



The K-Wire Fixation Technique for Endoscopic Brow Lift: A Long-Term Follow-Up

Paul E. Chasan, MD, FACS; and Adam T. Hauch, MD, MBA[Ⓞ]

Aesthetic Surgery Journal
2019, 1–10
© 2019 The American Society
for Aesthetic Plastic Surgery, Inc.
Reprints and permission: journals.
permissions@oup.com
DOI: 10.1093/asj/sjz215
www.aestheticsurgeryjournal.com

OXFORD
UNIVERSITY PRESS

Abstract

Background: Many techniques have been presented for fixation during endoscopic brow lift, but no singular technique has become dominant.

Objectives: The authors described a technique for fixation for endoscopic brow lift that is inexpensive, easy to use, and versatile and has minimal morbidity.

Methods: The charts of 284 patients who underwent the K-wire fixation technique between December 1996 and September 2018 were reviewed. This technique employs a transcutaneous K-wire to hold the brow in position until tissue adhesion creates a lasting elevation of the brow.

Results: A total of 284 patients underwent K-wire fixation for endoscopic brow lifting. Two patients had hematomas and 5 patients (1.8%) required a second unilateral brow lift procedure. Long-term elevation of the brow was maintained in all patients.

Conclusions: K-wire fixation for endoscopic brow lift is a simple, safe, and effective technique for fixation during endoscopic brow lifting that provides long-term aesthetic results.

Level of Evidence: 4

Editorial Decision date: July 25, 2019; online publish-ahead-of-print July 30, 2019.



The first endoscopic brow lift procedures were performed in the early 1990s and now have become the current standard for brow lifting amongst plastic surgeons in many areas, including in the San Diego, CA community.¹ There have been multiple fixation techniques developed including external dressings, screw fixation, cortical tunnels, absorbable screws, Mitek anchors (DePuy Synthes Companies, West Chester, PA), and the Endotine (MicroAire Surgical Instruments, LLC, Charlottesville, VA) device.² Despite nearly 3 decades of practice, however, there is still no consensus on which is the “best” option, and many surgeons still use a variety of techniques.

Many parameters are involved in what constitutes the best technique: ease of utilization, time constraints, expense, versatility of pull, morbidity, and longevity of results. To date, only a few papers have examined the long-term results of endoscopic forehead rejuvenation with follow-ups ranging from 1 to 13 years. Additionally, the methods for and duration of fixation are quite variable

between these studies, adding to the complexity of determining what is an appropriate fixation technique.³⁻⁷

In 1998 and 1999, the senior author (P.E.C.) published a novel technique, “the K-wire fixation technique,” which was believed to offer the best in each of these categories; however, it lacked long-term follow-up.^{8,9} The senior author has continued to employ this technique for all of his endoscopic brow lifts and has now reviewed the results from the last 20+ years. Review of more than 284 patients who underwent this technique has demonstrated that the

Dr Chasan is a plastic surgeon in private practice in Del Mar, CA. Dr Hauch is a Plastic Surgery Resident, Division of Plastic Surgery, University of California San Diego, San Diego, CA.

Corresponding Author:

Dr Paul E. Chasan, Ranch and Coast Plastic Surgery, 1431 Camino del Mar, Del Mar, CA 92014, USA.
E-mail: pchasan@ranchandcoastplasticsurgery.com;
Twitter: [@DrPaulChasan](https://twitter.com/DrPaulChasan)

operation is easy to perform, inexpensive, and precise; allows substantial versatility in elevation of the brow; and, most importantly, has minimal morbidity.

METHODS

Patient Selection

Our series is a retrospective analysis of 284 consecutive patients who underwent endoscopic brow lift with K-wire fixation. Many of these patients received combined procedures that included facelifts, eyelid surgery, and laser resurfacing. These patients were treated for over a 20-year period from December 1996 until September 2018. Patient ages ranged from 26 to 83 years old, and the majority were women but included 24 men. Written informed consent was obtained from all patients involved in the study. IRB approval was not obtained because the study was retrospective in nature, and pins are routinely placed into the outer table of the skull by neurosurgeons and during gamma knife treatments. The study was conducted in a manner consistent with the guiding principles defined by the World Medical Association Declaration of Helsinki. All procedures were performed by the senior author in a private American Association for Accreditation of Ambulatory Surgery Facilities-accredited facility.

Preoperative Analysis

In our series, all patients were examined in an upright sitting position. Examination was made of the brow height with eyes open with full animation, then with eyes open after coaching the patient not to raise their eyebrows after closing their eyes and relaxing their brow. For some, this was difficult to do because they had so much underlying tension in their brow. In many patients, their eyebrow height was normal with animation but associated with significant transverse forehead rhytids and dropped considerably with eyelid closure and relaxation of the brow. Other patients simply had low brows. It is important to assess “dynamic” ptosis of the brow as opposed to “static” ptosis. Static and dynamic qualities combine to give the brow a dynamic role in facial aesthetics and expression.¹⁰ The brow position is addressed in relationship with the supraorbital rim and the forehead height, and transverse forehead wrinkling severity must also be noted. Many patients appear to have a relative excess of upper eyelid skin but actually have a dynamic ptosis of the brows. In these patients, the wrong diagnosis would lead the surgeon down the path toward upper eyelid blepharoplasty when they really need a brow lifting procedure. Additionally, patient gender plays a significant role in the definition of brow ptosis. In males, the brow assumes a more horizontal

orientation along the supraorbital rim or just slightly above the supraorbital rim. As mentioned previously, the literature describes the ideal brow in women as starting at the supraorbital rim medially, arching superiorly in the first two-thirds significantly above the supraorbital rim, and lying horizontal or directed slightly downward in the lateral one-third. A brow lift is simulated in all patients to provide an idea of the amount of lift that is necessary to give an appropriate aesthetic result and to assess if concomitant upper eyelid blepharoplasty is required.

Surgical Technique

All patients underwent a thorough history and physical, and operations were performed in an American Association for Accreditation of Ambulatory Surgery Facilities-accredited private office facility. All patients received general anesthesia with the exception of 2 patients who underwent the surgery with local anesthesia and sedation. If a facelift was performed, it was performed first. If upper eyelid blepharoplasty was performed, it was done so before the brow lift due to surgeon preference. It is our preference to perform the more delicate eyelid procedure first to avoid subsequent swelling from the brow lift. When upper blepharoplasty was combined with brow lift, patients were marked for the upper blepharoplasty incisions in the supine position because we feel this position results in simulation of the brow lift and allows more appropriate markings. By performing the upper blepharoplasty first, brow elevation can subsequently be simulated intraoperatively, and brow lift may be performed without alteration to the normal K-wire placement.

For the brow lift procedure, the anterior scalp, superior orbital rim, temporal line of fusion, and temporal areas are injected with approximately 20 cc of 0.5% lidocaine with epinephrine. The access incisions are the 2 paramedian anterior scalp incisions placed approximately 1.5 to 2 cm off the midline and the 2 temporal incisions that are at the level of the highest point of the temporalis muscle approximately 1 to 2 cm posterior to the temporal hairline. This usually corresponds to a line drawn from the lateral nasal ala extrapolated through the lateral canthus to the temporal hairline. This is confirmed in the preoperative phase by having the patient bite and release while palpating the temporalis muscle. As everyone has subtle anatomic differences, it can be disconcerting to dissect the temporal area expecting to find temporalis fascia to sew to and see only bone because that person has a low temporalis origin. Each access incision is made approximately 1 cm in length and Bactroban ointment is used to manage the hair. The subperiosteal dissection is initiated from the paramedian incision to release the anterior scalp and forehead down to the zone of adherence 1 to 2 cm above the supraorbital



Figure 1. Illustration demonstrating surgical technique. The K-wire protrudes 5 mm from the end of the 16-gauge needle. Placement of the K-wire is at the junction of the anterior and temporal hairline and corresponds to an extrapolated line from the lateral nasal ala through the mid-pupil. Upward tension is placed on the K-wire/needle complex and skin to achieve the desired amount of brow elevation.

rim. At this point, the scope is brought into the optical cavity, and a complete release of the supraorbital rim is performed under direct visualization. Brow elevation is dependent on the interplay between depressor and muscle elevators. Although depressor muscle resection will lead to a reduction in glabellar lines, in our experience we have found that muscle modification also leads to the unpredictable and undesirable elevation of the medial brow. We therefore intentionally avoid this area as well as maintain 2 cm of midline periosteal attachments in the glabellar area to allow for more lateral brow elevation. When necessary, we subsequently treat glabellar rhytids through chemodenervation with Botox (Allergan, Inc., Irvine, CA) postoperatively.

The temporal incisions are dissected down to deep temporal fascia. From the temporal incision, a superior to inferior sweep of the temporal line of fusion is performed with the back of closed facelift scissors. This is performed in a sweeping motion staying directly on bone. Final lateral release is performed under direct visualization utilizing the scope along the lateral orbital rim along the bone



Video. Watch now at <https://academic.oup.com/asj/articlelookup/doi/10.1093/asj/sjz215>



Figure 2. This 37-year-old woman with brow ptosis (A) preoperatively, (B) 3 months postoperatively, (C) and 17 years postoperatively demonstrating maintained brow position and aesthetically pleasing long-term results. *Figure 2, A and B* have been reprinted with permission from Oxford University Press.⁹



Figure 3. This 36-year-old woman with brow ptosis (A) preoperatively, (B) 3 months postoperatively, (C) and 18 years postoperatively demonstrating maintained brow position and aesthetically pleasing long-term results. *Figure 3, A and B* have been reprinted with permission from Springer-Verlag New York Inc.⁸

with the tips of the facelift scissors in a scissor-spreading technique. Bilateral temporal fixation sutures are placed from the deep temporal fascia to the under surface of the temporal flap with a 3-0 Vicryl suture. All 4 access incisions are then closed with staples. In men, the paramedian incision is made horizontally along the anterior aspect of the hairline and closed with a 6-0 Prolene suture.

The K-wire fixation technique is then performed as follows: a standard 0.035" K-wire is introduced through a

16-gauge needle, which is used as a tissue protector and depth gauge. The K-wire is placed at the junction of the anterior and temporal hairline corresponding to the extrapolation of a line from the lateral nasal ala through the mid-pupil (*Figure 1*). This can be modified to the location that achieves the best and most aesthetic elevation of the brow. The K-wire is allowed to protrude 5 mm out of the end of the 16-gauge needle, and the K-wire gun is then tightened with finger pressure to secure the K-wire relative to the needle.



Figure 4. (A, C) Preoperative photographs of this 65-year-old female demonstrating asymmetric brows. (B, D) Photographs taken 3.5 years postoperatively following endoscopic brow lift, upper and lower blepharoplasty, facelift, fat transfer, and rhinoplasty. For asymmetric brows, release followed by fixation with different degrees of vertical pull is performed in order to achieve symmetry between the brows.



Figure 5. (A, C) Preoperative photographs of this 60-year-old female demonstrating complete brow ptosis particularly medial. (B, D) Four months postoperatively following endoscopic brow lift, upper and lower blepharoplasty, facelift, fat transfer, and fractional CO₂ laser. Please note that long-term photographs are unavailable because the patient lives out of town. This figure is included despite the short-term follow-up to demonstrate medial brow elevation.



Figure 6. This 73-year-old male (A) preoperatively, (B) 4 months postoperatively, (C) and 12 years postoperatively following endoscopic brow lift as well as facelift and fractional CO₂ laser. Maintenance of brow position is demonstrated over this period of time. The endoscopic technique for males is the same as for females except that incisions are placed on the anterior hairline in the balding male. K-wire placement is not adjusted for hair pattern or anticipated hair loss. No secondary hair loss has been noticed.

The surgeon's assistant then holds the head in place. The brow is elevated into the correct position and stabilized. The K-wire/16-gauge needle complex is then introduced percutaneously at a direct 90-degree angle, and the K-wire drill is initiated with significant pressure until either the outer table is traversed in which there is palpable give or the end of the 16-gauge needle stops as the needle stops at the bone, whichever occurs first (Video, available as Supplemental Material online at www.aestheticsurgeryjournal.com). It should be noted that there is a wide variety of bone densities, softness, and thickness requiring a wide range in pressure to pass the K-wire into the bone. After the first K-wire is placed, it is cut approximately 5 mm above the skin and the remaining segment of the K-wire is utilized on the contralateral side. In most patients, only the 2 K-wires are employed; however, if there is asymmetry or the need to elevate the medial brow, a paramedian K-wire is placed and sometimes a K-wire directly through the brow itself. No hair loss or scarring has ever been seen at the K-wire sites. **WARNING: NEVER PLACE A K-WIRE IN OR NEAR THE MIDLINE BECAUSE THE SAGITAL SINUS COULD BE PIERCED.** The K-wires are very well-tolerated and we have found that they do not routinely require a rubber covering. The patient is placed in a standard head dressing overnight, and the K-wires are removed on the third through fifth postoperative day utilizing a large needle holder. Removal of the K-wires is generally painless and requires little effort.

RESULTS

A total of 284 patients underwent the K-wire fixation technique over a 20+ year period. The technique has

changed very little during this time. Patients—260 women and 24 men—ranged in age from 26 to 83 years (mean, 48 years) and were followed-up for an average of 6 years postoperatively (range, 3 months to 18 years) (Figures 2-6).

Two instances of hematoma formation and 5 patients (1.8%) have required unilateral repositioning. The hematomas occurred in the immediate postoperative period and were treated with exploration and cauterization of a bleeding vessel. The hematomas appeared to be unrelated to the K-wires. The required brow repositionings were performed at approximately 2 to 3 months postoperatively and were felt to be secondary to inadequate release. On reoperation, these patients were found to have periosteal attachments or scar bands to the frontalis muscle remaining. Following release of these attachments, the patients were again refixedated with a temporary K-wire and subsequently did not require further interventions. No complications have been related to the K-wires themselves, specifically retained or broken wires, excessive discomfort related to the wires, hair loss or scarring, or neurologic symptoms.

DISCUSSION

In 1974, Westmore described the characteristics of the ideal brow shape as an arch where the brow terminates above the lateral limbus of the iris, with the medial and lateral ends of the brow at the same horizontal level.¹¹ Although slight refinements have been made by others, this description has remained the traditional teaching and preferred eyebrow shape in the literature.^{12,13} As people age, brow ptosis occurs to varying degrees, changing the shape and position of the brows. These age-related changes

frequently compromise the vitality, youth, and expression associated with an aesthetically ideal face. Unlike other areas of the body where there is relative descent of soft tissues, there is paradoxical elevation of the eyebrows, particularly the medial and mid-brow, with aging. These findings explain why surgical elevation of the mid and medial brow provides results that are neither youthful nor aesthetically pleasing. Techniques that selectively elevate the lateral brow are more likely to have a rejuvenating effect on the upper third of the female face.^{14,15}

These principles form the basis of our facial analysis and goals for brow aesthetics. The key to successful brow lifting depends more on maintenance or improvement in the brow shape to match the characteristics of a youthful brow, as previously described, and not necessarily on the amount of elevation obtained. A variety of surgical techniques exist that try to capture this ideal brow shape. Endoscopic forehead rejuvenation has largely replaced both the coronal and anterior hairline brow lift and has become the procedure of choice for many aesthetic patients who undergo correction of brow ptosis, provided the length of the forehead justifies such a choice.³ In our experience, we have found that patients with a high forehead may still be treated with endoscopic brow lifting by minimal dissection at the anterior scalp and that only patients with excessively high foreheads that require lowering are contraindicated for the endoscopic technique. Additionally, thick heavy skin envelopes are not a contraindication as long as adequate release can be performed.

In the San Diego, CA plastic surgery community, endoscopic brow lift is now recognized as the primary technique for brow lifting; however, multiple techniques are still employed for fixation. The K-wire fixation technique as described here allows a precise and effective elevation and fixation of the brow that is inexpensive, easy to perform, quick, associated with minimal pain or discomfort, and without “tension” hair loss at the access sites.

The senior author’s experience with endoscopic brow lifting began in 1994. At that time, the most commonly employed techniques for fixation were the Ramirez dressing and screw fixation through the access incisions.¹⁶ The Ramirez dressing worked and allowed variability of pull but was cumbersome. The screw fixation technique worked as well, but was felt to have little control in the vector of pull because screw placement was dependent on the location of the access incisions. On several occasions, patients treated with the screw fixation technique were felt to have excessive medial elevation and not enough lateral elevation of the brow. Additionally, it was felt that patients experienced a disappointing amount of postoperative discomfort and that a significant amount of alopecia and skin indentation occurred around the access incisions. The senior author also experimented with the Endotine

(MicroAire Surgical Instruments, LLC, Charlottesville, VA) device and again was disappointed by the lack of variability of pull, the larger size of the access incisions, and the palpability of the device. In our experience, cortical tunnels also posed similar problems because they were more cumbersome to perform, required larger incisions, and did not provide the flexibility in pull that we desired to consistently obtain an ideal brow shape.

The K-wire fixation technique satisfies many of the criteria deemed necessary by surgeons before implementation. It is inexpensive, easy to perform, and has minimal morbidity. But are the results long-lasting? The most pertinent question is this: Does temporary fixation of the forehead flap permit long-term repositioning of the brow if there is an adequate release of the supraorbital periosteum? Based on extensive experience with the last 20+ years of follow-up, we believe the answer is “yes.”

Some of the largest and most sophisticated analyses of longevity following endoscopic brow lift were conducted by Jones et al.^{3,4} The authors examined their long-term outcomes following endoscopic brow lift and periosteal fixation utilizing cortical tunnels and 2-0 polydioxanone sutures. By employing objective measurements and a sophisticated and validated subjective aesthetic scoring system, Jones et al conducted the first study to provide accurate evidence of the morphology, benefits, and longevity of endoscopic brow-lift surgery. Their technique of cortical tunnels, however, was shown not to have a significantly long-lasting effect specifically on lateral brow elevation. We argue that our technique of temporary K-wire fixation allows for more variability in the direction of brow positioning with the avoidance of permanent fixation to achieve long-term lateral brow elevation with minimal scarring. It is our opinion that, compared with cortical tunnels, temporary single point K-wire fixation is easier, faster, and provides more versatility in the direction of pull because it does not rely on the location of the incision.

Many surgeons believe it is important to have “permanent” fixation of the soft tissue in order to have a long-lasting result. On the other hand, Guyuron and Troilius argue that it is the release of the dense adhesions between the galea and the periosteum medial to the superior temporal fusion line as well as the orbicularis retaining ligaments/arcus marginalis along the superior and lateral orbital rim that is much more powerful than the type of forehead flap fixation performed.¹⁷⁻¹⁹ Despite believing that fixation methods are not as critical to maintenance of brow position as wide periosteal dissection and mobilization of the forehead flap from the underlying periorbital retaining ligaments, Guyuron’s group still performs single-point fixation laterally by attaching the superficial temporal fascia to the deep temporal fascia in the majority of patients and Troilius performed forehead taping in an upward-pulling direction. Additionally, Guyuron’s group

occasionally utilized a second bone tunnel for fixation in patients with asymmetry who do not respond to differential release of the attachments alone intraoperatively.^{17,18}

We also believe that the adequacy of the release is paramount to a successful result. This is demonstrated by the fact that of the 5 (1.8%) reoperations that we performed for unilateral brow re-elevation, all were successfully treated by extensive dissection and release of all suspensory ligaments followed by temporary fixation, although a lack of fixation was not the underlying issue. We have evolved our technique over the years to also include release of the lateral orbital periosteum under direct visualization to minimize the potential for an unseen lack of complete release as Guyuron describes. All of our unilateral revisions were effective, and, to date, no other patient has requested a revisional brow lift. Similarly, we believe that some sort of temporary fixation is still required. In our experience, the adherence of the forehead flap to the underlying periosteum occurs very quickly, within a few days, and allows removal of the K-wires within 3 to 5 days. These patients have long-lasting results without the need for more cumbersome procedures or retained hardware.

A number of studies have detailing the thickness of the frontal bones.²⁰⁻²³ The average for women is 5.7 mm and for men is 6.3 mm. Keeping the maximum penetration to 5 mm or less has been safe, and no patient has experienced a complication related to the depth of penetration or placement of the wire fixation.

There are several limitations and shortcomings to our study. Admittedly, this is a retrospective review of a single surgeon's experience with endoscopic brow lift. We believe, however, that our K-wire fixation technique is safe and should be able to be easily performed by most experienced plastic surgeons. Additionally, objective measurements or a validated subjective aesthetic scoring system were not employed in this study. Exploring long-term results utilizing such scoring systems as described by Jones et al^{3,4} is certainly warranted by future studies.

CONCLUSIONS

The K-wire fixation technique is a safe, quick, simple, inexpensive, and effective technique for fixation in endoscopic brow lifting that allows precise elevation of the brow and variability in the positioning of the brow. Temporary fixation of the brow, other than the temporal fixation sutures, appears to have significantly long-lasting results.

Supplementary Material

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

Acknowledgments

The authors thank Jim McConlogue for his help with creating the illustration in this paper.

Disclosures

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Funding

The authors received no financial support for the research, authorship, and publication of this article.

REFERENCES

1. Isse NG. Endoscopic facial rejuvenation: endoforehead, the functional lift. Case reports. *Aesthetic Plast Surg.* 1994;18(1):21-29.
2. Rohrich RJ, Beran SJ. Evolving fixation methods in endoscopically assisted forehead rejuvenation: controversies and rationale. *Plast Reconstr Surg.* 1997;100(6):1575-1582; discussion 1583.
3. Behmand RA, Guyuron B. Endoscopic forehead rejuvenation: II. Long-term results. *Plast Reconstr Surg.* 2006;117(4):1137-1143; discussion 1144.
4. Jones BM, Grover R. Endoscopic brow lift: a personal review of 538 patients and comparison of fixation techniques. *Plast Reconstr Surg.* 2004;113(4):1242-1250; discussion 1251.
5. Jones BM, Lo SJ. The impact of endoscopic brow lift on eyebrow morphology, aesthetics, and longevity: objective and subjective measurements over a 5-year period. *Plast Reconstr Surg.* 2013;132(2):226e-238e.
6. McKinney P, Sweis I. An accurate technique for fixation in endoscopic brow lift: a 5-year follow-up. *Plast Reconstr Surg.* 2001;108(6):1808-1810; discussion 1811.
7. Papadopoulos NA, Eder M, Weigand C, Biemer E, Kovacs L. A review of 13 years of experience with endoscopic forehead-lift. *Arch Facial Plast Surg.* 2012;14(5):336-341.
8. Chasan PE, Kupfer DM. Direct K-wire fixation technique during endoscopic brow lift. *Aesthetic Plast Surg.* 1998;22(5):338-340.
9. Chasan PE. How I modified the K-wire fixation for endoscopic brow lift. *Aesthet Surg J.* 1999;19(5):410-411.
10. Matros E, Garcia JA, Yaremchuk MJ. Changes in eyebrow position and shape with aging. *Plast Reconstr Surg.* 2009;124(4):1296-1301.
11. Westmore M. Facial cosmetics in conjunction with surgery. Presented at the Aesthetic Plastic Surgical Society Meeting, May 1974, Vancouver, British Columbia, Canada.
12. Freund RM, Nolan WB 3rd. Correlation between brow lift outcomes and aesthetic ideals for eyebrow height and shape in females. *Plast Reconstr Surg.* 1996;97(7):1343-1348.
13. Ellenbogen R. Transcoronal eyebrow lift with concomitant upper blepharoplasty. *Plast Reconstr Surg.* 1983;71(4):490-499.

14. Lambros V. Observations on periorbital and midface aging. *Plast Reconstr Surg.* 2007;120(5):1367-1376; discussion 1377.
15. Baker SB, Dayan JH, Crane A, Kim S. The influence of brow shape on the perception of facial form and brow aesthetics. *Plast Reconstr Surg.* 2007;119(7):2240-2247.
16. Ramirez OM. Transblepharoplasty forehead lift and upper face rejuvenation. *Ann Plast Surg.* 1996;37(6):577-584.
17. Guyuron B. Endoscopic forehead rejuvenation: I. Limitations, flaws, and rewards. *Plast Reconstr Surg.* 2006;117(4):1121-1133; discussion 1134.
18. Guyuron B, Lee M. A reappraisal of surgical techniques and efficacy in forehead rejuvenation. *Plast Reconstr Surg.* 2014;134(3):426-435.
19. Troilius C. Subperiosteal brow lifts without fixation. *Plast Reconstr Surg.* 2004;114(6):1595-1603; discussion 1604.
20. Moreira-Gonzalez A, Papay FE, Zins JE. Calvarial thickness and its relation to cranial bone harvest. *Plast Reconstr Surg.* 2006;117(6):1964-1971.
21. Elahi MM, Lessard ML, Hakim S, Watkin K, Sampalis J. Ultrasound in the assessment of cranial bone thickness. *J Craniofac Surg.* 1997;8(3):213-221.
22. Pensler J, McCarthy JG. The calvarial donor site: an anatomic study in cadavers. *Plast Reconstr Surg.* 1985;75(5):648-651.
23. Mowlavi A, Pham S, Lee R, Huynh P, Wilhelmi B. Cortical thickness parameters for endoscopic browlift fixation. *Aesthet Surg J.* 2012;32(5):547-551.