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The therapeutic effect of IPL on children with refractory seasonal allergic conjunctivitis

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Abstract

Objective To observe the effectiveness of intense pulsed light(IPL) treatment as an adjuvant treatment of refractory seasonal allergic conjunctivitis in children.

Methods A total of 31 patients with refractory seasonal allergic conjunctivitis who did not respond well to anti-allergic drug treatment were randomly selected to receive drug therapy combined with IPL treatment (17 patients) and drug treatment alone (14 patients) for 1 week, and the ocular surface symptom questionnaire and ocular surface sign score were performed before and after treatment, respectively.

Result After treatment, the IPL group had significantly lower scores in eye rubbing, blinking, eye itching, discharge, tearing, and total scores than before treatment ($P < 0.05$), while there was no significant difference in foreign body sense scores before and after treatment ($P > 0.05$). There were no significant differences in eye rubbing, blinking, eye itching, discharge, foreign body sensation, tearing, and total score between the control group after treatment ($P > 0.05$). After treatment, the scores of ocular signs in the IPL group and the control group were lower than those before treatment, and the difference was statistically significant ($P < 0.01$).

Conclusion IPL therapy is effective in improving ocular surface symptoms in children with refractory seasonal allergic conjunctivitis, especially in suppressing eye itching, with good results.

Keywords Intense pulsed light, Allergic conjunctivitis, Olopatadine eye drops, Ocular surface symptom questionnaire, Dry eye syndrome

Background

Seasonal allergic conjunctivitis (SAC) is prevalent in spring and autumn, with symptoms mainly including eye swelling, itching or a foreign body sensation, accompanied by mucous-like secretions [1]. Children have poor tolerance to pain and itching. After the onset of SAC, they often rub their eyes vigorously, which aggravates the allergic symptoms. SAC belongs to Type I

hypersensitivity reaction, with acute onset and strong discomfort. Currently, the commonly used treatment method is anti-allergic drug therapy, including local application of anti-allergic eye drops and oral anti-allergic drugs [2]. Most of the children patients can have their symptoms relieved rapidly after taking the medicine, and allergy symptoms can be smoothly managed through drug maintenance treatment. However, there are still some patients whose eye symptoms do not reach relief after medication or whose disease recurs despite continuous medication, causing great physical and psychological burdens to the children. Intense pulsed light (IPL) was previously mainly used in skin beauty treatments, featuring short operation time, no trauma and

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low pain. In recent years, multiple studies have shown that IPL treatment has significant effects on some ocular surface diseases such as meibomian gland dysfunction, dry eye, blepharitis and related keratoconjunctivitis. For SAC with poor response to drug treatment and recurrent episodes, our research attempts to use IPL treatment as an adjuvant treatment for refractory SAC and observe its efficacy.

Object and methods

Research object and group

Our research collected patients diagnosed with seasonal allergic conjunctivitis at the Ophthalmology Department of Hebei Children's Hospital from January 2022 to November 2024. All patients underwent allergen testing and allergen avoidance. The first choice of treatment was drug therapy, using 0.1% olopatadine eye drops (twice a day). For patients with severe allergic reactions or no improvement in symptoms after using olopatadine hydrochloride eye drops, 0.02% fluorometholone eye drops (three times a day) were added. Patients with obvious symptoms or recurrent episodes after two weeks of drug treatment were included in the refractory SAC group. A total of 31 patients were included, among whom 17 agreed to receive IPL-assisted treatment (IPL group) and 14 continued with drug treatment alone (control group). The right eye of each patient was selected as the research object.

According to the wishes of the child's guardian, the guardian has been informed of this study and agreed to accept IPL treatment, and voluntarily signed the informed consent form.

Inclusion criteria: (1)Children under 15 years old, male or female; (2)Conform to the diagnostic criteria of seasonal allergic conjunctivitis; (4)No history of wearing contact lenses; (5)No other inflammatory eye diseases or diseases that may cause dry eye or meibomian gland dysfunction were found in the eyes; (6)Normal intraocular pressure; (7)No autoimmune diseases.

The diagnostic criteria of seasonal allergic conjunctivitis [2]

- (1)Chief complaint: It usually occurs in spring or autumn, with symptoms such as itchy eyes and a foreign body sensation. Mucus-like secretions can be seen around the eyes or in the palpebral fissure area. In children, it may manifest as frequent eye rubbing and photophobia.
- (3)Physical sign: There were varying degrees of conjunctival congestion and edema, no papillae on the palpebral conjunctiva, and no corneal epithelial lesions.

Treatment methods

- (1)Patients in the control group continued to use olopatadine eye drops in combination with fluorometholone eye drops. After continuous use of fluorometholone eye drops for 2 weeks, the medication was discontinued, and subsequent maintenance treatment was carried out with olopatadine eye drops.
- (2)For the IPL group, patients received drug treatment combined with IPL treatment. They initially received one session of IPL treatment, and the drug treatment principle was the same as that of the control group. The "EYESIS Light Pulse MOPT Meibomian Gland Dysfunction Treatment Instrument" was used for the IPL treatment of the patients. The children were placed in a supine position, with ceramic eye masks covering both eyes. Coupling agent was applied to the lower eyelids and temporal sides. The physician wore protective glasses and held the treatment handle, performing IPL treatment from the nasal side to the temporal side of the lower eyelid. Each eye was irradiated five times. The energy of the pulsed light was selected at 8 to 12 J/cm². Before the treatment, a lower energy was used for a trial, and the energy was adjusted according to the children's tolerance.

The children were followed up after the treatment to see if there was any adverse reaction.

Observation indicators (Scores were measured respectively before treatment and one week after treatment.)

- (1)Ocular surface symptom questionnaire (Fig. 1): To be filled out jointly by the guardian and the child patient, and the total score is recorded.
- (2)Ocular surface sign score (Fig. 2): The same physician conducted the examination of the ocular surface under slit lamp and recorded the total score.

Statistical analysis

The analysis was conducted using the statistical software IBM SPSS Statistics26. The gender differences between the two groups of cases were compared using the chi-square test, and the age differences were compared using the independent sample t-test. Record the mean and standard deviation of the ocular surface symptom questionnaire and ocular surface sign score. Independent sample t-test was used for intergroup comparison. Paired sample t-test was used for comparison before and after treatment within the same group. $P < 0.05$ indicates that the difference is statistically significant.

Ocular Surface Symptom Questionnaire						
	Name	Gender	Age			
Symptoms	4	3	2	1	0	Score
Rubbing eyes	frequently	intermittently	occasionally	rarely	none	
Frequent blinking	frequently	intermittently	occasionally	rarely	none	
Frequency of itchy eyes	continuously	intermittently	occasionally	rarely	none	
Abnormal secretions	a lot of	quite a few	a little	rarely	none	
Foreign body sensation	Strong	slightly intense	occasionally	rarely	none	
Tearing	a lot of	quite a few	occasionally	rarely	none	
Total:						
Date:						

Fig. 1 Ocular Surface Symptom Questionnaire

Ocular surface signs			
	Name	Gender	Age
Signs	Score	Description	
Conjunctival congestion	3	Severe with obvious dilation of blood vessels, unable to distinguish the course of the vessels	
	2	Between mild and severe	
	1	point Slight dilation of blood vessels	
	0	Not present	
Conjunctival edema	3	Generalized conjunctival edema protruding from the conjunctival sac	
	2	Generalized conjunctival edema but not protruding from the conjunctival sac	
	1	Only bulbar conjunctival edema	
	0	Not present	
Total:			
Date:			

Fig. 2 Ocular Surface Signs Assessment Form**Table 1** Comparison of age, gender differences between IPL group and control groups

	IPLgroup	Control group	<i>p</i>
Mean Age(years)	7.47	7.79	0.649
Female	6(35.29%)	6(42.86%)	0.679
Male	11(64.71%)	8(57.14)	
Total	17	14	

Results

Gender, age and current address of patients in IPL group and the control group

The current addresses of both groups of cases are all local.

In the IPL group, there were 17 cases (11 males and 6 females, mean age 7.47 years,). In the control group, there were 14 cases (8 males and 6 females, mean age 7.79 years). There was no significant difference in gender and age between the two groups of cases ($P > 0.05$). (Table 1).

Ocular surface symptoms

2.1 After IPL treatment, the scores for rubbing eyes, blinking, eye itching, secretions, tearing, and the total score were all lower than those before treatment, with statistically significant differences ($P < 0.05$). However,

there was no statistically significant difference in the foreign body sensation score before and after treatment ($P > 0.05$) (Table 1; Fig. 3).

2.2 There was no statistically significant difference in the differences of eye rubbing, blinking, eye itching, secretions, foreign body sensation, tearing and total score after treatment in the control group ($P > 0.05$) (Table 2; Fig. 4).

2.3 No adverse reactions were found in both IPL group and control group.

3. Ocular surface signs (total score): The ocular surface sign scores of both the IPL group and the control group were lower after treatment than before treatment, and the difference was statistically significant ($P < 0.01$) (Table 3).

Discussion

Seasonal allergic conjunctivitis is the most common type among allergic conjunctivitis, and the principal treatment modality is anti-allergic drug therapy. At present, there are a wide variety of anti-allergy drugs available for the eyes. Many scholars have repeatedly compared the therapeutic effects of various anti-allergy eye drops on SAC, and although there are slight differences, all can

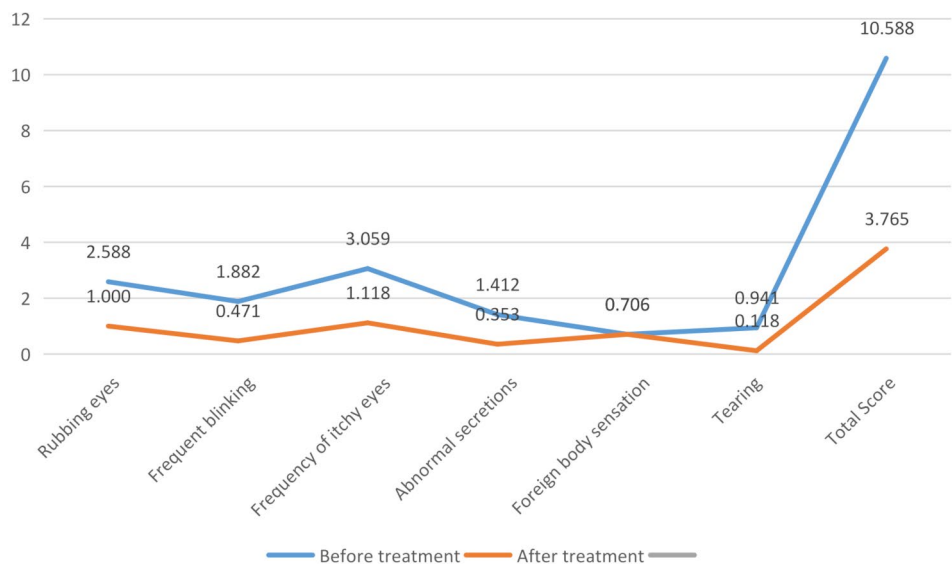


Fig. 3 Scores of the ocular surface symptom questionnaire before and after IPL treatment in the IPL group

Table 2 Comparison of the scores of the ocular surface symptom questionnaire before and after treatment between the IPL group and the control group

		IPL group		control group	
		Mean	Standard deviation	Mean	Standard deviation
Rubbing eyes	Before treatment	2.588	1.121	2.714	0.914
	After treatment	1.000	0.791	2.143	0.864
	<i>t</i>	5.334		1.847	
	<i>P</i>	0.000		0.088	
Frequent blinking	Before treatment	1.882	0.697	2.286	0.825
	After treatment	0.471	0.514	1.643	0.842
	<i>t</i>	6.689		1.883	
	<i>P</i>	0.000		0.082	
Frequency of itchy eyes	Before treatment	3.059	0.659	3.143	0.864
	After treatment	1.118	0.857	2.643	0.633
	<i>t</i>	8.282		1.836	
	<i>P</i>	0.000		0.089	
Abnormal secretions	Before treatment	1.412	0.507	1.571	0.756
	After treatment	0.353	0.493	1.143	0.535
	<i>t</i>	6.628		2.121	
	<i>P</i>	0.000		0.054	
Foreign body sensation	Before treatment	0.706	0.772	1.000	0.679
	After treatment	0.706	0.686	0.571	0.756
	<i>t</i>	0.000		1.578	
	<i>P</i>	1.000		0.139	
Tearing	Before treatment	0.941	0.659	0.857	0.770
	After treatment	0.118	0.332	0.714	0.611
	<i>t</i>	4.197		0.694	
	<i>P</i>	0.001		0.500	
Total Score	Before treatment	10.588	3.261	11.571	4.164
	After treatment	3.765	2.84	8.857	3.461
	<i>t</i>	6.191		1.983	
	<i>P</i>	0.000		0.069	

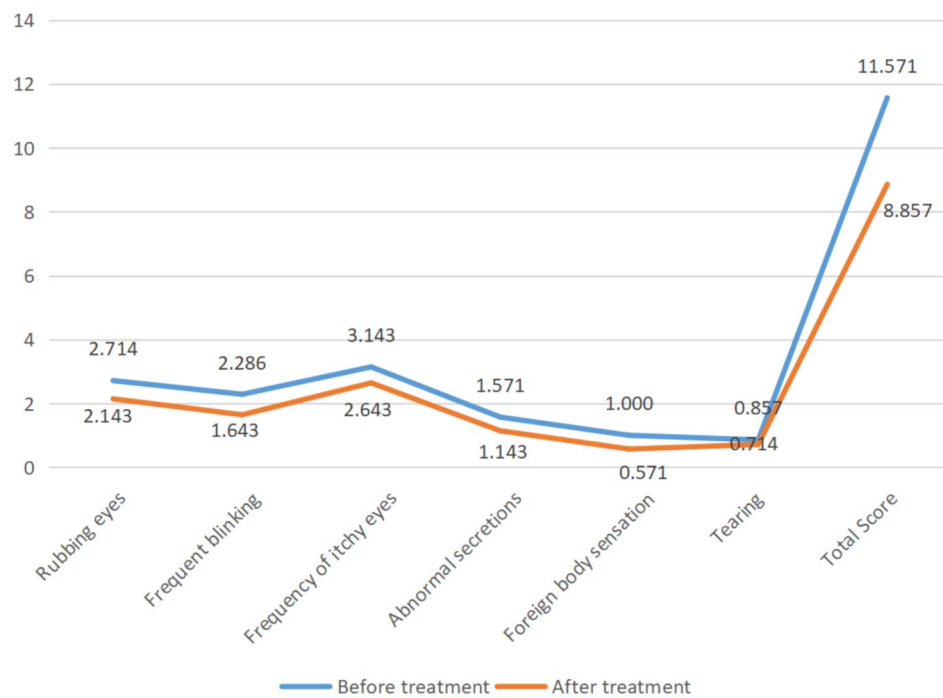


Fig. 4 The scores of the ocular surface symptom questionnaire before and after treatment in the control group

Table 3 Comparison of ocular surface sign scores before and after treatment in the IPL group and the control group

	IPL group		control group	
	Mean	Standard deviation	Mean	Standard deviation
Before treatment	3.000	0.866	3.071	0.829
After treatment	1.294	0.920	2.571	0.646
<i>t</i>		7.649		3.606
<i>P</i>		0.000		0.003

achieve good results [3–5]. In order to control allergic conjunctivitis more effectively, An increasing number of new drugs are being developed, for example, 0.5% epinastine topical eyelid cream may be considered an effective drug to prevent the onset of seasonal allergic conjunctivitis [6]; Bilastine 0.6% ophthalmic solution was effective in reducing ocular symptoms associated with allergic conjunctivitis [7–8]. However, in clinical practice, we still encounter patients who respond poorly to drug treatment from time to time. Especially for pediatric patients, although the symptoms such as redness and swelling of the eyes can be alleviated after medication, the symptoms such as eye rubbing and squinting caused by itching are still very obvious. The main characteristic of seasonal allergic conjunctivitis, especially refractory SAC, is the symptom of eye itching, and the main objective of the treatment is also to alleviate the discomfort in the eyes. Our research found that IPL combined with drug therapy can effectively ameliorate the subjective ocular surface symptoms of patients, especially for a series of ocular

surface symptoms caused by itching. At the same time, it can also ameliorate ocular congestion and edema. The reason for this result may be related to the unique mechanism of action of IPL treatment.

The basic principle of IPL treatment is selective photothermal. IPL is a broad-spectrum, high-intensity, non-coherent light with a wavelength range of 515 nm to 1200 nm. This relatively wide wavelength range encompasses the absorption peaks of melanin, oxyhemoglobin and deoxyhemoglobin [9]. The light energy of IPL is selectively absorbed by hemoglobin in the abnormally dilated capillaries on the ocular surface. It is converted into heat energy, causing hemoglobin to coagulate and form microthrombi, thereby blocking the abnormally dilated capillaries and reducing the secretion of ocular surface inflammatory factors and the inflammatory response [10–11].

Due to its excellent performance in improving meibomian gland function, IPL has been widely used in the treatment of dry eye syndrome [12]. Allergic conjunctivitis is one of the risk factors for dry eye syndrome [13–14]. Some scholars have attempted to apply IPL to allergic keratoconjunctivitis [15] and perennial allergic conjunctivitis [16], and found that IPL also has an auxiliary effect on the treatment of such allergic conjunctivitis. The principle is still based on the selective photothermal effect of IPL to relieve ocular surface inflammatory reactions, improve meibomian gland function, and enhance tear film stability. Our study also considers the powerful anti-inflammatory ability of IPL when applying it to

refractory SAC. By controlling the activation of ocular surface inflammatory factors, it can achieve antihistamine and inhibit mast cell degranulation, thereby alleviating eye itching symptoms [17]. Studies have shown that, for patients with various inflammatory and atopic skin diseases, phototherapy can significantly ameliorate their itching symptoms [18–19]. However, temperature has a significant impact on children's allergic diseases. The photothermal effect generated during phototherapy can also aggravate acute allergic reactions in the eyes [20]. However, IPL has its own advantages, it can rapidly release light energy in a very short time. At the same time, the laser probe is equipped with a cooling device, which can cool the local skin after releasing light energy. This avoids the situation where the skin temperature becomes too high and aggravates the allergic reaction.

Regarding the safety of IPL treatment, no adverse reactions occurred in all cases in our research. The adverse reactions of IPL treatment were mainly pain and local redness and swelling of the skin. Children have poor tolerance to pain. To avoid the occurrence of adverse reactions, we chose a lower treatment energy during the treatment and the stimulation to the local skin was very small.

We fully utilized the advantages of IPL treatment such as short operation time, no trauma and low pain, and combined it with traditional drug therapy to enhance the therapeutic effect. This provided a new idea for the treatment of allergic conjunctivitis. Meanwhile, no adverse reactions occurred during our treatment process, indicating the reliability of the safety of the combined therapy. There are still some deficiencies in our study. The follow-up observation of all patients in this experiment lasted for one week. The Shortcoming is the lack of long-term follow-up data of the patients. Therefore, in future clinical work, we will conduct long-term follow-up on patients and observe the recurrence situation. Meanwhile, the sample size of this study is small, and there may be biases caused by various factors. So the research results still need to be further verified by large-sample, randomized controlled, and multicenter prospective studies.

Conclusions

To sum up, the results of our research indicate that IPL treatment is effective in ameliorating the ocular surface symptoms of seasonal allergic conjunctivitis in children, particularly in suppressing eye itching, with favorable outcomes. For children who respond poorly to anti-allergic drug treatment, IPL can be chosen as an adjunctive therapy.

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Author contributions

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Jiang Jiao, Yang Xiaoge, Wang Jianchang, Du Feifan and Zheng Wei. The first draft of the manuscript was written by Jiang Jiao and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability

Data availability
The datasets used during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Medical Ethics Committee of Hebei Children's Hospital. According to the wishes of the child's guardian, the guardian has been informed of this study and agreed to accept IPL treatment, and voluntarily signed the informed consent form.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. Tariq F, Allergic Conjunctivitis. Review of current types, treatments, and trends. *Life (Basel)*. 2024;14(6):650. <https://doi.org/10.3390/life14060650>
2. Bielory BP, O'Brien TP, Bielory L. Management of seasonal allergic conjunctivitis: guide to therapy. *Acta Ophthalmol*. 2012;90(5):399–407. <https://doi.org/10.1111/j.1755-3768.2011.02272.x>
3. Castillo M, Scott NW, Mustafa MZ, Mustafa MS, Azuara-Blanco A. Topical antihistamines and mast cell stabilisers for treating seasonal and perennial allergic conjunctivitis. *Cochrane Database Syst Rev*. 2015;2015(6):CD009566. <https://doi.org/10.1002/14651858.CD009566.pub2>
4. Owen CG, Shah A, Henshaw K, Smeeth L, Sheikh A. Topical treatments for seasonal allergic conjunctivitis: systematic review and meta-analysis of efficacy and effectiveness. *Br J Gen Pract*. 2004;54(503):451–6.
5. Mortemousque B, Bourcier T, Khairallah M, Messaoud R, Brignole-Baudouin F, Renault D, Rebika H, Brémond-Gignac D, Ketotifen Study Group. Comparison of preservative-free ketotifen fumarate and preserved Olopatadine hydrochloride eye drops in the treatment of moderate to severe seasonal allergic conjunctivitis. *J Fr Ophtalmol*. 2014;37(1):1–8. <https://doi.org/10.1016/j.jfo.2013.02.007>. Epub 2013 Dec 31.
6. Fujishima H, Shoji J. Safety and efficacy of a novel 0.5% epinastine topical eyelid cream in allergic conjunctivitis: a phase 3 trial. *Jpn J Ophtalmol*. 2024;68(6):651–9. <https://doi.org/10.1007/s10384-024-01108-9>
7. Kuna P, Jutel M, Pulka G, Tokarski S, Arranz P, Hernández G, Fernández Hernando N. Safety and tolerability of Bilastine 0.6% ophthalmic solution: an 8-Weeks phase III study. *Clin Ophthalmol*. 2023;17:735–46. <https://doi.org/10.2147/OPTH.S398168>
8. Gomes PJ, Ciolino JB, Arranz P, Hernández G, Fernández N. Bilastine 0.6% Preservative-free eye drops: A Once-daily treatment for allergic conjunctivitis. *J Investig Allergol Clin Immunol*. 2024;34(3):167–76. <https://doi.org/10.18176/jiaci.0894>
9. Babilas P, Schreml S, Szeimies RM, Landthaler M. Intense pulsed light (IPL): a review. *Laser Surg Med*. 2010;42:93–104. <https://doi.org/10.1002/lsm.20877>
10. Toyos R, McGill W, Briscoe D. Intense pulsed light treatment for dry eye disease due to meibomian gland dysfunction: a 3-year retrospective study.

- Photomed Laser Surg. 2015;33(1):41–6. <https://doi.org/10.1089/pho.2014.3819>
11. Husain Z, Alster TS. The role of lasers and intense pulsed light technology in dermatology. *Clin Cosmet Investig Dermatol*. 2016;9:29–40. <https://doi.org/10.2147/CCID.S69106>
 12. Cote S, Zhang AC, Ahmadzai V, Maleken A, Li C, Oppedisano J, Nair K, Busija L, Downie LE. Intense pulsed light (IPL) therapy for the treatment of meibomian gland dysfunction. *Cochrane Database Syst Rev*. 2020;3(3):CD013559. <https://doi.org/10.1002/14651858.CD013559>
 13. Zemba M, Ionescu MA, Pirvulescu RA, Dumitrescu OM, Daniel-Constantin B, Radu M, Stamate AC, Istrate S. Biomarkers of ocular allergy and dry eye disease. *Rom J Ophthalmol*. 2023 Jul-Sep;67(3):250–9. <https://doi.org/10.22336/rjo.2023.42>
 14. Chen X, Zhou Y, Gao X, Zhu Y, Cai Q, Yin B, Sun Z, Xiong Y, Wang Y, Huang X. Prevalence of symptomatic dry eye and influencing factors among Chinese adolescents: A cross-sectional study. *PLoS ONE*. 2024;19(10):e0312725. <https://doi.org/10.1371/journal.pone.0312725>
 15. Li D, Lin SB, Cheng LH, Zhang MZ, Cheng B. Intense pulsed light treatment for itch associated with allergic keratoconjunctivitis: A retrospective study of 35 cases. *Photobiomodul Photomed Laser Surg*. 2021;39(3):196–203. <https://doi.org/10.1089/photob.2020.4826>. Epub 2021 Feb 23.
 16. Li D, Lu J, Hu Z, Liang J, Lin S. Intense pulsed light attenuates oxidative stress in perennial allergic conjunctivitis. *Photobiomodul Photomed Laser Surg*. 2023;41(1):17–25. <https://doi.org/10.1089/photob.2022.0063>
 17. Ackerman S, Smith LM, Gomes PJ. Ocular itch associated with allergic conjunctivitis: latest evidence and clinical management. *Ther Adv Chronic Dis*. 2016;7(1):52–67. <https://doi.org/10.1177/2040622315612745>
 18. Maul JT, Kretschmer L, Anzengruber F, Pink A, Murer C, French LE, Hofbauer GF, Navarini AA. Impact of UVA on pruritus during UVA/B phototherapy of inflammatory skin diseases: a randomized double-blind study. *J Eur Acad Dermatol Venereol*. 2017;31(7):1208–13. <https://doi.org/10.1111/jdv.13994>. Epub 2016 Oct 25.
 19. Ortiz-Salvador JM, Pérez-Ferriols A. Phototherapy in atopic dermatitis. *Adv Exp Med Biol*. 2017;996:279–86. https://doi.org/10.1007/978-3-319-56017-5_23
 20. Yu S, Bigambo FM, Zhou Z, Mzava SM, Qin H, Gao L, Wang X. Impact of temperature and relative humidity variability on children's allergic diseases and critical time window identification. *BMC Public Health*. 2024;24(1):2068. <https://doi.org/10.1186/s12889-024-19573-9>

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