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Subtle Eyelid Retraction after Lower Blepharoplasty

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Summary *Background:* Lower blepharoplasty is one of the commonest cosmetic surgeries performed in the United States. The delicate balance of the lower eyelid may be detrimentally altered in lower blepharoplasty, leading to lower eyelid retraction with the attendant functional and cosmetic consequences. Marginal reflex distance-2 (MRD2) is an insensitive measure for subtle lower eyelid retraction, and the MRD2 at the lateral limbus ($MRD2_{limbus}$) and tarsal marginal show (TMS) may be more sensitive in identifying eyelid retraction and eversion.
Methods: This is a cohort study of consecutive patients undergoing lower blepharoplasty with skin pinch removal, laser resurfacing, or skin pinch removal with prophylactic lateral canthal resuspension. Mean follow-up was 22.1 weeks.
Results: There was no significant difference in MRD2 after surgery after either laser resurfacing, skin pinch, or skin pinch with canthoplasty, either after surgery or between groups. $MRD2_{limbus}$ was significantly increased after surgery in the skin pinch only group ($p < 0.05$). There was a significant difference in postoperative $MRD2_{limbus}$ in the skin pinch with canthoplasty group compared to that in the skin pinch only group ($p < 0.05$). TMS was significantly increased after both laser resurfacing ($p < 0.001$) and skin pinch only ($p < 0.05$), and both postoperative groups demonstrated significantly increased TMS compared to skin pinch with canthoplasty ($p < 0.05$).

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Conclusions: $MRD2_{limbus}$ and TMS are more sensitive markers for lower eyelid retraction than MRD2. Subtle eyelid retraction and eversion occur after anterior lamellar work and can be prevented with prophylactic lateral canthal resuspension.

Introduction

Esthetic rejuvenation of the periorbita is a mainstay of cosmetic surgery in the United States.[1] A lower eyelid with a tight apposition to the globe and a gentle curve, just touching the inferior limbus, is considered esthetically pleasing.[2] Such a shape is maintained by several factors including eyelid laxity, canthal position, relation of the globe to the maxilla, and the muscular homeostasis of the eyelid protractors and retractors.[3] This delicate balance may be detrimentally altered by cosmetic surgery, leading to eyelid retraction and functional or esthetic complications.

There is a large body of literature dealing with lower eyelid retraction, treatments, and methods to prevent the development of this condition.[4,5] However, the typical measure of lower lid retraction, marginal reflex distance-2 (MRD2), may be inadequate to measure subtle changes in the lid position, contour, or eversion that occur with mild retraction. We theorize that lower eyelid retraction is common and underreported with traditional methods of evaluation; we suggest two parameters to quantitatively evaluate this – the $MRD2_{limbus}$ and the tarsal marginal show (TMS).

Methods

Consecutive patients who underwent lower blepharoplasty with ablative CO_2 resurfacing to the lower lids, skin pinch removal, or skin pinch removal with a lateral canthal resuspension from October 2017 to July 2018 by the senior authors (A.B.B. and S.R.) were screened for entry. Patients were included in the study if they had at least 12 weeks of postoperative follow-up. Exclusion criteria were subsequent noncosmetic surgery of the lower lids (e.g., traumatic reconstruction, skin cancer resection, etc.), botulinum toxin injection, or inadequate photographs for meaningful analysis. Full-face photographs were obtained using a standardized technique in the frontal position with eyelids open and facial muscles relaxed. Photographs were taken at the preoperative visit and postoperative month 3. Primary outcome measures were MRD2, $MRD2_{limbus}$, and TMS.

Measurements were taken by a single examiner (J.H.) with ImageJ software (Bethesda, MD) (Figure 1). The photograph was calibrated by setting a standard right corneal diameter of 12 mm. MRD2 was measured from the pupillary center to the lower lid margin. $MRD2_{limbus}$ was measured from the midpupillary line at the lateral limbus to the lower lid margin. The TMS was measured as the area of the lower eyelid margin visible in the photograph *en face*.

Surgical technique

Lower lid blepharoplasty was performed by a standardized technique through a transconjunctival incision as previously described.[6] All patients in the laser resurfacing group and skin pinch only group underwent fat excision. Three out of ten patients in the skin pinch with canthoplasty group had lower lid fat transposition in the preperiosteal plane as described in the literature.[7] Briefly, an incision was made in the lower lid conjunctiva and retractors with a monopolar cautery until the orbital fat was encountered. This was dissected free and either resected or secured with 4-0 plain gut suture and transposed into a preperiosteal pocket that had been dissected with a periosteal elevator. The conjunctiva was left to heal without any sutures.

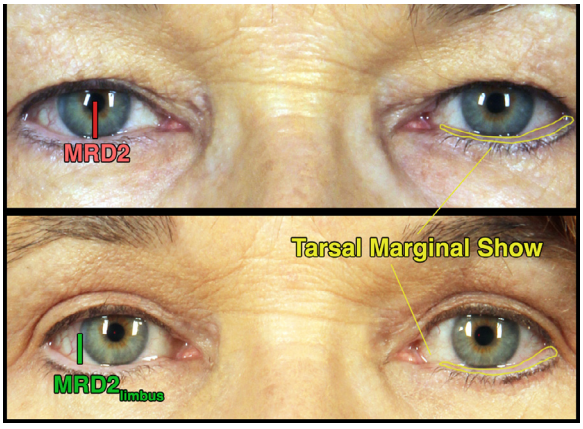

Figure 1 Representative schematic demonstrating measurements of photographs after surgery (preoperative, top, and postoperative, bottom). MRD2 was measured from the pupillary center to the lower eyelid margin. $MRD2_{limbus}$ was measured from the midpupillary line to the lower eyelid margin, at the lateral limbus. Tarsal marginal show was measured as the area of exposed eyelid margin visible with a full face frontal photograph.

Laser resurfacing

Patients who underwent laser resurfacing were subsequently washed with aqueous chlorhexidine 2% in the lower face and 10% iodine in the periocular region. Treatments were performed with a fully ablative CO_2 laser (UltraPulse 5000C, Coherent Corporation, Palo Alto, CA) set in the pulsed mode at 250 mJ and 60 W, with a density of 4 (corresponding to a 20–30% spot overlap) and 2.25 mm spot size. Two confluent, nonoverlapping passes with the computerized pattern generator were made in the lower eyelid from the nasal root medially to the hairline laterally and from the mid-cheek to the lash line on each pass. A saline-soaked gauze was used to remove desiccated tissue between passes. Petrolatum ointment was applied immediately postoperatively, and patients followed a wound care regimen of ointment and vinegar soaks.

Table 1 Mean values ± standard deviation for marginal reflex distance-2 (MRD2) (mm), $MRD2_{limbus}$ (mm), and tarsal marginal show (mm^2). Patients who underwent skin pinch only had a significantly increased $MRD2_{limbus}$ postoperatively. Patients who underwent laser resurfacing or skin pinch only had a significantly greater tarsal marginal show postoperatively than patients who underwent prophylactic lateral canthal resuspension.

	MRD2			$MRD2_{limbus}$			Tarsal marginal show		
	Pre	Post	*p*	Pre	Post	*p*	Pre	Post	*p*
Laser	4.90 ± 0.66	5.00 ± 0.56	0.95	4.29 ± 0.81	4.67 ± 0.59	0.35	22.9 ± 6.2	30.7 ± 6.9	**<0.001**
Skin pinch only	5.05 + 0.76	5.14 ± 0.49	0.97	3.93 ± 0.83	4.61 ± 0.59	**<0.05**	24.9 ± 5.6	29.7 ± 6.4	**<0.05**
Skin pinch with canthoplasty	4.78 ± 0.61	4.89 ± 1.01	0.94	4.47 ± 0.89	4.61 ± 1.11	0.93	21.6 ± 6.4	22.5 ± 6.0	0.95

Table 2 Results of repeated-measures ANOVA with multiple comparisons correction. $MRD2_{limbus}$ was significantly increased with skin pinch only versus skin pinch with prophylactic lateral canthal resuspension. Canthal resuspension significantly decreased postoperative tarsal marginal show compared to groups who had skin pinch alone or laser resurfacing.

	MRD2	$MRD2_{limbus}$	Tarsal marginal show
Laser vs. skin pinch only	0.99	0.39	0.09
Laser vs. skin pinch with canthoplasty	0.99	0.99	**<0.05**
Skin pinch only vs. skin pinch with canthoplasty	0.98	**<0.05**	**<0.0001**

Skin pinch

Patients who underwent skin pinch resection of the anterior lamellae had their lower eyelids placed on upward traction with a 4-0 silk suture. A conservative pinch of skin was made with a straight hemostat, with the patient opening their mouth and looking upward to ensure no changes in eyelid contour and minimize excessive resection. The redundant skin was excised and the wound sutured with a 6-0 fast gut suture.

Lateral canthal resuspension

Patients who underwent subsequent lateral canthal resuspension were treated according to a standardized technique as described in the literature.[8-10] Through the upper lid crease incision, blunt dissection through the orbicularis oculi to the lateral canthal tendon was performed. The anterior limb of the lateral canthal tendon was disinserted *ab interno* from the lateral orbital rim, and the lateral lower eyelid tarsus was sculpted to create a raw tarsal tongue in an *en glove* fashion. A 4-0 Maxon suture (Covidien, Dublin, Ireland) engaged the raw lower tarsal tongue and reapproximated the lateral canthal complex to Whitnall's tubercule for a posterosuperior vector.

Statistical analysis

A sample size of 8 patients in each group was calculated to be necessary to identify a 50% change in the primary outcome measures, with an α of 0.05 and β of 0.80. MRD2, $MRD2_{limbus}$, and TMS were measured, mean with standard deviation calculated, and significance tested with a repeated-measure ANOVA with multiple comparisons correction. All analyses were performed with Prism 8 (GraphPad, La Jolla, CA).

Results

Thirty patients (10 per cohort) met inclusion and exclusion criteria for the study. Male patients comprised 10% of the laser cohort, 30% of the skin pinch cohort, and 50% of the skin pinch with canthal resuspension cohort. Mean follow-up was 20 ± 7.6 weeks in the laser cohort, 22.6 ± 9.7 weeks in the skin pinch only cohort, and 22.8 ± 12.66 weeks in the skin pinch with canthoplasty cohort; ANOVA showed no difference between the three cohorts ($p = 0.74$). Ancillary procedures included upper lid blepharoplasty, ptosis surgery, and sub-SMAS face-lifting. No postoperative complications including hematoma, infection, or wound dehiscence were noted.

Mean measured values for MRD2, $MRD2_{limbus}$, and TMS are shown in Table 1, and statistical analysis between the cohorts is shown in Table 2; data are depicted in Figure 2. Representative postoperative photographs are shown in Figure 3. There was no significant difference in MRD2 postsurgery after laser resurfacing, skin pinch, or skin pinch with canthoplasty, either after surgery or between groups. $MRD2_{limbus}$ was significantly increased after surgery in the skin pinch only group ($p < 0.05$). There was a significant difference in postoperative $MRD2_{limbus}$ in the skin pinch with canthoplasty group compared to the skin pinch only group ($p < 0.05$) but no difference from the laser resurfacing group. TMS was significantly increased after both laser resurfacing ($p < 0.001$) and skin pinch only ($p < 0.05$), and both postoperative groups demonstrated significantly increased TMS compared to skin pinch with canthoplasty ($p < 0.05$).

Discussion

Lower blepharoplasty is a precise surgery where lack of attention to detail can lead to cosmetic deformities or functional impairment, and even blindness. Subtle lower eyelid retraction can lead to dissatisfied patients, who may be perturbed by the ocular surface symptoms as well as the unintended aesthetic result. Moreover, as the lower eyelid hangs in a delicate balance, particularly in patients with maxillary retrusion and a negative vector, initially subtle lower lid retraction may progress to something much more significant.

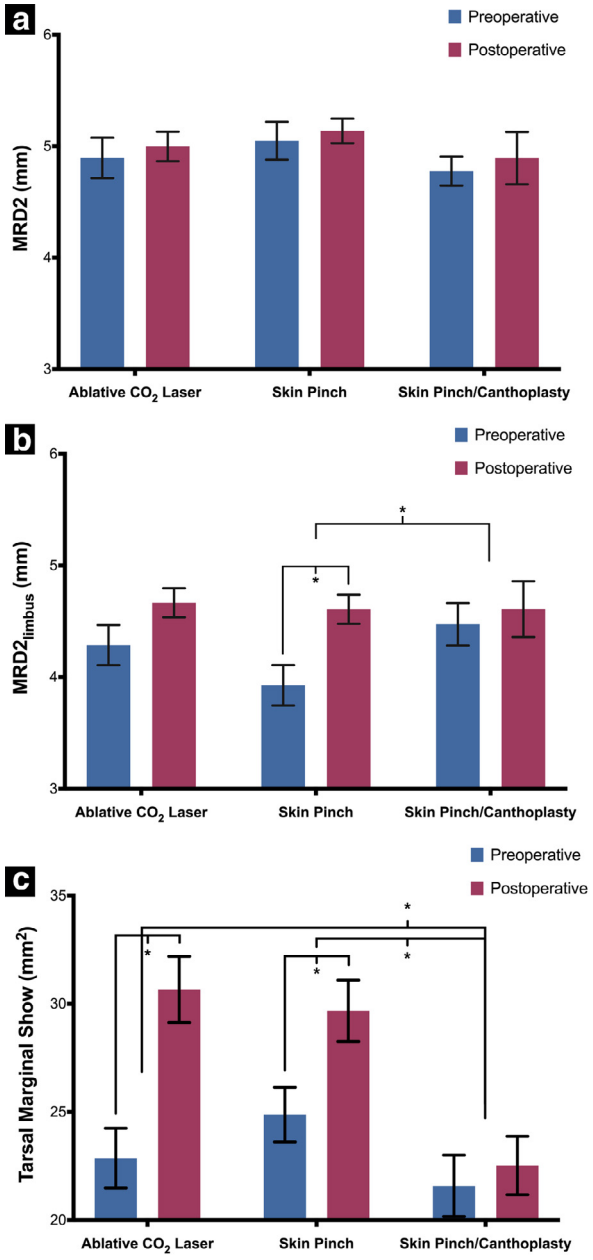

Figure 2 Measured data for the three cohorts, including pre- and post-operative (a) marginal reflex distance-2 (MRD2), (b) $MRD2_{limbus}$, and (c) tarsal marginal show (TMS). For MRD2, there was no significant difference, either after surgery within cohorts, or between cohorts postoperatively. $MRD2_{limbus}$ was significantly greater after skin pinch alone ($p < 0.05$), and prophylactic lateral canthal resuspension prevented this change ($p < 0.05$). TMS was increased postoperatively after laser resurfacing and skin pinch alone. Both cohorts had significantly increased TMS postoperatively compared to the cohort who underwent prophylactic lateral canthal resuspension ($p < 0.05$).

A recent national survey of blepharoplasty surgeons found that >97% of surgeons believe addressing the anterior lamellae is important, and nearly twice as many perform skin pinch compared to laser resurfacing; 96% of respondents also concurrently tighten the lower eyelid.[11] Our study provides critical data in directly comparing these contemporary techniques with regard to their effect on lower lid position in three dimensions.

While MRD2 is traditionally used to evaluate lower lid position after esthetic procedures, this evaluates only the lower lid position centrally and in one dimension – vertical. It is, however, the lateral lower eyelid that is most susceptible to lower eyelid retraction, perhaps due to the combination of a lax lateral canthal tendon, poor maxillary support, and a tendency of surgeons to remove more skin in the lateral lower eyelid.[12]

Our data support this theory, in that the lower eyelid at the lateral limbus is much more sensitive to descent than the central lower eyelid, leading to the observed increase in $MRD2_{limbus}$ after skin pinch removal. Furthermore, the lower eyelid is noted to subtly evert as measured by the TMS, after both laser resurfacing and skin pinch removal. The TMS is thus an extremely sensitive measure of retractive and everting forces in the lower eyelid and further provides information in the *z*-axis, unlike previous measures of retraction.

The lower eyelid has several potential forces that can exert a downward force – its own weight, cicatrization of the anterior, middle, or posterior lamellae, and the gravitational pull of the cheek and lower face.[13] Only the canthal ligaments and the orbicularis oculi muscles provide an opposing force. Our data underscore this precarious equilibrium, in that subtle eyelid retraction (as measured by $MRD2_{limbus}$ or TMS) is induced by anterior lamellar work (either laser resurfacing or skin pinch). While this retraction is not significant enough to lead to scleral show at the inferior limbus, the retractive forces lead to a change in the eyelid contour with a nadir laterally and an increased lateral scleral triangle.[9] The fact that skin pinch blepharoplasty leads to more pronounced retraction (postoperative increase in $MRD2_{limbus}$ *and* TMS) than laser resurfacing may be due to the fact that the surface of the orbicularis oculi muscle may be disturbed during the procedure. Inflammation in multiple layers of the eyelid – the posterior lamella through the transconjunctival incision, the middle lamella by superficial damage to the orbicularis oculi muscle, and the anterior lamella during the skin pinch – may be instrumental in this subtle retraction.[14] Laser resurfacing largely leaves the middle lamellar tissue untouched, preserving the dermal appendages and removing only the superficial layers of the epidermis with typical settings.[11,15] As such, only the most sensitive[2] markers of eyelid retraction (e.g., TMS) are able to quantitate the subtle retractive and everting forces imposed on the lower eyelid after laser resurfacing. Avoiding the pretarsal tissue on subsequent laser passes may further help reduce the observed eyelid eversion, although this was not tested in our study.

Prophylactic enhancement of the elevating forces of the lower eyelid may help counter these subtle retracting forces after skin pinch or laser resurfacing.[16] While there are currently no treatments to rehabilitate orbicularis oculi function, canthal laxity may certainly be addressed and there

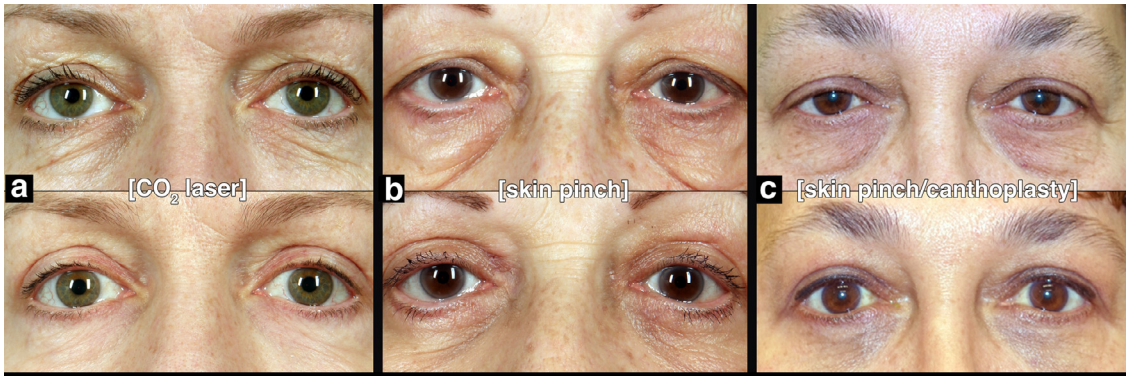

Figure 3 Representative photographs demonstrating postoperative (>3 months) results in each cohort. Eyelid retraction with a lateral bias, as well as slight eversion of the lower lid, is present in the cohorts who underwent laser resurfacing or skin pinch without prophylactic lateral canthal resuspension. (a) A patient who underwent upper and lower blepharoplasty, upper lid ptosis surgery, and laser resurfacing of the lower eyelids without canthoplasty; (b) a patient who underwent upper and lower blepharoplasty with skin pinch resection without canthoplasty; and (c) a patient who underwent upper and lower blepharoplasty with skin pinch resection of the lower eyelids, with concomitant lateral canthal resuspension.

is a large body of literature advocating this.[8,9,13,17-19] However, lower eyelid tightening or horizontal shortening is not a panacea, as patient-specific factors such as negative vector, maxillary retrusion, and canthal phimosis need to be taken into account or the lateral canthus may actually become more phimotic and retracted.[20] We prefer a technique that repositions the lateral canthus *en bloc*, rather than dividing the lateral commissure or shortening the lower eyelid[9] to minimize these risks. The data from this study demonstrate that prophylactic, minimally invasive, lateral canthal resuspension is effective in preventing even these subtle changes in $MRD2_{limbus}$ and TMS after anterior lamellar removal in lower blepharoplasty. In light of these data, the senior author (S.R.) routinely performs lateral canthal resuspension in all patients for whom anterior lamellar shortening is indicated.

Limitations of this study include the fact that patients were not randomized to treatments, and as such, patient-specific factors may have introduced bias. The study was powered to detect a 50% change in primary outcome variables; a larger sample size may have elucidated a significant difference in $MRD2_{limbus}$ after laser resurfacing as well. Finally, the surgical results of two individual surgeons may not be generalizable to the population at large, although the surgical technique was standardized according to published techniques.

Conclusion

Lower blepharoplasty remains a mainstay of facial rejuvenation. The lower eyelid is extremely sensitive to forces that induce eversion and retraction, and surgeons should evaluate the $MRD2_{limbus}$ and the TMS along with MRD2 to identify the subtlest cases of retraction. Concomitant prophylactic lateral canthal resuspension can serve a protective role in reducing the incidence of postblepharoplasty lower eyelid retraction.

Declaration of Competing Interest

None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.

Financial disclosure

No financial disclosures are reported.

References

1. Yeh CC, Williams EF 3rd. Midface restoration in the management of the lower eyelid. *Facial Plast Surg Clin N Am* 2010;**18**(3):365-74.
2. Beigi B, Khandwala M, Degoumois A, Ogbuehi KC, Gupta D. Lower eyelid excursion: a functional and cosmetically relevant parameter in the treatment of lower eyelid retraction. *J Plast Reconstr Aesthet Surg* 2019;**72**(2):310-16.
3. Cook T, Goldberg RA, Douglas R, Eshaghian B, Shorr N, Fagien S. The horizontal dynamic of the medial and lateral canthus. *Ophthal Plast Reconstr Surg* 2003;**19**(4):297-304.
4. Rohrich RJ, Villanueva NL, Afrooz PN. Refinements in upper blepharoplasty: the five-step technique. *Plast Reconstr Surg* 2018;**141**(5):1144-6.
5. Rohrich RJ, Ghavami A, Mojallal A. The five-step lower blepharoplasty: blending the eyelid-cheek junction. *Plast Reconstr Surg* 2011;**128**(3):775-83.
6. Wong CH, Mendelson B. Extended transconjunctival lower eyelid blepharoplasty with release of the tear trough ligament and fat redistribution. *Plast Reconstr Surg* 2017;**140**(2):273-82.
7. Goldberg R. Transconjunctival orbital fat repositioning: transposition of orbital fat pedicles into a subperiosteal pocket. *Plast Reconstr Surg* 2000;**105**(2):743-8 discussion 749-751.
8. Taban M, Nakra T, Hwang C, et al. Aesthetic lateral canthoplasty. *Ophthal Plast Reconstr Surg* 2010;**26**(3):190-4.
9. Ramesh S, Gupta A, Rootman DB, Goldberg RA. Long-term follow-up of lateral canthal resuspension. *Asia-Pac J Ophthalmol* 2018;**7**(2):90-4.

10. Georgescu D, Anderson RL, McCann JD. Lateral canthal resuspension sine canthotomy. *Ophthal Plast Reconstr Surg* 2011;**27**(5):371–5.
11. Kossler AL, Peng GL, Yoo DB, Azizzadeh B, Massry GG. Current trends in upper and lower eyelid blepharoplasty among American society of ophthalmic plastic and reconstructive surgery members. *Ophthal Plast Reconstr Surg* 2018;**34**(1):37–42.
12. Kim KH, Baek JS, Lee S, et al. Causes and surgical outcomes of lower eyelid retraction. *Korean J Ophthalmol* 2017;**31**(4):290–8.
13. Rosenberg DB, Lattman J, Shah AR. Prevention of lower eyelid malposition after blepharoplasty: anatomic and technical considerations of the inside-out blepharoplasty. *Arch Facial Plast Surg* 2007;**9**(6):434–8.
14. Schwarcz R, Fezza JP, Jacono A, Massry GG. Stop blaming the septum. *Ophthal Plast Reconstr Surg* 2016;**32**(1):49–52.
15. Massry GG. Comprehensive lower eyelid rejuvenation. *Facial Plast Surg* 2010;**26**(3):209–21.
16. Honrado CP, Pastorek NJ. Long-term results of lower-lid suspension blepharoplasty. *Arch Facial Plast Surg* 2004;**6**(3):150.
17. Codner MA, Wolfli JN, Anzarut A. Primary transcutaneous lower blepharoplasty with routine lateral canthal support: a comprehensive 10-year review. *Plast Reconstr Surg* 2008;**121**(1):241–50.
18. Jacobs SW. Prophylactic lateral canthopexy in lower blepharoplasties. *Arch Facial Plast Surg* 2003;**5**(3):267.
19. Tepper OM, Steinbrech D, Howell MH, Jelks EB, Jelks GW. A retrospective review of patients undergoing lateral canthoplasty techniques to manage existing or potential lower eyelid malposition: identification of seven key preoperative findings. *Plast Reconstr Surg* 2015;**136**(1):40–9.
20. Goldberg RA. Review of prophylactic lateral canthopexy in lower blepharoplasties. *Arch Facial Plast Surg* 2003;**5**(3):272.