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# Central Corneal Thickness in Patients with Atopic Keratoconjunctivitis

Authors' Contribution:
Study Design A
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Statistical Analysis C
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**Background:** The aim of this study was to evaluate central corneal thickness in patients with atopic keratoconjunctivitis.

**Material/Methods:** The study was conducted in the Atatürk University School of Medicine between April 2011 and June 2013. The study group included 60 eyes of 30 patients with atopic keratoconjunctivitis. Sixty eyes of 30 healthy individuals without any ophthalmic or systemic pathology were used as a control group. The central corneal thickness was measured with ultrasonic pachymetry.

**Results:** In each group, all subjects included in the study had a best corrected visual acuity (BCVA) of 20/25 or better. In the study group past medical histories revealed eczema in 19 patients, asthma in 16, and atopic dermatitis in 15. During clinical examination cicatricial conjunctivitis was noted in 5 patients, giant papillae in 4, symblepharon in 2, and entropion in 2. The mean central corneal thickness was 523.45±18.03 µm in the study group (mean age: 37.05±5.7 years) and 540.30±38.91 µm in the control group (mean age: 36.55±7.1 years), and the difference was statistically significant ($p<0.001$).

**Conclusions:** Evaluation of corneal thickness is important in situations such as corneal refractive surgery and contact lens use, and is an essential parameter in a wide range of ocular disorders, including glaucoma and keratoconus. Therefore, ophthalmologists should be aware of the low central corneal thickness in patients with atopic keratoconjunctivitis.

**MeSH Keywords:** Conjunctivitis, Allergic • Cornea • Corneal Pachymetry

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## Background

Allergic diseases have dramatically increased in recent decades [1,2]. Allergic conjunctivitis refers to a group of ocular allergic reactions: seasonal allergic conjunctivitis (SAC) and perennial allergic conjunctivitis (PAC), which are acute, and vernal keratoconjunctivitis (VKC) and atopic keratoconjunctivitis (AKC), which are chronic. Giant papillary conjunctivitis (GPC) due to contact lenses or other ocular prosthesis is often classified with these ocular allergies. However, GPC results from chronic ocular microtrauma, not allergic reaction, and should be managed by an ophthalmologist [3].

In AKC, bilateral chronic inflammation of the ocular surface and eyelid is the result of IgE-mediated mast cell degranulation and Th1- and Th2-lymphocyte-derived cytokine-mediated immune mechanisms, as well as contributions from eosinophils and other inflammatory cells [4,5]. AKC patients often have a history of eczema and asthma [6] and AKC has been described as the ocular counterpart of atopic dermatitis or atopic eczema [7]. AKC is characterized by red, thickened, macerated, and fissured eyelids with chronic staphylococcal blepharitis, with or without giant papillae. Other common clinical signs are micropapillary conjunctivitis, cicatricial conjunctivitis, symblepharon, entropion, trichiasis, madarosis, and ectropion/epiphora of the lower lip due to tightening of the facial skin. Corneal vascularization may also be present [8,9].

Keratoconus (KC) is a degenerative disorder in which the structural integrity of the cornea is compromised, leading to corneal thinning and conical protrusion. In the literature, KC has been associated with VKC, atopy, and eye rubbing [4,10]. In atopic patients, more rapid progression of KC, early need for surgical intervention, and more frequent immunological and surgical complications have been reported [5]. Matrix metalloproteinases (MMPs), which are degradative proteins released in response to chronic corneal epithelium trauma, have been implicated as a cause of the tissue damage seen in KC [11–13].

Central corneal thickness (CCT) is important as an indicator of overall corneal health [14], and corneal thickness measurement has recently gained recognition as having implications in contact lens use and refractive surgery, as well as being an early diagnostic tool for individuals at higher risk of developing primary open-angle glaucoma [15,16]. The aim of this study was to investigate central corneal thickness in patients with AKC.

## Material and Methods

The study was conducted in the Atatürk University School of Medicine between April 2011 and June 2013. The study protocol was approved by the Atatürk University Faculty of Medicine local ethics committee. All patients provided written informed consent prior to the study, which was conducted according to the guidelines and in accordance with the tenets of the Declaration of Helsinki.

The study group consisted of 60 eyes of 30 patients with chief complaints consistent with AKC. The control group included 60 eyes of 30 healthy individuals without any ophthalmic or systemic pathology. For each participant, a full ophthalmological examination, including refraction, external eye examination, slitlamp examination and evaluation of posterior segments, was performed.

Diagnosis of AKC, as previously described in the literature [17,18], was based on the presence of the following: burning, itching, redness, irritation, photophobia, swelling of the conjunctiva, tearing, mucoid discharge, eyelid edema, and chemosis. In addition, other clinical signs, including giant papillae, eyelid inflammation and damage, micropapillary conjunctivitis, cicatricial conjunctivitis, symblepharon, entropion, ectropion, trichiasis, and madarosis, were observed in the AKC group.

Patients with KC or suspected KC and patients with cataract, corneal epithelial defect, or corneal punctate epithelial erosions were excluded from the study. Patients with a history of ophthalmic or systemic pathology, or those who were currently using topical medication were not included in the study.

CCT was measured with an ultrasonic pachymetric system (Pacline, Opticon Rome, Italy). The cornea was anaesthetized with topical proparacaine hydrochloride. The probe was aimed perpendicularly to the cornea at the center of the pupil and 3 consecutive measurements were taken for each eye. For the statistical analyses, we excluded patients with a history of corneal disease, ocular trauma, and/or ocular surgery in 1 or both eyes due to factors that impaired accurate CCT measurement (Fuchs' dystrophy, corneal edema, or stromal scarring).

Data analyses were conducted using Statgraphics® Plus ver. 5.1 (Statistical graphics Corp, USA) and SPSS ver. 15.0 (SPSS Inc., Chicago, IL, USA). Standardized kurtosis and standardized skewness were derived to measure spread, and data distribution was considered normal if spread values were between –2 and 2. One-way analysis of variance (ANOVA) was used when comparing groups. A 95% normal range (defined as the mean ±1.96 SD) summarizes the range of CCTs in 95% of the eyes. Linear regression analysis was used to detect correlation between variables. A $p$ value of $\leq 0.05$ was accepted as statistically significant.

## Results

The study group consisted of 60 eyes of 30 AKC patients, 16 (53.3%) female and 14 (46.6%) male, with mean age 37.05±5.7





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years (range: 30–50 years). The control group consisted of 60 eyes of 30 healthy patients, also 16 (53.3%) female and 14 (46.6%) male, with mean age 36.55±7.1 years (range: 30–50 years).

Best corrected visual acuity (BCVA) of all patients included in the study was 20/25 or better, and there was no statistically significant difference in BCVA between the study and control group ($p>0.05$). Refractive error (D) was –0.65±2.03 (median: 0.00, range –7.25 to +5.38) in the study group and –0.51±2.20 (median: 0.00, range: –7.25 to +4.50) in the control group.

The mean CCT in the study group was 523.45±18.03 µm (95% CI: 522.1–524.3; range: 410–550). The mean CCT in the control group was 540.30±38.91 µm (95% CI: 539.9–541.1; range, 510–600). Analysis by ANOVA showed that the difference in mean CCT between the AKC group and the healthy control group was significant ($p<0.001$).

All patients in the study group had burning, itching, irritation, photophobia, tearing, swelling of the conjunctiva, mucoid discharge, and redness. Secondary symptoms and comorbidities of AKC were also common in the medical histories of the study group: 17 (56.7%) patients with contact lens intolerance; 19 (63.3%) with asthma; and 15 (50.0%) with atopic dermatitis. Furthermore, cicatricial conjunctivitis was found in 5 (16.7%) patients, giant papillae in 4 (13.3%), symblepharon in 2 (6.7%), and entropion in 2 (6.7%).

## Discussion

Allergic conjunctivitis is a frequent complaint, affecting an estimated 25% of the population [19,20]. A common cause for the recent increases in cases of AC has not been identified, and it is believed that multiple factors, including air pollution, household pets, genetic predisposition, and exposure to allergens in early childhood, may be involved [21]. The conditions included under the term AC vary in their clinical presentation and pathophysiology, and symptoms range in severity from mild irritation to sight-threatening complications [19,20]. AKC is a particularly severe form of AC and can result in vision loss [22]. AKC and VKC, the 2 chronic types of AC, share certain clinical features, such as the presence of giant papillae and Trantas dots, and their pathogeneses may also have similarities; however, VKC usually resolves by 20 years of age, whereas AKC typically presents in adults [23].

AKC is characterized by red, elevated, eczematous lesions on the eyelids and sometimes other parts of the body, particularly the antecubital and popliteal areas. Other symptoms include significant burning, itching, irritation, and photophobia. Itching is a primary complaint in AKC, and is worsened by scratching. AKC patients may also experience tearing, mucoid discharge, eyelid edema, and mild to severe conjunctival injection and chemosis. Secondary effects of AKC may be blurred vision, contact lens intolerance, ocular surface damage, and ocular infection [17].

In the current study, all patients in the study group experienced burning, itching, irritation, photophobia, tearing, conjunctival injection and chemosis, and mucoid discharge. Their medical histories also revealed high rates of secondary symptoms and comorbidities of AKC such as contact lens intolerance (56.7%), asthma (63.3%), and atopic dermatitis (50.0%). Other clinical signs were seen in moderate proportions: cicatricial conjunctivitis (16.7%), giant papillae (13.3%), symblepharon (6.7%), and entropion (6.7%).

Keratoconus, a disorder characterized by corneal degradation and distortion, has been associated with both VKC and AKC [4,8–10]. Matrix metalloproteinases (MMPs) have been implicated as a factor in the corneal tissue damage seen in KC. These degradative enzymes normally function in epithelial turnover; elevated MMP levels due to chronic corneal epithelial trauma results in excessive extracellular matrix degradation and destruction of corneal tissue. In a study by Kumagai et al, active forms of MMP-2 and MMP-9 were found at higher levels in the tears of VKC patients compared to healthy controls and patients with other forms of AC, indicating that these 2 MMPs may play a role in the KC frequently seen in VKC patients [11–13,24]. In atopic patients, KC often follows a more rapid progression, requires earlier surgical correction, and more frequently results in complications [5,25]. The incidence of KC is higher in AKC patients compared to the general population [8,9]. Kaya et al. reported that keratoconic eyes with atopy had lower CCT and steeper cone than that of eyes without atopy [26].

Maintenance of corneal thickness depends on a healthy endothelium with an intact barrier function, making the central corneal thickness an important indicator of overall corneal health [14]. Significant alterations in CCT may interfere with accurate measurement of intraocular pressure (IOP), and underestimation of IOP due to corneal thinning has the potential to delay diagnosis and treatment of glaucoma. Corneal thickness provides valuable information about possible changes in the cornea due to disease, trauma, or hypoxia [27]. Therefore, evaluation of corneal thickness is essential in a wide range of ocular disorders such as glaucoma, keratoconus, corneal refractive surgery, dry eye, and atopic keratoconjunctivitis [15,16]. Ultrasonic pachymetry is the most widely accepted method used to measure corneal thickness [15,28,29], and was the technique chosen for this study due to its reliability and precision.

In patients with atopic keratoconjunctivitis, evaluation of corneal thickness provides clinically useful information on the physiological status of the cornea. Although there have been many studies on the relationship between AKC and keratoconus, to the best of





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our knowledge, CCT values in AKC patients have not been previously reported in the literature. Therefore, it was not possible to compare our data to those of other studies. Further studies with larger patient numbers are needed to more clearly define the relationship between corneal thickness, the mechanisms that regulate corneal regeneration, and inflammation and AKC.

## Conclusions

This study revealed that mean CCT in patients with AKC was significantly lower than in normal eyes ($p<0.001$). Ophthalmologists should be aware of this relationship when following AKC patients in order to gauge the severity of the disease and provide early diagnosis and management of corneal thickness-related complications such as KC or delayed recognition of glaucoma.

**Statement**

We received no financial support and have no proprietary interest regarding this manuscript.

The authors declare that they have no conflict of interest in the publication of this article.

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