ARTICLE

ABSTRACT

Aim: To investigate factors associated with anterior open bite in individuals aged from 2 to 33 years with developmental disabilities. Design: This is a cross-sectional study. A total of 271 dental records were examined. The anterior open bite analyzed was determined based on clinic exam. These variables were also analyzed: gender, age, education level of mother, International Code of Diseases (ICD), mouth breathing, use of anticonvulsant drugs, hyperkinesis, pacifier use, thumb sucking, seizure, and involuntary movements. For the purposes of analysis, the individuals were categorized as being with and without anterior open bite. Variables with a *p*-value of < 0.25 in the bivariate analysis were incorporated into the logistic regression models. Results: Mouth breathers had a 2.60-fold (95% CI: 1.35–5.01) greater chance of exhibiting anterior open bite than nasal breathers. Pacifier users are more likely to have an anterior open bite (3.32-fold, 95% CI: 1.62–6.77). Individuals with reported involuntary movements had a 2.66-fold (95% CI: 1.26–5.63) greater chance of exhibiting anterior open bite. Users of anticonvulsants drugs had a 3.05 (95% CI: 1.57–5.92) greater chance of showing anterior open bite. Conclusion: Involuntary movements, mouth breathing, using anticonvulsant drugs, and using pacifier are factors associated with anterior open bite in patients with developmental disabilities.

KEY WORDS: anterior open bite, cerebral palsy, developmental disabilities

Factors associated with anterior open bite in children with developmental disabilities

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Introduction

The anterior open bite is one of the most common occlusal abnormalities in the deciduous dentition. In individuals with developmental disabilities, especially in cases of cerebral palsy, anterior open bite is more common due to muscle hypotonia, abnormal tongue posture, the inability to perform lip seal, tongue impulses, and sucking habits. Patients with cerebral palsy are more likely to have an anterior open bite when compared to individuals with mental disabilities[1] or individuals with Down syndrome.[2] Among these individuals, there are other causes for this problem, such as: thumb sucking,[2] the use of pacifiers,[3] the resting position of the head in hyperextension, atypical swallowing,[4] and the child's neurological status.[5] These factors play a role in the pressure of the tongue on the palate and in its interposition between the jaws during swallowing.[2,5,6] Other authors speculate that anterior open bite in these patients may be also due to an inefficient salivation reflex and frequent mouth breathing.[4,7] Spastic patients present a higher incidence of anterior open bite, especially in patients with clinical patterns of quadriplegia, diplegia, and double hemiplegia.[8]

The anterior open bite is diagnosed when the lower incisors were not overlapped in the vertical plane by the upper incisors, and did not occlude with them.[2,6] The anterior open bite is an occlusal abnormality is related to

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disorders of the normal functions of the stomatognathic system like feeding, breathing, language, and salivation[8] and may be corrected through the use of orthodontic appliances that is not always possible to be performed in patients with developmental disabilities. Because of the limitation of the dental therapeutic approach, it is important to know variables associated with anterior open bite in these individuals. As far as it was possible to review the scientific literature, the role of factors, such as diagnosis given by the International Code of Diseases, the presence of involuntary movement, the use of anticonvulsant medication, the current history of seizures, hyperkinesis, and maternal schooling in this group of patients, are not adequately clarified.

The objective of this study was to investigate if there was relationship between the factors above and anterior open bite, among individuals with developmental disabilities, attended by a dental service of the Dental School of Federal University of Minas Gerais.

Material and methods

Study design

This is a cross-sectional study, carried on in a reference center for the rehabilitation of children with neuromotor disabilities, that has a partnership with the Federal University of Minas Gerais, through the Dental School. These individuals are in rehabilitation treatment in the Associação Mineira de Reabilitação. A convenience sample was used, and data were collected from records of individuals that were undergoing dental treatment or regular checkups in this center for rehabilitation. No patient was under orthodontic treatment. The collection of these data was performed in the first dental session of the patient with the exception of the medical diagnosis, which was defined during neurological treatment.

Data collection

Only one trained member of the team (Cohen kappa = 1.0)[9] collected the data, extracted from the patient charts on the outcome and independent variables, simultaneously. The database had been created in Excel for Windows (Microsoft, WA, USA).

In relation to the clinical examination, the diagnosis was made by the students are conferred by the same teacher for 20 years. No intraexaminer and interexaminer validity test was performed. The anterior open bite was recorded from the patient's direct observation.

There was registration about absence or presence of anterior open bite in 271 dental records out of 628 analyzed. The lack of registration is in part due to the fact that 289 (46%) of the dental medical records belonged to children under 2 years old, and in many of them it was not possible to observe the presence or absence of the event. Other reasons are the lack of annotation of this item in the dental record by the student and the absence of anterior teeth.

Statistical analysis

For the determination of associations, the data were submitted to simple logistic regression, with the calculation of respective odds ratios (ORs) and *p*-values. In this analysis, variables with a *p*-value of < 0.25 were incorporated into the multiple logistic regression models. Variables with a *p*-value of < 0.05 were maintained in the final model. Adjusted ORs with the respective 95% confidence intervals (CIs) and *p*-values were calculated by the Forward Stepwise method. All statistical analyses were performed using the SPSS program, version 19.0 (SPSS Inc., Chicago, IL, USA).

Ethical aspects

This study was approved by the ethical committee of Federal University of Minas Gerais-UFMG, under the number COEP UFMG 219/03.

Results

In a total of 271 studied records, the anterior open bite was verified in 108 (39.85%). The age of the patients ranged from 2 to 33 years old, average of 4 years and median of 3 years. All of them were undergoing dental treatment or regular checkups.

The boys were 144 (53.1%) of the sample. Cerebral palsy was found in 109 (52.40 %) medical records (G80.0–98; G80.1–6; G80.2–2; G80.3–2) (Table 1). Other diagnoses were: G82.4 (spastic tetraplegia), F82 (specific developmental disorder of motor function), G54.0 (brachial plexus disorders), G71 (primary disorders of muscles), M40.1 (other secondary kyphosis), P27.1 (bronchopulmonary dysplasia), P14.3 (other brachial plexus injuries), Q05.2 (lumbar spina bifida with hydrocephalus), Q05.3 (sacral spina bifida with hydrocephalus), Q05.7 (lumbar spina bifida without hydrocephalus), Q05.9 (spina bifida unspecified), Q90 (Down syndrome), R62.8 (other lack of expected normal physiological development), and R62.9 (lack of expected normal physiological development unspecified).

Pacifier use was identified in 76 (28.25%) of the dental records and the digital sucking act in 48 (17.71%). Maternal education greater than 4 years was found in 231 cases (89.53%). Eighty individuals (30.07%) had seizures, 70 (26.31%) were hyperkinetic, 126 (53.15%) were mouth breathers, 144 (53.13%) were medicated with anticonvulsants, and 63 (23.50%) had involuntary movement (Table 1).

The final model demonstrated that children who use pacifiers were 3.32 times more likely ($p = 0.001$) to have an anterior open bite than children who do not use it. Individuals with involuntary movement were 2.66 times more likely ($p = 0.01$) to develop the anterior open bite than those who do not have involuntary movements. Patients using central-acting medication have 3.05 ($p = 0.001$) times more likely to have an anterior open bite than those who do not use this medication. Finally, mouth breathers have 2.44 times ($p = 0.004$) more chances of developing anterior open bite than nasal breathers (Table 2). The multiple logistic regression model was

Table 1. Clinical and sociodemographic characteristics of patients with developmental disabilities, Belo Horizonte, Brazil, 1998–2016.

Variables	N (%)
Open bite (n = 271)	108 (39.85%)
Male	144 (53.13%)
Female	127 (46.86)
ICD (n = 208)	
Cerebral palsy	109 (52.40%)
Pacifier use (n = 269)	76 (28.25%)
Thumb sucking (n = 271)	48 (17.71%)
Seizure	80 (30.07%)
Without seizure	186 (69.93%)
Hyperkinesis (n = 266)	70 (26.31%)
Maternal education greater than 4 years (n = 258)	231 (89.53%)
Mouth breathing	143 (53.15%)
No mouth breathing	126 (46.85%)
Medicated with anticonvulsants	144 (53.13%)
No medicated with anticonvulsants	127 (46.86%)
With involuntary movement	63 (23.50%)
Without involuntary movement	205 (76.50%)
2–12 years	262 (96.67%)
Above 13 years	9 (3.32)

considered adequate (p = 0.703; Hosmer–Lemeshow test).

Discussion

Anterior open bite is a problem among patients with developmental disabilities and has been independently associated with involuntary movement, mouth breathing, pacifier use, and consumption of anticonvulsant medication.

In this study, the prevalence of anterior open bite among individuals with developmental disabilities was very similar to that found in a previous study, in Brazil,[2,10] lower than that found in Chile[3] and higher than that found in Croatia,[6] Hong Kong,[7] and India.[1,11,12]

Regarding the pacifier use, it is worrying how easily the object is offered to children with, or without cerebral palsy. The most serious problem is related to the change in the lingual dynamics of children who have this habit. The interposition of an object on the tongue causes it to always rest on the jaw and never on the maxilla. The tongue stimulates the growth and development of the maxilla. If it does not come into contact with the palate, as a consequence, it has an atrophied palate (maxillary compression) and an increase in the open bite.[3]

In relation to the presence of involuntary movement, the compromised neurological condition of these individuals could explain why we found results similar to those found by Carmagnani *et al.*[8] For those authors, spasticity leads to neuromuscular involvement with bone consequences modifying facial growth and occlusal development patterns. For Martinez-Mihi *et al.*,[4] anterior open bite (or at least their severity) could be reduced avoiding hyperextended patterns gaining control or modifying the resting posture of the head from an early age.

The tongue thrust is natural and physiological in children under 6 years old, as part of a childhood motor pattern, that is not very neurologically elaborated. The interposition of the tongue between the maxilla and the jaw may be present till 10 years of age, but if the habit persists, it may be related to neuromuscular disorders, common in individuals with cerebral palsy.[5] These children, especially those who present spasticity, have postural alterations that include inclination of the head to the back and lowering of the mandible[5] favoring the genesis of the anterior open bite.

Our results are similar to those found previously[6] and the considerations about their consequences on atypical lingual positioning[3] should be emphasized. Children with cerebral palsy are at risk of developing significant respiratory problems due to insufficient respiratory muscle strength.[13] In this sample, where epilepsy is common, mouth breathing is associated with the consumption of anticonvulsant medication.[14] The medication used for its control (especially benzodiazepines) is capable of producing respiratory depression, hypoventilation, hypoxia, and obstructive sleep apnea. The mechanisms involved in this process are related to the elimination by the action of the anticonvulsant from the chemical and neural control of respiration or by decreasing the wakefulness by altering the duration of sleep stages or decreasing the amount of REM (rapid eyes movements) stage.[15] In this way, mouth breathing becomes an alternative means for oxygen intake[14] with probable consequences in the altered positioning of the tongue, causing the anterior open bite.

Oliveira *et al.*[2] pointed out that it is the role of the dental surgeon to provide guidance for establishing good habits in the child's first year of life. Children who have nonnutritive sucking habits for more than 24 months are more likely to develop malocclusions in the deciduous and mixed dentition. So, one of the ways to prevent the problem is through health education strategies, especially when the dental team has the opportunity to work with younger children. In the present study, the variable that may undergo the intervention of the dental team in terms

Table 2. Association between anterior open bite and independent variables among individuals with developmental disabilities, Belo Horizonte, Brazil, 1998–2016.

Variable	Anterior open bite	Odds ratio (95% CI)	*p*-Value	Adjusted odds ratio (95% CI)	*p*-Value
With ICD G80.0	45	1.74 (0.99–3.06)	0.052		
Without ICD G80.0	36	1			
With ICD G80.1	2	0.77 (0.13–4.31)	0.768		
Without ICD G80.1	79	1			
With ICD G80.2	0	0.000	0.999		
Without ICD G80.2	81	1			
With ICD G80.3	1	1.57 (0.09–25.53)	0.749		
Without ICD G80.3	80				
With ICD G82.4	4	1.26 (0.33–4.86)	0.730		
Without ICD G82.4	77	1			
Mother education level > 4 anos	91	1	0.613		
Mother education level ≤ 4 anos	12	1.23 (0.55–2.74)			
Seizure	44	2.44 (1.43–4.17)	0.001		
Without seizure	62	1			
Boys	53	1	0.276		
Girls	55	1.32 (0.80–2.13)			
Use of pacifier	41	2.20 (1.28–3.77)	0.004	3.32 (1.62–6.77)	0.001
Do not use of pacifier	67	1		1	
Not thumb sucking	93	1			
Thumb sucking	15	0.63 (0.32–1.23)	0.182		
With involuntary movement	36	2.51 (1.41–4.47)	0.002	2.66 (1.26–5.63)	0.01
Without involuntary movement	71				
Hyperkinetic	22	0.58 (0.32–1.04)	0.070		
No hyperkinetic	86				
Use of anticonvulsant medication	75	3.09 (1.85–5.17)	0.000	3.05 (1.57–5.92)	0.001
Do not use anticonvulsant medication	33				
Mouth breathing	65	2.56 (1.55–4.23)	0.000	2.60 (1.35–5.01)	0.004
No mouth breathing	42				
Idade			0.691		

Note: Data for some variables are missing.

of health education is the use of pacifier. Some orthodontic and orthopedic devices are used in such cases successfully, but these measures do not prevent the anterior open bite. Anticonvulsant medication of is paramount for the control of seizures and nothing can done by dentists on its prescription. Mouth breathing, associated with the use of this medication, is also a variable in which the dental team has no control. Finally, involuntary movement is a characteristic of the neurological condition of a large part of the individuals of this sample, and it is a variable that can be modified by the dental team with the work done with physiotherapy, if started in the early children's age.

The total number of records observed in this study is two and a half times higher than the study carried out by Carmagnani *et al.*[8] which among those listed above, is the one with the highest number of individuals studied.

One limitation of this research is that the data were created to guide the decisions of dentists in relation to the dental treatment of the patient. Thus, the ability to generalize the results to the population of individuals with developmental disabilities has certain limitations. In this study, due to limitations of the dental records, other factors associated with

anterior open bite in the literature were not collected. In addition, the cross-sectional study does not allow the determination of cause and effect.

Conclusion

In this study, we got to the conclusion that being mouth breather, the use of anticonvulsants drugs, having involuntary movements, and the use of pacifier, are factors associated with anterior open bite in children with developmental disabilities, attended by this dental service.

Conflict of Interest

Lia Silva de Castilho declares that he has no conflict of interest. Mauro Henrique Nogueira Guimarães Abreu declares that he has no conflict of interest. Luiz Gustavo de Almeida Pires e Souza declares that he has no conflict of interest. Leiliane Teresinha Romualdo declares that he has no conflict of interest. Vera Lúcia Silva Resende declares that he has no conflict of interest.

Ethical Statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was submitted and approved by the Human Research Ethics Committee of Federal University of Minas Gerais State (protocol number ETIC 219/03).

Castilho LS and Oliveira RB participated in data collection, manuscript writing and data analysis. Resende VLS, Silva MES and Abreu MHNG devised the study, developed the study design and protocols and contributed to manuscript revision.

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