**Objective:** To evaluate the long-term efficacy of transcaruncular medial canthal ligament (MCL) plication in the treatment of eyelid malposition.

**Methods:** Transcaruncular MCL plication was performed on 176 eyelids of 125 patients with symptomatic ocular exposure due to lower eyelid malposition in which MCL laxity was an important component. Preoperative and postoperative ocular exposure symptoms, lower eyelid position, lagophthalmos, and keratopathy were compared.

**Results:** At an average±SD follow-up time of 25±27 months (range, 1-103 months), 88% of preoperative symptoms resolved or improved. Lower eyelid position (P<.001), lagophthalmos (P<.001), and keratopathy (P<.001) were significantly improved. In 11% of eyelids undergoing MCL plication as the only repair, results were comparable with those in which other repairs were performed concurrently. Complications were suture breakage in 2 cases and pyogenic granuloma in 1 case.

**Conclusions:** Transcaruncular MCL plication is a safe and effective technique for MCL laxity that contributes to lower eyelid malposition. This minimally invasive technique achieves good functional and cosmetic outcomes by re-establishing the vectoral forces for eyelid support that are normally provided by the tripartite ligament.

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MEDIAL CANTHAL LIGAMENT (MCL) laxity frequently contributes to lower eyelid malpositions, which result in symptoms and signs of blurred vision, discomfort, foreign body sensation, tearing, and superficial punctate keratopathy.1-3 Causes of MCL laxity may be involu- tional attenuation or fatty infiltration of the ligament.4 It may also result from persistent traction due to cicatrical or paralytic lower eyelid and midfacial re- traction.1

The complex anatomy of the MCL and its close association to the lacrimal drainage system makes surgical correction of the lax ligament difficult.5-8 This has spawned publication of numerous surgical methods for MCL repair.9-17 Anterior approaches do not improve, and they often exacerbate, poor eyelid-globe apposition following repair since they do not address laxity of the posterior limb of the ligament. In 2001 in an initial report, we described a transcaruncular approach for medially canthal plication for lower eyelid laxity.1 We found this method to be a safe, effective, and reproducible procedure in patients with MCL laxity. We report our long-term experience with this technique on 176 eyelids, describing its benef- eficial effects on symptoms and signs of clinically significant MCL laxity.

**METHODS**

A retrospective review was performed on 125 medical records for patients undergoing transcaruncular MCL tightening by 1 surgeon (V.M.E.) at the Eye Plastic and Orbital Surgery Service of the University of Michigan Kellogg Eye Center. Included in this study were patients with asymptomatic lower eyelid malpositions resulting from MCL laxity or loss. All patients arrived for examinations and were operated on between November 1994 and August 2005. The institutional review board at the University of Michigan approved this study.

Data included patient age, sex, laterality of involvement, and concurrent or prior lower eyelid surgery. The presence and severity of ocular symptoms, including blurred vision, discomfort, foreign body sensation, and tearing, were recorded from preoperative and postoperative examinations. Inability to maintain a prosthesis was documented for anophthalmic sockets since this was the major complaint in these cases. Also recorded were preoperative and postoperative signs, including lower eyelid position, degree of MCL laxity, lagophthalmos, and superficial punctate keratopathy. The position of the lower eyelid was measured in millimeters from the inferior limbus to the...
lower eyelid margin with the eye in primary gaze and with the coronal plane of the patient’s head perpendicular to the floor. Lower eyelid retraction, ectropion, entropion, or punctal ecr
tropion were also documented as present or absent. Medial can
thal ligament laxity was assessed by laterally distracting the lower eyelid while observing movement of the punctum as previously described.1 Lagophthalmos, measured during gentle eye
lid closure, was measured in millimeters. Superficial punctate keratopathy was graded from 0 to ++ and the percentage of corneal surface involved with keratopathy was multiplied by the grade to derive the corneal exposure index.

SURGICAL METHOD

After we obtained informed consent, we performed transcar
runcular MCL plication entirely from a transconjunctival ap
proach as described by Fante and Elner3 or a recent modifica
tion of the method (Figure 1). Anesthesia was accomplished
with intravenous sedation and local infiltration with bupiva
caine 0.5% mixed in equal parts with lidocaine hydrochloride
1% with epinephrine 1:100 000 or with epinephrine supple
mentation to 1:50 000 as previously described.18 Briefly, 2 sepa
rate small incisions were made: a 5-mm incision through the
inferior palpebral conjunctiva to expose the inferior margin of
the tarsus just lateral to the ampulla and a 10-mm medial conj
unctival fornix incision made posterior to the junction of the
caruncle and plica semilunaris. The medial orbital wall peri
orbita posterior to the posterior lacrimal crest was then ex
posed by blunt dissection performed via the medial fornix in
cision through the fascial extensions from the medial rectus
muscle sheath (check ligament). This anterior orbitotomy ap
proach provides safe passage by preserving the integrity of the
medial rectus muscle, the lacrimal canaliculi and sac, and the
deep heads of the orbicularis muscle (Horner muscle) constit
uting the lacrimal pump.

Medial canthal ligament plication using 4-0 clear polypro
pylene suture on a semicircular P-2 needle (Ethicon, Somer
ville, NJ) was performed by initiating the passage of the suture
either through the eyelid or medial fornix incision. In earlier
cases, the suture was initially passed coronally to engage the
full height of the medial inferior tarsus just lateral to the am
pulla and tunneled deep to the conjunctiva, but superior to the
origin of the inferior oblique muscle to reach the medial or
nical incision. Under direct visualization, the needle was then
passed to engage the periostem at or just superior to the pos
terior lacrimal crest while the globe was gently retracted lat
erally with a malleable retractor. The suture was then passed
retrograde subconjunctivally from the medial fornical inci
sion to reach the original subtarsal eyelid incision. The suture
was tied while observing the tension of the lower eyelid. The
tension was ascertained after securing the initial double throw
of a surgeons’ knot by distracting the eyelid laterally while ex
amining for punctal position with respect to the superior pun
tum, the kinking of the canaliculus, and the 3-dimensional con
tour of the medial lower eyelid as compared with the contralat
eral side. Once these parameters were achieved, the knot was tied
permanently and rotated toward the medial orbital wall.

The conjunctival incisions were not sutured. In later cases (Figure 1),
suture passage was initiated by first engaging periostem via
the fornix incision followed by passage to the subtarsal eyelid
incision, engagement of the tarsus, and retrograde passage to
the medial fornix incision. This positions the knot near the or
bital wall without the need for suture rotation.

All groups of data are expressed as averages plus or minus
standard deviations. Statistical significance of differences be
tween preoperative and postoperative groups of measurements
was determined using a 2-tailed t test. Differences between groups
were considered to be statistically significant at P<.05.

RESULTS

The transcaruncular MCL plication was performed on 176
eyelids of 125 patients with an average±SD follow-up time
of 25±27 months (range, 1-103 months). The average±SD
patient age was 66±17 years (range, 10-97 years); there
were 70 men and 55 women. Six patients (5%) had a pre
vious history of lateral canthal ligament repair, 2 of whom
had had concurrent lower eyelid retractor reinsertion (2%). Two patients (2%) had undergone previous lat
eral tarsorrhaphy.

The most common preoperative symptoms were epiphora, discomf
ort, and lower eyelid malposition (Table 1). Postoperatively, 81% of patients’ initial symp
toms resolved (Table 1) while an additional 7% improved. Medial canthal ligament laxity, present in all
eyelids preoperatively, was successfully treated by pli
cation in more than 90% of eyelids (Table 2). Preopera
tive lower eyelid retraction was present in 128 eyelids
(73%) (Table 2). Retraction improved in 120 eyelids (94%)
with complete resolution in 98 eyelids (77%) (Figure 2
and Figure 3). Preoperatively, the lower eyelid margin
averaged 1.3±1.0 mm inferior to the corneoscleral limbus

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in retracted eyelids (Figure 4). This measure was significantly improved to 0.3±0.8 mm superior to the limbus postoperatively (P < .001). Other lower eyelid malpositions included punctal ectropion, entropion, and entropion, which were present in 9%, 18%, and 9% of patients, respectively (Table 2). These eyelid malpositions responded variably to the procedure. Entropion resolved in 87% of cases in which it was present, and entropion resolved in 56% of cases (Figure 5). As reported previously, punctal entropion was not effectively addressed in most cases, resolving in only 38% of cases when present.

Preoperative lagophthalmos was present in 56 eyes (32%) (Table 2). Of these eyes, 42 improved (75%), including 22 eyes (40%) that showed complete resolution (Figure 6). Lagophthalmos was significantly improved from an average of 2.3±1.9 mm preoperatively to 1.1±1.6 mm postoperatively (P < .001) (Figure 7).

Preoperative superficial punctate keratopathy was present in 155 eyes (88%) (Table 2). Superficial punctate keratopathy improved in 112 eyes (72%) of which 53 eyes (30%) showed complete resolution. The initial corneal exposure index averaged 0.3±0.4 mm (Figure 8). The postoperative reduction in corneal exposure index to 0.1±0.1 mm was statistically significant (P < .001).

In this large series, most patients had other eyelid abnormalities in addition to MCL laxity that required repair. Lateral canthal ligament repair was the most common additional procedure (70%) followed by midfacial lift (30%), repositioning of lower eyelid retractors (29%), hard palate grafting (18%), and lateral tarsorrhaphy (14%). Seven patients (4%) requiring plication of the MCL whose integrity was compromised by malignant tumor resection also underwent additional reconstructions with flaps or grafts. Nineteen eyelids of 14 patients had transcaruncular MCL plication as their only surgical repair. Resolution or improvement of symptoms occurred in 16 eyes (84%). Medial canthal ligament laxity was eliminated in 17 eyelids (89%). Superficial punctate keratopathy, present in 15 eyes (79%) preoperatively, was only seen in 9 (47%) postoperatively while the preoperative average corneal exposure index of 0.27±0.04 was improved to 0.03±0.03. Lower eyelid retraction, observed in 11 eyelids (58%) nonparetiately, improved in all (100%) and completely resolved in 7 (64%). Lower eyelid retraction improved from an average±SD of 1.55±1.09 mm inferior to the corneoscleral limbus to 1.06±1.4 mm superior to the limbus. Preoperative lagophthalmos, seen in 6 eyes (32%), improved in all eyes (100%) and completely resolved in 5 (83%). Improvement in all of these parameters was similar to the overall patient population when compared statistically.

No complications occurred during any of the operations. Postoperative complications were suture breakage in 2 cases and a pyogenic granuloma in 1 case. Early postoperative kinking of the lower eyelid margin, sometimes occurring just lateral to the punctum at the site of tarsal suture anchoring, resolved in the early postoperative period. Postoperative swelling, limited to the caruncle and semilunar fold region, resolved in all cases within 3 weeks. No patient developed wound infection or complained of postoperative ocular surface irritation.

**COMMENT**

The MCL comprises 3 limbs that serve to anchor the medial end of the tarsus to the bone of the maxilla anteriorly, the periosteum overlying the lacrimal bone posteriorly, and the dense connective tissue overlying the fundus of the lacrimal sac superiorly. Together these MCL structures provide for posterior, medial, and superior vectoral support for the lower eyelid. Such support is essential to maintain lower eyelid height and contour, proper apposition of the lower eyelid to the globe, and support for lacrimal pump function. Medial canthal liga-

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Table 1. Symptoms Due to Lower Eyelid Malposition at First and Last Visits

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Preoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptomatic</td>
<td>3 (2)</td>
<td>102 (82)</td>
</tr>
<tr>
<td>Symptomatic</td>
<td>42 (34)</td>
<td>11 (9)</td>
</tr>
<tr>
<td>Epiphora</td>
<td>24 (19)</td>
<td>9 (7)</td>
</tr>
<tr>
<td>Discomfort</td>
<td>14 (11)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Entropion</td>
<td>14 (11)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Unable to keep the prosthesis</td>
<td>14 (11)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Dryness</td>
<td>12 (10)</td>
<td>0</td>
</tr>
<tr>
<td>Unable to close the eye</td>
<td>6 (5)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Lower eyelid entropion</td>
<td>4 (3)</td>
<td>0</td>
</tr>
<tr>
<td>Loss of MCL due to tumor resection</td>
<td>6 (5)</td>
<td>NA</td>
</tr>
</tbody>
</table>

Table 2. Clinical Features of Lower Eyelid Malposition at First and Last Visits

<table>
<thead>
<tr>
<th>Clinical Feature</th>
<th>Preoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCL laxity</td>
<td>Absent</td>
<td>0</td>
</tr>
<tr>
<td>Absent</td>
<td>120 (68)</td>
<td>142 (81)</td>
</tr>
<tr>
<td>Mild</td>
<td>36 (20)</td>
<td>6 (3)</td>
</tr>
<tr>
<td>Moderate</td>
<td>84 (48)</td>
<td>5 (3)</td>
</tr>
<tr>
<td>Severe</td>
<td>56 (32)</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Superficial punctate keratopathy</td>
<td>Absent</td>
<td>21 (12)</td>
</tr>
<tr>
<td>Absent</td>
<td>155 (88)</td>
<td>102 (58)</td>
</tr>
<tr>
<td>Lower eyelid retraction</td>
<td>Absent</td>
<td>48 (27)</td>
</tr>
<tr>
<td>Absent</td>
<td>129 (73)</td>
<td>30 (17)</td>
</tr>
<tr>
<td>Lagophthalmos</td>
<td>Absent</td>
<td>120 (68)</td>
</tr>
<tr>
<td>Absent</td>
<td>56 (32)</td>
<td>34 (19)</td>
</tr>
<tr>
<td>Punctal ectropion</td>
<td>Absent</td>
<td>160 (91)</td>
</tr>
<tr>
<td>Absent</td>
<td>18 (10)</td>
<td>10 (6)</td>
</tr>
<tr>
<td>Entropion</td>
<td>Absent</td>
<td>144 (82)</td>
</tr>
<tr>
<td>Absent</td>
<td>32 (18)</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Entropion</td>
<td>Absent</td>
<td>160 (91)</td>
</tr>
<tr>
<td>Absent</td>
<td>16 (9)</td>
<td>7 (4)</td>
</tr>
</tbody>
</table>

Abbreviations: MCL, medial canthal ligament; NA, not applicable.
ment laxity has the potential to compromise each of these functions, particularly when the laxity is not compensated by good orbitalis oculi muscle tone. The patients in this study all exhibited symptoms and signs of MCL functional compromise due to laxity or loss. The most common symptoms were epiphora, discomfort, and visible malposition of the lower eyelid (Table 1) while the predominant signs were lower eyelid retraction, lagophthalmos, and exposure keratopathy (Figures 4, 7, and 8).

To address the functional need to restore posterior and superior support of eyelids with symptomatic medial canthal ligament laxity, we developed and applied a transcaruncular approach for MCL plication. This technique demonstrated promise in our initial study by resolving symptoms in 23 eyelids of 15 patients during a mean follow-up period of 12 months. In this study, we report the results using this method on 176 eyelids of 125 patients followed up for an average of 2 years. Our present results confirm our initial findings and show significant improvement in virtually all symptoms and signs while demonstrating that the benefits remain stable over time. Transcaruncular MCL plication was equally effective whether performed alone or in conjunction with other procedures to repair symptomatic lower eyelid malposition.

Medial canthal ligament plication, as initially described, addressed the anterior limb. Ritleng and Sullivan and Collin first reported methods to provide posterior support as a component of MCL plication to address shortcomings of anterior plication, principally poor eyelid-globe apposition resulting in epiphora and ocular exposure. Both of these techniques involve full-thickness eyelid and canalicular resection to access and shorten the posterior limb, requiring complex repair of the eyelid and lacrimal drainage system. Jordan et al published a simi-
lar method using a medial tarsal strip, which resects a portion of the medial eyelid, sacrificing the punctum and canaliculus. Edelstein and Dryden described a complex transcutaneous approach to expose the medial orbital periosteum from which a flap is woven through the canalicular region to reach the tarsus. Subsequent to our initial report, Moe and Kao reported an interesting anatomical approach consisting of a precaruncular technique in the region occupied by the common canaliculus that requires a long incision parallel and adjacent to the canaliculus and an anchoring suture placed to the medial edge of the tarsus where the ampulla is located.

Our method of MCL plication provides support that simulates the normal vectoral forces exerted by the tripartite ligament. It achieves this through passage parallel to the posterior limb while allowing the surgeon to direct the plication superiorly by modifying the location of the periosteal anchoring. This method of MCL plication provides posterior, medial, and superior eyelid support. The transcaruncular technique is rapid and requires no skin incisions or tissue resection. Damage to the lacrimal drainage system is avoided. There are no wounds that require closure. The procedure requires minimal manipulation of medial canthal structures and may be per-

Figure 5. Severe left and mild right ectropion treated with medial canthal ligament plication and lateral canthal repair in an 81-year-old woman. Appearance before (A) and after (B) surgical correction.

Figure 6. Severe paralytic right lower eyelid ectropion and lagophthalmos treated with medial canthal ligament plication and lateral tarsorrhaphy in a 66-year-old man. Appearance before (A) and after (C) surgical correction. Preoperative lagophthalmos (B) was substantially improved following surgical correction (D).
formed using local anesthesia. Our recent modification of the suture passage has eliminated the need for suture rotation, making the procedure easier to perform and less traumatic. Limited dissection and short operative time reduce postoperative morbidity and complications. The method has proven to be safe with few complications or adverse effects. The MCL procedure has resulted in excellent cosmesis and patient acceptance.

This procedure does not supplant transnasal wiring, microplate, and anchor techniques used for MCL avulsions and craniofacial reconstructions and is not consistently effective in treating patients with significant punctal ectropion (Table 2). This inconsistency is caused by the plicating suture’s engagement of the inferior tarsal margin. This results in a vectoral force that itself is unable to rotate the punctum inward. In cases in which the technique is successful in resolving punctal ectropion, plication-dependent improved pretarsal orbicularis ocular muscle position and tone is probably responsible. To directly address punctal ectropion, we described a modification of this technique in which an anterior limb of the plicating suture is added to brace the anterior surface of the tarsus and canaliculus.

The transcaruncular technique for MCL plication targets the functional and cosmetic needs of patients with medial ligament laxity, regardless of severity. Alone, or in conjunction with adjunctive procedures, this technique has demonstrated efficacy and high patient satisfaction.

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