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ORIGINAL RESEARCH

Evaluating the levels of Salivary biomarker C-reactive protein in children with sleep problems and Class II malocclusion before and after twin-block therapy

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Abstract:

Background

Class II malocclusion is a common dental condition in children, often associated with sleep disturbances. C-reactive protein (CRP) is a salivary biomarker that indicates inflammation and may be linked to sleep problems. This study aims to assess the levels of salivary CRP in children with sleep problems and Class II malocclusion before and after treatment with twin-block therapy.

Materials and Methods

This prospective study included 50 children aged 8-14 years diagnosed with Class II malocclusion and sleep disturbances. Salivary samples were collected from each participant at baseline and after six months of twin-block therapy. Salivary CRP levels were measured using enzyme-linked immunosorbent assay (ELISA). Sleep quality was assessed using the Children's Sleep Habits Questionnaire (CSHQ). Statistical analysis was performed using paired t-tests to evaluate changes in CRP levels and sleep quality.

Results

At baseline, the mean salivary CRP level was 3.5 mg/L (±1.2), and the mean CSHQ score was 56.3 (±7.5). After six months of twin-block therapy, the mean salivary CRP level significantly decreased to 2.1 mg/L (±0.9) ($p < 0.01$), and the mean CSHQ score improved to 49.8 (±6.4) ($p < 0.01$). A strong correlation was observed between the reduction in CRP levels and improvement in sleep quality ($r = 0.72$).

Conclusion

Twin-block therapy effectively reduces salivary CRP levels and improves sleep quality in children with Class II malocclusion and associated sleep problems. Salivary CRP can serve as a useful biomarker for monitoring inflammation and treatment progress in this population.

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Keywords: C-reactive protein, salivary biomarkers, Class II malocclusion, sleep disturbances, twin-block therapy, pediatric dentistry.

Introduction

Class II malocclusion is one of the most prevalent orthodontic problems among children and adolescents, characterized by the misalignment of the upper and lower jaws, leading to aesthetic and functional issues (1). This condition not only affects oral health but has also been linked to various systemic problems, including sleep disturbances (2). Sleep disturbances in children are of particular concern as they can lead to behavioral issues, impaired cognitive development, and reduced overall quality of life (3).

Recent research has highlighted the role of inflammation in the pathophysiology of sleep disturbances (4). C-reactive protein (CRP), an acute-phase protein, is a well-established marker of systemic inflammation and has been detected in saliva, offering a non-invasive method for assessing inflammatory status (5). Elevated salivary CRP levels have been associated with sleep disorders, suggesting a potential link between inflammation and sleep quality (6).

Orthodontic interventions, such as twin-block therapy, are commonly used to correct Class II malocclusion. Twin-block therapy involves using removable appliances to reposition the jaws, improving occlusion and facial aesthetics (7). Beyond its mechanical effects, there is emerging interest in exploring the broader health benefits of orthodontic treatments, including their impact on inflammatory markers and sleep quality (8).

Despite the known relationship between malocclusion and sleep disturbances, limited research has investigated the effects of orthodontic treatment on inflammatory biomarkers and sleep outcomes in children with Class II malocclusion. Therefore, this study aims to evaluate the impact of twin-block therapy on salivary CRP levels and sleep quality in children with Class II malocclusion and sleep problems. We hypothesize that twin-block therapy will reduce salivary CRP levels and improve sleep quality, highlighting its potential benefits beyond dental correction.

Materials and Methods

Study Design and Participants

This prospective study was conducted at the Department of Orthodontics, involving 50 children aged 8-14 years with Class II malocclusion and self-reported sleep disturbances. Participants were recruited based on the following inclusion criteria: Angle's Class II malocclusion, a Children's Sleep Habits Questionnaire (CSHQ) score indicating sleep problems, and no prior orthodontic treatment. Exclusion criteria included systemic diseases, use of medications affecting inflammation or sleep, and any craniofacial syndromes.

Intervention

All participants underwent twin-block therapy, a widely used functional appliance technique for correcting Class II malocclusion. The twin-block appliance was custom-fabricated for each participant and adjusted monthly to ensure optimal fit and function. The duration of the therapy was six months.

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Data Collection

1. **Salivary Sample Collection:** Salivary samples were collected from participants at baseline (prior to the initiation of twin-block therapy) and after six months of treatment. Samples were collected between 8:00 and 10:00 AM to control for diurnal variations in salivary composition. Participants were instructed to avoid eating or drinking for at least 30 minutes before sample collection. Unstimulated saliva was collected by passive drooling into sterile tubes and stored at -80°C until analysis.
2. **Salivary CRP Measurement:** Salivary CRP levels were quantified using a commercially available enzyme-linked immunosorbent assay (ELISA) kit, following the manufacturer's instructions. Each sample was analyzed in duplicate to ensure accuracy, and the mean CRP level was calculated.
3. **Sleep Quality Assessment:** Sleep quality was assessed using the Children's Sleep Habits Questionnaire (CSHQ), a validated tool for evaluating sleep behavior in children. The CSHQ consists of 33 items grouped into eight subscales, with higher scores indicating poorer sleep quality. The questionnaire was administered at baseline and after six months of therapy.

Statistical Analysis

Data were analyzed using SPSS version 25.0 (IBM Corp, Armonk, NY). Descriptive statistics were calculated for all variables. Paired t-tests were used to compare pre- and post-treatment salivary CRP levels and CSHQ scores. Pearson correlation analysis was conducted to examine the relationship between changes in CRP levels and sleep quality. A p-value of <0.05 was considered statistically significant.

Results

The study included 50 children with Class II malocclusion and sleep disturbances. The mean age of the participants was 11.2 years (±2.1), with 28 boys and 22 girls. The results demonstrated significant changes in salivary CRP levels and sleep quality following twin-block therapy.

Table 1: Salivary CRP Levels Before and After Twin-Block Therapy

Time Point	Mean CRP Level (mg/L)	Standard Deviation	p-value
Baseline	3.5	1.2	
Post-Treatment	2.1	0.9	< 0.01

At baseline, the mean salivary CRP level was 3.5 mg/L (±1.2). After six months of twin-block therapy, the mean salivary CRP level significantly decreased to 2.1 mg/L (±0.9), with a p-value of <0.01, indicating a statistically significant reduction in inflammation.

Table 2: Children's Sleep Habits Questionnaire (CSHQ) Scores Before and After Twin-Block Therapy

Time Point	Mean CSHQ Score	Standard Deviation	p-value
Baseline	56.3	7.5	
Post-Treatment	49.8	6.4	< 0.01

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The mean CSHQ score at baseline was 56.3 (±7.5), indicating poor sleep quality. After treatment, the mean CSHQ score improved significantly to 49.8 (±6.4), with a p-value of <0.01, reflecting enhanced sleep quality.

Correlation Between Changes in Salivary CRP Levels and Sleep Quality

A strong positive correlation (r = 0.72) was observed between the reduction in salivary CRP levels and the improvement in sleep quality scores. This suggests that the decrease in inflammation was associated with better sleep outcomes.

Discussion

This study investigated the impact of twin-block therapy on salivary CRP levels and sleep quality in children with Class II malocclusion and sleep disturbances. Our findings indicate that twin-block therapy significantly reduces salivary CRP levels and improves sleep quality, suggesting potential benefits beyond orthodontic correction.

The significant reduction in salivary CRP levels following twin-block therapy aligns with previous studies that have demonstrated the relationship between malocclusion, inflammation, and sleep disturbances (1, 2). CRP is a well-known marker of systemic inflammation, and its presence in saliva offers a non-invasive method to monitor inflammatory status in children (3). The decrease in CRP levels observed in this study may reflect the alleviation of oral and systemic inflammatory responses associated with malocclusion.

Improvement in sleep quality, as measured by the CSHQ, further supports the notion that correcting Class II malocclusion can positively influence sleep. Previous research has highlighted the association between orthodontic treatment and improved sleep outcomes, suggesting that such interventions can alleviate airway obstructions and enhance respiratory function during sleep (4, 5). Our results are consistent with these findings, demonstrating a significant improvement in sleep quality following six months of twin-block therapy.

The strong correlation between the reduction in CRP levels and the improvement in sleep quality suggests that inflammation may play a key role in mediating the relationship between malocclusion and sleep disturbances. Inflammation is known to affect sleep regulation, and elevated levels of inflammatory markers have been associated with sleep disorders (6, 7). By reducing inflammation, twin-block therapy may help mitigate these effects, thereby improving sleep quality in children with malocclusion.

The findings of this study have important clinical implications. Monitoring salivary CRP levels could serve as a useful biomarker for assessing treatment progress and evaluating the broader health benefits of orthodontic interventions. Furthermore, improving sleep quality through orthodontic treatment may contribute to better cognitive and behavioral outcomes in children, underscoring the importance of addressing malocclusion not only for dental health but also for overall well-being.

Despite the promising results, this study has limitations. The sample size was relatively small, and the study was conducted over a six-month period. Longitudinal studies with larger sample sizes and longer follow-up periods are needed to confirm these findings and further explore the long-term effects of orthodontic treatment on inflammatory markers and sleep quality.

Conclusion

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In conclusion, twin-block therapy effectively reduces salivary CRP levels and improves sleep quality in children with Class II malocclusion and sleep disturbances. These findings highlight the potential for orthodontic treatment to address broader health concerns, such as inflammation and sleep, emphasizing the importance of a comprehensive approach to managing malocclusion in pediatric patients.

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