved in the current study, males
recorded higher degrees of subjective satisfaction.

Out of the 25 patients, 20 patients showed accepted net nasal tip appearance,
while the rest 5 patients recorded aesthetic deformities of the nasal tip as flat tip,
bulky tip as well as deviated tip. Only 3 of them decided to undergo subsequent
corrective operation for the residual tip deformities.

As regard the development of secondary deformities, there were only 6
patients developed these deformities in the form of asymmetrical nostril, obtuse
naso-facial angle, alar web and unpleasant lip scar. Those patients were instructed to follow up in the out-patient clinic for further assessment of their conditions and to decide if they are in need for further intervention. This incidence of post-operative secondary naso-labial deformities are comparable to the results achieved by (Ashoor, 2008).

During post-operative follow up of the operated patients, we were faced with minor non-aesthetic complications such as epistaxis, minor degree of wound infection and also contact dermatitis from the adhesive tape. All of them responded well to simple medical conservative measures.

However, there was one case of disruption of the transcolumellar incision, this mostly occurred due to relatively short columella in comparison with the columellar strut graft. This case was managed by daily dressings under cover of antibiotics, then and after 5 days, the case underwent trimming of the edges and secondary closure after shortening of the columellar strut graft. After that, the patient show unremarkable post-operative period.

*Cochran and Landecker (2011)*, stated that complications and suboptimal results do occur, even for experienced surgeons. A thorough knowledge of the principles of postoperative management of these complications can minimize their deleterious effects and preserve an aesthetic outcome.

As regard the donor site, we were not faced with any operative complication or even serious complaint from the donor site either costal or auricular. So, the autologous cartilaginous graft could be considered as a safe, cheap as well as relatively easily obtained nasal tip support with good long-term results. The same absence of donor site complications was achieved by (Tiong et al., 2014).

Cleft lip nasal deformity are not only associated with cosmetic complaints, but also accompanied by functional symptoms. In this study, two main functional complaints were found, which were nasal breathing difficulty due to deformed
valves and nasal tone of speech. Augmentation rhinoplasty with correction of both internal and external nasal valves showed complete improvement in their breathing complaints, but unfortunately failed to achieve the same marvelous results regarding the abnormal voice tone. The same improvement in the nasal breathing was recorded by (Chaithanyaa et al., 2011). However, on the other hand (Huempfner-Heirl et al., 2009) concluded that augmentation cleft rhinoplasty makes no improvement regarding the functional complaints.
Summary

Cleft lip nasal deformities are challenging problems in all aspects and there are debates about timing, approaches, techniques as well as types of the used grafts.

The current study tried to explore the different surgical options for reconstruction of the nasal tip in cases of secondary cleft lip nasal deformity, evaluate of their esthetic and functional results and demonstrate the subjective satisfaction for each case.

In this study, twenty five patients having cleft lip nasal deformity underwent rhinoplasty to correct the nasal deformity in which the definition and position of the nasal tip were the corner stones in evaluation of the net aesthetic result. All patients with previous nasal bone fracture or primary cases of cleft nasal deformity under the age of 12 years old were excluded.

The post-operative results were evaluated concerning subjective satisfaction, objective assessment of the nasal tip, development of secondary deformities or complication and finally regarding the improvement of the recorded pre-operative functional complaints.

The results of this study showed that:

- A debate is going on whether to attempt immediate manipulation of alar cartilage to correct the deformity or to postpone the management until full growth of the nose.
- The corner stone for achieving the best aesthetic outcome is total nasal reconstruction via external rhinoplasty technique.
- The vast majority of the operated patients had an obvious degree of satisfaction after 6 months of post-operative follow up.
• Use of autologous cartilaginous grafts is considered an excellent source of supporting nasal grafts with no recorded intra- or post-operative donor site morbidity.

• The costal cartilage is the most preferable and suitable source of cartilaginous grafts as it can achieve the most superior results.

• Use of different types of nasal grafts is mandatory in all cases of cleft lip nasal deformity.

• The post-operative complications and deformities could occur even after meticulous surgical technique. So, all post-operative sequels, possibilities and expectations should be discussed frankly in details with the patient pre-operatively.

• Rhinoplasty for cleft lip nasal deformity improved some of the pre-operative functional symptoms, the sense of difficult breathing. But failed to improve the abnormal voice tone.
**Conclusion**

A naturally looking nasal tip projection not only determines the patients’ degree of satisfaction but also is considered the ultimate aesthetic as well as functional goal for the surgeons.

Tip rhinoplasty in cases of cleft lip nasal deformity is a complex procedure. As in the current study, 105 surgical options (either sutures or grafts) in addition to the secondary procedures were used in the operated 25 patients aiming to achieve the desired post-operative results.

Nasal grafts are essential for considerable good outcomes for cases of cleft nasal deformity.

Autologous cartilaginous grafts are the most suitable type of nasal grafts, and costal cartilage graft is the most superior between them.

Further studies are needed to justice if primary rhinoplasty is beneficial or it disturbs the nasal symmetry and leave scared tissues for a potential future intervention.
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الملخص العربي

تحتلت عمليات تجميل الأنف مكاناً رافعاً بين عمليات تجميل الوجه وهذا راجع إلى عامليين هما: هو المكان الأüst من تحلل الأنف في الوجه وثانيهما هو الوظيفة الحيوية التي تقوم بها الأنف كما تمثل العيوب الخلقية في الأنف بمثابة تحدياً للجراح أضاف إلى ذلك العامل النفسي المهم بالنسبة للمرضى أو أسرته.

تحدث الشفاة الأرنبية نتيجة لفشل عملية التحام النتوء الأنفي الأنسي مع النتوء الوظيجي في الأسبوع الرابع إلى الثامن من الحياة الجنينية وعادة ما يصاحبها أيضاً فشل في التحام النتوءات المكونة لسفق الفم (الحلب) وتزداد البجوة (القلح) بين النتوءات في أثناء تطور الجنين تصل إلى أقصاها أثناء الولادة.

ويوجد العديد من التشوهات التي قد تحدث بالأنف في حالات الشفاة الأرنبية ومنها:

- انكساف بجاية الأنف والورود العضوية الوحشين بالأنف.
- اعوجاج طرف الأنف ناحية الجانب السليم.
- قصر عيد الأنف ناحية الشفة الأرنبية.
- عدم التبالت بين جلد الأنف.
- ينزاع جناح الأنف الأسفل والحلف.

لذا يجب أن يراعى الجراح عدة جوانب قبل إجراء عمليات الأنف مثل:

- تطبيق كلاً من فتحتي الأنف من حيث الحجم والشكل.
- ايجاد النسبة القياسية بين الشفاه والأنف وبين الأنف والوجه.
- التقليل قدر الإمكان من وجود أثار ندبات جراحية ظاهرة في وجه المريض.
- عدم التأثير على مجرى التنفس.
- عدم التأثير على الطبيق بالشكل السليم.
- وجود الوجهاتين بمكانهما الطبيعي بما يلائم ملاح الوجه.

وهناك نوعان أساسيان من عمليات تجميل الأنف المصاحبة للشفة الأرنبية وهما:

1. جراحة أولية: وهي تعني إجراء عمليات تجميل الأنف في أثناء العملية الأولية للشفة الأرنبية أصبح هذا النوع من العمليات ذات أهمية وخصوصاً في العشرين عاماً الأخيرة وتتميز هذه العمليات بأن نتائجها مرشدة بأنها كبر وهي في حال حدوث تشوهات ثانوية فيمكن إجراء عمليات أخرى أقل تعقيداً وتكون النتيجة النهائية أفضل.

2. جراحة ثانوية: وهي تعني إجراء العملية التجميلية للأنف لاحقاً عقب إجراء صمالي الشفة الأرنبية وغالباً ما يتم هذا النوع من الجراحات في العقد الثاني من العمر.
وتتمثل معظم العيوب الثانوية في الأنف عقب تصليح الشفية الأرنبية في:

- انكسار طرف الأنف.
- انبعاث الغضروف السفلي الوحشي.
- انسعاق فتحة الأنف بصورة أكبر من مثيلتها على الجانب السليم.
- قصر عميق الأنف.
- انسعاق الجزء المركزي البارز في الشفاه العلوية.
- قصر التمث الشدقي.
- عدم اتساق الشفاه العليا.

وبعدها نستطيع القول بأنه في حالة كون التشوهات الأرنبية بسيطة فإننا نستطيع تقييمها عن طريق عملية رأس الأنف الفصيسي أما في حالات التشوهات العينية والتي غالبا ما تكون مصاحبة لبعض في توقيع عظام الوجه فعادة ما يتم اللجوء إلى رااسعة عظم سنخي متبوعا بعملية لرأب الحاجز والأنف.

وقد هدفت هذه الدراسة إلى استعراض بعض الطرق الجراحية لتحسين عيوب الأنف في حالات الشفية الأرنبية وتقييم نتائج هذه العمليات من حيث المظهر النهائي لطرف الأنف ومدى رضا المريض أو ذويه عن هذه الجراحة.

وقد أجريت هذه الدراسة على خمسة وعشرين مريض كانوا يعانون من تشوهات ثانوية بالأنف مصاحبة لشفة الأرنبية أو تشوهات أولية في عمر تجاوز الثالثة عشر. وتمت هذه الدراسة في كل من مستشفى القصر العيني (جامعة القاهرة) ومستشفى بنها الجامعي في الفترة من يناير 2013 وحتى يونيو 2014.

وكانت عوامل الاستبعاد كالآتي:

1- الامراض الطبية التي تجعل من المريض غير مناسب للتخدير الكلي.
2- وجود تاريخ سابق لكسور عظام الأنف أو الوجه.
3- حالات التشوهات الأولية في مريض لم يتجاوز الثالثة عشر من عمره.

وتمثل عوامل التقييم في:

1- مدى رضا المريض عن نتائج العملية الجراحية.
2- تقييم الشكل النهائي لطرف الأنف ومقارنته بما كان عليه قبل اجراء العملية.
3- حدوث أي مضاعفات عقب الجراحة سواء في صورة تشوهات ثانوية أو أي مضاعفات أخرى.
4- مدى حدوث تحسن في أي شكو وظيفية قد تم تسجيلها قبل اجراء العملية.
وقد انتهت الدراسة إلى عدة نتائج منها:

- لا يزال هناك جدل ولغز بخصوص التوقيت الأفضل للتدخل الجراحي في حالات تشوهات الأنف المصاحبة للشفة الأرنبية.
- لا بد من تصليح الأنف عن طريق الفتح، حيث أن الفتح الجراحي يمكننا من استيعاب كافة التشوهات الموجودة بالأنف إضافة إلى تقييمها بصورة سليمة.
- تبين أن نتائج التدخل الجراحي يبقى رضا واسع لدى المرضى خصوصا إذا ما قورن بالوضع السابق للعملية.
- يمثل استخدام الرقعة الغضروفية حل مناسب في تلك الحالات. وقد كانت أفضل النتائج هي التي تم بها الغضاريف الضلعية في الترميز متبوعة بغضروف الحاجز الأنفي وآخيرا غضارف الأنف.
- تكون بعض المضاعفات أو التشوهات واردة عقب التدخل الجراحي. لذا يلزم الجراح أن يكون ملم بها ويجيب مناقشتها بصورة مفصلة مع المريض قبل العملية الجراحية.
- أحيانا تعاني تلك الحالات من شكتي وظيفية تتمثل في صعوبة في التنفس الأنفي أو نغمة (نيرة) الصوت. وقد وجد أن هناك تحسن بصورة ملحوظة عقب عمليات تصليح الأنف وخصوصا فيما يتعلق بصعوبة التنفس.
تقييم طرف الأنب في حالات الفشة الأرنبية المصحوبة بتشوهات بالأنف

دراسة مقدمة تومنة للحصول على درجة الدكتوراه في الجراحة العامة

مقدمة من

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