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REVIEW

A Review of Acupuncture for the Treatment of Dry Eye Syndrome: Mechanisms, Efficacy, and Clinical Implications

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Abstract: Dry eye disease (DED) is a prevalent ocular condition characterized by discomfort and vision impairment in affected individuals. This review discusses various etiologies of DED, including autoimmune, drug-induced, and mechanical factors, each with distinct underlying causes. Acupuncture, a traditional therapeutic modality, has garnered increasing attention in recent years as a potential complementary treatment for DED. Current clinical evidence demonstrates that acupuncture for DED, when performed by qualified practitioners following standardized protocols, exhibits favorable safety profiles with only mild and transient adverse reactions (eg, minor local bleeding, brief needling pain, or mild needle syncope) potentially occurring. This review provides a comprehensive analysis of recent studies investigating the underlying mechanisms, therapeutic efficacy, and clinical applications of acupuncture in the treatment of DED. Findings suggest that acupuncture enhances tear production, reduces ocular inflammation, and regulates nervous system function, offering a multifaceted approach to DED management. Clinically, acupuncture may reduce reliance on medications, thereby minimizing the risk of side effects and drug interactions. Additionally, it has the potential to improve patients' quality of life by alleviating discomfort, enhancing ocular health, and promoting overall well-being. These insights underscore the role of acupuncture as a complementary treatment and highlight its implications for improving patient outcomes and guiding future research in this field.

Keywords: acupuncture, dry eye disease, efficacy assessment, traditional Chinese medicine, treatment

Introduction

Dry eye disease (DED) is a multifactorial ocular condition characterized by the disruption of tear film homeostasis, leading to ocular symptoms and potential damage to the ocular surface.[1–3] It has become increasingly recognized as a significant public health issue due to its high prevalence and impact on an individual's quality of life. Epidemiological research has estimated that DED affects approximately 5 to 50% of the population, with prevalence varying based on factors such as age, gender, and environmental conditions.[4] The condition is notably common in individuals with autoimmune diseases, such as rheumatoid arthritis, where it may exacerbate symptoms and contribute to visual impairment.[5–7]

The etiology of DED is multifaceted, involving factors such as age, hormonal changes, environmental influences, and medical conditions. Meibomian gland dysfunction is a leading cause of evaporative dry eye, while aqueous tear deficiency often arises from conditions such as Sjögren's syndrome or lacrimal gland dysfunction.[8] Lifestyle factors, including prolonged screen use and contact lens wear, are also significant contributors to dry eye symptoms.[9] A comprehensive understanding of these underlying causes is essential for the effective management of DED, as treatment strategies must be customized to address the specific factors affecting each individual.

Conventional first-line therapies for DED include artificial tears, immunosuppressants, and anti-inflammatory agents. While these treatments can provide symptomatic relief, they often have limitations, such as transient efficacy, the need

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for frequent application, and potential side effects, including ocular irritation and discomfort.[10] Moreover, preservative-containing topical treatments may exacerbate ocular surface damage over time, further highlighting the need for alternative approaches.

Acupuncture, a practice rooted in traditional Chinese medicine (TCM), has been increasingly explored for its application in treating various health conditions, including DED.[11] This ancient technique involves the insertion of fine needles at specific points on the body to promote healing and restore physiological balance. Acupuncture has a long history of use in addressing a broad range of ailments, and its potential role in ophthalmology is gaining attention.[12,13] Recent studies have investigated its effectiveness in alleviating dry eye symptoms, highlighting its potential as a complementary approach to conventional therapies.[14–16]

In ophthalmology, acupuncture is being explored for its potential to improve tear production and relieve symptoms associated with DED. Several clinical trials and reviews have reported favorable outcomes, indicating that acupuncture may enhance ocular surface health and provide symptomatic relief for patients with DED.[17,18] As acupuncture gains increasing recognition for its effectiveness in treating DED, it has also become a growing area of interest. However, further research is needed to fully understand its underlying mechanisms. As research continues to evolve, integrating acupuncture into the management of DED could serve as a valuable complement to existing treatment options, offering patients a more holistic approach to eye care.[19,20]

This article systematically discusses the core issue of acupuncture treatment for dry eye syndrome from multiple dimensions, including the elucidation of its mechanisms of action, the review of clinical evidence, and the exploration of future directions. The aim is to construct a scientific framework for understanding acupuncture therapy and to provide new insights for translational research in the clinical setting.

Mechanisms of Acupuncture Treatment in DED

Mechanism of Promoting Tear Secretion

Acupuncture has been shown to enhance tear secretion, a vital component in the management of DED. The stimulation of specific acupuncture points has been found to activate the lacrimal gland function, resulting in increased tear production. Clinical observations support this effect, showing improved tear film stability and prolonged tear break-up time following acupuncture treatment.[21] For instance, a randomized controlled pilot trial reported significant increases in tear secretion among patients with DED following refractive surgery, indicating a direct relationship between acupuncture stimulation and improved lacrimal function.[22] The careful selection of acupuncture points plays a critical role in these therapeutic effects. Research has identified specific points that, when stimulated, effectively target the lacrimal apparatus, promoting tear production and alleviating dry eye symptoms.[23] These findings highlight acupuncture's potential as a non-pharmacological strategy to boost tear secretion and support ocular surface health.

Reduction of Ocular Inflammatory Response

Chronic inflammation is a key feature of DED, contributing to both discomfort and visual disturbances. Acupuncture has demonstrated anti-inflammatory effects in animal studies, offering potential benefits for the management of DED. These effects are achieved through the modulation of inflammatory cytokines and the enhancement of local microcirculation, which helps reduce ocular surface inflammation.[24–26] Clinical findings have reported significant reductions in ocular discomfort and inflammation after acupuncture treatment.[27,28] Additionally, acupuncture may influence neuroimmune pathways involved in ocular inflammation, reducing the production of pro-inflammatory mediators and supporting the healing of the ocular surface.[29] When combined with conventional therapies, such as artificial tears, acupuncture has been demonstrated to improve overall efficacy by addressing both inflammation and lubrication requirements in DED.[30] This integrative approach underscores the potential of acupuncture to not only alleviate symptoms but also target the underlying inflammatory mechanisms associated with DED.

Regulation of Nervous System Function

The regulation of nervous system function is another important mechanism by which acupuncture may alleviate DED. Acupuncture has been demonstrated to influence autonomic nervous system balance, particularly by enhancing parasympathetic activity, which is crucial for maintaining ocular health. Stimulation of specific acupuncture points has been associated with increased parasympathetic outflow, facilitating the repair of corneal epithelium damage and sensory neuron function, thereby alleviating ocular surface neuralgia.[31] Additionally, acupuncture has been linked to reductions in anxiety and stress, both of which can worsen dry eye symptoms. A case report demonstrated that acupuncture not only improved ocular symptoms but also addressed associated anxiety, highlighting the therapy's holistic benefits.[32,33] This regulatory effect on the nervous system may further enhance sensory function and eye comfort, ultimately improving the quality of life for patients with DED. Therefore, acupuncture offers a promising approach to managing dry eye by addressing tear production, inflammation, and nervous system regulation through a multifaceted therapeutic strategy.

Acupuncture Treatment for DED

Results of Randomized Controlled Trials

Recent randomized controlled trials have provided strong evidence supporting the effectiveness of acupuncture in managing DED. One clinical study assessed the therapeutic impact of acupuncture on patients with DED following cataract surgery. The findings showed that acupuncture significantly improved tear secretion, tear film stability, and ocular symptoms, thereby enhancing the patients' overall quality of life.[34] In another study, the effectiveness of adjunctive acupuncture with standard care for post-refractive surgery DED was evaluated. The study demonstrated a notable difference in ocular surface disease index scores between individuals receiving acupuncture combined with standard care and those receiving standard care alone. These results suggest that a four-week course of adjunctive acupuncture alongside standard care is a viable and effective treatment strategy for DED after refractive surgery.[22] A systematic review and meta-analysis also supported these outcomes, demonstrating that combining acupuncture with artificial tears effectively mitigates DED symptoms, highlighting its potential as a complementary therapy.[16] Collectively, these studies offer substantial evidence that acupuncture can enhance tear production and alleviate ocular discomfort, positioning it as a valuable intervention for the treatment of DED. However, in a systematic review included 19 studies (1126 patients) comparing the efficacy of acupuncture with artificial tears, subgroup analysis using the Bucher method showed that acupuncture had better overall efficacy in treating DED than artificial tears, but there was high heterogeneity.[35]

Comparison of Acupuncture with Traditional Treatment Methods

Acupuncture has demonstrated promising outcomes when compared with conventional treatments for DED, such as artificial tears and anti-inflammatory medications. Artificial tears, commonly employed as the primary first-line therapy, often provide only short-term relief.[36] In contrast, acupuncture addresses the underlying mechanisms of DED by enhancing local blood circulation and stimulating tear secretion. Research has demonstrated that combining acupuncture with standard treatments resulted in better symptom management than standard treatments alone, particularly in patients with computer vision syndrome.[30] Furthermore, the incorporation of acupuncture into treatment regimens has been associated with a reduced reliance on medications, thereby minimizing potential side effects.[33] This comparative analysis highlights the potential of acupuncture as a viable alternative or complementary therapy in the management of DED.

Efficacy Analysis of Different Acupuncture Techniques

The efficacy of various acupuncture techniques for managing DED has been evaluated in numerous clinical studies. Methods such as acupuncture, auricular acupuncture, and needle-knife therapy have been evaluated to determine their therapeutic effectiveness. A single-blind randomized controlled trial demonstrated that both intradermal acupuncture and biodegradable microneedle acupuncture significantly improved tear secretion, tear film stability, and ocular comfort, thereby enhancing patients' overall quality of life.[37] Additionally, research indicates that needle-knife therapy, when used alongside standard acupuncture methods, was associated with further improvement in treatment outcomes.[38] Studies have

also shown that the acupuncture steaming eye mask effectively alleviates dry eye symptoms in users who frequently use visual display terminal.[39] Similarly, press needle therapy has been reported to improve dry eye symptoms more effectively than sodium hyaluronate eye drops alone, showing superior results in tear film stability, tear secretion, and corneal epithelial integrity.[40] Clinical studies also demonstrate that laser acupuncture adjunctive to conventional therapy significantly enhances both symptomatic relief and tear film parameters in DED ($p<0.05$).[35,41] These evidences support the incorporation of LA into stepwise management protocols for treatment-resistant DED cases. These findings highlight that while acupuncture remains a valuable treatment, exploring alternative techniques may provide enhanced therapeutic benefits for patients with DED.

Acupuncture Treatment for DED: Specific Methods

Common Acupoints and Their Selection

Acupuncture has been established as an effective approach for managing DED, with acupoint selection based on TCM principles. According to meridian theory, perspective, DED treatment primarily focuses on acupoints located on yang meridians, with approximately 62.7% of the selected acupoints located along these pathways. Among them, the three foot-yang meridians, which originate from or surround the eye, are commonly targeted. This approach reflects the TCM principle that "where the meridian passes, it governs".[23]

The typical selection of acupoints combines both proximal and distal points. Proximal acupoints include local points such as BL1 (Jingming), BL2 (Zanzhu), ST1 (Chengqi), ST2 (Sibai), and adjacent points like B20 (Fengchi), GB14 (Yangbai), and GV20 (Baihui). Distal points include LI4 (Hegu), ST36 (Zusanli), and SP6 (Sanyinjiao).[23,36,42–44]

Recent research highlights the importance of tailoring acupoint selection based on the individual's TCM syndrome diagnosis. For instance, liver and kidney yin deficiency is a common syndrome associated with DED. A clinical observation demonstrated that Tiaoshen acupuncture, combined with artificial tears, produced promising outcomes in patients with this condition. This highlights the necessity of personalized treatment approaches that address both the physiological and psychological dimensions of DED.[45]

Frequency and Duration of Acupuncture Treatment

The frequency and duration of acupuncture treatment for DED can significantly impact therapeutic outcomes. Treatment sessions are typically recommended two to three times per week, with each session lasting between 30 to 45 minutes. The standard course of acupuncture generally spans 4 to 6 weeks, depending on the severity of the symptoms and the patient's response to the therapy. Research has shown that consistent and regular acupuncture sessions can result in improved tear film stability and reduced ocular discomfort.[46] A systematic review indicated that interventions lasting longer than one month are more effective than short-term treatments. Additionally, the frequency of sessions plays a role; treatments conducted less than three times a week were found to be more effective than those administered at higher frequencies.[42] The optimal treatment schedule should be tailored to individual patient characteristics, including their response to therapy and any coexisting health conditions, highlighting the necessity of personalized treatment plans.

Comprehensive Treatment Plans Combining Other Therapies

Integrating acupuncture with other therapeutic approaches can improve treatment outcomes for DED. For instance, the combination of acupuncture with artificial tears has proven to be particularly beneficial, addressing both symptom relief and the underlying mechanisms of dryness.[16] A randomized controlled trial highlighted that combining acupuncture with TCM offers greater efficacy than monotherapy.[30] In addition to these approaches, lifestyle changes, such as maintaining proper hydration and making dietary adjustments, can complement the treatment process. Adjunctive therapies, such as moxibustion—a TCM practice—have also been investigated as supplementary treatments, showing both good efficacy and safety in managing DED[47] This comprehensive treatment strategy not only targets physical symptoms but also addresses psychological factors, such as anxiety, which can exacerbate dry eye symptoms, thereby providing a holistic approach to care.[17,32] Such a multifaceted model underscores the significance of an integrated and patient-centered approach in effectively managing DED.

Table 1 Summary of Acupuncture Points and Their Application in Dry Eye Disease Treatment

Acupoint	Location	Treatment Frequency (Per Week)	Treatment Duration (Weeks)	Type of Acupuncture
BL1 (Jingming)	Proximal acupoint	2-3	4-12	Manual Acupuncture (MA); Laser Acupuncture (LA)
BL2 (Zanzhu)	Proximal acupoint	2-3	4-12	Manual Acupuncture (MA); Laser Acupuncture (LA); Intradermal acupuncture (IDA); Press Needle
ST1 (Chengqi)	Proximal acupoint	2-3	4-12	Manual Acupuncture (MA); Laser Acupuncture (LA); Intradermal acupuncture (IDA)
ST2 (Sibai)	Proximal acupoint	2-3	4-12	Manual Acupuncture (MA); Laser Acupuncture (LA); Press Needle
B20 (Fengchi)	Adjacent point	2-3	4-6	Manual Acupuncture (MA), Electroacupuncture (EA)
GB14 (Yangbai)	Adjacent point	2-3	4-6	Manual Acupuncture (MA), Electroacupuncture (EA)
GV20 (Baihui).	Adjacent point	2-3	4-6	Manual Acupuncture (MA), Electroacupuncture (EA)
LI4 (Hegu)	Distal point	2-3	4-12	Electroacupuncture (EA), Laser Acupuncture (LA)
ST36 (Zusanli)	Distal point	2-3	4-12	Electroacupuncture (EA), Laser Acupuncture (LA)
SP6 (Sanyinjiao)	Distal point	2-3	4-6	Electroacupuncture (EA)

Summary of Acupuncture Treatment for DED

Table 1 and Figure 1 summarize the common acupoints used in acupuncture treatment for DED, their locations, treatment frequency, duration, and types of acupuncture applied. Table 2 summarizes improvement in dry eye over the years in acupuncture treatment for DED.

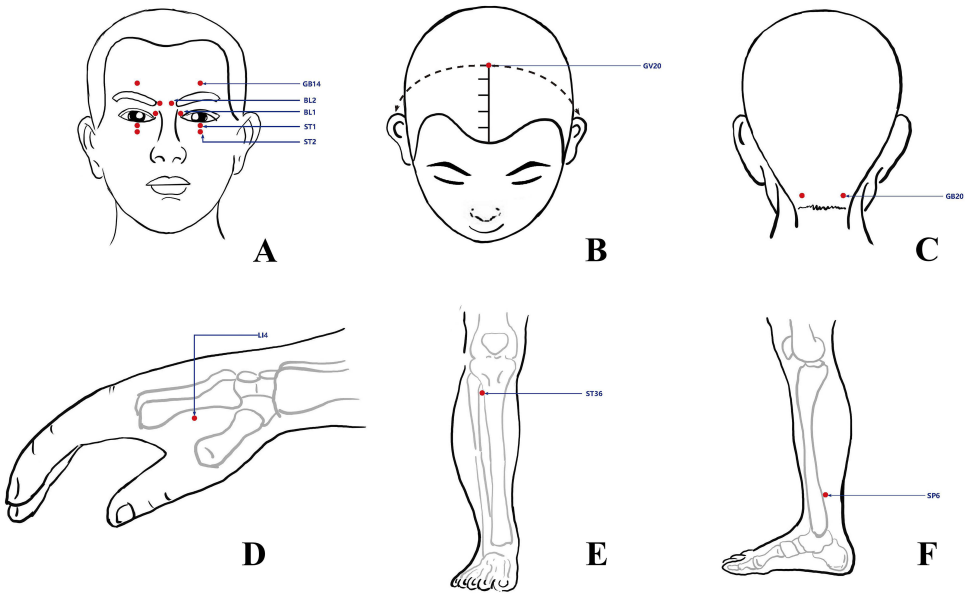

Figure 1 Acupuncture Points for the Treatment of Dry Eye Disease (DED). This figure illustrates the key acupuncture points used in the treatment of Dry Eye Disease (DED), as identified in traditional Chinese medicine (TCM). The points are selected to promote tear secretion, reduce ocular inflammation, and regulate nervous system function, thereby offering a multifaceted approach to DED management. (**A**) Displays facial acupuncture points GB14 (Yangbai), BL2 (Zanzhu), BL1 (Jingming), ST1 (Chengqi), and ST2 (Sibai). These points are crucial for enhancing tear production and alleviating dry eye symptoms. (**B**) Highlights the head acupuncture point GV20 (Baihui), which influences the autonomic nervous system balance, particularly by enhancing parasympathetic activity, crucial for maintaining ocular health. (**C**) Shows the ear acupuncture point GB20, used in auricular acupuncture, which targets points on the ear for therapeutic effects, including the treatment of DED. (**D**) Illustrates the hand acupuncture point LI4 (Hegu), a distal point that contributes to the regulation of the nervous system and the reduction of inflammation. (**E**) Depicts the leg acupuncture point ST36 (Zusanli), known for its ability to strengthen the immune system and reduce inflammation, valuable in the treatment of DED. (**F**) Presents the foot acupuncture point SP6 (Sanyinjiao), another distal point used to regulate the nervous system and alleviate DED symptoms by enhancing the body's natural healing processes.

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Table 2 Summary of Clinical Studies on the Efficacy of Acupuncture in Dry Eye Disease Treatment

Study Reference	Publication Year	Result Measurement	Conclusions
[37]	2024	Intradermal acupuncture (IDA) and Biodegradable microneedle acupuncture (BMA) remarkably improved the OSDI score, VAS score, QoL score, and tear secretion after 4 weeks ($P < 0.05$).	BMA and IDA had the same therapeutic effect for improving DED and both were safe.
[30]	2023	The NIBUT f and NIBUT av in the acupuncture-medication group and the acupuncture group were higher than those in the Chinese medication group and the western medication group ($P<0.05$), The OSDI score, total score, eye symptom score, and body symptom score of CVS in the acupuncture-medication group were lower than those in the acupuncture group, the Chinese medication group, and the western medication group ($P<0.01$, $P<0.05$).	Acupuncture has advantages in improving NIBUT f, NIBUT av, and CVS physical symptoms and cognitive symptoms.
[34]	2022	The estimated mean change from baseline in the noninvasive TFBUT was 1.52 for true acupuncture versus 0.77 for sham acupuncture (adjusted difference −0.75 [95% CI −1.39 to −0.12]; P = 0.02) at week 8 and 1.49 for true acupuncture versus 0.81 for sham acupuncture (adjusted difference −0.68 [95% CI, −1.29 to −0.07]; P = 0.029) at week 12.	Among patients with post-cataract surgery DED, acupuncture resulted in statistically significant benefit on tear film stability.
[33]	2022	After the treatment, the clinical symptom score, FL and HAMA scores in the acupuncture combined with medication group were lower than the medication group ($P<0.05$), the levels of SIT and BUT in the acupuncture combined with medication group were higher than the medication group ($P<0.05$). The total effective rate in the acupuncture combined with medication group was 90.9% (30/33), which was higher than 71.9% (23/32) in the medication group ($P<0.05$).	Tiaoshen acupuncture combined with artificial tears could promote the secretion of tears for patients of dry eye syndrome with yin deficiency of liver and kidney, repair corneal defect and prolong tear film break-up time, and alleviate anxiety state, its curative effect is better than simple artificial tears.
[22]	2021	Although preliminary, changes in OSDI from the baseline values were significantly different between the two groups at week 5 ($p = 0.0003$). There was a significant difference in the trends of OSDI changes between the acupuncture plus usual care and the usual care only groups ($p = 0.0039$).	Four weeks of acupuncture treatment in addition to usual care is a feasible treatment for dry eye syndrome after refractive surgery.
[38]	2020	After treatment of acupuncture and needle-knife, SIT was increased, BUT was prolonged, scores of CFS and eye symptom were reduced ($P<0.01$);	Needle-knife at cervical spine area as adjunctive therapy can relieve the clinical symptoms and improve the function of lacrimal gland in patients with dry eye syndrome.

Application of Acupuncture in DED Types

Mechanical DED

Mechanical DED often results from environmental influences or physical obstructions that compromise tear film stability. Acupuncture has emerged as a promising therapeutic approach for alleviating the symptoms associated with this condition. Research has demonstrated that acupuncture can enhance tear production and reduce symptoms of dryness and discomfort.[34] For instance, a randomized controlled pilot trial showcased acupuncture's effectiveness in managing DED following refractive surgery, highlighting its potential to support ocular surface health.[22] Moreover, acupuncture may address underlying factors such as inflammation and nerve sensitivity, which are frequently present in mechanical dry eye cases.[48] The selection of specific acupoints targeting the ocular region has been associated with positive clinical outcomes, as observed in studies emphasizing the importance of personalized acupuncture treatment plans.[21] In summary, acupuncture offers a valuable alternative or complementary therapy for patients experiencing mechanical DED, especially when conventional treatments do not provide sufficient relief.

Drug-Induced DED

Drug-induced DED is a frequent side effect of various medications, such as antihistamines, antidepressants, and specific antihypertensive drugs. The underlying mechanism typically involves changes in tear production and composition caused by pharmacological agents. A study examined the effects of acupuncture on patients with DED, particularly focusing on those whose symptoms influenced by drug-induced factors. Notably, patients experiencing external contributors to their dry eye symptoms, including those with drug-induced causes, showed a more significant response to acupuncture treatment compared to individuals with internal factors. This finding suggests that acupuncture can effectively help manage drug-induced dry eye symptoms.[49]

Another study demonstrated the benefits of combining acupuncture with artificial tears, indicating that this integrative approach could improve tear film stability and alleviate ocular discomfort.[16] Moreover, acupuncture may address the inflammation often associated with drug-induced dryness by modulating cytokine expression in the conjunctiva, as observed in research investigating the mechanisms of acupuncture in dry eye treatment.[50] These results suggest that acupuncture not only offers symptomatic relief but also addresses the underlying inflammatory processes triggered by medications. Therefore, acupuncture presents a valuable adjunct therapy in managing drug-induced DED, providing a comprehensive treatment strategy for affected patients.

Autoimmune DED

Autoimmune DED, especially in conditions like Sjögren's syndrome, poses a significant therapeutic challenge due to its complex pathophysiology, which involves chronic inflammation and immune system dysfunction. Acupuncture has emerged as a potential treatment for this form of dry eye, with research indicating its ability to reduce ocular surface inflammation and enhance tear production.[5,7] Additionally, acupuncture has been shown to improve the overall quality of life for patients with autoimmune disorders, addressing issues such as anxiety and stress that often accompany these conditions.[32] Incorporating acupuncture into the treatment plan for autoimmune DED not only targets the ocular symptoms but also offers a holistic approach to managing the systemic manifestations of the disease. Consequently, acupuncture serves as a valuable complementary therapy in treating autoimmune dry eye, improving both patients' subjective experiences and their overall well-being.

Future Research Directions and Challenges

Standardization and Regulation of Acupuncture

The standardization and regulation of acupuncture practices are essential for ensuring safety, efficacy, and consistency in treatment outcomes. Current research highlights significant variability in acupuncture techniques, needle types, and treatment protocols, leading to inconsistent clinical and research results. A systematic review has emphasized the necessity of establishing comprehensive guidelines that cover practitioner training, acupoint selection, and needle insertion and stimulation methods.[51] Furthermore, the World Federation of Acupuncture-Moxibustion Societies has initiated efforts to develop standardized protocols, focusing on risk control to ensure the safe application of

acupuncture.[52] These efforts aim to provide a structured framework for practitioners, thereby strengthening the legitimacy of acupuncture as a therapeutic practice. However, challenges remain in harmonizing acupuncture practices with modern medical standards and addressing cognitive biases that influence the acceptance of acupuncture within various healthcare systems.[53] Future research should prioritize the development of robust standardization methodologies, including universally accepted terminology and adaptable treatment protocols that respect different cultural contexts.

Moreover, enhancing patient adherence to acupuncture treatment is essential for optimizing therapeutic outcomes in DED management. Standardized protocols can improve patient confidence and trust in acupuncture as a reliable treatment option, ultimately encouraging better adherence to prescribed regimens. Future research should prioritize developing universally accepted terminology and adaptable treatment protocols that align with both clinical efficacy and patient preferences.

The Necessity of Large-Scale Clinical Trials

Many studies have small sample sizes and lack large-scale randomized controlled trials, which limits the generalizability and reliability of the research results.[16,43] Therefore, the importance of conducting large-scale clinical trials in acupuncture research cannot be overstated. Although numerous small-scale studies have shown the potential benefits of acupuncture for various conditions, the absence of large, multicenter trials limits the ability to generalize these findings.[46] Large-scale studies address critical issues such as sample size, diversity among patient populations, and result reproducibility, all of which are essential for confirming acupuncture's efficacy and safety on a broader scale. Recent discussions have highlighted insights gained from the COVID-19 pandemic, where the rapid initiation of clinical trials underscored the significance of adaptability and robust data collection methods.[54] Additionally, incorporating advanced statistical models and artificial intelligence into trial design and analysis can provide deeper insights into patient responses and treatment outcomes.[55,56] Future research should prioritize multicenter collaborations that enable large-scale trials, ultimately creating a more robust evidence base for integrating acupuncture into mainstream healthcare practices.

The Potential of Integrating Acupuncture with Modern Medicine

The integration of acupuncture with modern medical approaches offers a promising path for improving patient care and treatment outcomes. Recent research suggests that acupuncture can serve as an adjunctive therapy for DED, effectively enhancing tear production, prolonging tear film break-up time, and alleviating patients' subjective symptoms.[18,57,58] Clinical studies show that combining acupuncture with modern medical treatments provides a more comprehensive approach to managing DED. For instance, a systematic review and meta-analysis highlighted that the combination of acupuncture and artificial tears is more effective than using artificial tears alone.[16]

This integrative approach not only expands treatment options but also promotes a holistic perspective on health, addressing both physical and psychological aspects. Studies indicate that combining acupuncture with pharmacological treatments can improve therapeutic outcomes while minimizing side effects, particularly in chronic conditions like anxiety and depression.[32] Furthermore, the use of mobile health technologies to collect patient data can support personalized medicine, thereby refining management strategies for DED.[59]

However, future research should focus on developing interdisciplinary training programs to equip healthcare professionals with the skills and knowledge necessary to integrate acupuncture into clinical practice effectively. Additionally, continued research should aim to clarify the mechanisms through which acupuncture and modern medical treatments interact synergistically, fostering a more comprehensive understanding of acupuncture's role in treating DED.

In recent years, acupuncture has gained attention as a potential therapeutic approach for DED, demonstrating effectiveness in alleviating symptoms and enhancing overall ocular health. This review underscores the benefits of acupuncture, notably its capacity to stimulate tear production and reduce inflammation—both key factors in managing DED. Integrating acupuncture into standard treatment protocols may provide a holistic strategy, addressing not only the physiological aspects of the condition but also the psychosomatic factors often associated with chronic conditions.

Despite the encouraging findings in the current body of literature, it is crucial to acknowledge the limitations of existing studies. Many clinical trials are hindered by small sample sizes, a lack of standardized protocols, and variability

in acupuncture techniques, which contribute to inconsistent outcomes. These factors make it challenging to draw definitive conclusions about the efficacy and safety of acupuncture for DED. Additionally, the subjective nature of symptom assessment in DED poses challenges in evaluating treatment effects, highlighting the need for robust methodological frameworks in future research.

Going forward, it is essential to prioritize high-quality research that meets rigorous scientific standards. Conducting randomized controlled trials with larger sample sizes, standardized treatment protocols, and objective outcome measures will be critical in establishing the therapeutic value of acupuncture in managing DED. Furthermore, investigating the mechanisms by which acupuncture influences the pathology of dry eye could offer valuable insights, deepening our understanding of its potential advantages.

Cost-Effectiveness Analysis of Traditional Therapies and Acupuncture

When evaluating the cost-effectiveness of traditional therapies and acupuncture for DED, it is essential to consider both direct and indirect expenses. Traditional Chinese medicine (TCM) treatments often involve costs related to medicinal herbs, treatment sessions, and the patient's time investment. Studies indicate that the diversity in herbal medicine formulations and treatment approaches contributes to a complex cost structure. Due to individual variability in response to treatment, overall expenses may differ significantly among patients. However, the long-term therapeutic benefits of TCM may lead to improved health outcomes, potentially reducing financial burdens associated with prolonged illness and preventing disease-induced poverty.

Acupuncture treatment also entails specific cost components, including needle expenses, treatment frequency, and time-related costs per session. While the initial investment in acupuncture therapy may appear relatively high, its ability to provide rapid symptom relief can shorten recovery time and reduce subsequent medical expenditures. Additionally, acupuncture is associated with a favorable safety profile and minimal side effects, offering a potential long-term economic advantage. Furthermore, by effectively alleviating symptoms and enhancing patients' quality of life, acupuncture can help reduce psychological distress and financial stress, contributing to overall well-being.

Considering these economic factors, future research should explore comprehensive cost-benefit analyses of integrating acupuncture into standard DED treatment protocols. Understanding how acupuncture compares to conventional treatments in terms of both clinical efficacy and financial sustainability will be crucial for its broader acceptance in mainstream healthcare.

This study acknowledges several limitations. First, the lack of standardization in acupuncture operation parameters, such as stimulation intensity and needle retention time, as well as in acupoint prescription schemes, leads to significant heterogeneity among studies. Second, the average sample size of the included randomized controlled trials (RCTs) is small, and there is a lack of validation through multicenter, large-sample studies. Third, the current evaluation systems rely heavily on subjective symptom scales and lack validation using objective biomarkers. To address these limitations, future studies should standardize acupuncture operation protocols for dry eye syndrome and establish a database of core acupoint combinations to ensure consistency across studies; conduct multicenter RCTs and build real-world data platforms to validate the findings with larger sample sizes; create a panel of multi-omics biomarkers for the ocular surface microenvironment and apply deep learning models to objectively quantify the effects of acupuncture.

Conclusion

In conclusion, while acupuncture offers a promising approach to treating DED, including mechanical dry eye disease, pharmacologically-induced dry eye, quiescent autoimmune-associated dry eye, and particularly in treatment-refractory cases or patients with drug intolerance, it is important to maintain a balanced perspective. The integration of acupuncture into clinical practice should be based on empirical evidence from well-designed studies. As the field advances, collaboration between acupuncturists and ophthalmologists will be crucial in delivering comprehensive, effective, and safe patient care. The ultimate aim is to establish a more integrated approach to dry eye management, improving patient outcomes and overall quality of life.

Abbreviations

DED, Dry eye disease.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Disclosure

The authors declare that they have no conflicts of interest in this work.

References

1. Sheppard J, Shen Lee B, Periman LM. Dry eye disease: identification and therapeutic strategies for primary care clinicians and clinical specialists. *Ann Med*. 2023;55(1):241–252. doi:10.1080/07853890.2022.2157477
2. Zhang YN, Ouyang WJ, Hu JY, Liu ZG. Targeting Nrf2 signaling in dry eye. *Int J Ophthalmol*. 2024;17(10):1911–1920. doi:10.18240/ijo.2024.10.19
3. Donthineni PR, Das AV, Basu S. Dry eye disease in children and adolescents in India. *Ocul Surf*. 2020;18(4):777–782. doi:10.1016/j.jtos.2020.07.019
4. Rouen PA, White ML. Dry eye disease: prevalence, assessment, and management. *Home Healthc Now*. 2018;36(2):74–83. doi:10.1097/NHH.0000000000000652
5. Caban M, Omulecki W, Latecka-Krajewska B. Dry eye in Sjögren's syndrome - characteristics and therapy. *Eur J Ophthalmol*. 2022;32(6):3174–3184. doi:10.1177/11206721221091375
6. Abd-Allah NM, Hassan AA, Omar G, et al. Dry eye in rheumatoid arthritis: relation to disease activity. *Immunol Med*. 2020;43(2):92–97. doi:10.1080/25785826.2020.1729597
7. Shan H, Liu W, Li Y, Pang K. The autoimmune rheumatic disease related dry eye and its association with retinopathy. *Biomolecules*. 2023;13(5):724. doi:10.3390/biom13050724
8. Akpek EK, Wu HY, Karakus S, Zhang Q, Masli S. Differential diagnosis of sjögren versus non-sjögren dry eye through tear film biomarkers. *Cornea*. 2020;39(8):991–997. doi:10.1097/ICO.0000000000002299
9. Almutairi AH, Alalawi BS, Badr GH, Alawaz RA, Albarry M, Elbadawy HM. Prevalence of dry eye syndrome in association with the use of contact lenses in Saudi Arabia. *BMC Ophthalmol*. 2021;21(1):147. doi:10.1186/s12886-021-01912-8
10. Figus M, Agnifili L, Lanzini M, et al. Topical preservative-free ophthalmic treatments: an unmet clinical need. *Expert Opin Drug Deliv*. 2021;18(6):655–672. doi:10.1080/17425247.2021.1860014
11. Na JH, Jung JH, Park JG, Song PH, Song CH. Therapeutic effects of acupuncture in typical dry eye: a systematic review and meta-analysis. *Acta Ophthalmol*. 2021;99(5):489–498. doi:10.1111/aos.14651
12. Zhao JS. Conceptual history of acupuncture-moxibustion-historical writing and reconstruction foundation of acupuncture-moxibustion theory. *Zhongguo Zhen Jiu*. 2021;41(8):834–837. Chinese. doi:10.13703/j.0255-2930.20210603-0004
13. Zhang D, Zhao Y, Yang Y, et al. Efficacy of electroacupuncture for patients with dry eye syndromes: a randomized controlled trial. *J Acupunct Tuina Sci*. 2022;20(6):489–498. doi:10.1007/s11726-022-1350-4
14. Yan HY, Hua JS, Li HJ, Zhang YY, Chen F. Therapeutic advantages and evaluation indexes of acupuncture and moxibustion in the treatment of ophthalmoxerosis. *World Chin Med*. 2023;18(4):572–5+82.
15. Song JH, Park SY. Safety and efficacy of combined acupuncture (body and intradermal acupuncture) for dry eye disease: study protocol for a pilot, single-centre, assessor-blinded, randomised, artificial tear drop-controlled trial at Naju Dongshin University Korean Medicine Hospital. *BMJ Open*. 2024;14(1):e077913. doi:10.1136/bmjopen-2023-077913
16. Wang Y, Peng J, Xiao L, et al. Effectiveness of acupuncture combined with artificial tears in managing dry eye syndrome: a systematic review and meta-analysis. *Medicine*. 2024;103(1):e36374. doi:10.1097/MD.0000000000036374
17. Yang G, Kong X, Guo X, et al. Effects of electroacupuncture on dry eye: a pilot randomized controlled trial. *Acta Ophthalmol*. 2023;101(3):e315–e326. doi:10.1111/aos.15271
18. Dhaliwal DK, Zhou S, Samudre SS, Lo NJ, Rhee MK. Acupuncture and dry eye: current perspectives. A double-blinded randomized controlled trial and review of the literature. *Clin Ophthalmol*. 2019;13:731–740. doi:10.2147/OPTH.S175321
19. Zhang X, Zhang B, Peng S, Zhang G, Ma J, Zhu W. Effectiveness of acupuncture at acupoint BL1 (Jingming) in comparison with artificial tears for moderate to severe dry eye disease: a randomized controlled trial. *Trials*. 2022;23(1):605. doi:10.1186/s13063-022-06486-4
20. Wu M, Tang Q, Gao W, Zhu L. A novel approach to the immediate effects of electroacupuncture on dry eye: a case series. *Explore*. 2024;20(3):430–433. doi:10.1016/j.explore.2023.10.010
21. Zhu D, Gao C, Zhong YM. Clinical observation of dry eye syndrome treated with acupuncture. *Zhongguo Zhen Jiu*. 2019;39(8):837–840. Chinese. doi:10.13703/j.0255-2930.2019.08.010

22. Lee JH, Han K, Kim TH, et al. Acupuncture for dry eye syndrome after refractive surgery: a randomized controlled pilot trial. *Integr Med Res*. 2021;10(1):100456. doi:10.1016/j.imr.2020.100456
23. Ma XJ, Zhao YD, Zhang GX, Zhao CZ. The rules of acupoint selection of acupuncture for dry eye. *Zhongguo Zhen Jiu*. 2019;39(1):87–90. Chinese. doi:10.13703/j.0255-2930.2019.01.021
24. Ding N, Wei Q, Deng W, Sun X, Zhang J, Gao W. Electroacupuncture alleviates inflammation of dry eye diseases by regulating the α7nAChR/NF-κB signaling pathway. *Oxid Med Cell Longev*. 2021;2021:6673610. doi:10.1155/2021/6673610
25. Fu Z, Wan M, Jin T, et al. Electroacupuncture modulates the TLR4-NF-κB inflammatory signaling pathway to attenuate ocular surface inflammation in dry eyes of type 2 diabetic rats. *Cell Mol Biol*. 2024;70(5):111–118. doi:10.14715/cmb/2024.70.5.15
26. Yang Y, Zhang D, Wu L, et al. Electroacupuncture inhibits the corneal ROS/TXNIP/NLRP3 signaling pathway in a rat model of dry eye syndrome. *Acupunct Med*. 2022;40(1):78–88. doi:10.1177/09645284211039235
27. Duan H, Zhou Y, Ma B, et al. Effect of acupuncture treatment on the ocular pain, mental state and ocular surface characteristics of patients with dry eye disease: a non-randomized pilot study. *Clin Ophthalmol*. 2024;18:2751–2764. doi:10.2147/OPTH.S476573
28. Tang N, Tang L, Lyu J, et al. Effect of acupuncture on tear proteomics in patients with video display terminal-related dry eye. *J Proteome Res*. 2024;23(6):2206–2218. doi:10.1021/acs.jproteome.4c00134
29. Ding N, Wei Q, Xu Q, et al. Acupuncture alleviates corneal inflammation in New Zealand white rabbits with dry eye diseases by regulating α7nAChR and NF-κB signaling pathway. *Evid Based Complement Alternat Med*. 2022;2022:6613144. doi:10.1155/2022/6613144
30. Zhao L, Dong BQ, Zuo T, Zhang ZQ, Wang FY, Zhou HM. Combination of acupuncture and medication for dry eye complicated with computer vision syndrome: a randomized controlled trial. *Zhongguo Zhen Jiu*. 2023;43(10):1134–1138. Chinese. doi:10.13703/j.0255-2930.20221009-0001
31. Jin T, Liu X, Li Y, et al. Electroacupuncture reduces ocular surface neuralgia in dry-eyed Guinea pigs by inhibiting the trigeminal ganglion and spinal trigeminal nucleus caudalis $P2X_3R$-PKC signaling pathway. *Curr Eye Res*. 2023;48(6):546–556. doi:10.1080/02713683.2023.2176886
32. Pesavento F, Lovato A, Cappello S, Postiglione M. Acupuncture in the treatment of Dry Eye Syndrome with anxiety symptoms. A case report. *Eur J Transl Myol*. 2022;32(2):10482. doi:10.4081/ejtm.2022.10482
33. Sun YZ, Chen CY, Yu TY, Wang LY. Clinical observation of *Tiaoshen* acpuncture for dry eye syndrome with *yin* deficiency of liver and kidney. *Zhongguo Zhen Jiu*. 2022;42(2):162–166. Chinese. doi:10.13703/j.0255-2930.20201108-k0005
34. Kong X, Long J, Liu H, Ding Q, Jin H, Zou Y. Randomized, sham-controlled trial of acupuncture for post-cataract surgery dry eye disease. *Complement Ther Clin Pract*. 2022;49:101680. doi:10.1016/j.ctcp.2022.101680
35. Kim BH, Kim MH, Kang SH, Nam HJ. Optimizing acupuncture treatment for dry eye syndrome: a systematic review. *BMC Complement Altern Med*. 2018;18(1):145. doi:10.1186/s12906-018-2202-0
36. Park JG, Lee BH, Na JH, Jung JH, Song CH. Optimal acupuncture protocol improving symptoms of typical dry eye syndrome: meta-analysis and systematic review. *Heliyon*. 2023;9(7):e18226. doi:10.1016/j.heliyon.2023.e18226
37. Song JH, Park SY. Biodegradable microneedle acupuncture has equivalent efficacy to traditional intradermal acupuncture for dry eye disease: a pilot single-blinded, randomized controlled trial. *Medicine*. 2024;103(2):e36864. doi:10.1097/MD.0000000000036864
38. Zhang JW, Liu NG. Effect of needle-knife as adjunctive therapy on dry eye syndrome. *Zhongguo Zhen Jiu*. 2020;40(7):731–735. Chinese. doi:10.13703/j.0255-2930.20190706-0001
39. Lee CY, Yang SF, Hsiao CH, et al. Effectiveness of an acupuncture steam-warming eye mask on dry eye disease in visual display terminal users: a prospective randomized controlled trial. *Diseases*. 2024;12(8):192. doi:10.3390/diseases12080192
40. Gong T, Huang Q, Zhang H, et al. Press needle: a traditional chinese medicine therapy for myopia patients with dry eye. *J Vis Exp*. 2024;(206). doi:10.3791/66727
41. Wei QB, Ding N, Wang JJ, Wang W, Gao WP. Acupoint selection for the treatment of dry eye: a systematic review and meta-analysis of randomized controlled trials. *Exp Ther Med*. 2020;19(4):2851–2860. doi:10.3892/etm.2020.8561
42. Lin YH, Wu HC, Hsieh PC, Tzeng IS, Wu SY, Kuo CY. An association rule analysis of combined acupoints for the treatment of patients with dry eye disease. *Complement Med Res*. 2021;28(4):317–324. English. doi:10.1159/000512674
43. Cheng J, Li Q, Ren LH, Zhao YN, Wang FF. Clinical observation of eye acupuncture combined with conventional acupuncture on dry eye syndrome with *yin* deficiency of liver and kidney. *Zhongguo Zhen Jiu*. 2019;39(9):945–949. Chinese. doi:10.13703/j.0255-2930.2019.09.008
44. Hu WL, Yu HJ, Pan LY, et al. Laser acupuncture improves tear film stability in patients with dry eye disease: a two-center randomized-controlled trial. *J Altern Complement Med*. 2021;27(7):579–587. doi:10.1089/acm.2020.0524
45. Hu WL, Wu PC, Pan LY, Yu HJ, Pan CC, Hung YC. Effect of laser acupuncture on dry eye: a study protocol for a 2-center randomized controlled trial. *Medicine*. 2018;97(22):e10875. doi:10.1097/MD.0000000000010875
46. Lu YQ, Yang G, Li MY, et al. Electroacupuncture for mild-to-moderate dry eye: study protocol for a multicentre, randomised, single-blind, sham-controlled trial. *BMJ Open*. 2023;13(12):e069369. doi:10.1136/bmjopen-2022-069369
47. Zi Y, Ji M, Deng Y, et al. The effectiveness and safety of moxibustion for dry eye: protocol for a systematic review. *Medicine*. 2019;98(15):e15178. doi:10.1097/MD.0000000000015178
48. Jang H, Lee S, Kim TH, Kim AR, Lee M, Lee JH. Acupuncture for dry eye syndrome after refractive surgery: study protocol for a randomized controlled trial. *Trials*. 2013;14(1):351. doi:10.1186/1745-6215-14-351
49. Nepp J, Derbolav A, Haslinger-Akramian J, Mudrich C, Schauersberger J, Wedrich A. Akupunktureffekt bei Keratoconjunctivitis sicca [Effect of acupuncture in keratoconjunctivitis sicca]. *Klin Monbl Augenheilkd*. 1999;215(4):228–232. German. doi:10.1055/s-2008-1034704
50. Zhang D, Zhao Y, Yang YT, et al. A mechanism study of electroacupuncture for dry eye syndrome by targeting conjunctival cytokine expressions. *Curr Eye Res*. 2020;45(4):419–427. doi:10.1080/02713683.2019.1666997
51. Wang M, Zhang S, Zhang X, Tian Y, Sun Y. Standardization studies of acupuncture prescriptions: a new approach to translational medicine in acupuncture. *Zhongguo Zhen Jiu*. 2024;44(1):94–98. Chinese, English. doi:10.13703/j.0255-2930.20230505-0003
52. Wang JJ, Cui S, Hu J, Chen ZJ, Zhang Y, Wu ZC. Developing process and term analysis of WFAS standard: general requirements for the risk control in the safe use of acupuncture. *Zhongguo Zhen Jiu*. 2023;43(7):837–842. Chinese. doi:10.13703/j.0255-2930.20221017-k0011
53. Wu XD. Clarify some cognitive problems of standardization of acupuncture and moxibustion based on the characteristics of disciplines. *Zhongguo Zhen Jiu*. 2019;39(5):529–533. Chinese. doi:10.13703/j.0255-2930.2019.05.018
54. Horsley AR, Pearmain L, Knight S, et al. Large scale clinical trials: lessons from the COVID-19 pandemic. *BMJ Open Respir Res*. 2022;9(1):e001226. doi:10.1136/bmjresp-2022-001226

55. Xu T, Wen J, Wang L, et al. Acupuncture indication knowledge bases: meridian entity recognition and classification based on ACUBERT. *Database*. 2024;2024:baae083. doi:10.1093/database/baae083
56. Song Z, Chen G, Chen CY. AI empowering traditional Chinese medicine? *Chem Sci*. 2024;15(41):16844–16886. doi:10.1039/d4sc04107k
57. Zhu Y, Zhao Q, Jia H, Zhang H, Zhang Y. Acupuncture for the treatment of dry eye: protocol for systematic review and meta-analysis. *Medicine*. 2020;99(32):e21625. doi:10.1097/MD.0000000000021625
58. Prinz J, Maffulli N, Fuest M, Walter P, Hildebrand F, Migliorini F. Acupuncture for the management of dry eye disease. *Front Med*. 2022;16 (6):975–983. doi:10.1007/s11684-022-0923-4
59. Inomata T, Sung J, Yee A, et al. P4 medicine for heterogeneity of dry eye: a mobile health-based digital cohort study. *Juntendo Iji Zasshi*. 2023;69 (1):2–13. doi:10.14789/jmj.JMJ22-0032-R