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CLINICAL STUDY

Endoscopic Browlift in Patients With Receding Hairlines

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Abstract: Patients with receding or high hairlines have traditionally been considered unfavorable candidates for endoscopic brow lift as this can further lengthen the hairline. We analyzed outcomes in patients that underwent a novel endoscopic brow lift technique with placement of incisions and anchoring Endotine Forehead Devices (CoApt AQ6 Systems Inc) directly at the natural forehead crease lines, in an effort to minimize elevation of the hairline, whereas providing well-hidden scars. We retrospectively reviewed all patients who underwent this new Endotine and incision placement between 2016 and 2020. Preoperative and postoperative photographs of all patients were analyzed to determine the postoperative changes in brow elevation and forehead length proportion (defined as length from cranium to chin).

The forehead length proportion was unchanged pre- and postoperatively, with no statistically significant differences noted ($P = 0.48$). The average brow position elevation ranged from 2.78 mm in the medial location to 5.05 mm in the lateral location. All patients were happy with their appearance and had improved visual fields postoperatively. The forehead scars healed well and were well hidden in forehead rhytids at long term follow-up.

This novel endoscopic brow lift technique provides an option to utilize a minimally invasive approach in patients with receding hairline. With this technique, visible scars were minimized, whereas still being able to achieve reasonable brow elevation. Thus, our approach enables long term maintenance of brow elevation with inconspicuous scars in the forehead.

Key Words: Brow position, endoscopic browlift, facial aging, receding hairline

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Age-related changes of the face are particularly noticeable in the orbital region, where drooping of the brow is often the telltale sign of aging. Loss of tissue elasticity causes the descent of the brow and adds to lateral hooding, which in turn results in a tired and depressed appearance. Severe cases of brow ptosis not only reduce facial aesthetics, but also result in functional deficits such as visual field impairments.[1,2]

Several surgical approaches have been described to address aesthetic and functional brow position. According to a report of the International Society of Aesthetic Plastic Surgery, brow lifts continue to rank among the most frequently performed face and head procedures worldwide, with a total of 220,055 procedures reported in 2018.[3] With the introduction of the endoscope use for brow lifts in 1992, brow lift surgery has slowly moved away from the traditional open coronal lift surgery to the endoscopic, minimally invasive approach.[2,4,5] Currently, brow rejuvenation procedures are performed endoscopically in over 50% of cases.[6]

However, in patients with a receding hairline, endoscopic brow lift is typically not considered feasible, as the access incision points are usually placed within the hair bearing scalp to prevent stigmatizing scarring.[7] These incisions are placed behind the hairline and the fixation points are placed in the upper forehead, subsequently raising the hairline even further. Our group described a novel endoscopic brow lift technique in the patient with a receding hairline, whereas utilizing minimal incisions to elevate the brow, thus allowing the endoscopic brow lift technique to be considered in patients with receding or high hairlines.[8] By modifying forehead incisions and hiding scars within the apparent horizontal forehead rhytids, we were able to achieve inconspicuous scarring, whereas at the same time providing successful eyebrow elevation. Other established techniques for brow elevation in receding hairline patients include using a pretrichial incision directly anterior to the hairline[9] or a direct browplasty.[10]

To further investigate the feasibility of this endoscopic brow lift approach in patients with receding hairlines, we performed a retrospective outcome analysis of 14 consecutive cases undergoing brow lifts using this modified technique. This study evaluated the effects of the novel endoscopic brow lift technique on postoperative brow position and its effect on modifying the anterior hairline position.

MATERIALS AND METHODS

Sample Investigated

The investigated study sample consisted of 14 consecutive cases (14 males) with receding hairlines who underwent endoscopic brow lift at the Division of Plastic Surgery at Mayo Clinic, Rochester, MN. All patients underwent a brow lift procedure by the senior author of the study (S.M.). Patients were of Caucasian ethnic background, with a mean age of 65.1 years. Medical files of the patients were reviewed retrospectively and analyzed for patient demographics, smoking status, concomitant procedures, brow position, and complaint at postoperative 1 month and subsequent follow-up. This retrospective data analysis is conducted with

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Institutional Review Board approval and Health Insurance Portability and Accountability Act authorization.

Operative Technique (Fig. 1)

The operative technique and incision points have been previously described in detail.[8] Briefly, patients were operated on under general endotracheal anesthesia, and a total of 4 incisions were made. Two 1-cm horizontal incisions were placed at the upper forehead bilaterally within horizontal forehead rhytids, either at the level of the peak of the brow or slightly more medial to the peak. The incisions were placed between the upper third and lower two-thirds of the forehead, which enabled brow elevation without changing the position of the anterior hairline. The forehead skin between the level of the Endotine and the level of the anterior hairline (the upper one-third of the forehead) accommodated for brow elevation without changing the position of the hairline. In most patients, incisions were made in asymmetric locations in order to create impressions of unplanned scars rather than planned incisions. For the temporal lift portion of the procedure, bilateral 2.5-cm incisions were placed either parallel to or 1 to 2 cm posterior to the temporal hairline, starting superiorly 1 cm inferior to the temporal fusion line. In the completely bald patients, we placed the incision 2 to 3 cm more posteriorly than usual to decrease the visibility of the scar.

Dissection was performed to the level of the deep temporal fascia then proceeding anteriorly over the deep temporal fascia toward the sentinel vein. Further dissection was performed over the frontal bones by continuing the dissection medially through the temporal line of fusion and thus entering the subperiosteal plane. The forehead tissue was elevated in a blind fashion from lateral to medial and inferior to superior, except for the 2 cm^2 area above the supraorbital rim. The endoscope was introduced, the sentinel vein was identified and all attachments surrounding the sentinel vein were dissected completely. The forehead incisions were then dissected down to the subperiosteal plane. The dissection of the forehead incision was performed by making an incision through the skin, then spreading with scissors perpendicular to the incision to identify and avoid injuring the sensory branches of the supraorbital nerve. Once all the periosteum was elevated through the temporal and forehead incisions, the periosteum was divided at the level of the supraorbital rim across the forehead in its entirety, with care taken not to injure the supraorbital and supratrochlear neurovascular bundles. Two Endotine devices (CoApt Systems Inc, Palo Alto, CA) were utilized to engage the periosteum above the level of the transverse periosteal incision. By cutting the periosteum across the lower forehead and placing tension on the periosteum superior to the cut, the superior pull on the periosteum created a separation at the level of the periosteal cut, transferring tension from the periosteum to the superficial brow tissue. In this series we did not perform any glabellar muscle modification as the indication was purely functional.

Forehead Measurement (Fig. 2)

Preoperative and postoperative visits and photographs were reviewed. Digital photographs of the patients were obtained by a professional photographer. Specifically, the patients were photographed in a studio with the same lighting for all patients, with them sitting at a standardized length from the camera. The patients were instructed to remain in neutral, whereas photos are taken. The same digital camera system was used for all the patients. The images were exported in a 1920 × 1080 resolution for analysis. Postoperative changes in the forehead length proportion, defined as the length ratio from pupil to hairline by the total length from cranium to chin (Fig. 2), were analyzed on Adobe Photoshop software (San Jose, CA), and compared to preoperative values.

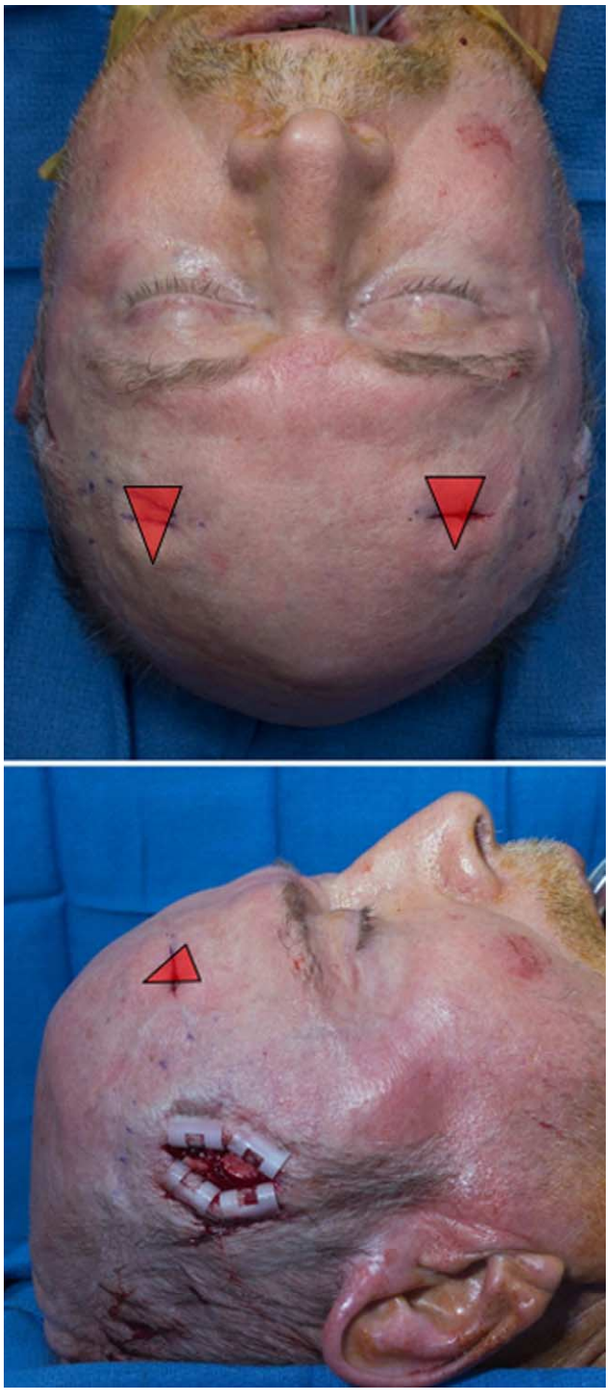

FIGURE 1. This was a 77 year male patient that underwent bilateral endoscopic brow lift and upper blepharoplasty. Intraoperative photographs of the forehead incisions are shown with red triangles indicating the location of the Endotine devices. The forehead was advanced superiorly so that the incision is superior to the Endotine device. (Top) Bilateral 1-cm horizontal incisions were made on the upper forehead, at the level of the temporal limbus of the iris, placed within apparent horizontal forehead rhytids (para-central incisions). (Bottom) Bilateral 3-cm vertical incisions laterally, below the lateral temporal fusion line (temporal incisions). Finally, possible 2-cm vertical incisions at midsagittal plane, hidden in the hairline (central incision) if needed to aid in dissection. AQ18

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FIGURE 2. Measurement of the forehead length proportion (FLP), defined as the length ratio from pupil to hairline by the total length from cranium to chin, shown on a 62 year male patient that underwent bilateral endoscopic brow lift, upper blepharoplasty, and Müller muscle resection at his 3 months postoperative visit.

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Brow Measurements (Fig. 3)

Brow position was measured retrospectively at 3 locations in pre- and post-operative photographs, according to the method previously described by Georgescu et al.[11] The horizontal iris diameter (white-to-white) of the right eye was used to equalize the measurement with an arbitrary value of 12 mm in each photograph. A horizontal line was drawn between the 2 pupils. Medial, central, and lateral brow levels were measured from this line to the following landmarks: tip of the medial brow, the upper edge of the central brow (corresponding to the center of the pupil), and the highest point of the lateral brow. Mean follow-up was at 109.81 ± 72.37 weeks postoperatively. Increases (+) or decreases (−) in brow position was given in millimeters (mm). Retrospective measurements incur variability due to the angle of the face relative to the photographer. Standardization was best accomplished through the use of iris diameter and photographs taken in our professional photography studios. Future studies should incorporate the use of direct measurements of the patient in real time to limit variability.

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Analytic Procedure

Statistical analyses were conducted using SPSS Statistics Version 26 (IBM, Armonk, NY) and results were considered statistically significant at a probability level of ≤ 0.05 to guide conclusions. Paired *t* test and analysis of variance were used to determine statistical significance of postoperative eyebrow positioning.

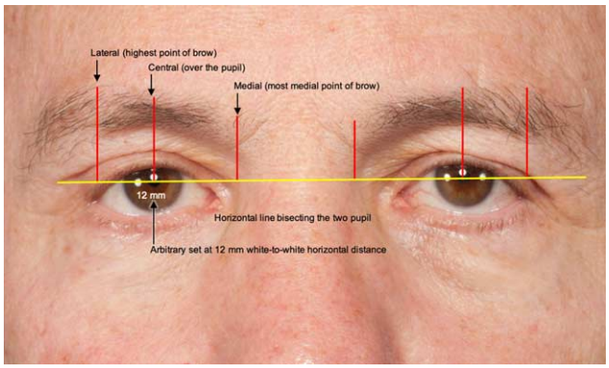

FIGURE 3. This was a 72 year male patient at 4 months follow-up after our endoscopic brow lift procedure and upper blepharoplasty. Brow elevation measurements were based on descriptions by Georgescu et al.[10] Horizontal iris diameter (white-to-white) of the right eye was used to equalize the measurement with an arbitrary value of 12 mm in each photograph. A horizontal line was drawn between the 2 pupils. Medial, central, and lateral brow levels were measured from this line to the following landmarks: tip of the medial brow, the upper edge of the central brow (corresponding to the center of the pupil), and the highest point of the lateral brow.

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RESULTS

Patient Characteristics (Supplementary Digital Content, Table 1, http://links.lww.com/SCS/D233)

Fourteen male patients with a mean age of 65.06 ± 7.67 years (range: 51.28–76.91) suffering from brow ptosis and a receding hairline received an endoscopic brow lift between 2016 and 2020. Half of all patients (n = 7/14) were former-smokers, whereas the other half were never-smokers (n = 7/14). On average, 2 concomitant procedures were performed in addition to the endoscopic brow lift (range: 0–5). Of these, bilateral upper blepharoplasty was the most common procedure.

Outcomes After Endoscopic Brow Lift (Supplementary Digital Content, Table 1, http://links.lww.com/SCS/D233, Fig. 4)

The most common complaints at the 1-month postoperative visit were numbness (n = 5/14, 35.7%) and sensitivity or palpable Endotines (n = 7/14, 50%). Four patients (28.6%) did not have any complaints at their 1-month postoperative follow-up. Complaints resolved spontaneously after an average of 3.75 months. In 1 patient early in the series, the 3.5 mm Endotine was noticeable as a prominence in the forehead on both sides. Under local anesthesia, the 2 Endotines were removed through the 2 forehead incisions at 3 weeks postoperatively. Subsequently, all patients afterwards had 3.0 mm Endotines placed with none having complaints of a visible Endotines.

Preoperatively, all of the brows were below the supraorbital rim. Postoperatively, 13 out of 14 were above the supraorbital rim. The forehead length proportion was unchanged pre- and post-operatively, with no significant differences noted ($P = 0.48$).

Mean follow-up for measurements of brow position was 109.81 ± 72.37 weeks postoperatively. The mean increase of the

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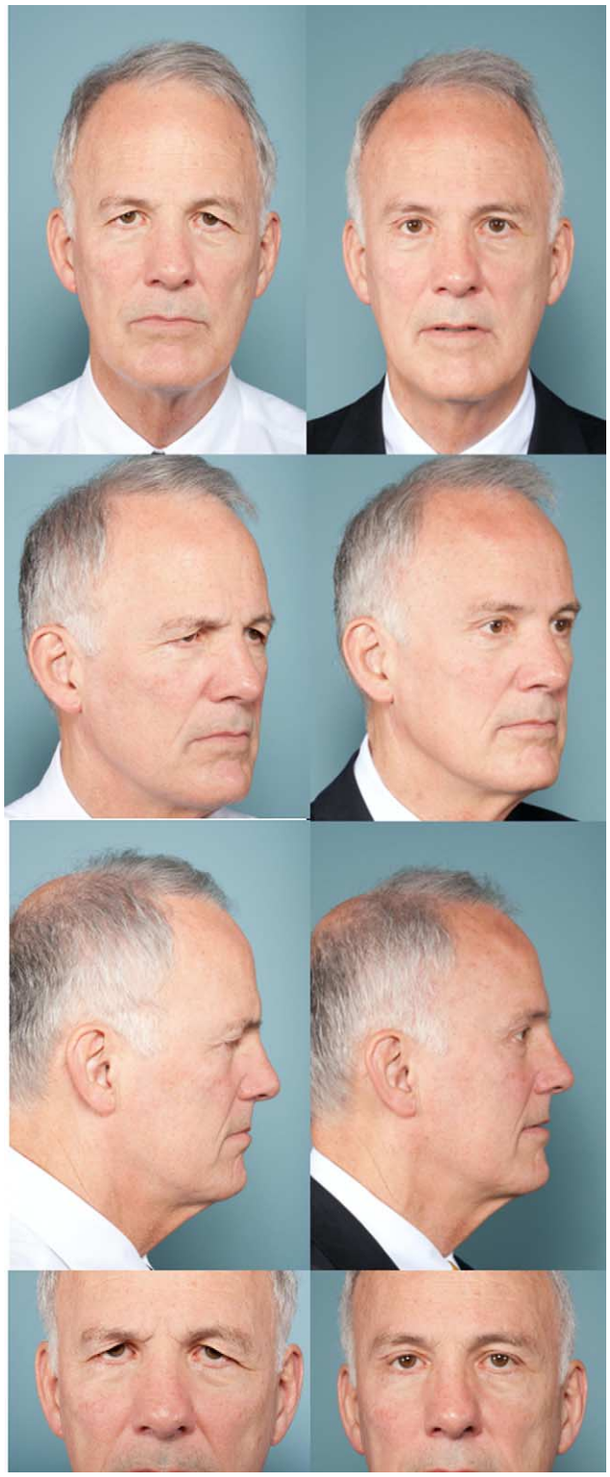

FIGURE 4. Preoperative frontal, oblique, and side views of a 72 year male patient (left). Images obtained at 4-month follow-up after endoscopic brow lift and upper eyelid blepharoplasty (right).

right lateral brow position was 5.05 ± 4.33 mm ($P = 0.001$, compared to preoperative values) and the left lateral brow position was 4.41 ± 3.91 mm ($P = 0.001$). The mean increase of the right central brow position was 4.78 ± 3.98 mm ($P = 0.001$) and the left central brow was 3.03 ± 4.14 mm ($P = 0.017$). The mean increase of the right medial brow position was 3.38 ± 3.01 mm ($P = 0.001$) and the left medial brow position was 2.78 ± 3.07 mm ($P = 0.017$), respectively.

No significant difference of brow elevation could be found within the respective locations ($P = 0.480$). All patients were happy with their appearance and had noted improvement in visual fields postoperatively on subjective evaluations documented in the clinical notes. The forehead scars were not noticeable based on the photographs at long term follow-up, as it was hidden nicely in their forehead rhytids.

DISCUSSION

This single-center study investigated the feasibility of endoscopic brow lift in patients with receding hairlines, based on a retrospective outcome analysis of 14 consecutive cases. Brow position was determined using standardized photographs and by scaling the horizontal iris diameter of the right eye to equalize the measurement with an arbitrary value of 12 mm in each photograph.

Endoscopic brow lift has become the favored technique when it comes to forehead rejuvenation for many surgeons, as it reduces scarring, is minimally invasive, has a quicker recovery period and can require less procedure time in the hands of experienced surgeons. Although brow ptosis is a common feature acquired during the process of aging, men oftentimes also suffer from a receding hairline.[12] In this patient group, brow ptosis management is a challenging problem.[8] This study presents an operative technique that enables endoscopic brow lifting in men with a receding hairline, by applying standardized temporal incisions and 2 small horizontal incisions in horizontal rhytides of the forehead.

The results of this study revealed that brow position was effectively elevated medially, centrally and laterally. The amount of elevation in our series was comparable to those reported by Georgescu et al[11] with lateral brow position found to be elevated the most. We also showed correction of preoperative brow asymmetry.

Brow position differs according to patients' gender. In young males, the brow assumes a flat configuration with a horizontal orientation along the supraorbital rim, whereas in women optimal positioning of the brow arches superiorly between the lateral limbus and lateral canthus.[1,11,13] Thus, 1 could falsely assume that overcorrection of the lateral, as compared to the medial aspect of the brow, as is the case in this patient series, could result in a more feminine appearance of our male patients. However, it is of importance to recognize that during the process of aging, the lateral eyebrow descends to a relatively higher extent, also referred to as outer brow ptosis and lateral hooding, thus requiring more correction in order to obtain a flat but elevated eyebrow position.[14,15] Conversely, overly elevated eyebrows, especially in the medial aspect, can result in a surprised or even unintelligent look leading to unaesthetic results and dissatisfied patients.[16,17]

We reported the result on 1 patient previously,[8] and now present the results on a series of 14 patients. The only other known endoscopic approach to the receding hairline forehead brow rejuvenation was reported by Hamas in 1997.[18,19] He utilized plication AQ9 sutures in the area immediately anterior to the hairline, and reported good results. We believe our method allows for a simple and reliable method to elevate the brow without changing the position of the hairline and avoid significant forehead skin bunching.

The forehead scar hides nicely in the natural rhytids and is well accepted by patients. The forehead scar heals as a fine line without any obvious noticeability after scar maturity. The scar placement also avoids issues with hair loss that can happen and might be more obvious in patients with shorter hair styles. There may be concerns of hypertrophic or hyperpigmented scars in patients of higher Fitzpatrick skin types. However, our patient demographics consisted mainly

of Caucasians and those with low Fitzpatrick skin types, and thus we were unable to comment on our personal experience with scar quality in higher Fitzpatrick types. Likely, we will be cautious in offering this procedure for those with darker skin types.

When compared to direct browlifts, our method offers several advantages, including smaller scar lengths to accommodate the Endotine placements. In direct browlifts, a larger excision of skin is typically required for elevation. In addition, the scar can be placed in a forehead rhytid, which on most occasions is less noticeable compared to the direct incision. Lastly, many older patients have thinner brows, making the direct browlift scars more visible when compared to our method.

The incisions also facilitated dissection and simplified the endoscopy. Objective measurements demonstrated a stable length of the forehead and a comparable degree of brow lift when to previously published reports using traditional endoscopic brow lift approach.[20,21] In the evolution of our practice, we were also more careful to prevent issues with prominence of the Endotine device. We transitioned from using the 3.5 to 3.0 mm Endotine size. We placed the device on the forehead in areas with no significant convexity, thereby ensuring the device was flush with the bone and did not have prominent edges. Note that the Endotine device was placed between the upper and lower two-thirds of the forehead in order to engage the upper portion of the periosteum to elevate the brow, whereas also minimizing the bunching of the forehead.

In line with current literature, data analysis revealed transient postoperative sensitivity in several patients. Sensitivity is a described side effect of endoscopic browlift procedures.[26,27] In all cases, sensitivity resolved spontaneously. During our dissection we preserve the supraorbital and supratrochlear nerves, although theoretically the transverse incision can cut across 1 of the supraorbital nerves.[19] Further complications can be attributed to the use of the Endotine forehead device for brow fixation. Although it has been found to provide reproducible and secure brow elevation,[28] possible complications such as dislocation of the device, loss of fixation, discomfort, palpability, scalp hypoesthesia and/or dysesthesia, post-surgical neuralgia, and focal alopecia have also been described.[29,30] Other methods of fixations are available,[31] but we believe the Endotine device offers the most reliable form of fixation without prolonging operative time or comorbidities during the operation.

Our study limitations included the inaccuracy of brow position measurement from photo analysis and patient frontalis activation. One of our patients had chronic activation of the frontalis muscle on 1 side that was apparent at the post-op photo analysis. Two patients also had a noticeable smile after the surgery, although we instructed them to be neutral. This can influence frontalis activation and, therefore, brow position. In addition, although we utilized professional photographers, 3 of our patients has noticeable parallax error, where the patient's face was tipped up or down and thus the camera was not completely level at the horizontal plane of the patient's eye.

Endoscopic brow lift is feasible also in patients with a receding hairline providing significant eyebrow elevation and aesthetically pleasing results. The authors suggest using a surgical technique that hides incision points within horizontal rhytids in order to minimize visible scarring, whereas allowing for brow elevation without altering the position of the hairline.

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