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Herbal fumigation combined with vessels acupoint improves the prognosis and reduces inflammation in patients with dry eye disease: A retrospective study of 123 cases

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Abstract: Dry eye disease (DED) is a prevalent condition often associated with inflammation and tear film dysfunction. Complementary treatments such as herbal fumigation and acupoint applications have shown promise in handling EDE. This study evaluates the combined efficacy of herbal fumigation and vessels acupoint in treating DED. A total of 123 DED patients were randomly assigned to three groups: Fumigation group, Acupoint group, and combined group. Treatment outcomes were assessed using the Schirmer I test (SIT) for tear production, the Ocular surface disease index (OSDI) for symptom evaluation, corneal sensitivity measurements, and inflammatory cytokine levels. All groups showed significant improvements post-treatment, with the combined therapy yielding the greatest effects. SIT scores increased by an average of 4.5 mm in Fumigation group, 5.0 mm in Acupoint group, and 6.6 mm in combined group. OSDI scores improved by 31.0%, 34.5%, and 40.8% for each group, respectively. Corneal sensitivity and cytokine levels also showed the highest improvement in combined group, indicating enhanced tear production and anti-inflammatory effects. The combination of herbal fumigation and acupoint application provides superior benefits for DED patients, enhancing tear production, symptom relief, and inflammatory reduction. This integrative approach could be a valuable complementary treatment for managing DED symptoms.

Keywords: Eye Function; Dry Eye Disease; Herbal Fumigation; Inflammation; Vessel Acupoint;

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INTRODUCTION

Dry eye disease (DED) is a prevalent ocular surface disorder significantly affecting millions of people globally, which is characterized by discomfort, visual disturbances, and tear film instability, leading to symptoms such as dryness, burning, and foreign body sensation (Bhujbal *et al.*, 2024; Britten-Jones *et al.*, 2024). Based on the data reported in TFOS DEWS II, the prevalence of DED ranges from 5% to 50% worldwide, with Asian countries showing higher incidence. Regarding DED epidemiology in China, the reported prevalence rates ranges from 17% to 33%, depending on the region and population studied (Stapleton *et al.*, 2017). The above symptoms finally lead to difficulties including difficulties with reading, working on screens, and driving, as well as associated psychological distress on patients' quality of life, and cause great burden to public health systems. Epidemiological studies estimate that the global prevalence of DED ranges from 5% to 33%, with higher rates observed in populations over 40 years of age (Britten-Jones et al., 2024; Zou *et al.*, 2018). It is well defined that either insufficient tear production or excessive evaporation can lead to the occurrence of DED, and compromise the protective function of the tear film on the ocular surface (Blanco and Zasa, 2024). The current treatments for DED majorly depend on treatments such as artificial tears, anti-inflammatory agents, and surgical interventions (Ghoghari *et al.*, 2024; Ren *et al.*, 2021), but many patients remain refractory to treatment or experience only temporary relief even after the treatments of these strategies (Bhandarkar *et al.*, 2024; Lin *et al.*, 2024). Moreover, the long-term use of medications, such as corticosteroids or immunosuppressants, can lead to adverse effects (Messmer *et al.*, 2023; Cutolo *et al.*, 2019), prompting the need for safer and more sustainable alternatives.

Traditional Chinese Medicine (TCM) offers a holistic approach to treating DEDs by addressing not only the symptoms but also the underlying imbalances in the body's internal systems. In TCM, dry eye is often associated with deficiencies in the liver and kidney yin, stagnation of Qi, or excess heat in the lungs (Liu, 2018; Hu *et al.*, 2025), which result in insufficient nourishment of the eyes, leading to dryness and discomfort. Thus, practitioners have utilized various methods, such as herbal medicine, acupuncture, and external therapies, to restore the balance of Yin and Yang and promote the circulation of Qi and blood to the eyes (Gong *et al.*, 2024; Su *et al.*, 2021). Of different treatment strategies, herbal fumigation is an external therapy that has gained attention for its potential in treating DED (Zhao, 2023; Tan, 2023; Hou, 2022). This method involves the vaporization of medicinal herbs, which are then applied directly to the eyes to relieve dryness, enhance tear production, and reduce inflammation (Hou, 2022; Zhao, 2023; Tan, 2023). Simultaneously, acupoint application therapy has also been widely employed in the treatment of DED. According to TCM

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theory, the Ren (Conception) and Du (Governor) vessels are among the primary meridians that influence ocular health. By stimulating specific acupoints along these vessels, such as Baihui and Yintang (EX-HN3), clinicians aim to enhance the flow of Qi and blood to the eyes, nourish the eye tissues, and promote healing (Leedasawat *et al.*, 2024; Wei *et al.*, 2020). Clinical studies have shown that acupoint application can alleviate dry eye symptoms by improving tear secretion, stabilizing the tear film, and reducing ocular inflammation. This approach offers a non-invasive, safe, and patient-friendly alternative or complement to conventional therapies (Tang, 2022). Given the efficiency of these to strategies in handling DED, it is reasonable to assess the effects of the combination of herbal fumigation and acupoint application, which has not been performed before and may provide synergistic effects on DED. In the current study, we aim to investigate the clinical efficacy of combining these two therapies based on the retrospective analysis of the prognosis and inflammatory cytokine levels in 123 DED patients in our hope. The analysis results of the current analysis will provide a new avenue for the treatment of DED and contributing to the growing body of evidence supporting the use of TCM in ophthalmology.

MATERIALS AND METHODS

Patient selection and study design

The current study included 123 patients in our hospital from Jan 2024 to Sep 2024 with different strategies (fig. 1).

Patients eligible for this study met the following criteria: aged 18–75 years; diagnosed with DED based on the Chinese Expert Consensus on Dry Eye (2020); ocular surface disease index (OSDI) score ≥ 13; schirmer I test (SIT) ≤ 5mm/5min without anesthesia; no prior ocular surgery within the last 6 months; no concurrent systemic diseases affecting tear production (e.g., Sjogren's syndrome, thyroid disorders). Patients were excluded if they: had severe ocular surface diseases other than DED; were currently using systemic or topical corticosteroids or immunosuppressants; had a history of allergies to the herbs used in the fumigation or acupoint application; were pregnant or breastfeeding. Upon enrollment, the 123 patients were randomly assigned to one of the three treatment groups using a computer-generated randomization sequence. The treatment duration was 4 weeks.

Fumigation group (n=30), patients in this group were treated with herbal fumigation therapy. The decoction was formulated based on traditional Chinese medicine principles, with the goal of nourishing the liver and kidney yin, moistening the eyes, and reducing heat. The decoction consisted of the following herbs that are decocted in water (200 mL): Gou Qi Zi (*Lycium barbarum*) (9 g), Ju Hua (*Chrysanthemum*) (12 g), Sheng Di Huang (*Rehmannia glutinosa*) (10g), Mai Dong (*Ophiopogon japonicus*) (10g), Bai Shao (*Paeonia lactiflora*) (15g). The decoction was vaporized using a fumigation device. Patients were exposed to the herbal steam in a seated position, with the vapor directed at the ocular region from a distance of 20–30 cm. Each session lasted for 30 minutes, and patients underwent this treatment once daily for 4 weeks.

Acupoint group (n=45), patients in this group were treated with vessels acupoint application. This therapy involved applying medicated herbal patches to key acupoints along the Ren (Conception) and Du (Governor) vessels. According to TCM theory, these vessels play a crucial role in regulating the body's Yin-Yang balance and are closely associated with eye health. The following acupoints were selected based on their therapeutic effects on dry eye symptoms: Baihui (DU20), Yintang (EX-HN3), Fengchi (GB20), and Shenting (DU24). Herbal patches, consisting of ingredients such as moxa leaf (*Artemisia argyi*) (45% in weight), ginger (*Zingiber officinale*) (45% in weight), and frankincense (Boswellia) (45% in weight), were applied to these acupoints. The patches were kept on for 6 hours daily and replaced once a day for the 4-week duration.

Combined group (n = 48), patients in this group received both fumigation and vessels acupoint simultaneously. The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of Ganzhou People's Hospital (approval no. 2023AGPH0125). All participants were provided with detailed information about the purpose, procedures, risks, and potential benefits of the study. Written informed consent was obtained from each participant before enrollment.

Schirmer I test (SIT)

The SIT was used to assess tear secretion in all patients. The test involved placing a filter paper strip (5mm wide) into the lower conjunctival sac at the junction of the middle and lateral thirds. After 5 minutes, the amount of moisture absorbed by the paper was measured. A result of ≤ 5mm/5min indicated significant tear production deficiency.

Ocular surface disease index (OSDI)

The severity of dry eye symptoms was assessed using the OSDI questionnaire. This 12-item questionnaire measures the frequency of dry eye symptoms, vision-related function, and environmental triggers. Scores range from 0 to 100, with higher scores indicating more severe symptoms. OSDI was administered at baseline and at the end of the 4-week treatment.

Corneal sensitivity test

Corneal sensitivity was evaluated using the Cochet-Bonnet

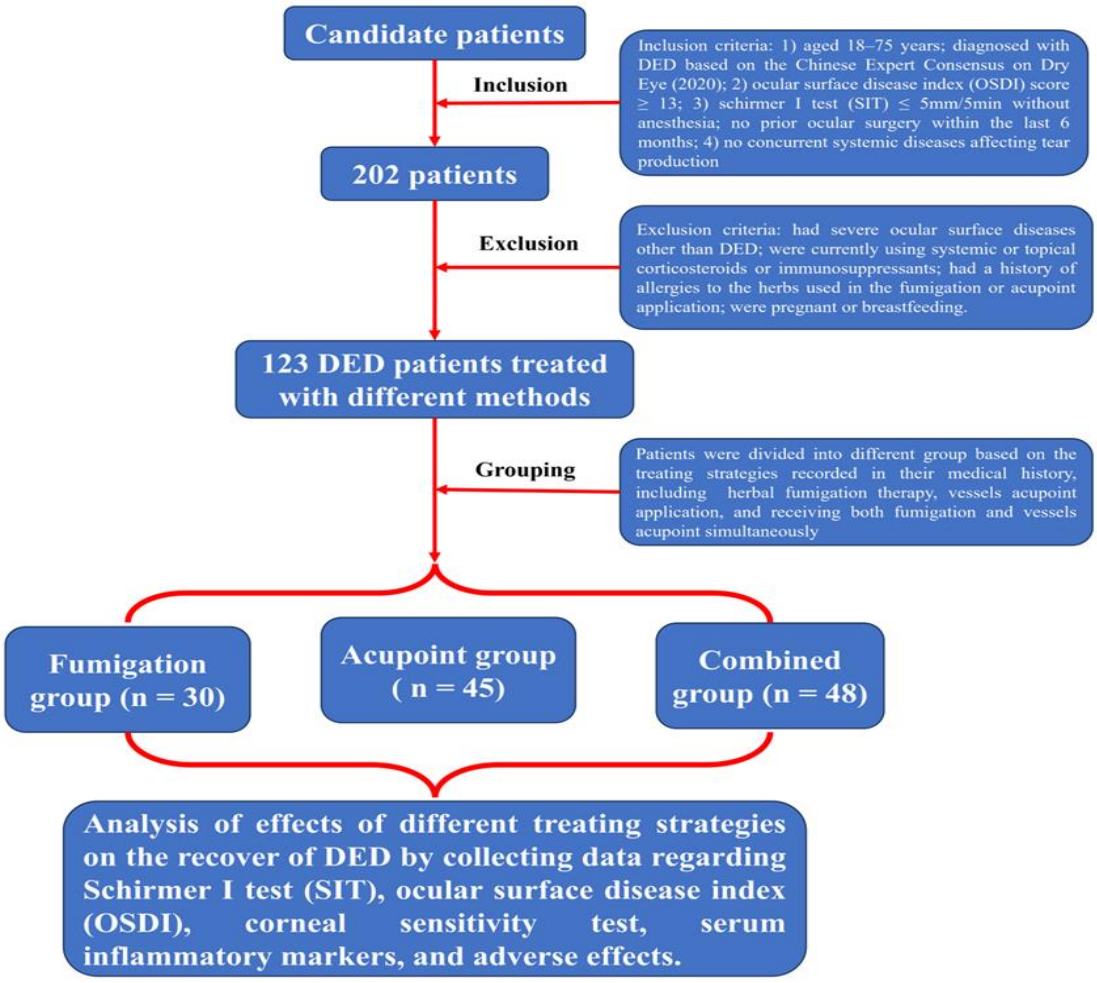

Fig 1: The flowchart elucidating the inclusion, exclusion, and grouping processes of the current study.

aesthesiometer. The test involved using a nylon filament of variable length to touch the central cornea. The length of the filament at which the patient first perceives the touch was recorded. Higher sensitivity indicated better corneal nerve function.

Serum inflammatory markers

To evaluate systemic inflammatory response, serum levels of IL-1β, TNF-α, and IL-6 were measured using enzyme-linked immunosorbent assay (ELISA) kits. Blood samples were drawn from each patient at baseline and after the 4-week treatment period. Elevated levels of these inflammatory cytokines are associated with more severe ocular surface inflammation.

Safety assessment

Safety was evaluated through the monitoring of adverse reactions and side effects in all three treatment groups. Local skin reactions (e.g., rash, itching) from the acupoint application, as well as systemic reactions (e.g., nausea, dizziness) from herbal fumigation, were recorded. Blood pressure, heart rate, and any signs of allergic reactions were monitored at each visit.

STATISTICAL ANALYSIS

Data were analyzed using SPSS 26.0 software. Continuous variables (e.g., SIT, OSDI, corneal sensitivity, and inflammatory markers) were expressed as mean ± standard deviation (SD) and compared between groups using an independent-samples t-test for normally distributed data or the Mann-Whitney U test for non-normally distributed data. Paired-samples t-tests were used to compare pre- and post-treatment results within each group. Categorical variables (e.g., incidence of adverse reactions) were compared using the Chi-square test or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULTS

Clinicopathological Characteristics

A total of 123 patients diagnosed with dry eye disease (DED) were enrolled and randomly assigned to three treatment groups. The average age for patients in Fumigation group was 50.7 ± 9.1 years old, with 14 males and 16 females. For patients in Acupoint group, the average

Table 1: Clinicopathological Characteristics of Patients at Baseline

Characteristic	Fumigation (n=30)	Acupoint (n=45)	Combined (n=48)	P value
Age (years)	50.7 ± 9.1	51.1 ± 8.9	50.9 ± 9.2	0.82
Gender (Male/Female)	14/16	21/24	22/26	0.95
Duration of DED (years)	3.2 ± 1.5	3.1 ± 1.4	3.3 ± 1.6	0.74
Schirmer I Test (mm/5min)	3.1 ± 0.8	3.0 ± 0.7	2.9 ± 0.9	0.68
OSDI score	55.2 ± 6.4	56.5 ± 5.9	57.3 ± 6.2	0.62
IL-1β (pg/mL)	15.6 ± 1.3	15.4 ± 1.4	15.8 ± 1.2	0.57
IL-6 (pg/mL)	22.1 ± 2.3	21.9 ± 2.5	22.3 ± 2.1	0.69
TNF-α (pg/mL)	11.7 ± 1.1	11.8 ± 1.2	12.0 ± 1.0	0.72

Table 2 Schirmer I Test Results (mm/5min) Before and After Treatment

Group	Pre-treatment	Post-treatment	Change	P value
Fumigation	3.1 ± 0.8	7.6 ± 1.1	+4.5 ± 1.0	< 0.001
Acupoint	3.0 ± 0.7	8.0 ± 1.2	+5.0 ± 1.1	< 0.001
Combined	2.9 ± 0.9	9.5 ± 1.3	+6.6 ± 1.4	< 0.001

Table 3: OSDI Scores Before and After Treatment

Group	Pre-treatment	Post-treatment	Change	P value
Fumigation	55.2 ± 6.4	24.3 ± 4.9	-30.9 ± 5.2	< 0.001
Acupoint	56.5 ± 5.9	21.8 ± 4.5	-34.7 ± 5.4	< 0.001
Combined	57.3 ± 6.2	16.5 ± 4.2	-40.8 ± 5.8	< 0.001

Table 4: Corneal Sensitivity Test (mm) Before and After Treatment

Group	Pre-treatment	Post-treatment	Change	P value
Fumigation	30.2 ± 1.4	45.6 ± 1.9	+15.4 ± 2.0	< 0.001
Acupoint	29.9 ± 1.6	46.0 ± 2.1	+16.1 ± 2.3	< 0.001
Combined	30.0 ± 1.5	50.5 ± 2.2	+20.5 ± 2.6	< 0.001

age was 51.1 ± 8.9 and the male proportion was 46.6% (21 males and 24 females). For patients in Combined group, the average age was 50.9 ± 9.2 and the male proportion was 45.8% (22 males and 26 females) (Table 1). No significant difference was detected regarding age and male proportion between the three groups. Regarding other parameters including duration of DED, SIT score, OSDI scores, or inflammatory cytokine levels between the three groups (all $p > 0.05$), there were no significant differences detected, which confirmed the homogeneity of the groups at baseline (Table 1).

Effects of different treatment strategies on SIT score

SIT was used to assess tear production. After four weeks of treatment, tear production as measured by SIT improved significantly in all groups (Table 2). At baseline, SIT scores were low, with a mean of 3.1 mm/5min in Fumigation group, 3.0 mm/5min in Acupoint Group, and 2.9 mm/5min in Combined Group, reflecting severe tear deficiency. After treatment, all groups showed a significant increase in tear production ($p < 0.001$). Additionally, the combination therapy resulted in a significantly greater increase in tear production compared to either monotherapy in the other two groups ($p < 0.05$), highlighting the superior efficacy of the combined approach.

Effects of different treatment strategies on OSDI score

The effects of treatments on OSDI score were shown in Table 3, which measures the severity of dry eye symptoms. At baseline, patients in all groups had high OSDI scores, indicating significant symptoms of dry eye. After treatment, OSDI scores decreased markedly in all three groups ($p < 0.001$). In Fumigation group, OSDI scores decreased from 55.2 ± 6.4 to 24.3 ± 4.9, a reduction of 30.9 ± 5.2 points. In Acupoint group, OSDI scores decreased from 56.5 ± 5.9 to 21.8 ± 4.5, a reduction of 34.7 ± 5.4 points. Combined group showed the greatest improvement, with OSDI scores dropping from 57.3 ± 6.2 to 16.5 ± 4.2, a reduction of 40.8 ± 5.8 points (Table 3). The combination therapy resulted in a significantly greater reduction in OSDI scores compared to either monotherapy, demonstrating its superior efficacy

Table 5: Inflammatory Cytokine Levels Before and After Treatment

Marker	Group	Pre-treatment	Post-treatment	Change	P value
IL-1β (pg/mL)	Fumigation	15.6 ± 1.3	9.3 ± 1.0	-6.3 ± 1.2	< 0.001
	Acupoint	15.4 ± 1.4	8.7 ± 1.1	-6.7 ± 1.3	< 0.001
	Combined	15.8 ± 1.2	6.8 ± 0.9	-9.0 ± 1.1	< 0.001
IL-6 (pg/mL)	Fumigation	22.1 ± 2.3	14.2 ± 1.7	-7.9 ± 1.5	< 0.001
	Acupoint	21.9 ± 2.5	13.5 ± 1.6	-8.4 ± 1.6	< 0.001
	Combined	22.3 ± 2.1	10.5 ± 1.5	-11.8 ± 1.6	< 0.001
TNF-α (pg/mL)	Fumigation	11.7 ± 1.1	6.2 ± 0.9	-5.5 ± 1.0	< 0.001
	Acupoint	11.8 ± 1.2	5.9 ± 1.0	-5.9 ± 1.1	< 0.001
	Combined	12.0 ± 1.0	4.5 ± 0.8	-7.5 ± 1.0	< 0.001

in alleviating dry eye symptoms

Effects of different treatment strategies on corneal sensitivity test

Corneal sensitivity, as measured by the Cochet-Bonnet aesthesiometer, improved significantly in all groups after treatment (Table 4). At baseline, corneal sensitivity was reduced in all patients, but after treatment, all groups showed improvement ($p < 0.001$). Patients in Fumigation group improved from 30.2 ± 1.4 mm to 45.6 ± 1.9 mm, an increase of 15.4 ± 2.0 mm. Patients in Acupoint group improved from 29.9 ± 1.6 mm to 46.0 ± 2.1 mm, an increase of 16.1 ± 2.3 mm. Patients in Combined group showed the greatest improvement, from 30.0 ± 1.5 mm to 50.5 ± 2.2 mm, an increase of 20.5 ± 2.6 mm. Again, the combination therapy resulted in significantly greater improvements in corneal sensitivity compared to the monotherapies (Table 4) ($p < 0.05$).

Effects of different treatment strategies on serum inflammatory

Inflammatory cytokines, including IL-1β, IL-6, and TNF-α, were measured before and after treatment. As shown in Table 5, all groups exhibited significant reductions in these markers after treatment ($p < 0.001$). However, the combination therapy demonstrated the greatest reductions in all three markers, indicating a superior anti-inflammatory effect (Table 5). The above results together suggest that the combination therapy had a more pronounced effect on reducing restoring eye function and systemic inflammation, compared to the individual therapies.

Safety assessment

All treatments were well tolerated, with no serious adverse events reported. Mild side effects included nausea and dizziness during fumigation, and mild itching or redness at the acupoint sites. These effects were transient and did not require discontinuation of treatment. In Fumigation Group, three patients (10%) experienced mild nausea, and two (6.7%) reported dizziness during fumigation. In Acupoint Group, five patients (11%) experienced mild itching at acupoint sites. In Combined group, four patients (8.3%) reported itching at acupoint sites, and two (4.2%) experienced mild dizziness during fumigation. The incidence of side effects was low and not significantly different between groups ($p > 0.05$), suggesting that all treatments were safe and well-tolerated.

DISCUSSION

The present study evaluated the efficacy and safety of combining herbal fumigation and vessels acupoint in treating dry eye disease (DED), compared to each treatment alone. The results demonstrated that the combination therapy significantly improved tear production, reduced dry eye symptoms, enhanced corneal sensitivity, and lowered systemic inflammatory markers, with a better safety profile. These findings suggest that the combination of herbal fumigation and acupoint therapy offers a novel and effective approach for managing DED, particularly for patients who may not respond adequately to conventional therapies.

The most significant improvement in tear secretion in the combination therapy group highlights the synergistic effect of combining herbal fumigation with acupoint application. Previous studies have shown that herbal therapies can improve tear film stability by moisturizing the eyes and enhancing the production of lacrimal fluid (Askeroglu *et al.*, 2013; Rák and Csutak, 2024; Muz *et al.*, 2020). In our herbal fumigation therapy, Gou Qi Zi (*Lycium barbarum*) is characterized by liver- and kidney-nourishing properties while enhancing visual acuity, which is commonly utilized for alleviating vision deterioration and symptoms of dry eyes (Chien *et al.*, 2018; Pop *et al.*, 2020). Ju Hua (*Chrysanthemum*) possesses functions in dispelling wind-heat, soothing the liver, and improving vision, and is widely used for relieving red, swollen eyes and dryness (Sun *et al.*, 2025; Zhang *et al.*, 2024). Sheng Di Huang (*Rehmannia glutinosa*) demonstrates cooling, blood-cleansing, and yin-nourishing effects, which contribute to alleviating eye dryness and blurred vision caused by yin deficiency and internal heat (Huang *et al.*, 2023). Mai Dong (*Ophiopogon japonicus*) is characterized by properties of nourishing yin, generating body fluids, and moistening the lungs. It is applied to mitigate dry eyes and

blurry vision (Yang *et al.*, 2022). Bai Shao (*Paeonia lactiflora*) functions in enriching the blood, soothing the liver, and alleviating pain, which is beneficial for addressing eye discomfort, particularly in cases associated with blood deficiency and liver dysfunction (Zhao *et al.*, 2019). Collectively, the ingredients in the herbal fumigation together contribute to the alleviation of DEE after vaporization.

Acupoint stimulation, particularly at the Ren and Du vessels, has been linked to improved blood circulation and regulation of Qi, which can further promote tear production (Wei et al., 2020; Pesavento *et al.*, 2022). The reduction in OSDI scores was also most pronounced in the combination therapy group. As a critical measure of symptom severity in DED (Chatterjee *et al.*, 2021; Akowuah *et al.*, 2022), the significant reduction in OSDI scores in Combined group suggests that the combined therapy is more effective at relieving symptoms such as dryness, burning, and foreign body sensation. This aligns with the TCM principle that both external (herbal fumigation) and internal (acupoint therapy) factors must be addressed to restore balance and alleviate symptoms (Su et al., 2021; Ling *et al.*, 2021).

Corneal nerve dysfunction is a common issue in DED and is associated with nerve damage due to chronic inflammation and tear film instability (Galor *et al.*, 2021). Both herbal fumigation and acupoint therapy have demonstrated anti-inflammatory effects in previous studies. For example, the herbal components of fumigation therapy are known for their anti-inflammatory and neuroprotective effects, which could contribute to the repair of damaged corneal nerves (Pop et al., 2020; Xing *et al.*, 2016; Zhang et al., 2024). Acupoint application can further modulate immune responses by stimulating the nervous and endocrine systems, leading to a reduction in pro-inflammatory cytokines. Additionally, acupoint therapy, particularly through the stimulation of the Ren and Du meridians, is believed to enhance neural function by improving blood flow and reducing stagnation (Wu, 1990).

The synergistic effects observed in the combination therapy group may be explained by the complementary mechanisms of action of herbal fumigation and vessels acupoint. The vaporization of medicinal herbs allows for rapid absorption through the skin and mucous membranes, providing a direct effect on the eyes and surrounding tissues. Acupoint therapy, on the other hand, works through the stimulation of key meridians that regulate Qi and blood flow, enhancing the body's ability to heal itself and maintain homeostasis. By addressing both local (ocular surface) and systemic (Qi and blood flow) factors, the combination therapy offers a holistic approach to managing DED. While the results of this study are promising, there are some limitations to consider. First, this was a relatively short-term study, with a treatment duration of 4 weeks. Long-term follow-up studies are needed to assess the sustained efficacy of the combination therapy. Second, this study did not include a placebo or sham control group, which would help clarify the extent to which the observed effects are due to the specific interventions versus placebo effects. Thus, further research, including longer-term studies and comparisons with placebo controls, is warranted to fully establish the therapeutic potential of this combination therapy.

CONCLUSIONS

The combination of herbal fumigation and vessels acupoint offers a safe and effective treatment for DED, providing superior outcomes compared to either therapy alone. This integrative approach aligns with the principles of TCM and could serve as a valuable adjunctive therapy for patients with DED who do not respond to conventional treatments.

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