EAS Journal of Dentistry and Oral Medicine
Abbreviated Key Title: EAS J Dent Oral Med
ISSN: 2663-1849 (Print) & ISSN: 2663-7324 (Online)
Published By East African Scholars Publisher, Kenya

Volume-7 | Issue-2 | Mar-Apr-2025 | DOI: https://doi.org/10.36349/easjdom.2025.v07i02.001

Original Research Article

The Correlation between the Presence of Polyps in the Maxillary Sinuses and Musculoskeletal Variables

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Article History
Received: 28.01.2025
Accepted: 04.03.2025
Published: 10.03.2025

Journal homepage: https://www.easpublisher.com

Quick Response Code

Abstract: Upper airway obstruction refers to difficulty breathing through the upper respiratory tract, including the nostrils, mouth, pharynx, and larynx. This condition can be caused by factors like nasal congestion, allergies, septal deviation, and the presence of polyps in the paranasal sinuses. Nasal polyps can lead to symptoms such as persistent nasal congestion, difficulty breathing through the nose, and loss of smell. As a result, individuals may breathe through their mouths, which can lead to a low tongue position and an "adenoidal facies," characterized by an elongated face. Additionally, changes in the stomatognathic system, such as a reduced upper dental arch, malocclusions, and clockwise mandibular growth, may be observed. This study aims to explore the correlation between nasal polyps and skeletal patterns. Clinical records from 147 orthodontic patients at the Faculty of Dentistry, Mexicali, were analyzed. Information gathered included gender, skeletal class (I, II, or III), and facial biotype (dolichofacial, mesofacial, or brachyfacial). CBCT images were obtained, and various parameters, including the Jarabak index and nasal polyp presence, were analyzed. The results revealed that mesofacial biotype was the most common (40%), and skeletal Class II predominated (48%). A counterclockwise growth pattern was observed in 50% of patients, while 79% had no nasal polyps. The study concluded that no significant correlation was found between nasal polyps, skeletal class, and facial pattern. However, the absence of polyps was more common in mesofacial patients and those with skeletal Class II. The study recommends further research with larger sample sizes and standardized data collection methods to confirm these findings.

Keywords: Nasal Polyps, Skeletal Class, Facial Biotype, CBCT.

INTRODUCTION

Upper airway obstruction generally refers to difficulty in the passage of air through the upper respiratory tract,1 which includes the nostrils, mouth, pharynx, and larynx [1, 2]. A decrease in the volume of air passing through the nostrils can be a symptom of upper airway obstruction [3]. This could be due to various causes, such as nasal congestion from colds, allergies, septal deviation, or other medical conditions [2, 3].

Upper airway obstruction is a globally prevalent condition that affected 262 million people in 2019 [4, 5]. In children, it is usually due to infections, allergies, enlarged tonsils and adenoids, septal deviation, foreign bodies, asthma, and congenital diseases [3-5]. In adults, it is primarily caused by chronic obstructive pulmonary disease, asthma, chronic respiratory infections, tumors, obstructive sleep apnea syndrome, and/or smoking [6-8]. Prevalence increases in patients exposed to environmental factors such as air pollutants, allergens, occupational exposure, and climate changes [7, 8].

Obstruction of the airways caused by the presence of polyps in the paranasal sinuses is a medical condition that can affect normal breathing ability, leading to various symptoms [4-9]. These polyps are benign growths of tissue in the nasal mucosa or paranasal sinuses, and when they grow large enough, they can block the nasal airways, causing breathing problems [1-

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5]. Common symptoms include persistent nasal congestion, difficulty breathing through the nose, loss of the sense of smell, and occasionally, facial pain [4, 5].

This obstruction leads to difficulty, resistance, or inability to breathe through the nose, which may result in the harmful habit of mouth breathing [1-4]. Mouth breathing leads to a low tongue position and a characteristic facial expression known as "adenoidal facies," which is characterized by an elongated face [10-14]. Additionally, changes are observed in the stomatognathic system, such as a reduced upper dental arch, increased dental overjet [14-16], improper eruption of teeth, crowding, malocclusions, and clockwise mandibular growth, along with an increase in vertical dimensión [16]. These changes affect patients functionally, aesthetically, and psychologically [15-17]. The research is justified by the need to understand and address this condition.

The goal of this research is to determine if there is a correlation between the presence of polyps in the maxillary sinus and the skeletal pattern, in order to serve as an updated research reference.

Materials and Methods

- Clinical orthodontic records from the Faculty of Dentistry, Mexicali, were used to create a database with complete patient data, including name, gender (female or male), and diagnostic information (presence or absence of nasal polyps, skeletal class, and facial biotype).
- A total of 147 DICOM files corresponding to initial CBCT scans were collected.
- CBCT images were captured using the CareStream CS9300C tomography machine (2015 model).
- Patients were positioned upright with feet slightly apart and hands placed on the lower support of the tomography device.
- The mouth was positioned with the chin resting on the chin rest, centered using a laser beam, with teeth in occlusion and tongue in contact with the palate.
- Patients were instructed to remain still, avoid swallowing, and keep their hands on the base of the device with feet properly separated.

The scan protocol used a field of view (FOV) of 17X13.5, a voxel size of 300, and exposure times adjusted based on the patient's body constitution:

- Very thin corpuscular constitution: kV: 80, mA: 4.0, Seg: 11.30, mGy.cm2: 1146
- Thin corpuscular constitution: kV: 85, mA: 4.0, Seg: 11.30, mGy.cm2: 1359
- Medium corpuscular constitution: kV: 90, mA: 4.0, Seg: 11.30, mGy.cm2: 1585
- Thick corpuscular constitution: kV: 90, mA: 5.0, Seg: 11.30, mGy.cm2: 1982
- A computer with CS 3D Imaging v3.8.7 software (CareStream Health Inc.) was used to visualize the DICOM files.

Three reference planes were adjusted:

- The sagittal plane (marked with a blue vertical line) was positioned at the first upper molar (Figure 1).
- The axial plane (marked with a yellow horizontal line) was located at the furcation of the first upper molar (Figure 1).
- The coronal plane (marked with a purple vertical line) was positioned above the first upper molar at the furcation level (Figure 1).
- A customized cut was used to scan the maxillary sinuses for the presence of nasal polyps (Figure 1).
- The study aimed to explore the relationship between skeletal classes and the presence of nasal polyps and between facial biotypes and nasal polyps. Data was organized into tables reflecting these relationships.

Patient data were recorded in a Microsoft Excel 365 database. The distribution of the data was analyzed using an inference test on two normal distributions, from normal to binomial. ANOVA was used to analyze skeletal classes and facial biotypes, and T-Student tests were employed for intergroup comparisons. The p-value was calculated using the standard normal distribution.

The study followed the ethical guidelines set by the 2013 Helsinki Declaration and received approval from the Orthodontics Postgraduate Coordination at the Universidad Autónoma de Baja California, Mexicali campus. Informed consent was obtained from all patients.

Results

The study included 147 patients, with 62 males (42%) and 85 females (58%) (Figure 2). The distribution of facial biotype, skeletal class, and presence of nasal polyps showed the following results: the most common facial biotype was mesofacial (40.1%), skeletal Class II predominated (48.2%), and nasal polyps were absent in 116 patients (78.91%) (Table 1).

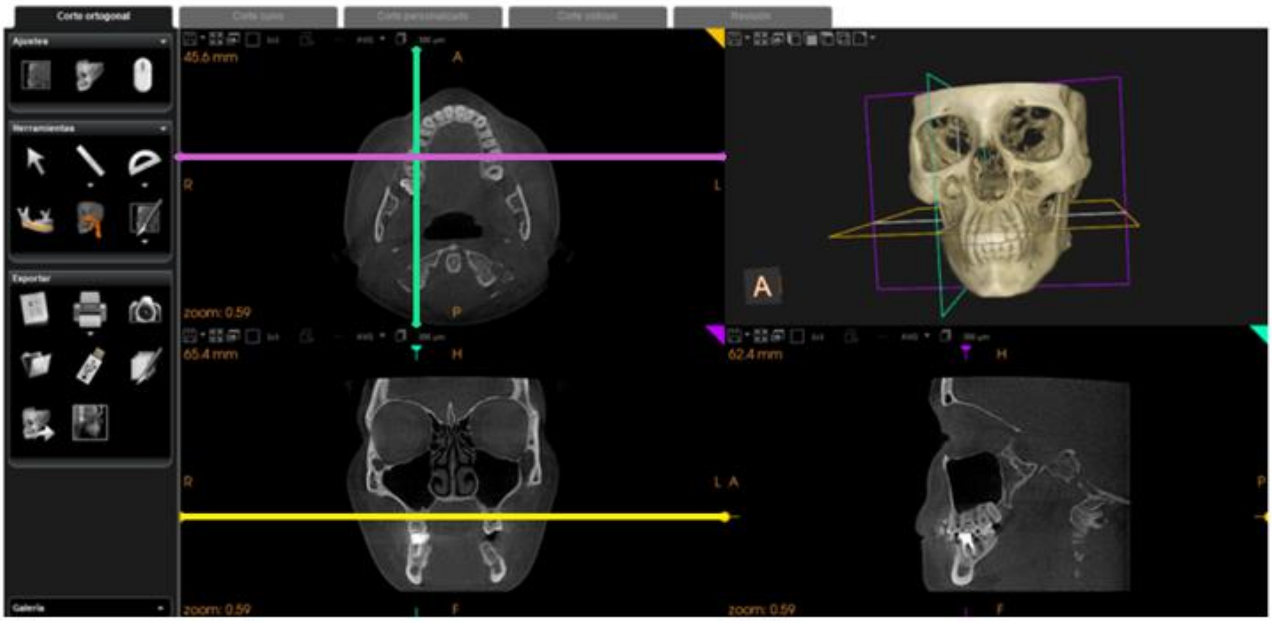

Figure 1. Reference planes in CBCT.

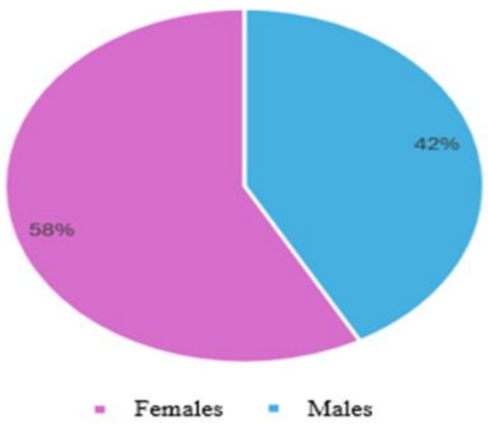

Figure 2. Distribution by sex.

Table 1: Results obtained from the Excel database

Variable	Frequency	Percentage
Facial Biotype		
Dolichofacial	41	27.8%
Mesofacial	59	40.1%
Brachyfacial	47	31.9%
Skeletal Class		
I	63	42.8%
II	71	48.2%
III	13	8.8%
Presence of Polyps		
Yes	31	21.08%
No	116	78.91%

Statistical Analysis Results:

Table 2: Results of the ANOVA test applied to Group 1

Group 1. Skeletal Classes		
Class I	Class II	Class III
µ	0.8491	

ANOVA for Skeletal Classes: The p-value of 0.8491 indicated no statistically significant difference in skeletal classes.

Table 3: Results of the Student's t-test applied to Group 1-A

Group 1-A	
Class I	Class II
µ	0.8410

The obtained p-value, 0.8410, shows that the results do not reach statistical significance.

Table 4: Results of the Student's t-test applied to Group 1-B

Group 1-B	
Class I	Class III
µ	0.5708

The obtained p-value, 0.5708, suggests that the available evidence is not sufficient to discard the hypothesis.

Table 5: Results of the Student's t-test applied to Group 1-C

Group 1-C	
Class II	Class III
µ	0.6405

Since p = 0.6405 is greater than a common significance threshold (e.g., α = 0.05), there is not enough evidence to reject the null hypothesis.

Table 6: Results of the ANOVA test applied to Group 2

Group 2. Facial Biotypes		
Mesofacial	Dolichofacial	Brachyfacial
µ	0.4450	

P = 0.4450 is greater than the typical significance level (α = 0.05), indicating that there is not enough evidence to reject the null hypothesis.

Table 7: Results of the Student's t-test applied to Group 2-A.

Group 2-A	
Dolichofacial	Brachyfacial
µ	0.8015

The obtained p-value, 0.8015, suggests that the available evidence is not sufficient to discard the hypothesis.

Table 8: Results of the Student's t-test applied to Group 2-B

Group 2-B	
Mesofacial	Dolichofacial
µ	0.4927

P = 0.4927 is greater than the common significance level (α = 0.05), meaning there is not enough evidence to reject the null hypothesis.

Table 9: Results of the Student's t-test applied to Group 2-C

Group 2-C	
Mesofacial	Brachyfacial
µ	0.7385

The obtained p-value, 0.7385, suggests that the available evidence is not sufficient to discard the hypothesis.

Table 10: Summary of the data found according to Jarabak

Jarabak	**Presence of Polyps**	**No Presence of Polyps**	**Male**	**Female**
CCW	18	56	36	38
CW	5	25	8	22
N	8	35	18	25
Total	31	116	62	85

Summary of Findings According to Jarabak Index:

- **CCW Growth (Counterclockwise)**: 18 individuals with polyps, 56 without, with a slight majority of women (38 women vs 36 men).
- **CW Growth (Clockwise)**: 5 individuals with polyps, 25 without, with more women (22 women vs 8 men).
- **Neutral Growth**: 8 individuals with polyps, 35 without, with more women (25 women vs 18 men).

No statistically significant association was found between the presence of nasal polyps and facial biotypes, skeletal classes, or growth patterns according to the Jarabak index. The absence of polyps was consistent across all groups, suggesting that nasal polyps may not significantly influence skeletal patterns or facial biotypes. The results also indicated a higher proportion of females in all groups, which may warrant further investigation into gender-related factors in the development of nasal polyps.

Discussion

This study investigated the relationship between the presence of nasal polyps and skeletal class, as well as facial biotype according to the VERT index, in 147 CBCT scans.

The results showed no association between the presence of nasal polyps with skeletal class or facial biotype, and it was observed that the majority of the sample showed an absence of nasal polyps.

Authors such as Rodrigues, M. M., *et al*., mention that nasal polyps are one of the common causes of nasal obstruction, affecting approximately 25% of the general population.18 These alterations in facial growth, such as skeletal class II and III profiles, may be associated with a reduced airway space; however, in our study, no statistically significant relationship was found [18].

The results of the study conducted by Katyal V., *et al*., show statistical support for associating craniofacial disharmony (such as an increased ANB angle and a decreased SNB angle) with sleep-disordered breathing, such as OSA and primary snoring [19]. However, these variables were not considered in our study.

Although there are significant differences in the ANB angle between patients with OSA and controls, these differences are less than 2 degrees. Therefore, although there is a statistically significant difference, it is considered to have little clinical relevance. This suggests that the ANB angle alone is not a strong indicator of respiratory disorders [19].

Stellzig, in his publication, describes how nasorespiratory function, particularly nasal obstruction, affects dentofacial development. Chronic nasal obstruction can lead to mouth breathing, which alters the position of the tongue and jaw during growth, resulting in what is known as "adenoid facies."[20]. This condition is characterized by an open-mouth posture, increased facial height, mandibular retrognathia, and a narrow maxilla, among other traits. However, the direct relationship between mouth breathing and mandibular growth is not entirely clear. It is challenging to control variables such as exposure to teratogenic agents, pathogens, pollutants, and other environmental factors that may predispose individuals to the formation of nasal polyps [21].

Conclusions

Based on the findings of this study, the following conclusions can be established:

- No statistically significant relationship was found between the presence of nasal polyps and skeletal class.
- There is no statistically significant association between facial pattern and the presence of nasal polyps.
- No relationship was observed between growth according to Jarabak and the presence of nasal polyps.
- The absence of nasal polyps was more frequent in patients with a mesofacial biotype and those with skeletal class II.

It is recommended to conduct future studies with a larger and more representative sample, as well as to establish standardized protocols for data collection and clinical records.

The evaluation of respiratory obstructions is essential for functional diagnosis in orthodontics. Therefore, it is crucial to use effective diagnostic tools that allow the visualization and measurement of nasal polyps and other obstructions.

Additionally, the method proposed in this study proves to be valuable, as it provides a wealth of information that can be used to offer timely and comprehensive treatment to patients seeking orthodontic care.

This information may contribute to a better understanding of the relationship between nasal obstructions and facial development, which could optimize therapeutic approaches and improve clinical outcomes.

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