ImageJ Assessment of Argon Laser Efficacy in Treatment of Mild Lower Eyelid Ectropion with Punctal Eversion

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Research Article

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Abstract

**Purpose:** To describe a new, simple and minimally invasive technique for correction of mild medial lower lid ectropion with punctal eversion and measuring the efficacy of the technique by measuring the tear film meniscus pre and post argon laser treatment using imagej software.

**Methods:** This study included 23 eyes, 19 patients with lower eyelid punctal eversion. All patients were treated by argon laser of lower medial conjunctiva. Tear film thickness was assessed using imagej software pre and post argon laser treatment.

**Results:** There was a highly significant difference between before and after argon laser treatment as regarding the height of tear film which was found to be significantly lower after argon laser treatment compared to before it (81.1 pixels versus 193.1 pixels respectively) (p< 0.001).

**Conclusion:** In conclusion, argon laser to lower medial palpebral conjunctiva is a simple, easy, safe, and effective procedure which can be applied as a sole treatment in early cases of punctal eversion with no or mild medial canthal tendon laxity.

**Clinical Trials Registration** no clinical trial registration.

Introduction

Involutional (Senile) medial ectropion of the lower eyelid is an anatomic malposition in which the medial aspect of the eyelid is rolled away from the globe. Occurrence of ectropion involves an interplay of different factors; the aging process results in atrophy of muscular and tendon structures with inferior retractor dehiscence, horizontal eyelid laxity, and disinsertion of fascial attachments between the anterior and posterior lamella (1, 2). As a consequence of ectropion, the punctum become visible and everted causing various symptoms such as epiphora, ocular irritation, foreign body sensation, pain, corneal ulcers, and scarring. These symptoms force the patient to eye rubbing, which may further exacerbate the condition (3).

The most important factors in decision-making for surgical repair of involutional ectropion are the severity of the dysfunction and the degree of canthal tendon laxity. Surgical procedures aim at lid shortening either horizontal or vertical shortening to bring it in a good apposition with the globe. In cases of medial lid laxity, an inverting procedure to the medial part of the eyelid, with correction of any horizontal eyelid laxity obtained by full-thickness lid resection, medial canthal suture, or transconjunctival diamond excision in the medial part of the lid (the ‘lazy-T’ procedure) or the medial spindle procedure both of which require excision of posterior lamella tissue (1, 4–8)

In medial ectropion, the close relation with the punctum and the canalicular system renders these surgical procedures more complicated. These procedures may sacrifice medial lower eyelid tissue or result in disruption of the lacrimal system (9)
ImageJ is one of the most image analysis programs commonly used in the biological sciences. ImageJ software has been previously used in different subspecialties of ophthalmology; Bandlitz and Pult used it to measure tear film (10), and Simoes et al. used it to measure peripapillary choroidal thickness (11) while Rodrigues and co-authors used it to measure corneal incision architecture (12).

For this fact, we described argon laser applied to the conjunctival surface of the medial aspect of the lower eyelid for correction of cases with mild senile medial ectropion with lower punctal eversion accompanied with no or mild medial canthal tendon laxity.

This study aimed to evaluate the use of argon laser as a new technique for the treatment of cases with mild medial lower lid ectropion with punctal eversion.

**Patients And Methods**

This prospective, interventional study included 23 eyes of 19 patients with mild medial lower eyelid ectropion with punctal eversion who underwent argon laser application on lower medial palpebral conjunctiva in the period from February 2018 to August 2020.

The technique, likely post-treatment results, and potential complications were explained to all patients. Written consent was obtained from all patients. Consent included permission to publish their photos. This research was approved by the Institutional Review Board of the Alpha Vision Center and was adherent to the ethical principles outlined in the Declaration of Helsinki as amended in 2013.

**Preoperative assessment**

All patients provided a full medical history and received a detailed ophthalmological examination.

Patients were assessed for eyelid and punctual position, any associated medial canthal tendon (MCT) laxity, and accompanying symptoms. Lower eyelid laxity was evaluated using the lateral distraction test. A lateral distraction test is performed by displacing the medial canthal tendon laterally. The endpoint is the point at which the punctum stops on full lateral distraction and can no longer be pulled laterally with sustained traction, and ranges from grade 1 to 6.(13) (Figure 1)

Fluorescein dye disappearance test and syringing of lacrimal drainage system were done for all patients to exclude anatomical obstruction. Patients were assessed by the lateral distraction test and only patients with grades $\leq$ 2 were included in this study. Patients with more advanced grades of medial canthal tendon laxity, previous lid surgery, lacrimal passages obstruction, severe dry eye, skin scarring, and blepharitis, were also excluded from the study.

**Technique and follow-up:**

Topical anesthesia benoxinate 0.4% eye drops were applied 5 times 2 minutes apart. A corneal shield was applied for protection from laser light. A slit-lamp-mounted argon laser (Ziess Argon/Green Laser Visuals...
532s) was used with the following parameters: spot size 200-400 µm, pulse duration 0.3–0.5 s, and power ranging from 500 to 700 MW. The patient was asked to look upward. The medial part of the lower lid was everted by the index finger to facilitate visualization of the conjunctiva. Argon laser was applied to the conjunctival surface of the medial aspect of the lower eyelid to create a directed posterior lamellar scar and fibrosis for correction of punctual ectropion. (Figure 2)

Primary outcome measures included measurement of the marginal tear film height by ImageJ software to assess the functional success. Secondary outcome measures included restoration of the normal lower punctual position to assess the anatomical success and improvement, or disappearance of patient’s complaints (epiphora or discomfort) as reported by patient satisfaction.

Antibiotic eye drops gatifloxacin five times daily and paracetamol 500 tablets three times daily were added as a post-laser treatment for one week. We didn't use any anti-inflammatory as we believed these drugs may decrease the post-laser fibrotic effect on the conjunctiva.

The follow-up period was 6 months. Photographic documentation was carried out before laser treatment and at the end of the follow-up.

Analysis of preoperative and 6-months postoperative photos was performed using ImageJ Version 1.2.4 software to evaluate the height of tear film. (Figure 3) All patients were assessed pre and post-laser treatment by a senior blinded investigator for the evaluation of correction of lower punctual position.

All data were collected, tabulated, and statistically analyzed using SPSS version 20.

**Results**

This prospective, interventional study was performed on 23 eyes of 19 patients (4 had bilateral lower lid punctal eversion) including 13 men and 6 women, with a mean age of 64.8 years (range 54-73).

The watery eye was the commonest complaint, followed by ocular irritation.

There was a highly statistically significant difference between the preoperative and postoperative value of the height of the marginal tear film "using ImageJ software" which was found to be significantly lower after argon laser therapy compared to before it (81.1 pixels versus 193.1 pixels respectively). (Figure4).

As regards the anatomical success results, the punctum was not seen (return to the normal anatomical position) in 69.6% after the intervention compared to 0% before it with a highly statistically significant difference between them. (Table1)

Table (1): Comparison of punctal visibility before and 6 months post argon laser among the studied group (anatomical success):
<table>
<thead>
<tr>
<th>Variable</th>
<th>Before intervention (n=23)</th>
<th>After intervention (n=23)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td></td>
</tr>
<tr>
<td>Punctum:</td>
<td>23 (100)</td>
<td>2 (8.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Seen:</td>
<td>0 (0)</td>
<td>5 (21.7)</td>
<td>(HS)</td>
</tr>
<tr>
<td>Partially seen:</td>
<td>0 (0)</td>
<td>16 (69.6)</td>
<td></td>
</tr>
<tr>
<td>Not seen:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regarding patient satisfaction more than half of the studied participants (60.9%). (Table 2)

Table (2): Degree of patient’s satisfaction among the studied group:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before intervention (n=23)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
</tr>
<tr>
<td>Degree of satisfaction:</td>
<td>3 (13)</td>
</tr>
<tr>
<td>Not satisfied:</td>
<td>6 (26.1)</td>
</tr>
<tr>
<td>Partially satisfied:</td>
<td>14 (60.9)</td>
</tr>
<tr>
<td>Highly satisfied:</td>
<td></td>
</tr>
</tbody>
</table>

Postoperatively, there was a highly significant correlation between different degrees of patient satisfaction and the height of tear film which was found to be significantly lower among those who were highly satisfied compared to those with partial and no satisfaction (70.2 pixels versus 78.8 pixels and 136 pixels respectively).

By comparing percent reduction of tear film among the different degrees of satisfaction, it was found to be higher among those who were highly satisfied compared to those who were partially or not satisfied (63.1%, 57.9%, and 35.6% respectively) with a highly significant difference between them. (table 3)

Table (3): Comparison of height of tear film and different degrees of satisfaction among the studied group:
No complications were present in our study except for two patients with mild early red eye following argon laser which resolved within two weeks.

### Discussion

Ectropion is a common disorder encountered in the clinic, and its early and adequate management is of utmost importance. Repair of involutional ectropion remains a challenge in oculoplastic surgery. Depending on its etiology and the underlying pathology, a variety of surgical procedures are described. The close position of MCT and orbicularis muscle with the canaliculi and lacrimal apparatus is an alarming point for surgeons in ectropion repair, as complex surgical procedures with medial eyelid resection may sacrifice medial lower eyelid tissue with disruption of the lacrimal system that may interfere with functional and cosmetic success.

In this study, we described the effect of argon laser on lower medial palpebral conjunctiva in early cases with grade ≤2 MCT laxity. This technique aims to create a firm conjunctival scar below the lower punctum, sparing the canaliculus. This technique aims to create a firm conjunctival scar below the lower punctum, sparing the canaliculus to reverse scar everted punctum to normal position.

Jordan described current techniques for MCT laxity repair as technically difficult and do not always achieve a satisfactory outcome. These techniques only aim at firm medial fixation with little consideration to fine anatomical and physiological details of the medial canthus. Due to the hazards associated with these procedures, most surgeons avoided early MCT repair, and surgery may be delayed until the MCT laxity become advanced.
In our study, we used an objective measurement for evaluation correction of punctual eversion in the form of decrease of tear film meniscus measured by image j software. It is considered a unique method as none of the previous literature mentioned objective documentation of amelioration of symptoms after correction of ectropion. In this study also, we correlate the objective data in the form of tear film meniscus level with patient satisfaction after amelioration of epiphora.

There was a highly significant difference between values recorded before and after argon laser intervention regarding the height of tear film which was found to be significantly lower after the intervention compared to before it (81.1 versus 193.1 respectively). The more the degree of reduction of tear film height the more the satisfaction of patients.

To our knowledge, using of argon laser without excision of tissue, or the use of full-thickness everting sutures has not been described before. While, in their retrospective consecutive case series performed over 6 years in medial ectropion with moderate to severe medial canthal tendon laxity, Vahdani K and Thaller VT described MCT as an adjunctive procedure to standard surgery for correcting their eyelid malposition that included lateral Bick’s shortening ± medial retractor plication. Strong diathermy was applied with bipolar forceps, avoiding the canaliculus to whiten the conjunctiva and underlying Horner’s muscle. They concluded that MCT only stabilizes the medial canthus in treated cases, so it must be combined with an eyelid shortening procedure if significant laxity persists (9).

Medial lower eyelid ectropion with mild to moderate degree of MPL (Medial Palpebral Ligament) laxity is corrected with horizontal eyelid shortening procedures such as retro-punctal cautery, lazy-T procedure, medial spindle, and resection of the posterior lamellar flap. These procedures can be augmented by horizontal eyelid tightening using a lateral tarsal strip or a full-thickness pentagonal resection (17).

Medial spindle surgery involves the excision of a diamond shaped part of the conjunctiva and retractors with the sutures tied anteriorly on the skin (18). The lazy-T technique, described by Byron Smith in 1976, is another option for the treatment of medial ectropion of the lower lid. Both Horizontal and vertical eyelid shortening is achieved by full-thickness excision of a portion of the lower lid as well as the posterior lamella in a sideways (19). Both of these procedures are invasive and involve the excision of part of posterior lamella tissue to achieve inversion of the eyelid. However, the procedure described in our study is less invasive and can achieve the same effect.

In Goel and colleges study they noted that at 1 year follow up anatomical success was achieved in 28 (90%) patients and functional success in the form of the disappearance of epiphora was noted in 27 (87%) patients after lower eyelid suspension using polypropylene suture for the correction of punctal ectropion. They also mentioned that results did not correlate to the type of laxity nor the degree of ectropion (20). Raus and colleges concluded that repair of early to intermediate ectropion of the lacrimal punctum using the Raus–Garito clamp has a good functional and cosmetic outcome (21).

Argon laser on the lower medial palpebral conjunctiva has many advantages. It is a simple, easy, and quick technique that can be performed under topical anesthesia in the outpatient clinic. Furthermore, it is
minimally invasive (non-incisional) and avoids excision of any part of the posterior lamella or conjunctiva. Unlike medial canthal resection procedures, it is safe for the canalicular and the lacrimal system with no risk of trauma or injury.

Limitations of the current study were the inclusion of only patients with no or early MCT laxity study. Advanced cases with punctal eversion more than grade 2 were not included. Further studies including these cases with more patients and a longer duration of follow-up are needed.

**Conclusion**

In conclusion, Argon laser on the lower medial palpebral conjunctiva is a simple, easy, safe, and effective procedure that can be applied as a sole treatment in early cases of punctal eversion with no or mild medial canthal tendon laxity.

It has good anatomical and functional outcomes, preserves the canaliculus, and eliminates or reduces the need for eyelid resection. It gives satisfactory relief of symptoms, with minimal or no complications.

**Declarations**

**Data Availability**

Data available on request from the authors

**Animal Research**

The study was not conducted on animals

**Consent to Participate**

Informed consent was obtained from all individual participants included in the study

**Consent to publish**

Patients signed informed consent regarding publishing their data and photographs.

**Author Contributions**

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Moustafa Abdullah Salamah], [Hani A.Al bialy],[Mohammed A.Hegab] and [Hesham A.Enany]. The first draft of the manuscript was written by [Moustafa Abdullah Salamah] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

**Conflict of Interest**
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethics approval

This research was approved by the Institutional Review Board of the Alpha Vision Center (number 2/1-2-2018, approval date 1-2-2018) and was adherent to the ethical principles outlined in the Declaration of Helsinki as amended in 2013.

References


Figures
Figure 1

Lateral distraction test and grading of lower lid laxity.
Figure 2

Post argon laser curved arrow represent punctum and astric represent laser mark on conjunctival surface.

Figure 3

a) pre argon laser treatment tear film thickness equal 176 pixels. b) 6 months post argon laser treatment tear film thickness equal 80 pixels.
Figure 4

Bar chart showing the mean tear film height measurements pre and 6 months post argon laser therapy.