

Clinical Correlations of Dry Eye Syndrome and Allergic Conjunctivitis in Korean Children

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ABSTRACT

Purpose: Clinical patterns in pediatric patients with dry eye syndrome and allergic conjunctivitis were investigated.

Methods: Children aged 6 to 15 years with dry eye symptoms were included. Slit-lamp examinations including tear film break-up time, Schirmer's test, and fluorescent staining were performed, and subjective symptoms were investigated. Patients with allergic conjunctivitis were subjected to skin prick tests.

Results: Tear film break-up time was shorter and the number of symptoms related to dry eyes was higher in pediatric patients with allergic conjunctivitis than in those without allergic conjunctivitis. Patients with

allergic conjunctivitis who had higher numbers of positive allergens on the skin prick test also had shorter tear film break-up time.

Conclusion: Because pediatric patients with dry eye syndrome tend to complain less about their symptoms than adult patients, dry eye syndrome is commonly overlooked. This study showed that dry eyes tended to be more severe with the presence of allergic conjunctivitis; the more allergens present, the more severe the dry eyes. More attention should be paid to the treatment of pediatric patients with dry eyes accompanied by allergies.

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INTRODUCTION

Clinical patterns and the epidemiology of pediatric dry eyes have been investigated less than those of adult dry eyes. The descriptions of symptoms among pediatric patients are unclear and children tend to be less cooperative during tests than adults, making accurate diagnosis difficult. Moreover, the prevalence is lower in children than in adults, there are limitations in diagnosis, and physicians may overlook symptoms.

The incidence of allergic eye disease is on the rise due to rapid changes in the living environment, including increasing exposure to environmental pol-

lution and electronic devices (eg, computer monitors and game devices) and the use of contact lenses. An epidemiological study of pediatric patients aged 7 to 15 years in Japan showed that the number of patients with allergic conjunctivitis increased significantly from 2,158 (13.3%) in 1996 to 3,324 (25.2%) in 2006 ($P < .0001$).¹ Allergic conjunctivitis aggravates ocular dryness by exacerbating the inflammatory reaction on the ocular surface.

In this study, we aimed to investigate the clinical patterns of pediatric dry eyes and the correlation between dry eye syndrome and allergic conjunctivitis.

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PATIENTS AND METHODS

Pediatric patients aged 6 to 15 years who visited the ophthalmology department of our hospital who complained of dry eyes were included in this study. After modifying the Delphi classifications, the presence or absence of symptoms including itching, photophobia, foreign body sensation, and burning sensation were assessed because the Ocular Surface Disease Index, a test for assessing dry eyes in adults, includes activities not applicable to children. The child's medical history was also examined. We excluded children taking medications.

To measure tear film break-up time, a fluorescent test strip was placed on the conjunctival sac; the patients were then asked to blink their eyes several times. Then, the time elapsed until deficiency of fluorescent pigment staining occurred in the form of a black dot, hole, or line in the stained tear film was assessed using a slit lamp as a cobalt blue light source.

For Schirmer's test, 5 minutes after anesthetic eye drops were instilled, a standardized Schirmer's test strip (Color Bar; EagleVision, Memphis, TN) was placed on the lateral one-third portion of the lower eyelid for 5 minutes. Then the length of the wet area of the test strip was marked in millimeters. To detect allergic conjunctivitis, the conjunctival papilla observed in the slit-lamp examination was considered positive, and cases with corneal epitheliopathy attributable to eyelid abnormality or eyelash rolling and blepharitis were excluded. We included patients with conjunctival papilla and one or more symptoms, including the itching sensation.

For patients diagnosed as having allergic conjunctivitis, a skin prick test for 51 types of allergens was performed. The skin prick test was performed using commercially available patch tests; histamine patches were used to determine positivity and physiological saline patches were used to determine negativity. To assess allergic skin reactions, the Bencard skin prick test (Bencard Co., Brentford, UK) was performed. Based on the Morrow Brown Grading System, a skin reaction identical to the histamine control value was graded 3+; a skin reaction two or more times higher than the histamine control value was graded 4+; a skin reaction corresponding to 50% of histamine control value was graded 2+; and a skin reaction corresponding to 25% or less than the histamine control value was graded 1+. When no reaction occurred in response to the negative control and the diameter of the weal was 3 mm or

more, or when the grade of the reaction was 3+ or more, the test was considered positive.

Data analysis was performed using SPSS version 18.0 software (SPSS, Inc., Chicago, IL). Independent *t* tests were performed to identify correlations between Schirmer's test and tear film break-up time according to the presence or absence of accompanying allergic conjunctivitis. For correlations between the Schirmer's test and tear film break-up time according to the skin prick test positivity rate, Kruskal–Wallis tests were performed. *P* values less than .05 were considered statistically significant.

Informed consent was confirmed by the Institutional Review Board (IRB Number: C2012029).

RESULTS

The male-to-female ratio was 25:25 in the allergic conjunctivitis group (50 patients [100 eyes]) and 19:31 in the group without allergic conjunctivitis (50 patients [100 eyes]). The mean ages of the two groups were 9.30 ± 2.00 and 8.68 ± 2.21 years, respectively, and were not significantly different.

The survey showed that the number of symptoms was significantly higher in patients with allergic conjunctivitis (1.42 ± 0.67) than in patients without allergic conjunctivitis (1.24 ± 0.55) ($P = .04$). Tear film break-up time and Schirmer's test values were significantly lower in patients with allergic conjunctivitis than in patients without allergic conjunctivitis ($P < .05$) (Table 1).

In the group with accompanying allergic conjunctivitis, 44% of patients tested negative for all 51 types of allergens, 46% tested positive for one type of allergen, and 10% tested positive for two or more allergen types based on the skin prick test. House dust mite sensitivity resulted in the highest positivity rate, with 87% of the patients in the group with allergic conjunctivitis being positive (combined European and American mites). When patients were grouped based on the allergens to which they tested positive and tear film break-up time and Schirmer's test value were compared, the tear film break-up time was significantly shorter when the positivity rate was higher ($P < .05$), although there were no correlations between the Schirmer's test value and positivity rate for allergens ($P = .31$).

DISCUSSION

Causes of pediatric dry eye include congenital anomalies of the lacrimal organ, autoimmune dis-

TABLE 1
Tear Break-up Time (TBUT), Schirmer's Test, and No. of Symptoms in Patients With and Without Allergic Conjunctivitis

Variable	Allergic Conjunctivitis	No Allergic Conjunctivitis	P ^a
TBUT (sec)	6.40 ± 1.73	8.01 ± 1.90	.000
Schirmer's test (mm)	17.84 ± 3.42	19.36 ± 2.47	.039
No. of symptoms.	1.42 ± 0.67	1.24 ± 0.55	.000

^aIndependent t test, $P < .05$.

eases (Sjögren syndrome, juvenile rheumatoid arthritis), skin diseases (injection, epidermolysis bullosa), endocrine diseases (pediatric diabetes mellitus, pediatric thyroid disease), nutritional problems (undernutrition, vegetarian diet), and drugs (beta-blockers and anticonvulsants).

The severity of dry eyes varies from mild to severe, and may progress to corneal limbal deficiency in the worst cases.² Thus, when systemic disease is present, the case is sometimes initially referred to the pediatrics department and an in-depth work-up is performed when patients are referred to the ophthalmology department. However, when systemic disease is not present, dry eye syndrome in children is likely to be overlooked.

The underlying mechanism of dry eyes is lacrimal pathology, although ophthalmologic conditions such as allergic conjunctivitis are known to be closely related. Patients with allergic conjunctivitis complain of itch, hyperemia, and tears. Allergic conjunctivitis, one of the most common eye allergy diseases, is a type I hypersensitivity reaction in which allergens such as house dust mite, pollen, and pet hairs are dissolved in the tears and react with IgE attached to mast cells of the conjunctiva.

Dry eyes and allergic conjunctivitis have similar symptoms and often occur together, leading to confusion in diagnosis. The correlations between and incidence of dry eyes and allergic conjunctivitis have been studied, but mostly in adults. Thus, this study was performed to better evaluate the conditions in pediatric patients.

According to the Uchino et al.³ study of 3,443 high school students aged 15 to 18 years in Japan, a large-scale epidemiological study on the use of contact lenses and the prevalence of dry eyes, 4.3% of male students and 8.0% of female students were diagnosed as having clinical dry eyes and 21.0% of male students and 24.4% of female students com-

plained of serious dry eye symptoms. These prevalence rates were not low compared to the prevalence of dry eyes in adults (14.4% to 33%).⁴⁻⁷

In a study of 105 male middle school students aged 13 to 15 years without ocular disease in which tear film break-up time was analyzed in relation to the duration of computer use and Schirmer's test was performed, Park and Yi reported that increased computer-related work, watching television, and smartphone use is expected to increase the incidence of pediatric dry eyes.⁸

In a survey performed by Ahn et al.⁹ on allergic rhinoconjunctivitis, atopic skin disease, and asthma in children aged 6 to 7 and 13 to 14 years according to the International Study of Asthma and Allergies in Childhood (ISAAC) to estimate the prevalence of allergic disease, the prevalence rates of allergic conjunctivitis and atopic skin disease drastically increased during those 10 years. The prevalence rate of allergic rhinoconjunctivitis in the participating countries of the ISAAC was 8.5% in children aged 6 to 7 years and 14.6% in children aged 13 to 14 years.¹⁰ Given that the prevalence rate is 18.9% in children aged 6 to 7 years and 19.2% in children aged 13 to 14 years in South Korea, the prevalence rate in South Korean children aged 6 to 7 years is the third highest following Taiwan (21.8%) and Venezuela (20.4%). The prevalence rate in South Korean children aged 13 to 14 years corresponds to the upper one-third of countries when prevalence rates of countries participating in the ISAAC were ranked by the average scores of phases I and II.

In Ahn et al.'s survey,⁹ allergic conjunctivitis was not independently investigated; instead participants were asked "Have you ever experienced nasal symptoms such as sneezing, nasal discharge, or nasal congestion along with itchy eyes and tears in the past 12 months?" If the answer was "yes," the symptom was defined as allergic rhinoconjunctivitis. Because this

definition is different from our definition of allergic conjunctivitis, it is not feasible to directly apply the statistics of the survey to our studies. However, it is believed that the results of the survey reflect the fact that allergic conjunctivitis has drastically increased in the past 10 years.

Our study was limited by selection bias because it was performed only on pediatric patients who visited our hospital and it does not reflect prevalence rates in the general pediatric population. However, given that tear film break-up time in children with allergic conjunctivitis was significantly shorter (6.40 ± 1.72 s) than in children without allergic conjunctivitis (8.01 ± 1.90 s) ($P < .05$), the prevalence of pediatric dry eyes is expected to increase at the same rate as allergic conjunctivitis in children.

As shown in the results of the Delphi investigation, the average number of items answered was two or less. This indicates that the patients had limitations in expressing their symptoms because of their youth. Thus, criteria for the assessment of symptoms that are appropriate for pediatric patients should be established to enable more accurate diagnosis of pediatric dry eyes.

Schirmer's test values varied significantly depending on the presence or absence of allergic conjunctivitis ($P < .05$), whereas significant differences associated with the results of the skin prick test were not detected ($P = .31$). For the Schirmer's test, patients may have had foreign body sensation even after the instillation of anesthesia. Pediatric patients had difficulty maintaining the test strip for 5 minutes and blinked their eyes more often than adults did.

In our study, cases in which the Schirmer's test failed or the patients' cooperation was poor were excluded. Although tear film break-up time and Schirmer's test are commonly performed for the study of dry eyes in adults, other diagnostic methods are required for the study of dry eyes in children.

Tear film break-up time was shorter and the number of symptoms related to dry eyes was high-

er in pediatric patients with allergic conjunctivitis than in those without allergic conjunctivitis. In addition, in pediatric patients with allergic conjunctivitis, the higher the number of allergens to which the patient tested positive on the skin prick test, the shorter the tear film break-up time. This indicates that ophthalmic symptoms caused by dry eyes may be more common in patients with allergic conjunctivitis than in those without allergic conjunctivitis. Thus, for pediatric patients with allergic conjunctivitis, active treatment is required for dry eyes and avoidance therapy is important. In addition, further studies on the prevalence rates of dry eyes and allergic conjunctivitis in the general pediatric population are needed.

REFERENCES

1. Kusunoki T, Morimoto T, Nishikomori R. Changing prevalence and severity of childhood allergic diseases in Kyoto, Japan, from 1996 to 2006. *Allergol Int.* 2009;58:543-548.
2. Alves M, Dias AC, Rocha EM. Dry eye in childhood: epidemiological and clinical aspects. *Ocul Surf.* 2008;6:44-51.
3. Uchino M, Dogru M, Uchino Y, et al. Japan Ministry of Health study on prevalence of dry eye disease among Japanese high school students. *Am J Ophthalmol.* 2008;146:923-939.e2.
4. Caffrey BE, Richter D, Simpson T, et al. The Canadian Dry Eye Epidemiology Study. In: Sullivan DA, Dartt DA, Meneray MA, eds. *Lacrimal Gland, Tear Film and Dry Eye Syndromes 2*. New York: Plenum Press; 1998:805-806.
5. Shimmura S, Shimazaki J, Tsubota K. Results of a population-based questionnaire on the symptoms and lifestyles associated with dry eyes. *Cornea.* 1999;4:408-411.
6. Moss SE, Klein R, Klein BE. Prevalence of and risk factors for dry eye syndrome. *Arch Ophthalmol.* 2000;118:1264-1268.
7. Schein OD, Munoz B, Tielsch JM, Bandeen-Roche K, West S. Prevalence of dry eye among the elderly. *Am J Ophthalmol.* 1997;124:723-728.
8. Park HJ, Yi K. Relationship between middle school students' computer using time and dry eye. *J Korean Ophthalmol Soc.* 2002;43:449-454.
9. Ahn K, Kim J, Kwon HJ, et al. The prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in Korean children: nationwide cross-sectional survey using complex sampling design. *J Korean Med Assoc.* 2011;54:769-778.
10. Ait-Khaled N, Pearce N, Anderson HR, et al. Global map of the prevalence of symptoms of rhinoconjunctivitis in children: The International Study of Asthma and Allergies in Childhood (ISAAC) Phase Three. *Allergy.* 2009;64:123-148.