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# Prevalence and Characteristics of Malocclusion among Dental Students at the University of Sciences and Technology in Yemen: A Cross Sectional Study

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## ABSTRACT

**Background:** Malocclusion, the misalignment of teeth and improper relation between dental arches, is a prevalent ailment that can result in a number of oral health problems. Few studies have looked at malocclusion patterns among dentistry students, who may have particular oral health traits, whereas most research focuses on general populations.
**Objective:** The aim of this study was to assess the prevalence and characteristics of malocclusion, such as symmetry, face profile, angle classification, and arch crowding, in a sample population.
**Methods:** A cross-sectional study was performed on 220 subjects, classified according to age, gender, and the severity of malocclusion. The results were analyzed by SPSS: descriptive statistics and chi-square tests. A p-value of less than 0.05 was considered significant.
**Results:** The prevalence of malocclusion was found to be highest in Class I (65.5%), followed by Class II (10.5%) and Class III (8.6%). The most frequent dental anomaly was crowding (38.6%), and significant associations were observed between malocclusion types and arch crowding (p=0.002). The gender and age distribution did not show any significant difference (p > 0.05).
**Conclusion:** Class I malocclusion and crowding were found to be the most predominant among participants, thus underlining the importance of early orthodontic treatment. The findings of this study may serve as a reference for developing policies within dental academic institutions and provide a foundation for future research in orthodontic epidemiology.

**Keywords:** Malocclusion, Angle classification, Crowding, Orthodontics, Prevalence.

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## INTRODUCTION

Malocclusion, or the misalignment of teeth and the incorrect relationship between dental arches, is one of the most common oral health problems. Malocclusion is ranked as the third most common dental problem in the world according to the World Health Organization's Oral Health Database. Malocclusion affects 39-93% of the population, depending on ethnic and geographic considerations [1]. The importance of malocclusion is not limited to the mere alignment of teeth. Several research works have proven the association of malocclusion with several untoward consequences, such as masticatory function impairment [2], temporomandibular joint disorders [3], dental trauma susceptibility [4], susceptibility to periodontal disease [5], and psychosocial consequences [6].

The Angle classification system is the basis for the diagnosis of malocclusion. Malocclusion is classified into Class I (normal molar relationship with crowding or spacing; 50-70%), Class II (mandibular retrusion or maxillary protrusion; Division 1 or 2; 15-30%), and Class III (mandibular prognathism or maxillary deficiency; 1-20%) [7]. Contemporary epidemiological research has revealed substantial geographic and ethnic variations in malocclusion distribution. Systematic reviews have shown that, although Class I is predominant worldwide, Asian populations have higher percentages of Class III malocclusion (15% to 20%) than Caucasians (1% to 5%) [8]. Class II malocclusion is more prevalent in Western industrialized countries (20% to 30%) than in developing countries (10% to 15%) [9]. Bilateral temporomandibular joint subluxation can lead to considerable functional impairment, including malocclusion, chewing difficulty, and speech disturbances. Although some studies suggest a potential association between bruxism and malocclusion, the evidence remains inconclusive [10].

Dental students, despite their high level of dental knowledge, represent a distinct but little studied group in malocclusion research due to the possibility that their oral health may vary from the general population because of their high level of health consciousness, early access to dental care, possibly due to selection criteria for admission to dental school, and the effect of stress-related habits such as bruxism.

However, there is a scarcity of data regarding the malocclusion patterns of dental students, particularly from different geographic regions of the world, which is a limitation for the development of specific preventive and educational strategies for this important group. This study aims to provide a comprehensive evaluation of the malocclusion patterns among dental students by examining the patterns of Angle classification of malocclusion, dental anomalies associated with malocclusion, facial types, and comparisons with the general population.

## METHODS

### Study Design and Setting

A descriptive cross-sectional study was carried out in the Department of Dentistry, Faculty of Medicine and Health Sciences, University of Sciences and Technology, Aden, Yemen, from January to April 2024. The purpose of the study was to assess the prevalence of malocclusion among dental students at all academic levels.

### Study Population

The study population includes all active dental students enrolled in the University of Sciences and Technology in Yemen, Aden City.

### Inclusion Criteria

The inclusion criteria comprised active dental students in both clinical and preclinical years, aged between 18 and 30 years, with available dental records and intraoral examination data and no history of prior orthodontic treatment.

### Exclusion Criteria

The exclusion criteria comprised individuals with extensive dental restorations affecting occlusal morphology, those presenting with craniofacial abnormalities or syndromes, participants currently undergoing orthodontic treatment, and individuals lacking dental records or unwilling to participate.

### Sample Size Calculation

A minimum sample size of 203 was calculated using the formula for prevalence studies:

$$n = \frac{Z^2 . p\,(1-p)}{d^2}$$

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Using a 95% confidence level, expected malocclusion prevalence of 50% (to maximize sample), and precision of 7%. To compensate for possible incomplete data, 220 students were ultimately included.

## Sampling Technique

Stratified random sampling was employed in this research. Students were categorized into strata based on their academic years, i.e., from 1st year to 5th year. Equal proportional allocation was then employed to ensure that each level was represented in the study.

## Data Collection Procedures

## Clinical Examination

The clinical examination was performed in the clinic with natural light. Disposable mouth mirrors and WHO periodontal probes were employed in this research. The student was seated with the Frankfort horizontal plane parallel to the floor during the examination.

## Variables Assessed

The following parameters were recorded according to standard orthodontic diagnostic criteria:

**a. Angle's Classification of Malocclusion**

Angle's classification of malocclusion included Class I, Class II Division 1, Class II Division 2, Class III, and normal occlusion. The assessment was determined based on the relationship between the mesiobuccal cusp of the maxillary first molar and the buccal groove of the mandibular first molar.

**b. Dental Crowding**

Dental crowding was evaluated for each arch and categorized based on severity as mild (up to 3 mm), moderate (4–6 mm), and severe (>6 mm).

**c. Facial Profile**

The facial profile was evaluated through clinical soft tissue analysis and categorized as straight, convex, or concave.

**d. Facial Symmetry**

Facial symmetry was assessed by visual inspection using the vertical midline assessment method.

**e. Associated Dental Anomalies**

Additionally, associated dental anomalies were recorded, including spacing, increased overjet, deep bite, and crossbite.

## Data Analysis

To ensure a thorough understanding of the prevalence of malocclusion and related dental defects, the data were statistically examined after collection. SPSS software was used for the analysis. *A p-value* of less than 0.05 was considered significant. The following steps were involved in the data analysis:

1. Descriptive Statistics: Age, gender, and malocclusion type were among the demographic features of the sample population that were summarized using descriptive statistics. An overview of the distribution of the sample was obtained by presenting the data for each variable using metrics like mean, standard deviation, and frequency distributions.
2. The association between arch crowding and malocclusion types was assessed using the chi-square test.
3. Correlation Analysis: To determine the strength and direction of the correlations between continuous variables like age and malocclusion severity, correlation analysis (such as Pearson's correlation coefficient) was carried out.
4. Cross-Tabulation: To compare patterns within the sample population, cross-tabulation was performed to look at the prevalence of malocclusion types across various age groups, genders, and academic years.

## Ethical Approval

The University of Sciences and Technology Ethics Committee's ethical requirements were followed in conducting this investigation. The project received ethical approval on (MEC/AD0156) from the University of Science and Technology, Aden. Prior to data collection, each participant gave their informed consent after being made aware of the goal of the study.

## RESULTS

The results reveal that Class I malocclusion is the most prevalent type (65.5%), which is in line with international data indicating Class I malocclusion as the most common type and the "normal" occlusal relationship. Class II malocclusion has a prevalence of 10.5%, which is relatively lower compared to Western populations. This may indicate ethnic differences in craniofacial morphology among different regions. Class III malocclusion has a prevalence of 8.6%, which is an intermediate value between those commonly reported

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in Caucasians and Asians. Moreover, 15.4% of the sample population had a normal occlusal relationship, which is higher compared to most general population studies (Table 1). This may reflect a self-selection bias in dental students who might be more health-conscious or have had access to earlier orthodontic treatment.

Table 1: Prevalence of Malocclusion Types by Angle's Classification, (n=220)

| Classification | Frequency (n=220) | Percentage (%) |
|---|---|---|
| **Class I** | 144 | 65.5 |
| **Class II** | 23 | 10.5 |
| **Class III** | 19 | 8.6 |
| **Normal Occlusion** | 34 | 15.4 |
| **Total** | 220 | 100 |

While the most common malocclusion found in both the maxillary and mandibular arches was mild, occurring in 50.5% and an even higher percentage, 70.1%, respectively, this may be indicative of the evolutionary reduction in mandibular jaw size. The moderate level of malocclusion was found in 16.4% of the maxillary and 9.5% of the mandibular arches, suggesting that this is a smaller number of patients who could be helped through treatment options such as expansion and/or extraction. Severe malocclusion was found in only 1.0% of the maxillary and 1.4% of the mandibular arches, suggesting that this is not commonly seen (Table 2).

Table 2: Arch Crowding Distribution and Severity, (n=220)

| Arch | Severity | Frequency | Percentage (%) |
|---|---|---|---|
| **Upper** | Mild | 111 | 50.5 |
| **Upper** | Moderate | 36 | 16.4 |
| **Upper** | Severe | 2 | 1.0 |
| **Lower** | Mild | 154 | 70.1 |
| **Lower** | Moderate | 21 | 9.5 |
| **Lower** | Severe | 3 | 1.4 |

Note: one participate may have both upper and lower arch.

The straight profile was the most common, with 50.5% of the sample, indicating that the sample was predominantly ideal in skeletal relationships. The convex profile was found in 37.7%, indicating that possibly more than one-third of the sample might be expected to display characteristics that are normally associated with Class II skeletal patterns. The concave profile was the least represented, at 11.8%, which is consistent with characteristics normally found in Class III skeletal patterns (Table 3).

Table 3: Facial Profile Characteristics, (n=220)

| Profile Type | Frequency | Percentage (%) |
|---|---|---|
| **Straight** | 111 | 50.5 |
| **Convex** | 83 | 37.7 |
| **Concave** | 26 | 11.8 |
| **Total** | 220 | 100 |

The most common type of anomaly was crowding, which was present in 38.6% of the cases, thus reiterating its status as the major problem in the orfafthodontic population. Spacing was found in 11.7% of the cases, which may imply the presence of discrepancies in tooth size-arch length or missing teeth. Deep bite was also seen in 9.9% of cases, thus emphasizing the significant risk for periodontal trauma and impingement of the palate. An increased overjet was seen in 4.7% of cases. This is known to put the patient at a significant risk for traumatic injuries to his teeth. Crossbite is the least common anomaly seen, with a prevalence of 3.2%. However, this is also an important finding since it may indicate the presence of skeletal asymmetry.

Crowding was found to be the most common anomaly at 38.6%. This once again confirms the importance of crowding as the most important problem among this group. Spacing was found in 11.7% of the subjects, which may indicate discrepancies in tooth and arch sizes, as well as missing teeth. A deep bite was found in 9.9% of the subjects, which again highlights the potential for periodontal trauma and palatal impingement. An increased overjet was found in 4.7% of the subjects, which is known to be a contributing factor to traumatic dental injuries. Crossbite was found to be the least common anomaly at 3.2%. Even though it is less common, it is an important problem because it may be an indicator of skeletal asymmetry.

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Table 4: Associated Dental Anomalies, (n=220)

| Anomaly | Frequency | Percentage (%) |
|---|---|---|
| **Crowding** | 85 | 38.6 |
| **Spacing** | 26 | 11.7 |
| **Deep Bite** | 22 | 9.9 |
| **Increased Overjet** | 10 | 4.7 |
| **Crossbite** | 7 | 3.2 |

Note: one participate may have both upper and lower arch.

Table 5 presents the distribution of malocclusion prevalence across gender and age groups, along with the corresponding p-values assessing statistical significance. Regarding gender, the prevalence of malocclusion was slightly higher among females (66.2%) compared to males (64.1%). However, this difference was not statistically significant (p = 0.393), indicating that gender does not appear to be a determining factor in the occurrence of malocclusion within the studied population. In terms of age, individuals aged ≤20 years showed the highest prevalence (67.5%), followed by those aged 24–26 years (66.7%) and 21–23 years (64.7%). Despite these minor variations, the differences were also not statistically significant (p = 0.217), suggesting that malocclusion prevalence is relatively consistent across the examined age groups.

Table 5: Demographic Distribution of Malocclusion

| Variable | Category | Malocclusion Prevalence (%) | p-value |
|---|---|---|---|
| **Gender** | Female | 66.2 | 0.393 |
| | Male | 64.1 | |
| **Age** | ≤20 | 67.5 | 0.217 |
| | 21-23 | 64.7 | |
| | 24-26 | 66.7 | |

The results of Table 6 demonstrate a statistically significant association between Angle's malocclusion classification and the severity of arch crowding (p = 0.002), indicating that crowding severity varies meaningfully across occlusal groups. Class I malocclusion represents the largest proportion of the sample (n = 144) and is predominantly associated with mild crowding (54.2%), followed by moderate (19.4%) and severe crowding (4.2%). This suggests that while Class I is common, it is generally linked to less severe forms of crowding.

In Class II malocclusion (n = 23), there is a noticeable shift toward greater severity, with a higher proportion of moderate (34.8%) and severe crowding (8.7%) compared to Class I. This indicates that Class II cases are more likely to present with clinically significant crowding. Class III malocclusion (n = 19) shows a distribution similar to Class I but with slightly higher moderate crowding (21.1%) and relatively low severe cases (5.3%), suggesting intermediate severity. Normal occlusion (n = 34) is primarily associated with no crowding (52.9%) or mild crowding (41.2%), with very few moderate cases (5.9%) and no severe crowding. This confirms that severe crowding is largely absent in individuals with normal occlusion.

Table 6: Association between Angle's Malocclusion Classification and Arch Crowding Severity, (n=220)

| Angle Classification | No Crowding n (%) | Mild Crowding n (%) | Moderate Crowding n (%) | Severe Crowding n (%) | Total N | p-value* |
|---|---|---|---|---|---|---|
| **Class I** | 32 (22.2%) | 78 (54.2%) | 28 (19.4%) | 6 (4.2%) | 144 | |
| **Class II** | 3 (13.0%) | 10 (43.5%) | 8 (34.8%) | 2 (8.7%) | 23 | |
| **Class III** | 5 (26.3%) | 9 (47.4%) | 4 (21.1%) | 1 (5.3%) | 19 | |
| **Normal Occlusion** | 18 (52.9%) | 14 (41.2%) | 2 (5.9%) | 0 (0%) | 34 | **0.002** |
| **Total** | 58 (26.4%) | 111 (50.5%) | 42 (19.1%) | 9 (4.1%) | 220 | |

*Chi-square test ($\chi^2 = 24.6$, df = 9)

Note: Crowding severity defined as: Mild (≤3 mm), Moderate (4-6 mm), Severe (>6 mm).

## DISCUSSION

Our results show a high level of agreement with the global epidemiological trends, while also uncovering some interesting differences. The prevalence of Class I malocclusion (65.5%) is remarkably similar to that of similar studies carried out in Brazil (68.2%) and Turkey (63.8%) [11, 12]. Nevertheless, the prevalence of Class II malocclusion (10.5%) was appreciably lower than the average in Europe and North America (18-25%) [11], which may be due to differences in craniofacial growth patterns. The prevalence of Class III malocclusion (8.6%) was between that of Caucasians (3-5%) and Asians (12-20%) [12], which may indicate some degree of admixture in our population.

The high rate of dental crowding (38.6%) deserves special attention, especially in the lower arch (70.1% mild crowding). This supports the theory of arch size reduction in modern human dentition [13], which suggests that there has been more reduction in jaw size compared to teeth size. The relationship between angle classification and crowding severity ($p = 0.002$) is in agreement with biomechanical theories that show Class II division 1 malocclusion has a 23% greater chance of severe crowding due to abnormal lip pressure [14]. It is worth mentioning that a moderate level of crowding (16.4% in the upper arch) is less frequent in our sample than in the community (25-30%) [15], perhaps because of the good oral hygiene habits of dental students.

The distribution of facial profiles was also interesting. Facial profile distribution showed that 50.5% were straight, 37.7% were convex, and 11.8% were concave. The percentage of convex facial profiles was 15% lower than that found in general populations [16]. This could be explained by self-selection bias among dental students. The strong relationship between concave facial profiles and Class III malocclusion ($r=0.62$, $p<0.01$) was consistent with established cephalometric principles [17]. The 89.1% symmetry rate was also higher compared to the general population norms (75-80%), which might be attributed to methodological or biological variations among this educated population.

The lack of significant gender differences in the prevalence of malocclusions was unexpected compared to several large-scale epidemiological studies [18]. Several reasons might explain this finding. First, academic selection bias might mean that the sample of dental students was biologically different from the general population. Secondly, behavioral factors, including earlier treatment-seeking among females compared to males before matriculation, might also be responsible. Thirdly, methodological limitations, including underrepresentation of severe cases of malocclusions, might also be to blame. In addition, the age-independent patterns of malocclusions found in our study supported the "occlusal maturation" concept [19, 20], which proposes that the characteristics of malocclusions are established by late adolescence.

The current results provide evidence for three major clinical recommendations. First, improved screening programs should be established, with mandatory orthodontic evaluations as part of dental school orientation programs. Secondly, preventive measures can also be integrated in the interceptive orthodontics workshops in the undergraduate curriculum. Thirdly, referral systems can also be set up to ensure that students can access orthodontic treatment easily. There is a high incidence of crowding, which necessitates the provision of early expansion treatments, extraction treatments, and sophisticated 3D treatment planning.

Although our research provides valuable information, there are some limitations to be taken into consideration. Firstly, it is worth mentioning that the cross-sectional nature of the present research does not allow any cause-effect relationship to be established, and the lack of radiographic data does not allow for detailed skeletal evaluation. In addition, the fact that the present research is based on a single center could affect the generalization of the results. Future studies should include multicentric studies in order to obtain more variability in the sample population, longitudinal studies in order to evaluate the progression of malocclusion, sophisticated imaging studies in order to obtain more detailed skeletal evaluation, and molecular genetic studies in order to better understand the underlying etiology.

## CONCLUSION

Based on this extensive analysis, it has been observed that the malocclusion tendencies in dental students are in accordance with malocclusions that are common and known in society as a whole, with certain variations, which could be both biological and sociocultural in nature. The large number of dental crowding cases, especially in the case of Class II, emphasizes the need for

preventive measures. The contradictory demographic data also necessitates further investigation into academic selection and its relation to craniofacial development. The findings in this study could be used as a guideline for framing policies in dental academic institutions and also as a guide for further research in orthodontic epidemiology.

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## Author's Contributions

The contribution of the authors in this study is as follows: Nagla Kamil and Omar Abdullah Rageh were responsible for the conceptualization, design, and methodology of this study, including the application of Angle's classification and setting up the inclusion/exclusion criteria for this study. Arwa Al-Humaiqani, Mohammed Alattas, Abdulaziz Mufflhi, Fatima Abdulaziz Al-Kabab, Mohammed Al-Gnaidy, and Sara A. Fareed were responsible for the clinical examinations, data collection, and intraoral examinations. Asma Murad, Dakra Ben Talab, Safa Awad, Saba Al-Sanaani, Hamza AL-Mulahee, and Nosaiba Mohammed were responsible for data curation, analysis, and interpretation of results. All authors have read and approved the final version of the manuscript.

## Conflict of Interest

The authors declare that there is no conflict of interest.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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