Midfacial Rejuvenation Via a Minimal-Incision Brow-lift Approach

Critical Evaluation of a 5-Year Experience

Edwin F. Williams III, MD; Hannah Vargas, MD; Ravinder Dahiya, MD; Christopher R. Hove, MD; Bret J. Rodgers, MD; Samuel M. Lam, MD

Objective: To evaluate the surgical technique, cosmetic results, and complications of patients who underwent a midface-lift via a minimal-incision brow-lift performed by the senior author (E.F.W.).

Setting: Private, ambulatory surgical center.

Design: A retrospective review of 325 midface-lifts performed over a 5-year period by a single surgeon.

Patients: A total of 325 consecutive patients who underwent a midface-lift, with or without concurrent rhytidectomy and other adjunctive procedures, and who completed 3 months of follow-up were reviewed for perioperative complications. One hundred patients who had complete photographic and chart records and who had a minimum of 6 months of follow-up were randomly selected for photographic rating and chart review. Of the patients who had a minimum of 1 year of follow-up, 50 were randomly selected to determine if midfacial elevation led to any evidence of lateral-canthal distortion.

Main Outcome Measures: Midfacial elevation was assessed in 3 facial zones by 3 independent evaluators. Zone I represents the malar-infraorbital complex; zone II, the nasolabial sulcus; and zone III, the jawline. The zones were rated on a scale from 0 to 2 (0, no improvement; 1, mild improvement; 2, marked improvement). Change in the lateral-canthal position was measured in the vertical and horizontal axis for each eye. All complications were recorded.

Results: The 3 independent evaluators correlated well in their scores (κ=0.643) and found that most patients showed the best improvements in zone I, with 70% of patients showing marked improvement (P<.001). Moderate improvement was noted in zone III (marked improvement, 30%; mild improvement, 50%; and no improvement, 20%). Little or no improvement was noted in zone II (marked improvement, 4%; mild improvement, 60%; and no improvement, 36%). Patients who underwent a rhytidectomy along with a midface-lift showed better elevation in zone III. However, patients who underwent a brow/midface-lift alone also showed favorable improvement along the jawline (zone III). Although the postoperative lateral-canthal position revealed statistically significant vertical elevation of the lateral canthus on the right side, this finding did not correlate with any perceived clinical significance by the reviewer or patient (P<.01). Temporary morbidity included 2 subperiosteal abscesses and 3 frontal and 1 buccal facial nerve neuropraxias that resolved by 6 months. Permanent complications included 1 case of unilateral cranial nerve V2 paresthesia. Five patients had alopecia requiring scar revision. Many of these complications, including subperiosteal abscess and alopecia, have subsequently been avoided by minor technique modifications.

Conclusion: The technique of midface-lift via transbrow approach is a safe, reliable method of midfacial rejuvenation and avoids the unnatural lateral-canthal distortion previously described in the literature.

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From the Division of Otolaryngology, Department of Surgery, Albany Medical College, and the Williams Center for Facial Plastic Surgery, Albany, NY (Drs Williams, Vargas, and Dahiya); the Section of Facial Plastic and Reconstructive Surgery, Otolaryngology Division, Stanford University, Stanford, Calif (Dr Hove); the Rodgers Center for Facial Plastic Surgery, Boise, Idaho (Dr Rodgers); and the Lam Facial Plastic Surgery Center, Dallas, Tex (Dr Lam).
METHODS

All patients who underwent a midface-lift by the senior author (E.F.W.), with or without concurrent rhytidectomy and other adjunctive procedures, were included in our study. One hundred of the 325 study patients who had complete photographic and chart records and a minimum of 6 months of follow-up were randomly selected for aesthetic facial rating. Of the patients who had complete 1-year follow-up records, 50 were randomly selected for lateral-canthal position evaluation.

AESTHETIC FACIAL RATING

Elevation was assessed in 3 facial zones by 3 independent evaluators. Zone I represented the malar/infraorbital complex; zone II, the nasolabial sulcus; and zone III, the jawline. The zones were rated on a scale from 0 to 2 (0, no improvement; 1, mild improvement; and 2, marked improvement) (Figure 1).

LATERAL-CANTHAL POSITION

A total of 50 preoperative and postoperative photographs of patients who underwent a midface-lift were evaluated for horizontal and vertical changes in their lateral-canthal position. All postoperative photographs were taken at least 1 year after surgery. Photographs that were studied were both digital images and 35-mm transparencies. A method was devised to ensure consistent and standardized preoperative and postoperative measurements. First, all measurements taken were divided by a known fixed distance, the intercanthal distance, that was assumed not to change from the preoperative to the postoperative period. Second, by dividing the lateral-canthal position (both horizontal and vertical) by the respective preoperative and postoperative intercanthal distance, any slight differences in photographic camera-to-subject distance could be eliminated as only ratios and not absolute values were compared. The change in lateral-canthal position was determined for each eye independently in both the horizontal and the vertical axis (Figure 2).

The horizontal dimension was evaluated by measuring the distance from the medial to the lateral canthus for each eye and dividing by the aforementioned fixed value of the intercanthal distance. The percentage of change of the lateral-canthal position in the horizontal axis was calculated by subtracting the preoperative horizontal distance (A) from the postoperative horizontal distance (B) and dividing the total by the preoperative horizontal distance. The following formula summarizes this mathematical calculation: \( \frac{(B/IC_{post}) - (A/IC_{pre})}{A/IC_{pre}} \), where IC indicates intercanthal distance; post, the postoperative measurement; and pre, the preoperative measurement. Statistical analysis was applied to the above-mentioned data.

The vertical lateral-canthal position was measured in respect to a line drawn through the medial canthus. Values that fell below this line were considered a negative distance; accordingly, measurements that fell above this line were assigned a positive value. Again, all values were divided by the intercanthal distance to establish comparable preoperative and postoperative values. To quantify the change in vertical position of the lateral canthus, the angle of deflection, upward or downward, of the lateral canthus was examined in relation to that of the medial canthus. The angle of deflection was measured as the interception of the line drawn through the medial canthus and a line drawn through the medial and lateral canthi. The preoperative and postoperative angles were measured and subtracted from one another to determine the net change, upward or downward, of the lateral canthus. These values were subjected to statistical analysis.

COMPLICATIONS

After careful review of the charts of 325 patients who underwent a midface-lift via a brow approach, all complications and
outcomes were recorded and included. All 325 patients had complete 3-month follow-up records, which afforded analysis of perioperative morbidity.

STATISTICAL ANALYSIS

Facial-rating scores were subjected to a Mann-Whitney confidence interval and test. Interobserver agreement was assessed by κ analysis, and lateral-canthal position measurements were compared in the horizontal and vertical positions by paired t tests.

SURGICAL TECHNIQUE

Five standard endoscopic browlift-incisions are marked out with a surgical marking pen, with 1 incision located in the midline, 2 incisions located lateral to the midline (approximately at the lateral canthus) just posterior to the hairline, and 2 additional, longer incisions located more temporally, camouflaged by the hairline. One percent lidocaine with 1:100,000 epinephrine is then infiltrated into the incision sites, orbital rim, and midface.

The midline brow incision is carried out with a No.15 Bard-Parker blade down through the periosteum. A small, sharp, flat periosteal elevator is used to dissect subperiosteally for a distance of a few centimeters circumferentially around the incision site. A larger, sharp, flat periosteal elevator that reduces the risk of injury to the periosteum is then introduced to elevate the central pocket down to the orbital rim in order to release the arcus marginalis, but no aggressive dissection of the glabellar musculature is undertaken.

After the surgical maneuvers have been completed via the midline-brow incision, the same technique of subperiosteal dissection is carried out via the 2 paramedian ports. Again, the sharp, flat periosteal elevator is used to carry out blind dissection down to the arcus marginalis for proper periosteal release at the orbital rim. However, the elevator is held only in an upward, lifting motion when the elevator tip approaches a 1- to 2-cm distance above the supraorbital notch in order to avoid any paresthesias or neuromas that may ensue from violating the supraorbital neurovascular bundle. With proper retraction at one of the paramedian incision sites, a hand drill (Stryker Corp, Kalamazoo, Mich) outfitted with a drill bit (1.5 mm wide and 6 mm long) is used to enter the outer calvarial table at 30° and joined with an opposing entry of the drill to form a bone tunnel through which the brow-fixating suture may be passed at the end of the case. A similar bone tunnel is created in the contralateral paramedian incision site, and the expanded polytetrafluoroethylene CV-3 needle (Gore-Tex; WL Gore & Associates, Flagstaff, Ariz) is passed through the tunnel to ensure easy passage of the needle at the end of the case. We have found that a 6-mm-long recessed drill bit permits ease of bone-tunnel creation, while minimizing inadvertent entry through the full thickness of the skull, if the drill bit is angled approximately 30° to the skull contour. Similarly, a 1.5-mm-wide bit will accommodate our desired caliber of needle.

The longer, lateral temporoparietal incisions are then addressed. Dissection is carried through the temporoparietal fascia so that a proper tissue plane may be achieved between the temporoparietal fascia and the true temporals fascia to avoid injury to the frontal branch of the facial nerve. The incision should be situated approximately 1 cm behind the hairline to lie over the temporalis muscle and not more posteriorly to avoid transection of the superficial temporal artery and to minimize the long trajectory of dissection needed to reach the midface. Initial dissection is performed with a large, blunt periosteal elevator over the true temporals fascia, and then the larger, flat periosteal elevator is used to break the conjointed tendon of the temporalis muscle that divides the central and lateral pockets. Of note, only 3 periosteal elevators are used for the entire case (the small, sharp, flat elevator; the large, sharp, flat elevator; and the large, rounded, blunt elevator).

Under direct vision with a headlight and a Converse retractor, dissection is carried out to the orbital rim with the small, sharp periosteal elevator, with care taken to look for the presence of the cephalic vein. If the vein lies in the direct path between the upper and middle areas of the face, it may be skeletonized and cauterized with a bipolar device and transected with scissors to permit entry into the midface area. Injudicious cauterization of the cephalic vessel, especially if the bipolar cautery tips are aimed superficially, may jeopardize the frontal branch of the facial nerve. Then, the periosteal elevator is used to release the arcus marginalis from the superolateral orbital rim near the lateral canthus. The assistant places a finger along the lateral margin of the orbital rim to limit the surgeon’s dissection and to avoid excessive release of periosteum from the lateral canthus, which may otherwise contribute to undesirable lateral-canthal elevation.

Again, under direct view, the large, sharp periosteal elevator is guided downward to enter the temporal fat pad and then to release the periosteal attachments overlaying the zygomatic arch itself (Figure 3). This technique offers the surgeon direct access to the midfacial structures. Next, the periosteal elevator is continued inferiorly over the malar eminence to release the zygomaticus major and minor muscular attachments and the malar fat pad from the underlying malar bone. Although minimal medial dissection limits both lateral-canthal distortion and potential facial nerve injury, the dissection is continued until the midfacial structures are adequately released. Once the zygomatic muscular attachments have been severed, the surgeon should be wary of further inferior dissection and unintended massteric elevation that may result in trismus. A CV-3 suture (Gore-Tex; WL Gore & Associates) is passed through the temporals fascia and muscle just anteroinferior to the temporoparietal incision and then passed through the malar fat pad with a long needle driver (Figure 4). Before the suture is affixed to the temporals muscle superiorly, the frontalis muscle is secured to the bone tunnels in the paramedian ports. Then, the midface suture is suspended to the overlying temporals muscle, followed by 2 sutures that suspend the temporoparietal fascia to the temporals suture on each side (as undertaken in a standard endoscopic brow-lift). All incisions are closed with staples. Bacitracin ointment is applied to the external incisions, and a pressure dressing is fashioned into place.
RESULTS

AESTHETIC FACIAL RATING

The study group consisted of 91 women and 9 men, with postoperative follow-up of 6 to 50 months (mean, 23 months). The 3 independent evaluators correlated well, with a $\kappa$ value of 0.643. The majority of patients (70%) had marked improvement in zone I (30% had mild improvement and 0% no improvement). Most individuals (50%) had mild improvement in zone III (30% had marked improvement and 20% no improvement) and showed only mild (60%) or no (36%) improvement in zone II (4% had marked improvement). The differences between the 3 zones differed significantly ($P < .001$). Patients who underwent concurrent rhytidectomy had better outcomes in zone III. Of those patients with marked improvement, 81% underwent a concurrent rhytidectomy. However, 57% of patients who underwent an isolated brow/midface-lift demonstrated mild to marked improvement along the jawline (zone III).

LATERAL-CANTHAL POSITION

The horizontal change in the lateral-canthal position was evaluated independently for each eye and measured in percentage of change from the preoperative value. The mean lateral-canthal position change was less than 1% for both eyes: 0.09% medially for the left eye and 0.006% laterally for the right eye. The median change was 0%. A paired $t$ test revealed no significant change in horizontal position for either eye (left eye, $P = .92$; right eye, $P = .54$).

Similarly, the vertical change in the lateral-canthal position was evaluated independently for each eye. However, the percentage of change could not be assessed, because the starting value for the lateral-canthal position was oftentimes 0 (as it fell on the line drawn through the medial canthi). Instead, the angle of deflection, upward
or downward, of the lateral canthus was measured (Figure 2). The net angle of deflection was derived by subtracting the postoperative from the preoperative values. The mean upward angle of deflection was 0.77° in the left eye and 0.86° in the right eye. Despite the small net upward deflection in both eyes, there were almost as many deflections downward (15 left eyes and 18 right eyes) as upward (20 left eyes and 21 right eyes) as no change at all (15 left eyes and 11 right eyes). A paired t test showed no significant change in the left eye (P = .12) but a significant change in the right eye (P < .01) in the upward vertical direction. Despite this statistically significant change in the vertical position of the right eye, the aforementioned data reveal only an insignificant net deflection of less than 1° upward, with almost as many deflections upward as downward, as no change at all. The median and mode for the preoperative to the postoperative change in both vertical and horizontal axes were 0.

COMPLICATIONS

Two patients developed malar subperiosteal abscesses, both of which required incision, drainage, and antibiotic therapy. The first case resolved without sequelae. However, malar wasting requiring an alloplastic implant developed in the second case. The intraoral technique was used in both cases but was abandoned after evidence of a second abscess. No further cases of infection were noted in the next 269 cases after this technique modification. Three patients developed mild, transient frontal-branch neuropraxia, and 1 patient developed temporary buccal-branch motor weakness. All 4 pa-

Figure 6. Preoperative (A and B) and 1-year postoperative (C and D) views of a 49-year-old woman who underwent an endoscopic brow- and midface-lift, a rhytidectomy with submentoplasty, and perioral carbon dioxide laser resurfacing.
Patients had complete resolution by their 6-month follow-up visit (Figure 5). One patient had decreased sensation in the distribution of the maxillary division of the trigeminal nerve that did not resolve. Five cases of alopecia in the area of the paramedian incision were revised, without recurrence. All 5 patients had brow fixation via a removable-screw placement technique. After adoption of a bone-tunnel technique, no further cases of alopecia were noted. No evidence of temporal wasting was noted by either patient or physician. One patient commented that she was unsatisfied with the shape of her eyes 6 months after surgery, noting an unnatural elevation of the lateral-canthal position. However, the elevated position of her lateral canthus returned to normal at 1 year, without compromise of her surgical result, and she expressed satisfaction at that time.

**COMMENT**

Traditional approaches to brow rejuvenation have involved extended incisions carried across the entire arc of the scalp, eg, via coronal, pretrichial, or posttrichial incision lines.1-4 Over the past decade, the endoscopic technique has arisen as a viable alternative to the more traditional methods.8-12 More recently, the “smart-hand” technique, in which the endoscope has been eliminated, has been introduced—a method that forms the basis for the technique explained in this article. The midface has of-
ten been neglected when facial rejuvenation is enter-
tained because of the expressed concerns about poten-
tial morbidity and the risk of lateral-canthal distortion.
This article endeavors to review a large clinical series in
a rigorous scientific fashion to determine the risks and
benefits of the transbrow midface-lift.

First, we sought to determine the efficacy of mid-
facial rejuvenation via this approach with 3 indepen-
dent evaluators, who rated improvement on a 3-point
scale. Although the analysis was subjective, the indepen-
dent interobserver correlation remained high ($\kappa = 0.643$).
We were also determined to evaluate the degree of im-
provement that our technique provided to the de-
scended nasolabial sulcus (zone II) and the jawline (zone
III). Clearly, the retrospective nature of this study im-
parts obvious limitations in analysis, eg, concurrent rhyti-
dectomy was performed in some cases. However, all 3
independent evaluators were blinded as to what proce-
dures were performed, and our analysis reflects the role
of rhytidectomy in rejuvenation of the middle and lower
areas of the face. The majority of our patients (70%)
showed marked improvement in the midface (zone I).
The jawline (zone III) was improved only moderately in
most patients. As expected, those patients who also un-
derwent rhytidectomy demonstrated better outcomes in
zone III, with 86% showing improvement (marked, 39%;
mild, 48%) compared with those who did not undergo
this additional procedure, 57% of whom had improve-
ment (marked, 12%; mild, 43%). Conversely, we found
little to no effect in the nasolabial sulcus (zone II), whether
or not a rhytidectomy was performed concurrently. This
finding contradicts several articles that report improve-
ment of the nasolabial fold with malar fat pad eleva-
tion.13,14 Our results in the 3 zones of the face (zone I,
marked improvement; zone II, least improvement; and
zone III, moderate improvement) significantly differed
from one another ($P < .001$). The above-mentioned scores
and the accompanying photographs clearly demon-
strate the marked rejuvenation of the midface with this
technique (Figures 6, 7, 8, and 9).

The second objective of this article was to examine
the change in lateral-canthal position in 2 axes: vertical
and lateral. Although statistical review of the data re-
veals that the right eye was elevated significantly ($P < .01$),
careful study of the data points shows almost as many
downward movements of the canthus (15 left and 18 right
eyes) as upward movements (20 left and 21 right eyes)
as well as no change at all (15 left and 11 right eyes). Also,
the net deflection was negligible: less than 1° upward for
both eyes. No statistically significant changes occurred
in the lateral axis (left eye, $P = .92$; right eye, $P = .54$). Be-

tween objective measurements, with the exception of 1
individual, the patients did not report any unfavorable
canthal repositioning. The 1 patient complained of an up-
ward eye slant for the first few postoperative months but
stated that this problem had resolved by 1 year. Al-
though subjective reports of lateral-canthal position were
not formally obtained from the patient population, a de-
tailed review of the medical charts failed to elicit any com-
ment about dissatisfaction other than the stated case. It
should also be mentioned that the senior author (E.F.W.)
attentively records patient complaints in the postopera-
tive notes and critically evaluates all patients for abnor-
mal lateral-canthal positioning; he has noted lateral-
canthal distortion only in the immediate postoperative
period. Preservation of the lateral-canthal position may
be attributed to surgical technique. A deliberate effort is
made to stay over the lateral prominence of the malar bone
and to align the suture-fixation vector in a vertical di-
rection rather than diagonally from a more medial point
of fixation (Figure 4). The extent of medial dissection is
dictated by what is necessary for proper midfacial re-

Figure 8. Preoperative (A) and 1-year postoperative (B) views of a 43-year-old woman who underwent an endoscopic brow- and midface-lift, bilateral upper and
lower (transconjunctival) blepharoplasties, cervical liposuction, submentoplasty, and carbon dioxide laser resurfacing of the lower eyelids and perioral region.
lease. Finally, the conservative release of the arcus marginalis near the lateral canthus may limit unnatural canthal elevation.

The third objective of this article was to evaluate the complications that developed as a result of this more extended endoscopic brow technique and to find out why they occurred. After review of the data, a pattern was noticed in which evolution and modifications in surgical technique led to fewer incidences of morbidity. With changes in technique, 2 types of permanent complications, ie, infraorbital nerve injury and alopecia, have been avoided. The 2 cases of infection resulted from the intraoral route of midfacial suture placement, a technique that has since been abandoned. No subsequent cases of infection occurred in the 269 cases that followed modification of this technique. Five patients required scar revision for alopecia that arose in the area of the erstwhile-placed, temporary, suspensory screw. Since the introduction of bone tunneling in lieu of a suspensor screw, there have been no further cases of alopecia. Three

Figure 9. Preoperative (A and B) and 6-month postoperative (C and D) views of a 50-year-old woman who underwent an endoscopic brow- and midface-lift, bilateral upper and lower (transconjunctival) eyelid blepharoplasties, and full-face chemical exfoliation with Jessner solution, followed by a 35% trichloroacetic acid peel and carbon dioxide laser resurfacing of the glabellar and lower-eyelid regions.
patients developed neuropraxic injury to the frontal branch of the facial nerve and 1 patient to the buccal branch (Figure 5). Fortunately, all of these deficits were transient, resolving over a 6-month period. In our experience, inferior dissection over the zygomatic arch with a blunt elevator and a gentle sweep of the instrument off the bony prominence will rarely lead to neural transection. A review of the above-mentioned cases has led us to propose a likely mechanism by which these injuries occurred. First, transection of the superficial temporal artery, or its many tributaries, can stain the soft tissue and obscure planes of dissection. Further, indiscriminate, or even judicious, bipolar cautery of this excessive bleeding may also jeopardize the facial nerve. The extended period needed to control hemorrhage may also result in untoward edema that may, in turn, encroach on neural viability. Finally, unrelated to all of these reasons, we have also noticed that more aggressive dissection medially over the malar eminence to involve portions of the orbicularis oculi may contribute to the incidence of facial nerve paresis. Therefore, we advocate deliberate dissection, assiduous hemostasis, and limited medial midfacial dissection to minimize these adverse outcomes. The only permanent neural injury in the present study occurred in the infraorbital nerve. Although the patient has become acclimated to the sensory deficit, she still exhibits impaired sensation in that distribution. This injury occurred when the intraoral route was used to guide midfacial suture placement but has not recurred since modification of our technique. Again, the midface should remain laterally elevated over the malar prominence and under the zygomaticus musculature to reduce the inadvertent injury to sensory and motor nerve branches.

Although many, perhaps justifiable, fears and potential encumbrances surround the extended brow approach to midfacial rejuvenation, our goal was to provide a critical appraisal of this technique as performed by a single surgeon over a 5-year period and thereby to dispel some misguided prejudices and to encourage wider adoption of this valuable technique. We have noted significant improvement in the midface, without clinically apparent lateral-canthal distortion. Patient satisfaction has remained high, and after adjustment in technique, we have noted very little morbidity with this approach. We contend that a transbrow approach offers a safe, viable alternative, if not principal means, for midfacial rejuvenation.

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