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Aesthetic outcomes of upper eyelid blepharoplasty: a systematic review

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Abstract. Although upper blepharoplasty is a common cosmetic surgical intervention, a better scientific understanding of the aesthetic results and the preferred surgical technique to achieve the best aesthetic results is still needed. A systematic search using four search engines (PubMed, Embase, CINAHL, and Cochrane) was performed to identify any study on the aesthetic outcome of a solitary upper blepharoplasty; these were subjected to quality assessment for possible inclusion. Eligible studies were randomized controlled trials, controlled trials, cohort studies, and case series ($n \geq 10$). A total of 4043 studies were assessed, of which 26 were included. Aesthetic outcomes included patient-reported outcome measures, scarring, eyebrow height, tarsal platform show, and panel or expert evaluation. Meta-analysis was not possible. Patients were generally satisfied with the aesthetic result and scar formation after an upper blepharoplasty. The amount of tarsal platform show increases, which positively affects the aesthetics. The eyebrow seems to move down slightly. The surgical technique used (skin only or skin/muscle removal) did not influence patient satisfaction or the physician-assessed aesthetic outcomes. Patients are generally satisfied after an upper blepharoplasty. The optimal design of the skin excision is still a matter of debate, especially when addressing lateral hooding. Further objective research is advised.

Key words: blepharoplasty; eyelid correction; eyelid surgery; esthetic; aesthetic.

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When looking at a face, the eyes are the first and most looked at feature[1]. Eye-tracking studies confirm this; age judgements are made upon preferential attention towards the eye region[2]. A face can be judged as more aged, fatigued, and less attractive in the presence of tired-looking eyes and excess skin[2,3]. Aesthetic surgery to the eye region may therefore be one of the most effective interventions to enhance facial aesthetics[4].

Blepharoplasty of the upper eyelids is one of the most commonly performed surgical procedures in aesthetic surgery[5]. In the past, surgeons were more inclined to perform a more invasive blepharoplasty, where excess skin is removed together with a strip of orbicularis oculi muscle, sometimes combined with excision or redistribution of fat from the medial and central fat compartments. The rationale for both muscle and fat resection along with skin is, however, unclear[6].

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Nowadays, surgeons tend to be more conservative and less invasive by sparing the orbicularis oculi muscle and orbital fat, because this preserves the fullness of the periorbital region, thus preventing the aged hollow orbit appearance[7–10]. The preferred shape of the skin excision is also not clear, varying from elliptical[11], lenticular[12,13], S-shape[8,14], and trapezoid[15] to excisions that extend beyond the lateral orbital rim[16]. Each surgeon has their own preference, but there is no consensus as to which is the most suitable blepharoplasty procedure and for which patient[6]. Therefore, the literature was systematically reviewed to assess which technique gives the best aesthetic results.

Methods

A systematic review protocol was established before beginning the review process by following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This review has been registered in the International Prospective Register of Systematic Reviews (PROSPERO, registration number CRD42018117291).

Search methods for identification of studies

The following electronic databases were searched: PubMed, Embase, CINAHL, and Cochrane Central Register of Controlled Trials. The search key words included ''blepharoplasty'', ''upper'', ''eyelids/surgery'', ''eyelid reconstruction'', ''eye lid correction'', ''blepharochalasis'', ''dermatochalasis'' and ''eye lid surgery'' (for the full list of key words, see the **Supplementary Material** online). The reference lists of the full-text papers were screened for relevant studies missed in the search.

Eligibility criteria

Studies were eligible if a solitary surgical upper blepharoplasty had been performed on adult Caucasian patients (≥18 years of age, both sexes) and aesthetic outcome variables (e.g. visibility of scars) had been assessed after surgery. Evaluations by a panel as well as patient-reported outcome measures (PROMs) were considered. Direct postoperative variables such as oedema, bruising, and bleeding were not included, since the focus of this review was on the final more long-term aesthetic results.

Eligible studies were randomized controlled trials, controlled trials, cohort studies, and case series (≥10 participants), without language restriction. Studies were excluded if additional cosmetic or surgical procedures had been done simultaneously or during follow-up (e.g., peeling, 'double eyelid' operation, 'Asian blepharoplasty', surgical creation of a supratarsal crease, lower blepharoplasty, ptosis correction, browpexy).

Study selection (Fig. 1)

Duplicates were removed by one reviewer (MH). Further study selection was performed by two reviewers (MH and JS) and was conducted in two steps. On assessing the titles and abstracts according to the inclusion criteria, the selection process was tested by applying the inclusion criteria to a sample of 10 excluded papers to check whether they could be interpreted reliably. The full text was only assessed if the study appeared to meet the inclusion criteria or when a decision on inclusion could not be made based on the title and/or abstract alone. The quality of the assessment was piloted by applying the Methodological Index for Non-randomized Studies (MINORS) criteria[17,18] and by completing the data extraction form on a small sample of papers. Subsequently, the two reviewers independently performed the study selection. Any disagreement was discussed during a consensus meeting. When necessary, a third independent expert (RS) was available to make a binding decision.

Inter-observer agreement

After assessing the titles and abstracts, the agreed observations between the two observers (MH and JS) was 97.5%; agreement was 100% after the consensus meeting. Cohen's kappa was 1.0 after the consensus meeting.

Quality assessment

The methodological quality of the included studies was assessed by two independent reviewers (MH and JS) using the MINORS criteria[17,18].

Data extraction

After the full-text assessment, both reviewers (MH and JS) extracted the data from the included studies using the data extraction form and checked the data independently for accuracy and completeness.

Data synthesis

The included studies covered a range of outcomes; therefore the data could not be pooled and no meta-analysis was possible. Only a narrative synthesis is reported.

Results

Study selection

A total of 4043 studies were screened (after removal of duplicates), of which 127 full texts were assessed for eligibility. Twenty-six studies were suitable for systematic review. The first search was performed on October 10, 2018. This search was updated on February 22, 2019, but did not result in any additional studies. Also, the search of the reference lists did not result in any additional inclusions (see Fig. 1).

Study characteristics (Table 1)

The aesthetic outcomes after an upper blepharoplasty were assessed by PROMs, panel or expert evaluation, the amount of scarring, eyebrow height, and tarsal platform show. The MINORS assessment of study quality revealed a mean (± standard deviation) score of 13.5 ± 6. A synthesis of the included studies is described below.

PROMs

Satisfaction with appearance and improved quality of life are important outcomes for patients undergoing facial aesthetic procedures. Twelve studies evaluated an aesthetic aspect using a PROM. Most of these studies used a blepharoplasty technique whereby skin, orbicularis muscle, and fat (on indication) were removed[11,13,19–24]. Patient satisfaction after blepharoplasty was generally high[13,19,23].

van Exsel et al.[23] removed skin and a small strip of orbicularis muscle (2–3 mm) and patient satisfaction was 9.5 and postoperative cosmetic satisfaction was 9.3 (assessed using a questionnaire with a visual analogue scale). Jaggi et al.[21] used elliptical incisions with a temporal flare in a crow's foot and the patients were satisfied regardless of the suture material used (running fast-absorbing or non-absorbable sutures). Also, 98% of the patients were satisfied when skin and orbicularis muscle were removed and independently sutured[22]. Joshi et al.[19] and van der Lei et al.[20] both cauterized the septum during blepharoplasty, and the patients were satisfied according to satisfaction scoring method[19,20]. Saalabian et al.[24] compared

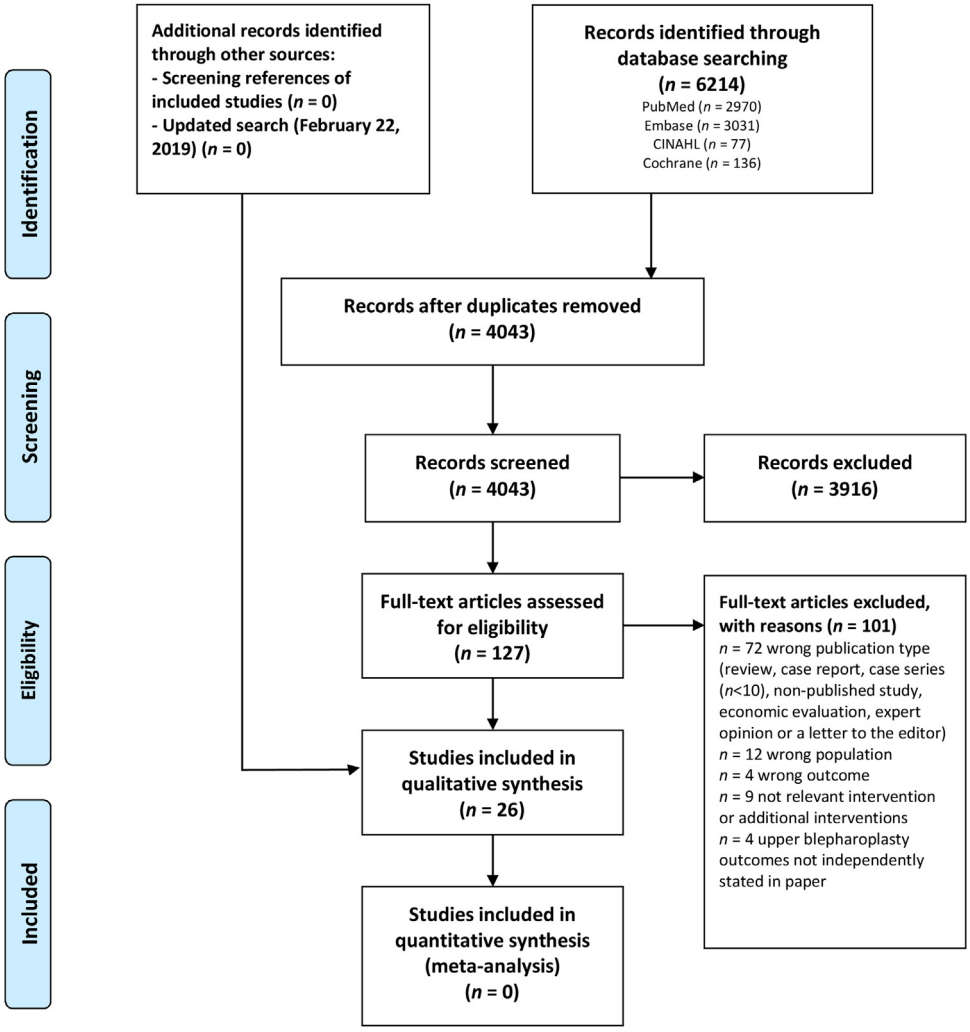

Fig. 1. Flow diagram of the study process and article selection.

the satisfaction levels of patients according to tissue resection categories (skin, skin/muscle, skin/muscle/fat, skin/fat). There were no differences in relation to scar aspects, recovery period, or complication rates. However, patients with more risk factors (i.e., hypertension, smoking, and anticoagulation or platelet anti-aggregation therapy) showed worse scar ratings, a longer recovery period, and more complications. Scar aspects were also evaluated by Kouba et al.[14] and concluded that tissue adhesive appears to provide greater cosmesis than absorbable suture material.

There were only two skin-only studies in which resection of fat was performed when indicated[16,25]. Patients were highly satisfied in most cases, with high satisfaction ranging from 78.6%[25] to 83%[16].

One study used a split-face design whereby one side had only skin removed and the other had skin and orbicularis muscle removed, but there was no significant difference in cosmetic appearance of the eyelids between the two techniques[15].

Paixao et al.[26] did not specify their surgical marking or techniques used. However, they concluded that satisfaction levels with the surgery were significantly related to the absence of undesirable effects (i.e., hypertrophic scar, small changes in vision, chemosis, pruritus, milia, and the feeling of tightness).

In summary, patients are generally satisfied after an upper blepharoplasty. It appears that the technique used, suture material used, and whether or not the septum is coagulated do not influence patient satisfaction. However, only a few split-face or randomized controlled trials compared these techniques using patient-reported aesthetic outcomes. Also, the shape of the surgical markings was not always described, so the influence of this rather important variable on aesthetics could not be assessed.

Expert panel or expert evaluation

Surgeons may have a different interpretation of the result than the patient. All studies with an expert evaluation had removed skin and orbicularis muscle [11,15,27–29], or no or little removal of orbicularis muscle[13], or did not state their technique[14].Two studies had a split-face design to compare the aesthetic outcomes of upper blepharoplasty with or without resection of the preseptal orbicularis oculi muscle. Blinded physician evaluations of the overall cosmetic appearance did not differentiate significantly between the eyelids on the two sides[15]. Damasceno et al.[29] concluded that the aesthetic outcome was worse on the skin-only side

Table 1. Characteristics of the included studies.

Author (year)	Aesthetic outcomes	Aim	(1) Study design (2) Surgical technique (3) Preoperative markings	Method of measured outcome(s)
Joshi et al. (2007)[19]	PROMs	Evaluation of established suture materials and techniques for blepharoplasty closure and determination of any differences in rates of complications between these groups	(1) Prospective study (2) Removal of a strip of skin; redundant muscle was also resected; the septum was cauterized; upper eyelid fat removal on indication (3) Markings not stated	Erythema, suture marks, wound infections, milia, standing cone deformity, unacceptable scarring, dehiscence, and satisfaction
van der Lei et al. (2007)[20]	PROMs	Report on experience with bipolar coagulation-assisted orbital septoblepharoplasty	(1) Retrospective study (2) Skin/muscle (3) Crease demarcation (7–9 mm above the upper eyelid margin centrally), medially from the level of the lacrimal punctum and laterally the extension depends on the presence of lateral hooding	Complication scoring (satisfaction and scarring)
Jaggi et al. (2009)[21]	PROMs Satisfaction Scarring	Patient satisfaction, pain, and wound quality of absorbable suture closure versus non-absorbable suture closure in upper blepharoplasty	(1) Prospective, split-face study (closure of the incision using absorbable sutures and non-absorbable sutures) (2) Removal of skin, muscle, and fat (3) Supratarsal crease bilaterally, and a temporal flare was placed in a suitable crow's foot	Validated questionnaire (BOE questionnaire) on patient satisfaction, scar visibility, and pain
Thomas and Perez-Guisado (2012)[22]	PROMs Satisfaction	Explanation of a new approach for anatomical reconstruction of the upper eyelid crease and the results obtained when an independent resection of the orbicularis oculi muscle and subsequent suture are performed	(1) Retrospective study (2) Removal of skin and independent resection of orbicularis oculi muscle, similar in size to the resected skin; the orbital septum is opened and middle pocket is trimmed using dissection, excision and cautery; the excess medial fat pocket is removed in a similar fashion; subsequent suturing of the muscle and then the skin was sutured (3) Markings shown as a figure	Patients were asked if they were completely satisfied or dissatisfied with the outcome of their operation
van Exsel (2016)[23]	PROMs Satisfaction	To investigate the efficacy of arnica ointment after upper blepharoplasty	(1) Prospective study (2) Removal of skin and a 2- to 3-mm strip of orbicularis oculi muscle without opening the orbital septum; the septum was then cauterized (3) Marking not stated	Study participants were randomized for topical arnica ointment or placebo ointment Primary outcome: subjective overall outcome of the appearance of the periorbital areas as based on light photography

Table 1 (*Continued*)

Author (year)	Aesthetic outcomes	Aim	(1) Study design (2) Surgical technique (3) Preoperative markings	Method of measured outcome(s)
Jacobsen et al. (2017)[13]	PROMs Panel/expert Satisfaction	Investigation of the functional benefits and patient satisfaction with upper blepharoplasty	(1) Prospective study (2) Upper blepharoplasty as described by Drolet and Sullivan (2014); the skin is removed, no or little removal of orbicularis, removal of fat if necessary in the case of asymmetry (3) Lenticular marking	Before and after blepharoplasty standardized photographs were taken and quantitative measurements were performed: (a) skin fold/MRD-visual axis (right and left eye); (b) skin fold/MRD-visual axis (worst eye) A questionnaire concerning functional and psychosocial impact of their eyelids and (postoperative) their satisfaction with the result The surgeon who performed the operation evaluated the surgical outcome using a five-step scale
Saalabian et al. (2017)[24]	PROMs Satisfaction Scarring	Comparison of satisfaction levels of patients in categories of tissue resection: skin, skin/muscle, skin/muscle/fat, skin/fat Evaluated by questionnaires Also the numbers of medical preconditions were scored	(1) Retrospective study (2) Removal of skin and muscle (when laxity was observed) (3) Markings: along the supratarsal fold to outline inferior resection borders; distance between superior incision lines and lower border of the brow >12 mm; lenticular medial margins, lateral triangular margin markings	Medical records review, questionnaire, telephone inquiry
Raschke et al. (2011)[25]	PROMs	Description of an objective photo-assisted evaluation for pre- and postoperative evaluation of blepharoplasties	(1) Prospective study (2) Excessive skin excision with redundant fat from medial and central fat compartment (3) Marking the lax skin above the supratarsal fold	Patient satisfaction questionnaires
Bellinvia et al. (2013)[16]	PROMs Scarring	To describe a technique for upper blepharoplasty reducing the need for browpexy or browlifting Indications and surgical outcomes are also presented	(1) Retrospective study (2) Removal of skin and medial fat pads when indicated; the strip of orbicular muscle was not excised (3) Cutaneous excision extended beyond the eyelid to include the lower lateral portion of the eyebrow area	Telephone interview including overall satisfaction (very satisfied, satisfied, dissatisfied) and the degree of visibility of scars (insignificant, modest, marked)

LoPiccolo et al. (2013)[15]	PROMs Panel/expert Satisfaction	To conduct a single-blind, randomized, controlled, split-face study to evaluate the effects of orbicularis oculi muscle stripping on upper eyelid blepharoplasty	(1) Prospective, randomized, single-blind, split-face study (2) Technique: each patient was randomized to receive upper lid blepharoplasty with orbicularis oculi muscle stripping on one eyelid (treatment) and without muscle stripping on the other (control) (3) Marking: The bilateral upper lids were first marked along the supratarsal fold to delineate the inferior boarder of the excision, approximately 8–9 mm above the ciliary margin; the superior portion was marked at least 10 mm from the inferior brow edge; lines connecting these margins were then inked to define the lateral borders of the excision, with the medial portion being lenticular and the lateral more trapezoidal in shape	Subjects performed cosmetic evaluation (scar thickness, width, colour, texture, and overall lid appearance); a composite score was calculated as the sum of these five scores In addition, two blinded physicians assessed the overall cosmetic outcome using photographs Scoring for each parameter was performed on a scale of 1 (excellent eyelid aesthetics, scar matches surrounding skin) to 5 (poor eyelid aesthetics, scar does not match surrounding skin) for patient and blinded physician evaluations
Paixao et al. (2008)[26]	PROMs	To evaluate the impact on quality of life of patients submitted to upper blepharoplasty	(1) Prospective study (2) (3) Technique and markings not stated	Standardized questionnaire on quality of life and complications Intraoperative: time of surgery, bleeding Postoperative: erythema, bleeding, oedema, pain, wound/scar appearance
Baker et al. (2002)[27]	Panel/expert	Comparison of free beam CO_2 laser versus diamond laser scalpel	(1) Prospective, split-face study, with blinded evaluation (2) Skin/muscle fat removal (3) Markings not stated	
Ritland et al. (2004)[28]	Panel/expert Scarring	Comparison of haemorrhage and wound healing after radiosurgery or conventional surgery for dermatochalasis	(1) Prospective, split-face study: scalpel incisions on one side, radiosurgery on the other side (2) Orbicularis tissue was removed; no fat removal (3) Markings not stated	One masked colleague scored haemorrhage/oedema/discolouration and wound healing (Hollander score) 1 hour, 1, week, 3 months after surgery
Damasceno et al. (2011)[29]	Panel/expert	Comparison of the aesthetic outcomes of upper blepharoplasty with or without resection of the preseptal orbicularis oculi muscle	(1) Prospective, randomized, double-blind, split-face study: one side (group 1) had resection of only skin; the other side (group 2) had resection of skin and the same amount of preseptal orbicularis oculi muscle (2) Orbital fat was preserved in all cases (3) The mark was extended from a point above the lacrimal punctum to the lateral canthus; then, the mark was extended laterally and superiorly as far as the orbital rim	Three masked ophthalmic plastic specialists analysed aesthetic outcomes by VAS 7, 30, and 90 days after upper blepharoplasty
Scaccia et al. (1994)[11]	PROMs Panel/expert Scarring	Comparison of two closure techniques: running subcuticular 5–0 polypropylene and running skin suture 6–0 fast-absorbing catgut	(1) Prospective, double-blind study (2) Skin, muscle, and fat excision (3) Marking: elliptical	Clinical evaluation: infection, erythema, suture marks, milia, uneven scar, hypertrophic scar, dehiscence, final aesthetic result Postoperative discomfort scale 0–10 Photographic evaluation by surgeon and patient: which side best result on scale 0–10

Table 1 (*Continued*)

Author (year)	Aesthetic outcomes	Aim	(1) Study design (2) Surgical technique (3) Preoperative markings	Method of measured outcome(s)
Kouba et al. (2011)[14]	PROMs Panel/expert Scarring	To assess upper eyelid blepharoplasty scars in participants whose incision had been closed with 6–0 polypropylene sutures, 6–0 fast-absorbing gut sutures, or ECA	(1) Prospective, split-eyelid, single-blinded randomized study (2) Surgical technique not stated (3) Modified elliptical incision	Split-eyelid study of the short (1 month) and intermediate term (3 months) efficacy of polypropylene, fast-absorbing gut, and ECA Participant preference of closure technique and cosmetic evaluation (thickness, width, texture, colour change, overall cosmetic outcome) Blinded physician assessed cosmetic outcomes using photographs; scoring was performed on a 5-point scale from 1 (excellent wound healing, scar matches surrounding skin) to 5 (poor scar wound healing, does not match surrounding skin)
Prado et al. (2012)[32]	Eyebrow height	Assessing the occurrence of secondary brow ptosis after upper lid blepharoplasty	(1) Prospective study (2) Preseptal orbicularis skin and muscle were removed using a scalpel; the orbital septum was opened and the preaponeurotic fat was removed (3) Markings not stated	Pre-and postoperative photographs and angular measurements were used (lateral canthal angle of the brow, the most medial point of the brow, and the medial canthal angle and the lateral canthal angle of the lid as reference points)
Huijing et al. (2014)[33]	Eyebrow height	Evaluation of the direct effect of an upper eyelid blepharoplasty on the position of the eyebrows in a population with complaints of visual impairment	(1) Study design not stated (retrospective/ prospective) (2) Excessive skin was excised together with a 2-mm strip of orbicularis muscle after which the orbital septum was shrunk by electrocoagulation (3) Crease demarcation (7–9 mm above the upper eyelid margin centrally), medially from the level of the lacrimal punctum and laterally the extension depends on the presence of lateral hooding	Measurement of the position of the eyebrows at three positions for each eye (centre of pupil, lateral iris, and lateral canthus) using standardized photographs
Pool and van der Lei (2015)[34]	Eyebrow height	Evaluation of dermatochalasis, eyebrow position and (a)symmetry in both sides in patients before and after blepharoplasty	(1) Retrospective study (2) Bipolar coagulation assisted orbital (BICO) septoblepharoplasty; this consists of removing redundant skin and a very small rim of the preseptal orbicularis muscle; subsequently, bipolar coagulation of the septum is performed resulting in shrinkage of the septum and disappearance of the bulging fat compartments without removal of the fat (3) Crease demarcation (7–9 mm above upper eyelid margin centrally), medially from the level of the lacrimal punctum and laterally the extension depends on the presence of lateral hooding	Pre- and postoperative photographs were evaluated for (asymmetry in) degree of skin surplus (5-point grading scale), eyebrow height (distance between lower bound of eyebrow and centre of the pupil), and eyelid fissure height (distance between upper and low

Baker et al. (2016)[35]	Eyebrow height	Evaluation of internal suture browpexy, endoscopic Endotine browplasty, and to compare these techniques in patients undergoing simultaneous upper blepharoplasty	(1) Retrospective study (2) Removal of skin and orbicularis muscle (3) Markings not stated	Standardized photographs were used to measure pre- and postoperative brow position at three positions (central, medial, and lateral)			
Hassanpour and Kermani (2016)[36]	Eyebrow height	Analysis of the effect of upper blepharoplasty on eyebrow position	(1) Retrospective study (2) Skin excision (authors of this study also mention that all patients underwent 'traditional blepharoplasty') (3) Markings not stated	Pre- and postoperative digital photographs and measurement of the distance between the upper lid margin and the brow			
Starck et al. (1996)[37]	Eyebrow height Tarsal platform show	Description of a method for quantification of changes that occur after blepharoplasty	(NS)	Photographs were recorded and expressed as anthropometric ratios; anthropometric measurements consisted (amongst others) of medial brow height (inferior medial brow to endocanthion) and lateral brow height (inferior lateral brow measured vertically from exocanthion to endocanthion line at iris)			
Frankel and Kamer (1997)[38]	Eyebrow height	Evaluation of upper eyelid blepharoplasty causing eyebrow position to drop in a cosmetic surgery population	(1) Retrospective study (2) Excision of skin, a strip of orbicularis muscle, and fat when indicated (3) Markings not stated	Change in eyebrow height reflected as a percentage of the pretreatment height Measurements were based on standardized photographs; the measurements included the distance from the midpupil vertically to the inferior-most eyebrow hairs and from the inferior alar-labial groove to the medial canthus			
Dar et al. (2015)[39]	Eyebrow height	Evaluation of the effect of upper blepharoplasty on eyebrow height, accounting for ocular dominance, fat excision, change in MRD1, and degree of dermatochalasis	(1) Retrospective study (2) Excision of redundant skin, orbicularis muscle (leaving a small strip of orbicularis inferiorly), and fat when indicated (3) Markings not stated	Standardized photographs and digital measurement of medial canthus to inferior eyebrow cilia, centre of the pupil to the inferior eyebrow cilia, central upper eyelid margin to the corneal light reflex, and from the lowest point of dermatochalasis to the corneal light reflex			
Fagien (1992)[40]	Eyebrow height	Determination of significant brow ptosis occurring after removal of excessive upper eyelid skin in patients with brow ptosis	(1) Study design not stated (2) Excision of skin and orbicularis muscle; some patients underwent excision and contouring of the sub-brow fat; herniated orbital fat pads were excised when present (3) Horizontal elliptical markings	Measurements of MRD, margin to fold distance (MFD), eyebrow to lid margin distance (BLD), and eyebrow to skinfold distance			
Novaes de Figuerdo et al. (2016)[41]	Tarsal platform show	Evaluation of the efficacy of upper blepharoplasty with or without a technique (brassiere sutures) to increase tarsal platform show (TPS) and decrease brow fat span (BFS)	(1) Prospective, randomized study (2) Traditional upper blepharoplasty (removal of preseptal orbicularis muscle and skin; group A) versus orbicularis oculi muscle fixation to the periosteum (group B) (3) Marking not stated	Tarsal platform show (TPS) and brow fat span (BFS) measured at three anatomic landmarks; asymmetry calculated as the smaller subtracted from the larger value of TPS and BFS			
Author (year)	Number of (blepharoplasty-only) participants included	Mean age of participants (years)	Sex (% female)	Outcomes		Length of follow-up (months)	MINORS score

Table 1 (*Continued*)

Author (year)	Number of (blepharoplasty-only) participants included	Mean age of participants (years)	Sex (% female)	Outcomes	Length of follow-up (months)	MINORS score
Joshi et al. (2007)[19]	866	52	86%	There were significant differences between the groups with respect to the formation of milia, scarring, and persistent erythema ($P < 0.008$) Fast-absorbing gut suture with two interrupted Prolene sutures yielded the best results and lowest rates of complications Satisfaction (568 patients): 74% highly satisfied, 21% satisfied, 5% unsatisfied	3	16
van der Lei et al. (2007)[20]	296	53.7 (females) 56.0 (males)	84	Satisfied/very satisfied (data not shown)	9 weeks (72%), 24 months (28%)	8
Jaggi et al. (2009)[21]	28	NS	NS	No significant differences	>12	19
Thomas and Perez-Guisado (2012)[22]	50	53.6	84%	98% satisfied 2% unsatisfied and re-intervention needed	2	8
van Exsel (2016)[23]	116	53.6 in the arnica group 56.5 in the placebo group	76%	Patient satisfaction: Satisfaction with postoperative recovery was 9.1 (range 4.9–10) in the arnica study arm and 9.5 (range 7.1–10) in the placebo arm Satisfaction with the postoperative cosmetic outcome was high, scoring 9.3 (range 5.5–10) in the arnica arm and 9.3 in the placebo arm ($P = 0.872$)	1.5	24
Jacobsen et al. (2017)[13]	45	59.6	76%	The mean change in skin fold/MRD axis for the worst eyes was 1.43 mm in females and 2.09 mm in males ($P = 0.16$) Satisfaction with result: All subjects were satisfied with the postoperative result Surgeon evaluation: Two patients had a fair result and 34 had a good result	3	11
Saalabian et al. (2017)[24]	387	63.5	83.5	Aesthetic and scar-related aspects, recovery period, complication rates: no differences between tissue resection groups With more risk factors: longer recovery period, more complications, and worse scar ratings	NS	11
Raschke et al. (2011)[25]	31	57	100% female	Most patients highly satisfied (11 patients; 78.6%)	3	12
Bellinvia et al. (2013)[16]	100	NS	NS	Overall satisfaction: 83% very satisfied; 16% satisfied; 1 dissatisfied Visibility of scar: 92% insignificant; 8% modest; 0% marked	>36	8

LoPiccolo et al. (2013)[15]	10	56.9	70% female	Blinded physician evaluation failed to show a difference in the overall cosmetic appearance of the eyelids between the control and treatment sides at any time point Analysis of the composite of all patient scores showed a trend favouring the control side at 3 months ($P = 0.28$) and the treatment side at 17 months ($P = 0.50$), but neither difference was significant	17	20
Paixao et al. (2008)[26]	41	Median 53 ±9.3	100%	Quality of life with greater impact in the first postoperative week was related to physical appearance perception Satisfaction levels with the surgery were significantly related to the absence of undesirable effects ($P < 0.01$)	3	11
Baker et al. (2002)[27]	10	Range 46–61	80% female	No significant differences between groups	4	20
Ritland et al. (2004)[28]	13	65	69% female	Tendency of higher Hollander score at 1 week after radiosurgery; both good results at 3 months	3	19
Damasceno et al. (2011)[29]	15	56.7	100% female	1 week postoperative: Mean VAS score 4.6 group 1; 6.5 group 2 ($P = 0.01$) 1 month postoperative: Mean VAS score 6.7 group 1; 6.8 group 2 ($P = 0.09$) 3 months postoperative: Mean VAS score 7.9 group 1; 8.2 group 2 ($P = 0.20$)	3	22
Scaccia et al. (1994)[11]	20	NS	NS	Tendency that absorbable running suture has slightly superior aesthetic result, somewhat faster in wound closure, improvement in patient comfort Physician assessment showed a preference for the results obtained with the fast-absorbing suture: subjective ratings averaged 9.5, compared with 8.6 for the polypropylene suture; self-assessment by patients paralleled this result	Mean 3.5 (range 1–8)	19
Kouba et al. (2011)[14]	36	55.8 ± 5.4	97% female	At 1 month, ECA was superior to fast-absorbing gut (2.33 vs 2.83; $P = 0.03$) and had a marginally better outcome than polypropylene (2.33 vs 2.67; $P = 0.25$), and polypropylene had an equivalent outcome to fast-absorbing gut ($P = 0.46$) At the 3-month follow-up, ECA remained superior to fast-absorbing gut ($P = 0.03$)	3	20

Table 1 (*Continued*)

Author (year)	Number of (blepharoplasty-only) participants included	Mean age of participants (years)	Sex (% female)	Outcomes	Length of follow-up (months)	MINORS score
Prado et al. (2012)[32]	45	60.5 ± 8.8	82% female	Significant changes in all angular measurements obtained before and after upper blepharoplasty (in accordance with tendency of the brow to move down); alterations were most apparent in the lateral portion of the eyebrow	2–4	8
Huijing et al. (2014)[33]	140	55.1	90% female	Mean drop in eyebrow position for all patients at each point ranged from 0.35% to 1.23% In females, no significant drop of the eyebrows after surgery; in males, the distance from the centre of the pupil to the inferior border of the eyebrow of the left eye displayed a significant decrease in the eyebrow of 7% ($P = 0.005$)	2	10
Pool and van der Lei (2015)[34]	365	51.5	86.3% female	(1) Eyebrow height: Preoperative mean 15.8 mm for the right side and 15.9 mm for the left side Postoperative mean 15.2 mm for the right side and 15.1 mm for the left side On both sides, the eyebrow height was significantly lower postoperatively than preoperatively ($P = 0.000$) This applied to males and females (2) Degree of skin surplus: Skin surplus was significantly lower postoperatively vs. preoperatively ($P = 0.000$) Asymmetry in degree of skin surplus was present in 107 patient preoperatively vs. 52 postoperatively ($P = 0.000$)	2.5	8
Baker et al. (2016)[35]	30 (blepharoplasty only group)	67 (blepharoplasty only group)	63% female (blepharoplasty only group)	Significant brow descent at all three brow positions (mean −1.7 mm, $P \leq 0.04$)	4.1–5.2	12
Hassanpour and Kermani (2016)[36]	70	49.7	83% female	The postoperative brow position was unchanged in 46 cases (65.8%) and brow depression was noted in 24 cases (34.2%) The measurements after blepharoplasty showed significant differences from those before surgery Changes were more significant in the lateral portion of the eyebrow and they occurred bilaterally (*P*-values not stated)	6	8

Starck et al. (1996)[37]	15	54	100% female	TPS was doubled postoperatively ($P < 0.05$), and upper iris coverage decreased (−6%; $P < 0.05$) postoperatively. Medial and lateral brow heights were not significantly affected by upper blepharoplasty surgery	6	9
Frankel and Kamer (1997)[38]	40 in the treatment group (subgroup) and 28 in the control group)	45.5 in the treatment group	90% female	The mean drop in eyebrow position for the treatment group was 7.69% and for the control group was 7.80% ($P = 0.08$); no statistically significant difference between the two groups	9–40	16
Dar et al. (2015)[39]	19	73.2	53% female	No significant changes in eyebrow height at all positions Multivariable comparison found insufficient evidence to suggest MRD1, ocular dominance, or dermatochalasis were significantly associated with mean percentage change in brow height at all positions with or without fat excision	>1.5	7
Fagien (1992)[40]	15	62	Not stated	11 (of 15) patients had a change in their eyebrow position (average of 1 mm) after surgery; two patients had a mild descent of the eyebrow (average ≤2 mm); two patients were felt to have significant induction of eyebrow ptosis (average ≤3 mm)	6–24	5
Novaes de Figuerdo et al. (2016)[41]	50 (28 group A, 22 group B)	Group A: 60.7 Group B: 55.0	100% female	Preoperative and postoperative evaluation: Significant increase in TPS and decrease in BFS in both groups ($P < 0.05$) No significant differences between the groups in TPS, BFS, and TPS/BFS ratio ($P > 0.05$) No significant asymmetries ($P > 0.05$)	8.9 months	21

compared to the skin–muscle side at 1 week postoperative, but not at 1 month or 3 months postoperative.

Baker et al.[27] compared upper blepharoplasty performed with a free beam CO_2 laser or with a diamond laser scalpel to make surgical incisions and found no significant difference between the groups regarding wound or scar appearance. Skin, orbicularis muscle, and fat were removed in their patients. Also, Ritland et al.[28] compared the use of a scalpel and an electrosurgical instrument when removing skin and orbicularis muscle (fat was preserved). At 3 months, there was no significant difference in Hollander wound score, which assesses step-off borders, contour irregularities, margin separation, edge inversion, excessive distortion, and overall scar appearance[30].

Thus, expert evaluation found no apparent influence on the aesthetic outcome for the depth of the resected tissue (skin/muscle/fat) or the use of different surgical instruments to make the skin incision.

Scarring

The amount of visible scarring is vital for the aesthetic outcome after upper blepharoplasty. The optimal scar is invisible. There are various ways of assessing scar aspects such as pigmentation, vascularity, irregularities, and length and width, either self-reported or as assessed by experts or a panel. Six studies evaluated scarring after blepharoplasty, three of which considered different suture materials.

Scaccia et al.[11] removed the skin after elliptical surgical markings, orbicularis muscle, and fat. On a scale from 1 to 10 (10 being excellent results), the physician's subjective ratings after 3 months averaged 9.5 for the running 6–0 fast-absorbing catgut suture, compared to 8.6 for the running 5–0 polypropylene suture[11]. The patients' self-assessments paralleled this result[11]. In contrast to this, Jaggi et al.[21] reported no differences in patient-reported scar visibility when using absorbable or non-absorbable sutures.

In another study[14], participants and a blinded physician rated scars and the overall cosmetic outcome on a five-point scale (0 being excellent wound healing, scar matches surrounding skin) after using different suture materials. It was mentioned that only a modified elliptical marking was used. Tissue adhesive (ethyl cyanoacrylate, ECA) had a superior cosmetic outcome after 1 month compared to 6–0 fast-absorbing gut ($P = 0.03$), but there were no significant differences when comparisons were made with 6–0 polypropylene. The

mean score decreased at 3 months postoperative as the scars became less visible. Participant and physician ratings for the overall cosmetic outcome were the same for the different suture materials used. The participants were also asked to evaluate the scar outcome according to five categories: thickness, width, texture, colour change, and overall cosmetic outcome. The most significant differences here were that ECA was preferred over fast-absorbing gut suture in each of the following categories: scar thickness at 1 month ($P = 0.04$) and 3 months ($P = 0.03$), erythema at 1 month ($P = 0.03$), and composite score (sum of scores for thickness, width, texture, colour change) at 1 month ($P = 0.03$) and 3 months ($P < 0.001$). Scar texture did not differ between the groups[14].

Saalabian et al.[24] compared aesthetic and scar-related aspects between the tissue resection categories (skin and/or muscle and/or fat) and found no differences. Ritland et al.[28] used the Hollander wound score and found good results after 3 months (skin and muscle removal). Furthermore, the visibility of the scar in the study by Bellinvia et al.[16] was classed as insignificant by 92% of the respondents after 8 months of follow-up, despite the extension of the excision beyond the lateral orbital rim (removal of skin with or without fat).

In summary, the amount of scarring after upper blepharoplasty appears to be acceptable. However, data were conflicting or missing regarding suture material, suture technique (e.g., running, intradermal, or solitary), the shape of the surgical markings, whether the surgical marking was beyond the lateral orbital rim or not, and as to which blepharoplasty technique should be used to achieve the least amount of visible scarring. Interestingly, no study mentioned whether any measures should be taken to minimize wound tension and/or enhance wound healing. Also, scar maturation can take more than 1 year[31], so it would be advisable to have at least 1 year of follow-up when assessing scar aesthetics.

Eyebrow height

Decreased eyebrow height and dermatochalasis are the two main causes of lateral hooding, i.e. the excess skin lateral to the eyelid. Consequently, pre- and post-blepharoplasty aesthetics are affected by both the amount of excess skin and the possible change in position of the eyebrow. Therefore, the peri-orbital region with eye and eyebrow is considered as one aesthetic unit.

Nine studies assessed the occurrence of secondary brow ptosis after upper blepharoplasty. They all reported some lowering of the eyebrow after blepharoplasty, which was significant in five studies (a total of 650 participants)[32–36]. Four studies (a total of 89 participants) either mentioned insignificant results for eyebrow height[37–39] or did not mention any significance levels[40]. No study reported elevation of the eyebrow after upper blepharoplasty.

The duration of follow-up varied widely between the included studies (from 1.5 to 40 months). Most of the studies performed an upper blepharoplasty that consisted of skin excision and at least removal of the orbicularis muscle. Only Starck et al.[37] did not mention their surgical technique. All studies used standardized pre- and postoperative photographs to evaluate eyebrow height, except for Fagien et al.[40], who did not specify their method. However, most of these studies failed to provide a detailed description of how the standardized photographs were taken. Only Prado et al.[32] and Dar et al.[39] described their standardization, which were ''primary, maximally relaxed, standard fashion'' and ''primary position of the eye'', respectively.

When an eyebrow descent was measured, this was observed for the whole eyebrow[34,35], for the middle portion in males[33], and as most pronounced in the lateral part of the eyebrow[32,36]. The four other studies did not report a significant effect on eyebrow descent after upper blepharoplasty[37–40].

In summary, the eyebrows tend to move down after blepharoplasty, although the extent and the influence on the aesthetic outcome require further elucidation.

Tarsal platform show (TPS)

Masking of the tarsal platform, also known as the 'eyeshadow space', may be considered an undesirable trait. The tarsal platform can be masked by dermatochalasis and/or brow ptosis. Therefore, the distance between the upper eyelid and the crease (TPS or upper lid sulcus height) and the area between the sulcus and eyebrow (brow fat span, BFS) affect the aesthetic outcome after upper blepharoplasty. Novaes de Figuerdo et al.[41] showed an increase in TPS and a decrease in BFS, after the traditional blepharoplasty technique (removal of preseptal orbicularis muscle and skin), without asymmetry. This was similar across the three measured regions: the centre of the pupil region, lateral corneal limbus region, and at the eyelid lateral canthus. Starck et al.[37] evaluated the anthropometric measurements and found that the TPS was doubled postoperatively ($P < 0.05$), and that upper iris coverage had decreased slightly postoperatively (-6%; $P < 0.05$). The blepharoplasty technique was not stated.

In summary, the amount of visible eyelid skin/tarsal show increases after blepharoplasty.

Conclusions

In conclusion, patients are generally satisfied with the overall aesthetic result and scar formation after upper blepharoplasty. This procedure results in an increase in the tarsal platform show, which positively affects aesthetics. The eyebrow seems to move downwards after upper blepharoplasty, which may or may not affect the aesthetics negatively. The technique used (skin or additional muscle resection) does not influence patient satisfaction, or aesthetic outcomes. The optimal design of the skin excision continues to be a matter of debate, especially when addressing lateral hooding.

Discussion

The purpose of this systematic review was to gain a better understanding of the aesthetic results after upper blepharoplasty and to determine which surgical technique is preferable. It appears that patients are generally satisfied with the overall aesthetic results after any surgical upper blepharoplasty technique. However, these results should be interpreted with care because of the possible presence of publication bias and also because of the poor quality of some of the studies. Since blepharoplasties are performed to give a pleasing aesthetic result, it is possible that only positive results are published and negative results may not be.

Also, not all studies mentioned whether all consecutive patients were included and several studies were retrospective. Another potential bias is the fact that not all studies were executed in a double-blind, or even single-blind manner, which is especially important when evaluating aesthetic results.

It is difficult to measure aesthetic results objectively. Beauty is in the eye of the beholder and therefore the definition of a beautiful eye varies, but it is generally agreed that youthfulness correlates with attractiveness. In other words, an eye is considered to be 'attractive' when it has

typical youthful features instead of aging ones[3]. A beautiful, youthful eye is described as full and convex[7,8,42–50]. Conversely, an aging eye appears hollower, due to volume loss and fat atrophy. Therefore, a trend is noted in blepharoplasty surgery towards a more conservative treatment of only removing excess skin[16], presumably preventing the hollowing of the eye with aging.

Histological studies have revealed that changes in the aging upper eyelid occur primarily in the skin and subcutaneous layers, with characteristic loss of collagen elastic fibres, while the whole muscle layer remains histologically intact, with no signs of aging[51]. Therefore, preserving the orbicularis muscle during upper blepharoplasty, to supposedly maintain a fuller and more youthful upper eyelid, is postulated to be a wise approach[16]. Based on the results of the present systematic review, the technique used (skin only or additional muscle resection) does not influence aesthetic outcomes. Therefore, it seems rational to perform the least invasive method (skin only).

The eyebrows are also an important part of the periorbital aesthetic unit. Although it is not entirely clear what happens with the eyebrows during aging, it seems that they tend to descend as the years pass[3,52]. The lateral end of the eyebrow drops in older people due to progressive loss of collagen fibre elasticity, changes in the orbital rim contour, and lipoatrophy[3,52], creating lateral hooding and limiting tarsal show. The temporal part of the eyebrows descends more and earlier than the more central parts[52]. Ko et al.[52] state that the lack of deep tissue support and lack of suspension from the frontalis muscle are more pronounced in the lateral part of the eyebrow, but this may not apply to men[53].

Regarding attractiveness, the more homogeneous and even the tarsal show, the more attractive the eye[3]. This often means addressing the lateral hooding. Some authors state that skin resection should not extend beyond the lateral orbital rim, because the scar will not be hidden within a natural skin fold[12]. The lateral hooding may then be corrected by an eyebrow or forehead lift, but this is not always necessary or wanted. Friedland et al.[54] and Bellinvia et al.[16] proposed a technique that includes extending the upper incision further laterally and upwards, towards the tail of the eyebrow. However, Beraka et al.[55] wrote a response commenting on this method.

The studies included in this systematic review reported a variety of excision shapes, if mentioned at all. Therefore, it remains uncertain as to which shape of skin excision should be used for which indications.

Patient consent

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Competing interests

None.

Appendix A. Supplementary data

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