Simplified technique for lateral canthal tendon canthopexy

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Purpose: Different techniques for lateral canthal suspension have been used in the management of various eyelid malpositions. We describe a simplified technique for lateral canthal suspension and review its outcome along with a review of existing variations. Methods: We conducted a retrospective chart review of 28 eyelids in 22 patients who underwent simplified lateral canthal suspension. Demographics, symptoms at presentation, and associated eyelid malposition were noted. We evaluated the palpebral fissure and margin-reflex distance 2 (MRD2) on the preoperative and final postoperative photographs by using MEEI FACE-gram software. We also reviewed existing literature on different surgical management options for comparison. Results: At three-month postoperative follow-up, presenting symptoms resolved in all cases. The average postoperative decrease in palpebral fissure was 0.73 mm (P = 0.018) and the average decrease of the MRD2 was 1.02 mm (P = 0.0003). Recurrence occurred by three months in one eyelid (4%) with ectropion due to moderate eyelid laxity, and this case was managed with tarsal strip procedure. One patient (5%) who had bilateral surgery had asymmetric lower eyelid position and one patient (5%) had persistent edema of the operated eyelid for six months. Conclusion: This simplified canthal suspension is a simple and effective technique that tightens the lateral canthal tendon and improves the lower eyelid position. It can be used in various mild-to-moderate eyelid laxities and has favorable operative characteristics compared with many existing techniques.

Key words: Canthopexy, ectropion, entropion, eyelid malposition, lateral cantonal tendon, surgical technique

Dry eye, discomfort, irritation, and tearing are common symptoms of eyelid malposition. These symptoms are often associated with horizontal laxity of the lower eyelid, and surgical correction is often used to address this laxity by tightening the lateral canthal tendon (LCT).1,2 The main aims of lateral canthal tightening or suspension are to re-establish or impede alteration in the position, tension, and shape of lower eyelid and lateral canthus. This is achieved with either canthopexy or canthoplasty, tightening the lower eyelid at the lateral canthal angle while directing the canthus posteriorly toward its physiologic insertion at or near Whitnall’s tubercle.3-5

There is a long history to the treatment of lower lid laxity. In 1966, Dr Malcom Bick published a paper discussing a novel approach to treating “senile ectropion and entropion”. Before his publication, surgical treatment typically involved canthoplasty. Canthoplasty entails cutting through the orbicularis oculi muscle, detaching the lateral canthal tendon from the bone at the side of the eye socket, and shortening the lateral canthal tendon. The tarsus is then pulled over and re-attached to the lateral orbital rim at an adjusted height. Dr Bick was the first to propose the less surgically invasive canthopexy procedure as an alternative in the treatment of lower lid laxity.6 In contrast, canthopexy does not involve detachment of the lateral canthal tendon, but rather tightening achieved through the meticulous placement of sutures.

Canthoplasty, however, remains common. In 1979, Anderson and Gordy developed the lateral tarsal strip (LTS) procedure to manage more severe cases of lower eyelid malposition.7 This technique was widely adopted and remains the procedure of choice for eyelid laxity or malposition, especially in more severe cases. Since the development of the LTS procedure, several modified eyelid tightening techniques have been proposed.7-10 These include variations for lower lid laxity correction in anophthalmic socket cases or in combination with other procedures. Techniques involving canthopexy at the time of upper and/or lower blepharoplasty (using the same surgical wound to assess the LCT), canthoplasty combined with lower retractors suture to the periosteum, suture methods variations of the tarsal strip to higher orbital rim sites and modified lateral tarsorrhaphy have been reported. Such procedures include the

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locking Y lateral canthopexy with osseous integration, inferior retinacular lateral canthopexy, inferior retinacular suspension, dermal orbicular pennant, and lateral canthal resuspension sine canthotomy.[13]

We describe a novel simplified lateral canthal tendon canthopexy technique for various lower eyelid malposition and review our outcomes. For full context, we compare this simplified technique to existing variations of canthopexy and to the lateral tarsal strip procedure.

Methods

A total of 39 eyelids of 22 patients who underwent simplified lateral canthal tendon canthopexy for various lower eyelid malposition by one surgeon were included in the study. Graves’ eye disease patients, patients who were under 18 years of age, had a shorter follow-up period than three months and underwent any additional major reconstruction procedures (such as tumor excision) at the same session were excluded. Twenty-eight eyelids were included after exclusion. Demographic features, surgical indication, and follow-up were noted. Patient outcomes were analyzed regarding lower eyelid position (margin reflex distance 2 (MRD2) and palpebral fissure) and superficial punctate keratopathy at presentations at each postoperative visit.

The MEEI FACE-gram software, previously validated to measure the palpebral fissure and margin reflex distance, was used to analyze the difference in pre- and postoperative eyelid positions of the patients.[14,17] Eighteen eyelids of 14 patients who had photographic documentation at preoperative and three-month postoperative visits were analyzed. In each photograph, the palpebral fissure width and the MRD2 were measured. Statistical analysis with t-test was performed to determine the significant difference between pre- and postoperative eyelid positions. For those subjects with anophthalmic socket, the surgical outcome was deemed successful when the ocular prosthesis could be retained on the operative side and patient satisfaction with cosmetic appearance was achieved.

A search of peer-reviewed journals was completed based on a wide range of key terms including “canthopexy”, “lateral tarsal strip”, “lateral canthal anchoring”, “simplified suturing canthopexy”, and “lateral retinacular suspension”. Five databases and journals were searched including Ovid, PubMed, JAMA Ophthalmology, Aesthetic Surgery Journal, and the National Center for Biotechnology Information. Furthermore, the reference section for each article found was searched to find additional articles.

Surgical technique [Fig. 1]

1. A small (5–7 mm in length) lateral canthal skin incision was marked, starting 5 mm lateral the lateral commissure [Fig. 1a], and incision was made with a surgical blade or monopolar cautery.
2. Blunt scissors were used to dissect toward the lateral orbital rim where Whitnall’s tubercle was located. The inner part of the orbital rim’s periosteum was exposed [Fig. 1b and 1c].
3. A 4.0 polydioxanone suture (PDS) on P2 needle was placed through the periosteum, inside the orbital rim over Whitnall’s tubercle at the desired height [Fig. 1d].
4. The needle was then passed through the medial end of the lateral canthal tendon and the lateral border of the lower

| Case | Number of Eyelids | Surgery Indication | Sex | Age | Longest Follow-Up |
|------|-------------------|--------------------|-----|-----|-------------------|
| 1    | 1                 | Entropion OS       | f   | 63  | 1 year- released  |
| 2    | 1                 | Involution entropion OS | m   | 77  | 3 months          |
| 3    | 1                 | Involution entropion OD | f   | 81  | 6 months          |
| 4    | 1                 | Involution entropion OD | f   | 71  | 3 months          |
| 5    | 1                 | Involution entropion OD | f   | 57  | 3 months          |
| 6    | 1                 | Involutional ectropion OD | f   | 77  | 12 months         |
| 7    | 2                 | Involutional ectropion | m   | 88  | 3 months          |
| 8    | 2                 | Involutional ectropion | m   | 81  | 6 months          |
| 9    | 2                 | Involution ectropion | f   | 74  | 10 months         |
| 10   | 1                 | Prosthesis malposition OS | f   | 54  | 3 months          |
| 11   | 1                 | Prosthesis malposition OS | m   | 82  | 6 months          |
| 12   | 1                 | Prosthesis malposition OD | f   | 89  | 3 months          |
| 13   | 1                 | Prosthesis malposition OS | f   | 87  | 3 months          |
| 14   | 1                 | Prosthesis malposition OS | m   | 72  | 6 months          |
| 15   | 1                 | Prosthesis malposition OS | f   | 62  | 3 months          |
| 16   | 1                 | Prosthesis malposition OS | f   | 61  | 6 months          |
| 17   | 1                 | Prosthesis malposition OS | m   | 77  | 6 months          |
| 18   | 1                 | Eyelid laxity causing tearing OD | m   | 77  | 7 months          |
| 19   | 1                 | Eyelid laxity causing tearing OD | m   | 79  | 8 months          |
| 20   | 2                 | Eyelid laxity causing tearing | f   | 56  | 3 months          |
| 21   | 2                 | Eyelid laxity causing tearing | m   | 76  | 3 months          |
| 22   | 2                 | Eyelid laxity causing tearing | f   | 58  | 18 months         |

OD, Right eye; OS, Left eye; F, Female; M, Male
eyelid tarsus in a vertical direction without disturbing lateral canthal angle or eyelid margin. The suture was tied by bringing the lower eyelid to the desired height [Fig. 1e].

5. Orbicularis layer was closed with an interrupted, buried 6-0 poliglecaprone suture (Monocryl®, Ethicon) followed by skin closure [Fig. 1f]

Results

The patients’ demographics, surgical indications and follow-up period are displayed in Table 1. The average age was 72.6 years (range: 56–89 years) and the female-to-male ratio was 13:9. The surgery indications were involutional entropion in five patients or five eyelids (EN group), involutional ectropion in four patients or seven eyelids (EC group), inability of keeping the ocular prosthesis in eight patients or eight eyelids, and epiphora due to lower eyelid laxity in five patients or eight eyelids (EP group). Of the 22 patients, 16 had unilateral procedure and 6 patients underwent bilateral procedure.

All patients reported improvement in tearing and noted a reduction in ocular irritation due to exposure (conjunctival hyperemia, discomfort, and photophobia) at the three-month follow-up. All patients who had difficulty in retaining the prosthesis were able to keep their prosthesis and reported satisfaction with final eyelid positions. The average postoperative change in palpebral fissure was 0.73 mm ($P = 0.018$) and the

Figure 1: (a-f) Photographs demonstrating the surgical steps of our technique. A 5–7 mm skin incision is made, starting 5 mm lateral to the lateral angle (a). Dissection is extended towards the lateral orbital rim (b) and to Whitnall’s tubercle (c). A 4.0 PDS suture is placed through the periosteum, inside the orbital rim over Whitnall’s tubercle at the desired height (d). The suture is then passed through the medial end of the lateral canthal tendon and the lower eyelid tarsus and tied (e). Overlying orbicularis oculi muscle is closed, followed by skin closure using 6.0 monocryl suture (f)
Table 2: A comparison of current and experimental surgical techniques and modalities in the treatment of involutional ectropion

| Surgical Modalities and Techniques | Procedure Outline | Advantages | Disadvantages |
|-----------------------------------|-------------------|------------|---------------|
| Inferior retinacular lateral canthoplasty | Upper blepharoplasty incision Skin-muscle flap at the lateral canthus Inferior crus of lateral canthal tendon displaced Tendon attached to lateral orbital rim periosteum | Avoids horizontal lid shortening | Reduced permanency Lesser lower eyelid tightening Postoperative overcorrection Deep dissection posterior to the lateral canthal tendon Prolonged edema may occur |
| Inferior retinacular suspension (transcantho-cathopexy) | Blepharoplasty incision 1-mm lower eyelid incision Suture passed through incisions behind lateral canthal tendon | | Reduced longevity Two incisions Deep dissection Difficult visualization |
| Dermal orbicular pennant | Raises the skin and orbicularis oculi muscle along with lateral canthus tendon Skin incision to visualize the lateral canthus tendon LCT separated from orbital rim. Structures reattached to level of upper border of pupil | Lateral tarsus can be shortened Decreased length disparity or overhanging of the upper eyelid | Skin and the orbicularis oculi muscle are inherently lax Postoperative droop is common Deep dissection Disruption of the local anatomy |
| Lateral canthal resuspension sine canthotomy | Upper eyelid incision Orbicularis oculi muscle elevated at lateral orbital rim Stevens scissors inserted under orbicularis oculi muscle Vertical spreading to release the orbitomalar, zygomatic malar ligaments and superficial lateral palpebral ligament 4.0 PDS suture around the lateral canthal tendon and periosteum inside orbital rim | Avoids imbrication of the upper and lower eyelids | Deep dissection Disruption of local anatomy Not recommended for patients with floppy eyelid syndrome or facial nerve palsy |
| Locking y lateral canthopexy with osseous integration | 5-0 monofilament polypropylene suture passed under superficial lateral canthal tendon Second inferior needle passed around inferior crus Zygomatic bone exposed for 2 drill holes Sutures pass under inferior and superior lateral canthal tendons | Avoidance of the cheese-wiring effect because of the placement of the sutures in bone rather than periosteum[6] | This surgery is more invasive and requires drilling into the zygomatic bone |
| Simplified technique for lateral canthal suspension | 5-7 mm lateral canthal incision lateral to the lateral commissure Dissect towards the Whitnall's tubercle Orbital rim periosteum exposed 4.0 PDS through periosteum Needle passed through medial end of lateral canthal tendon and lateral border of lower eyelid tarsus in vertical direction without disturbing lateral canthal angle or eyelid margin Suture tied by binging lower eyelid to desired height | Minimal surgical manipulation Less surgical time Fast postoperative recovery Minimal Sparing of the tarsal plate for future procedures Good postoperative lateral canthal angle appearance Cura of the LCT is easily visible and identifiable | Reduced longevity compared to LTS Not indicated for severe lower eyelid laxity |
| Lateral tarsal strip | The first step is to conduct a canthotomy. The epithelium is removed from the tarsus to create a tarsal strip. The tarsus is then connected to the lateral orbital periosteum | Longevity Increased correction | Cosmetically undesirable reduction of the horizontal palpebral aperture Risk for imbrication Increased surgical manipulation and surgical time |

average decrease of the MRD2 was 1.02 mm ($P = 0.0003$). When we evaluated subgroups separately, the average change in the palpebral fissure was 0.58 mm in the EN group; 1.7 mm in EN group, and 0.05 mm in EC group. The mean change in the MRD2 was 1.19 mm ($P=0.011$) in EN cases, 2 mm ($P<0.01$) in EC cases and 0.25 mm ($P=0.11$). The mean follow-up was of 5.6 months (range: 3 to 18 months); 10 patients were followed up for three months and the remaining 12 patients for six or more months.
Among the epiphora due to lid laxity patients, three (33.3%) did not present decrease in the MRD2 or palpebral fissure width. Although statistically significant reduction was not found in this group, all patients showed complete improvement of symptoms and no further intervention was necessary. Example outcomes are illustrated in Figs. 2a–b and 3a–b.

One patient who underwent bilateral surgery showed a slight asymmetry between lower eyelids position. One patient had persistent edema of the operated eyelid for six months. One case developed recurrence of ectropion.

Table 2 describes several common variations of surgical management of lower eyelid malposition along with the advantages and disadvantages of each technique.

**Discussion**

The simplified technique for the lateral canthal tendon canthopexy (ST-LCTC) proposed here effectively reconstructed the lower eyelid position and improved symptoms in all eyes. All but one eye maintained lower eyelid position at the end of a six-month follow-up. Successful results were achieved in 95.4% of our patients. However, proper case selection is essential for the success of the procedure. Our cases were typically mild cases that required suspension or tightening of the lateral canthal tendon alone without additional procedures.

Since its development, the lateral tarsal strip procedure, a canthoplasty technique, has remained the most used technique for eyelid tightening. Although shown to have the greatest longevity to tarsal strip rigidity postoperatively, the procedure is not without its pitfalls.[18] During the suturing step of the technique, the surgeon must pass through the medial end of the lateral tarsal strip from posterior to anterior and make a loop to secure the suture on the anterior surface of the strip. This can lead to damage to structures such as the inferior tarsal plate.[19] In comparison, our simplified technique for the lateral canthal tendon canthopexy only involved the suture to pass anteriorly, thus avoiding possible damage to the inferiorly lying structures. The LTS involves significantly more surgical manipulation, including canthotomy, cantholysis, tarsal strip fashioning, debridement of the palpebral conjunctival epithelium, separation of the anterior lamellae and eyelash follicle, tarsal shortening and excision of mucocutaneous tissue from the eyelid margin.[20] Complications include granuloma formation, suture extrusion, suture abscess, lateral canthal dehiscence and orbital rim tenderness.[21,22] Lateral canthal disruption may cause eyelid overlap, rounding canthus and trichiasis that can be completely avoided by canthopexy. While the ST-LCTC has several potential advantages over the LTS, as Danks and Rose previously showed, moderate to severe laxity of the LCT or recurrent cases benefit from the tarsal strip procedure, since the shortening of the tarsus helps to prevent the recurrence of the malposition.[23]

In part to avoid the downsides of the LTS, several variations have been proposed, which may be more relevant to compare with the ST-LCTC procedure. Such procedures include locking Y lateral canthopexy with osseous integration, inferior retinacular lateral canthopexy, inferior retinacular suspension, dermal orbicular pennant, and lateral canthal resuspension sine canthotomy.

The locking Y lateral canthopexy with osseous integration involves placing a double-armed 5-0 monofilament polypropylene suture between the superior and inferior crura of the lateral canthal ligament and frontal process of the zygomatic bone by drilling holes. A study conducted by Kossler et al. reported 3.8% reoperation rate in a review of 42 patients who underwent locking Y lateral canthopexy procedures. It was shown that in patients with profound eyelid laxity, the locking Y lateral canthopexy procedure could not fully correct the lateral canthal positioning, and thus severe cases will likely benefit from canthoplasty eyelid shortening techniques instead. Although drilling the bone prevents cheesewiring of the soft tissue, as a canthopexy procedure for mild cases, the downsides of this technique are operative complexity and time, and increased tissue manipulation.[23]

Inferior retinacular lateral canthopexy is another alternative canthopexy technique. It involves two incisions—upper eyelid lateral blepharoplasty and lower eyelid incisions—and placement a double-armed 5-0 nylon suture around the lateral canthal tendon through these incisions. In this technique, as the suture is passed posteriorly to the lateral canthal tendon
blindly, visualization and placement of the suture in the correct plane and tissues can be more challenging.\textsuperscript{[20]}

Other common surgical techniques that are used in the correction of involutional ectropion include, inferior retinacular suspension, dermal orbicular pannent, and lateral canthal resuspension sine canthotomy.\textsuperscript{[3]} These procedures have similar disadvantages in that they involve deep dissection which risks damage to the structures of the tarsal plate and increased operative time and complexity, without significantly improved outcomes.\textsuperscript{[23]} A comparison of these procedures are outlined in Table 2.

The simplified technique for LCT canthopexy requires minimal surgical manipulation, less surgical time and simpler visualization and operation. Minimal manipulation of tissues may shorten the rehabilitation period. Additionally, the sparing of the tarsal plate may be valuable for future procedures. Excellent postoperative lateral canthal angle appearance is achieved with this procedure due to the unoperated lateral canthal angle. This technique can be used as a single procedure or can be combined with reattachment of lower eyelid retractors, if necessary.

**Conclusion**

In summary, we described a simplified lateral canthal tendon canthopexy technique that can be used alone or in combination, for various eyelid malposition. This procedure is effective for mild-to-moderate lower lid laxity, requires minimal dissection and tissue manipulation, involves simple direct visualization, and may serve as an additional option for the benefit of patients and their surgeons.

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**Conflicts of interest**

There are no conflicts of interest.

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