A Retrospective Comparison of Open and Endoscopic Brow-lifts

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Objectives: To measure and compare surgical brow elevation with open and endoscopic techniques; to compare patients who did and did not undergo an eyelid procedure in the same setting as the brow-lift; and to determine whether a learning curve exists for a successful endoscopic brow-lift procedure.

Design: A retrospective review of patients who underwent coronal, trichophytic, and endoscopic brow-lift surgery from January 1, 1993, to December 31, 1997 (performed by K.A.L.). We analyzed preoperative and postoperative photographs obtained from 10 to 56 months after surgery while masked to the surgical technique used. Measurements included a horizontal baseline drawn through the midpoint of the right and left medial canthi, and extended laterally across the face; the distance from the baseline to the superior border of the medial eyebrow on the right and left sides; and the distance from the baseline to the highest point of the brow on the right and left sides. A second, nonbiased observer analyzed a random sampling of patient photographs to determine the degree of interobserver variation.

Setting: Private facial plastic and reconstructive surgery practice. All procedures were performed in an ambulatory surgery setting.

Participants: We identified 125 patients (average age, 54 years) with greater than 10 months of postoperative photographic documentation. We excluded 41 patients owing to several inconsistencies between their preoperative and postoperative photographs and included 84. These patients were divided into 3 groups: those undergoing coronal, trichophytic, and endoscopic procedures. Of the patients undergoing concomitant eyelid procedures, 12 underwent upper lid blepharoplasties; 15, lower lid blepharoplasties; 6, periorbital laser resurfacing or chemical peel; 1, canthoplasty; and 1, ptosis repair. The endoscopic brow-lift procedure was not performed in this facial plastic surgery practice until 1995. To determine whether better results were obtained in the later half of the study, when the surgeon had more experience, this group was divided between the 14 patients who underwent the procedure from January 1, 1995, to June 30, 1996, and the 20 who did from July 1, 1996, to December 31, 1997.

Main Outcome Measure: Comparison of preoperative photographs with postoperative 10- to 32-month follow-up photographs and with final 35- to 56-month follow-up photographs.

Results: We found no statistically significant difference in: the distance of the medial brow ($P=0.89$) or highest elevated point of the brow ($P=0.93$) between the coronal, trichophytic, and endoscopic groups; the distance that the medial brow ($P=0.15$) or the highest point of the brow ($P=0.11$) was raised for those patients undergoing concomitant eyelid procedures; and the distance that the medial brow ($P=0.80$) or highest point of the brow ($P=0.79$) was raised between the 2 endoscopic brow-lift groups. Interobserver variation in brow measurements was 0.1 cm or less in more than 90% of cases.

Conclusions: Both open and endoscopic brow-lift techniques described herein elevate the entire brow successfully. We found no statistical difference in patients undergoing concomitant eyelid procedures, and there was no identification of a “learning curve” for a successful endoscopic brow-lift with the surgical technique described.

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The aesthetic importance of the upper third of the face is well established. The recognition of brow ptosis is essential to the achievement of good cosmetic and functional results in surgical repair of upper eyelid redundancy. Marked interest has been generated in the surgical treatment of brows, forehead, and glabellar regions. In the past, the coronal forehead lift has been the procedure of choice. The precise contouring of brow position is difficult to achieve through a distant incision, thus making a midforehead lift or a direct browlift a more desirable procedure to correct marked brow ptosis. The latest technique in brow-lifting has been the endo-
scopnic approach. Numerous reports 5-10 have described various techniques for the endoscopic brow-lift. The advantage of small incisions placed within the hair-bearing scalp are minimal scarring and less alopecia, numbness, bleeding, postoperative ecchymosis, and swelling, leading to a more rapid patient recovery. The disadvantage of the endoscopic technique appears to be a significant learning curve. However, the high degree of patient satisfaction and surgeon enthusiasm for the endoscopic approach has allowed it to become the procedure of choice in most patients for brow rejuvenation at present.

Within our own patient population, we sought to determine whether a discernable difference existed in the ultimate brow position between those patients who underwent an open or an endoscopic brow-lift. Does the distance of the incision from the brow affect the ultimate placement of the brow? Does evidence of a learning curve exist with regard to the amount of forehead/brow elevation obtained in the endoscopic brow-lift technique?

An upper or lower eyelid procedure is often performed with a brow-lift, but the impact this may have on the overall brow-lift result is not known. Several surgeons question the safety of performing both procedures concomitantly.11 The difficulty arises in balancing the amount of forehead/brow elevation and the amount of skin excision from the upper eyelid area. Overresection of skin and muscle leads to incomplete closure of the eyes, and underresection generally leads to a less-than-ideal result. We therefore reviewed those patients who underwent eyelid surgery at the time of the brow-lift procedure and compared their outcomes with those of patients who underwent a brow-lift only.

**METHODS**

**PARTICIPANTS**

We identified 125 patients in a retrospective review of those who had undergone coronal, trichophytic, or endoscopic forehead/brow-lift procedures with long-term photographic documentation. Forty-one patients with less-than-ideal photographs were removed from the study. Difficulties with photographic analysis included photographs with excessive use of eyebrow pencil, making the eyebrow hairs difficult to identify accurately; overplucking of the medial aspects of the eyebrow; excessive facial animation; bangs that covered a portion of the eyebrow; altered head position; patients lost to follow-up; and slightly altered camera settings between the preoperative and postoperative photographs. If any discrepancy was found between the preoperative and postoperative photographs, the patient was removed from the study. Immediate postoperative photographs were not routinely obtained; therefore, long-term photographic analysis was the focus of our study.

Measurements were obtained using the method introduced by K.A.L. 12 First, a horizontal baseline was drawn through the right and left medial canthi and was extended in a straight line, laterally across the face. Next, the distance in centimeters from the baseline to the superior border of the medial eyebrow was documented separately for the right and left sides, and the distance in centimeters from the baseline to the highest point of the brow was documented for the right and left sides (Figure 1). The author documenting the measurements (C.M.P.) was masked to the surgical technique used. A second, nonbiased observer analyzed a random sampling of patient photographs to determine the degree of interobserver variation.

**TECHNIQUES**

Incision sites were marked preoperatively with the patient in a sitting position. The coronal incision was marked as a curvilinear line 4 to 6 cm posterior to the hairline, whereas the trichophytic incision was marked at the anterior hairline. The endoscopic incisions were placed just inside the hairline, centrally and at the junction of the frontotemporal hairline, and temporally well behind the hairline. The amount of brow-lift desired was measured preoperatively by raising the brow manually into the position desired, placing the surgical marking pen at the superior brow level, letting the brow drop, and measuring this distance marked as the desired level of elevation to be effected. All procedures were performed with the patient under general anesthesia or under local anesthesia with monitored anesthesia care.

The coronal brow-lift incision was beveled along the direction of the hairs. The trichophytic incision was beveled across the direction of the hairs to allow hair growth through the scar, and the flap was elevated in the subgaleal plane to the level of the orbital rims. The periosteum was incised at the orbital rim releasing the arcus marginalis and all orbital depressor muscles. The supraorbital neurovascular bundles were identified and preserved. The corrugator and procerus muscles were removed from their origin at the medial orbital rim to the insertion near or
within the orbicularis, removing as much muscle as could be identified, and preserving the supratrochlear nerves. Bipolar electrocautery was used sparingly. Cross-hatching incisions were made in the frontalis muscle between the supraorbital nerves directed at the area of the deep forehead furrows that were present. Closed suction drainage was used in all cases. The flap was repositioned and excess skin was excised, bringing the brows into the desired position. The galea was approximated with interrupted 3.0 polygactin 910 (Vicryl) sutures (Ethicon, Inc, Somerville, NJ), and the scalp was closed with staples. The trichophytic incision was closed with a running 3.0 polypropylene (Prolene) suture (Ethicon, Inc). A light dressing was applied.

The endoscopic brow-lift incisions were carried through to the periosteum centrally and laterally. The temporal incisions were made and carried down through the temporalis fascia to the superficial layer of the deep temporal fascia. A small nick was made in the temporalis fascia to mark the resting position. The central and lateral incisions were taken down to the periosteum. The periosteum was gently elevated on either side for a short distance. A 1-mm drill hole placed at the anterior aspect of the incision was used to mark the beginning position of the scalp in relation to the cranium. The periosteum was then elevated posteriorly to the vertex area and laterally to the temporal line. The dissection proceeded laterally over the superficial layer of the deep temporal fascia and connected to the subperiosteal dissection medially, and the subperiosteal dissection advanced anteriorly to the orbital rims. Endoscopic guidance was used to identify the supraorbital neurovascular bundles. The "sentinel" veins over the temporalis fascia anteriorly and inferiorly were dissected out and underwent bipolar electrocautery. Care was taken to stay on the superficial layer of the deep temporal fascia when cauterizing. The arcus marginalis was released from the entire supraorbital rim to the lateral canthus under endoscopic control. The corrugator and procerus muscles were carefully removed. A closed-suction drain was placed in the supraorbital area extending across the forehead. The amount of elevation was determined in relation to the position of the previously placed reference drill holes, adding 2 mm to the desired elevation to account for postoperative gravitational forces. Cortical bone fixation was used as described by Newman et al. A 2.0 polypropylene (Prolene) suture was passed through this cortical bone bar and placed through the anterior aspects of the incisions, catching a generous bite of periosteum. The temporal advancement was achieved by taking a line from the nasal ala through the lateral canthus and extending it back into the temporal region approximately 1 cm behind the previous marking incision. A generous bite of deep temporalis fascia on the anterior portion of the scalp incision was taken, thereby tying these sutures and affecting temporal elevation. The incisions were closed with staples. A light dressing was applied.

RESULTS

Seventy-five women and 9 men (average age, 54 years) were included in the study. These patients were divided into 3 groups. The coronal brow-lift group contained 13 women and 1 man (average age, 54 years); the trichophytic group, 31 women and 1 man (average age, 55 years); and the endoscopic group, 31 women and 7 men (average age, 53 years).

The average follow-up time was similar for all 3 groups (coronal, 22.9 months; trichophytic, 20.5 months; and endoscopic, 16.9 months), but different enough that time was considered in the analysis. Therefore, an analysis of covariance was used for the follow-up time. The medial brow measurements had no significant difference in the mean distance raised for the 3 groups. At a follow-up time of 19.4 months (the average follow-up time for all 3 groups), the measurements were 0.36 cm for the coronal group, 0.33 cm for the trichophytic group, and 0.35 cm for the endoscopic group. Likewise, the high point of the brow measurements had no significant difference in the mean distance raised for the 3 groups. At the same average follow-up, these measurements were 0.35 cm for the coronal, 0.34 cm for the trichophytic, and 0.32 cm for the endoscopic groups.

Long-term follow-up (35-56 postoperative months) comparisons were performed between the coronal and trichophytic brow-lift groups. Using the follow-up times as a covariant, we found no difference in the mean measurements for these two groups. The brows have remained elevated up to 56 months postoperatively. However, because of the small number of patients (n=6) with this length of follow-up, no statistically significant statements could be made (Figures 2, 3, and 4).

We found no statistically significant differences in the brow measurements for those patients with eyelid procedures performed concomitantly with their brow-lift procedure. Concomitant procedures included upper-lid blepharoplasty (n=12), lower-lid blepharoplasty (n=15), bilateral upper- and lower-lid blepharoplasty (n=16), periorbital laser resurfacing/chemical peel (n=6), canthoplasty (n=1), and ptosis repair (n=1). We defined an indicator variable for an eyelid procedure as 1 if an eyelid procedure was performed and 0 if no eyelid procedure was performed. The indicator variable was then used as a predictor in the analysis of covariance. We found no significant difference in the medial brow elevation (P=.15) or the highest point of the brow elevation (P=.11) between patients who underwent or did not undergo an eyelid procedure.

The endoscopic brow-lift procedure was not performed in this private facial plastic surgery practice until 1995. The 18 patients who underwent an endoscopic brow-lift from January 1, 1995, to June 30, 1996, were placed in the first group, and the 20 who underwent an endoscopic brow-lift from July 1, 1996, to December 31, 1997, were placed in the second group. A multiple regression model was used to determine whether experience was a factor in the amount of brow elevation obtained. We found no statistically significant difference between the distance of the medial brow (P=.80) or high point of the brow (P=.79) between these groups, suggesting that no learning curve was involved in obtaining successful brow elevation.

We randomly selected 27 female and 5 male photographs to test for the interobserver variance. Both observers were masked to the technique used. In more than 90% of the cases, the interobserver measurement difference was 0.1 cm or less. This finding was believed to have no impact, since the brow measurements are determined by a difference between preoperative and postoperative measurements, and any bias would be eliminated when the multiple measurements involved were considered.
It appears from this study that no significant difference exists in the amount of brow elevation among the coronal, trichophytic, or endoscopic forehead/brow-lift techniques. The distance of the incision from the brow did not affect the ultimate brow elevation in these trichophytic and coronal groups, a finding that is surprising in that common wisdom has suggested that the farther the incision is placed from the brow, the less likely the brow elevation is to be maintained. There has been discussion whether the subgaleal or the subperiosteal technique is significant in the distance the brow can ultimately be elevated. A recent study has shown that a subgaleal dissection was associated with less flap tension compared with the subperiosteal dissection with or without periosteal release at the orbital rim. In our study, the subgaleal dissection was used with the coronal and trichophytic brow-lifts, and the subperiosteal dissection was used with the endoscopic brow-lift. suggested that the periosteal release at the orbital rim was needed to attain the desired brow elevation with the subperiosteal dissection plane. Common to all brow-lifts in our study, the periosteum was released at the entire supraorbital rim and at myectomies of the brow depressors. Perhaps these caveats have more to do with the success of the brow-lift than the plane of dissection. The endoscopic brow-lift procedure entails more extensive

Figure 2. Photographs of a 45-year-old woman who presented with brow ptosis. A, Preoperative photograph. B, Postoperative photograph taken 56 months after a trichophytic brow-lift.

Figure 3. Photographs of a 53-year-old woman who presented with brow ptosis. A, Preoperative photograph. B, Postoperative photograph taken 56 months after a coronal brow-lift.

Figure 4. Photographs of a 37-year-old woman who presented with brow ptosis. A, Preoperative photograph. B, Postoperative photograph taken 25 months after an endoscopic brow-lift.

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subperiosteal elevation over the anterior and posterior skull, to shift all tissues posteriorly and thus the brow upward. The brows were secured in this elevated position with a transcalvarial suture technique for long-term support during all aspects of the healing phase.

By combining the open coronal brow-lift with a concomitant upper eyelid blepharoplasty, the goals of the patient and the standards of the surgeon can be effectively and safely achieved. Our study also shows this to be true with the endoscopic brow-lift technique. We were able to demonstrate no discernable difference in brow elevation with the open or endoscopic brow-lift techniques, with or without concomitant eyelid procedures.

We also sought to determine whether evidence of a learning curve existed within our patient population who underwent an endoscopic brow-lift. Because the endoscopic forehead/brow-lift procedure was not performed in this private facial plastic practice until 1993, the long-term follow-up was not as extensive as for the open brow-lift groups. However, we divided the endoscopic procedures into an earlier and a later group and found no difference in the brow height of the early group compared with the later group, when the surgeon had more experience with this technique.

Brow-lift procedures are gratifying to the patient and surgeon alike. The lack of a thorough release of the periosteum and depressor muscles (corrugator, procerus, orbicularis oculi, and depressor supercilius muscles) is probably the most common reason that brow-lift procedures fail. Releasing the attachments of the brow at the orbital rim allows the frontalis-galea-occipitalis sling to exert a posterior force on the brow and thus allow for elevation and fixation by the surgeon. Our study has demonstrated that both the open and endoscopic techniques described herein are successful at attaining long-lasting brow elevation. It was interesting to find consistent brow elevation between all brow-lift groups, including those that had combined eyelid procedures, as well as the lack of a presumed “learning curve” in the 2 endoscopic brow-lift groups.