Malocclusion prevalence and comparison between the Angle classification and the Dental Aesthetic Index in scholars in the interior of São Paulo state - Brazil

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Abstract

Introduction: The malocclusions are among the main buccal health problems all over the world, together with dental cavity and periodontal disease. Several indexes are being used for malocclusion registration. The present study verified the prevalence of this condition, using the Angle classification and the Dental Aesthetic Index (DAI), the severity and the necessity of orthodontic treatment registered with the DAI and the results of both indexes were compared, seeking to correlate collected data pattern and the viability of using them together. **Methods:** The sample consisted of 734 schoolchildren with 12 years of age, both male and female from the public municipal schools in Lins-SP, Brazil. The exams were performed at the school's playgrounds with the use of IPC probes with a naked eye. **Results:** For the Angle classification, it was found that 33.24% of the children presented normal occlusion and 66.76% presented malocclusions. It was observed, with the DAI, that 65.26% of the children had no abnormalities or had slight malocclusions. The defined malocclusion was present in 12.81%, severe malocclusion was observed in 10.90% and very severe or disabling malocclusion in 11.03%. Most of the children (70.57%) presented normal molar relationship and the anterior maxillary overjet was the most frequently observed alteration. When the indexes were compared there were similarities and divergences. **Conclusion:** DAI was not sensitive for some occlusion problems detected by the Angle classification, and vice-versa, demonstrating that both indexes have different points in malocclusions detection, so they could be used mutually in a complementary way.

Keywords: Malocclusion. Angle classification. Dental Aesthetic Index. Prevalence. Index.

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INTRODUCTION

Epidemiological studies allows to evaluate the distribution and severity of morbid conditions that occur in a population. It also allows checking the interference of etiological factors on the occurrence of diseases, providing data for planning preventive and curative actions. Currently malocclusions are third in the ranking of priorities among the problems of dental public health worldwide, surpassed only by dental cavity and periodontal diseases.[11] However, with the reduction of caries in children and adolescents in recent decades, this condition has received more attention.[25] In fact, malocclusions represent one of the studied problems, over time, using different classifications in different populations, often to learn about its prevalence, causes and establishing treatment protocols. Nevertheless, occlusal problems remain in direct relationship with the other two most prevalent in dentistry, i.e., dental cavities and the appearance of gingival inflammation with possible painful symptoms.[7]

The publication of the Angle classification in 1899 was a milestone in the development of orthodontics not only to classify the malocclusions, but also to include the first simple and clear definition of normal occlusion of the natural dentition.[27] This method has probably been the most used instrument to record malocclusions until now.[27]

The World Health Organization (WHO), concerning to acknowledge the real malocclusion conditions in different countries, advocated the Dental Aesthetic Index (DAI) in the 4th edition of the Manual of Basic Oral Health Surveys,[22] so that there would be a suitable instrument to gather epidemiological information. Data from the SB Brazil 2003 survey,[8] as well as several papers in the literature[2,4,7,10,19] used DAI for malocclusion analysis.

Because both the Angle classification and DAI represent highly used indexes in the assessment of malocclusions, it becomes relevant the verification of the similarities and differences in collected data by both, in comparative terms, as well as the feasibility of using both together. So, the objective of this study was to check the malocclusions prevalence using Angle classification and DAI, its severity and the orthodontic treatment need with the DAI, and to compare the collected data in both indexes.

METHODOLOGY

This is an epidemiological study with 734 children aged 12 years old of both genders, from public schools in Lins-SP, Brazil. An analytical tool based on Angle's traditional classification[13] and on the Dental Aesthetic Index (DAI)[22] was elaborated, in order to assess the prevalence of malocclusions, its severity, the need for treatment and to compare both classifications. After the approval of the Araçatuba Dental School, UNESP (Univ. Estadual Paulista) Standing Committee on Ethical Research with Humans (Case 01649/2002), an initial calibration was performed where 20 children not participating in the study population were examined, aiming to find possible difficulties for the experiment.

In the experimental phase, tests were performed only by a professional dentist, orthodontic specialist, and occurred in schoolyards, with good lighting conditions, using wooden spatulas, masks, caps and IPC probes (designed by WHO) with a naked eye. Only those children whose parents have consented by signing the Consent Term were examined.

Criteria used for the Angle's classification
Class I (neutral occlusion)

Alteration of tooth position in which there is a normal anteroposterior relationship between the maxilla and the mandible. The triangular ridge mesiobuccal cusp of the upper first permanent molar occludes in the mesiobuccal groove

of the first lower permanent molar. Therefore, it was considered as Class I, a person who, having the aforementioned molar relationship, showed one or more of the following characteristics: rotation, diastema, crossbite, open bite, deep bite and/or dental arch atresia.

Class II (Distocclusion)

Malocclusion in which is observed a "distal relationship" of the mandible in respect to maxilla. The first permanent molar mesiobuccal groove occludes after the mesiobuccal cusp of the upper first permanent molar, where:

• Division 1: Distocclusion in which the upper incisors are typically projected.

• Division 2: Distocclusion in which the upper central incisors are nearly in its anteroposterior normal position or present a mild retroclination, while the upper lateral incisors have a labial and mesial inclination.

Class III (mesiocclusion)

Malocclusion presenting the mandible "mesial" to the maxilla. The mesiobuccal groove of the lower first permanent molar occludes previously to the upper first permanent molar mesiobuccal cusp.

Criteria used for the DAI[22]

Absence of incisor, canine and premolar

We considered the number of permanent incisors, canines and premolars absent in the upper and lower arches. In this index, 10 teeth must be present in each arch, so if there are less than 10, the difference is the number of absences. The absence history of all anterior teeth was verified in order to really know if extractions were made with esthetic purpose. The teeth were not recorded as missing if the spaces were closed; if a primary tooth was in the position of his successor that had not yet erupted; or if an absent incisor, canine or premolar were replaced with fixed prostheses.

Crowding in the incisor region

The incisors region of the upper and lower arches were examined for verification of crowding. The crowding in the incisor region is the condition in which the space between the right and left canine is insufficient to accommodate all four incisors in normal alignment. The crowding in the incisor region was recorded as follows:

0 = No crowding.
1 = Only one region with crowding.
2 = Both regions with crowding.

Spacing in the region of incisors

For this condition the upper and lower arches were considered. As determined, when it is measured in the incisor region, spacing represented the condition in which the total available space between the right and left canines exceeds the required space to accommodate all four incisors in normal alignment. If one or more incisors had an interproximal surface without interdental contact, the region was recorded as having spacing. The space created because of a recently exfoliated deciduous tooth was not considered, if it was clear that the replacement by the permanent tooth would happen soon. The record considered:

0 = Without spacing.
1 = One region with space.
2 = Both regions with spaces.

Diastema

The space in millimeters between the contact points of the mesial surfaces of maxillary central incisors were considered.

Anterior jaw misalignment

We considered the positions and rotations in relation to normal alignment of teeth for the four incisors in the upper jaw. The misalignment location between adjacent teeth was measured by the IPC periodontal probe. The probe point was

placed in contact with the tooth's buccal surface that is positioned more lingually or rotated while the probe is maintained in a direction parallel to the occlusal plane and in a 90 degrees angle to the normal arch line. The misalignment in millimeters was estimated by the probe marks.

Anterior mandibular misalignment

The measurement was considered as described for the upper arch.

Anterior maxillary overjet

Was measured as the horizontal relationship between the upper and lower incisors with the teeth in centric occlusion. The distance between the labial-incisal edge of most prominent maxillary incisor and the incisor buccal surface was measured with the corresponding periodontal probe parallel to the occlusal plane. For edge to edge incisor occlusion, the score was considered zero.

Anterior mandibular overjet

The mandibular overjet was recorded when a lower incisor presented with anterior or buccal protrusion in relation to the opposite upper incisor, or in crossbite. The measurement was performed in the same manner as for the upper arch.

Vertical anterior open bite

Was considered as the lack of vertical overlap between any opposing incisor pair with the measurement performed with the periodontal probe.

Anteroposterior molar relationship

Evaluation often based on the upper and lower first permanent molar relationship. When the evaluation could not be made based on the first molars, due to the absence of these teeth or other reasons (dental cavity, incomplete eruption), the relationship between canines and premolars was assessed. The right and left sides were evaluated with the teeth in occlusion and only the largest

deviation from the normal molar relationship was recorded, considering the indexes:

0 = Normal.

1 = Half cusp: The first molar displaced half cusp mesial or distal to the normal occlusal relationship.

2 = One cusp: The first molar displaced a whole cusp or more to the mesial or distal of normal occlusal relationship.

Regression equation to calculate the DAI score

(visible missing teeth x 6) + (crowding) + (space) + (diastema x 3) + (anterior maxillary misalignment) + (anterior mandibular misalignment) + (anterior maxillary overjet x 4) + (anterior mandibular overjet x 4) + (anterior vertical open bite x 4) + (anteroposterior molar relationship x 3) + 13

For the diagnostic criteria maintenance, tests were performed in duplicate in 67 children (9.13% of total sample). Regarding Angle's Classification, the results were identical. There were three differences in the Dental Aesthetic Index for the 402 measurements performed in these children using a ICP probe, where the error was 1 mm in all of them, resulting in error rate of 0.7462%, which was disregarded (error smaller than 1.00%).

Malocclusion severity	Treatment need	DAI Score
Without abnormality or mild malocclusion	Little or no need	≤ 25
Defined malocclusion	Elective	26 to 30
Severe malocclusion	Highly desirable	31 to 35
Very severe or disabling malocclusion	Indispensable	≥ 35

TABLE 1 - Standard DAI values distribution, according to the malocclusion severity.

Table 1 shows the correlation index, malocclusion severity and treatment need, according to DAI.

After the examinations were done, a database was created using the EPI-INFO software version 6.04 for Windows, produced by Center for Disease Control and Prevention (CDC), Atlanta, Georgia, USA, in collaboration with the World Health Organization. Then statistical analysis was performed using Chi-square test to compare the sensitivity of the indexes, Angle's classification and DAI, in malocclusion diagnosis (scores obtained in DAI versus Angle's classes).

RESULTS

Considering the Angle classification of 734 examined children, 244 (33.24%) had normal occlusion (139 females and 105 males) and 490 (66.76%) had malocclusion (288 females and 202 males) according to classes shown in Table 2.

Among the 210 infants who had Class II malocclusion, 193 (91.9%) was registered as Division 1 and 17 (8.1%) as Division 2.

The Tables 3, 4 and 5 show the examined children's pattern according to the DAI. Tables 6 and 7 show the comparative result between the Angle classification and DAI.

TABLE 2 - Malocclusions distribution in 12 years old schoolchildren, according to Angle classification in the city of Lins, SP, 2002.

Malocclusions	Number	%
Normal occlusion	244	33
Class I	274	37.3
Class II	210	28.6
Class III	6	0.8
TOTAL	734	100

TABLE 3 - Distribution of orthodontic treatment need in 12 years old schoolchildren, according to the Dental Aesthetic Index (DAI) in the city of Lins, SP, 2002.

DAI score	Severity	Treatment need	n	%
≤ 25	Without abnormality or mild malocclusion	Little or no need	479	65.26
26 to 30	Defined malocclusion	Elective	94	12.81
31 to 35	Severe malocclusion	Highly desirable	80	10.90
≥ 35	Very severe or disabling malocclusion	Indispensable	81	11.03
TOTAL			734	100

TABLE 4 - Distribution of dentition, occlusion and space components, according to the Dental Aesthetic Index (DAI) in schoolchildren in the city of Lins, SP, 2002.

DAI components	Presence		Absence	
	n	%	n	%
DENTITION				
Upper tooth loss	1	0.14	733	99.86
Lower tooth loss	1	0.14	733	99.86
SPACE				
Crowding	245	33.38	489	66.62
Spacing	83	11.31	651	88.69
Diastema	64	8.72	670	91.28
Maxillary misalignment	174	23.71	560	76.29
Mandibular misalignment	258	35.15	476	64.85
OCCLUSION				
Anterior maxillary overjet	278	37.87	456	62.13
Anterior mandibular overjet	8	1.09	726	98.91
Anterior open bite	25	3.41	709	96.59

TABLE 5 - Distribution of molar relationship component according to the Dental Aesthetic Index (DAI) in schoolchildren from the city of Lins, SP, 2002.

Molar relationship	n	%
(0) Normal	518	70.57
(1) Half cusp	57	7.77
(2) One cusp	159	21.66
TOTAL	734	100

TABLE 6 - Dental Aesthetic Index (DAI) association with normal occlusion and Angle classification in schoolchildren of the city of Lins, SP, 2002. ($x^2 = 150.51$, p <0.0001 for the comparison of DAI scores versus Angle classification).

DAI score	Normal Occlusion		Angle's Class I		Angle's Class II		Angle's Class III		TOTAL	
	n	%	n	%	n	%	n	%	n	%
≤ 25	244	50.94	192	40.08	39	8.14	4	0.84	479	100
26 to 30	0	0	44	46.81	49	52.13	1	1.06	94	100
31 to 35	0	0	25	31.25	54	67.50	1	1.25	80	100
≥ 35	0	0	13	16.05	68	83.95	0	0.00	81	100
TOTAL	244	-	274	-	210	-	6	-	734	-

TABLE 7 - Dental Aesthetic Index (DAI) value 13 score distribution in Normal Occlusion and within the Angle Classification in schoolchildren in the city of Lins, SP, 2002.

DAI score	Normal occlusion		Angle's Class I	
	n	%	n	%
13	244	91.73	22	8.27

DISCUSSION

In 734 children examined using Angle's classification, 244 children (33.24%) with normal occlusion and 490 children (66.76%) with malocclusion were found. In the individual study of each class of malocclusion proposed by Angle and using the ratio test, it was verified that Class I (55.92%) was higher than Class II (42.86%) which was larger than Class III (1.22%), this difference was statistically significant (Table 2). These results have sustainability in the international literature.[5,6,26,29]

Using the Dental Aesthetic Index (DAI), 479 children (65.26%) without abnormality or with mild malocclusion were found. The defined malocclusion was found in 94 children (12.81%), severe malocclusion was observed in 80 children (10.90%) and very severe or disabling malocclusion in 81 children (11.03%) (Table 3). Several authors obtained similar results,[1,12,15,20,21] however others[16,25] obtained different results, because the defined malocclusion, severe and very severe, were higher than the mild or absent malocclusions. Still analyzing Table 3, more than half of children (65.26%) had no treatment need or slight need, indicating elective treatment for 12.81% of them, highly desirable to 10.9% and essential to 11.03%. Other surveys have highlighted the need to treat around 50%[2] and in the city of Recife (Brazil) also using the DAI, the need to treat was demonstrated in 77%, but at the age of 13 to 15 years.[17]

In relation to the dentition anomalies two cases of absence of lateral incisors were registered, one case in the upper arch and other in lower arch (Table 4). This condition was the lowest found in this study and corroborates with some works.[20,21] Regarding the condition of space and occlusion, anterior maxillary overjet was the change more frequently observed (278 children = 37.87%), the second was mandibular misalignment (258 children = 35.15%), that was followed by crowding in the incisor region (245 children = 33.38%). The DAI component which had the lowest frequency (Table 4) regarding space and occlusion anomalies was anterior mandibular overjet (8 children = 1.09%), as found in others surveys.[16,20,21,23] Previous observations using the DAI already showed dental crowding in 37%, maxillary overjet in 37.5%, and teeth absence and mandibular overjet in low frequency in children aged 10 to 14 years old.[18]

According to previous evidences,[9,23] also in this study, most children (70.57%) presented normal anteroposterior molar relationship and a smaller portion (29.43%) characterized deviation

from normal molar relationship (Table 5).

The statistical analysis demonstrated that the considered indexes in this study had the same sensitivity (X^2 = 150.51, p <0.0001) for malocclusion diagnosis (Table 6). In descriptive terms, from 479 children with mild malocclusion or without abnormality in the DAI, 50.94% were classified as normal occlusion, 40.08% as Angle's Class I, 8.14% as Angle's Class II and 0.84% as Angle's Class III, which suggested a diagnostic sensitivity difference between the methods. Of the 94 children with defined malocclusion by the DAI, 46.81% were classified as Class I Angle's malocclusion, 52.13% as Class II Angle's malocclusion and 1.06% as Class III Angle's malocclusion.

Considering the 80 children with severe malocclusion, by the DAI, 31.25% were classified as Class I Angle's malocclusion, 67.50% as Class II Angle's malocclusion and 1.25% as Class III Angle's malocclusion. Considering the 81 children with very severe or disabling malocclusion, by the DAI, 16.05% were classified as Class I Angle's malocclusion and 83.95% as Class II Angle's malocclusion, showing a good correlation between the indexes considered in the data analysis.

Naturally, according to the technique principles, in the regression equation used to calculate the values for the standard DAI, a constant value of 13 is added—therefore all the cases considered as normal occlusion in this index, had a score of 13. Of the 266 children with the DAI 13 value, the vast majority (244 or 91.73%) were classified with normal occlusion in Angle's classification, but 22 (8.27%) of them, were positioned as Class I Angle's malocclusion (Table 7). These children had posterior crossbite and/or posterior open bite and/or deep bite, situations that are not evaluated in the DAI. These factors may have a considerable impact on diagnosis of orthodontic treatment needs, which may impair the index validity.

Of the 6 children with Angle's Class III malocclusion, four were, according to the DAI, without abnormality or with mild malocclusion, one with slight malocclusion and one child with severe malocclusion. Out of these, 50% had lower anterior overjet and when in centric occlusion the incisors occluded edge to edge, so there is more disagreement in the ranking, while the majority of cases found in Angle's Class III malocclusion didn't fit, in the DAI distribution, in the real severity of the malocclusion.

With the DAI, the WHO attempted to create an easy index, universally accepted and that could be used in epidemiologic research to establish the orthodontic treatment need and the priority of orthodontic care in public programs. This index has the characteristic of being measurable, objective, simple and easy to use, but regarding the results obtained in this study, it wasn't sensitive to some occlusion problems. Another factor that limits this index is the fact that it was developed for the permanent dentition, therefore inadequate for the deciduous and mixed dentition, being unable to identify malocclusion cases in its early stages, which hampers the prevention and early treatment.[17,24]

Angle's classification has limitations too, because the first upper permanent molar is not stable in the craniofacial skeleton. It is based only on the positioning of teeth, not elucidating bone and muscular aspects, in addition, it only considers the sagittal changes disregarding the vertical or transversal alterations.[13] Angle's classification feasibility and reliability for epidemiological studies has been questioned because it is a qualitative method and not a malocclusion quantitative index.[27] Despite these factors, over time and in order to overcome the technique limitations, problems such as anterior and posterior crossbite, anterior and posterior open bite and upper and lower crowding, diastemas, individual tooth malposition, overjet and overbite were subjected to additional studies with their own classification criteria.[14]

As an example, the DAI could also receive modifications in order to overcome limitations. A critical analysis of several methods of malocclusion registration showed that it was not yet proposed an ideal classification that could be used as standard in the malocclusion studies.[27]

CONCLUSIONS

- The malocclusions (66.76%) were more prevalent than the normal occlusion (33.25%) and the Class I malocclusion prevailed among them (55.92%).
- In the DAI the item "no abnormality or mild malocclusion" (no need or slight need of treatment) was found in most children (65.26%).
- The anterior maxillary overjet was the alteration observed with greater frequency.
- Most of the children had normal molar relationship (70.57%).
- Not all children with a DAI score of 13 (no abnormality) in fact, have normal occlusion because they had abnormalities that this index doesn't identify.
- The majority of cases with Angle's Class III malocclusion were classified in the DAI in treatment needs non-consonant with the severity of the problem.
- The DAI was not sensitive to some occlusion problems, when it was compared with Angle's classification.
- The differences found in both indexes exposes the alternative of using them in a mutually complementary form.

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