

Simple Surgical Approach with High-Frequency Radio-Wave Electrosurgery for Conjunctivochalasis

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Objective: To introduce a new simple surgical approach with high-frequency radio-wave electrosurgery to reduce conjunctivochalasis (CCh).

Design: Prospective, noncomparative, interventional case series analysis.

Participants: Twelve patients (20 eyes) with CCh were recruited from the outpatient service of the Department of Ophthalmology, Kangbuk Samsung Hospital, Seoul, Korea.

Methods: On the inferior bulbar conjunctiva, subconjunctival coagulation was performed with a fine-needle electrode using a high-frequency radio-wave electrosurgical unit (Ellman Surgitron; Ellman International, Inc., Hewlett, NY) in coagulation mode.

Main Outcome Measures: Conjunctivochalasis grade; epiphora and dry eye symptoms (the Ocular Surface Disease Index [OSDI]; Allergan Inc., Irvine, CA, holds the copyright); and intraoperative and postoperative complications.

Results: Eighteen eyes (90%) recovered a smooth, wet, and noninflamed conjunctival surface within 1 month and remained stable for a follow-up period of 3 months. At 3 months postoperatively, 18 eyes (90%) had grade 0 CCh. There was a statistically significant decrease of the OSDI score at 3 months postoperatively ($P < 0.001$).

Conclusions: A surgical approach with high-frequency radio-wave electrosurgery produced a significant reduction in CCh and an improvement in symptoms. Radio-wave surgical techniques represent a favorable alternative to surgical treatment of CCh.

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The term *conjunctivochalasis* (CCh), taken from the Greek term meaning “relaxation of the conjunctiva,” was first coined by Hughes in 1942.¹ It describes a redundant, loose, nonedematous inferior bulbar conjunctiva interposed between the globe and the lower eyelid. Patients vary in the degree of their symptomatology, ranging from asymptomatic to ocular irritation, pain, subconjunctival hemorrhage, epiphora, dry eye, and ulceration.^{2–4} Conjunctivochalasis is associated with disruption of the tear meniscus,^{2,5} delayed tear clearance,^{3,6} and punctal occlusion.⁷ Although the underlying mechanisms that lead to CCh have not been identified clearly,^{2,8} evidence for age-related elastotic degeneration of the conjunctiva^{9,10} and chronic inflammation^{8,11,12} has been put forward in previous studies.

Treatment of CCh varies depending on the severity of symptoms. Asymptomatic eyes can be left untreated and followed periodically for signs of progression. Symptomatic patients are often treated with artificial tears, lubricating gels, corticosteroid drops, antihistamine drops, or nocturnal patching as first lines of treatment.² When these approaches fail, surgical removal of the redundant conjunctiva becomes necessary. Different surgical procedures

have been described to reduce CCh, such as simple excision,^{3,13} excision and amniotic membrane transplantation (AMT) with suture or fibrin glues,^{14–17} fixation of the conjunctiva to the sclera,¹⁸ or superficial cauterization with a bipolar electrical cauterizer.¹⁹ However, these surgical procedures introduce certain disadvantages, including prolonged operating time, postoperative discomfort, and suture-related complications.

Radiofrequency instrumentation has a lengthy documented history of use in oral, ophthalmic, plastic, and gynecologic surgery. Radio-wave technology provides good surgical control, precision, versatility, and safety. High-frequency radio-wave electrosurgery minimizes heat dissipation and thus cellular alteration. The clinical benefits include reduced postoperative discomfort, minimal scar tissue formation, maximum readability of histologic specimens, enhanced healing, and excellent cosmetic results. We introduce a new simple surgical approach with high-frequency radio-wave electrosurgery to reduce CCh. To the best of our knowledge, this is the first report of CCh reduction with this type of procedure in the medical literature.

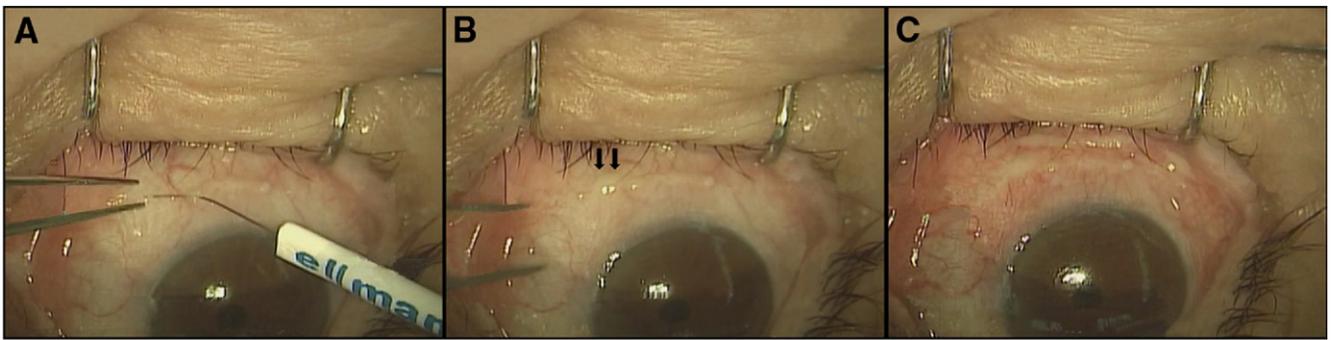


Figure 1. Surgical steps of high-frequency radio-wave electrocauterization for conjunctivochalasis (CCh). **A**, After the redundant inferior bulbar conjunctiva was grabbed and lifted with a 0.12 forceps, subconjunctival coagulations were made with a fine-needle electrode. **B**, After subconjunctival coagulations, there was some conjunctival ridge. This conjunctival ridge disappeared within 1 week postoperatively. **C**, Approximately 10 to 20 subconjunctival coagulations were made primarily in a horizontal direction.

Materials and Methods

Patients

This prospective, noncomparative, interventional case series analysis was performed in adherence with the Declaration of Helsinki and approved by the institutional review board and ethics committee of the Kangbuk Samsung Hospital in Seoul, Korea.

Twelve patients (20 eyes) with CCh were recruited from the outpatient service of the Department of Ophthalmology, Kangbuk Samsung Hospital, and consecutively underwent operations between July 2007 and June 2008.

All patients had symptoms of severe ocular surface irritation for an extended period, despite conventional medical management, including topical lubricating drops or ointments, steroids, cyclosporin A, and antibiotics. Before surgery, all subjects underwent a full medical and ocular history and a detailed ocular examination, including measurement of visual acuity, external eye examination, intraocular pressure measurement, slit-lamp examination and photography, fluorescein staining, and a fluorescein clearance test.

Diagnoses of CCh were made on the basis of the observation of loose conjunctival folds at the inferior lid margin by one of the authors (Choi) using slit-lamp biomicroscopy. Patients with coexistent lid disorders, such as blepharitis or meibomian gland dys-

function, nasolacrimal duct obstruction, corneal disorders, ocular infections, dry eye, or ocular allergy, and those using contact lenses were excluded from the study. Patients with a history of ocular surgery within the last 6 months were also excluded.

Conjunctivochalasis was graded preoperatively and postoperatively according to the grading system proposed by Meller and Tseng.² Patients were classified as grade 0 (no persistent fold), grade 1 (a single, small fold), grade 2 (≥ 2 folds, but not higher than the tear meniscus), or grade 3 (multiple folds and higher than the tear meniscus). Grading was done separately for the temporal, middle, and nasal areas of the conjunctiva. The presence or absence of punctal occlusion, as defined by the contact of the punctum with a redundant conjunctival fold, was noted for the inferior punctum.

Epiphora and dry eye symptoms were specifically evaluated. Dry eye symptoms were assessed with the Ocular Surface Disease Index (OSDI; Allergan, Inc., Irvine, CA, holds the copyright),²⁰ a 12-item questionnaire designed to assess the severity of symptoms with good to excellent reliability and validity.²¹ The 12 items of the OSDI questionnaire were graded on a scale of 0 to 4: 0 = never; 1 = some of the time; 2 = half of the time; 3 = most of the time; and 4 = all the time. The total OSDI score was then calculated with the following formula: $OSDI = ([\text{sum of scores for all questions answered}] \times 100) / ([\text{total number of questions an-}$



Figure 2. Representative cases of high-frequency radio-wave electrocauterization for conjunctivochalasis (CCh). **A–D**, Case 1. A 67-year-old woman. **A**, Preoperative appearance. **B, C**, One day postoperatively. **D**, One month postoperatively. **E–G**, Case 2. A 59-year-old woman. **E**, Preoperative appearance. **F, G**, One month postoperatively.

swered] × 4). Thus, the OSDI is scored on a scale of 0 to 100, with higher scores representing greater disability.²¹

Surgical Technique (Choi's Procedure)

Before surgery, the alternatives, risks, and benefits were fully explained to the patients, and written informed consent was obtained. All procedures were performed under an operating microscope by one of the authors (Choi). After preparing and draping the eye and inserting the lid speculum, drops of 0.5% proparacaine were instilled to the ocular surface for anesthesia. The surgical procedure is shown in Video 1 (available at <http://aaojournal.org>). After the presence and distribution of CCh were confirmed by grabbing the conjunctiva with a smooth forceps, the redundant inferior bulbar conjunctiva was grabbed and lifted with a smooth forceps. Next, subconjunctival coagulations on the redundant conjunctiva were made with a fine-needle electrode (Fine Insulated Coated Needle, 004 Super Fine) using a high-frequency radio-wave electrosurgical unit (Ellman Surgitron; Ellman International, Inc., Hewlett, NY) in coagulation mode. The output power intensity of the radiofrequency generator was adjusted to produce shrinkage of the redundant conjunctival tissues without charring the tissue. A power setting of 0.5 to 1 was used on the majority of patients. Approximately 10 to 20 subconjunctival coagulations were made primarily in a horizontal direction, although vertically directed coagulations were made in severe cases (Fig 1). Subconjunctival coagulation in the horizontal direction was made for conjunctival laxity in the horizontal direction, and coagulation in a vertical direction was made for conjunctival laxity in the vertical direction. Caution was taken not to cauterize vessels or the conjunctiva close to the limbus. The operation was complete when the operator observed conjunctiva without redundant tissues. Antibiotic eye drops (0.5% levofloxacin) were applied at the end of the procedure. None of the patients required patching or a shield.

Postoperative Care

After the procedure, patients received a topical steroid eye drop (0.1% fluorometholone) and an antibiotic eye drop (0.5% levofloxacin) 4 times per day for 1 month. Patients were examined postoperatively after 1 day, 1 week, 1 month, and 3 months. During each postoperative visit, changes in the patients' symptoms were recorded in addition to routine examinations and photography. At a mean of approximately 3 months after surgery, the patient's symptoms were assessed with the OSDI.

Statistical Analysis

All statistical analyses were performed with the Statistical Package for the Social Sciences 15.0 (SPSS Inc., Chicago, IL). Statistical testing included the paired *t* test for comparison of symptom improvement (OSDI) preoperatively and postoperatively. *P* < 0.05 was considered statistically significant.

Results

The mean age of the 12 patients was 68.6 ± 7.1 years. Ten patients (83.3%) were women, and 2 patients (16.7%) were men. All patients showed symptomatic CCh that was refractory to conventional therapies, and 8 of them (66.7%) had bilateral disease. The surgical approach with high-frequency radio-wave electrosurgery was well tolerated by all patients and produced excellent results with relief of symptoms beginning on postoperative day 1. This approach required less surgical time and resulted in

Table 1. Conjunctivochalasis Grade (n=20)

	Before Surgery	After Surgery
Grade 0	0 (0%)	18 (90%)
Grade 1	6 (30%)	1 (5%)
Grade 2	10 (50%)	1 (5%)
Grade 3	4 (20%)	0

less postoperative patient discomfort. After surgery, all patients were followed for a minimum of 3 months. Eighteen eyes (90%) recovered a smooth, wet, and noninflamed conjunctival surface within 1 month and remained stable for a follow-up period of 3 months (Fig 2).

Conjunctivochalasis Grade

The grade of CCh decreased after the procedure in all patients. Preoperatively, 6 of the 20 eyes (30%) had grade 1 CCh, 10 eyes (50%) had grade 2 CCh, and 4 eyes (20%) had grade 3 CCh. At 3 months postoperatively, 18 eyes (90%) had grade 0 CCh, 1 eye (5%) had grade 1 CCh, and 1 eye (5%) had grade 2 CCh (Table 1). In 1 eye with grade 3 CCh preoperatively, there was undercorrection during surgery, and this undercorrection remained stationary at grade 2 CCh after 3 months. This patient underwent reoperation with the same procedure and improved to grade 0.

Symptom Evaluation

Improvement in epiphora was evident from the first postoperative day. During the follow-up period, no patients had epiphora. Eleven patients (91.7%) obtained symptomatic improvement of dry eye. There were no reports of worsened dry eye symptoms. There was a statistically significant difference between the OSDI score preoperatively and 3 months postoperatively (*P* < 0.001). The mean OSDI score was 31.7 ± 15.2 preoperatively and 4.2 ± 2.1 at 3 months.

Intraoperative and Postoperative Complications

Unexpected excessive subconjunctival hemorrhage was observed in 1 eye during surgery, although this improved after 1 month without additional treatment. One eye also developed chemosis 1 week postoperatively, and this subsided spontaneously. For the 19 eyes in the study, no complications were noted during the follow-up period.

Discussion

Conjunctivochalasis is a chronic ocular surface disorder that presents with both dry eye symptoms and epiphora and has the potential to be misdiagnosed and treated inappropriately.² In CCh, tear flow is blocked along the lower tear meniscus by redundant conjunctival tissue,^{6,13} causing insufficient tear drainage and delayed tear clearance. This may explain symptoms or signs such as intermittent epiphora in tear-sufficient eyes, pseudoepiphora in dry eyes with maintained reflex tear secretion, and exacerbation of possible dry eye-related inflammation.⁶ Moreover, redundant conjunctiva occupying the lower tear meniscus not only may interfere with the delivery of tears from the meniscus to the

ocular surface, which inhibits effective delivery of instilled eye drops to the ocular surface, but also may produce an ectopic meniscus beside the redundant conjunctiva, inducing neighboring tear film thinning and precorneal tear film instability. These mechanisms may cause deterioration of dry eye.

Elastotic degeneration has been shown to be an important pathogenetic mechanism responsible for the development of CCh.^{2,9,11} Elastotic degeneration is believed to result from blink-induced mechanical friction between the ocular surface and the eyelids.⁹ It has been suggested that both elastotic degeneration and collagenolysis may independently contribute to the development of CCh.² Furthermore, inflammation may have a role in the pathogenesis of CCh. Erdogan-Poyraz et al¹² reported that the clinical severity of CCh parallels increased tear interleukin (IL) levels. Previous studies have reported the presence of inflammatory cytokines (IL-6, IL-8, IL-10, and IL-12) in ocular tears of patients with CCh⁸ as well as matrix metalloproteinases in tissue cultures of CCh fibroblasts.^{22,23}

Conjunctivochalasis has traditionally been treated by using a surgical approach in which sutures are used to rejoin margins after a conjunctival resection has been performed. The most commonly described method, described by Hughes,¹ includes a simple crescent excision of the inferior bulbar conjunctiva 5 mm away from the limbus, followed by closure with absorbable sutures. A modified technique, proposed to avoid visible scarring or retraction of the inferior conjunctival fornix, includes peritomy close to the limbus, after which 2 radial relaxing incisions to excise the redundant conjunctiva are made.²⁴ Meller et al¹⁴ used preserved human amniotic membrane to restore the large conjunctival defect created during surgical removal of CCh. They reported that scarring-induced complications, such as cicatricial entropion of the lower lid, retraction of the lower fornix, and restricted motility noted in previous reports,^{3,24} were not noted in removal of CCh with AMT.¹⁴

The placement of sutures, although common practice, does induce a minimal amount of risk with regard to infection and has been shown to induce more inflammation and increase patient discomfort levels, including a foreign-body sensation.^{25,26} Sutures also introduce certain disadvantages, including prolonged operating time and suture-related complications, such as abscesses, granuloma formation, and giant papillary conjunctivitis.¹⁷ Meller et al¹⁴ reported that the focal inflammation noted on the host conjunctiva adjacent to the amniotic membrane might be a form of suture knot-induced granulomatous reaction.

To avoid problems related to sutures, some sutureless techniques for CCh have been introduced. Kheirkhah et al¹⁷ reported that AMT using fibrin glue could be performed for refractory CCh and could alleviate its symptoms and signs. However, they noted that when AMT using fibrin glue was compared with AMT using sutures, there was a similar incidence of focal inflammation of the host conjunctiva adjacent to the border of the amniotic membrane. Haefliger et al¹⁹ reported that gentle superficial cauterization of the inferior bulbar conjunctiva could induce significant reduction of moderate CCh. However, too-powerful cauterization led to scarring of Tenon's capsule, inducing double vision

or shrinkage of the lower fornix associated with a symblepharon. Furthermore, when the conjunctiva was very thin, cauterization sometimes led to a small conjunctival buttonhole.

In this study, we introduced a new simple surgical approach with high-frequency radio-wave electrosurgery to reduce CCh. Radiofrequency surgery has a lengthy documented history of use in oral, ophthalmic, plastic, and gynecologic surgery. In ophthalmology, high-frequency radio-wave electrosurgery has been used for full-thickness eyelid resection and treatment of trichiasis.^{27,28} The radiofrequency unit generates a high-frequency radio-wave of 4 MHz. When this high-frequency wave is released from the generator, it is focused at the affected tissue through an electrode end. The tissue resistance in the path of these high-frequency waves produces heat that makes the intracellular water boil, thereby increasing the inner cellular pressure to the point of cell lysis. This phenomenon is called cellular volatilization and in turn produces shrinkage and coagulation of the tissues.²⁹ In CCh surgery, shrinkage of the conjunctiva may reduce the redundancy of the conjunctiva and conjunctival coagulation may induce reinforcement of conjunctival attachments to the globe, reducing conjunctival laxity. Because radiofrequency devices generate less heat than conventional cautery, less collateral damage is seen and therefore faster healing can be expected.

The outcomes of this study demonstrate that subconjunctival coagulation on the redundant conjunctiva with a high-frequency radio-wave electrosurgical unit can significantly reduce CCh grade. This procedure produced excellent results with relief of symptoms beginning on the first day after surgery. It was well tolerated by the patients, required less surgical time, and resulted in less postoperative discomfort for the patients. In particular, during the early postoperative period, radiofrequency surgery may provide faster improvement of symptoms and more comfort than traditional surgical approaches for CCh. Furthermore, there were no notable complications, such as suture-related complications, scarring-induced complications, or complications caused by powerful cauterization. Our results with the high-frequency radio-wave electrosurgical approach were satisfactory. However, further prospective comparative studies are needed to confirm the relatively excellent efficacy of this approach compared with traditional surgical approaches.

In conclusion, a surgical approach with high-frequency radio-wave electrosurgery produced a significant reduction in CCh and an improvement in symptoms. Radio-wave surgical techniques represent a favorable alternative for surgical treatment of CCh.

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