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RESEARCH ARTICLE

IMPACT OF SLEEP DEPRIVATION (ANIDRA) ON OCULAR SURFACE HEALTH: AN AYURVEDIC AND MODERN REVIEW

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Abstract

Adequate sleep plays a crucial role in preserving both physical well-being and mental health. However, the demands of modern lifestyles, including occupational stress, irregular daily schedules, and prolonged exposure to digital screens, have significantly increased the prevalence of sleep deprivation. Insufficient sleep adversely affects overall health and has a considerable impact on the ocular surface system, which comprises the cornea, conjunctiva, lacrimal glands, and meibomian glands. From a contemporary medical perspective, sleep deprivation disrupts tear film homeostasis, contributing to the development of Dry Eye Disease (DED). This occurs through mechanisms such as inflamm atory responses, oxidative damage, and instability of the tear film. Acco rding to Ayurvedic principles, sleep disturbances are described under the conditions of Anidra or Nidranasha. These conditions are associated with the aggravation of Vata and Pitta Doshas, leading to the depletion of Kapha and Ojas, ultimately resulting in ocular dryness. As the functional integrity of the eyes is governed by Alochaka Pitta and supported by Tarpaka Kapha,inadequate sleep can directly compromise ocular health. This review aims to correlate contemporary ophthalmic evidence with Ayurvedic concepts and highlight integrative strategies for maintaining ocular surface health.

Introduction:-

The ocular surface serves as the first line of protection for the visual apparatus and plays a vital role in maintaining visual clarity. Tear film stability is essential for maintaining ocular surface integrity and optimal visual function.In recent years, lifestyle factors such as prolonged screen usage, late-night working schedules, and disruption of the natural sleep–wake cycle have contributed to a growing incidence of sleep-related disturbances and Dry Eye Disease (DED)[1]. In Ayurvedic literature, Swapnaviparyaya—which refers to improper sleep patterns or inadequate sleep—is recognized as an important Hetu (etiological factor) responsible for the development of various Netrarogas (ocular disorders)[2]. Ayurveda considers Nidra (sleep) as one of the three fundamental pillars of life (Trayopastambha), alongside Ahara (proper nutrition) and Brahmacharya (regulated lifestyle practices). Adequate sleep promotes physical strength, tissue nourishment, immune competence, and mental well-being. Conversely, disturbed or

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insufficient sleep results in Anidra, a condition associated with progressive depletion of body tissues and reduced functional capacity of various organs, including the eyes. The present review explores the association between sleep deprivation and disorders of the ocular surface by integrating contemporary scientific evidence with classical Ayurvedic concepts.

Methodology:-

The review was prepared using both Ayurvedic texts and modern scientific literature:-

1. **Ayurvedic Source Material:**A comprehensive review of classical Ayurvedic literature was conducted, with detailed examination of authoritative texts such as the Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, and Sarangadhara Samhita. Relevant references pertaining to Nidra Vegadharana (suppression of the natural urge for sleep), the etiopathogenesis of Anidra/Nidranasha (insomnia), and concepts related to Netra Sharira and ocular disorders were systematically analyzed.
2. **Modern Ophthalmic Literature:**To correlate classical Ayurvedic knowledge with contemporary scientific evidence, electronic databases including PubMed, ScienceDirect, and Google Scholar were searched extensively. The literature search incorporated focused keywords such as "sleep deprivation and tear film," "circadian rhythm and ocular surface," "dry eye disease and insomnia," and "oxidative stress in the lacrimal gland" to identify relevant studies and recent research findings.

Study Search Strategy:-

A structured literature search was conducted between January 2020 and May 2025 using PubMed, Scopus, ScienceDirect, and Google Scholar databases. Keywords used included "sleep deprivation", "ocular surface", "dry eye disease", "tear film instability", "circadian rhythm", "Anidra", "Nidranasha", and "Ayurveda".

Modern Review of Sleep Deprivation and Ocular Surface:-

Tear Film Changes and Lacrimal Gland Dysfunction:-

The tear film is composed of three distinct layers: an outer lipid layer, a central aqueous layer, and an inner mucin layer, all of which work together to maintain ocular surface integrity and visual quality. Adequate sleep is essential for preserving tear film homeostasis; however, sleep deprivation can adversely affect both tear secretion and tear film stability. Clinical studies have reported lower Schirmer's test scores and reduced Tear Break-Up Time (TBUT) among individuals experiencing insufficient sleep, indicating compromised tear film function.

Several mechanisms have been proposed to explain these changes:

• **Activation of the Hypothalamic–Pituitary–Adrenal (HPA) Axis:** Sleep deprivation elevates cortisol levels, which may impair the normal function of lacrimal gland cells and subsequently decrease tear production.

• **Autonomic Nervous System Dysregulation:** Enhanced sympathetic activity accompanied by altered parasympathetic regulation can interfere with physiological tear secretion, contributing to ocular surface instability and dryness.

Meibomian Gland Dysfunction (MGD)[4]:-

The meibomian glands are responsible for secreting the lipid component of the tear film, which plays a crucial role in minimizing tear evaporation and maintaining tear film stability. Sleep deprivation has been associated with increased production of pro-inflammatory cytokines, leading to inflammation, obstruction, and functional impairment of the meibomian glands. Consequently, disruption of lipid secretion accelerates tear evaporation, contributing to the development and progression of evaporative Dry Eye Disease (DED).

Corneal Damage and Oxidative Stress:-

Adequate sleep is essential for corneal repair and maintenance. Sleep deprivation increases the production of Reactive Oxygen Species (ROS), reduces antioxidant defense, and delays epithelial regeneration. These alterations impair corneal healing and may contribute to superficial punctate keratitis (SPK) and increased corneal staining.

Screen Time and Anidra[6]:-

Exposure to artificial blue light during late-night screen use disrupts the normal circadian rhythm. Prolonged digital stimulation alters neurotransmitter activity, including serotonin regulation, and suppresses melatonin secretion, thereby contributing to sleep deprivation or Anidra.

Ayurvedic Review of Anidra and Netra Health:-

Concept of Nidra:-

According to Ayurveda, sleep occurs when the mind and sense organs become tired and detach from sensory activities.

यदातुमनसिक्लान्तेकर्मात्मानःक्लमान्विताः|
विषयेभ्योनिवर्तन्तेतदास्वपितिमानवः||३५||[7]

Nidra is mainly controlled by Kapha Dosha and Tamas Guna. Chronic sleep loss increases Vata and Pitta Doshas while reducing Kapha, leading to dryness and irritation in the eyes.

Samprapti (Pathogenesis):-

The eyes are considered Tejas-dominant organs in Ayurveda. Sleep deprivation causes imbalance in Doshas.
When Anidra occurs, the following Samprapti takes place:

[Chronic Sleep Deprivation (Anidra / Nidra Vegadharana)]
▼
[Vitiation of Vata & Pitta Doshas]
▼
[Kshaya (Depletion) of Tarpaka Kapha & Ojas Systemically]
▼
[Srotodushti (Functional Impairment)]
▼
[Manifestation of Rookshata (Dryness) &Toda (Pain) in Netra Mandal][8]
▼
[Clinical Presentation matching Shushkakshipaka / Krichronmeela][9]

Correlation with Ayurvedic Eye Diseases:-

1. **Shushkakshipaka:** Ayurveda describes this condition with features such as Daruna Rookshata (marked ocular dryness), Kunjan (difficulty in blinking), Gharsana (foreign body sensation), and Vilavila Netra (ocular irritation and visual discomfort). These manifestations closely resemble the clinical presentation of severe Dry Eye Disease (DED).
2. **Krichronmeela:** Patients may experience pain, stiffness, and discomfort during eyelid movements, particularly while opening and closing the eyes. These symptoms can be correlated with meibomian gland dysfunction and ocular surface epithelial damage resulting from chronic sleep deprivation.

Additionally, Acharya Vagbhata[10] mentions that suppression of sleep (Nidra Vegadharana) may cause heaviness in the eyes (Akshi Gourava), drowsiness (Tandra), and redness or congestion of the eyes (Netra Raga).

Ayurvedic Management:-

Localized Ocular Interventions (Netra Kriyakalpa):-

Akshi Tarpana: Akshi Tarpana is a specialized ocular therapy in which medicated ghee, such as Go-Ghrita, Triphala Ghrita, or Jeevantyadi Ghrita, is retained over the eyes within a boundary prepared from black gram paste. Owing to its unctuous and lipid-rich properties, ghee enhances ocular lubrication, supports tear film stability, and helps minimize oxidative stress on the ocular surface.

Aschyotana: Aschyotana refers to the instillation of medicated eye drops into the eyes. This procedure is beneficial in alleviating burning sensation, irritation, and ocular discomfort associated with the aggravation of Vata and Pitta Doshas.

Neuro-Active Therapy (Murdha Taila):-

- **Shirodhara-** Shirodhara is a therapeutic procedure in which warm medicated oils such as Ksheerabala Taila or Chandanadi Taila, or in some cases Takra (buttermilk), are poured in a continuous rhythmic stream over the forehead. Preliminary studies and traditional Ayurvedic experience suggest that Shirodhara may improve sleep quality and stress levels. However, robust randomized controlled trials evaluating its direct effect on ocular surface parameters are currently limited.

- **Padabhyanga -** Padabhyanga involves therapeutic massage of the soles of the feet using substances such as ghee or Kansa Vataki. This procedure is considered to have a calming effect on the nervous system, promote better sleep quality, and may support ocular health through reflexogenic and systemic relaxation mechanisms.

Internal Medications (Abhyantara Chikitsa):-
Rasayana and Medhya Drugs- Ayurvedic herbs such as Ashwagandha (Withania somnifera), Jatamansi (Nardostachys jatamansi), and Yastimadhu (Glycyrrhiza glabra) are commonly used as Rasayana and Medhya medicines. These drugs help reduce stress, improve sleep quality, and minimize oxidative damage in the body.

Discussion:-

Comparison of modern ophthalmology with Ayurvedic principles shows a strong similarity in understanding the effects of sleep deprivation on ocular health. Modern medicine explains that treatment of dry eye with only artificial tears often provides short-term relief because the main underlying factor, disturbed sleep, is not properly addressed. Ayurveda overcomes this limitation through a holistic treatment approach. It considers Anidra as an independent disease condition and focuses on balancing aggravated Vata and Pitta Doshas, which are responsible for tear film disturbance and ocular dryness. Combining Ayurvedic therapies such as Akshi Tarpana with modern sleep hygiene practices, including reduced blue-light exposure and maintenance of proper circadian rhythm, may provide a more effective and comprehensive approach for protecting ocular surface health in today's stressful lifestyle. Although several studies demonstrate a significant association between poor sleep quality and dry eye disease, most available evidence is derived from cross-sectional observational studies, limiting the ability to establish causality. Furthermore, variations in sample size, diagnostic criteria, and sleep assessment tools may influence study outcomes. Therefore, larger longitudinal and interventional studies are required to strengthen the evidence linking sleep deprivation with ocular surface dysfunction.

Conclusion:-

Sleep deprivation (Anidra) is an important factor responsible for ocular surface damage. Modern medicine explains this through tear film instability, inflammation, and oxidative stress, while Ayurveda describes it through Vata-Pitta aggravation and depletion of Tarpaka Kapha. Evidence supporting Ayurvedic interventions in sleep-related ocular disorders remains promising but requires further well-designed clinical trials for validation. An integrated approach using modern diagnostic methods along with Ayurvedic therapies such as Shirodhara and Akshi Tarpana can help in effective management of sleep-related ocular disorders.

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