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Chapter 22

Endoscopic Oral and Maxillofacial Surgery

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Additional information is available at the end of the chapter

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1. Introduction

Endoscopy is the examination and inspection of the interior of body organs, joints or cavities through an endoscope. Endoscopic surgery uses scopes that go through small incisions or natural body openings to diagnose and treat disease. Another popular term is minimally invasive surgery (MIS), which emphasizes that diagnosis and treatment can be done with reduced body invasion. Endoscopes are revolutionary surgical tools that provide detailed video images, allowing visualization of internal structures through a skin incision the width of a thumb and an entry into the organ smaller than a pushpin. Small instruments that can cut, sample, or destroy abnormal tissue or tumors can also be passed through these tubes, allowing intricate surgery to be performed with little or no trauma. Endoscopy allows physicians to peer through the body's passageways.

Construction An endoscope uses two fiber optic lines. A "light fiber" carries light into the body cavity and an "image fiber" carries the image of the body cavity back to the physician's viewing lens. The portion of the endoscope inserted into the body may be rigid or flexible, depending upon the medical procedure. There is also a separate port to allow for administration of drugs, suction, and irrigation. This port may also be used to introduce small folding instruments such as scalpels, scissors, forceps, brushes, snares and baskets for tissue excision (removal), sampling, or other diagnostic and therapeutic work. They are inserted through different incisions and are used to perform the operation. Endoscopes may be used in conjunction with a camera or video recorder to document internal mages. New endoscopes have digital capabilities for manipulating and enhancing video images (Figures 1 and 2).

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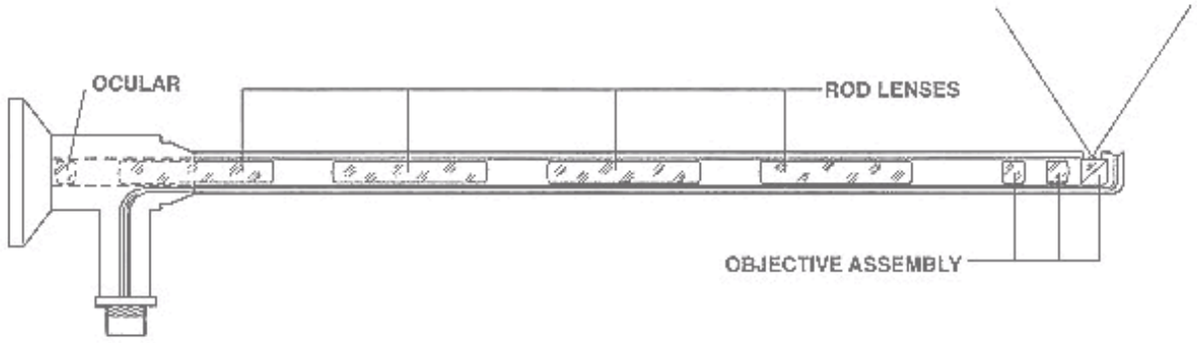


Figure 1. This figure shows an endoscope. The "image fiber" leads from the ocular (eye piece) to the inserted end of the scope. The "light fiber" is below and leads from the light source to the working end of the endoscope.



Figure 2. Endoscopic surgery equipment and instruments

1.1. Endoscopic plastic surgery

Endoscopic plastic surgery is one of the newest plastic surgery techniques. It allows surgeons to operate with fewer conspicuous incisions, reducing obvious scars. Improvements in

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technology have enabled surgeons to use endoscopy for many cosmetic procedures, including facelifts, forehead lifts, etc. Endoscopy can also be used in some reconstructive procedures. In many cases, the use of endoscopy results in shorter recovery.

Candidates must be in good health, have no active diseases or serious pre-existing medical conditions, and must have realistic expectations of the outcome of the surgery. Smoking, having recently quit smoking and being exposed to second-hand smoke are all contraindications. Primary and secondary smoking decreases blood flow to the body's tissues. This can result in prolonged wound healing, skin loss, infection, increased scarring, and a number of other complications depending on the kind of procedure performed.

The endoscope is merely a new tool to better achieve just that objective. Outcome enhancements initially predominated in aesthetic applications, but widespread use also in reconstructive endeavors has proved that today there is indeed a broad scope for minimally invasive surgery.

The goal of what today would be considered minimally invasive surgery may be to even surpass the outcomes possible with traditional open techniques, with diminished patient morbidity including accelerated recovery time and, at the same time, reducing overall healthcare costs. Initially conceived as a means to allow the direct examination of internal organs while avoiding large incisions, the origins of the clinical application of this concept can be traced back to Hippocrates in ~400 BC who used a rectal speculum to examine hemorrhoids. [1] The centuries to follow fostered slow, incremental improvements in instrumentation and light sources that would eventually allow the requisite access as well as proper illumination of the operative field. However, not until the 1950s did the advent of fiber-optic technology permit the transmission of light from an external light source along long, flexible glass or plastic threads so that a clear image could be obtained, yet now without risk of thermal injury.[1]

In 1990, ongoing research efforts at the University of Alabama at Birmingham culminated in reports of a broad clinical experience in endoscopy including endoscopic brow lift.[2] Nowhere were the early demands for minimally invasive surgery so prevalent than in cosmetic surgery.[3]

The interest in aesthetic endoscopic plastic surgery still predominates today, [4]-[11] and there is a concomitant explosion of novel applications in reconstructive surgery. An early thrust of the latter included relatively simple maneuvers such as the removal of benign lesions, decompressive fasciotomy for extremity compartment syndrome,[14] or retrieval of spare body parts such as tendon,[15] vein,[16] or nerve[17],[18] grafts. Congenital deformities such as torticollis[19] especially in the pediatric age group, [13] have been well suited to endoscopic correction, as the cosmetic result often is a major consideration. Acquired defects like facial fractures[20] may be directly or indirectly repaired. More complex indications for various tissue manipulations have included the safe placement of tissue expanders [21], [22] or harvest of local[23] or free adipofascial, muscle, and visceral flaps using endoscopic assistance. The realm in the future may be endoscopic robotic surgery for even greater precision, including not just the difficult and safe dissection of the vascular pedicles of all flaps but also the performance even of the microanastomoses themselves.[23], [24] The capability for all these

tissue manipulations could someday then be routinely performed in any distant land or even on another planet, where the immediate availability and skills of a surgeon will no longer be a concern!

2. Endoscopic sinus surgery

The sinuses are air-filled holes in the skull. They are connected to the nose and can get infected leading to discharge, pain, etc. This may be caused by allergies, polyps, abnormal shape or swelling inside the nose. Medical therapies, such as antibiotics, steroids, nasal sprays and decongestants will often cure bouts of sinusitis. Sinus surgery is advocated in those patients who fail to improve after medication. There are circumstances when immediate sinus surgery is warranted. Tumors of the sinuses, whether benign or malignant, often require surgical removal. Surgery may be the only option for some patients whose sinus condition aggravates other medical problems such as asthma. Cancer or immunocompromised patients may require drainage for culture or for treatment of a fungal infection. In the past, surgeries requiring an incision under the lip (Caldwell-Luc) or face (external ethmoidectomy) were used to drain sinus cavities. Most procedures are now performed using endoscopic technology (via small cameras through the nose), eliminating the need for external incisions. Endoscopic sinus surgery uses small rods of light with a camera (endoscope) to operate through the nostrils into the sinuses (Figure 3).

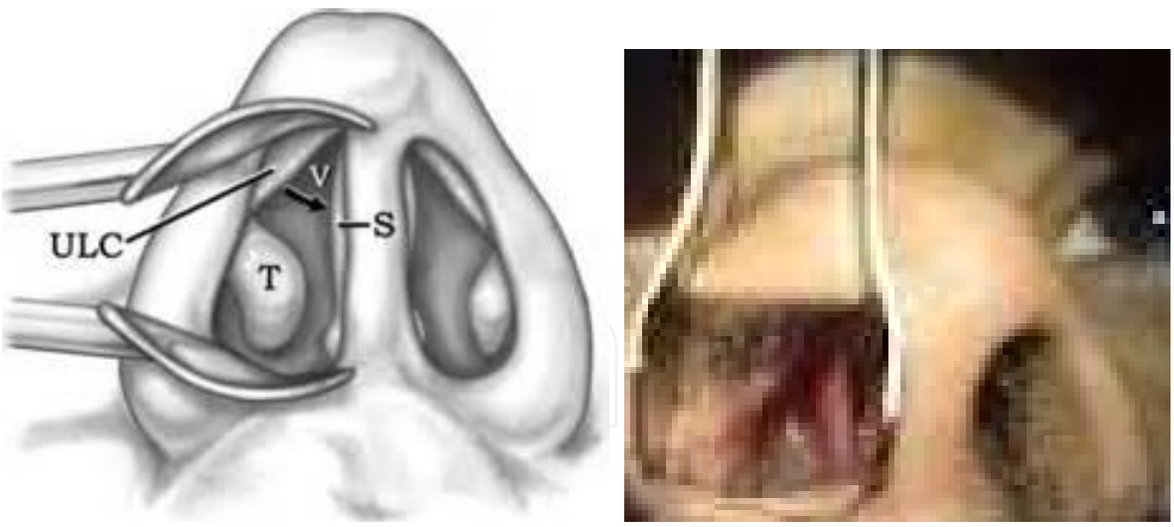


Figure 3. Entry to the sinus from the nostrils

This does not involve any incisions on the face, but may be combined with other external approaches, which may involve cuts. This surgery is usually done under general anesthesia for patient comfort. A CT scan will serve as a road map for the surgeon. ESS has presented a new philosophy allowing the surgeon to target the ostiumeatal complex (OMC). Obstruction of the OMC can lead to subsequent infection of the maxillary, frontal and sphenoid sinuses.

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Accordingly, ESS removes thickened and diseased tissue blocking the OMC. Most of the healthy tissue in the sinuses is undisturbed allowing for faster and better overall recovery. Endoscopic surgery can also be utilized for removal of polyps, nasal masses and sometimes straightening the septum to improve nasal airflow.

2.1. Functional endoscopic sinus surgery

Functional endoscopic sinus surgery (FESS) is the mainstay in the surgical treatment of **sinusitis** and **nasal polyps**, including bacterial, fungal, recurrent, acute and chronic sinus problems. FESS is a relatively recent surgical procedure that uses nasal **endoscopes** (using **Hopkins rod lens technology**) through the nostrils to avoid cutting the skin. FESS came into existence through the pioneering work of Drs. Messerklinger (in 1960 to 1970's) and his assistant Stamberger who became chief of the ENT department in Graz, Austria. Other surgeons have made additional contributions (first published in the USA by Kennedy in 1985).[25]

By the early 1990's endoscopic sinus surgery become one of the most popular procedures. In their 1990 publication, Stamberger [26] mentioned operating 4500 patients, roughly 450 patients annually. Most procedures were very limited surgical procedures; diseased ethmoid compartments were operated on (usually the ethmoidal bulla), stenotic clefts were widened (uncinate process) and prechambers (agar nasi cells) to the frontal and maxillary sinuses were freed from disease.

2.2. Indications

The most common indication for endoscopic sinus surgery is "chronic rhinosinusitis". Chronic rhinosinusitis is a term applied to various nasal processes which involve inflammation of the nose and sinuses that do not adequately improve with medical management. Less common indications include (but are not limited to): recurrent infections (rather than chronic inflammation), complications of sinus infections, nasal polyps, mucoceles, chronic sinus headaches, impaired sense of smell, tumors of the nasal and sinus cavities, cerebrospinal fluid leaks, nasolacrimal duct obstruction, choanal atresia, and the need to decompress the orbit. Additionally, recent advances in endoscopic techniques allow the operator to provide access to areas of the brain and pituitary gland for neurosurgeons or to the orbits (eye sockets) for certain ophthalmology procedures.

2.3. Technique

The frontal, maxillary, and anterior ethmoid sinuses drain into the middle meatus. Posterior ethmoids drain into the superior meatus. Sphenoid sinuses drain into the sphenoethmoid recess. Telescopes with diameters of 4mm (adults) and 2.7mm (pediatrics) and with a variety of viewing angles (0 to 30, 45, 70, 90, and 120 degrees) provide good illumination of the inside of the nasal cavity and sinuses. High-definition cameras, monitors and a host of tiny articulating instruments aid in identifying and restoring the proper drainage and ventilation relationships between the nose and sinus cavities. Cultures and biopsies can be easily obtained

to yield valuable diagnostic information to guide postoperative therapy for optimal long term results.

All the sinuses can be accessed at least to some degree by means of this device: The frontal sinuses located in the forehead, the maxillary sinuses in the cheek bones, the ethmoid sinuses between the orbits, and the sphenoid sinuses are located in the back of the nasal cavity at the base of the skull.

2.4. Extended approaches

Endoscopic access to pituitary tumors has been successfully accomplished for many years. More recently, further advanced techniques have allowed the paranasal sinuses to be a relatively low-morbidity approach to selected tumors even inside the skull or brain.

2.5. Benefits of ESS

The overall goal of sinus surgery is to improve the drainage pathway of the sinuses. By opening the natural drainage pathway of the diseased sinus, the frequency, duration and severity of infections should be reduced. Sinus surgery is not without risk, but it does have major benefits. Sinus issues left uncorrected may lead to abscess formation, permanent loss of sense of smell vision, or even death. Benefits of sinus surgery include asthma relief, polyps and fungus removal and less recurrence of sinus infections.

Although there are patients who have mechanical obstruction due to their particular anatomy, many patients have an intrinsic problem with the lining (mucous membrane) of their nose and sinuses. While the patients with mechanical obstruction, will receive the maximal benefit from surgery, the benefit for patients with mucous membrane disease is also tangible because the larger opening created during surgery will allow better drainage and more medication and rinses to get into the sinuses and help treat the diseased lining.

One of the most important benefits of surgery is the ability to deliver medications (e.g. sprays, rinses, nebulized drugs) to the lining of your sinuses after they have been accessed. Therefore, surgery is an adjunct to, not a replacement for, proper medical management. It is important to note, however, that if you are one of the patients who have diseased mucous membranes or form nasal polyps, no amount of surgery can change this fact. So although surgery plays a role in managing the disease, it may not cure sinus disease with polyps or other types of chronic inflammation. Therefore, it should be emphasized that surgery is one of the multiple steps in managing the disease.

2.6. Possible risks and complications related to functional endoscopic sinus surgery

Extreme care is required with this surgery due to the proximity of the sinuses to the eyes, optic nerves, brain and internal carotid arteries. However, these serious risks are rare occurrences and there are many potential benefits from a well-performed endoscopic sinus surgery with appropriate indications. All surgical procedures have risks and complications namely:

1. Bleeding from the nose in the days following the operation

2. Infection
3. Injury to the nasolacrimal duct or sac
4. Need for frequent post-surgical visits for cleaning
5. CSF leak
6. Impaired taste and/or smell (usually temporary)

2.7. CT navigation

Computed tomography (CT) navigation is a tool that may be used by surgeons to better correlate surgical anatomy with pre-operative CT imaging. A computer is used to identify the 3-dimensional location of a probe tip placed within the patient's nose or sinuses.

Definitive proof that CT navigation improves outcomes and decreases complications is lacking. A Swedish study of 212 patients undergoing sphenoethmoidectomy published in 2008 concluded that the clinical success of the procedure was similar with or without the use of CT navigation, and that the rate of complications might be slightly reduced.[27]

3. Endoscopic facelift (forehead lift, brow lift, midface lift)

As humans age, lines and wrinkles naturally form on the forehead due to constant muscle movement, making one look older than he/she would like. Additionally, those horizontal lines across the forehead, or vertical lines between the brows, can cause one to look angry, stressed, or simply unpleasant and unapproachable. Fortunately, with the help of endoscopic surgery, one can achieve a fresh-faced, smooth, youthful appearance.

3.1. Technique

In preparation for a classic forehead lift, the hair is tied back with rubber bands in front and behind the incision area. An incision is usually made across the top of the head, just behind the hairline. Forehead skin is gently lifted and portions of facial muscle and excess skin are removed. The incision is then closed with stitches or clips. The result of a forehead lift is a younger, more rested look (Figure 4).

In an endoscopic forehead lift, the muscles and tissues that cause the furrowing or drooping are removed or altered to smooth the forehead, raise the eyebrows and minimize frown lines. Surgeons may use the conventional surgical method, in which the incision is hidden just behind the hairline; or it may be performed with the use of an endoscope. Both techniques yield similar results, smoother forehead skin and a more animated appearance.

Low, heavy "V" shaped eyebrows create a tired, older, masculine, unfriendly appearance. Opening up the eyes and brows and smoothing the forehead is both powerful and subtle. Patients look more awake, fresh, healthy and youthful. Forehead surgery is normally done in combination with an eye lift (blepharoplasty) for best results.

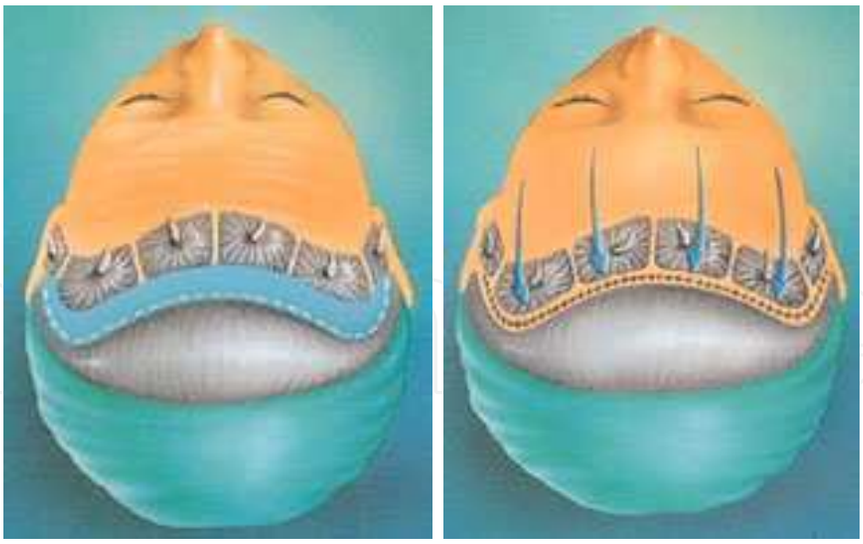


Figure 4. Classic forehead lift incision

Before the operation, motivations and demands of the patients must be analyzed. A careful study of the upper facial region and its relations with the rest of the face should be made. A preoperative assessment is normally conducted as required. The anesthesiologist will be seen in consultation at the latest 48 hours before surgery. No medication containing aspirin should be taken within 10 days prior to surgery. Smoking cessation is strongly recommended at least one month before and one month after surgery. An antiseptic shampoo should be used the night before and / or in the morning. It is essential to fast (not eat or drink) 6 hours before surgery.

3.2. Type of anesthesia

Two methods are possible:

- Local anesthesia deepened by intravenous tranquilizer
- General anesthesia

The choice between these different techniques will be the result of a discussion between patient, surgeon and the anesthesiologist.

Hospitalization is short. The admission is in the morning (or even the day before in the afternoon) and the discharge is permitted either in the evening or the day after the operation.

3.3. Technique of endoscopic forehead and eyebrow lift

Each surgeon adopts his/her own technique that he/she adapts to in each case in order to obtain the best results. However, some common basic principles are as follows:

Incisions are between 5 and 10 mm long, are three to five in number and are placed in the scalp, a few centimeters behind the forehead hairline. One of them will allow the passage of the endoscope connected to a mini video camera, the other giving way to the different instruments

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specifically adapted to endoscopic surgery. The path of these incisions is of course the future location of scars, which are therefore virtually invisible since they are very short and hidden in the hair. Detachment includes the temples and facial bones (Figures 5 and 6).

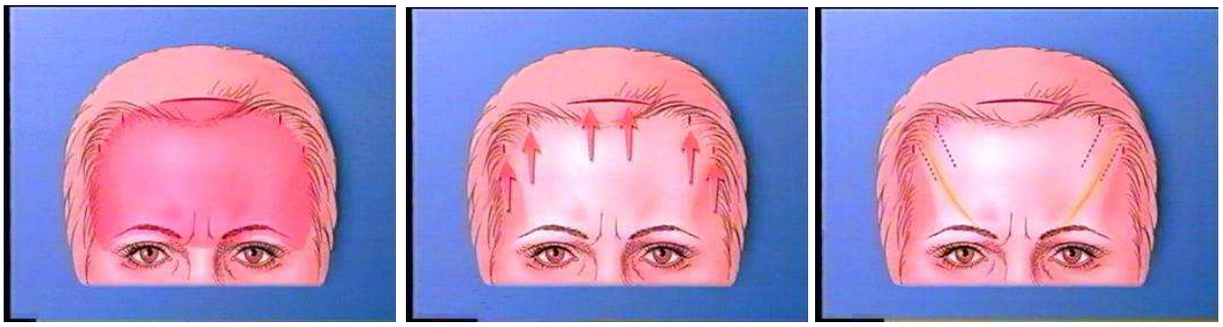


Figure 5. Incision sites for endoscopic forehead (brow) lift surgery

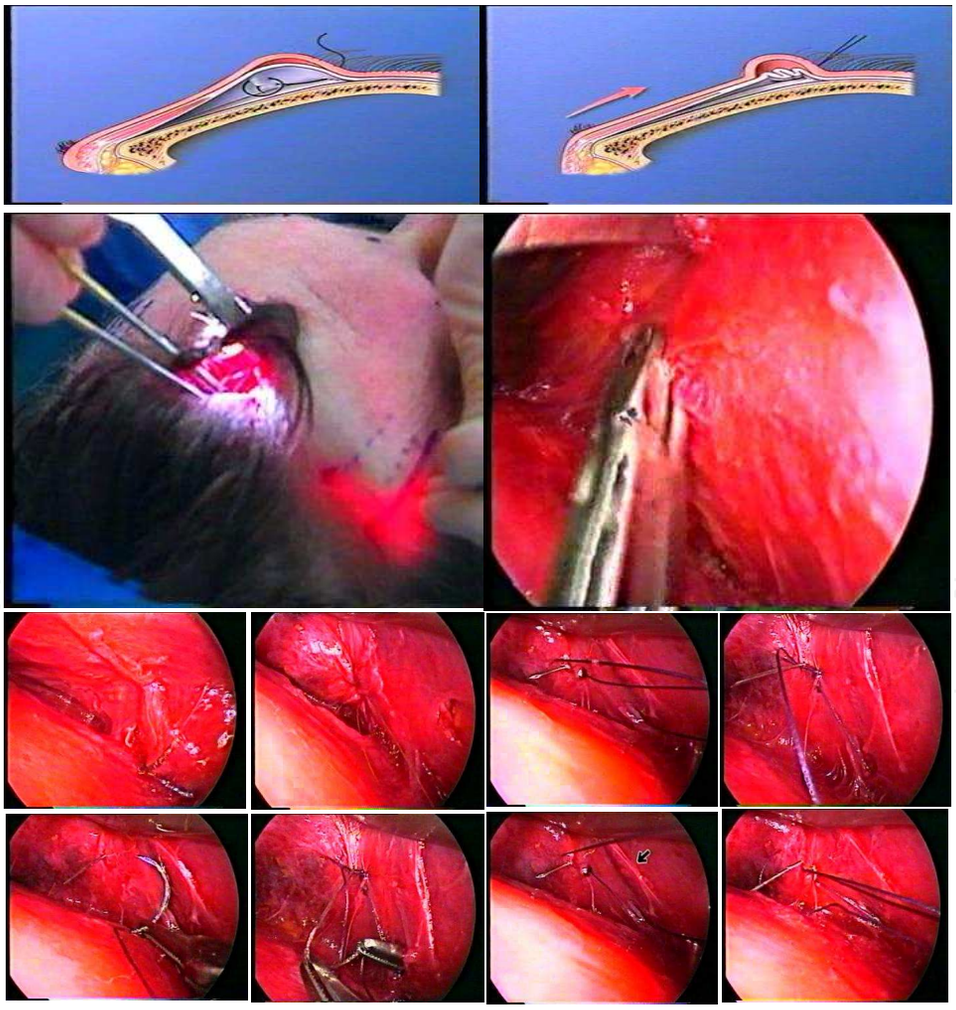


Figure 6. Dissection and suturing during endoscopic surgery

Replacement: Loose tissue will be retightened to soften the "crow's feet", move the tail of the eyebrows upward, and above all the cheek and fat under the eyes that had accumulated over the nasolabial folds will be held in position by deep fixation.

Sutures: The small incisions are closed, often with skin staples that are easily removed or with buried absorbable sutures.

Depending on the surgeon, the extent of improvements and the possible need for additional procedures, the intervention may take 2 to 3 hours. Possibly some discomfort with a feeling of tension on the temples and cheek may occur. The postoperative course is mainly marked by the appearance of edema (swelling) and ecchymosis (bruising) the size and duration of which is highly variable from one individual to another. The dressing should be removed between the 1st and 3rd days. Staples are removed between the 8th and 15th day. The stigma of the intervention will diminish gradually, allowing the return to normal social and professional life after a few more days (10-20 days depending on the magnitude of the surgery). Some numbness of the operated area, possibly some itching on the skull, may be observed during the first weeks. They gradually disappear. A delay of 3 to 6 months is necessary to assess the final outcome. This is the time for all of the edema to be reabsorbed and for the tissues to regain their flexibility. In most cases, intervention results in improvement and significant rejuvenation of the upper face, with an attenuation of nasolabial folds, padding the area under the eyes and cheeks (with disappearance of the "valley tears") and a decrease of the lower eyelid height.

The results are generally durable, although the aging process is not stopped by the intervention, the benefit of the lift will be present many years after.

3.4. Ideal candidates

Most patients opting for lifting are aged between 40 and 50 years, when brow lines and eyelids begin to sag noticeably and wrinkles or creases begin to appear along the forehead. Heredity sometimes causes these problems for people in their 20s and 30s, in which case a brow lift can help. Anyone considering this procedure should have a thorough understanding of what it can and cannot accomplish. After an in-depth discussion, some decide that a brow lift performed in conjunction with other procedures (e.g. a facelift (rhytidectomy) or eyelid surgery (**blepharoplasty**) will provide the best results

3.5. Facelift complications

All surgical procedures carry some uncertainty and risk. Even in the best hands, complications do occur. Fortunately, these are usually treatable. Patients vary in their anatomy, physical reaction to surgery, anesthesia, and healing capabilities, so that the outcome is never completely predictable. Surgeons know from experience that two operations in different patients, done almost exactly the same way, may have very different outcomes. Even operations on two sides of the same face or body can have different outcomes, particularly in terms of discomfort, bruising and swelling. Patients are often surprised at this.

It is best if patients anticipate having a complication, and if they do not that is a bonus. There is a well-known phrase in surgery: "The only way to avoid complications is by not operating."

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Experienced surgeons, particularly toward the end of their careers, are often very candid and admit that they've seen just about every complication in their practice over the years. It is important for the patient and doctor to have a mutual trustful relationship to manage complications when they develop.

A complication rate of 1% is commonly quoted. It seems small, only one in a hundred, and perhaps this is a rate that is comfortable from a psychological standpoint, an event that sometimes happens to other people. But it should not be too reassuring, even if it is correct. If patients encounter a complication, it's 100 percent as far as they are concerned. They have to understand that it could happen to them. They should have the surgery only if they can tolerate the risks.

Facelift risks and complications may include:

1. Excessive scarring, bleeding, hematoma, infection, skin necrosis, facial weakness or paralysis caused by facial nerve injury, asymmetry, numbness, burning or cold sensations, facial pain, skin contour irregularities, skin discoloration, swelling, hair loss along the incision lines or elsewhere and corneal injury.
2. Corneal injury. It is imperative that the corneas be protected from drying out. Normally, at night, the cornea is protected by the closed eyelids. However, after surgery, the eyelids may not close completely, due to swelling or weakness of the orbicularis muscle that encircles the eyelids. Incomplete eyelid closure places the cornea at risk. Until eyelid function returns, it is imperative that the corneas be kept from drying out with the use of lubricating ointment and eye drops.
3. Earlobe deformity ("pixie ear") is an unnaturally tethered ear. The earlobe is pulled down by the facelift scar. Usually this results from too much skin removal around the ear, so that there is tension on the skin closure, pulling down on the earlobe. Experienced plastic surgeons avoid any skin tension in the area of the earlobe to prevent such a complication of surgery.
4. The "lateral sweep," is an unnatural, operated-on appearance that can happen after facelifts that draw back on the skin of the lateral face, while leaving the vertical descent of the cheek and jowl untreated. The skin form may form horizontal folds. It is not a harmonious or pleasing appearance.
5. Another post-surgical problem is "joker's lines," unnatural lines of tension that extend from the corners of the mouth to the ears. Both problems may be prevented, and treated, with a deep-plane facelift that incorporates a cheek lift.
6. Tragal deformity: flattening of the tragus (the small bump just in front of the ear canal) may be avoided by using a pre-tragal incision, which is my preference. The tragus is a unique structure that is very difficult to recreate.
7. Nerve damage may concern some sensory branches and then be responsible for certain insensitivity and itching of the forehead and scalp that eventually subside after a few months. A paralysis of the frontal branch is much rarer and, fortunately, is only temporary in most cases described.

8. General dissatisfaction with the cosmetic results, possibility of revision surgery, depression or emotional mood changes may also develop.

3.6. Preoperative instructions

Before undergoing brow lift surgery, we must provide pre-operative instructions; these may include:

1. Stopping smoking four weeks before surgery
2. Stop taking certain medications, herbs, and vitamins (including those that thin the blood) two weeks before surgery
3. Purchase all supplies that will be needed during recovery, including pain medication, bandages, and groceries, before the day of surgery
4. Not eating or drinking anything after midnight the day of surgery
5. Not wearing make-up, contact lenses, or jewelry on the day of surgery
6. A family member or friend should drive the patient home.

3.7. Benefits of brow lift surgery

All men and women over the age of 40 see signs of aging in the face. The forehead is usually one of the first places where lines and wrinkles appear due to excessive muscle movement. Fortunately, brow lift surgery can do away with a number of cosmetic flaws on the upper third portion of the face. The many benefits of brow lift surgery include: Increase confidence with enhanced appearance, rejuvenated appearance, alleviation of tension in the forehead muscles, causes minimal side effects, fast recovery, excellent, long-lasting results (up to 10 years or more), incisions are well hidden and scarring is minimal, natural-looking results and few potential risks or complications.

4. Endoscopic midface lift

An endoscopic mid-facelift, also known as the anti-gravity lift, is a surgical procedure able to provide a natural, more youthful and refreshed appearance to the face by repositioning sagging cheeks, softening smile lines, reducing lower eye hollowness, elevating the corners of the lips, and restoring cheek fullness.

4.1. Best candidates

The best candidate for an endoscopic mid-facelift is a physically healthy man or woman who has realistic expectations and is interested in improving the appearance of sagging or sunken cheeks, smile lines, lower eye hollowness, and sagging corners of the lips. The procedure is ideal for patients in their late thirties to early sixties.

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4.2. Technique

After anesthesia is administered, tiny incisions are placed inconspicuously within the hairline at the temple and inside of the mouth. An endoscope is inserted into the incisions to help guide the surgeon as he or she elevates the fat pads of the cheeks as well as the deeper tissues. The incisions are then closed with sutures (Figure 7).



Figure 7. Schematic endoscopic midface lift. Tiny incisions are inconspicuously placed within the hairline at the temple and inside of the mouth, thus allowing for no visible scarring. There is no visible scarring after an endoscopic mid-facelift as very tiny incisions are inconspicuously placed inside of the mouth and within the hairline at the temple.

After an endoscopic mid-facelift, patients typically experience minimal discomfort which can easily be controlled with pain medication. Swelling and bruising may occur and typically fades within a few weeks. The head should be elevated for the first few days to help minimize swelling. Stitches are typically removed within seven days. Patients can typically return to work within a week after an endoscopic mid-facelift. As with all types of surgery there are potential complications that can occur with an endoscopic mid-facelift.

5. Endoscopic repair of facial fracture

Endoscopy is not a new concept; it is however, relatively new to the field of craniomaxillofacial surgery. Surgeons weigh the risk of an operation and its approach against the benefits of preventing complications, and recommend surgery based on this analysis. In general, if a

procedure has a lower risk of complications, it is more widely applied. Endoscopic techniques may provide lower rates of complications and higher acceptance rates in patients, and therefore, they may be more widely employed. Because these techniques are very detailed and have a steep "learning curve," surgeons should be patient in their evaluation and use.

5.1. Frontal sinus fracture repair

Fractures of the frontal sinus and orbit are relatively common in facial trauma patients (5 to 15% of all maxillofacial traumas).[28]-[31] Although a significant percentage of these fractures can be managed non-operatively, operative intervention is often required to avoid late complications. Frontal sinus fracture is commonly treated via an endoscope. If the fracture is a simple type that places a small depression on the forehead, it is very amenable to endoscopic techniques. Frontal sinus fractures essentially come in four types.

The first type is anterior table fracture only, which is perfect for endoscopic technique because these fractures are the easiest to treat and the most conspicuous. The fragments must be evaluated with anatomic precision. The bony fragments may be reduced in situ or, more likely, removed, plated, and replaced either through a scalp or a brow incision.

The second (most common) fracture type is fracture of the anterior and posterior tables. Because a large amount of energy is required to cause this type of fracture, patients are often comatose or require c-spine precautions and wound care until open reduction and internal fixation (ORIF) can be done. These fractures are often associated with CSF leakage and need not only facial and sinus surgery, but also dural repairs and brain surgery. Patients often require cranialization of the sinus and cannot be treated with endoscopic techniques.

The third type of fracture is fracture of the posterior table itself. These fractures are rare, but when they occur they require a craniotomy for repair.

The fourth type of fracture is one that disrupts the ducts. If the duct is damaged, the patient would benefit from some procedure to defunctionalize the sinus. This could be cranialization (if a craniotomy is required) or obliterations with bone or fat.

An illustration detailing the incisions for endoscopic repair of anterior table frontal sinus fractures can be seen in Figure 8.

5.2. Orbital fractures

Orbital fractures are common and typically occur as blow-out fractures (BOF). BOF fractures are fractures that result in trauma directly over the orbital rim and floor. These fractures are not associated with the typical zygomaticomaxillary complex fractures. Medial orbital fractures are treated similarly to floor fractures except that these require more extensive knowledge of intranasal anatomy. To undertake the endoscopic repair, you must be aware of endoscopic skull base anatomy and be comfortable taking or medializing the middle turbinate and taking the uncinate process and ethmoid bulla down. Medial wall fractures are essentially an extended ethmoidectomy and treated via placement of an alloplastic sheet.

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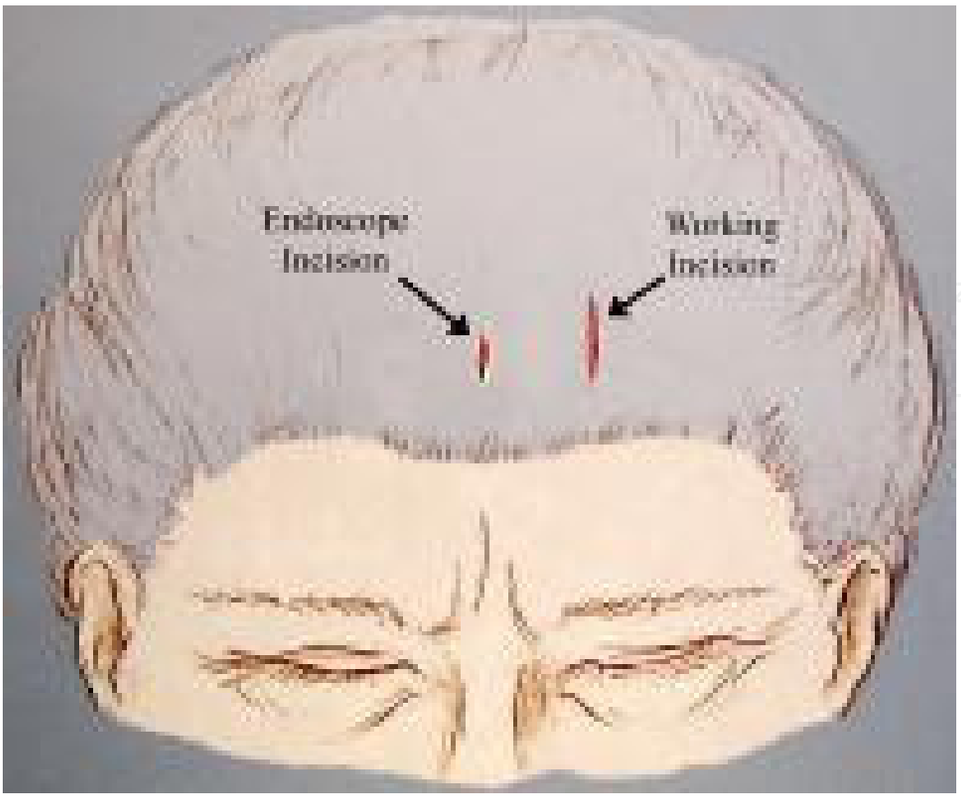


Figure 8. Illustration of incisions used for endoscopic repair of anterior table frontal sinus fractures. The working incision is in line with the fracture. The endoscope incision is just medial to the working incision.

The instrumentation is virtually identical. These techniques were first used for endoscopic subcondylar repair [28]-[30] and are now also used for transantral orbital floor reconstruction, zygomatic arch and frontal sinus repair. Subcondylar fractures are difficult to treat openly in even the best of circumstances and seeing and treating the condyle in its native position has numerous advantages. Once this use became more common, other facial fractures began to be examined from an endoscopic perspective.

Some of the more typical complications of orbital fractures are diplopia from muscle entrapment, visual loss, and exophthalmoses from volume expansion into the surrounding sinus leading to pseudoptosis. The typical complications from frontal sinus injuries are much less common but much more significant when encountered. These include frontal contour irregularities, spinal fluid leak (predisposing to meningitis), ocular complications including vision loss and blindness and late complications i.e. mucoceles (Figure 9).

Traditionally, external transorbital approaches have been used in the repair of blowout fracture (BOF) of the orbit. External approaches generally require either a medial canthal incision, a subciliary incision, or a transconjunctival incision, depending on the location, extent and complexity of the fracture. External repairs with transorbital incisions have known complications that include external scars, ectropion and a frequent need for alloplastic materials to support the fractured wall.[32]

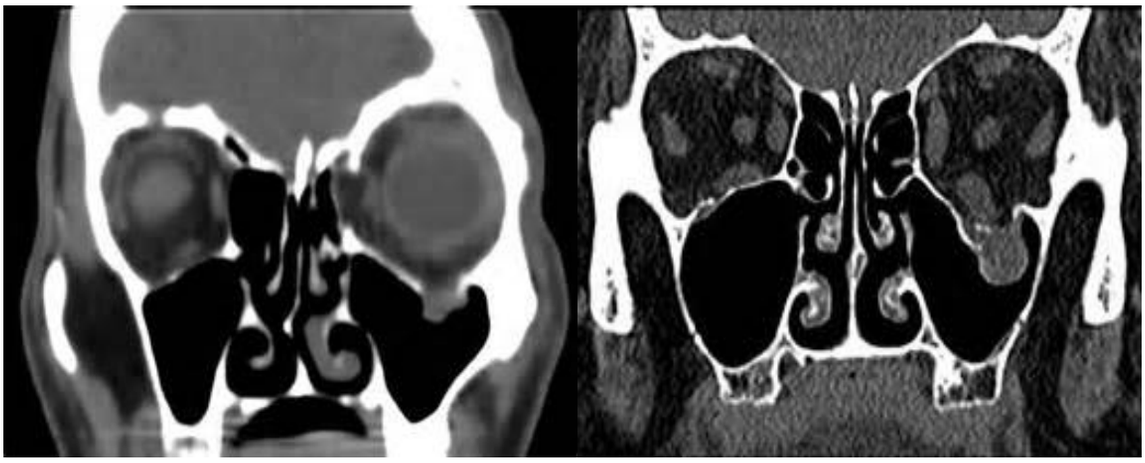


Figure 9. Coronal CT views of left orbital blow-out fracture

Endoscopic repair of BOF of the orbit has been reported to provide surgeons with several advantages over conventional external repair. [32]-[42]

First, it provides excellent visualization of the medial and inferior walls of the orbit, which enables safe removal of bony fragments and clear anatomic reduction of fractures. Second, the use of intraocular alloplastic implants, commonly used with external repairs, can be avoided or minimized.

Third, endoscopy virtually eliminates the risk of significantly visible facial scarring and eyelid complications, reported with transorbital incisions. Fourth, endoscopic surgery can be performed under local anesthesia, which makes intra-operative evaluation of ocular movements and diplopia possible.

When the anterior maxillary wall is fractured, Medpor is used to support the orbital floor; an endoscope enables clear identification of the bony shelves so that the implant can be placed safely and with adequate support (Figures 10 and 11).

No specific major disadvantages have been reported for endoscopic repair of BOF.[42], [43] One potential difficulty with transantral repair of inferior BOF is in the fabrication and maintenance of a balloon that conforms to the shape of the orbital floor to support the reduced orbital tissue. Under usual circumstances, the balloon is removed three to four weeks after surgery.

In medial BOF, the balloon can be removed early if the fracture is small or if only those bony fragments that might interfere with ocular muscle function are removed. In inferior BOF, the balloon can be removed early when a trapdoor type fracture is reduced with the bony fragment intact or when the fracture site is supported by a large bony fragment or implant. Usually, the balloon packing that supports the medial wall can be removed earlier than a balloon catheter that supports the inferior wall because the inferior wall must be rigid enough to support the orbit against gravity. Failure of diplopia to improve after adequate repositioning of orbital tissue is not an infrequent outcome after surgery for BOF. [42], [45] There are a few explanations for residual diplopia even after adequate surgery.

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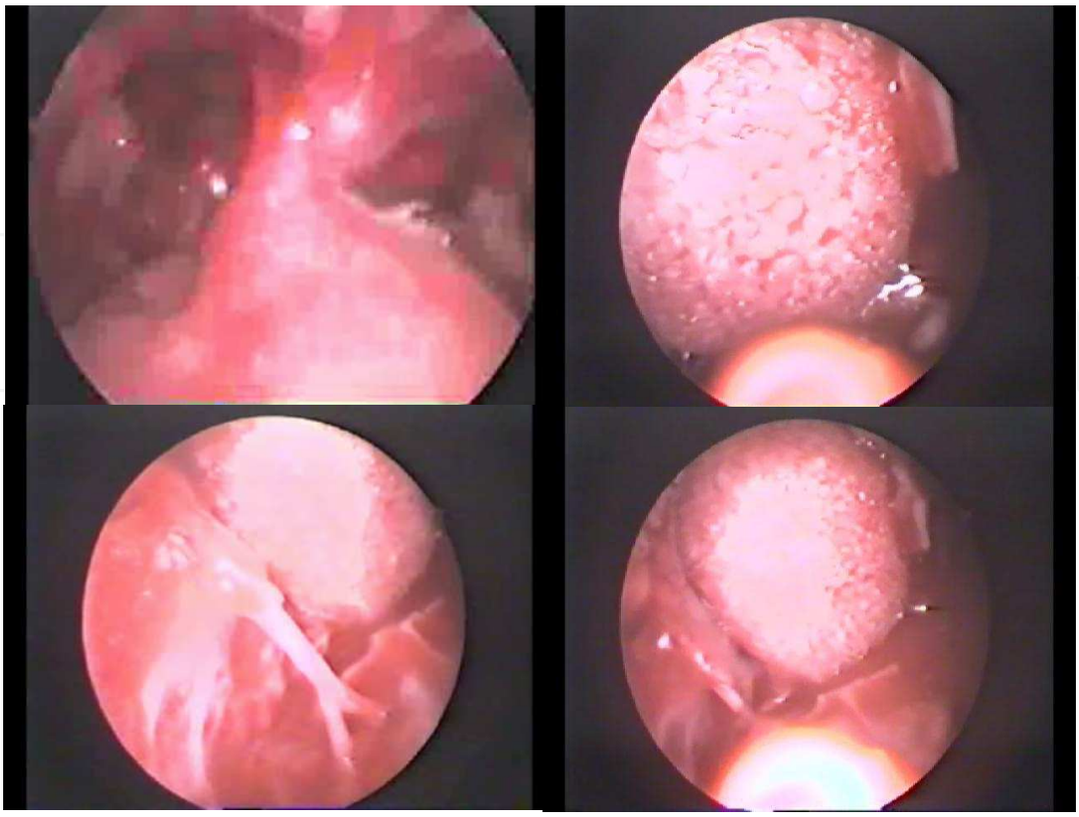


Figure 10. endoscopic repair of orbital floor fracture via alloplastic material

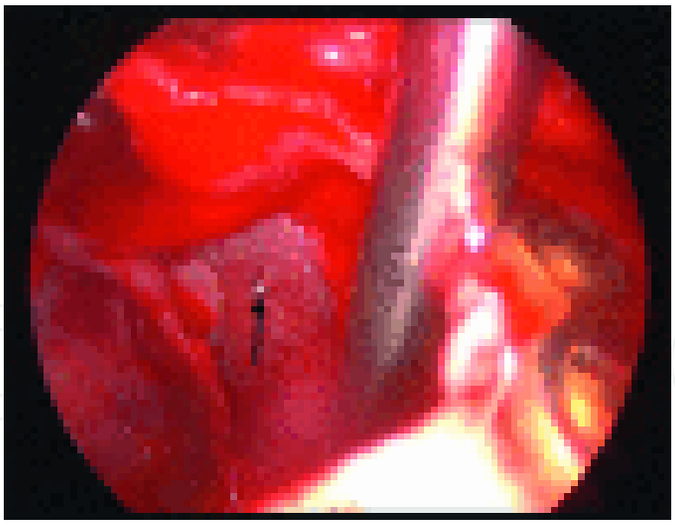


Figure 11. Medpor with the screw placed as a handle (arrow). Medpor in place to hold periorbital fat above the floor defect.

- The first possible explanation is that entrapment, contusion, or hematoma of ocular muscle by fractured
- Second, there may be an undetected, persistent palsy of the oculomotor nerve. [45],[46]

- Third, altered globe position may occur.

Exophthalmos of greater than 2 mm is another indication for surgery, mostly for cosmetic reasons.

Endoscopic repair of orbital blowout fractures represents an innovative and highly successful and safe alternative to external repairs.

Early applications for endoscopic treatment of facial trauma include subcondylar fractures of the mandible, [47]-[50] orbital blow-out fractures, [51]-[56] frontal sinus fractures, [57]-[58] and zygomatic fractures. [57]-[58]

Advantages of endoscopic repair include the following: More accurate fracture visualization, small external incisions, reduced soft tissue dissection, potential for visualization around corners and reduced duration of hospital stay.

Disadvantages of endoscopic repair include the following: Need for delicate instrumentation, moderate learning curve for the techniques, narrow field of view and limited ability for bimanual instrumentation without an assistant.

Indications for endoscopic repair are generally related to fracture location, size, degree of comminution, and the surgeon's ability. Some of the techniques described herein are still under development, and surgeons contemplating the use of these techniques must determine if institutional review board approval is necessary.

6. Endoscope-assisted transoral reduction and internal fixation of mandibular condylar process fractures

Owing to the risk of facial nerve damage and the creation of visible scars, surgical treatment of condylar mandible fractures using an extraoral approach remains controversial. The transoral endoscopically assisted approach of condylar fractures has been reported to avoid these complications. **Kokemueller** studied closed treatment of mandibular condylar neck fractures by endosurgical treatments. Treatment options may yield acceptable results for displaced condylar neck fractures. Especially in patients with severe malocclusion directly after trauma, endoscope-assisted transoral open reduction and fixation seems to be the appropriate treatment for prevention of occlusal disturbances.[59], [60]

The treatment of condylar mandible fractures with a minimal invasive endoscopically assisted technique is reliable and may offer advantages for selected cases, particularly concerning the lower occurrence of facial nerve damage.[61] In the treatment of condylar injuries, the endoscope is not only an aid; it alters the treatment philosophy, from the conservative MMF to anatomic repair. Each surgeon will have to decide on his or her indications for endoscopic repair, and indeed this may depend heavily on his or her experience and patient preference. The authors feel that anatomic reduction and fixation are the best ways to restore preinjury facial aesthetics and mandibular dynamics and to prevent late sequelae of internal derange-

ment. Thus, nowadays surgeons strongly advocate endoscopic repair of adult condylar neck and subcondylar fractures that demonstrate severe displacement or dislocation.

7. Summary

The use of endoscopes has become one of many standard methods for treatment of fractures within the head and neck. As the boundaries of endoscopic surgery expand further, patients will receive the benefits of shorter incisions, less pain and earlier recovery. And, as the surgeons become more and more facile with the instruments, more indications for this type of repair are justified, and more patients ultimately benefit from less invasive surgery. Traditional lid incisions may lead to rates as high as 5 to 10% of lid malposition, which is quite high, considering that the fractures in themselves have a very low rate of complications. Initial reports on transantral approaches were met with some skepticism, but new endoscopic techniques are much easier to perform and interest in this technique has re-emerged. The main advantages of these endoscopic techniques for the orbital fractures are: no skin incisions, easy visualization of the defect, and direct view of the posterior ledge. Despite all these benefits, endosurgery requires training experience and skill of the surgeon.

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