

# Deleterious Oral Habits Related to Vertical, Transverse and Sagittal Dental Malocclusion in Pediatric Patients

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## Research Article

**Keywords:** Habits, Malocclusion, children

**Posted Date:** October 12th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-959827/v1>

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# Abstract

**Background:** Mixed dentition is currently the stage with the highest prevalence of malocclusion, therefore, the objective was to determine the relationship of dental malocclusions in the vertical, transverse, sagittal planes with deleterious habits in pediatric patients.

**Methods:** A cross-sectional analytical study was carried out in 155 children aged 6 to 12 years attended at the clinic of the Dentistry School of The National University of San Marcos in 2017.

**Results:** Of the patients evaluated, 45.3% were identified with vertical malocclusion, 52.0% with sagittal malocclusion and 13.6% with transverse malocclusion. The most frequent type of malocclusion in the vertical plane was anterior deep bite (22.2%), in the transverse plane the Bis a Bis Bite (7.1%) and the Anterior Crossbite (6.5%) were less frequent. Finally, in the sagittal plane, Class II division 1 (20%) and Class III (20.7%) are frequent. Among the most common deleterious habits, anteroposition (58.7%) and mixed breathing (51.0%) were observed in contrast to the habit of retrposition, lip sucking and mouth breathing, which were the least frequent. Considering age and sex, children who have an atypical swallowing habits are more likely to have malocclusion in all three planes of space.

**Conclusions:** It is concluded that there is an association between the deleterious habits with the different types of malocclusion in the different planes of the space, being the atypical swallowing a habit that should be diagnosed early and treated interdisciplinary.

## Background

Malocclusion is an incorrect alignment of the upper and lower teeth, where an adequate gear of bone structures between the maxilla and jaw is not observed, resulting the lack of an ideal function of the masticatory apparatus (1). It is considered a public health problem because it can cause psychological problems and affect their quality of life. In addition, its prevalence is 79.4% in children during the period of mixed dentition (2, 3).

Malocclusions can be classified according to the three planes of space (vertical, transverse and sagittal). Vertical malocclusions are classified as open bite and deep bite. The open bite is one in which one or more teeth cannot contact their antagonists and is related to the mouth breathing habit when the airway obstruction is not resolved (4, 5). In contrast, the deep bite has an increased vertical overbite (6) and where according to Yu (2) boys have more overbite than girls.

Transverse malocclusions are disorders where the upper and lower posterior teeth do not occlude properly and are associated with prolonged sucking habits (7). They are classified as unilateral or bilateral posterior crossbite and scissor bite or Brodie bite. The posterior crossbite occurs when the vestibular cusps of the upper premolars and molars occlude into the fossae of the lower molars and premolars. The scissor bite or Brodie bite is when the palatal surfaces of the upper posterior teeth contact the vestibular surfaces of the lower teeth (8).

Sagittal malocclusion is classified according to Angle's classification into Class I, Class II and Class III malocclusion. Class I malocclusion is where the mesial cusp of the upper first molar occludes between the mesial and median cusps of the first lower molar. Class II malocclusion is when the permanent lower molar occludes distally from its normal position. Finally, Class III malocclusion manifests the inversion of dental relationships, by the first permanent lower molar that is mesially occluded with respect to its normal position (9).

Children are in a phase of growth and development in which their bone structures are moldable and physiological habits serve as stimuli for normal jaw growth (e.g. speech, normal swallowing, chewing). Detrimental habits, on the other hand, can interfere with the dental structure and therefore be part of the etiology of malocclusions (10). Therefore, the failure to do so cannot be corrected without first addressing these reflex activities.

Harmful oral habits include finger sucking, lip sucking and biting, nail biting, bruxism, mouth breathing and tongue thrusting (10). Children who develop harmful oral habits at an early age are candidates for occlusal disorders and alterations in the anatomy of the jaws causing an imbalance in muscle forces and changes in the normal functional esthetics of the whole stomatognathic apparatus (11). There are few conclusive studies on the association of deleterious habits with sagittal, vertical and transverse dental malocclusion; and it is still debatable whether oral habits and mouth breathing are part of the etiopathogenesis of malocclusions (12), therefore, studying the cause-effect relationship between malocclusions and deleterious habits is relevant for an adequate intervention in the treatment and to obtain better results.

The objective of this study was to determine the relationship of dental malocclusions in the vertical, transverse, sagittal planes with deleterious habits present in patients aged 6 to 12 years attended at the clinic of the Dentistry School of The National University of San Marcos in 2017.

## Methods

A cross-sectional analytical observational study was conducted, with a population of 260 children attending the Undergraduate Clinic of the Dentistry School of The National University of San Marcos (FO-UNMSM) in 2017. A probabilistic sampling was performed considering a confidence level of 95%, prevalence of malocclusion of 50% and accuracy of 5% obtaining 155 patients; a random selection was performed using the Epidat program, we worked with the list of numbers of medical records of patients. Eligible patients had to meet the inclusion criteria of being 6 to 12 years old; patients who received previous orthodontic treatment, had systemic disease or did not agree to participate in the study were excluded. Approval was obtained from the FO-UNMSM Research Committee. Patients signed consent and their parents informed consent. The research presented complies with all ethical statements in humans according to the Declaration of Helsinki. For the clinical examination, the technique of direct observation of the deleterious habits and the diagnosis of malocclusion in children was performed, for which the researcher had training with a specialist in orthodontics obtaining concordance values of Kappa Index

>0.8. To recognize the atypical swallowing habit, the patient was given a plastic cup half full of water and was asked to drink a small sip of water, lower the cup and slowly pass the content in his mouth, in this process it was observed if swallowing, makes a grimace, contraction of the orbicularis muscles of the lips, masseter or chin tassel. It was observed if there is water leakage or if there is interposition of the tongue between the incisors when swallowing. Cheek retractors were also used to better observe the tongue thrusting, and a little water was introduced with a syringe, the patient swallowed when indicated so it was clearly observed if there was tongue thrusting or not. To evaluate the digital sucking habit, all the fingers of the hands were observed to recognize if they were wet and/or wrinkled, callosities, irritative eczema, paronychia in the thumb or index finger. For lip sucking, the patient was observed for one minute to check if the patient sucks the lower lip in a resting state. To recognize the type of nasal and/or mouth breathing presented by each patient, a tape with some cotton and a mask cut in half with a napkin was used. For one minute, the patient's nasal breathing was evaluated by placing a tape on the septum of the nose and in each nostril some cotton threads, this allowed observing if there was movement of the cotton in each nostril, if the cotton moved it indicated air circulation through the airways, if the cotton did not move it indicated obstruction of the airway. The mouth breathing was analyzed by placing the mask with the napkin at the level of the patient's mouth for one minute, the movement of the napkin was observed to see if there was air flow through the mouth. The habit of onychophagia was evaluated by careful observation of the fingernails recognizing the shape of the nail saw, in addition to the lesions on the free edge of the nail and whether or not it disappears, also with the presence of microtrauma in the nail bed. Patient posture was evaluated with the sternal malar relation, in which, by means of a large square and a 30cm ruler, the patient was asked to stand in profile with a Frankfurt plane parallel to the floor to measure a line from the midpoint of the cheekbone of the face towards the midpoint of the jugular notch. If both coincide is a patient with an orthoposition, the malar point can be up to 2 cm in front of the midpoint of the jugular notch, if it exceeds this measure the head is in anteroposition. If the malar point is behind the midpoint of the jugular notch, the head is in retroposition. An analysis of the dentoalveolar malocclusion presented by the patient was performed: Sagittal dental malocclusion with Angle's classification (Class I, Class II div 1, Class II div 2 and Class III). Vertical dental malocclusion was evaluated according to the overbite. Deep bite was evaluated if there was an excessive overbite (>20%). In an anterior open bite one or more teeth do not reach the occlusion line and do not make contact with antagonists (null overbite or negative). A transverse dental malocclusion evaluated the unilateral or bilateral posterior crossbite according to the vestibular cusps of the lower premolars and molars that laterally overbite the upper ones in one or both hemiarchs; and scissor or brodie bite according to the palatal faces of the upper molars and premolars contacting the vestibular faces of the lower teeth. In addition, the chronological age and gender of the child were recorded. For the statistical analysis a significance level of  $p<0.05$  was considered. Descriptive measures of absolute and relative frequencies are presented for categorical variables. A bivariate analysis was performed to evaluate malocclusions and deleterious habits according to sex, in addition to the association of deleterious habits with the different types of malocclusions in the three planes using the Chi-square test and Fisher's Exact Test. Generalized linear models with Poisson distribution and robust variance adjustments were used to estimate the prevalence

ratios of having transverse, sagittal and vertical malocclusion according to the presence of deleterious habits, adjusting for age and sex. All analyses were performed with the Stata v.16 statistical package.

## Results

Of the 155 patients evaluated, 71% were identified with some type of malocclusion, 45.3% (n=57) with vertical malocclusion, 52.0% (n=75) with sagittal malocclusion and 13.6% (n=21) with transverse malocclusion. According to Table 1, the most frequent type of malocclusion in the vertical plane was anterior deep bite (22.2%), in the transverse plane, Bis a Bis Bite (7.1%) and Anterior Crossbite (6.5%) were less frequent. Finally, in the sagittal plane, Class II div 1 (20%) and Class III (20.7%) are frequent. Among the most common deleterious habits, anteroposition (58.7%) and mixed breathing (51.0%) were observed in contrast to retrposition habit, lip sucking and mouth breathing which were the least frequent.

Table 1  
Characteristics of patients aged 6 to 12 years attended at FO-UNMSM

	Total N=155	Men N=75	Women N=80	p
Deleterious Habits				
Atypical Swallowing	51 (32.9%)	23 (30.7%)	28 (35.0%)	0.566*
Onychophagia	48 (31.0%)	23 (30.7%)	25 (31.3%)	0.937*
Digital sucking	18 (11.6%)	8 (10.7%)	10 (12.5%)	0.722*
Lip sucking	8 (5.2%)	3 (4.0%)	5 (6.3%)	0.720†
Mouth breathing	10 (6.5%)	3 (4.0%)	7 (8.8%)	0.330†
Mixed breathing	79 (51.0%)	42 (56.0%)	37 (46.3%)	0.225*
Anteroposition	91 (58.7%)	43 (57.3%)	48 (60.0%)	0.736*
Retroposition	7 (4.5%)	3 (4.0%)	4 (5.0%)	1.000†
Malocclusion	110 (71.0%)	48 (64.0%)	62 (77.5%)	0.064*
- Vertical**				
Normal	69 (54.8%)	35 (56.5%)	34 (53.1%)	
Anterior Open Bite	12 (9.5%)	4 (6.5%)	8 (12.5%)	0.711*
Bis a Bis Bite	17 (13.5%)	9 (14.5%)	8 (12.5%)	
Anterior Deep Bite	28 (22.2%)	14 (22.6%)	14 (21.9%)	
- Transverse				
Normal	133 (86.4%)	64 (85.3%)	69 (87.3%)	
Bis a Bis Bite	11 (7.1%)	5 (6.7%)	6 (7.6%)	0.750*
Posterior Crossbite	10 (6.5%)	6 (8.0%)	4 (5.1%)	
- Sagittal				
Class I	75 (50.0%)	38 (52.1%)	37 (48.1%)	
Class II div 1	30 (20.0%)	11 (15.1%)	19 (24.7%)	0.359*
Class II div 2	14 (9.3%)	9 (12.3%)	5 (6.5%)	

\*Chi-Square Test. † Fisher's Exact Test

\*\* May add up to less than 155 for unrecorded values

	Total N=155	Men N=75	Women N=80	p
Class III	31(20.7%)	15 (20.6%)	16 (20.8%)	
*Chi-Square Test. † Fisher's Exact Test				
** May add up to less than 155 for unrecorded values				

Table 2 shows that of the different types of vertical dental malocclusion it is observed that the deleterious habit of atypical swallowing is statistically associated, with a higher proportion in the Bis a Bis Bite. Table 3 evaluates the different types of transverse dental malocclusion and it is found that it is associated with mouth and mixed breathing, as can be seen in 7 of the 10 patients who presented posterior crossbite presented mixed breathing. Table 4 shows the association with the types of sagittal malocclusion with the habits of atypical swallowing, lip sucking, anteroposition and retroposition.

Table 2

Deleterious habits by type of vertical dental malocclusion in patients aged 6 to 12 years.

Present	Normal (n=69)	Bis a Bis Bite (n=12)	Anterior Open Bite (n=17)	Anterior Deep Bite (n=28)	p
Atypical Swallowing	14	11	7	10	<0.001*
Onychophagia	23	1	6	7	0.305*
Digital sucking	5	2	3	5	0.366*
Labial sucking	3	1	0	3	0.389†
Mouth breathing	3	2	0	2	0.214†
Mixed breathing	36	9	9	9	0.080*
Anteroposition	41	9	7	15	0.305*
Retroposition	3	1	2	1	0.444†

\* Chi-Square Test. † Fisher's Exact Test

Table 3  
Deleterious habits by type of transverse dental malocclusion in patients aged 6 to 12 years.

	Normal (n=133)	Bis a Bis Bite (n=11)	Posterior Crossbite (n=10)	p†
Atypical Swallowing	40	7	4	0.070
Onychophagia	39	5	4	0.411
Digital sucking	15	2	1	0.748
Labial sucking	6	2	0	0.183
Mouth breathing	4	3	3	<b>0.001</b>
Mixed breathing	69	2	7	<b>0.043</b>
Anteroposition	79	7	5	0.877
Retroposition	4	1	1	0.189

† Fisher's Exact Test

Table 4  
Deleterious habits by type of sagittal dental malocclusion in patients aged 6 to 12 years.

	Class I (n=75)	Class II Div 1 (n=30)	Class II Div 2 (n=14)	Class III (n=31)	p
Atypical Swallowing	15	17	4	13	<b>0.002*</b>
Onychophagia	24	8	4	11	0.893*
Digital sucking	9	1	4	3	0.118†
Labial sucking	2	5	0	1	<b>0.039†</b>
Mouth breathing	3	4	0	0	0.088†
Mixed breathing	38	18	4	17	0.265*
Anteroposition	48	22	8	10	<b>0.006*</b>
Retroposition	1	0	0	5	<b>0.010†</b>

\* Chi-Square Test. † Fisher's Exact Test

Table 5 shows that children with atypical swallowing habit are more likely to have malocclusion in all three planes of space (vertical (RP=1.90), sagittal (RP=1.68) and transverse (RP=2.28). In addition, children with digital sucking are more likely to have vertical malocclusion, children with mouth breathing are more likely to have transverse malocclusion and children with retroposition are more likely to have sagittal malocclusion.

Table 5  
Deleterious habits associated with the presence of malocclusion in patients aged 6 to 12 years.

	<b>Malocclusion Vertical (n=126)</b>	<b>Malocclusion Sagittal (n=150) RPa (IC95%)</b>	<b>Malocclusion Transverse (n=154) RPa (IC95%)</b>
Atypical Swallowing	1.90 (1.31-2.74) <b>p=0.001</b>	1.68 (1.26-2.25) <b>p&lt;0.001</b>	2.28 (1.04-5.01) <b>p=0.040</b>
Onychophagia	0.79 (0.50-1.26) <b>p=0.325</b>	0.97 (0.69-1.36) <b>p=0.870</b>	1.66 (0.75-3.67) <b>p=0.214</b>
Digital sucking	1.54 (1.00-2.38) <b>p=0.049</b>	1.15 (0.75-1.76) <b>p=0.517</b>	1.29 (0.42-3.94) <b>p=0.660</b>
Labial sucking	1.26 (0.63-2.54) <b>p=0.512</b>	1.47 (0.96-2.26) <b>p=0.079</b>	1.94 (0.54-6.87) <b>p=0.307</b>
Mouth breathing	1.22 (0.60-2.47) <b>p=0.579</b>	1.09 (0.56-2.10) <b>p=0.809</b>	6.15 (2.96-12.8) <b>p&lt;0.001</b>
Mixed breathing	0.93 (0.63-1.38) <b>p=0.729</b>	1.11 (0.82-1.52) <b>p=0.504</b>	0.71 (0.31-1.59) <b>p=0.399</b>
Anteroposition	0.89 (0.61-1.30) <b>p=0.542</b>	0.82 (0.60-1.11) <b>p=0.200</b>	0.93 (0.41-2.08) <b>p=0.854</b>
Retroposition	1.26 (0.63-2.55) <b>p=0.508</b>	1.65 (1.13-2.42) <b>p=0.010</b>	2.67 (0.87-8.24) <b>p=0.087</b>

RPa: Prevalence Ratios (95% CI: 95% confidence intervals) adjusted with the sex and age variable

## Discussion

Digital and lip sucking habits are complex neuromuscular patterns considered normal in childhood and abnormal from 3 years of age (11). The persistence of these habits can affect dentofacial growth (1), therefore prevalence research in transversal and longitudinal evaluation allows us to understand their impact on child growth and development.

In research carried out in Nigeria (13), Cuba (14) and Peru (15) it was found that there was a direct relationship between deleterious habits and malocclusions, as in our study that a relationship was found

between the habit of atypical swallowing, digital sucking, mouth breathing and retrusion with the presence of malocclusion. However, in Spain another author shows that deleterious habits can initiate, predispose and aggravate dental malocclusions, although they may not be the main etiological factor governing their appearance (16).

Furthermore, according to Fialho and Col. (17) there is a relationship between non-nutritive sucking habits and anterior open bite, and concluded that the presence of deleterious habits was not determinant for facial morphology. That is why we recommend analyzing facial morphology and looking for an association with deleterious habits. In this study we understand that there are intrinsic factors that can be recognized by the dentist and there are also extrinsic factors (genetics) that can act in isolation or in combination leading to malocclusions.

This study shows the existence of a statistically significant relationship between anterior deep bite with the mixed breathing habit, anterior open bite with the atypical swallowing habit, and Jamilian (18) showed that children with the habit of digital sucking have greater risk of suffering anterior open bite and posterior crossbite, coinciding with the research paper carried out in Spain (19) and India (20).

It is important to mention that bottle feeding during weaning is a risk factor, not evaluated in this study, which was strongly associated with anterior open bite, according to the longitudinal study conducted by Moimaz S and Col. (21), who monitored sucking habits and nocturnal oral breathing from pregnancy to 30 months of birth.

Our results corroborated the findings of Acero L and Col. (22), showing that there is a statistically significant association of transverse malocclusion, such as posterior crossbite, with mouth breathing habit ( $p= 0.018$ ); bis a bis bite (transverse) with atypical swallowing habits ( $p=0.040$ ); mouth breathing ( $p=0.024$ ) and mixed ( $p=0.029$ ) and scissors bite with retrusion posture habit.

In addition, Thomaz EB and Col. (23) in a study in adolescents in Northeastern Brazil showed that deleterious habits cause premaxilla conditions, protrusion of the upper incisors causing anterior open bite and posterior crossbite. The prevalence of posterior crossbite is caused by poor oral habit leading to low tongue positioning during sucking, lack of tongue thrust to the palate mainly causes increased activity of the cheek muscles. This, in turn, leads to altered muscle pressure in the upper arch, resulting in malocclusion, according to Aloufi and Col. (24).

It should be noted that Acero L and Col. (22) added an anatomical factor to the research and found a direct relationship with maxillofacial alterations, according to the degree of adenoid obstruction caused by adenoid hypertrophy. Likewise, Rossi R and Col. (25) defined a direct relationship between the degree of nasal obstruction and its repercussion on the facial, skeletal and dental pattern. However, a strong evidence-based association has not yet been established (26).

In this research paper the Class I malocclusion without anterior crossbite was associated with atypical swallowing, however atypical swallowing does not generate a Class I malocclusion but rather, this habit

is present in open bites and in Class II malocclusions according to Jimenez (15), this association may be due to the fact that our sample has a Class I skeletal pattern and there has not been a transition of the swallowing pattern, they remain with childlike swallowing. The Class I malocclusion with anterior crossbite was related to digital sucking habit, coinciding with a research paper carried out in Brazil (27). This may be due to a digital sucking in a horizontal position of the fingers that stimulates a forward sliding of the jaw, just as Jimenez (15) we found that Class II division 1 malocclusion was related to atypical swallowing and lip sucking habits ( $p<0.05$ ). It was found in the research in agreement with the aforementioned authors that there is no statistically significant association of Class II division 2 malocclusion with deleterious habits, one possibility is that this malocclusion is influenced by genetics and not by habits.

Class III malocclusion without anterior crossbite was associated with anteroposition posture, the individuals in the sample presented a Class III dental malocclusion that could be due to loss of lower teeth that caused mesialization of the lower first molars, however, they have a Class I or II skeletal pattern. Class III malocclusion with anterior crossbite had a statistically significant association with retrposition posture. This is explained because in children with class III malocclusion the angle of cervical lordosis is lower than in children with class I and class II malocclusion according to D'Attilio and Col. (28).

Among the limitations that arose were not registering Graber's trident with which the intensity, duration and frequency of each deleterious habit can be evaluated and according to that relate it to skeletal changes. In addition, since it is a cross-sectional study, it is not possible to know if the habits appeared after having malocclusion. It is recommended to evaluate vertical, transverse and sagittal malocclusions with vertebral defects and find their correlation. It is also recommended to evaluate age ranges to investigate in which the deleterious habit generates greater malocclusion and in which type of dentition.

## Conclusions

It is concluded that there is an association between deleterious habits and the different types of malocclusion in the different planes of space, being atypical swallowing a habit that should be treated interdisciplinary and referenced from its diagnosis to reduce the probability of the presence of malocclusions.

## Abbreviations

FO-UNMSM: Undergraduate Clinic of the Dentistry School of The National University of San Marcos

## Declarations

- Ethics approval and consent to participate

This project was approved by the Academic Unit of the School of Dentistry of the Universidad Nacional Mayor de San Marcos (N°110/FO-VDAC-AYOE) to be executed and it was carried out with the use of informed consent and assent.

## • Consent for publication

Not applicable

## • Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

## • Competing interests

The authors declare that they have no competing interests

## • Funding

Chacón-Uscamaita PR was supported by the Fogarty International Center of the National Institutes of Health under Award Number D43TW009343 and the University of California Global Health Institute.

## • Authors' contributions

LR conceived the study, wrote the original protocol draft, and led the protocol development, with the assistance from AQ. LP as clinical research specialist in orthodontic contributed with his expertise in the clinical evaluation of patients and critically reviewed the first and subsequent protocol drafts. PRCh led the data management plan and analysis, with assistance from GPG. All authors read and approved the final manuscript.

## • Acknowledgements

Not applicable

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