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Treatment outcomes of modified argon laser photocoagulation for conjunctivochalasis

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Abstract

To determine the effectiveness of conjunctivoplasty using a modified argon laser photocoagulation method on patients with conjunctivochalasis (CCh). This study included 25 cases of symptomatic inferior CCh. After staining the surface of a redundant conjunctiva using a dark-purple marker, low-energy argon laser photocoagulation (500 μm spot size for 0.5 seconds at power 300 mW) was applied under topical anesthesia for a mean of 80 times. The patients were aged 67.6 ± 7.1 years (mean ± standard deviation). During a mean follow-up period of 7.8 months (range of 6–12 months), the CCh grades of 21 eyes (84%) decreased after laser conjunctivoplasty. Calculated reduction rates of grades 1, 2, and 3 were 90%, 75%, and 67%, respectively. Patient subjective symptoms were improved in 80% of cases. No postoperative complications such as conjunctival scarring or persistent ocular irritation were observed. Our modified argon laser photocoagulation method employs staining the conjunctival surface to increase the thermal laser energy absorbed by the target. This novel technique is simple and effective for treating mild-to-moderate-grade CCh in outpatient clinics.

Abbreviation: CCh = conjunctivochalasis.

Keywords: argon, conjunctivochalasis, conjunctivoplasty, laser, photocoagulation, staining

1. Introduction

Conjunctivochalasis (CCh) is one of the most common age-related ocular conditions and is characterized by excess conjunctival folds accumulating between the eyeball and the lower eyelid margin.[1] This can induce unpleasant and uncomfortable symptoms such as foreign body sensation, blurred vision, burning, ocular irritation, pain, and marginal corneal ulcers.[2–5] Redundant conjunctival tissue can induce epiphora through mechanically blocking tear drainage.[6] Moreover, the negative pressure and mechanical friction exerted by CCh also causes corneal and/or conjunctival abrasion, leading to ocular irritation and discomfort.[7] CCh also worsens dry eye disease by reducing tear film stability and storage capacity.[8]

The argon laser is one of the most used lasers in ophthalmology and it is available in most ophthalmology clinics. It has been used in many types of intraocular and extraocular surgeries due to its convenience, effectiveness, and safety, such as conjunctival nevus removal, iridotomy, trabeculoplasty, and retinal photocoagulation.[9–11] Shin et al[12] recently suggested using the argon laser procedure to treat CCh because they observed conjunctival shrinkage after applying the argon laser. Yang and Choi[13] also reported that argon laser photocoagulation successfully corrected CCh by shrinking the redundant conjunctiva.

We previously reported on modified argon laser photoablation method to remove conjunctival cysts by staining with a dark-purple marker, which increased thermal laser energy absorption by the cyst and indicated good results.[14] Considering this, staining the surface of the redundant conjunctiva with a dark-purple marker could also be helpful for CCh management using an argon laser. This study therefore investigated a new and effective method of low-energy argon laser photocoagulation for reducing CCh.

2. Materials and methods

We reviewed the medical charts of 25 eyes from 19 patients who were diagnosed with CCh and received modified laser photocoagulation treatment at the Konkuk University Hospital between March 2012 and August 2019. The study followed the Declaration of Helsinki principles and was approved by the Institutional Review Board/Ethics Committee of the

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Konkuk University Medical Center (IRB number 2022-03-059). Informed consent was obtained from each patient before undergoing the laser procedure.

All patients had CCh-related symptoms such as epiphora, ocular irritation, or discomfort. We recommended argon laser treatment if a patient was dissatisfied with medical treatments such as artificial tears, ointments, antihistamine drops, or anti-inflammatory drops. All patients underwent a complete ophthalmic examination including visual acuity measurements, external eye examination, intraocular pressure measurements, and slit-lamp anterior segment examination to evaluate their ocular surface and CCh grade. Patients were excluded if they had a history of trichiasis, entropion, blepharitis, pterygium, pinguecula, keratoconjunctivitis sicca, Sjögren's syndrome, prior history of ocular conjunctiva surgery, and several other systemic conditions relating to eye disease such as Graves' diseases.

CCh grades were determined as lid-parallel conjunctival folds under slit-lamp examination, as previously described.[13,15] Patients were classified as grade 0 (no persistent fold), 1 (single, small fold), 2 (more than 2 folds there were below the tear meniscus), or 3 (multiple folds that were above the tear meniscus). Patients were asked if their symptoms improved and if they thought the surgery was successful at the last follow-up. We defined surgical success as improvement in CCh grade without recurrence over 6 months and when a patient expressed subjective improvement and satisfaction during an office examination.

The overall procedure is depicted in Fig. 1 and shown in Video S1, Supplemental Digital Content, http://links.lww.com/MD/I308. The eye was initially anesthetized using 0.5% topical proparacaine. While their lower eyelid was pulled down, the patient was asked to look upward until the CCh was in the center of the slit-lamp microscope's field of view, and a dark purple skin marker was used to apply the ink directly to the redundant conjunctival surface (Fig. 1), which increased energy absorption at the conjunctiva by the argon laser, thereby reducing the required laser power. The beam was aimed at the outer inferior conjunctiva at least 2 mm from the limbus to avoid thermal damage. This low-energy argon laser photocoagulation method was applied a mean of 80 times with a 532 nm green argon laser (VISULAS 532s, Carl Zeiss Meditec, Jena, Germany) using a 500 μm spot size for 0.5 seconds at 250 to 400 mW. The power of the laser was increased by 50 mW starting from the baseline of 250 mW until the conjunctiva became blanched shrunken and had small cavitations in response to the laser. Coagulation was considered adequate when the conjunctiva became blanched and shrunken and had small cavitations. After the treatment, 0.3% gatifloxacin and 0.1% fluorometholone were topically applied 4 times daily for a week. All these procedures were performed by H.J.S. Patients were screened at 1 week, 1 month, 3 months, and 6 months after the procedure. After the 6-month follow-up, patients were instructed to visit if they had any discomfort. Only patients who visited the hospital for more than 6 months after the procedure were included in this study.

All statistical analyses were performed using SPSS version 20.0. Paired *t* tests were used to analyze the pre- and postoperative CCh grades of the patients.

3. Results

Table 1 lists the demographics, laser settings, and clinical data including initial CCh grades of the 25 included eyes (from 8 males and 11 females, mean age of 67.6 ± 7.1 years). All patients were followed up until 6 months after the surgery. Table 2 lists the clinical outcomes of all eyes.

3.1. Surgical outcomes

The CCh grades of 21 of the 25 eyes (84%) had decreased at 6 months after the modified argon laser conjunctivoplasty. There were 10, 12, and 3 preoperative eyes with grades 1, 2, and 3, respectively, and 12, 8, 4, and 1 postoperative eyes with grades 0, 1, 2, and 3, respectively (Table 2). CCh grades were significantly reduced at 6 months after laser conjunctivoplasty (Figs. 2–5) ($P < .001$). Of the 25 included eyes, 9 improved from CCh grade 1 to grade 0 (90%), 3 improved from grade 2 to grade 0 (25%), 7 improved from grade 2 to grade 1 (58%), and 2 improved from grade 3 to grade 2 (67%) after laser conjunctivoplasty. The total grade reduction after laser conjunctivoplasty (preoperative grade minus postoperative grade) was 0.96 ± 0.53 (mean ± standard deviation), and the postoperative grade decreased significantly from the initial grade ($P = .001$). Subjective satisfaction was reported by 20 patients (80%). The overall success rate of a single laser treatment was 80%.

3.2. Intra- and postoperative complications

Most of the patients complained of minimal pain during the procedure and a slight foreign body sensation for 1 week after the procedure. Mild conjunctival swelling developed postoperatively in 3 eyes, but this sign was subsided with postoperative treatment (0.3% gatifloxacin and 0.1% fluorometholone were topically applied 4 times daily) within 1 week. No conjunctival or scleral complications such as conjunctival granuloma, subconjunctival hemorrhage, or scleritis occurred during the follow-up period. No other noteworthy procedure-related pain was observed after the procedure.

4. Discussion

This study aimed to determine the effects of low-energy argon laser photocoagulation on CCh while staining the conjunctival surface. The mean CCh grade was 1.7 in our patient cohort. CCh was treated using an argon laser, which significantly reduced its severity in 84% of the eyes after a single argon laser

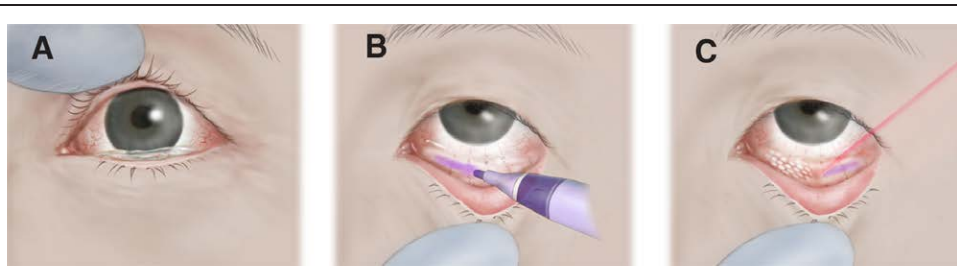

Figure 1. Our modified argon laser photocoagulation method for treating conjunctivochalasis (CCh). (A) Redundant conjunctival folds occupying the lower fornix. (B) A skin marker pen applied ink directly to the surface of the CCh area. (C) Low-energy argon laser photocoagulation was applied to the CCh. CCh = conjunctivochalasis.

Table 1

Demographic and clinical features of 25 eyes among 19 patients.

Characteristic	Value
Age at surgery, yr	67.6 ± 7.1 (55–80)
Sex, male/female	8 (13 eyes)/11(12 eyes)
CCh grade	1.72 ± 0.68
Subjective symptoms, E/F/D	12/10/3
Argon laser settings	
Spot size, μm	500
Power, mW	300 ± 52 (250–400)
Duration, milliseconds	500
Frequency	80.0 ± 14.1 (60–120)
Follow-up, months	7.1 ± 1.5

Data are mean ± SD, mean ± SD (range), or n values.
CCh = conjunctivochalasis, D = ocular discomfort, E = epiphora, F = foreign-body sensation, SD = standard deviation.

Table 2

CCh grade changes at 6 months after argon laser conjunctivoplasty.

Preoperative (n = 25)		Postoperative (n = 25)			
Grade	n	Grade 0	Grade 1	Grade 2	Grade 3
Grade 1	10	9	1		
Grade 2	12	3	7	2	
Grade 3	3			2	1

CCh = conjunctivochalasis.

session under slit-lamp visualization. The symptoms of 80% of the enrolled patients significantly improved after treatment, indicating that an argon laser can provide symptom relief or attenuation when used to treat CCh.

Various therapeutic procedures for CCh have been previously suggested.[4,6,7] In severe CCh cases, crescent-shaped redundant conjunctiva resection has been reported as a useful treatment,[16–18] but this procedure requires conjunctival stitches that often induce severe postoperative ocular irritation and which may persist several weeks after the procedure. The fibrin glue method alongside amniotic membrane transplantation is newer and omits the need for stitches, but is not widely utilized because amniotic tissue is not readily available. Another treatment option using fibrin glue, paste pinch-cut conjunctivoplasty, still has the disadvantages of surgery.[5] In moderate cases, high-frequency radio-wave electrosurgery or electrical bipolar cauterization has been used for CCh treatment.[19,20] However, these methods require special surgical instruments and facilities such as surgical tables, ophthalmic microscopes, and sterilizers. Moreover, penetrating the conjunctiva and contamination can be problems in radio-wave electrosurgery. Unexpected conjunctival perforation or laceration via the coagulation needle tip may also occur. These surgical treatments have additional limitations for patients with disabilities who cannot lie down due to heart failure or spinal problems.

In contrast to the above-mentioned approaches, laser conjunctivoplasty can be performed only if the clinic has an argon laser for panretinal photocoagulation. And laser conjunctivoplasty requires less consideration for patient position or disinfection. Argon laser photocoagulation is suitable for outpatient use. Argon laser photocoagulation has been used during procedures for treating anterior segment diseases such as removing conjunctival cysts and conjunctival nevus.[21] Furthermore, a study on medial ectropion repair using palpebral laser conjunctivoplasty indicated that laser-induced conjunctival shrinkage is safe since it does not induce excessive conjunctival burns or scarring.[22]

Conjunctival shrinkage may reduce its redundancy, and conjunctival coagulation may reinforcement the conjunctival attachment to the globe, reducing conjunctival laxity.[23] The photothermal mechanism underlying CCh shrinkage induced by the argon laser is similar to that of a thermal cautery device or high-frequency radiowaves.[19,20] However, slit-lamp biomicroscopy with an argon laser enables more-delicate control and produces additional benefits such as the ability to control its size, duration, energy level, and wavelength.[24]

Our modified mean power for the argon laser of 300 mW contrasts with previous studies (Table 3). Yang and Choi[13] applied a laser at 600 to 1200 mW 100 times. Aly[23] similarly the applied laser at 650 to 800 mW 120 times. In contrast to the conjunctival nevus, laser energy absorption by CCh may be insufficient as this redundant conjunctiva tends to not be pigmented. Applying such a high-powered laser can

Figure 2. A 61-year-old female presenting ocular discomfort. (A) Preoperative anterior segment photograph of the CCh. (B) Immediate postoperative photograph of the fluorescein staining (a white scar formed in the coagulated region). (C) CCh correction 6 months after modified laser conjunctivoplasty. CCh = conjunctivochalasis.

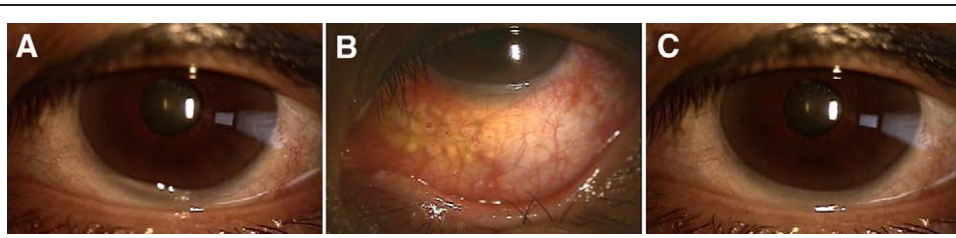

Figure 3. A 58-year-old female presenting foreign-body sensation and epiphora. (A) Preoperative anterior segment photograph of the CCh. (B) Immediate postoperative photograph. (C) CCh correction 6 months after modified laser conjunctivoplasty. CCh = conjunctivochalasis.

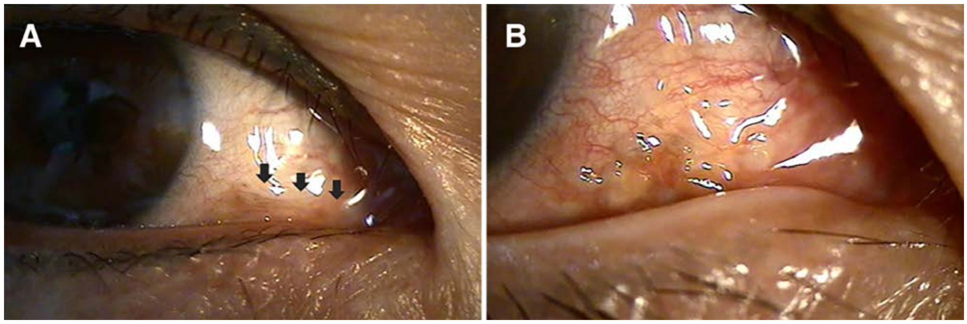

Figure 4. A 65-year-old male presenting epiphora. (A) Before argon laser photocoagulation. Photograph of the redundant nasal conjunctiva adjacent to the lower punctum. The arrows indicate the CCh boundary. (B) CCh correction 1 week after laser conjunctivoplasty. These photographs indicate that CCh induced shrinkage. CCh = conjunctivochalasis.

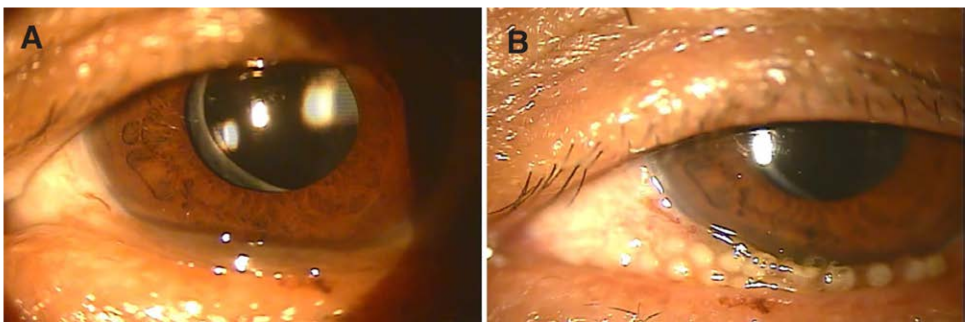

Figure 5. A 69-year-old male presenting with foreign-body sensation. (A) Preoperative excessive redundant conjunctiva. (B) Multiple laser marks immediately after laser conjunctivoplasty. The CCh has more or less been resolved. CCh = conjunctivochalasis.

Table 3

Argon laser photocoagulation for treating conjunctivochalasis (CCh).

Reference	Cases	Follow-up, months	Argon laser power, mW	Average number of laser applications	Argon-laser-related complications	Outcome
Aly (2018)[21]	20 eyes (10 patients)	10.3	650–800	120	Conjunctival injection after the treatment No serious complication*	Conjunctival laxity disappeared in 40% and improved in 60% of the eyes
Yang and Choi (2013)[11]	29 eyes (18 patients)	6.8	600–1200	101	Chemosis and hyperemia posttreatment Mild subconjunctival hemorrhage in 41% of the eyes, subsided completely within 1 month No serious complication*	Decrease in CCh grade in 86% of the eyes (25/29)
Shin et al (2012)[10]	5 eyes (5 patients)	3	400–450	N/A	No complication.	All patients had markedly improved subjective symptoms, ocular surface disease index scores, and CCh grades

N/A = not available.

*Serious complication: decreased vision, increased ocular pressure, corneal opacity, epithelial defect, keratitis, uveitis, or scleritis.

cause pain, treatment time, and damage surrounding tissues. To overcome these problems, the redundant conjunctiva occupying the inferior fornix was stained with a dark purple marker to allow efficient transfer of laser energy to the conjunctiva.[25,26] This staining technique was used to increase the absorption of laser energy when treating conjunctival cysts using thermoablation.[14] In addition, even if the laser reaches the adjacent tissue, its energy will still be absorbed far more in the marked area.

Conjunctival hyperemia occurred in all patients in the present study immediately after argon laser treatment. The conjunctival injection can be explained by the heat response delivered by the laser.[12] However, although there was no major complication during our procedure, conjunctival shrinkage could theoretically induce tear film abnormalities because the conjunctiva secrets mucous via goblet cells; however, pathological changes of conjunctival tissue after laser treatment have not been reported. Udell et al[27] reported that goblet cell density and epithelial cell morphological functions returned to normal levels after thermal cauterization of the redundant conjunctiva in patients with superior limbic keratoconjunctivitis. Similarly, Yang and Choi[13] reported ocular surface findings that tear film breakup time and Schirmer's test results did not deteriorate after laser conjunctivoplasty. Goblet cell recovery might therefore be expected during laser conjunctivoplasty, although this currently is unclear. Studies to determine the optimal laser settings (power and duration) are still required.

The limitations of the current study included the small sample and short follow-up period, which prevented the drawing of definitive conclusions regarding the long-term effects of argon laser therapy. In addition, this study was a retrospective chart review study and could not be compared with a control group.

Further studies with prospective design should therefore be performed on a larger number of patients with longer-term follow-ups and include investigation of other further additional factors such as tear breakup time, Schirmer's test results, and tear meniscus height.

In conclusion, our modified CCh photocoagulation method using a low-energy argon laser combined with a dark-purple marker reduces damage to the surrounding tissue and effectively treats symptomatic CCh, especially in mild-to-moderate-grade cases. The advantages of this novel approach include that it is noninvasive, cost-effective, quick, can be performed easily at outpatient clinics, and is well tolerated by patients. Our modified laser conjunctivoplasty method could therefore be used to treat symptomatic CCh before using other surgical methods.

Author contributions

Conceptualization: Hyun Jin Shin.
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Writing – original draft: Jisang Han, Hyun Jin Shin.
Writing – review & editing: Jisang Han, Chul Young Choi, Hyun Jin Shin.

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