Comparison of Efficacy and Complications Among Various Spacer Grafts in the Treatment of Lower Eyelid Retraction: A Systematic Review

Eugene Park, MD, Kevin Lewis, BA, Mohammed S Alghoul, MD
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Abstract
Background: Lower eyelid retraction is a difficult problem to treat, but it is a prevalent condition and a common complication of blepharoplasty. The use of spacer grafts to increase eyelid height and improve symptoms has been described for a long time, but the optimal choice of spacer graft material is unknown.

Objectives: The authors reviewed the currently available evidence to determine the best available spacer graft material in terms of efficacy and complications.

Methods: A systematic review of all available literature published between 1985 and the present was performed using the Pubmed, Ovid MEDLINE, and Cochrane library databases. Inclusion criteria were that the studies contain original content assessing the treatment of lower eyelid retraction in humans using a spacer graft and provide quantitative outcomes data.

Results: One hundred and twelve articles were reviewed following an initial screen using titles, and 19 articles were chosen for inclusion in this systematic review. Analysis of these articles revealed no spacer graft material that is clearly superior to others.

Conclusions: Due to a lack of high quality evidence, this review did not reveal one spacer graft material that is clearly superior to others. However, a narrative summary of the available evidence reveals unique sets of advantages and disadvantages associated with the various materials currently available. Further research in the form of well-designed studies will be necessary to further clarify advantages of certain spacer graft materials over others.

Level of Evidence: 3
negative vector eyelid topography and age-related involutionary changes predispose some to developing postsurgical lower eyelid retraction. Additionally, nonsurgical etiologies such as thyroid eye disease, burns, and trauma can also cause lower eyelid retraction, creating a substantial population of patients with this condition.

The functional problems caused by lower eyelid retraction can significantly impact a patient’s quality of life. Unfortunately, surgical correction is challenging and prone to recurrence. Numerous techniques have been described to return the lid margin to its native height and contour. One commonly described method is lysis of adhesions and release of the lower lid retractors, along with the use of a spacer graft. A spacer graft is an autologous, allogenic, or alloplastic substance inserted into the posterior lamella of the eyelid to provide structural support. Grafts are inserted below the tarsal plate after releasing the lower eyelid retractors inferiorly, and are used to replace the volume and reestablish the lid height lost by the initial scarring or involution. Many different materials have been used as spacer grafts including acellular dermis, ear cartilage, and hard palate mucosa, among others.

The use of spacer grafts is made difficult by unforgiving anatomy and a wide variety of described techniques, which can lead to unpredictable results in inexperienced hands. Furthermore, the choice of graft material is highly variable, depending mostly on surgeon preference, with no established guidelines on which material is best suited for a given pathology. In order to improve results and determine the best approach to the use of spacer grafts, it is necessary to become familiar with the latest body of evidence. One practical investigation would be to analyze the outcomes associated with all currently available spacer graft types. To date, however, no systematic reviews have been performed to compare the various spacer graft materials described in the literature.

The current study aims to determine the best available lower eyelid spacer graft by systematically reviewing studies that assess efficacy and complication rates among various spacer graft materials.

**METHODS**

Two independent reviewers (E.P. and K.L.) conducted a systematic review of available literature in April 2016 using the PubMed, Ovid MEDLINE, and Cochrane library databases in accordance with preferred reporting items for systematic reviews and meta-analyses guidelines. The initial database search used the following keywords: “ectropion,” “lower eyelid retraction,” or “lower eyelid malposition,” in combination with “repair,” “correction,” “graft,” “spacer graft,” “posterior lamellar graft,” “acellular dermal matrix,” “AlloDerm,” “hard palate mucosa,” “cartilage graft,” or “tarsoconjunctival graft.” The search was limited to English language journals.

Studies were screened by title, and relevant articles were selected for review. Bibliographies of potential articles and any review articles were searched for additional studies. Abstracts of selected studies were reviewed. The full text of selected articles was analyzed to determine compliance with our established inclusion and exclusion criteria.

Inclusion criteria were that the studies assess the correction of lower eyelid retraction using a posterior lamellar spacer graft, provide quantitative outcomes data, and have an average follow up of at least 3 months. Exclusion criteria included case reports, review articles, and studies using nonhuman subjects. Articles with original content meeting the above criteria were included in the review. Each reviewer performed the systematic review independently; discrepancies in article selection were settled by consensus or third party review (M.S.A.). The quality of each study was assessed by the reviewers, and demographic and outcomes data were extracted. Levels of evidence were determined by the reviewers (E.P. and K.L.) using the American Society of Plastic Surgeons Evidence Rating Scales.

**RESULTS**

**Literature Search**

The initial literature search using the technique described above resulted in 1071 articles. Following an initial screen using titles, 112 potential articles were left for abstract review. A review of abstracts to screen for relevance resulted in 39 articles. The full text of these 39 articles were then thoroughly reviewed and subjected to previously determined inclusion and exclusion criteria, resulting in 19 articles qualifying for systematic review (Figure 1). Narrative summaries of these articles
<table>
<thead>
<tr>
<th>Study</th>
<th>Graft evaluated</th>
<th>No. of patients</th>
<th>No. of eyelids</th>
<th>Mean follow-up (months)</th>
<th>Lid retraction etiology</th>
<th>Technique (incision)</th>
<th>Graft dimensions</th>
<th>Ancillary procedures</th>
<th>Outcomes</th>
<th>Complications</th>
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<tbody>
<tr>
<td>Kersten et al⁵⁰</td>
<td>Hard palate mucosa</td>
<td>18</td>
<td>25</td>
<td>11.6</td>
<td>Thyroid eye disease, trauma</td>
<td>Transconjunctival</td>
<td>Height: 2 × preop retraction Length: 25 mm</td>
<td>—</td>
<td>23 lids &lt;0.5 mm final scleral show, 2 lids &lt;1 mm final scleral show</td>
<td>&lt;10% contracture, 1 ocular irritation from graft keratinization</td>
</tr>
<tr>
<td>Patel et al⁵⁰</td>
<td>Hard palate mucosa</td>
<td>17</td>
<td>29</td>
<td>14</td>
<td>Postblepharoplasty</td>
<td>Transconjunctival</td>
<td>Height: 5 mm Length: 20-25 mm</td>
<td>Lateral tarsal strip</td>
<td>All lids &lt;0.5 mm final scleral show</td>
<td>2 corneal abrasions, 1 donor site hemorrhage</td>
</tr>
<tr>
<td>Wearne et al⁵⁰</td>
<td>Hard palate mucosa</td>
<td>68</td>
<td>102</td>
<td>3</td>
<td>Thyroid eye disease, facial nerve palsy, previous eye surgery, trauma, idiopathic</td>
<td>Transconjunctival</td>
<td>Height: 2 × pre-op retraction</td>
<td>Medial/lateral canthoplasty</td>
<td>2.3 mm scleral show reduction</td>
<td>15% persistent lid retraction, 7 donor site hemorrhage, 1 corneal abrasion, 3 graft buckling</td>
</tr>
<tr>
<td>Patel et al⁵⁰</td>
<td>Hard palate mucosa</td>
<td>17</td>
<td>24</td>
<td>13</td>
<td>Trauma, postblepharoplasty, tumor resection, facial nerve paralyis, thyroid eye disease</td>
<td>Transconjunctival</td>
<td>Height: 6 mm Length: 20 mm</td>
<td>Midface lift, lateral canthoplasty</td>
<td>2.5 mm scleral show reduction</td>
<td>1 oronasal palatal fistula, 1 corneal abrasion</td>
</tr>
<tr>
<td>Ben Simon et al⁵⁰</td>
<td>Hard palate mucosa</td>
<td>—</td>
<td>12</td>
<td>13</td>
<td>Postblepharoplasty, thyroid eye disease, facial nerve palsy, cicatricial ectropion</td>
<td>—</td>
<td>Height: Based on lower lid height</td>
<td>Midface lift, lateral tarsal strip</td>
<td>2.2 mm MRD₂ reduction</td>
<td>2 corneal abrasions</td>
</tr>
<tr>
<td>McAlister et al⁵⁰</td>
<td>Hard palate mucosa</td>
<td>32</td>
<td>46</td>
<td>15</td>
<td>Thyroid eye disease, postblepharoplasty, trauma, facial nerve palsy, chronic progressive external ophthalmoplegia, post-enucleation anopthalmos</td>
<td>Transconjunctival</td>
<td>Height: 4-6 mm</td>
<td>Lateral tarsal strip, tarsorrhaphy</td>
<td>0.71 mm lagophthalmos reduction, 0.43 mm scleral show reduction</td>
<td>3 donor site hemorrhage, 2 trichiasis, 1 pyogenic granuloma</td>
</tr>
<tr>
<td>Feldman et al⁵⁰</td>
<td>Donor sclera</td>
<td>68</td>
<td>—</td>
<td>2.95 - 4.40</td>
<td>Thyroid eye disease</td>
<td>Transconjunctival</td>
<td>Height: 4 × pre-op retraction</td>
<td>Lateral tarsal strip, tarsorrhaphy</td>
<td>1.30-2.38 mm MRD₂ reduction, 1.8-2.5 mm scleral show reduction</td>
<td>2 reoperations, 6 mild keratopathy</td>
</tr>
<tr>
<td>Olver et al⁵⁰</td>
<td>Donor sclera</td>
<td>13</td>
<td>20</td>
<td>7.8</td>
<td>Thyroid eye disease</td>
<td>Transconjunctival</td>
<td>Height: Preop retraction + 6 mm</td>
<td>—</td>
<td>1.3 mm MRD₂ reduction</td>
<td>—</td>
</tr>
<tr>
<td>Ferri et al⁵⁰</td>
<td>Tarsal conjunctiva</td>
<td>10</td>
<td>20</td>
<td>15</td>
<td>Postblepharoplasty</td>
<td>Transconjunctival</td>
<td>Height: 3-4 mm Length: 18-20 mm</td>
<td>Lateral tarsal strip, tarsorrhaphy</td>
<td>1.61 mm scleral show reduction</td>
<td>5 early complications (upper lid pyogenic granuloma, wound dehiscence, or ectropion), 3 superficial punctate keratitis</td>
</tr>
<tr>
<td>Tan et al⁵⁰</td>
<td>Porous polyethylene (MedPor)</td>
<td>32</td>
<td>35</td>
<td>22</td>
<td>Facial palsy, thyroid eye disease, ocular prosthesis instability, myotonia, maxillectomy with radio-therapy, and chemical burn</td>
<td>Subcilary</td>
<td>—</td>
<td>—</td>
<td>1.0 mm MRD₂ reduction</td>
<td>15 reoperations</td>
</tr>
</tbody>
</table>
Table 1. (Continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Graft evaluated</th>
<th>No. of patients</th>
<th>No. of eyelids</th>
<th>Mean follow-up (months)</th>
<th>Lid retraction etiology</th>
<th>Technique (incision)</th>
<th>Graft dimensions</th>
<th>Ancillary procedures</th>
<th>Outcomes</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kakizaki et al26</td>
<td>Cartilage</td>
<td>5</td>
<td>6</td>
<td>11.6</td>
<td>Thyroid eye disease</td>
<td>Subciliary</td>
<td>Height: 2 × preop retraction (4 mm for entropion cases) Length: 17 mm</td>
<td>—</td>
<td>2.88 mm scleral show reduction</td>
<td>—</td>
</tr>
<tr>
<td>Yoon et al29</td>
<td>Dermis</td>
<td>10</td>
<td>10</td>
<td>9.8</td>
<td>Chronic progressive external ophthalmoplegia with malar hypoplasia, facial nerve palsy, thyroid eye disease, cicatric formation</td>
<td>Transconjunctival</td>
<td>Height: Height of recipient site + 2 mm, but less than 8 mm</td>
<td>Lateral tarsal strip</td>
<td>3.0 mm scleral show reduction</td>
<td>1 persistent lid retraction with reoperation, 1 ocular irritation</td>
</tr>
<tr>
<td>Taban et al26</td>
<td>Thick AlloDerm</td>
<td>11</td>
<td>21</td>
<td>7.6</td>
<td>Postblepharoplasty</td>
<td>—</td>
<td>—</td>
<td>Midface lift, lateral canthopasty</td>
<td>1.6 mm MRD2 reduction</td>
<td>5 persistent lid retractions</td>
</tr>
<tr>
<td>Liao et al21</td>
<td>TarSys</td>
<td>32</td>
<td>37</td>
<td>6</td>
<td>Thyroid eye disease</td>
<td>Transconjunctival</td>
<td>Height: 4 × preop retraction (10 mm if retraction &gt; 2 mm)</td>
<td>Lateral canthopasty</td>
<td>1.5 mm MRD2 reduction</td>
<td>1 conjunctival granuloma</td>
</tr>
<tr>
<td>Scruggs et al20</td>
<td>BellaDerm</td>
<td>11</td>
<td>15</td>
<td>15.6</td>
<td>Involutional changes, cicatricial changes, paralytic changes, combined etiologies</td>
<td>Transconjunctival</td>
<td>Height: 2 × height of posterior lamellar defect</td>
<td>Lateral tarsal strip</td>
<td>2.2 mm MRD2 reduction, 1.7 mm scleral show reduction</td>
<td>1 persistent lid retraction</td>
</tr>
</tbody>
</table>

MRD2, inferior marginal reflex distance.

are provided below, and additional data are provided in Tables 1 and 2. Unless otherwise noted, all studies included utilized a transconjunctival incision and placed the spacer graft between the lower edge of the tarsal plate and the recessed lower lid retractors. A few studies included the use of different techniques for graft placement, and in these cases, the technique is included in the article summary.

**Studies Evaluating a Single Spacer Graft**

**Hard Palate Mucosa**

Kersten et al8 in 1990 performed a retrospective review of 25 cases of lower eyelid retraction in 18 patients treated with a hard palate mucosa spacer graft. Preoperatively, inferior lid margins were between 1.5 and 4 mm from the lower limbus. After a mean follow up of 11.6 months, 23 eyelids had an inferior lid margin within 0.5 mm of the lower limbus, and 2 eyelids were within 1 mm. Graft height measurement at follow up revealed a contracture rate of less than 10%. Initially, ocular irritation from graft keratinization occurred in an unspecified number of patients, but resolved in all but one patient by 6 months postoperatively. (Level IV, Therapeutic)

Patel et al18 in 1997 published a series of 29 cases of postblepharoplasty lower eyelid retraction in 17 patients treated using a hard palate mucosa spacer graft and lateral tarsal strip procedure with overcorrection. The average preoperative lower eyelid margin position was 2.3 mm (range, 1.5-4 mm) below the lower limbus. After a mean follow up of 14 months, the lower eyelid margin was within 0.5 mm of the lower limbus in all eyes. Two patients developed corneal abrasions, which resolved with the use of a bandage contact lens. One patient had donor site bleeding 7 days following surgery. No statistical analyses were performed. (Level IV, Therapeutic)
Wearne et al in 2001 performed a retrospective review of 102 cases of lower eyelid retraction in 68 patients treated using a hard palate mucosa spacer graft. Sixty per cent of the patients had undergone a previous lower eyelid repair. Twenty-five cases included a simultaneous lateral canthoplasty and an unspecified number of cases included a medial canthoplasty. Results were considered good or acceptable when the eyelid touched or was within 1 mm from the inferior limbus, respectively. The average preoperative lower eyelid retraction as measured by inferior scleral show was 3.1 mm (range, 1.5-6 mm). At 3 months postoperatively, mean lower eyelid retraction was 0.8 mm (range, 1 mm overcorrection to 4 mm residual inferior scleral show). After an average follow up of 17 months, 39% of cases had lower eyelid margins at the lower limbus and 46% of cases had lower eyelid margins within 1 mm of the lower limbus. Fifteen lids showed residual lower lid displacement. Seven patients had donor

<table>
<thead>
<tr>
<th>Study</th>
<th>Grafts evaluated</th>
<th>No. of patients</th>
<th>No. of eyelids</th>
<th>Mean follow-up (months)</th>
<th>Lid retraction etiology</th>
<th>Technique (incision)</th>
<th>Graft dimensions</th>
<th>Ancillary procedures</th>
<th>Outcomes</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sullivan et al</td>
<td>—</td>
<td>14</td>
<td>—</td>
<td>7.4</td>
<td>Postblepharoplasty, malar ptosis, thyroid eye disease, trauma, facial nerve paralysis, anophthalmic eyes</td>
<td>—</td>
<td>Largest possible for which anterior lamellar coverage available</td>
<td>Midface lift</td>
<td>—</td>
<td>—</td>
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<tr>
<td>AlloDerm</td>
<td>—</td>
<td>12</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>57% contracture, 1 reoperation</td>
</tr>
<tr>
<td>Hard palate mucosa</td>
<td>—</td>
<td>7</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>16% contracture, 1 reoperation</td>
</tr>
<tr>
<td>Li et al</td>
<td>—</td>
<td>60</td>
<td>4-51</td>
<td>—</td>
<td>Postblepharoplasty</td>
<td>Transconjunctival</td>
<td>—</td>
<td>Midface lift, lateral canthoplasty</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>AlloDerm</td>
<td>—</td>
<td>35</td>
<td>—</td>
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<tr>
<td>Hard palate mucosa</td>
<td>—</td>
<td>25</td>
<td>—</td>
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<tr>
<td>Oestreicher et al</td>
<td>—</td>
<td>400</td>
<td>—</td>
<td>16.5</td>
<td>Thyroid eye disease, previous surgery, trauma, idiopathic</td>
<td>Transconjunctival</td>
<td>—</td>
<td>Lateral tarsal strip, tarsorrhaphy</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Hard palate mucosa</td>
<td>—</td>
<td>253</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Height: 4-6 mm</td>
<td>—</td>
<td>0.81 mm scleral show reduction</td>
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<tr>
<td>Tarsal conjunctiva</td>
<td>—</td>
<td>348</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Height: 3-4 mm</td>
<td>—</td>
<td>1.27 mm scleral show reduction</td>
</tr>
<tr>
<td>Chang et al</td>
<td>—</td>
<td>8</td>
<td>—</td>
<td>4.2</td>
<td>Thyroid eye disease, paralytic cicatricial ectropion, orbital fracture, orbital tumor</td>
<td>“En Glove” dissection</td>
<td>Height: 8 mm Length: 35 mm</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>AlloDerm</td>
<td>—</td>
<td>7</td>
<td>—</td>
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<tr>
<td>Dermis-fat graft</td>
<td>—</td>
<td>4</td>
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<td>—</td>
<td>—</td>
<td>1.0 mm MRD&lt;sub&gt;2&lt;/sub&gt; reduction</td>
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</tbody>
</table>

MRD<sub>2</sub>, inferior marginal reflex distance.
site hemorrhage at 7 to 12 days postoperatively, requiring nonoperative intervention with local pressure. One patient developed a corneal abrasion due to keratinization of the graft with vellus hair growth. Other ocular complications included chronic mucous discharge and cysts along the graft border. There were also 3 cases of bulky lower lids due to graft buckling. (Level IV, Therapeutic)

Patel et al. in 2005 published their series of 24 cases of lower eyelid retraction in 17 patients treated using a combined approach of a hard palate mucosa spacer graft that was harvested with periosteum, preperiosteal midface suspension, and lateral canthoplasty. After a mean follow up period of 13 months, all patients had complete elimination of their symptoms, complete correction of scleral show, and lower lid position was corrected by an average of 2.5 mm. Complications included corneal irritation from sutures in one patient and an oronasal palatal fistula in another patient who had bilateral grafts harvested. (Level IV, Therapeutic)

Ben Simon et al. in 2006 performed a retrospective review of 43 cases of lower eyelid retraction in 34 patients treated using either a midface lift alone (31 cases) or a midface lift in addition to a hard palate mucosa spacer graft (12 cases). All patients also underwent a simultaneous lateral tarsal strip procedure. After a follow up of 13 months, mean reduction in lower lid retraction, as measured by inferior marginal reflex distance (MRD$_{i}$), was 2.2 mm in the hard palate mucosa graft group and 1.1 mm in the midface lift alone group (P = 0.02). Two cases of corneal abrasion were noted, and these were both in patients who received a hard palate mucosa graft. (Level III, Therapeutic)

McAllister et al. in 2012 reviewed their results from 46 cases of lower eyelid retraction in 32 patients undergoing repeat spacer grafting with hard palate mucosa. Secondary grafting was performed on average 26.6 months after the initial procedure. The overall mean reductions in inferior scleral show and lagophthalmos were 0.71 mm (80%), and 0.43 mm (76%), respectively, after 15 months of follow up. Three patients developed donor site bleeding requiring pressure or cautery following secondary grafting. Two lids developed trichiasis, and another developed a pyogenic granuloma. (Level IV, Therapeutic)

Feldman et al. in 1992 performed a retrospective review of 68 patients treated over a 15-year period for lower eyelid retraction using donor sclera as a spacer graft. The technique used by the authors went through 3 stages. From 1974 to 1985, 53 patients underwent scleral grafting alone. From 1986 to 1987, seven patients underwent scleral grafting with either a lateral tarsal strip procedure or lateral tarsorrhaphy. And from 1988 to 1989, eight patients underwent scleral grafting, lateral tarsal strip, and lateral tarsorrhaphy together. Improvement in MRD$_{i}$ was greater in the third technique compared to the first (2.38 mm vs 1.30 mm, P = 0.02). The second technique also showed greater improvement, but this difference was not statistically significant (2.07 mm vs 1.30 mm, P = 0.08). Additionally, improvements in inferior scleral show were greater in the third technique compared to the first (2.5 mm vs 1.8 mm, P = 0.02). Mean follow up was 4.4 months, 4.32 months, and 2.95 months for the first, second, and third technique groups, respectively. Six patients developed mild postoperative keratopathy due to apposition of the graft against the cornea (Level III, Therapeutic).

Olver et al. in 1998 published a prospective, randomized trial comparing the use of donor sclera spacer grafts to the application of antimetabolites, 5-fluorouracil and mitomycin C, in the treatment of lower eyelid retraction due to thyroid eye disease. Grafts were placed in 20 lids (13 patients), and antimetabolites, placed onto the capsulopalpebral fascia, were used in 15 lids (12 patients). Scleral donor grafts yielded an MRD$_{i}$ reduction of 1.8 mm (P < 0.001) at 1 month, 1.25 mm at 3 months (P < 0.001), and 1.3 mm at 6 months (P < 0.001). The antimetabolite cohort had an average MRD$_{i}$ reduction of 1.1 mm at 1 month (P < 0.01), but nonstatistically significant reductions at 3 and 6 months. Average follow up across all groups was 7.8 months. Complications among the scleral donor graft cohort included bulkier eyelids compared to the antimetabolite group. (Level II, Therapeutic)

Tarsal Conjunctiva

Ferri et al. in 2002 published a series of 20 cases of post-blepharoplasty lower eyelid retraction in 10 patients in which a free tarsal conjunctival graft from the upper eyelid was used as a lower eyelid spacer graft. A subset of patients underwent a concomitant tarsal strip procedure, and the rest of the patients underwent a tarsorrhaphy. Preoperatively, patients had an average inferior scleral show of 1.89 mm (range, 0.75-3.5 mm), and 5 cases (3 patients) had lagophthalmos averaging 1.3 mm (range, 0.5-2.5 mm). After an average follow up of 15 months, all patients had a reduction in the amount of inferior scleral show with an average reduction of 1.61 mm (range, 0.75-3.5 mm). All 5 cases with lagophthalmos had minimal residual lagophthalmos (less than 0.5 mm). No statistical analyses were performed. Five cases had early complications including upper lid pyogenic granuloma, wound dehiscence, and chemosis with slight ectropion. There were 3 cases of superficial punctate keratitis, and 4 patients remained symptomatic at follow up. (Level IV, Therapeutic)
**Porous Polyethylene**

Tan et al\(^\text{27}\) in 2004 published a series of 35 cases of lower eyelid retraction in 32 patients in which porous polyethylene (Meppor, Porex Surgical, Newnan, GA) was used as a spacer graft. The implant was inserted through a subciliary incision and sutured to the lower edge of the tarsal plate. At one year postoperatively, the median MRD\(_1\) had improved from 7 mm (range, 5-10 mm) to 6 mm (range, 3-8 mm) \((P = 0.006)\). Vertical palpebral aperture \((P < 0.001)\), lagophthalmos \((P = 0.04)\), and inferior scleral show \((P < 0.001)\) also showed improvement. Patients with less than 15 months of follow up were excluded from final analysis, resulting in a mean follow up of 22 months. Major complications occurred in eight out of 32 patients (25\%). There were 5 cases of implant exposure, 3 of which required implant removal. Three other implants were removed due to unexplained pain, poor eyelid mobility on downgaze, and outward rotation of the upper implant margin on downgaze. There were 9 minor complications including transient lash loss, skin contour abnormalities, and lid margin ectropion. Overall, 15 of the 32 patients required a revision procedure. (Level IV, Therapeutic)

**Cartilage**

Kakizaki et al\(^\text{28}\) in 2007 retrospectively reviewed 6 cases of lower eyelid retraction in 5 patients treated using ear cartilage as a spacer graft. Five of the 6 cases also had an associated cicatricial entropion. Grafts were placed between the tarsal plate and the recessed lower lid retractors via a subciliary incision. After an average follow up of 11.6 months following surgery, a mean lower lid height increase of 2.88 mm was achieved. This change was not statistically significant, which the authors attribute to the small sample size. (Level IV, Therapeutic)

**Dermis**

Yoon et al\(^\text{29}\) in 2014 retrospectively reviewed 10 cases of lower eyelid retraction in 10 patients who were treated using a postauricular dermal graft in addition to a lateral tarsal strip procedure. Three eyelids had previously been repaired with porcine acellular dermal matrix (Enduragen, Stryker, Kalamazoo, MI). The lower eyelid position was considered “good” when the eyelid margin was within 1 mm of the corneal limbus. Average preoperative inferior scleral show was 3.3 ± 2.6 mm (range, 0.5-10 mm). After an average follow up of 9.8 months following surgery, the mean inferior scleral show was 0.3 ± 1.2 mm (range, −1.5-0.5 mm, \(P = 0.004)\). Postoperative eyelid position was within 1 mm of the corneal limbus in 7 out of ten patients. One patient developed ocular irritation due to keratinization of the graft. Another patient developed a postoperative ectropion, which was corrected by excising a part of the graft. (Level IV, Therapeutic)

**Acellular Tissue Matrix**

Taban et al\(^\text{30}\) in 2005 performed a retrospective review of 21 cases of lower eyelid retraction in 11 consecutive patients, in which thick AlloDerm (LifeCell, Branchburg, NJ) was used as a spacer graft. Patients also underwent a simultaneous subperiosteal midface lift and lateral canthoplasty. All cases were due to previous blepharoplasty. Grafts were inserted into the posterior lamella, but technique and graft size were not described in detail. Preoperative MRD\(_1\) was 6.0 mm centrally and 5.0 mm laterally. After an average follow up of 7.2 months (range, 3-12 months), the mean improvements in central and lateral lid height were 1.6 and 1.1 mm, respectively. Five lids failed to show improvement, and in fact demonstrated an average decrease in lower eyelid height of 0.8 mm. The authors did not identify any factors associated with these negative outcomes (Level IV, Therapeutic).

Liao et al\(^\text{31}\) in 2013 published a series of 37 cases of lower eyelid retraction in 32 patients treated using decellularized porcine-derived membrane (TarSys, IOP Ophthalmics, Costa Mesa, CA) as a spacer graft. A lateral canthoplasty was performed on all patients. Preoperative MRD\(_1\) and lagophthalmos were 7.1 ± 0.5 mm and 1.7 ± 0.6 mm, respectively. At 6 months follow up, lower lid displacement and lagophthalmos were 5.6 ± 0.4 mm \((P < 0.0001)\) and 0.3 ± 0.4 mm \((P < 0.0001)\), respectively. Complications included prolonged lower lid swelling and slight puffy appearance in 6 patients, which resolved after 3 months, and conjunctival granuloma formation, which occurred in one patient (Level IV, Therapeutic).

Scruggs et al\(^\text{32}\) in 2015 published a series of 15 cases of lower eyelid retraction in 11 patients treated using BellaDerm (Musculoskeletal Transplant Foundation, Edison, NJ), a human-derived acellular dermal matrix taken from live donors in an attempt to minimize postmortem changes. A tarsal strip procedure was also performed in each case. After an average follow up of 15.6 months, patients had a mean lower eyelid elevation of 2.2 mm \((P < 0.0001)\), and a mean decrease in inferior scleral show of 1.7 mm \((P < 0.0001)\). In the subset of patients with more than 12 months of follow up (mean, 21.9 months), mean lower eyelid elevation was 2.4 mm \((P < 0.0001)\), and mean decrease in inferior scleral show was 1.7 mm \((P < 0.0003)\). All patients had resolution of conjunctival injection except one patient who had persistent lower eyelid retraction postoperatively. (Level IV, Therapeutic)

**Comparative Studies**

Sullivan et al\(^\text{33}\) in 2003 published a prospective cohort study comparing contracture rates between AlloDerm and hard palate mucosa. The study evaluated 19 cases of lower eyelid retraction and contracted anophthalmic socket in
14 patients treated using either AlloDerm or hard palate mucosa as spacer grafts. Six cases were performed for contracted sockets. Of the patients being treated for lower eyelid retraction, 7 received AlloDerm, and 6 received hard palate mucosa. Of the patients being treated for contracted socket, 5 received AlloDerm, and one received hard palate mucosa. After an average follow up of 7.4 months, AlloDerm displayed a mean graft contracture rate of 57% compared to 16% for hard palate mucosa (P < 0.005). Statistical analysis was performed using data pooled from both patients with lower eyelid retraction and those with contracted socket. In the subset of patients who had lower eyelid retraction, graft contracture rates were 55% and 19% for AlloDerm, and hard palate mucosa, respectively. Of those treated for lower eyelid retraction, one patient who received AlloDerm had a mild recurrence, and one patient who received hard palate mucosa developed a recurrent ectropion. Three hard palate mucosa grafts buckled, resulting in decreased vertical height of the lower lid. (Level II, Therapeutic)

Li et al\(^9\) in 2005 published a retrospective review comparing the use of AlloDerm and hard palate mucosa as spacer grafts in patients with lower eyelid retraction postblepharoplasty. The study included a total of 60 eyelid reconstructions, 35 using AlloDerm, and 25 using hard palate mucosa. All patients underwent a subperiosteal midface lift and lateral canthoplasty in addition to spacer graft placement, a combination that the authors call the “Madame Butterfly” procedure. After follow up ranging from 4 to 51 months, no significant difference was found in the amount of central lower eyelid elevation achieved, as measured with MRD\(_2\) on standardized preoperative and postoperative photographs. A larger elevation was seen in female patients with both AlloDerm (0.955 mm vs 0.458 mm) and hard palate mucosa (1.144 mm vs 0.758 mm) (P = 0.018). Gender distributions were similar between the 2 groups, and no difference in preoperative eyelid height was found. Complications were not addressed in this study. (Level III, Therapeutic)

Oestreich et al\(^8\) in 2008 published a retrospective review of 400 patients undergoing posterior lamellar grafting with either hard palate mucosa or tarsal conjunctival grafts taken from the upper eyelid for lower eyelid retraction. Two hundred and fifty-three eyelids received hard palate mucosa, and 384 eyelids received tarsal conjunctival grafts. Patients also underwent either a lateral tarsal strip or lateral tarsorrhaphy. Graft efficacy was evaluated in terms of inferior scleral show, lagophthalmos, and superficial punctate keratopathy (measured on a scale of 1 to 3), and separate analyses were performed for right and left eyes. After a mean follow up of 16.5 months, both graft types resulted in significant reductions in all 3 outcomes measures (P < 0.01). When comparing the 2 graft types, no significant differences in efficacy were found except in scleral show reduction, which was greater with tarsal conjunctival grafts, but only for right eyes (1.27 mm vs 0.81 mm, P < 0.0001). Ninety per cent of patients reported elimination of 1 to 3 symptoms (epiphora, dry eye, foreign body sensation) after surgery, with similar results between the 2 graft types. Complications included bleeding, mucous discharge, pyogenic granuloma formation, and wound dehiscence, and rates were similar for both graft types, except for wound dehiscence, which was higher among tarsal conjunctival grafts (10.4% vs 2.6%, P = 0.004). The authors attribute the greater rate of wound dehiscence to an alteration in their technique, which occurred early in their series and thus affected patients receiving tarsal conjunctival grafts more than those with hard palate mucosa. (Level III, Therapeutic)

Chang et al\(^3\) in 2011 retrospectively reviewed 11 cases of lower eyelid retraction in 8 patients receiving either AlloDerm (7 cases) or dermis-fat grafts (4 cases) as spacer grafts. Grafts were typically 8 × 35 mm in size. In the authors’ technique, a 1 cm horizontal incision is made just above or below the lateral canthal tendon, and an “en-glove” dissection of the subconjunctival space and release of lower eyelid retractors is performed using scissors. The graft is then tunneled into place and sutured to the medial skin and lateral canthal tendon or orbital rim to create a horizontal sling effect. Outcomes were evaluated using MRD\(_2\) measured from preoperative and postoperative photographs. At 3 months following surgery, the AlloDerm group had a mean improvement in lower eyelid height of 1.5 mm compared to 1.0 mm in the dermis-fat group. The difference between groups was not statistically significant. Improvements were maintained at 6-month follow up. Mean follow up was 4.2 months. Complications were not addressed. (Level III, Therapeutic)

**DISCUSSION**

Lower eyelid retraction is a challenging problem that affects lower lid position and function. Contributing etiologies include fibrosis, lack of support, and/or loss of tissue, all resulting in vertical shortening of the lower lid relative to the globe. Numerous repair techniques have been reported, such as canthal repositioning,\(^2\) scar lysis,\(^3\)\(^5\) midface lift,\(^9\) and spacer grafts.\(^2\) The reconstructive surgeon must take into account variables such as lid laxity, orbicularis muscle tone, and scarring within each layer of the eyelid when repairing a retracted lower lid. The use of a spacer graft serves to lengthen the vertical height of the lower lid, as well as to support and replace lost tissue.

The earliest mention of the use of grafts for lower eyelid support can be traced back to Blair and Byars in 1940.\(^3\) However, it was not until the 1970s and 1980s, that the use of sclera\(^5\) and ear cartilage\(^17\) in the treatment of lower eyelid retraction became popularized. Since then, a
large number of different graft types have become available, but the optimal choice of material is still unknown. The ideal spacer graft should be biocompatible and easily accessible. It should also have a low rate of contracture and some degree of stiffness to provide support. Lastly, it should promote tissue integration with minimal inflammation and allow mucosalization on the conjunctival side. The use of scleral grafts has largely fallen out of favor due to high rates of degradation and shrinkage.\(^5\)\(^4\) Hard palate mucosa is still considered by some to be the gold standard due to its stiffness, as well as its mucosal surface, which serves to replace the conjunctiva.\(^6\)\(^,\)\(^18\) However, it requires a secondary incision for harvest, and is associated with increased operative time, postoperative discomfort, and donor site complications. Acellular dermal matrices (ADMs) provide an off-the-shelf, ready-to-use alternative, but the type and thickness required for successful repair remains unknown. To our knowledge, there have been no reviews in the literature which summarize the body of evidence regarding the various spacer graft materials available. Here, we attempted to identify the best spacer graft currently available in terms of efficacy and complication rates by performing a systematic review of all quantitative studies describing the use of spacer grafts in the treatment of lower eyelid retraction.

The studies that met our inclusion criteria were mostly retrospective in nature with only 2 studies that were prospective. All studies provided quantitative measurements, mostly in the form of MRD, and degree of scleral show. The underlying etiology of lower eyelid retraction was mixed, which made this a heterogeneous group of patients. The techniques described for insertion of the spacer graft were similar with few exceptions; the majority of the studies utilized a transconjunctival incision and placed the graft between the inferior edge of the tarsus and the recessed edge of the lower lid retractors. The ancillary procedures, however, were different with 7 out of 18 studies indicating the performance of a tarsal strip procedure and 5 reporting a concomitant midface lift. The height of the graft used also varied significantly among studies, ranging from double to 4 times the height of the amount of retraction, to the largest height possible, indicating a lack of consensus on the degree of overcorrection needed. Perhaps in part due to these variables, analysis of studies evaluating single spacer graft types did not clearly reveal one material that is clearly superior to alternatives in terms of efficacy. In fact, all studies overall showed good success rates regardless of the spacer graft used, except for Medpor which had a high complication and failure rate. The majority of patients in all of these studies achieved a significant level of lower eyelid elevation with a small minority of patients developing complications. An analysis of comparative studies also did not reveal one graft material that is clearly superior to the rest in terms of efficacy. Specifically, there was no difference found between hard palate mucosa and AlloDerm. There are no prospective, randomized trials comparing the efficacy of one spacer graft material to another. All reviewed cohort studies comparing 2 graft types fail to show convincingly that one graft type resulted in greater eyelid elevation compared to another. Although one study showed that AlloDerm had higher contracture rate than hard palate mucosa, this did not have an effect on eyelid elevation and longevity of the results.\(^3\)\(^3\)

Systematic reviews are performed to provide physicians with a summary of all currently available relevant evidence with the goal of answering a specific clinical question. Due to a dearth of high quality evidence in the form of prospective, randomized trials, the conclusions we can draw from the current review are limited. However, an analysis of the characteristics and complication profiles of the various spacer graft materials does allow us to make better informed clinical decisions. A notable trend encountered in our review was the consistent development across multiple studies of donor site and eyelid complications with the use of hard palate mucosa.\(^2\)\(^1\)\(^,\)\(^22\) Despite this, it remains an excellent choice for a spacer graft given its mucosal surface, relative stiffness, pliability, and easy handling. The use of custom-molded dental plates has been shown to reduce donor site discomfort.\(^5\)\(^5\) The hard palate spacer should be placed in a low position in the eyelid to minimize contact with the cornea and should perhaps be avoided in patients with bleeding diathesis. Medpor is associated with high complication rate when used in the lower eyelid and is more suited for skeletal augmentation. Ear cartilage is the stiffest spacer available and is easily accessible with low donor site morbidity. However, it is almost too stiff to handle and finesse is required in shaping the graft in order to avoid noticeable contour deformities. It is also limited in size, especially the width of the harvested piece, and can be palpable for years after the procedure. Human acellular dermal matrix like AlloDerm is off-the-shelf, does not require a donor site, is easy to handle, has low complication rates, and most importantly can be shaped and sized without restrictions. However, it tends to contract more and may be associated with a higher resorption rate. It also lacks the stiffness of porcine dermis, which can provide a similar amount of support as ear cartilage with more ease of handling and contouring. It is also important, based on some of the studies’ findings on contracture and buckling of grafts, to overcorrect, as was the case in several of the techniques described, especially with hard palate mucosa and AlloDerm. The degree of overcorrection remains anecdotal without strong evidence to substantiate one over the other.

One major limitation of our review is that the techniques used to treat lower eyelid retraction were not standardized. Often, a surgeon’s experience and selection of technique can contribute more to outcomes than the spacer graft
used. Despite variations in technique and ancillary procedures performed among the studies included here, the results for each type of spacer graft were fairly consistent. There were also discrepancies in the way that results were evaluated. Most studies measured eyelid height during a clinical exam, whereas a subset of studies took measurements from photographs. Lastly, most studies pooled multiple etiologies of retraction together, which limits the applicability of the results to any one specific patient population. Postblepharoplasty and posttrauma eyelid retraction are associated with more loss of tissue and scarring compared to other etiologies, and are arguably more difficult to treat as evidenced by the relatively higher failure rate in Taban et al.30 which included only postblepharoplasty patients. Additionally, the different types of spacer grafts were not equally studied with quantitative data in the literature. The majority of the studies focused on hard palate mucosa and AlloDerm with the other grafts being assessed in only one or 2 studies each. For example, we were surprised to only find one small study that had quantitative data on the use of ear cartilage despite the versatility of this particular graft. Lastly, the thickness variable was not adequately addressed specifically with the use of ADMs. Thicker ADMs may have the advantage of having more stiffness and providing more lid support. Some authors have promoted the use of Enduragen over AlloDerm as it has a more consistent, predictable thickness.36 The only paper that reported the use of thick AlloDerm was Taban et al30 with no comparative data.

In focusing our review to include only those studies describing outcomes from spacer graft use in a quantitative manner, several noteworthy publications were excluded. In 2008, McCord et al published a retrospective review of 129 retracted eyelids in 69 patients, including 104 in the lower lid, treated using Enduragen.47 The group achieved effective resolution of lid retraction with a 10% complication rate, and endorsed Enduragen as a superior alternative to other tissue substitutes due to its greater rigidity and predictability of structure. Another group reported successful correction of lower eyelid retraction using Tarsys (IOP Inc, Costa Mesa, CA), a porcine decellularized dermal matrix.38 There is also evidence that select cases of lower eyelid retraction can be effectively treated without the use of spacer grafts, but such a discussion was outside the scope of this review.57

CONCLUSIONS

Our systematic review did not reveal one spacer graft material that is clearly superior to others in the treatment of lower eyelid retraction. However, narrative summary of the available evidence reveals unique sets of advantages and disadvantages associated with the various materials currently available, which may allow surgeons to make better informed decisions for their patients. The types of ADMs reviewed in this paper can be used safely and effectively as spacer grafts while avoiding donor site morbidity. Further high quality research, in the form of prospective, randomized, controlled trials will be necessary to further clarify advantages of certain spacer graft materials over others.

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