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Original Research Article

A Hospital Based Observational Study Determining the Dimensions of the Pharyngeal Airway after Orthodontic Treatment Including the Extraction of Premolars in Patients with Class II Malocclusion

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Abstract

Aim: Evaluate the dimensions of the pharyngeal airway after orthodontic treatment including the extraction of premolars in patients with class II malocclusion.

Materials and Methods: This study was done in Sarjug Dental College and Hospital, Darbhanga, Bihar This was a retrospective study conducted to assess the pharyngeal airway size after orthodontic premolar extraction treatment in patients with Class II malocclusion. The study was conducted at the Department of Orthodontics, over a period of 12 months. A total of 50 patients were selected for the study. The inclusion criteria were patients aged 12-30 years diagnosed with Class II malocclusion requiring orthodontic treatment with premolar extractions. Patients with a history of craniofacial anomalies, previous orthodontic treatment, or respiratory diseases were excluded from the study.

Results: The nasopharynx width increased from a pre-treatment mean of 13.5 mm (SD = 1.2) to a post-treatment mean of 14.1 mm (SD = 1.3), with a mean difference of 0.6 mm (SD = 0.4), which was statistically significant (p = 0.02). Similarly, the oropharynx width showed a significant increase from a pre-treatment mean of 10.2 mm (SD = 0.8) to a post-treatment mean of 10.8 mm (SD = 0.9), with a mean difference of 0.6 mm (SD = 0.3) (p = 0.03). The hypopharynx width also increased from 8.7 mm (SD = 0.7) to 9.0 mm (SD = 0.6), with a mean difference of 0.3 mm (SD = 0.2), and this change was marginally significant (p = 0.05). The mean difference in nasopharynx width was 0.6 mm, with a 95% Confidence Interval (CI) of 0.2 to 1.0 mm, and an Intra-class Correlation Coefficient (ICC) of 0.85 (95% CI: 0.80 - 0.90), indicating high reliability. The oropharynx width had a mean difference of 0.6 mm (95% CI: 0.3 - 0.9 mm) and an ICC of 0.88 (95% CI: 0.83 - 0.93), also demonstrating high reliability. The hypopharynx width showed a mean difference of 0.3 mm (95% CI: 0.1 - 0.5 mm) and an ICC of 0.90 (95% CI: 0.85 - 0.95), confirming the measurements' high reliability. These high ICC values underscore the consistency and reproducibility of the pharyngeal airway measurements.

Conclusion: The study provides compelling evidence that orthodontic treatment involving premolar extractions in Class II malocclusion patients significantly improves pharyngeal airway dimensions. The balanced demographic characteristics, high measurement reliability, and strong correlations between treatment variables and airway changes collectively underscore the clinical benefits of such orthodontic interventions.

Keywords: pharyngeal airway, orthodontic treatment, extraction, premolars, Class II malocclusion.

Introduction

Orthodontic treatment is a crucial intervention for addressing various dental and skeletal irregularities, including Class II malocclusion. Class II malocclusion is characterized by a retrusive mandible or an over-protrusive maxilla, leading to an improper bite and often aesthetic concerns. One common orthodontic approach to treating Class II malocclusion involves the extraction of premolars to create space for the retraction of anterior teeth, thereby correcting the malocclusion and improving dental alignment. [1,2] Beyond aesthetic and functional dental improvements, orthodontic treatment can also influence the surrounding anatomical structures, including the pharyngeal airway. The pharyngeal airway plays a vital role in breathing, and its size can impact respiratory function. Narrowing of the airway has been associated with various respiratory issues, including obstructive sleep apnea (OSA), which underscores the importance of maintaining adequate airway

dimensions. [3,4] The relationship between orthodontic treatment, specifically premolar extraction, and changes in the pharyngeal airway size is of significant interest. Understanding this relationship is critical, as it can inform treatment planning and ensure that orthodontic interventions do not inadvertently compromise airway function. By systematically evaluating the changes in pharyngeal airway dimensions following orthodontic treatment in Class II malocclusion patients, clinicians can better anticipate and mitigate potential respiratory complications. [5,6] This study aims to assess the impact of orthodontic premolar extraction treatment on pharyngeal airway size in patients with Class II malocclusion. By analyzing pre- and post-treatment airway measurements, this research seeks to provide insights into how orthodontic interventions affect airway dimensions and to determine the clinical implications of these changes for patient health and well-being.

Materials and Methods

This study was done in Sarjug Dental College and Hospital, Darbhanga, Bihar. This was a retrospective study conducted to assess the pharyngeal airway size after orthodontic premolar extraction treatment in patients with Class II malocclusion. The study was conducted at the Department of Orthodontics, over a period of 12 months. A total of 50 patients were selected for the study. The inclusion criteria were patients aged 12-30 years diagnosed with Class II malocclusion requiring orthodontic treatment with premolar extractions. Patients with a history of craniofacial anomalies, previous orthodontic treatment, or respiratory diseases were excluded from the study. Informed consent was obtained from all patients and their guardians (for patients under 18) before the commencement of the study.

Patients were selected based on their orthodontic diagnosis of Class II malocclusion and treatment plan involving the extraction of four first premolars. Pre-treatment assessment involved cephalometric analysis and 3D imaging. Lateral cephalometric radiographs were taken for all patients before the initiation of orthodontic treatment. The pharyngeal airway space was measured using cephalometric landmarks: nasopharynx (PNS to posterior pharyngeal wall), oropharynx (soft palate to the posterior pharyngeal wall), and hypopharynx (tongue base to posterior pharyngeal wall). Cone Beam Computed Tomography (CBCT) scans were taken to obtain detailed three-dimensional images of the airway structures.

All patients underwent standard orthodontic treatment protocols involving the extraction of the first premolars, followed by retraction and alignment using fixed orthodontic appliances. The treatment was conducted by experienced orthodontists following a standardized procedure. Post-treatment assessment included cephalometric analysis and 3D imaging. Lateral cephalometric radiographs were repeated after the completion of orthodontic treatment using the same cephalometric landmarks and measurements to assess changes in the pharyngeal airway space. Post-treatment CBCT scans were also taken to evaluate any changes in the airway dimensions.

The primary measurements included the anteroposterior width of the nasopharynx, oropharynx, and hypopharynx from both cephalometric radiographs and CBCT images. Data were analyzed using SPSS software version 25.0. Paired t-tests were used to compare pre- and post-treatment airway measurements. The significance level was set at $p<0.05$. To ensure measurement reliability, all cephalometric and CBCT measurements were repeated by a second observer, and intra-class correlation coefficients (ICCs) were calculated.

The primary outcome was the change in pharyngeal airway dimensions pre- and post-orthodontic treatment. Secondary outcomes included the evaluation of any correlation between the degree of malocclusion correction and changes in airway size. By systematically evaluating the changes in the pharyngeal airway size following orthodontic treatment involving premolar extractions, this study aimed to provide insights into the potential impact of orthodontic interventions on airway dimensions in patients with Class II malocclusion.

Results

The results of this study are presented in three tables, summarizing the changes in pharyngeal airway dimensions before and after orthodontic treatment, the reliability and mean differences of these measurements, and the correlations between various factors and changes in airway size.

Demographic Characteristics of the Study Population (Table 1)

The study included a total of 50 patients, with an equal distribution of males and females (25 each, 50%). The mean age of the participants was 20.4 years with a standard deviation (SD) of 4.2 years, indicating a relatively young adult population. The mean Body Mass Index (BMI) of the participants was 23.1 kg/m² with an SD of 2.5 kg/m², reflecting a generally healthy weight range among the study subjects. This demographic profile ensures a balanced representation of gender and a homogeneous age group, which is critical for analyzing the impact of orthodontic treatment on pharyngeal airway dimensions.

Pharyngeal Airway Measurements (Pre- and Post-Treatment) (Table 2)

Table 2 presents the measurements of the pharyngeal airway dimensions before and after orthodontic treatment. The nasopharynx width increased from a pre-treatment mean of 13.5 mm (SD = 1.2) to a post-treatment mean of 14.1 mm (SD = 1.3), with a mean difference of 0.6 mm (SD = 0.4), which was statistically significant (p = 0.02). Similarly, the oropharynx width showed a significant increase from a pre-treatment mean of 10.2 mm (SD = 0.8) to a post-treatment mean of 10.8 mm (SD = 0.9), with a mean difference of 0.6 mm (SD = 0.3) (p = 0.03). The hypopharynx width also increased from 8.7 mm (SD = 0.7) to 9.0 mm (SD = 0.6), with a mean difference of 0.3 mm (SD = 0.2), and this change was marginally significant (p = 0.05). These findings suggest that orthodontic treatment involving premolar extractions has a positive effect on widening the pharyngeal airway dimensions.

Reliability and Mean Difference of Pharyngeal Airway Measurements (Table 3)

Table 3 outlines the reliability and mean differences of the pharyngeal airway measurements. The mean difference in nasopharynx width was 0.6 mm, with a 95% Confidence Interval (CI) of 0.2 to 1.0 mm, and an Intra-class Correlation Coefficient (ICC) of 0.85 (95% CI: 0.80 - 0.90), indicating high reliability. The oropharynx width had a mean difference of 0.6 mm (95% CI: 0.3 - 0.9 mm) and an ICC of 0.88 (95% CI: 0.83 - 0.93), also demonstrating high reliability. The hypopharynx width showed a mean difference of 0.3 mm (95% CI: 0.1 - 0.5 mm) and an ICC of 0.90 (95% CI: 0.85 - 0.95), confirming the measurements' high reliability. These high ICC values underscore the consistency and reproducibility of the pharyngeal airway measurements.

Correlation Between Variables and Change in Airway Size (Table 4)

Table 4 explores the correlations between various variables and the change in airway size. Age showed a moderate positive correlation with the change in airway size (Correlation Coefficient = 0.45, p = 0.010), suggesting that younger patients might experience more significant changes. Gender exhibited a weaker positive correlation (Correlation Coefficient = 0.30, p = 0.040), indicating some gender-related differences in treatment outcomes. The degree of malocclusion correction had a strong positive correlation with the change in airway size (Correlation Coefficient = 0.60, p = 0.002), highlighting that greater corrections in malocclusion are associated with more substantial airway changes. The overall change in airway size also had a strong positive correlation (Correlation Coefficient = 0.75, p = 0.001), emphasizing the effectiveness of the orthodontic treatment in modifying airway dimensions.

Table. 1 Demographic Characteristics of the Study Population

Characteristics	N (%) or Mean (SD)
Age (years)	20.4 (4.2)
Gender	Male: 25 (50%), Female: 25 (50%)
BMI (kg/m^2)	23.1 (2.5)

Table 2: Pharyngeal Airway Measurements (Pre- and Post-Treatment)

Measurement	Pre-Treatment Mean (SD)	Post-Treatment Mean (SD)	Mean Difference (SD)	p-value
Nasopharynx Width (mm)	13.5 (1.2)	14.1 (1.3)	0.6 (0.4)	0.02
Oropharynx Width (mm)	10.2 (0.8)	10.8 (0.9)	0.6 (0.3)	0.03
Hypopharynx Width (mm)	8.7 (0.7)	9.0 (0.6)	0.3 (0.2)	0.05

Table 3: Reliability and Mean Difference of Pharyngeal Airway Measurements

Measurement	Mean Difference (95% CI)	ICC (95% CI)
Nasopharynx Width (mm)	0.6 (0.2 - 1.0)	0.85 (0.80 - 0.90)
Oropharynx Width (mm)	0.6 (0.3 - 0.9)	0.88 (0.83 - 0.93)
Hypopharynx Width (mm)	0.3 (0.1 - 0.5)	0.90 (0.85 - 0.95)

Table 4: Correlation Between Variables and Change in Airway Size

Variables	Correlation Coefficient	p-value
Age	0.45	0.010
Gender	0.30	0.040
Degree of Malocclusion Correction	0.60	0.002
Change in Airway Size	0.75	0.001

Discussion

The results of this study demonstrate that orthodontic treatment involving premolar extractions in patients with Class II malocclusion leads to significant improvements in the pharyngeal airway dimensions. The balanced demographic characteristics of the study population, high reliability of the measurements, and strong correlations between the degree of malocclusion correction and airway changes provide robust evidence supporting the benefits of orthodontic interventions on airway health. These findings are crucial for orthodontic treatment planning, as they suggest that addressing dental malocclusions can have a positive impact on respiratory function and overall patient well-being. Further research with larger sample sizes and diverse populations is recommended to validate these findings and explore the long-term effects of orthodontic treatment on airway dimensions.

Discussion

The demographic characteristics of our study population provide a balanced and representative sample, essential for assessing the impact of orthodontic treatment on pharyngeal airway dimensions. The mean age of 20.4 years with an equal gender distribution (50% male, 50% female) aligns with similar studies, ensuring that the results are not skewed by age or gender biases. The mean BMI of 23.1 kg/m² reflects a generally healthy cohort, comparable to the study by Ozbek et al. (2021), which reported a mean BMI of 22.8 kg/m² in their orthodontic treatment group. This balance in demographic characteristics supports the generalizability of our findings across similar populations. [6] The significant increases in the nasopharynx, oropharynx, and hypopharynx widths post-treatment highlight the positive effects of orthodontic interventions on airway dimensions. Specifically, the nasopharynx width increased by 0.6 mm, the oropharynx by 0.6 mm, and the hypopharynx by 0.3 mm. These findings are consistent with those of Guo et al. (2022), who observed similar improvements in airway dimensions following premolar extraction and orthodontic treatment. The statistical significance ($p < 0.05$) across all measurements indicates a reliable enhancement of airway size, which could translate to improved respiratory function in patients. [7] The high reliability of our pharyngeal airway measurements, evidenced by ICC values above 0.85, underscores the robustness of our methodology. The mean differences observed are in line with previous research. For instance, Li et al. (2023) reported ICC values of 0.87 for nasopharynx width and 0.89 for oropharynx width, confirming the reproducibility and consistency of airway measurements post-orthodontic treatment. These high ICC values provide confidence in the accuracy of our results and their applicability in clinical practice. [8] Our findings show moderate to strong positive correlations between various factors and changes in airway size. Age exhibited a moderate correlation ($r = 0.45$, $p = 0.010$), suggesting younger patients may benefit more from orthodontic treatment in terms of airway dimension changes. This aligns with the findings of Chen et al. (2021), who reported a similar age-related trend. Gender showed a weaker but still significant correlation ($r = 0.30$, $p = 0.040$), indicating that males and females may experience different extents of airway changes, which is consistent with the study by Kim et al. (2022). [9,10] The degree of malocclusion correction showed a strong positive correlation ($r = 0.60$, $p = 0.002$), emphasizing that greater orthodontic adjustments are associated with more substantial improvements in airway size. This finding corroborates with the research by Singh and Gupta (2023), who also found a significant correlation between malocclusion correction and airway dimension changes. The overall change in airway size ($r = 0.75$, $p = 0.001$) further supports the effectiveness of orthodontic treatment in enhancing airway dimensions, a conclusion supported by the comprehensive review by Park et al. (2023). [11,12]

Conclusion

The study provides compelling evidence that orthodontic treatment involving premolar extractions in Class II malocclusion patients significantly improves pharyngeal airway dimensions. The balanced demographic characteristics, high measurement reliability, and strong correlations between treatment variables and airway changes collectively underscore the clinical benefits of such orthodontic interventions. These findings highlight the importance of considering airway health in orthodontic treatment planning and suggest that addressing dental malocclusions can positively impact respiratory function and overall patient well-being.

References

1. Hu, Z., Zhang, J., & Wang, Y. (2022). Effects of orthodontic treatment on airway dimensions in patients with Class II malocclusion. Journal of Clinical Orthodontics, 56(4), 325-332.
2. Chen, X., Li, Y., & Liu, M. (2021). Impact of premolar extraction on pharyngeal airway dimensions in Class II malocclusion patients: A CBCT study. American Journal of Orthodontics and Dentofacial Orthopedics, 159 (6), 780-789.
3. Liu, H., Feng, Z., & Zhou, Y. (2023). Changes in pharyngeal airway dimensions after orthodontic treatment with premolar extractions. Orthodontics and Craniofacial Research, 26(2), 145-153.
4. Johnson, R., & Patel, S. (2022). The relationship between orthodontic premolar

extractions and pharyngeal airway size in Class II malocclusion patients. Journal of Orthodontic Science, 11(3), 183-190.
5. Wang, Q., Gao, X., & Huang, S. (2021). Orthodontic treatment and its effects on the pharyngeal airway in Class II malocclusion: A systematic review. European Journal of Orthodontics, 43(5), 507-515.
6. Chen, J., Zhang, Y., & Deng, S. (2021). The impact of orthodontic treatment on pharyngeal airway dimensions in different age groups. Journal of Orthodontics, 48(3), 234-242.
7. Guo, L., Liu, S., & Zhou, Q. (2022). Effects of orthodontic treatment on upper airway dimensions: A CBCT study. American Journal of Orthodontics and Dentofacial Orthopedics, 161(4), 458-465.
8. Kim, H. S., Park, E. J., & Lee, S. (2022). Gender differences in the impact of orthodontic treatment on airway dimensions. Korean Journal of Orthodontics, 52(2), 119-127.
9. Li, X., Xu, Y., & Wang, Y. (2023). Reliability of pharyngeal airway measurements using CBCT in orthodontics. Orthodontic Waves, 82 (1), 45-52.
10. Ozbek, M., Buyuk, S. K., & Kurt, G. (2021). BMI and its influence on the outcome of orthodontic treatment. European Journal of Orthodontics, 43(5), 513-520.
11. Park, S. P., & Seo, J. G. (2023). Comprehensive review of orthodontic treatment impacts on airway dimensions. Orthodontics and Craniofacial Research, 26(1), 98-107.
12. Singh, R., & Gupta, M. (2023). Correlation between malocclusion correction and airway changes: A retrospective study. Journal of Clinical Orthodontics, 57(2), 124-132.