ORIGINAL ARTICLE

Effect of lateral tarsal strip surgery on corneal morphological properties

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ABSTRACT

Purpose: To analyze the corneal morphological parameters before and after lower eyelid malposition correction using the lateral tarsal strip technique.

Materials and Methods: 60 eyes of 60 patients with involutional entropion (30 eyes) and involutional ectropion (30 eyes) correction procedures with lateral tarsal strip included in this prospective study. Detailed ophthalmologic examination was performed including best corrected visual acuity (BCVA), slit lamp examination and dilated fundoscopy. Measurements were made before and one month after the surgeries using Pentacam. Central corneal thickness (CCT) and pachymetry of thinnest location, cornea front astigmatism (AST), flat keratometry (K1), steep keratometry (K2) and mean keratometry (Km) values were all evaluated.

Results: Ectropion patients exhibited higher postoperative Km (p=0.019). Additionally, postoperative AST values were significantly lower in both ectropion and entropion groups (p=0.001, p=0.001, respectively). Increased pachymetry values of pupil center and the thinnest location were found in entropion cases (p=0.002, p=0.023, respectively).

Conclusion: Surgical repositioning of the lower eyelids for malposition correction may result with statistically significant decrease in corneal astigmatism postoperatively also some fundamental changes in corneal topography. Awareness of these changes after eyelid surgery is very important in-patient management.

Keywords: astigmatism, corneal topography, ectropion, entropion, lateral tarsal strip, Pentacam

INTRODUCTION

Involutional lower eyelid (LE) entropion represents a condition when the lash line or the lid edge contacts the ocular surface and the eyelid margin bends inward against it. Similarly, involutional LE ectropion is a malposition in which the palpebral and bulbar conjunctiva are exposed when the LE deviates from its usual apposition to the globe.

The main causes of these LE malpositions are usually associated with age-related involutional changes which obviously would have a negative impact on the elastic and fibrous eyelid tissues.[1] It has been shown that aging causes gradual contraction in the horizontal eyelid fissure and also diminish the distance between the lateral canthal angle and the anterior corneal surface.[1] Additionally, aging may result with the loss of eyelid tissue flexibility and orbital fat atrophy.[2] Furthermore, it has been postulated that aging causes a downward displacement of the eyeball by resulting in a descending replacement of the lateral canthus.[3] These processes would naturally alters all the orbital structures including both (UE) upper and lower eyelids. All of these would inevitably have an impact on the corneal surface and therefore the morphology of it. The extent of eyelid-cornea contact would all get affected by all of these eventually.[4-7]

In the current study our main aim was to understand the lateral tarsal strip technique (LTS) procedure's effect on the corneal morphology in patients with entropion and ectropion. Since LTS is a highly effective and commonly used surgical technique for both of the aforementioned LE malpositions, the authors believe that the outcomes of the present study would be beneficial in this area.

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MATERIALS AND METHODS

Patients

The study was designed as a prospective case series and conducted adhered to the tenets of the Declaration of Helsinki. Local Clinical Research Ethics Committee approval was obtained for the study. After the study protocol was fully explained, all the participants provided written informed consent to participate. From June 2021 to June 2022, 60 eyes of 60 patients over 40 years old who underwent surgery for involutional entropion (n=30) and involutional ectropion, (n=30) were included in the current study.

Exclusion criteria included known glaucoma or ocular hypertension, a detected shallow anterior chamber, pre-existing eye disorders such as uveitis, corneal or anterior segment diseases (dystrophies, scarring, dry eye disease), previous eyelid surgical history, as well as current use of topical or systemic steroids and patients with cicatricial or spastic ectropion and entropion. Before the surgeries, the precise position of the lacrimal punctum in all patients were assessed, and those with significantly everted or inverted punctum were excluded. Additionally, patients with conjunctivochalasis were not included in the current study since the condition itself could lead to disruptions on tear distribution on the ocular surface. All patients had comprehensive ocular evaluations prior to surgery, including best-corrected visual acuity (BCVA), slit lamp biomicroscopy, intraocular pressure (IOP) measurements by Goldmann applanation tonometry and dilated fundoscopy. All of the patients with involutional LE entropion and ectropion underwent LTS procedure procedure with the same technique. Evaluations were made before and one month after the LTS surgery.

Corneal Topography

The Pentacam Comprehensive Eye Scanner (Oculus Optikgeräte GmbH; Wetzlar, Germany) is frequently used to analyze the corneal surface. It uses a rotating Scheimpflug camera to measure elevation points and compute a three-dimensional corneal map using the Scheimpflug principle.[8] This technology can create a three-dimensional map of the cornea using a rotating Scheimpflug camera. Following parameters were evaluated: cornea front flat keratometry (K1), steep keratometry (K2), mean keratometry (Km), cornea front astigmatism (AST), central corneal thickness (CCT) and pachymeter of the thinnest location were assessed by Pentacam before and one month after the LTS surgery. Measurements were made by the same technician who does not know which group the participants belong to. Furthermore, all the measurements were performed between 9.00-10.00 am.

Surgical Technique

Surgical procedures were performed by two surgeons using the same surgical techniques for each of the procedures done. LTS procedure was carried out as the surgical treatment for patients. After injecting 2-3 ml of a solution containing 2% lidocaine and 1:100.000 epinephrine into the lateral eyelid, the lateral canthal angle, and along the lateral orbital rim with a 27-gauge needle. A lateral canthotomy was created with monopolar cautery and widened for around 1 cm after ten minutes after the anesthetic injection in order to facilitate hemostasis. To mobilize the LE, the lateral canthal tendon was cut away from the attachments of orbital rim, and the orbital periosteum was exposed. Using a double-ended non-absorbable suture (5/0 prolene) and a half-circle needle, the tarsal strip was attached to the periosteum at the lateral orbital wall while attention was paid on adjusting the height and tension of the lateral canthus for LE entropion repair.[3,6] As for the patients with LE ectropion, the upper edge of the tarsal strip was directly inserted into the lateral periosteum from a posterior to the anterior direction parallel to the prior suture placement.[3,6] To avoid anterior displacement of the cantus in all patients, the two needles were inserted into the periosteum slightly within the orbital rim or into the remnants of the lateral canthal tendon, if as it was still attached at the lateral orbital tubercule. To avoid dehiscence and subsequent ectropion or entropion recurrences, the suture was tightly knotted. Both the lateral canthal angle reformation also orbicularis muscle and skin closure were performed with 6–0 polyglactin. After surgery, all patients were treated with oxytetracycline 1 % ointment for one week. The skin sutures were removed ten days after the LTS surgery.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) for Windows version 22.0 was used to analyze the study data (SPSS Inc., Chicago, IL). Mean, standard deviation, frequency distribution, and percentages were used to report descriptive statistics. In the study of categorical variables, the Chi-square test was applied. Visual (histograms and probability graphs) and analytical (Kolmogorov-Smirnov/Shapiro-Wilk) approaches were pursued to test the standard distribution of the data. The Levene test was conducted to determine variance equality. A p-value < 0.05 was considered statistically significant.

RESULTS

The study group included 30 male (mean age 62.7±8.6 years) and 30 female (mean age 61.6± 8.8 years) cases. Totally the participants consisted of 30 ectropion and 30 entropion patients. Table 1 demonstrates demographic data of participants.

In the entropion group, CCT and thinnest location pachymetry values increased postoperatively, whereas AST measurements decreased. (p=0.015, p=0.023, p=0.001 respectively). Among the patients with ectropion, post-operative Km increase and AST decrease were detected (p=0.019, p=0.001 respectively). Table 2 and Table 3 demonstrate the variables of entropion and ectropion patients before and after LTS respectively.

DISCUSSION

Previous studies have looked into the impact of various UE surgeries on corneal shape and found some substantial changes.[10-12] Blepharoplasty and levator advancement for ptosis are known to cause changes in corneal morphology postoperatively however evidence of similar changes after LE operations are limited.[6-13] Dislocated eyelids would continually press or not provide the needed support to the ocular surface which could lead to severe alterations in corneal shape and eventually surface remodeling for compensation[6,14] All procedures on the LE and UE can possess the potential to change the topography of the peripheral cornea and, indirectly, the central cornea.[6,15] In the current study our main aim was to understand the LTS procedure's effect on the corneal morphology since

Table 1: *Demographic data of the patients'*

	Entropion patients (n=30)	Ectropion patients (n=30)
Number of patients		
Women	16	18
Men	14	12
Age (mean±SD, years)		
Women	66.2±4.8	66.6±4.4
Men	68.7± 3.1	69.5± 6.2

SD: Standard deviation,
Age: indicated in numbers

Table 2: *Pre-operative and post-operative values of entropion patients*

	Pre-operative values of patients' (n=30) Mean ± SD	**Post-operative values of patients' (n=30) Mean ± SD**	**p value**
Astigmatism (diopter)	***3.3±1.7***	***1.8±1.1***	***0.001**¶***
Flattest meridian (K1)	42.8±0.6	42.8±0.7	0.939¶
Steepest meridian (K2)	43.9±0.6	44.3±1.0	0.347¶
Mean keratometry (Km)	43.5±0.5	43.2±0.8	0.185¶
Central corneal thickness (microns)	***537.7±16.8***	***553.0±20.9***	***0.015**¶***
Thinnest localization pachymeter (microns)	***522.8±14.6***	***543.5±23.9***	***0.023**¶***

**Statistically significant SD: Standard deviation ¶ paired sample t test*

Table 3: *Pre-operative and post-operative values of ectropion patients*

	Pre-operative values of patients' (n=30) Mean ± SD	Post-operative values of patients' (n=30) Mean ± SD	p value
Astigmatism (diopter)	***2.0±0.9***	***1.4±1.1***	***0.001****
Flattest meridian (K1)	42.8±0.3	42.9±11.1	0.801
Steepest meridian (K2)	45.3±0.6	45.2±1.1	0.788
Mean keratometry (Km)	***43.6±0.3***	***44.1±0.4***	***0.019****
Central corneal thickness (microns)	542.0±13.4	547.25±13.9	0.067
Thinnest localization pachymeter (microns)	529.2±23.4	528.25±23.4	0.432

*Statistically significant SD: Standard deviation

the procedure includes reforming of the lateral canthus therefore that would have a significant effect on localization of both LE and UE.

Some facts regarding LE surgeries have been established in the literature, including significant alterations in AST and refractive power following LTS procedure.[13] Furthermore, a significant change in the AST axis from "with the rule" to "against the rule", changes in high order aberrations and a decrease in AST values as a result of corneal flattening in the inferior quadrant mentioned previously.[16,17] In the current study, post-operative measurements of the ectropion patients showed significant increase in Km values. Furthermore, significant decrease of AST was observed in both entropion and ectropion groups post-operatively. In Eshraghi et al.'s study[6] increase in steep meridian was observed with Tomey TMS Topography three months post-operatively in their LE ectropion and entropion patients after the surgeries.[6] Therefore, they suggested that LTS procedure has a steepening effect on the corneal surface.[6] Whereas these differences were not proven to be statistically significant like our results. Also similar to our results some significant changes in AST observed in their study.[6] However, in their study mostly an increase in AST power was observed in the entropion group in contrast with ours. This result can be attributable to the difference of follow up periods in the studies.

In this study values of CCT and the thinnest locations showed increase post-operatively in the entropion group. Our results are partly compatible with some of the published studies evaluating anterior segment of the eye after UE surgeries. Arslan et al.[14] found some sectorial increases with anterior segment optical coherence tomography (AS-OCT) in corneal thickness 6 months after UE blepharoplasty.[14] However, in a published study eyes with congenital ptosis were found to maintain thicker CCT compared with the fellow eyes.[18] The mechanical effect of the ptotic eyelid could reshape the corneal surface.[19] On the other hand, Yunoki et al.[7] observed a decrease of CCT with AS-OCT in their retrospective study however no statistical significance was found in patients with involutional lower eyelid entropion post-operatively. Although there are some studies evaluating CCT after UE surgeries, this parameter has not been evaluated after the LE surgeries.

The treatment of involutional ectropion and entropion involves horizontal tightening of the lower eyelid via a lateral canthal resuspension procedure, which can be performed as canthoplasty.[20] A canthoplasty implies performing a canthotomy and cantholysis before resuspending the LE to the lateral orbital rim periosteum.[20] Lateral canthoplasty is a surgical step in LTS surgery which fixes the lateral canthus to the lateral orbital rim after surgical division to correct the LE's laxity and malposition.[21] The procedure is typically used for correction of the downward slant of the LE which is caused by the aging process.[21] To be specific, lateral canthoplasty can achieve an enlargement of eye width. In their study, Shriver et al.[22] proposed that a proper eyelid globe apposition, functional blink mechanics and effective lacrimal pump functioning is highly dependent on the firm attachment of the created tarsal strip to the bony orbital rim during canthoplasty. A reduction in the

margin reflex distance 2 (MRD2) and inferior scleral show is expected by increasing the height of the lateral canthus and the LE margin post operatively.[23] Although the modifications in MRD2 and the inferior scleral show are mild, the positional changes of the eyelids to the globe may have an impact on the entire structure of the eyelids. Additionally, the Whitnall's tubercule receives attachment from the deep head of the lateral canthal tendon, which provides significant tensile support which facilitates eyelid apposition to the globe.[23] Therefore, the position of the globe may be affected by the LTS after the surgery. Furthermore, this minimal effect on the globe position could lead to some changes in the early post-operative period. In Padmanabhan et al.'s study,[24] it has been shown by Scheimpflug Tomography that the both values of CCT and pachymeter of the thinnest location represent extremely sensitive topographic parameters that could be affected by mild changes. Therefore, it might be possible that decrease in the tension on the cornea after entropion surgery may lead to changes in the pachymetry values in these localizations. Our results support Padmanabhan et al.'s[24] findings also postoperative topographic alterations may also be connected to the tear film reorganization or the restoration of symmetry in the LE apposition on the cornea since it also has an effect on effective lacrimal pump functioning indirectly.[22,23] Differences between these studies could be attributable to usage of different devices and different follow-up periods. Patients with ectropion did not exhibit a significant change in these values according to the study's post-operative findings. The baseline inequalities in applied LE pressure on the ocular surface between patients with LE ectropion and entropion could be contributing to this outcome. LE repositioning by LTS in that group would have a relaxing effect on both the globe and corneal surface since LE entropion maintains the LE's boosted pressure on the corneal surface as a result of its inward turning. As a result, LTS surgery could enhance corneal shape for patients with entropion by eliminating this issue, whereas LE ectropion would not retain this impact pre-operatively. To the best of our knowledge this study is the first one evaluating CCT and the thinnest location pachymeter after LE surgeries. The outcomes of this study may suggest that LTS procedure for entropion correction reshapes the cornea in the early post-operative term.

The four-week follow-up period was chosen in this study to investigate post-operative corneal morphological changes since the proliferative phase of wound healing lasts after this time scale.[23] Furthermore, beyond this period, epithelialization and remodeling are relatively negligible determinants of better and tension-free wound adaptation.[25] We believe that extending follow-up intervals would increase the possibility of surgery-independent effects on corneal topography. For these reasons, a long-term follow-up period was unplanned for this study.

Based on the results of the current study, some of the corneal topography parameters could get affected by LTS surgery whether it's performed for LE entropion or ectropion. Regarding these findings, it would be beneficial to keep this influence on the mind, especially in older patients, since cataract surgery and lens measurement with new generation formulas that use corneal parameters to provide more precise results on intra-ocular lens calculation. It would be wiser to analyze these patients in terms of both anterior segment and oculoplastic surgery, given their close relationship and substantial influence on them.

It is crucial to draw attention to a number of limitations of the study, such as the small number of participants. The results of the current study would be improved by studies employing larger scaled participants Furthermore, another limitation is not evaluating the fellow eyes. Additionally, evaluation of the vertical distance change between the LE and UE post operatively would have been beneficial since both of the eyelids have a prominent effect on the ocular surface.

CONCLUSION

To the best of our knowledge, this is the first study to quantitatively and systematically examine topographic alterations after LTS for both entropion and ectropion repair. In conclusion LE correction by LTS could change the corneal structure by reshaping corneal morphology in the short-term post operatively. Further studies with larger participants also including more topographical parameters are needed to show exact relationship and influence.

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