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Endoscopic Techniques in Facial Rejuvenation: An Overview. Part I

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Abstract. The use of endoscopic techniques in orthopedic, gynecological, and general surgery has had a significant effect on the traditional techniques in those specialties. The introduction of those techniques to plastic surgery, particularly to aesthetic surgery, has been very slow. However, recent interest in using endoscopic techniques in forehead plasty, corrugator–procerus resection, and breast augmentation has opened up countless possibilities in these and other areas of aesthetic and reconstructive surgery.

Key words: Endoscopic techniques — Facelifts — Corrugator–procerus muscle resection — Forehead lifts

Aside from a description of using endoscopy for carpal tunnel release, very little has been written about it in the plastic surgery-related literature [2, 9]. To my knowledge, the first presentation of the use of this technique in the face was made by Vasconez's group. The video, "Coronal Facelift with Endoscopic Techniques," was presented at the 61st Annual Scientific Meeting of the ASPRS in Washington, DC, in 1992 [3]. Another related video tape presentation is the one by Liang and Narayanan which was presented at the same meeting [7].

In February 1993, Aiache organized an endoscopic workshop that dealt with the application of the endoscopic technique to multiple aspects of aesthetic surgery. To my knowledge, this was the first workshop on the subject, except for the almost tutorial type of teaching that Gerald W. Johnson from Texas, has been doing on breast augmentation through the navel. Oneal and myself used the endoscope for the first time for teaching the different planes of dissection during subperiosteal facelift live surgery demonstrations at the Johns Hopkins Hospital in April 1992 [13].

In January 1992 I performed my first endoscopic corrugator–procerus muscle resection during a subperiosteal browlift with a precapillary incision with preservation of the neurovascular innervation of the scalp. Since then I have occasionally done procerus–corrugator muscle resections, but it was not until the cadaver demonstration and the presentation of the "Endoforehead" by Isse that I saw more possibilities for the technique [6].* Since then I have used different variations of this technique and have had the opportunity to develop new endoscopic techniques for facial rejuvenation. During the 1993 annual meeting of the Aesthetic Surgical Society, Hamas presented a paper entitled "Corrugator–Procerus Muscles Resection Through the Subgaleal Hairline Approach" [5]. Although this presentation raised new questions and possibilities, I felt that the corrugator–procerus muscle resection will be rarely indicated as an isolated procedure.

The use of endoscope in facial rejuvenation is still evolving and many modifications are expected in the

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* Editor's note: One of the earliest presentations of Isse's "Endoforehead" operative experiences took place at the November 1992 meeting of the Los Angeles Society of Plastic Surgery. This was followed by further reports by Isse in Buenos Aires in December 1992, at UCLA in February 1993, at the University of West Virginia in March 1993, at the Aiache Endoscopic Course in Los Angeles in March 1993, and in the aforementioned workshop in April 1993 in Baltimore [6].

Table 1. Endoscopic brow facelift options

(1) Corrugator–procerus muscles resection without lift (Hamas)
(2) Browlift with slit incisions
Subgaleal (Vasconez)
Subgaleal/subperiosteal (Isse)
Total subperiosteal (Ramirez I)
(3) Standard facelift combined with endoscopic corrugator—procerus laser ablation (Liang)
(4) Endoscopic subperiosteal browlift with precapillary skin excision with preservation of the scalp innervation (Ramirez II)
(5) Endoscopic browlift combined with excisional subperiosteal or composite facelift (Ramirez III)
(6) Endoscopic total facelift
subcutaneous (Aiache)
subperiosteal (Ramirez IV)

future. However, the pioneering technique and the different variations of it need to be established so plastic surgeons can compare their results more reliably.

Endoscopic Brow Facelift Options

There are six alternatives to the endoscopic brow facelift (Table 1):

(1) Corrugator–procerus muscle resection without lift: This procedure, described by Hamas [8], uses three incisions in the frontal scalp. The surgeon performs a subgaleal dissection of the forehead to expose the procerus and the corrugator muscles. With special endoscopic graspers, the procerus and the corrugator muscles are partially ablated. No brow or forehead lift is done. This technique is indicated for patients with significant hyperactivity of those muscles with minimal or no brow ptosis.

(2) Browlift with slit incisions: Each slit incision is from 1 to 1.5 cm. Generally, the incisions are made in the hair-bearing area of the scalp. Usually four or five incisions are used depending on the extent of dissection and maneuvering needed to mobilize the frontotemporal skin and scalp. The plane of dissection toward the orbital rim and toward the occiput varies with each author. Vasconez uses the subgaleal plane anteriorly and posteriorly. Isse uses the subperiosteal plane anteriorly and the subgaleal plane posteriorly. I use the subperiosteal plane anteriorly and posteriorly. Each one of the variations has its advantages and disadvantages, as well as its indications and contraindications. Those need to be studied and established in future reports.

(3) Standard facelift combined with endoscopic corrugator–procerus laser ablation: This technique uses the temporal extension of the standard facelift incision to introduce a fiber optic, flexible, pediatric scope to locate the procerus and the corrugator muscles. Ablation of those muscles is performed using the neodymium yag contact laser. No browlift is performed [7].

(4) Endoscopic subperiosteal browlift with hairline skin excision and preservation of the frontalis muscle and scalp sensation [11]: This is a biplanar dissection in which the subcutaneous and the subperiosteal dissections are combined to take advantage of and decrease the morbidity of each of the two techniques. The integrity of the temporoparietalis fascia and frontalis muscle is maintained, as well as the sensory innervation of the scalp behind the incision line. The periosteal release at the orbital rim and the corrugator–procerus resection are done with the assistance of the endoscope. The excess skin is resected at the precapillary incision. This technique is excellent for decreasing the height of the forehead.

(5) Endoscopic subperiosteal browlift combined with excisional subperiosteal midfacelift [11]: Endoscopic browlift is continued with the endoscopic degloving of the midface. The suspension of the midface is done endoscopically using the same tissues and some modifications of the steps that I have described for the open approach [10]. When the upper lifting of the soft tissues creates significant skin redundancy in the preauricular area, it can be excised in a conventional fashion. This lifting of the upper face and midface can be combined with a conventional cervicofacial rhytidectomy if needed. Although the pure endoscopic or the biplanar browlift can be combined with a standard or composite midfacelift, I prefer the subperiosteal approach because the dissection of the midface and the suspension of the midface soft tissues can be done in a vertical fashion endoscopically. The redundant skin is removed with a limited subcutaneous or sub-SMAS dissection.

(6) Total endoscopic full facelift: Aiache was the first to perform a subcutaneous facelift of the midface and neck without skin excision [1]. Since the skin tends to stretch and is more difficult to suspend, I prefer the subperiosteal approach. To my knowledge, the first case of a total endoscopic facelift that included forehead, midface, lower face, and neck was presented at the First Endoscopic Plastic Surgery Seminar [11]. This is indicated in patients with sagging facial soft tissues but without significant excess skin. There should be no skin excision.

Muscular Dynamics of the Brow

The brow and the forehead are the structures that have been more amenable to the endoscopic approach in the face. The endoscopic experience made us look at and analyze the muscles of the forehead

and the brow with a different perspective. For the proponents of the endoscopic approach there are many unanswered questions about the rationality and effectiveness of the traditional surgical techniques used to elevate the brow and rejuvenate the forehead. To my knowledge, there has been no report or study that shows the long-term effectiveness with the conventional browlift procedures. Such a study should be of consecutive patients and use reproducible mathematical measurements, without using blepharoplasty or blepharolipectomy, and there should be a minimum of 12 months of follow up. The advocates of the conventional approach have to produce studies that criticize the endoscopic technique. These studies would allow us to make a meaningful scientific comparison and not biased anecdotical criticisms. Likewise, similar studies are needed to compare conventional, sub-SMAS, or composite facelifts with the open or endoscopic subperiosteal facelift.

For an aesthetically pleasing orbital–brow–forehead complex, there should be a good balance between the elevator of the brow and the depressors of the brow. The only elevator of the brow is the frontalis–occipital complex muscle. The depressors of the brow are four muscles: the procerus, corrugator, depressor supercilii, and the orbital part of the orbicularis oculi muscle. I have my reservations regarding the frontalis segmental ablation, transection, or aggressive scoring of the frontalis muscle during the standard subgaleal browlift. From the muscular dynamic point of view, this technique does not make any sense since these maneuvers weaken the only muscle that is going to be able to elevate the brow. Therefore, in the standard subgaleal browlift procedure, when the frontalis muscle is weakened, you are relying on maintaining the brow's position by the traction exerted by the frontal flap and by the scar tissue that is formed following surgery. When the scar heals and the soft tissues soften, it is possible that the frontal flap will stretch back causing a relapse of the brow ptosis. This is probably one of the reasons why the study of McKinney et al. [8] suggested a resection/elevation ratio of about 3.5 : 1 to maintain a stable position of the brow. In most of the cases, this will elevate the forehead significantly.

Some patients develop early brow ptosis as a congenital trait. They have a tendency to develop frontalis muscle hyperactivity in an effort to elevate the brow. This frontalis muscle hyperactivity will develop into dynamic and later permanent forehead creases. With aging, the continuous action of the depressor muscles and gravity will turn the balance toward the depressors and a brow ptosis will develop. To counteract this effect, again there will be frontalis muscle hyperactivity with initial dynamic and later permanent forehead creases. The corrugator has traditionally been thought of as the muscle that forms vertical/oblique glabellar creases, however, the orbital portion of the orbicularis oculi seems to be the muscle most important during frowning. The orbital orbicularis oculi is more "corrugator" than the corrugator muscle. The corrugator muscle pulls the forehead down and medially, indirectly producing a frown and helping the other brow depressors to pull the brow down. The procerus and depressors supercilii muscles will form horizontal nasal root creases with concomitant ptosis of the brow. The orbicularis oculi muscle, specifically the orbital part, will pull the brow downward. This action is seen very clearly in the patient who has malignant blepharospasm. In this case, there is a significant brow ptosis as well.

Table 2. Indication for endoscopic forehead/browlift

(1) Brow ptosis
(2) Pseudoptosis eyelids
(3) Glabellar vertical wrinkles
(4) Root nose horizontal wrinkles
(5) Forehead wrinkles/frontalis hyperactivity
(6) Frontal bossing/prominent orbital rims (ancillary procedures)

Corrugator–Procerus Muscles Ablation

The surgical ablation and resection of the corrugators, procerus, and depressors supercilii muscles are well established techniques during rejuvenation of the upper face. Rejuvenation is done routinely with the open approach and can also be done effectively through the endoscopic approach. There are three approaches to the corrugator–procerus muscles: (1) frontal approach (Isse, Vasconez, Hamas), (2) endonasal approach (Ramirez), and (3) temporal approach (Liang). There are variations in the way that these muscles are dealt with. Isse prefers to "release," Vasconez prefers "division," Hamas does the "resection," and Liang does the "laser ablation of these muscles." I prefer to do a resection of these muscles using the endonasal approach which gives me direct access. Initially I resect the procerus and gradually advance superiorly and laterally toward the corrugator muscles. I believe that the simple weakening or division may produce a relapse of the hyperactivity of these muscles because the nerves and muscles in the face have a tendency to regenerate.

Indications

The indications for the endoscopic forehead/browlift are the same as for the open approach. These are outlined in Table 2.

Contraindications

If indeed the endoscopic browlift is effective in repositioning the brow and forehead, then the guidelines should follow the 5-cm limit of the height of the forehead [8]. It is feasible that this can be stretched to 6 cm, even 6.5 in some special situations in which the patient is willing to have a slightly higher hairline than have bicoronal or precapillary scars. This is feasible because the subperiosteal browlift relies more on repositioning than on stretching [12]. In Asians, American Indians, and some mestizos, it is significantly difficult to elevate the forehead reliably using the open approach. The same difficulties arise when using the endoscopic approach. This is because of the tight or thick skin in the forehead and the significant bony attachments of the frontal/periorbital soft tissues. In these groups of patients, the endoscopic approach will probably not work unless an extended periorbital release is made and a more reliable fixation of the advanced soft tissues is made.

For patients with significant fronto-orbital irregularities that require significant remodeling, probably the open approach will do better than the endoscopic approach. Again, if the patient is willing to accept less than desirable results as a tradeoff for scars, then the endoscopic approach can be used. However, the endoscopic approach works very well for minor frontal orbital remodeling.

Fundamentals of the Endoscopic Brow/Facelift

Isse and I favor the subperiosteal dissection of the frontal and periorbital areas. This plane of dissection is safer and probably as quick as the subgaleal and most of the dissections can be done in a blind fashion. The rigid periosteum will also allow effective traction for brow positioning after the galea periosteal layers are anchored to the cranium. The temporal scalp is dissected over the external leaf of the temporal fascia up to the zygomatic arch. It is important to lift with the flap the small fat pad that underlies the temporoparietalis fascia in which, on many occasions, the frontal nerve travels before entering into the frontalis muscle. This minor fat pad is different than the superficial and deep fat pads of the temporal fascias. If the midface subperiosteal dissection is going to be combined with an endoscopic browlift, then the superficial leaf of the temporal fascia should be entered and the dissection of the zygomatic arch done through the eyelid approach and/or a slit preauricular incision. After the zygomatic arch periosteum is elevated, the midface is dissected through an upper vestibular incision.

As mentioned previously, there are different approaches to the corrugator–procerus muscles. I prefer the endonasal *resection;* I emphasize resection as opposed to transection for the reasons mentioned before.

Table 3. Fundamentals of the endoscopic brow/facelift

(1) Subperiosteal dissection: frontal, periorbital (temporal scalp as usual)
(2) Endonasal resection of brow depressors
(3) Periorbital release at or above orbital rim
(4) Upward lift and galea–periosteal to cranial anchoring
(5) Subgaleal or subperiosteal sliding of postscalp flap
(6) Redraping/contracture postscalp flap

Since ptosis of the brow is a folding effect over a fixed attachment of the infrabrow tissues to the orbital rim, the periosteum should be released either at or just slightly above the orbital rim to allow an effective lifting of the brow. This is similar to the technique I described for the subperiosteal facelift [12]. This periorbital release can be done through the eyelid, the frontal, or the temporal incision, depending on the situation.

To maintain a stable position of the brow and frontal tissues after the upward lifting of these tissues, the galea periosteal layer is anchored to the cranium either with screws, plates, or cortical tunnels.

Above and posterior to the level of the scalp slit incisions, the dissection is made in the subperiosteal or subgaleal plane, up to the parietal–occipital junction, to allow the posterior scalp flap to slide. This posterior sliding is maintained with external support with staples applied to the scalp and tied-over sutures. The posterior scalp flap is probably maintained in a permanent position by a redraping effect. At this point we do not know if the tissues "contract." If indeed there is a contraction of the flap rather than simple redraping, it's something that deserves further study (Table 3).

Advantages of the Endoscopic Lift

The main advantage of the endoscopic brow/facelift is the minimization of scars. This is particularly true for the scalp. In my experience, the less acceptable scar on patients undergoing facial rejuvenation is the coronal or hairline scar. Even if we were able to obtain almost invisible scars, my patients are not readily willing to accept the idea of having their "scalp cut away." This idea, in addition to the potential for scar's widening, alopecia, and numbness beyond the incision line, makes the endoscopic browlift more acceptable. This is particularly true for women with thin hair or the bald patient. Because there are no significant incisions on the forehead, there is less bleeding. During the bicoronal incision,

Table 4. Advantages of the endoscopic lift

(1) Decreased scarring (scalp)
(2) Less numbness (scalp)
(3) Acceptability
(4) Good for thin hair or bald patient
(5) Less bleeding
(6) Less edema

if hemostasis is not done properly the patient can easily lose a pint or more of blood.

With respect to other incisions needed to perform the rest of the facelift, I believe you have to balance the potential for skin redundancy, particularly in the preauricular area, with a scar around the ear which, if it is properly done, is almost invisible. It is more acceptable to combine the endoscopic browlift with the subperiosteal facelift of the midface with excision of redundant skin around the periauricular area. Likewise, the subperiosteal endoscopic browlift can be combined with any other facelift technique. In a young individual without signifciant skin excess but with mild laxity of the midface, the combination of the endoscopic brow and midface subperiosteal lift is very appealing. In some cases, this can be combined with cervicoplasty with minimal incisions which consists of defatting the neck, corset platysmoplasty, and definition of the jaw line with suture suspension to the mastoid area. This technique very similar to the one described by Giampapa [4].

One of the advantages of the endoscopic lift that I have seen during my early experience with it is that the initial swelling resolves very quickly because the venous and lymphatic pathways of drainage are not significantly interrupted. Table 4 summarizes the advantages of the endoscopic lift.

Disadvantages

Like any other new procedure there is a learning curve that must be followed to achieve the optimal technical expertise which will yield the best results. This requires new training, which is better done in a workshop type of meeting. Completely new instrumentation is required. We are now in the process of designing new instruments and redesigning some of the instruments that are presently used in other aspects of endoscopic surgery. We need to determine the limitations of this technique and when to combine the endoscopic technique with other traditional methods (see Table 1).

Complications

One of the potential complications of this technique is the elevation of the hairline. As previously mentioned, if this technique is effective in elevating the brow, obviously the hairline will be elevated as well. The 5-cm limit, determined by McKinney et al., should probably be followed; however, because there is no significant stretching of the soft tissues with a subperiosteal technique, this limit can be extended to 6 cm.

There is the potential for injuring the supraorbital or the supratrochlear nerves during the dissection or during the ablation of the corrugator–procerus muscles. Another potential complication is bleeding. If there is any brisk bleeding during the dissection, this should be electrocoagulated. Asymmetry and unsatisfactory brow elevation is probably caused by faulty technique (during the dissection or anchoring).

Unknown at this point is the potential for and rate of relapse of the brow and face ptosis. As the technique evolves, this potential complication will be eliminated.

Surgical Technique

Anesthesia

Initially, until you feel more comfortable working with the endoscope and until the technique is mastered, it is better probably to do the surgery under general anesthesia. This will give you more control of the patient's head. However, this procedure can be done satisfactorily with IV sedation, local infiltration, and nerve blocks. For the nerve blocks I use 1% xylocaine with 1 : 100,000 epinephrine mixed with 0.5% marcaine with 1 : 200,000 epinephrine mixed in a half-and-half ratio. This is mixed with 8.4% sodium bicarbonate in a 10 : 1 ratio. For infiltration of the deep tissues, I use the following combination: 150 cc of 0.9 normal saline, 50 cc of 1% plain xylocaine, 1 cc of epinephrine (1 : 1,000 concentration.)

Incisions

For a pure endoscopic browlift, I use two paramedial longitudinal incisions at the superior projection of the head of the brows 2–3 cm posterior to the hairline, and two parietal temporal incisions, also 2–3 cm posterior to the hairline. Each incision is between 1 and 1.5 cm long. I found that making the incisions a little larger than the size needed to introduce the endoscope avoids damaging the hair follicles at the edges of the incision.

If I combine the endoscopic browlift with a standard or a subperiosteal midfacelift in which I must excise the skin, then the preauricular incisions are extended around the sideburn and into the temple

area in a way similar to that described by Guyuron. This obviates the parietal temporal slit incisions. If I need to do lateral orbital rim contouring or lateral canthal repositioning, then I use a slit incision on the lateral upper eyelid. If an upper blepharoplasty is done concomitantly, then I use this incision to approach the orbital rim and the lateral canthal tendon.

Dissection

Anterior to the incisions, the dissection is immediately done in the subperiosteal plane. Initially, this is done under direct vision. When the initial subperiosteal plane is developed the rest of the dissection, up to 3 cm above the orbital rim, is done in a blind fashion. At this point, the endoscope is introduced and the rest of the dissection is done under direct endoscopic view. Dissection is continued down to the orbital rim and to the root of the nose. Laterally, the dissection is continued to the lateral rim. More laterally in the temporal area, the dissection is done over the superficial leaf of the temporal fascia, deep to the temporoparietalis fascia to near the zygomatic arch. Posterior to the slit incisions, the dissection is done in the subperiosteal plane to the posterior portion of the parietal bones.

Periosteal Release

Periosteal release of the frontal flap is done at or just above the orbital rim. Laterally, the superolateral orbital rim and the zygomatic arch periosteum can be released through a lateral upper-eyelid slit incision.

Fronto-Orbital Contouring

Lateral orbital rim contouring is easily done through the upper blepharoplasty incision or a lateral eyelid slit incision. For this a small pineapple burr is used. I prefer to do a transosseous fixation of the lateral canthal ligament to secure the position of the lateral canthal tendon. Although I have remodeled fronto-orbital irregularities using the endoscopic approach, we need better instrumentation than presently available to decrease the likelihood of tissue damage.

Resection of the Corrugator and Procerus Muscles

I prefer to resect the corrugator and procerus muscles using the intransal approach. This is done through a small intercartilaginous incision. Subperiosteal dissection of the dorsum of the nose is performed and dissection is continued until the frontal glabellar area is connected with the nasal dissection. To perform the muscle resection, I make a midline periosteal opening from the proximal nose to 2 cm above the glabella to expose the procerus muscle. After the supraorbital and supratrochlear nerves are identified, I remove the muscles by small bites with an endoscopic grasper. To avoid depression caused by muscle ablation, I replace the muscle with a fat graft obtained from the eyelid fat pockets or from the submental lipectomy. This is fixed into the glabella with a temporary percutaneous stitch.

Hemostasis

Hemostasis is done by electrocoagulation, pressure, or application of ice packing over the flaps. Bleeding has not been a problem in my experience. If bleeding obstructs your view during surgery, then continuous saline irrigation is required. Brisk bleeders are electrocoagulated with specially designed suction coagulators.

Frontotemporal Flap Fixation

After the elevation and upward advancement of the frontotemporal flap, it is fixed with periosteal–galeal stitches anchored to (1) microscrews (2 mm × 4 mm external cortical screws), (2) microplates, or (3) cortical tunnels. I use 2-0 vicryl stitches. Laterally, the temporal parietalis fascia is fixed to the temporal fascia or to cortical bone screws. The skin incisions are closed with skin staples and the edges are freshened up if needed.

Drains

Drains are used sparingly. I apply contouring 0.5-in. paper tape to the forehead, an external support with skin staples in the frontal scalp to skin staples on the occipital scalp, and tied over sutures longitudinally applied over sponges for about 10 days. This external support avoids prolong bandaging and protects the deep support.

Instrumentation

Endoscopic unit: I use a 4-mm 30° angle arthrocope. The rigid scopes provide better visualization than the flexible ones. However, in some circumstances the flexible scope may be needed, especially if some deep areas on the face need to be approached. Specially designed curved scopes will be needed to facilitate this procedure. The use of a monitor and a

specialized assistant handling the camera and the scope facilitates the surgery and frees up the surgeon's hands. For documentation, I use a VCR machine and a printer.

Special periosteal elevators: For this surgery curved, long, strong, and sharp periosteal elevators are required. For the periosteal release at the orbital rim, a periosteal elevator that has the distal end shape like a hook is needed.

Other special instruments: To optimize and expedite the surgery, more specialized scissors, graspers, elevators, and retractors are needed. These are in the process of being designed.

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