

# Orthodontic treatment need and occlusal traits in the early mixed dentition among 8-9-year old Saudi children

## Purpose

The present study aimed to assess the prevalence of occlusal traits and to evaluate the orthodontic treatment need among children aged 8-9 years in Al Ahsa, Eastern region of Saudi Arabia.

## Materials and Methods

A descriptive cross-sectional study was conducted among 282 Saudi children who were randomly selected from those visiting dental outpatient clinics at the College of dentistry in King Faisal University, AlAhsa. All the children were evaluated using the DHC and AC components of Index of Orthodontic Treatment Need (IOTN). Descriptive statistics, chisquare test and Fisher's Exact test were used for data analysis with statistical significance set at  $p < 0.05$ .

## Results

The most prevalent malocclusal trait was crowding (39.7%) followed by increased overjet (28.4%). About 30.9% and 17% of the children were in definite need for orthodontic treatment according to DHC and AC of IOTN, respectively. There was no statistical difference in the distribution of DHC ( $p=0.116$ ) and AC ( $p=0.177$ ) scores between the gender.

## Conclusion

This study demonstrated high percentage of malocclusal traits and orthodontic treatment need in the mixed dentition period among 8-9-year-old children in the Eastern region. Emphasis should be placed on early orthodontic screening and treatment in the mixed dentition stage of dental development.

**Keywords:** Children, index of orthodontic treatment need, malocclusion, mixed dentition, prevalence

## Introduction

Tooth position and occlusion in permanent dentition is determined by the transition of discrepancies from deciduous dentition to permanent dentition through the mixed dentition period. Hence early detection of various occlusal traits in the mixed dentition that influence the development of malocclusion of the permanent dentition is essential. Several orthodontic indices are available in the literature for the assessment of malocclusions such as the Index of orthodontic treatment need (IOTN), peer assessment rating index, Index of complexity, outcome and need (ICON), and Index for preventive and interceptive orthodontic treatment needs (IPION) (1-4). Among these IOTN has been the most widely used index to assess the orthodontic treatment needs in children. It consists of two separate components: Dental Health Component (DHC) and Aesthetic Component (AC). The DHC is the objective component and includes five grades of treatment need, which records the severity of the malocclusion using specific occlusal traits. The IOTN-AC is the subjective component

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and consists of a 10-point scale illustrated by a series of intraoral frontal colour photographs showing different levels of dental attractiveness. It measures the patient's perception of presenting malocclusion and treatment needs through visual assessment (1).

Several observational studies pertaining to occlusal traits of the mixed dentition have confirmed that the occlusal features vary among different populations and ethnic groups (5-9). Most studies conducted on the prevalence of malocclusal traits and orthodontic treatment need in Saudi Arabia were limited to Northern, Central, Western and Southern regions (10-13). To our knowledge, no such data in the literature seems to be available in the population of Eastern region of Saudi Arabia. So, this study was carried out to evaluate the distribution of occlusal traits and orthodontic treatment need in early mixed dentition of 8-9-year-old children of Al Ahsa, in the Eastern region of Saudi Arabia. The null hypothesis tested in this study is that no difference could be found in the distribution of DHC and AC scores between the gender.

## Materials and Methods

### *Ethical statement*

The present study was approved by the Research Ethics Committee of the King Faisal University (Registration number: KFU-REC/2020-11-24). This study was designed according to the guidelines of Helsinki declaration and the informed consent was obtained from all study participants.

### *Sample size estimation*

No previous study on the prevalence of orthodontic treatment need in mixed dentition in Eastern Saudi Arabia is available, and so the sample size was estimated at 50% prevalence with 5% precision and a confidence level of 90%. The minimum number of subjects needed for this study was 270. Convenience sampling technique was used to enroll the study sample. Random dates were chosen, and all children aged 8-9 years presenting at the clinics on the day of the study were invited to participate in the study. Child age at the last birthday was considered as the child age at time of examination.

### *Study design*

This descriptive cross-sectional study included children aged 8-9 years, seeking routine dental care in the dental outpatient clinics at college of dentistry in King Faisal University, AlAhsa, during the period extended from January to October 2020. The present study is the first in a series of investigations analysing the prevalence of occlusal traits and orthodontic treatment need in mixed dentition. Participation in the study was voluntary, and no child was refused a consultation. Study sample included Saudi nationality children, of both genders, aged 8-9 years with presence of erupted first permanent molars in the early mixed dentition, and with a written informed consent signed by their parents or guardians. The exclusion criteria were subjects who were non-cooperative, not able to be guided to have a stable occlusion

or having incomplete data collection, had developmental anomalies, systemic diseases, or craniofacial anomalies and those with history of previous orthodontic treatment. A total of 305 children were invited to participate in the study. After applying exclusion criteria, 23 children were excluded, and the final sample consisted of 282 children.

### *Data collection*

Clinical examinations were conducted under strict infection control protocol as outlined by the Centers for Disease Control and Prevention were used (14). Each subject was examined using disposable surgical gown and gloves, a face mask, face shield, disposable examination kit and a sterile periodontal probe. The malocclusal traits in the dental examination was predefined and included crowding, anterior spacing, molar relationship, overjet, overbite, open bite and crossbite. Overjet was recorded as normal (0-3mm), increased (>3.5mm), and was measured by periodontal probe from labial surface of the most protruded lower incisor to labial surface of the most protrude upper incisor. Overbite was measured based on the amount of overlap of lower incisors by the upper incisors in vertical dimension. If the overbite was one-third, it was recorded as normal and more than two-thirds were considered a deep bite. If an overbite is zero, it would be edge-to-edge; in the case of no contact between the upper and the lower anterior teeth, it would be considered an open bite. The sagittal molar relationship was recorded according to Angle in habitual inter-cuspitation position. Any deviations from Angle class I relation of half cusp widths or more were recorded as class II or III molar relation. Transverse anomalies included anterior crossbite (upper incisors occluded lingual to lower incisors) and posterior crossbite (two or more lower posterior teeth occluded buccal to their opposing teeth). The children who presented one or more of the following indications were registered as malocclusion: increased overjet (>3.5mm), Angle class III, anterior crossbite, deep overbite (>2/3 overlap), open bite, posterior crossbite, anterior or posterior crowding (>2 mm), and anterior spacing (>4 mm) (15). The highest numerical values of the malocclusion severity were recorded.

The DHC component of the IOTN has been grouped into five grades, where Grades 1-2 represent no or little need for treatment; Grade 3-borderline or moderate need for treatment; and Grades 4-5 represent severe/extreme need for treatment. The IOTN-AC is composed of ten photographs representing different severity and attractiveness levels of anterior malocclusion. It has 10 grades; grades 1-4 represent no/slight need, grades 5-7 represent borderline/moderate need, and grades 8-10 represent severe/extreme need for orthodontic treatment (16). The subjects observed their teeth in the mirror and compared them with one of the ten levels of AC.

### *Observers' agreement*

Two experienced and calibrated examiners, working blind to each other's findings, conducted the examination and recorded the scores. 10% of the cases were randomly selected and re-examined after one-week interval. The intra-examiner and inter-examiner agreements evaluated using the

weighted kappa statistic were found to be 0.87 and 0.89, respectively.

*Statistical analysis*

The data was entered in Microsoft excel spreadsheet and subjected to statistical analysis by using the Statistical Package for the Social Sciences (IBM SPSS v.20 software for Windows IBM Corp, Armonk, NY, USA). Descriptive statistics and frequencies were ascertained. The chi-square test and fisher's exact test were used to detect any statistical differences between the gender. Chi-square and Fisher's exact test (where necessary) were used to compare the frequencies of occlusal traits. The confidence interval was set to 95% and *p* values of less than 0.05 were considered statistically significant.

**Results**

The final study sample included 282 children (146 males and 136 females) with a mean age of 9.08±0.32 years (Mean±SD). Gender distribution of the IOTN-DHC grades revealed that majority of cases (43.3%) were in the no/slight need of treatment category followed by 30.9% of the cases that required severe/extreme need for orthodontic treatment, and moderate/borderline need (25.8%) respectively (Table 1). According to the IOTN-AC grades, only 17% of the cases fell in the severe/extreme need of treatment. Most cases were in the no/slight need of treatment (53.9%) followed by moderate/borderline need category (29.1%) (Table 2). There were no statistically significant gender differences in both the DHC (*p*=0.116) and AC grades (*p*=0.177).

The prevalence of individual malocclusal traits in the study sample is shown in (Table 3). Crowding was the most frequent trait (39.7%) followed by increased overjet (28.4%) and overbite (16.3%). Angle Class I molar relation was observed in 75.2% followed by 23.4% in Angle class II and 1.4% in class III molar relation, respectively (*p*=0.256) (Table 4). Statistically significant difference was only seen between the genders in the frequency of crowding (*p*=0.020). Despite females showing more tendency to increased overjet in comparison to males, the difference was not significant (*p*=0.123).

**Table 1.** Frequency of the dental health component of the IOTN by gender.

IOTN DHC (Grades)	Gender		Total	p-value
	Male, N (%)	Female, N (%)		
No/Little need (1-2)	68 (46.6%)	54 (39.7%)	122 (43.3%)	0.116
Borderline need (3)	41 (28.1%)	32 (23.5%)	73 (25.8%)	
Definite need (4-5)	37 (25.3%)	50 (36.8%)	87 (30.9%)	
Total	146 (51.8%)	136 (48.2%)	282 (100.0%)	

**Table 2.** Frequency of the aesthetic component of the IOTN by gender.

IOTN AC (Grades)	Gender		Total	p-value
	Male, N (%)	Female, N (%)		
No/Little need (1-4)	82 (56.2%)	70 (51.5%)	152 (53.9%)	0.177
Borderline need (5-7)	45 (30.8%)	37 (27.2%)	82 (29.1%)	
Definite need (8-10)	19 (13.0%)	29 (21.3%)	48 (17.0%)	
Total	146 (51.8%)	136 (48.2%)	282 (100.0%)	

**Table 3.** Distribution of occlusal traits among the study sample. Percentage values of variables in the table include those registered only as malocclusion. aChi-square test; bFisher's Exact test \*Gender difference was present only for crowding (*p*<0.05).

	Total n (%)	Male n (%)	Female n (%)	p-value
Crowding (>2mm)	112 (39.7%)	48 (32.9%)	64 (47.1%)	0.020 <sup>a*</sup>
Overjet (>3.5mm)	80 (28.4%)	34 (23.3%)	46 (33.8%)	0.123 <sup>b</sup>
Overbite (>2/3 <sup>rd</sup> overlap)	46 (16.3%)	25 (17.1%)	21 (15.4%)	0.736 <sup>b</sup>
Anterior crossbite	40 (14.2%)	20 (13.7%)	20 (14.7%)	0.865 <sup>b</sup>
Anterior spacing (>4mm)	20 (7.1%)	8 (5.5%)	12 (8.8%)	0.354 <sup>b</sup>
Posterior crossbite	17 (6.0%)	9 (6.2%)	8 (5.9%)	1.000 <sup>b</sup>
Anterior open bite	12 (4.3%)	5 (3.4%)	7 (5.1%)	0.736 <sup>a</sup>

**Table 4.** Distribution of Angle's molar relation among the study sample. \*pearson chi-square test.

Gender	Class I n (%)	Class II n (%)	Class III n (%)	p-value*
Male (n=146)	115 (78.8%)	30 (20.5%)	1 (0.7%)	0.256
Female (n=136)	97 (71.3%)	36 (26.5%)	3 (2.2%)	
Total (n=282)	212 (75.2%)	66 (23.4%)	4 (1.4%)	

**Discussion**

Children in the age group of 8-9 years are in early mixed dentition stage during which early intervention is possible through preventive and/or interceptive orthodontic procedures which could reduce the complexity and cost of the orthodontic treatment done at later stages. Index for preventive and Interceptive Orthodontic Needs (IPION) has been developed and tested to determine the treatment needs

specifically in mixed dentition. However, studies found that it has limitations, as it lacks sensitivity, related to choosing cases specific for preventive or interceptive orthodontics (17). IOTN was used in the present study as the validity and reliability of this index has been verified in previous studies (18-20).

In our study, with regards to IOTN-DHC, about 30.9% of children have been found to require definite orthodontic treatment need which was higher than that reported in previous studies conducted in Saudi Arabia (19,20). Another study by Alharbi (12) had reported a higher definite orthodontic treatment need compared to that seen in the present study. However, results of these studies cannot be compared to our study as they were conducted in a different and/or wider range of age group than in our study. To our knowledge, this is the first study conducted in early mixed dentition of Saudi children and as such comparison of results from the present study with those of similar population group was limited.

Similar to our finding, Steinmassil *et al.* (7) reported that 30.6% of 8-10-year-old Austrian children were in definite orthodontic treatment need. Studies conducted in similar age group from other countries showed comparatively lower rates of definite need of orthodontic treatment (9,21). Nur Yilmaz *et al.* (8) had reported that 45.9% of 7-8-year-old and 56.9% of 9-10-year-old Turkish children showed definite orthodontic treatment need which was higher than that reported in our study.

The IOTN-AC score of severe/extreme treatment need (17%) seen in this study was higher than that reported in Turkish children from a similar age group but was much lower than that found in a previous study on Saudi children by Alharbi (42.94%) (8,12), although the age of the examined children was different. In the present study, 53.9% of children did not think they needed orthodontic treatment as they rated themselves being in IOTN-AC categories 1-4, despite a substantial score (56.7%) in the IOTN-DHC grade 3 and 4 categories. This was found to be much lower than that seen in Turkish study (84.5%) conducted on subjects in similar age group (8). Recent studies on older children from other regions of Saudi Arabia found that 17.9% of children, did not express any desire for orthodontic treatment (12). The differences in these results could be attributed to the fact that the AC component is based on self-perception of subjects, whereas the DHC includes objective analysis of occlusal characteristics of the dentition. Moreover, variable perception of attractiveness between the patients and clinicians, and those among different cultures or population groups has been ascribed to high discrepancies in treatment needs between the DHC and AC of IOTN. Furthermore, variations in study criteria, design and sample selection in different studies might contribute to conflicting results (22).

There were no statistically significant differences seen in the present study between the gender and orthodontic treatment needs which corroborates with most studies in the literature. Despite not being a precise indicator of self-evaluation, IOTN-AC can be used to reflect the subjective self-perceived treatment need (23). Furthermore, as school children may or may not be aware of their clinical malocclusion, studies on this population group may not reflect the subjective perception of aesthetics.

Most studies in the literature explored the incidence of malocclusal traits, whilst the present study focussed on traits that contributed to the severity of the case. The most prevalent malocclusal trait recorded in the present study was crowding (39.7%) followed by increased overjet (28.4%), which is similar to that seen in previous studies on different age groups in Saudi Arabia (12,19), and in other middle east countries (22,24). Our study presented a slightly higher value of increased overjet (28.4%) when compared to other studies in the literature which had reported prevalence rates ranging between 7.1% to 21.8% in Saudi Arabia (10,19,20). Contrary to this, elevated rates of 55.12% and 44.6% for increased overjet have been reported in studies on Romanian and Nigerian children respectively (21,25). Alajlan *et al.* (20) in their study on Saudi children found deepbite (16.2%) to be the most commonly occurring occlusal trait, which is almost similar to that seen in our study (15.4%). However, other authors had reported a lower rate of 8.6% of deepbite in 8-9-year-old male Saudi children (10). Whilst anterior crossbite was seen in 14.2% of our sample, most studies in other regions of Saudi Arabia had showed prevalence values ranging from 2.80%-11.76% (11,12). On the contrary, studies by Fatani *et al.* (9) and Rapeepattana *et al.* (26) had reported higher values of 22.3% and 18.98% respectively (9,26).

Majority of authors had reported anterior spacing to have occurred in the range of 16.1% - 27.2% (19,26). This is in contrast to our study where only 7.1% of the sample was found to have anterior spacing to be considered as malocclusion. Anterior open bite (4.3%) and posterior crossbite (6%) were the least common traits recorded in this study which corroborates with the finding of other studies (10-12,19). In the present study, Angle class I molar relation was the most frequent finding (75.2%), followed by class II (23.4%) and only a small percentage of class III molar relation (1.4%). Another recent study conducted in 7-12-year-old children of northern Saudi Arabia reported almost similar results including class I (70.4%) and Class II (21.3%) except that Class III molar relation (8.3%) showed higher values than in our study (20). Other studies in children of similar age reported values of 78.7% (9) and 82.2% (25) for Angle class I molar relation, and between 12.9% (25) and 35.9% (21) for class II molar relationship. The frequency for Angle class III molar relationship in our study (1.4%) was lower than most studies reported in the literature and varies between 2.5% and 7.7% (7,21,25). No Statistically significant differences between the gender and recorded malocclusal traits was found, except that the females showed tendency to more crowding ( $p=0.020$ ) in the present study. Variations in the results of the prevalence of malocclusion traits could be related to differences in ethnicity, criteria of study design, sample size and age groups under investigation. In addition, the role of genetic, environmental, and socio-behavioral factors in the development of malocclusion should be further investigated in Saudi Population.

One limitation was that the present study was an institution-based one conducted at a single centre, in a specific age group on a limited sample size which could affect the generalizability of the findings. During the transition of mixed dentition to permanent dentition, transient malocclusions might be spontaneously corrected, depending on the aetiology and severity. Therefore, the final orthodontic treatment needs in permanent dentition might vary. Early

orthodontic screening and treatment during mixed dentition period might reduce the need for complex treatment at later stages and could pose a huge challenge with regard to implementation and management of resources, especially in Saudi Arabia, owing to its public health system funding for orthodontic treatment.

## Conclusion

The present study demonstrated that a high percentage of the 8-9-year-old children were in need of orthodontic treatment need. Crowding and increased overjet were the most common occlusal traits defining the DHC component. No difference between the genders was found with regard to DHC and AC scores. Further research to assess the prevalence of malocclusion in the mixed dentition and need for early orthodontic treatment using larger samples is recommended. Additionally, emphasis should be placed on establishing effective policies to prevent the occurrence of malocclusion.

**Türkçe Özet:** 8-9 yaş aralığında bulunan Suudi çocuklarda erken karma dişlenme dönemindeki oklüzal özellikler ve ortodontik tedavi ihtiyacı Amaç: Doğu vilayetindeki Suudi çocukların oklüzal özellikleri ile ortodontik tedavi ihtiyacına ilişkin epidemiyolojik veriler yetersizdir. Bu çalışma Suudi Arabistan'ın Doğu bölgesinde bulunan AlAhsa'da yaşayan ve yaş aralığı 8-9 olan çocukların oklüzal özelliklerinin prevalansını ve ortodontik tedavi ihtiyacını değerlendirmeyi amaçlamaktadır. Bireyler ve yöntem: AlAhsa, Kral Faysal Üniversitesi Diş Hekimliği Fakültesi diş polikliniklerini ziyaret eden hastalardan rastgele seçilen 282 Suudi çocuk hasta arasında tanımlayıcı kesitsel bir çalışma yürütülmüştür. Tüm çocuklar Ortodontik Tedavi İhtiyacı İndeksi'nin (IOTN), DHC ve AC bileşenleri kullanılarak değerlendirilmiştir. Veri analizi için tanımlayıcı istatistikler, ki kare testi ve Fisher's Exact testi kullanılmış ve istatistiksel anlamlılık  $p \leq 0.05$  olarak değerlendirilmiştir. Bulgular: En sık görülen maloklüzyon özellikleri çapraşıklık (% 39.7) ve ardından artmış overjet (% 28.4) olarak tespit edilmiştir. Çocukların yaklaşık % 30.9'u ve % 17'sinde IOTN'nin sırasıyla DHC ve AC'sine göre ortodontik tedaviye kesin olarak ihtiyaç duyulduğu tespit edilmiştir. Cinsiyetler arasındaki DHC ( $p = 0.116$ ) ve AC ( $p = 0.177$ ) puanlarının dağılımında istatistiksel olarak anlamlı bir fark bulunmamıştır. Sonuç: Bu çalışmada, Doğu bölgesinde yaşayan ve yaş aralığı 8-9 olan çocukların, karma dişlenme döneminde maloklüzyona sahip oldukları ve ortodontik tedaviye yüksek oranda ihtiyaç duydukları tespit edilmiştir. Diş gelişiminin karma dişlenme döneminde, erken ortodontik tarama ve tedaviye önem verilmesi gerektiği vurgulanmıştır. Anahtar Kelimeler: Çocuklar, ortodontik tedavi ihtiyaç indeksi, maloklüzyon, karışık dişlenme, prevalans

**Ethics Committee Approval:** The study was approved by Research Ethics Committee of the King Faisal University (Registration number: KFUCREC/2020-11-24).

**Informed Consent:** The informed consents were provided by all the participants.

**Peer-review:** Externally peer-reviewed.

**Author contributions:** GSM and SAA participated in designing the study. GSM and SAA participated in generating and gathering the data for the study. SAA and ASA participated in the analysis of the data. GSM wrote the majority of the original draft of the paper. SAA and ASA participated in writing the paper. GSM, SAA, ASA have had access to all of the raw data of the study. GSM has reviewed the pertinent raw data on which the results and conclusions of this study are based. GSM, SAA, ASA have approved the final version of this paper. GSM guarantees that all individuals who meet the Journal's authorship criteria are included as authors of this paper.

**Conflict of Interest:** The authors declared no conflict of interest.

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