ENDOSCOPIC BROW SURGERY

Mark L. Zukowski, MD

Endoscopic brow lifting techniques were developed in the early 1990s. These techniques were subsequently popularized by Oscar Ramirez, Nicanor Isse, John Bostwick III, and other leaders in the field through a series of national teaching courses starting in the summer of 1993. Endoscopic intervention represented a paradigm shift in the field of plastic surgery. These techniques finally allowed surgeons to perform major procedures through minor incisions, which was the historical perception of the public. Since its introduction starting with breast augmentation and brow lifting, the endoscope has been used as an adjuvant in cosmetic procedures of the face and abdomen and in reconstructive procedures such as tissue expander placement, muscle flap harvest, and craniofacial corrections.7

This article concentrates on personal perspectives developed by the author since first learning the technique from Oscar Ramirez in May 1993, performing his first solo procedure in June 1993, and participating on numerous national and international faculties teaching these techniques since December 1993.

BACKGROUND

There was a great degree of controversy in the early years of endoscopic brow surgery. The argument centered on whether endoscopic minimal scar techniques could elevate the eyebrows in a lasting manner similar to open techniques. In 1993, the author incorporated endoscopic techniques into an ongoing prospective study that attempted to compare different facelift approaches using a reproducible cephalometric analysis.10 Endoscopic subperiosteal brow procedures were compared to open subperiosteal approaches. Twenty patients were enrolled, with follow-up ranging from 13 months for the endoscopic subset to 30 months for the open subset. The patients perioperatively had barium paste applied over the eyebrows with analysis performed using anteroposterior cephalograms. The supraorbital bony rim was used as a fixed horizontal reference plane. Statistical analysis of the data was performed using the following three tests:

1. Analysis of variance using the general linear models procedure method
2. Performance of a mean comparison of factors that went into variance analysis with the Turkey's studentized range test
3. Performance of comparison of the mean and standard deviations between different groups with Student's t test

From the analysis the following conclusions were made:

1. There was a statistically significant elevation in the eyebrow positions achieved for all browlifts compared to the preoperative eyebrow positions (P < 0.0001).
2. There was no statistically significant descent in eyebrow position for any browlift after 5 postoperative days (P > 0.4).
3. There was no statistically significant difference in the degree of eyebrow elevation between any of the browlift groups (P > 0.7).

Such findings are even more relevant considering that these endoscopic procedures were per-
formed early in the learning curve when this procedure was still in evolution.

THE LEARNING CURVE

In the summer of 1993 only a few prototype instruments were available, and the surgical approaches and fixation techniques were in a state of flux. The author believes that the learning curve for surgeons with minimal endoscopic experience involves approximately 50 patients. It takes this number of cases to feel confident in one’s surgical ability and to encounter the multiple variations in the anatomy that allow one to elevate the eyebrows easily and predictably with stable long-term results. Even surgeons with excellent intracorporal endoscopic skills are initially stymied by the lack of a large volume optical cavity. The learning curve can be decreased in an experienced endoscopic surgeon’s hand, however. It is imperative with this technique to use properly designed endoscopic instruments and be prepared to convert to an open technique. The greatest technical hurdle to overcome is obtaining adequate release of the supraorbital brow. Proper spreading and separation of the galea along the orbital rim and disruption of the corrugators, depressors, and lateral orbital ligament are the hardest technical points to learn. The subtleties of preoperative eyebrow asymmetries as they relate to height and arch form add complexity to the technique. Adequate release and asymmetry correction are addressed at the end of what often proves to be a challenging series of technical maneuvers that leave the surgeon mentally taxed. The hesitation in dissecting too much or damaging a vital neurovascular structure leads to insufficient release and suboptimal correction of eyebrow ptosis. Unfortunately, this iatrogenic failure is often ascribed to the inadequate nature of the endoscopic technique and not that of the surgeon. The following paragraphs outline selection criteria and technical sequences currently used by the author, that he has found easiest to teach to others.

PATIENT SELECTION

One of the most difficult aspects of a cosmetic surgery procedure is making the proper preoperative diagnosis and individualizing the technique to a patient’s unique needs. Controversy still exists with endoscopic procedures, and numerous variants that combine open and endoscopic techniques have been developed. The author’s experience is that endoscopic or biplaner techniques can be applied to every individual. The author has never needed to convert to an open approach. The key factor in performing these procedures is obtaining an adequate degree of orbital rim eyebrow release. In evaluating the patient, one must conform to basic established anatomic guidelines. Although extensive anthropometric measurements have been determined by Farkus, for most surgeons simple measurements and esthetic guidelines suffice.

Probably the most helpful determination for brow ptosis is the distance from the high point of the eyebrow as it relates to the midpupil of the eye. This measurement is normal at 2.5 cm (Fig. 1). The other determination is the height of the forehead, measured between the eyebrows to the trichion of the hairline. With open superciliary and subgaleal techniques, the height of the forehead is an important measurement in deciding between a traditional bicoronal or prehairline incision. This has become a less important measurement with endoscopic techniques. The eyebrows are elevated differentially in relationship to the rest of the forehead, and an increase in the perceived height of the forehead is usually not seen. The author performs a pure endoscopic technique in patients whose foreheads average heights up to 6.5 cm (Fig. 2). At this forehead height, the author has a discussion with the patient about using a biplanar variant technique, which consists of a prehairline incision with preservation of the supraorbital neurovascular bundle on a pedicle of galea.

Subcutaneous dissection of the upper third of the forehead is performed with skin excision that reduces the height of the forehead (Fig. 3). The eyebrows are still elevated endoscopically. The author has found this technique to be the most effective in teaching a surgeon endoscopic browlift techniques.

Most candidates for a browlift present with concerns of upper eyelid heaviness. A rare patient is savy enough to request a forehead lift. It is incumbent upon the surgeon to educate patients in the relationship between these two procedures. It is not for the purpose of selling patients on a procedure but allowing them to understand the direct relationship between these structures. The easiest way to demonstrate the effect of a browlift is to elevate the eyebrow to its highest position while the patient looks in the mirror. Although this may be an unrealistic position to obtain permanently, it allows patients to see the extreme that surgery may accomplish in the immediate postoperative period. One must be careful to elevate realistically the arch similar to what one tries to accomplish intraoperatively.

There is more emphasis on lateral elevation of the brow. Medial elevation is kept to a minimum to prevent a surprised look. The author uses 0.5-in steristrips, cuts them in half, and elevates the patient’s brow so that he or she can spend a few hours to better appreciate how elevation of the eyebrow can improve the appearance. For the surgeon who performs a combination browlift and upper lid blepharoplasty, the same technical pitfalls exist as they did with the combination of
Figure 1. The distance between the high point of the brow and the midpupil of the eye should be 2.5 cm in the nonptotic eyebrow.

Figure 2. A distance of 6.5 cm or higher between the medial eyebrows to the trichion is usually an indication for a biplaner brow lift technique.
these techniques using open approaches. One can overcorrect and excise too much skin from the lid or, more commonly, undercorrect and have residual upper eyelid fullness. The need for a minor revision of the upper eyelids should be discussed to minimize any patient dissatisfaction or unexpected expense in the postoperative period. As was true with open forehead lifts, this combination of procedures should be reserved for surgeons who are comfortable with obtaining predictable results with endoscopic techniques.

A condition that is important to be familiar with is the spastic frontalis syndrome. The frontalis spasm in an attempt to raise the eyebrow position to counter the dehiscence of the levator aponeurosis from the tarsal plate of the upper eyelid. In the spasm state, the eyebrow appears to be in a normal position with reference to the midpupil. The patient complains of deep forehead furrows and upper lid heaviness. A nerve block demonstrates the true degree of functional ptosis of the upper eyelid. Without the proper functional correction of the levator dehiscence, one does not get a satisfactory result.

It is important to discuss the nuances of hair growth and determine by history whether patients are in an anagen or telogen hair cycle. In cases of severe preoperative thinning, a dermatology consultation is helpful. The author has found that female patients are attuned to any hair loss. Surgery can result in a temporary telogen resting phase with some subsequent thinning. This phase can last 6 to 9 months and then resolves. It can be disconcerting to patients in the interim.

INSTRUMENTATION

Instrumentation is typically specific to the preferences of the individual surgeon. A 5-mm endoscope with xenon light source is a basic requirement. Endoscopic techniques are much like microsurgical techniques. One must have proper instruments in excellent condition to overcome the technical difficulties associated with this procedure. Each instrument is used for a specific technical maneuver. The author uses the entire Ramirez sequenced elevator set (Snowden Pencer, Tucker, GA) with a few select lisse instruments (Wells Johnson, Tucson, AZ). A great deal of thought and redesign have gone into these instruments. There are, however, excellent instruments designed by other leaders within the endoscopic field.

FIXATION

Fixation of the eyebrows is a matter of preference, and it is important to choose a fixation system that works best in the surgeon’s hands. The eyebrows must be suspended against gravity to obtain reproducible results. Numerous methods of fixation have been tried and consist of bolster dressings, internal suturing, internal suturing with
screw or bone fixation, K-wire absorbable fixation, and adjustable screw or staple post fixation. The author has tried them all and has evolved to using an adjustable screw or staple post fixation for 10 days postoperatively (Fig. 4). The author uses the Bioplate portable fixation set with 1.5-mm diameter screws that range from 13 to 17 mm in length. Only 4 mm of the screw is threaded. Fixation is not as key as proper orbital rim release. Improper release gives suboptimal results regardless of the fixation method used. Fixation prevents gravity relapse after adequate release. There should be no undue tension with fixation. Undue tension or using the fixation as a means to counter improper release leads to problems such as focal or global alopecia.

TECHNIQUE

The author prefers to use a six portal technique in women and a four portal technique in men. The latter approach is especially important if there are any concerns with a receding hairline. One can use any number of incisions but typically a six portal incision is comfortable because one’s hands move in concert through each anatomic region (Fig. 5). Decreasing portal number and increasing forehead height more than 6 cm increase technical difficulty, which can cause greater trauma to the surrounding skin with resultant alopecia. The vertex of the patient’s head should be flush with the end of the operating room table. The ability to pivot the instruments on a fulcrum that abuts the hand adjacent to the scalp without hitting the operating table. The portal incisions typically range between 12 and 15 mm, and there is a tendency to tear the incisions or damage adjacent hair follicles with smaller lengths. It is important to be gentle when dealing with the hair around the incisions. The author typically combs this down with surgilube and uses double prong skin hooks when retracting any incisions. One should never use the patient’s hair to do this. One must be careful to place all incisions parallel to the base of the hair follicle and stay subperiosteal when dissecting under hair follicles.

The author places the two central incisions in line with the supraorbital neurovascular bundle, the two lateral incisions in line with the temporal line of fusion, and the two temporal incisions in a typical bicoronal position. Making the temporal incisions 2.5 cm has no adverse effect and allows one a wider operating area in this region. Care must be taken because one typically encounters the posterior branch of the superficial temporal artery. Meticulous hemostasis is important to prevent postoperative hematoma and any undue trauma to the hair follicles. The author uses the Ramirez elevators for dissection in technical sequences that are well described.3 The dissection is done centrally at a subperiosteal level without the scope down to a point approximately two finger breadths above the superior orbital rim. The dissection in the temporal region stays on the temporal fascia proper until the imaginary line starting two finger breadths above the superior orbital rim medially and running to the superior helical crus of the ear laterally is encountered. There is nothing to damage in this area and direct visualization adds nothing.

It is important not to carry the temporal dissection in this plane closer than 1.5 cm to the zygomatic arch because the frontal branch of the facial nerve is potentially endangered in this area. It is important to stay subperiosteal centrally and on
top of the temporal fascia proper laterally. The temporal line of fusion is initially left intact. This attachment and that along the orbital rim should be dissected only under direct visualization with the endoscope. One encounters an aberrant location of the supraorbital neurovascular bundle exiting through a separate foramina above the orbital rim in approximately 30% of cases. The temporal line of fusion is dissected either directly with scissors or with sharp periosteal elevators. Occasionally the zygomatico-orbital neurovascular bundle is encountered and one must be prepared to obtain good hemostasis. If one uses elevators to do this, it is important to dissect from the lateral temporal to central bone direction to avoid inadvertent undermining of the fascia in the area of the temporalis muscle.

Adequate retraction is accomplished using the endoscope in the nondominant left hand if one is right handed. The skin envelope can be tented with an elevator in the right hand while introducing the scope in a downward fashion to the location that one wishes to visualize. The handle of the scope is dropped toward the bed to allow the extensor sheath to tent the galea, which creates an optical cavity. Too much retraction pressure in the area of the frontal branch could cause a temporary neuropraxia. The author finds no use in any extensor sheaths that angle in the upward direction. Care must be taken not to perforate the galea inadvertently when introducing the endoscope. Inadvertent perforations in the galeal or periosteal level cause disruption of the visual field. The author typically transitions into a subgaleal plane first in the area that runs from supraorbital neurovascular bundle to supraorbital neurovascular bundle. The author spreads the periosteal or galeal interface in this region and identifies the supraorbital neurovascular bundle and corrugator muscles (Fig. 6). The author performs a blunt dissection in these muscles and is careful to identify and preserve the neurovascular bundles. Initially, the author was meticulous in removing virtually all aspects of the corrugator muscles and is still aggressive in disrupting the corrugator and depressor muscles, but he removes only the muscle that ruptures during dissection. It is important not to be overzealous with muscle excision because one can leave behind a flat and depressed triangular segment centrally about which the patient may complain a few months postoperatively.

The author carries the dissection laterally and makes the transition from a subperiosteal to a subgaleal plane while carefully disrupting the depressor muscles. Care must be taken not to damage the neurovascular structures, but it is important to free up aggressively behind them because this is a frequent point of inadequate release. The author cuts the temporal line of fusion and frees up the area of the lateral orbital ligament. Inadequate release of this area is the primary reason for relapse of the lateral brow postoperatively. It is important to document preoperatively any existing eyebrow asymmetries. One must release more completely eyebrows that are lower. The author compensates approximately 2 mm for every 1 mm of asymmetry, which causes the eyebrows in the immediate postoperative period to have a
reverse asymmetry. The patient must be prepared for residual asymmetry.

When the author believes that he has obtained adequate release of the eyebrows, he wets the fingertips of his gloved hands and gently retracts the orbital rim to determine residual tightness. He continues with focal release of all tight areas until he is satisfied with the lack of depressor tension. It is important to check for meticulous hemostasis around the neurovascular bundles and be aware that the magnification factor of the scope makes insignificant oozing seem serious. One must be careful when spreading close to the dermis along the orbital rim. It is easy with sharp instruments to tear through the skin inadvertently.

After release, one is ready to suspend the brow. With adequate release, one must suspend the eyebrows in an elevated position under minimal tension. With adequate release, the eyebrows should stay in an elevated position. If one exerts undue tension with fixation, it is necessary to recheck to determine if there has been a full disruption of the depressors. The author uses a screw or staple postfixation system using the Bioplate drill set (Bioplate Inc., Los Angeles, CA), which is hand driven. The screw serves as a stable post with staples placed posterior to it that prevent forward migration of the scalp. An added benefit of this fixation technique is that one can advance or pull back the staples to allow minor postoperative changes in eyebrow elevation. The author leaves fixation in place for a 10-day period. In the temporal region, he uses a 3-0 PDS suture to fix the deep dermis of the scalp to the temporal fascia proper (Fig. 7). This gives lateral or oblique upward advancement to the most lateral aspect of the eyebrow. In the area of the frontozygomatic suture line, one can transition above the periosteum and dissect around the lateral orbital rim down to the zygomaticofacial neurovascular bundle. This approach gives added correction to the crow’s feet.

Transitoning above the periosteum in the area of the lateral orbital rim carries no risk to the frontal branch of the facial nerve. Generally all scalp incisions are closed with staples. A light dressing is applied that consists of steristrips, Topifoam (Lyonix, Carpenteria, CA), and a light pressure wrap of gauze and Coban (3M Health Care, St. Paul, MN). This wrap is typically kept on for a 48- to 72-hour period. The bruising with a subperiosteal endoscopic forehead lift is minimal and generally patients are comfortably back to work within 96 hours postoperatively.

If combining an upper lid blepharoplasty with the browlift, it is important to mark the upper lid excision carefully and precisely at the start of the procedure before any local anesthesia is injected. Maximum upward traction is placed on the eyebrows. Redundant upper eyelid skin is then marked. With experience, one gains a better appreciation for immediate postoperative eyebrow descent associated with the technique and takes into account age, texture of the skin, and the tone of the muscles. Postoperatively, patients are cautioned not to dye their hair for 1 month. Care must be taken to minimize hot blow dryers and curling irons, and a hand should be interposed between these devices if they are used. The forehead has diminished sensation in the immediate postoperative period, and patients are at a higher risk of
damaging hair follicles with extremes of heat or cold. Sensation to vibration and pain can return as early as 2 weeks postoperatively, but in most cases normal return of sensation with pure endoscopic techniques is expected approximately 8 to 12 weeks postoperatively. This period can be shorter or longer depending on the experience of the surgeon and the subtleties of the technique used around the supraorbital neurovascular bundle.

SUMMARY

Although initially frustrating and technically humbling, endoscopic techniques are simple and reproducible methods for obtaining longlasting eyebrow lifting. One should introduce this technique into practice through biplanar methods and be prepared for a steep learning curve. There is no role for open brow lifts in a twenty-first century cosmetic surgery practice, and endoscopy represents the new gold standard for the profession.

References


Address reprint requests to
Mark L. Zukowski, MD
3612 West Lake Avenue
Wilmette, IL 60091
Endoscopic Assisted Craniofacial Surgery

F. VICARI and M. ZUKOWSKI*
Department of Surgery, Division of Plastic Surgery
Northwestern University Medical School,
The Children's Memorial Hospital, Chicago, IL, USA
*Department of Surgery, Division of Plastic Surgery,
The Naval Medical Center Portsmouth,
Portsmouth, VA, USA

SUMMARY

The application of endoscopic assisted dissection brings the benefits of minimal incision surgery to craniofacial procedures. The dissection of the dura away from the inner table of cranial bone using the direct magnified vision of the endoscope brings a new approach to these dissection planes. These techniques, coupled with newly designed instrumentation allow us to perform craniotomies without the need to reflect scalp flaps.

The immediate results are minimal incisions, decreased operating time and blood loss, decreased postoperative swelling and shorter hospital stays.

There is also the intuitive benefit from minimizing the amount of cranial bone which must be dissected to accomplish a given procedure. Finally, there is the addition of these new techniques and equipment to the armamentarium of the craniofacial surgeon who will find new and beneficial applications.

INTRODUCTION

Endoscopic assisted procedures have proved advantageous in many surgical disciplines. These advantages include minimal or remote incisions, decreased operating time and blood loss, as well as shorter hospital stays and recovery time. Craniofacial approaches commonly involve extended incisions and the turning of scalp flaps at either the subgaleal or subperiosteal level. The consequence of these exposures are time lost in opening and closing extended incisions, swelling from flap congestion, blood loss from the flap edges and exposed bone, and a long surgical scar. One faces the challenge of integrating traditional surgical techniques with endoscopic assisted ones in order to provide the same, if not better, degree of surgical precision.

We present a series of six (6) infants with scaphocephaly secondary to sagittal suture synostosis, whose ages ranged from 3-6 months. These children underwent endoscopic assisted sagittal strip craniectomy with osteofracture of the parietal plates during the period from August 1, 1994 to March 3, 1995. The procedures were accomplished through two 3 - 4 cm incisions without the need of the usual bicornal scalp flaps. Surgical time ranged from 97 - 185 minutes (ave=153 min.), blood loss ranged from 75 to 200 cc (ave=138 cc.), and length of hospitalization ranged from 1 - 5 days (ave=3 days), Table 1.

These parameters compared favorably to a similar group of ten infants matched in age and diagnosis who underwent consecutive sagittal strip craniectomy and biparietal out-fracture using standard open techniques through a bicornal incision. There have been no complications or mortality in either group. Our initial group will have a follow up of 8 - 14 months at the time of presentation.

Table 1: Sagittal Strip Craniectomy, Open/Endoscopic Techniques.

<table>
<thead>
<tr>
<th>Age (mos.)</th>
<th>Blood Loss (ml)</th>
<th>Length of Surgery (min.)</th>
<th>Length of Stay (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>3.05 / 4.08</td>
<td>115.5 / 117.5</td>
<td>180.5 / 130.</td>
</tr>
<tr>
<td>Median</td>
<td>3 / 4</td>
<td>120 / 140</td>
<td>190 / 172</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>1.3 / 1.28</td>
<td>46.87 / 55.6</td>
<td>23.03 / 36.54</td>
</tr>
<tr>
<td>Minimum</td>
<td>2 / 2.5</td>
<td>50 / 75</td>
<td>135 / 97</td>
</tr>
<tr>
<td>Maximum</td>
<td>6 / 6</td>
<td>200 / 215</td>
<td>200 / 185</td>
</tr>
</tbody>
</table>
MATERIALS AND METHODS

Six infants underwent endoscopic assisted sagittal strip craniectomy for sagittal suture synostosis between August 1, 1994 and March 3, 1995. The procedures were performed through two small 3-4 cm incisions, one at the posterior margin of the anterior fontanelle and a second over the Lambda. The sagittal sinus was exposed under direct vision through these two incisions, ensuring the safety of the procedure. Endoscopic assisted dissection of the dura away from the inner table of the cranial bone was easily accomplished using a 4mm in diameter, 30 degree upturned endoscope from Snowden-Pencer which was sheathed to provide an optical cavity. The actual dissection was accomplished using a guarded suction dissection device, with the dissection proceeding from anterior fontanelle to lambda. The emissary veins were easily identified and cauterized, helping to minimize blood loss. Once the dura in the area of the strip craniectomy was freed from the inner table, attention was turned to the elevation of the scalp. This is accomplished at the subgaleal or subperiosteal level at the discretion of the neurosurgeon. The area undermining was approximately one centimeter larger on each side than the proposed strip craniectomy. The craniectomy was performed without the need to “turn” the scalp flaps with the use of a Midas Rex AF cutting tool with a #4 side cutting bit fitted with a newly designed guard. The guard fits between the dura and the inner table of cranial bone while the device itself glides between the outer table of bone and the scalp. The side cutting bur is spinning at 70,000 rpm and can cut in any direction. This configuration allows the craniectomy to be performed in a minimal number of passes (often a single pass is sufficient) through these small incisions without turning scalp flaps. The parietal bone plates are then mobilized by passing this same cutting device along the coronal sutures and lambdoid sutures to the level of the squamosal suture. The parietal bones are then greenstick out-fractured manually, completing the procedure. The wounds are then closed in layers using absorbable suture with or without drains, again at the discretion of the neurosurgeons. The estimates of surgery time and blood loss were taken from the anesthesia records in all cases. These parameters were compared to a group of ten infants of similar age and diagnosis who were treated for scaphocephaly with sagittal strip craniectomy and bi-parietal out-fracture via an “open” technique.

RESULTS AND CONCLUSIONS

Fig. 1: Pre-operative A-P and Lateral photographs of a 4 month old infant with Scaphocephaly secondary to sagittal synostosis.

Fig. 2: Four month post-operative A-P and Lateral photographs of same infant. Note absence of biconoral scar.

Figures 1 and 2 are pre-operative a-p and lateral photographs and 4 month post-operative a-p and lateral photographs of a representative case. From the post-operative view in figure 2 one can note the absence of the typical biconoral scar. A limited comparison of open
and endoscopic techniques is given in Table I. Space does not allow for a more in depth presentation of data or additional photographs. The average length of surgery and length of hospital stay was less for the endoscopic group than for the "open" group with essentially the same blood loss for both groups. Clearly there is a learning curve for any new procedures, however, we believe that the benefit of decreased surgical time and hospital stay will continue to improve as comfort and expertise develop with the new equipment and techniques. These benefits, coupled with the obvious benefit of minimal surgical incisions, provide a clear advantage to endoscopic assisted techniques.

Sagittal strip craniectomy and biparietal osteotomy can be safely performed through minimal incisions without need of large scalp flaps. These procedures are facilitated first by the use of endoscopic assisted dissection of the dura away from the inner table of the cranial bone under direct vision and secondly by the use of a new guardeddevice to allow us to perform a "blind" craniectomy.

The next step in the evolution of these techniques may be the combining of endoscopic assisted dissection, improvement in operative equipment and the addition of distraction techniques to reevaluate our approach to many of the more difficult congenital anomalies. The inventiveness and creativity of the craniofacial surgeon is the only limitation.