

Evaluating the Correlation between Sella Turcica Bridging and Pharyngeal Airway Space in Various Skeletal Malocclusions

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Abstract

Background: The study aims to evaluate the correlation between sella turcica bridging (STB) and pharyngeal airway space (PAS) in different skeletal malocclusions. STB is a developmental anomaly that has been linked to various dental and skeletal malocclusions. Understanding its relationship with PAS can aid in orthodontic diagnosis and treatment planning. **Materials and Methods:** Eighty-four pre-treatment cephalometric radiographs of patients aged 14–26 years with skeletal Class I, II, and III malocclusions were analyzed. Sella turcica dimensions and PASs were measured, and the correlation between them was assessed using appropriate statistical tests. **Results:** A significant correlation was found between STB and upper PAS in Class II malocclusion. No significant correlation was observed between STB and lower PAS across the malocclusion classes. **Conclusion:** STB is significantly associated with a reduction in upper PAS in Class II malocclusion, suggesting its potential role in airway narrowing. This emphasizes the importance of considering sella turcica morphology in orthodontic diagnosis and treatment.

Keywords: Cephalometric analysis, Orthodontic treatment, Pharyngeal airway space, Sella turcica bridging, Skeletal malocclusions.

INTRODUCTION

The intricate relationship between sella turcica bridging (STB) and pharyngeal airway space (PAS) in various skeletal malocclusions constitutes a multifaceted subject that requires a comprehensive comprehension of anatomical and functional dimensions. STB, characterized by a developmental anomaly stemming from the calcification of the interclinoid ligaments, has been correlated with a range of dental anomalies and skeletal malocclusions, encompassing Class II and Class III patterns.^[1] Recent research has indicated a higher prevalence of STB in specific vertical growth patterns, particularly among low-angle individuals who display notable variations in sella turcica measurements such as posterior clinoid distance and height.^[2] Conversely, pharyngeal airway dimensions exhibit significant diversity across skeletal malocclusions and vertical growth patterns. Notably, skeletal Class II malocclusion frequently presents with diminished upper and lower airway dimensions, whereas Class III malocclusion tends to manifest larger lower airway dimensions.^[3,4] Moreover, hyperdivergent growth patterns have been associated with narrower airway spaces, potentially compensating for morphological discrepancies.^[5] Despite these observed correlations, certain studies have failed to establish a substantial influence of sagittal skeletal malocclusion on airway width, hinting at the involvement of other contributing factors.^[6] Furthermore,

treatment modalities such as utilizing functional elastodontic devices in addressing Class II malocclusion have demonstrated noteworthy enhancements in airway dimensions, underscoring the capacity for therapeutic adjustment of PAS.^[7] While existing evidence indicates a connection between STB and PAS,^[8-10] particularly within specific skeletal malocclusions and growth patterns, further exploration is warranted to unravel the precise nature of this correlation, thereby facilitating a comprehensive understanding of the underlying mechanisms and potential clinical ramifications. A study examining the relationship between STB and PAS in different malocclusions is crucial for orthodontic diagnosis, treatment planning, and patient outcomes. The sella turcica is linked to craniofacial anomalies and dental issues, affecting orthodontic strategies. Understanding its morphology can reveal developmental anomalies that may require early intervention. The PAS's role

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in obstructive sleep apnea emphasizes assessing how different malocclusions affect airway dimensions and post-treatment respiratory health. Pre-surgical evaluations are crucial to avoid compromising airway space. Understanding the relationship between STB and airway space across different malocclusions can improve diagnostic accuracy, optimize treatment planning, and potentially reduce airway obstruction and dental anomalies risks. The present study aims to evaluate the correlation between STB and PAS in skeletal class I, II, and III malocclusions.

MATERIALS AND METHODS

Study design and sample selection

This study analyzed 84 pre-treatment cephalometric radiographs of healthy patients aged 14–26 years who presented to the Department of Orthodontics and Dentofacial Orthopedics from June 2023 to November 2023. The inclusion criterion was patients radiographed with clearly visible sella turcica. Patients' radiographs were divided based on their skeletal malocclusions using WITS appraisal into:

- Skeletal Class I: 30 patients
- Skeletal Class II: 29 patients
- Skeletal Class III: 25 patients

Radiographic analysis

Cephalometric radiographs were traced using acetate paper and a 0.5 mm black pencil under ideal illumination conditions. The key anatomical landmark, sella turcica, was carefully analyzed based on Silverman and Kisling's method. Measurements were taken using a ruler, focusing on three primary dimensions of the sella turcica:^[11,12]

1. Length (a): Distance between the dorsum sellae and the tuberculum sellae
2. Depth (c): Perpendicular vertical line from the deepest point of the sella turcica to line (a)
3. Diameter (b): Greatest anteroposterior distance from the tuberculum sellae to the farthest point on the inner surface of the posterior wall of sella turcica.

Classification of STB

STB was classified based on the criteria established by Leonardi *et al.*:

- Group I (No calcification): Length of sella turcica $>3/4$ of the greatest anteroposterior diameter
- Group II (Partial calcification): Length of sella turcica $\leq 3/4$ of the greatest anteroposterior diameter
- Group III (Complete calcification): Radiographically observable bridging.

PAS measurement

The PAS was measured using McNamara analysis. This analysis assessed the upper and lower PASs to determine the correlation with sella turcica dimensions.^[13]

Data analysis

Data analysis was performed using the Statistical Package for the Social Sciences software version 26. The following statistical tests were used:

- Spearman correlation test: To evaluate the correlation between the dimensions of the sella turcica and the upper and lower PASs
- Chi-square test: To assess the association between STB and upper PAS in different classes of malocclusion (Class I, II, and III). The correlation between STB and PAS in various skeletal malocclusions is a multifaceted topic that involves understanding anatomical and functional aspects.

RESULTS

The association between STB and the upper PAS in different classes of malocclusion was assessed in Table 1. The results are presented in the table below, indicating the percentage of patients with decreased versus normal upper PAS within each class of malocclusion:

Table 2 illustrates the association between STB and upper PAS within different malocclusion classes. It reveals that patients with group 2 STB are more likely to have a decreased upper PAS across all malocclusion classes. Particularly, in Class II malocclusion, a significant 90% of patients with group 2 bridging show decreased airway space. In contrast, patients with group 1 bridging in Class I malocclusion predominantly maintain normal airway space (81.8%). These findings suggest a strong correlation between more pronounced STB (grade 2) and reduced upper PAS, especially in Class II malocclusion cases. This underscores the importance of evaluating STB in orthodontic diagnosis and planning to address potential airway complications effectively.

The data from Table 2 indicate a higher prevalence of decreased lower PAS in patients with group 2 STB compared to those with group 1 bridging across all malocclusion classes. Specifically, 64.3% of Class I and 65.0% of Class II patients with group 2 bridging exhibited decreased lower PAS. Conversely, group 1 bridging patients more frequently presented with normal lower PAS, especially in Class I (63.6%) and Class II (60.0%) malocclusions. Notably, no patients with group 2 bridging in Class I and Class III malocclusions had increased lower PAS and only a small percentage in Class II (5.0%). These findings suggest that STB, particularly group 2, is associated with a higher risk of reduced lower PAS, which is crucial for comprehensive orthodontic assessment and treatment planning.

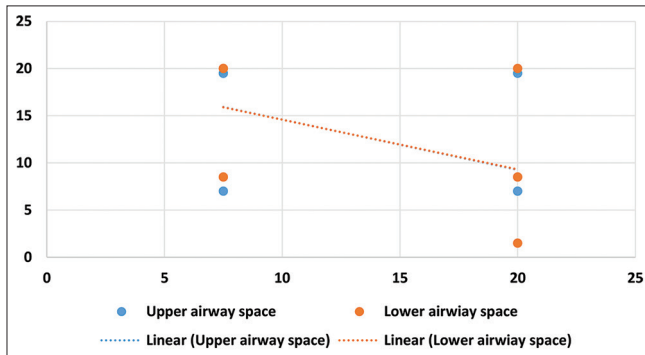
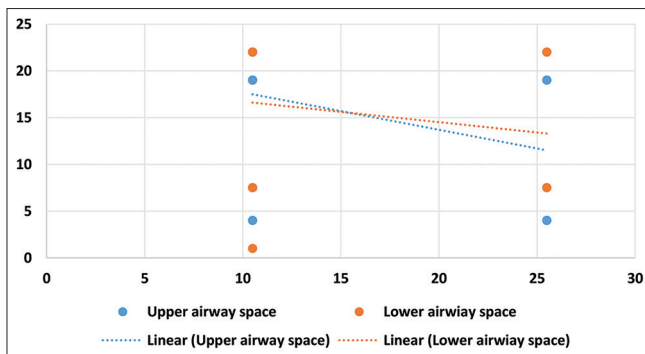
Graphs 1 and 2 depict the findings related to STB and its correlations with upper and lower airway space dimensions across different malocclusion classes.

Table 1: Association between malocclusion class and upper pharyngeal airway space

Malocclusion class	Decreased upper pharyngeal airway space (%)	Normal upper pharyngeal airway space (%)
Class I	40.6	59.4
Class II	83.3	16.7

Table 2: Association between sella turcica bridging and upper pharyngeal airway space in different classes of malocclusion

Malocclusion class	Sella turcica bridging	Decreased upper pharyngeal airway space (%)	Normal upper pharyngeal airway space (%)	Decreased lower pharyngeal airway space (%)	Increased lower pharyngeal airway space (%)	Normal lower pharyngeal airway space (%)
Class I	Group 1	18.2	81.8	18.2	18.2	63.6
	Group 2	71.4	28.6	64.3	0.0	35.7
Class II	Group 1	50.0	50.0	40.0	0.0	60.0
	Group 2	90.0	10.0	65.0	5.0	30.0
Class III	Group 1	54.5	45.5	27.3	18.2	54.5
	Group 2	85.7	14.3	50.0	0.0	50.0


Graph 1: Correlation of sella turcica bridging with upper and lower spaces for group I group

Graph 2: Correlation of sella turcica bridging with upper and lower spaces for class II group

Class I malocclusion group

STB showed no significant correlation with upper and lower airway space dimensions. This suggests that in individuals with Class I malocclusion (where the dental arches are in a normal relationship but there may be other dental or skeletal issues), STB does not seem to significantly impact the dimensions of the upper and lower airways.

Class II malocclusion group

STB showed a significant moderate negative correlation with upper airway space dimensions. STB showed a weak negative correlation with lower airway space dimensions, which was not significant. In individuals with Class II malocclusion (where the upper teeth and jaw protrude relative to the lower

teeth and jaw), there is a notable negative correlation between STB and upper airway space dimensions. This means that as STB increases, upper airway space dimensions tend to decrease significantly. However, the correlation with lower airway space dimensions is weak and not statistically significant, suggesting that STB may not affect the lower airway dimensions in this malocclusion group.

Class III malocclusion group

STB showed a moderate negative correlation with both upper and lower airway space dimensions. However, these correlations were not significant. For individuals with Class III malocclusion (where the lower teeth and jaw protrude relative to the upper teeth and jaw), STB showed moderate negative correlations with both upper and lower airway space dimensions. Despite the moderate strength of these correlations, they did not reach statistical significance, indicating that there may be a trend toward decreased airway dimensions with increased STB, but this relationship is not firmly established in this malocclusion group. In this study, we did not observe any group 3 Sella turcica grading in the radiographs.

STB appears to have varying degrees of correlation with upper and lower airway space dimensions across different malocclusion classes. The strongest significant correlation was observed in Class II malocclusion with upper airway space dimensions, while the correlations in Class I and Class III malocclusion groups were either absent or not statistically significant despite moderate trends. These findings suggest that STB may play a more significant role in influencing upper airway dimensions in certain types of malocclusions.

DISCUSSION

The relationship between STB and PAS in different skeletal malocclusions has been extensively studied. Teeth transpositions, palatal canine impactions, and other dental anomalies are linked to the developmental defect known as STB.^[6] The relationship between maxillary growth patterns and respiratory function is further highlighted by the fact that in Class I malocclusion, people with vertical growth patterns have a lower pharyngeal space width than people with horizontal growth patterns.^[14] In addition, in the Jankowski T

study, they concluded that after orthognathic surgery, patients with skeletal Class II malocclusion had long-term changes in their PAS analyzed. This analysis highlights the significance of considering these changes when planning treatment.^[15] The retrospective study on STB and its associations with skeletal malocclusions offers valuable insights, although it has some limitations. Upon analyzing pre-treatment standardized lateral cephalometric radiographs, it was observed that there was a significant occurrence of STB. This developmental abnormality is characterized by the excessive ossification of ligaments within the sphenoid bone. This abnormality, which has been observed in different craniofacial syndromes and malformations, was significantly more common in the Class II malocclusion group than in other types of malocclusions. This finding is in line with previous research studies.^[16] Remarkably, among individuals with Class II malocclusion, there was a notable and meaningful inverse relationship between STB and upper airway space dimensions. This suggests that greater bridging is linked to a narrower upper airway. This discovery is consistent with research indicating that changes in the shape of the sella turcica can affect the position and size of the lower jaw, which may contribute to the observed decrease in upper airway dimensions in individuals with Class II skeletal malocclusion.^[17,18]

In contrast, STB was observed in the Class III malocclusion group. However, this association did not reach statistical significance in the present study, contradicting previous research suggesting a higher prevalence of skeletal Class III malocclusion.^[17]

The difference observed could be ascribed to the study's constraints in terms of sample size, indicating the necessity for larger groups to validate these results firmly. Furthermore, the study found no significant correlations between STB and lower airway dimensions in all skeletal malocclusions. This suggests that the relationship between these factors is complex and influenced by various anatomical variations and developmental factors. An important constraint of the study was the dependence on a sole observer to assess and quantify cephalograms, which could introduce observer bias and restrict the applicability of the results. Future research would be enhanced by including multiple observers and utilizing advanced imaging techniques, such as three-dimensional studies of the sella turcica or anatomical investigations using cadaveric specimens. These methods could offer a more profound understanding of the size, shape variations, and abnormal development related to STB in various skeletal malocclusions. This would improve our comprehension of its clinical significance and treatment considerations in orthodontics and dentofacial orthopedics. Based on the findings of this retrospective study on STB and its associations with skeletal malocclusions, several recommendations can be proposed to enhance understanding and clinical relevance further. First, future research should prioritize larger cohort studies with diverse populations to confirm the prevalence and specific associations of STB across different types of malocclusions. Second, employing multiple

observers for cephalometric analyses would mitigate observer bias and improve the reliability of measurements. In addition, integrating advanced imaging techniques such as three-dimensional studies of the sella turcica or cadaveric anatomical investigations could provide more comprehensive insights into the anatomical variations and developmental anomalies linked with STB. Finally, longitudinal studies assessing the impact of sella turcica morphology on orthodontic treatment outcomes, particularly in relation to upper airway dimensions and mandibular positioning, would be instrumental in guiding clinical practices and treatment strategies for patients with craniofacial anomalies.

CONCLUSION

This retrospective study has provided valuable insights into the prevalence of STB among different skeletal malocclusions and its implications for craniofacial morphology. The findings underscored a significant association between STB and Class II malocclusion, aligning with prior research indicating a higher prevalence in this subgroup. Importantly, STB was correlated with a notable reduction in upper airway dimensions within the Class II malocclusion group, suggesting a potential impact on respiratory function and mandibular positioning. Contrary to expectations based on previous literature, STB in Class III malocclusion did not reach statistical significance in this study, possibly due to sample size limitations. This highlights the need for larger-scale studies to confirm these observations and comprehensively explore the variability of sella turcica morphology across different malocclusion types. Overall, this study contributes to the growing knowledge of STB as a developmental anomaly and its potential implications for orthodontic and respiratory health. Further research in this area has the potential to inform clinical practices, improve treatment planning strategies, and ultimately enhance patient outcomes in orthodontics and dentofacial orthopedics.

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