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REVIEW OCULOPLASTIC

Is Orbicularis Oculi Muscle Resection Necessary in Upper Blepharoplasty? A Systematic Review

Osama A. Samargandi[1,2] · Neetin Prabhu[3] · Colton Boudreau[3] · Jason Williams[1]

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Abstract

Background Our objective is to evaluate the evidence on the aesthetic effect and complications of skin-OOM strip resection compared to skin only upper blepharoplasty.

Methods A systematic search of EMBASE, PubMed, Cochrane and Google Scholar databases was performed using our search strategy through to 31 December 2019. Only comparative studies of the two upper blepharoplasty techniques were included. Three reviewers performed study selection process, data extraction, and quality assessment.

Results A total of six articles were eligible for final inclusion. The included studies consist of two controlled retrospective cohorts and four small randomized controlled studies (RCT). Three of which, were double blinded. Those RCTs were assigned level 2 evidence due to small size and methodological limitations. The sample size of included was studies 407 in the two retrospective studies and 57 in the four RCTs. The outcomes showed that resection of OOM along with skin in upper blepharoplasty showed no difference in long-term aesthetic outcome when skin only procedure is performed. Muscle strip resection was associated with initially higher ophthalmological morbidity (edema, bruising, pain, dry eye, sluggish eye closure and lagopthalmos). Those resolved a few weeks later with conservative treatment.

Conclusion The resection of OOM along with skin in upper blepharoplasty showed no difference in long-term aesthetic outcome and was associated with initially higher ophthalmological morbidity compared to skin only procedure. While we are not suggesting that OOM resection is never required, the evidence strongly support its preservation during standard upper blepharoplasty.

Level of Evidence III This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords · Orbicularis oculi muscle · Skin · Upper blepharoplasty · Oculoplastic · Blepharoplasty

Background

The eyelid is regarded as one of the most important areas in the observed perceived aesthetics of the face [1]. The most common surgical approach to rejuvenate the upper eyelid is upper blepharoplasty [2–4]. Several surgical techniques have been described and utilized among surgeons. The popularity of these techniques widely depends on the experience and personal preference of the surgeon. Strip resection of the orbicularis oculi muscle (OOM) along with skin excision is a common approach and thought to help to better define the supratarsal fold [2–8]. The actual benefit of resecting of the OOM in standard blepharoplasty has been questioned in several studies [9–11]. In fact, a significant concern about strip resection of OOM is the addition of more morbidity to the patient's recovery period

✉ Osama A. Samargandi
Osamargandi@dal.ca

1 Division of Plastic Surgery, Faculty of Medicine, Dalhousie University, Room 4447, Halifax Infirmary, 4th Floor, Plastic Surgery, 1796 Summer Street, Halifax, NS B3H 3A7, Canada

2 Division of Plastic Surgery, Department of Surgery, King Abdulaziz University, Jeddah, Saudi Arabia

3 Faculty of Medicine, Dalhousie University, Halifax, NS, Canada

with potentially equivalent aesthetic outcome [11]. Therefore, the objective of this systematic review is to evaluate and amalgamate the evidence for the aesthetic effect and complications of skin-OOM strip resection compared to skin only excision upper blepharoplasty.

Methods

Eligibility Criteria

The population of interest in our studies were adult patients undergoing upper eyelid blepharoplasty for cosmetic reasons. The main intervention was skin only upper blepharoplasty and the comparative intervention was skin-OOM upper blepharoplasty. The outcome of interest included final aesthetic outcome and relevant postoperative complications. Studies of interest included all comparative studies published in English language. We excluded all non-comparative studies and non-English studies.

Search Strategy

The collection of data was performed using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) process [12]. A computerized search of EMBASE, PubMed, Cochrane and Google Scholar databases was performed using our search strategy through to 31 December 2019. Our search strategy utilized the following operating terms: ("upper eyelid blepharoplasty" or "upper blepharoplasty" or "eyelid surgery") and ("orbicularis oculi" or "cosmetic" or "lagophthalmos" or "dermatochalasis" or "aesthetic surgery" or "strip" or "plastic surgery" or "muscle-sparing" or "skin-only").

To be considered for inclusion, the topic of comparing skin only resection to orbicularis oculi muscle resection during blepharoplasty was required. The following criteria were used for exclusion: commentaries, opinion pieces, animal studies, case reports, studies not specific to plastic surgery. Cross bibliography was performed manually on all included studies which met inclusion criteria for full capture. The initial screen involved study title and abstract; studies in the title and abstract screen which met inclusion or required more information were pulled for full study review. Any disagreements in study inclusion were discussed between the authors to achieve consistency.

Assessment of Quality

Each study was assessed for methodological quality using one of three validated scoring methods. The methodological index for non-randomized studies (MINORS) was used for non-randomized and observation studies. MINORS utilizes a 12-item validated assessment to investigate the methodological quality of the non-randomized studies either controlled or non-controlled [13]. Each factor assessed is given a score out of two, with a total potential score of 16 in non-comparative studies and 24 in comparative studies. Any score below 16 for comparative studies or below 10 for non-comparative is regarded as low quality [13]. All randomized controlled trials (RCTs) were assessed using the Cochrane instrument to evaluate seven domains of methodological quality. The Cochrane tool is not a numerical scale, but rather assesses potential biases prevalent in the study [14]. To assess systematic reviews with randomized or non-randomized primary studies, the AMSTAR 2 instrument was utilized [15]. The AMSTAR 2 does not provide an overall numerical scale, but instead creates an overall rating (critically low, low, moderate and high). To achieve a high rating, the study would have had zero or one non-critical weakness, a moderate rated study would involve one non-critical weakness, a low rated study had one critical with or without a non-critical weakness, and critically low study includes more than one critical flaw with or without any non-critical weaknesses [15].

Data Extraction

Variables extracted from each study that met inclusion were as follows: year of study, country of origin, published journal, number of study authors, sample size of the study, mean patient age, age range of study, name of intervention, comparative intervention, funding source (non-peer reviewed grant, governmental grant, charity funding, internally funded, none), study design, follow-up time (months), outcomes expected, results. The level of evidence of the study was also recorded (I-high-quality, multicentre or single centre, randomized controlled trials with adequate power, or systematic review of these studies; II-lesser-quality, randomized controlled trials, prospective cohort or comparative study or systematic review of these studies; III-retrospective cohort or comparative study, case-control study or systematic review of these studies; IV-case series with pre/post-test or only post-test results; V-expert opinion developed via consensus process, case report or clinical example or evidence-based physiology) [16]. Data extraction was performed by three reviewers (N.P., C.B. and O.S.) using an Excel (Microsoft Corp., Redmond, Washington) spreadsheet.

Analysis of Heterogeneity

All studies were assessed for significant clinical heterogeneity. The clinical heterogeneity of a study is related to differences within the studied population that relate to, but not inclusive of, the study setting, outcome timing and

intervention and/or participant characteristics [13, 14, 16]. If significant clinical heterogeneity is present in the studies, then this is taken into consideration when drawing conclusions and the determination of if meta-analysis can be acceptably performed [13, 14].

Results

Study Selection

Data bases search identified 1483 articles. After screening the titles and abstracts of the initial literature search, 33 articles were selected for full-text read. Figure 1 illustrates the flow diagram of the search strategy. After full text read, 27 articles were excluded for not satisfying the study question, leaving six articles eligible for final inclusion. The included studies consist of two controlled retrospective cohorts and four randomized controlled studies (RCT). Three of which were double blinded.

Study Characteristics

Characteristics of the included studies and their patient populations are shown in Table 1. Publication dates ranged from 2011 to 2018. The pooled sample size of all the studies is 464 patients. Of these, 407 in the two retrospective studies and 57 in the four RCTs. The included RCTs randomized each eye for either skin only blepharoplasty or skin and OOM resection blepharoplasty. The most common reported outcome was aesthetics results (five studies), followed by dry eye/irritation (three studies).

Quality of Evidence

Two of the included studies were of level III evidence (33.3 percent), while the rest of the included of studies included were of level II evidence (66.6 percent) (Table 1). The Cochrane instrument assessments for RCTs showed the results in Table 2. All four of the RCTs included in this study had at least one domain considered to be at high risk of bias. These RCTs included a sample size ranged from [10–22] patients and compared both eyes in each patient. There was no sample size calculation in any of the included RCTs. In addition, no allocation concealment was

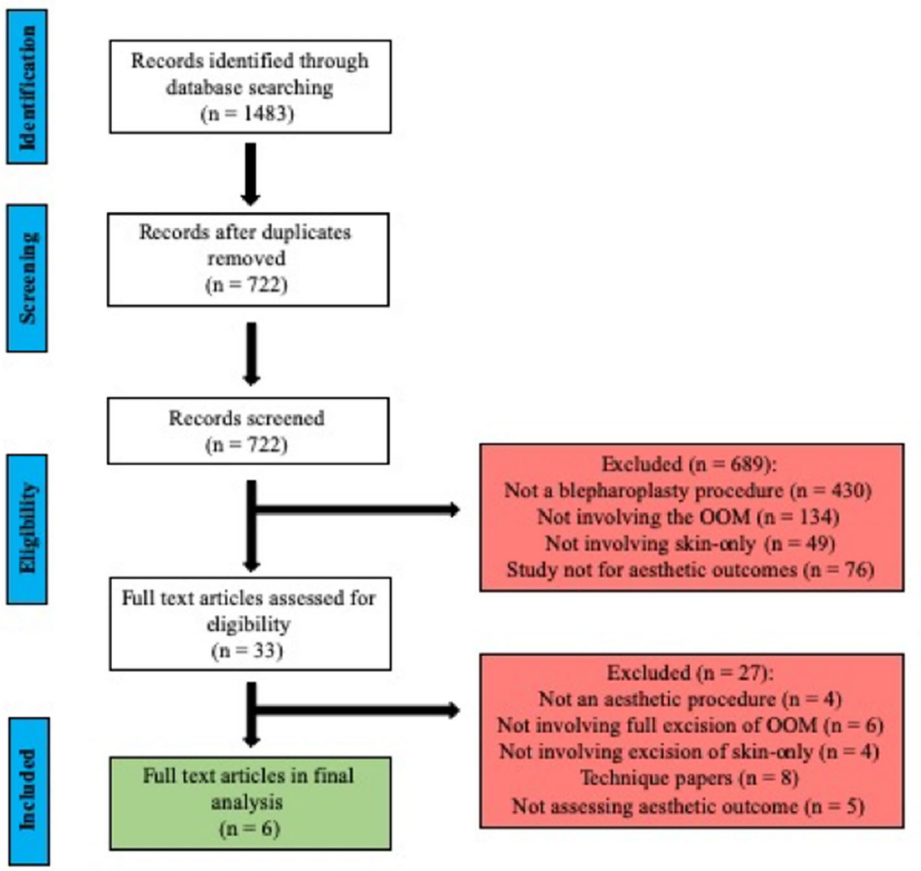

Fig. 1 Flow diagram illustrating the search strategy to identify eligible studies (*N*=6)

Table 1 Study population characteristics

Study	Sample Size, n	Skin Only vs. OOM resection	Design (LOE)	Follow up (weeks)	Outcome reported									
					Edema	Bruising	Hematoma	Pain	Aesthetic	Patient satisfaction	Dry eye/ irritation	Scar	Lagophthalmos	Return to public/work
Damasceno[11]	15	30 Eyes randomized	RCT [2]	1, 2, 3	Y	N	Y	Y	Y	N	N	N	N	N
Kiang[19]	22	44 Eyes randomized	RCT [2]	1, 2, 6, 24	N	N	N	N	Y	Y	Y	N	Y	N
LoPiccolo[18]	10	20 Eyes randomized	RCT [2]	4, 12, 73	N	Y	N	N	Y	N	N	N	N	N
Van Meer[17]	10	20 Eyes randomized	RCT [2]	6	N	N	N	N	N	N	N	N	N	N
Mohommed[20]	20	12 VS 8	Retrospective [3]	1, 4	N	N	N	N	N	Y	Y	Y	N	Y
Saalabien[21]	387	95 vs 61	Retrospective Controlled [3]	Retrospective	Y	N	N	Y	Y	N	Y	N	N	N

LOE, Level of Evidence; *OOM*, Orbicularis Oculi Muscle; *RCT*, Randomized Controlled Trial; *TFBUT*, Tear film break up time; *Y*, yes; *N*, no

Table 2 Cochrane instrument assessment for all randomized controlled trials (*N*=4)

Study	Random sequence generation	Allocation concealment	Blinding participants and personnel	Blinding outcome assessment	Attrition bias	Reporting bias
Damasceno[11]	Low	High	Low	Low	Low	Unclear
Kiang[19]	Unclear	High	High	Low	High	High
LoPiccolo[18]	Unclear	High	Low	Low	High	Low
Van Meer[17]	Unclear	High	High	Low	Low	High

implemented in those RCTs. However, all of the outcome evaluators were blinded. The two observational controlled studies (level III) were assessed with the MINORS instrument were comparative studies and had a mean score of 22.5 (range 21–24) with all considered to be of high methodological quality (Table 3).

Analysis of Studies Heterogeneity

We identified significant differences between the studied outcome measurement and follow-up assessment which eventually made performing meta-analysis not feasible.

Outcome

Postoperative Edema, Hematoma, Bruising and Pain

Damasceno et al. [11] evaluated postoperative edema, hematoma and pain in 7, 13 and 19 days. These were scored symptoms as either normal, mild, moderate and severe. The authors found that OOM resection group scores were worse than the skin only resection blepharoplasty in the 1st week mark. Nevertheless, no difference observed in the 2nd and 3rd week. Van Meer et al. [17] concluded in their controlled study that omitting the incision of orbicularis oculi muscle limited the reside of bleeding and swelling. Table 4 summarizes all postoperative complication outcomes.

Eyelid Scar

In the LoPiccolo et al. [18] study, the participants scored their scar thickness, width, color, texture and overall lid appearance using a 5 point Likert scale (excellent to poor). They found no significant difference between the skin only resection blepharoplasty and skin-OOM resection group at 1, 3 and 17 months follow-up (Table 4).

Dry Eye and Irritation

In an RCT involving 22 patients, Kiang et al. [19] found that seven (vs 0) patients reported varying degrees of dry eyes symptoms in eyes that underwent skin-OOM resection. These symptoms include tearing, foreign body

Table 3 MINORS instrument assessment for all non-randomized studies (*N*=2)

Items	*Study*	
	Mohammed	Saalabien
A clearly stated aim	2	2
Inclusion of consecutive patients	2	2
Prospective collection of data	2	2
Endpoints appropriate to the aim of the study	1	2
Unbiased assessment of the study endpoint	1	2
Follow-up period appropriate to the aim of the study	2	2
Loss to follow-up less than 5%	2	2
Prospective calculation of the study size	2	2
An adequate control group	2	2
Contemporary groups	2	2
Baseline equivalence of groups	2	2
Adequate statistical analyses	2	1
Total score	21	24

Items are scored 0 (not reported), 1 (reported but inadequate) or 2 (reported and adequate)

Table 4 Complication outcome assessments

Outcome	Outcome measurement	Results	Evidence
Edema	4 points Likert scale (normal, nile, moderate, severe)	Week 1: worse edema in skin-OOM resection week 2 and 3: no difference observed	2
Hematoma/ Bruising	4 points Likert scale (normal, nile, moderate, severe)	Week 1: worse edema in skin-OOM resection week 2 and 3: no difference observed	2
Pain	4 points Likert scale (normal, nile, moderate, severe)	Week 1: worse edema in skin-OOM resection week 2 and 3: no difference observed	2
Eyelid scar	5 points Likert scale (excellent to poor)	Month 1, 3 and 17: no difference observed	2
Dry Eye/ irritation	Presence of dry eye symptoms postoperatively	Skin-OOM resection: 7/22 Skin only resection: 0/22	2
	Tear film break up time (TFBUT)	Significant difference in postoperative levels in skin-OOM resection group (vs preoperative). Levels improved overtime	3
Sluggish eyelid closure	Patients asked to close their eyes or blink normally	Significant number of sluggish eye closure among skin-OOM (7/22)	2
Lagophthalmos	Measured in millimeters	Significant number of lagophthalmos (< 3 mm) among skin-OOM (5/22)	2

sensation and irritation. These symptoms were associated with lagophthalmos or sluggish eyelid closure in five patients. Mohammed et al. [20] conducted a retrospective controlled study including 20 patients (eight patients with skin-OOM excision vs 12 patients with skin only excision). They assessed the impact of OOM excision on the tear film break up time (TFBUT) and postoperative dry eye symptoms. The result of the study revealed a statistically significant decrease in postoperative TFBUT mean values in skin-OOM excision compared to preoperative levels (11 vs 9.7). They also reported that this decrease was only temporary. On the other hand, there was no statistical difference in pre and postoperative TFBUT mean levels in skin only excision group. In addition, dry eye symptoms were more prevalent in skin-OOM excision group (50%) vs skin only excision (17%). The former showed more severe degree of symptoms. Similar to TFBUT values, these symptoms were also temporary and resolved with conservative treatment and time. Table 4 summarizes all postoperative complication outcomes.

Sluggish Eyelid Closure and Lagophthalmos

Kiang et al. [19] found in their RCT (22 patients) that after 1 week post-operatively, there was a statistically significant increase in the incidence of sluggish eyelid closure with skin-OOM resection group compared to skin only resection group (seven vs zero; p-value <0.05). This was evaluated by asking patients to close their eyes as though sleeping or by having patients blink normally. Of these seven patients, four exhibited lagophthalmos and five reported dry eye symptoms simultaneously. Lagophthalmos (<3mm) was found in five patients with skin-OOM resection and measured in millimeters in extreme downward gaze. The risk of lagophthalmos was found to appear in those who undergone at least 13mm orbicularis oculi strip resection. They were found to resolve following 2–6 weeks. Table 4 summarizes all postoperative complication outcomes.

Aesthetic Outcome

In the RCT conducted by Damasceno et al. [11], three masked assessors evaluated the aesthetic outcome using the visual analog scale, from 0 (worst result) to 10 (best result). They found that initially (one week) the skin only resection blepharoplasty showed better aesthetic results than skin-OOM resection group (6.6 vs 4.6; p-value 0.01). However, after one month, there was no noticeable difference in the aesthetic outcome. In another RCT, LoPiccolo et al. [18] failed to identify any significant difference in the overall aesthetic appearance when two blinded physicians assessed the outcome using a 5 point Likert scale (excellent to poor) at 1, 3 and 17 months follow-up. Kiang et al. [19] presented the aesthetic outcome in their RCT which were scored by blinded expert panel and participants themselves via survey. The evaluating three surgeons were blinded to the type of techniques between the two eyes within the same patients. They scored each patients' result as "good and comparable," "good but not comparable" and "poor on one or both sides." Eighteen out of 22 (82%) were rated as "good and comparable." In addition, there was no statistical significance in the aesthetic outcome between the two techniques. Only 19 patients responded to their survey. Of them, 15 patients rated the outcome as "comparable" for both sides. In a retrospective review, Saalabian et al. [21]

evaluated patients' satisfaction of their postoperative upper eyelid appearance following upper blepharoplasty with or without muscle resection via a questionnaire. They used a 5 point Likert scale from excellent [1] to insufficient [5]. Overall, there was no statistical difference in satisfaction, aesthetics appearance and return to work scoring between skin-OOM resection groups and skin only resection group. The aesthetic outcome assessment is summarized in Table 5.

Discussion

This is the first evidence-based systematic review to qualitatively assess the outcome between skin only upper blepharoplasty compared with skin-OOM upper blepharoplasty. Since the Hoorntje et al. [10] narrative review which was published a decade ago, several high quality controlled studies have been published. In addition to the two controlled observational studies, a total of four small RCTs were included in our study. These RCTs conducted a left-right comparison trials within single patients (one eyelid with OOM excision and the other without). In addition, the outcome of these RCT was assessed with blinded assessors. This design is considered ideal to judge whether or not resecting the OOM would actually make a difference in final aesthetic outcome as well as evaluate the potential complication that could occur as consequence to that. The included RCTs were not immune from their own issues such as small sample size, lack of power analysis, unclear randomization and concealment process. However, we believe that together those RCTs along with the controlled observational studies can address the questionable role of OOM resection in standard upper blepharoplasty and provide concise evidence to guide clinical practice.

The practice of OOM resection stemmed from several described advantages [10]. Those include the desire to create a crisp, defined supratarsal crease [10], to debulk and create less heavy upper eyelid postoperatively [2, 5], to diminish extra load on levator aponeurosis and possibly improve ptosis [22], avoid tenting of upper eyelid from excess OOM [23], and to correct lateral hooding which is thought to be commonly associated with hypertrophic OOM [24]. Moreover, Furnas et al, believed that excising a small strip of OOM would facilitate exposure of post-septal fat compartment and the levator aponeurosis [25]. On the other hand, preserving OOM has been supported in the literature mainly to prevent lacrimal pump insufficiency [26] and enhance the upper eyelid fullness which is paramount to achieve youthful aesthetic results [27]. The latter can be achieved with either leaving the OOM untouched or imbricating the muscle to enhance fullness.

In our systematic review, several drawbacks have been associated with resecting OOM during upper blepharoplasty. Although resecting a strip of OOM can facilitate the exposure of the septum and post septal fat compartments, there is an additional risk of injury to the levator aponeurosis which will potentially result in ptosis [18]. In addition, this step can also leave a hollowed, sculpted appearance which is not aesthetically ideal in selected patients [18]. Overall, all of the included studies found no significant difference in final aesthetic outcome using different measuring outcome tools with follow-up ranged from one week to 17 months [11, 18, 19, 21]. In fact, in the first visit after one week, the side that underwent OOM resection showed worse aesthetic outcome [11]. This can be attributed to the significant high rate of edema, bruising,

Table 5 Aesthetic outcome assessments

Study	Outcome measurement used	Evaluator	Blinded evaluator	Results	Evidence
Damascano[11]	VAS (0-10), 10 = best	3 Physicians	Yes	1 week postoperative: Skin only resection showed better aesthetic results (6.6 vs 4.6; *p*-value 0.01)4 weeks: no difference observed	2
LoPiccolo[18]	5 Points Likert scale (excellent to poor)	2 Physicians	Yes	1, 4, 17 months: No difference observed	2
Kiang[19]	3 Points Scale (good/ comparable, Good but not comparable, Poor)	3 Physicians	Yes	Both techniques were evaluated as "Good and comparable" in 18/22 (82%)	2
	3 Points Scale (good/ comparable, Good but not comparable, Poor) via questionnaire	Patients themselves	No	About 15/19 rated the results as "Comparable"	2
Saalabian[21]	5 Point Likert scale (excellent to insufficient) via questionnaire	Patient themselves	No	No difference in satisfaction with aesthetic appearance between the two techniques (1.60 vs 1.52; *p*-value 0.47)	3

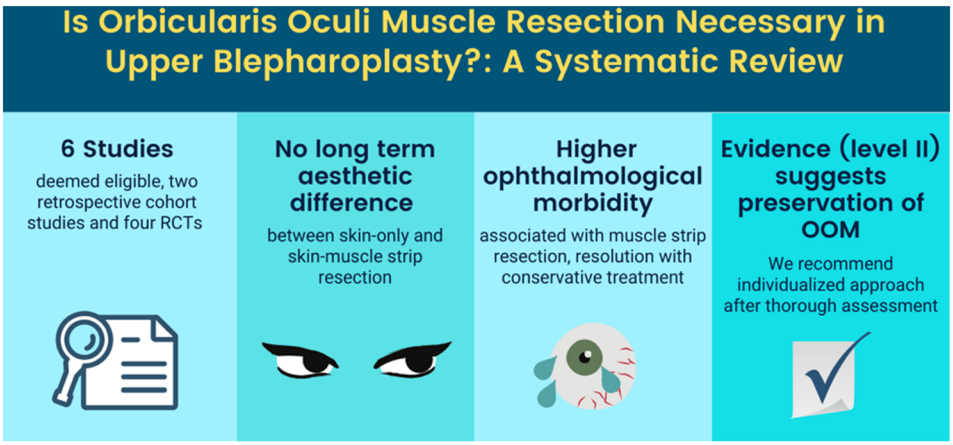

Fig. 2 A visual abstract of the study results. OOM, orbicularis oculi muscle; RCT, randomized controlled trial

and pain among the side that underwent OOM resection in the first week [11, 21]. These symptoms were found to occur not only from excising OOM strip but also from only interrupting the muscle by an incision to access the septum [21]. Nevertheless, those symptoms have resolved spontaneously in later follow-ups.

We also found in this review, that resecting OOM strip can result in temporary but significant ophthalmological complications despite the lack of difference in aesthetic outcome. These complications include dry eye, irritation sensation, sluggish eye closure, and lagophthalmos [19, 20]. If not treated, these can leave the eyes vulnerable to scratches, corneal ulceration, and keratopathy. Adequate lubrication and temporary eye patches are sufficient to treat these symptoms and they should resolve in the following two to six weeks. The width of the OOM strip and older age was found to be associated with these complications. A strip wider than 9mm is associated with dry eye and irritation and at least 11mm strip is needed to cause sluggish eye closure and lagophthalmos [19].

Resection of a narrow strip from the OOM can be indicated in certain selected cases. To define the supratarsal crease in patients who lack this structure, only a 2–3 mm strip is required to achieve that goal [26, 28]. In addition, accessing the post septal fat compartments for resection or relocation and the levator aponeurosis for true ptosis repair. This can be achieved by only incising the muscle or resecting a narrow strip [10].

Our systematic review has several limitations. The limitations of the included original studies are the main limitation of this systematic review. These include the lack of sample size calculation and small sample size in the included RCTs. This limitation can result in type 2 error (false negative) from the lack of power. In addition, there was no allocation concealment in these RCTs where the surgeon was aware of the side with muscle resection. This may have influenced the validity of the results. The design of those RCTs seemed to be a superiority trial design although it was not mentioned in the method section. Ideally, a non-inferiority or an equivalent design should be considered for the study hypothesis. There was no trial protocol registration for those RCTs. This is necessary for a clear transparent reporting and avoidance of post-hoc analysis. The lack of use of a standardized measurement outcome by these RCTs can undermine the quality of the presented results. Unfortunately, the heterogeneity of the outcomes, outcome measurement tools, and follow-up timelines between the studies prevented us from pooling the results and augmenting the power of these RCTs. These issues should be taken into consideration in future studies. Figure 2 summarizes the take-home messages of this study.

In conclusion, resection of OOM along with skin in upper blepharoplasty showed no difference in long-term aesthetic outcome and was associated with initially higher ophthalmological morbidity compared to skin only procedure. While we are not suggesting that OOM resection is never required, the evidence strongly support its preservation during standard upper blepharoplasty.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose.

Human Participants and Animals Rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent For this type of study, informed consent is not required.

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