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Malocclusion in Saudi Arabia: A scoping review

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Abstract

Background: Malocclusion features the third highest prevalence among oral pathologies, second to tooth decay and periodontal disease and therefore rank third among worldwide dental public health priorities.

Objectives: To analyze orthodontic malocclusion in Saudi Arabia and its components including Angle classification, facial profiles, overbite, overjet, crossbite, scissor bite, crowding, spacing, and treatment needs.

Methods: The methods which were used for this review were to search in PubMed database, using specific words "Malocclusion; Angle classification; Facial profiles; Overbite; Overjet; Crossbite; Scissor bite; Crowding; Spacing; Treatment needs; and Saudi Arabia".

Results: Angle's classifications were reviewed showing Class I angle's malocclusion to be the most common type of malocclusion. Facial profiles were investigated which presented straight facial profile to be the most common type of facial profile. Overbite and overjet were revised in literature concluding the norms and abnormalities, which showed different results. Crossbite and Scissor bite were studied identifying their prevalence, which presented variable findings. Crowding and spacing were reviewed recognizing their commonness, which disclosed their high prevalence and impact. Lastly, treatment needs were investigated which presented severe or extreme need to be the most prevalent category in relevance to orthodontic treatment needs.

Conclusion: In Saudi Arabia, orthodontic malocclusion and its components were well-discussed in literature. Malocclusion showed high prevalence and impact on Saudi population.

Keywords: Malocclusion, Angle classification, Facial profiles, Overbite, Overjet, Crossbite, Scissor bite, Crowding, Spacing, Treatment needs and Saudi Arabia

Introduction

Oral health is an important component of general health and is associated with the development of a healthy personality [1]. The importance of aesthetic dental alignment appearance has shown to be an important element in society's acceptance of an individual [2]. In modern times, much focus is laid upon the development of orofacial disorders and treatment of the resulting malocclusions [3]. Malocclusion (or malalignment) is defined as an irregularity of the teeth or a malrelationship of the dental arches beyond the range of what is accepted as normal [4]. Malocclusion features the third highest prevalence among oral pathologies, second only to tooth decay and periodontal disease and therefore rank third among worldwide dental public health priorities [5]. Malocclusion in itself is not a life-threatening condition; however, it may unfavorably affect social interactions and psychological well-being of patients [6]. It often causes psychosocial problems as it affects the aesthetics of the person, disturbances of oral function, such as speech, mastication and swallowing, increased susceptibility to trauma, gingival and periodontal diseases and finally the general health of the individual [7]. The etiology of malocclusion is multifactorial as the dentofacial structure is mainly determined by genetic factors and environmental factors such as habits which might induce malocclusion during growth and development [8]. Furthermore, the prevalence of malocclusion has been reported to vary from nation to nation and among diverse gender and age groups [9]. In Saudi Arabia, various studies investigated malocclusion and its various components [10]. The aim of this study is to review malocclusion statues in Saudi Arabia, by summarizing what is reported in literature using its fundamental components such as Angle classification, facial profiles, overbite, overjet, crossbite, scissor bite, crowding, spacing, and treatment needs.

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Methodology

Systemically reviewing the topic Orthodontic Malocclusion in Saudi Arabia and its components including Angle classification, facial profiles, overbite, overjet, crossbite, scissor bite, crowding, spacing, and treatment needs. The methods which were used for this systemic review were to search in the PubMed database, using specific keywords where were Malocclusion; Angle classification; Facial profiles; Overbite; Overjet; Crossbite; Scissor bite; Crowding; Spacing; Treatment needs; and Saudi Arabia. Inclusion criteria was applied to select articles that discussed the topic orthodontic malocclusion and the following components (Angle classification; Facial profiles; Overbite; Overjet; Crossbite; Scissor bite; Crowding; Spacing; Treatment needs), PubMed indexed, conducted on Saudi population, and published in English language. Exclusion criteria were applied to exclude studies that discussed different aspects of malocclusion, not PubMed indexed, conducted on non-Saudi population, or published in a language other than English. The articles were retrieved, nine papers were identified that matches the inclusion criteria, and were critically appraised and reviewed. Findings of all the nine included studies were presented the result section of this review.

Results

A- Angle's Classification

Rinchuse DJ *et al.*, reported that in the early 1900s, Edward H. Angle classified occlusions using the relationship between the first molars of both arches as the key factor in determining occlusions. The four classes according to Angle's classification are as follows ^[11]. First, normal occlusion: the mesiobuccal cusp of the upper first molar occludes with the buccal groove of the lower first molar. Second, Class I malocclusion: same as normal occlusion but characterized by crowding, rotations, and other positional irregularities. Third, Class II malocclusion: the mesiobuccal cusp of the upper first molar occludes anterior to the buccal groove of the lower first molar. There are two subtypes of Class II malocclusion. Class II, division 1: where upper incisors are proclined or Class II, division 2: where upper incisors are retroclined. Forth, Class III malocclusion: the mesiobuccal cusp of the upper first molar occludes posterior to the buccal groove of the lower first molar. A study conducted in the northern border region of Saudi Arabia by Gudipaneni RK *et al.* ^[12] concluded the most common malocclusions in order of prevalence as Angle's Class I (52.8%), Angle's Class II (31.8%), Angle's Class III (15.4%). Another study conducted by AlQarni MA *et al.* ^[9] in Asser Region of Saudi Arabia suggested that the most common malocclusion to be Angle's Class I representing (75%) population, followed by Angle's Class II (14%) and lastly Angle's Class III (11%). Most of the studies conducted in Saudi Arabia showed similar results in regard to Angle's classification. Class I Angle's classification showed to be the most common type of malocclusion (followed by Class II and then III) which is defined as a normal occlusion but characterized by other malocclusion components such as crowding, rotations, and other positional irregularities. As reported by Jones WB *et al.* ^[13] different alignment of teeth may affect the soft tissue component and contribute to different facial profiles.

B- Facial Profiles

Arnett GW *et al.* ^[14] described the facial profile in different malocclusions according to the angle of facial convexity using three distinct point in the face (Glabella, Subnasale, and

Pogonion). Glabella (G) is the most anterior midpoint on the fronto-orbital soft tissue contour. Subnasale (Sn) is the midpoint on the nasolabial soft tissue contour between the columella crest and the upper lip. Pogonion (Pg) is the most anterior soft tissue midpoint of the chin. A line connecting the three points (G–Sn–Pg) is used to determine the facial profile. The formed line representing facial profile or angle of facial convexity can be described as convex, straight, or concave. A study conducted in the northern border region of Saudi Arabia by Gudipaneni RK *et al.* ^[12] reported that the most common facial profiles determined in the sagittal plane, were the straight facial profile (49.2%), convex (42.6%) and concave (8.2%). Another study conducted by AlBarakati SF *et al.* ^[15] comparing facial profile between Saudi population and European-Americans concluded that "Adult Saudis generally had increased facial convexity associated with retruded mandible, more obtuse lower face-throat angle, increased bimaxillary lip protrusion, greater mentolabial sulcus, decreased vertical lip-chin ratio, and increased maxillary incisor exposure than European-Americans". Also AlBarakati SF *et al.* ^[15] concluded that Saudi females had more obtuse nasolabial angle and decreased lower vertical height-depth ratio than European-American females. Comparisons between the males and females indicated that Saudi females had a reduced lower vertical height-depth ratio, smaller lower lip distance more obtuse nasolabial angle and decreased interlabial gap than males. The significant features in facial structures of Saudis between the genders should be of a great help for diagnosis of orthodontic and orthognathic surgical cases in Saudi adults. As suggested by Arnett GW *et al.* ^[14], facial profile and appearance can be affected by many factors including the relation between maxillary and mandibular teeth. The vertical and horizontal relation between upper and lower anterior teeth is mainly described by the overbite and overjet, respectively.

C- Overbite and Overjet

In regard to overbite, it is described as the extent of vertical (superior-inferior) overlap of the maxillary central incisors over the mandibular central incisors. The normal overbite range is (2-4mm) as reported by Kinaan BK *et al.* ^[16]. A study conducted in the northern border region of Saudi Arabia by Gudipaneni RK *et al.* ^[12] reported that the prevalence of excessive overbite to be (23.4%) and the prevalence of reduced overbite to be (12.2%). Moreover, another study conducted in Riyadh, Saudi Arabia by Asiry MA *et al.* ^[17] concluded that "the majority of the subjects (76%) had overbite with 1-3 mm overlap, while (6.52%) showed 4-6 mm overlap and only (0.16%) with more than 6 mm overbite". Also, Albakri FM *et al.* ^[18] conducted a study in Riyadh, Saudi Arabia reporting that open bite was present in (4%) of the sample while deep bite was present in (9.6%) of the population.

In relevance to overjet, it is described as the extent of horizontal (anterior-posterior) overlap of the maxillary central incisors over the mandibular central incisors. The normal overjet range is (2-4 mm) as reported by Kinaan BK *et al.* ^[16]. A study conducted by Gudipaneni RK *et al.* ^[12] in the northern border region of Saudi Arabia concluded that the prevalence of excessive overjet to be (22.2%) and the prevalence of reduced overjet to be (11.4%). furthermore, Asiry MA *et al.* ^[17] conducted another study in Saudi Arabia, Riyadh which reported that "(10%) of the subjects exhibited negative overjet or edge to edge relationship, (67%) had overjet between 1-3 mm, (15%) had overjet between 4-6 mm, and only (1.2%) had

overjet of more than 6 mm". Additionally, another study conducted in Riyadh, Saudi Arabia by Albakri FM *et al.* [18] concluded that the sagittal relationship of the jaws (overjet) was observed, reversed overjet seen in (2.8%). Normal overjet (0-4 mm) was seen in (75.4%) while a slight increase in overjet (4-6 mm) was found in (15.2%). Severe increase in overjet (6-9 mm) was seen in (6.6%).

D- Crossbite and Scissor bite

As reported by Kutin G, *et al.* [19] crossbite is a form of malocclusion where a tooth (or teeth) has a more buccal or lingual position than its corresponding antagonist tooth in the upper or lower dental arch. In other words, crossbite is a lateral misalignment of the dental arches. In relevance to anterior crossbite. Zietsman ST *et al.* [20] suggested that anterior crossbite can be referred as negative overjet, and is typical of class III skeletal relations (prognathism). The overall prevalence of anterior crossbite in Saudi population is (4.8%) as stated by Gudipaneni RK *et al.* [12]. Additionally, another study conducted by Albakri FM *et al.* [18] found that the anterior crossbite represented (2.8%) of the population. In regard to posterior crossbite, Björk A *et al.* [21] concluded that posterior crossbite as a bilateral or unilateral malocclusion where the buccal cusps of canine, premolar and molar of upper teeth occlude lingually to the buccal cusps of canine, premolar and molar of lower teeth, and often correlated to a narrow maxilla and upper dental arch. The overall prevalence of posterior crossbite in Saudi population is (9.4%) as stated by Gudipaneni RK *et al.* [12]. In addition, another study conducted by Albakri FM *et al.* [18] found that the posterior crossbite represented (6%) of the population, of which (1.4%) was unilateral and (4.6%) was bilateral.

In respect to scissor bite, it is defined by Sakamoto T *et al.* [22] as the buccal displacement of the maxillary posterior teeth, with or without contact between the lingual surface of the maxillary lingual cusp and the buccal surface of the buccal cusp of its mandibular antagonist. It results due to the combination of excessive maxillary width and a narrow mandibular alveolar process [23]. AlQarni MA *et al.* [9] conducted a study in Asser Region of Saudi Arabia reporting that the prevalence of scissor bite to be (5%) of the Saudi population. Another study by Hassan AH *et al.* [24] suggesting scissor bite prevalence to be (10.9%).

E- Crowding and Spacing

Lestrel PE *et al.* [25] defined dental crowding as a discrepancy between tooth size and jaw size that results in a misalignment of the tooth row. Proposed reasons for crowding include excessively large teeth, small jaws, and a combination of both. A study conducted in the northern border region of Saudi Arabia by Gudipaneni RK *et al.* [12] reported crowding present in (47.2%) of patients, while (52.8%) of patients had no crowding. Another study conducted by Al-Hummayani FM *et al.* [26] suggested an overall prevalence of crowding to be (48.8%). Furthermore, AlQarni MA *et al.* [9] conducted a study in Asser Region of Saudi Arabia reporting that crowding prevalence was (40%) and it was more commonly seen in the anterior arch segment than posterior, and this was in agreement with previous studies of the Saudi population. Specifically, Albakri FM *et al.* [18] concluded the prevalence of crowding in Saudi population to be (23.2%) in maxilla and (28%) in mandible.

Ribeiro GL *et al.* [27] defined dental spacing as a dental anomaly characterized by interdental spaces and lack of contact points between teeth. When spacing concerns both

anterior and posterior teeth it is generalized, in contrast to localized spacing when only two or four teeth are involved. Gudipaneni RK *et al.* [12] conducted a study in northern border region of Saudi Arabia reporting spacing to be present in (27.2%) of patients, while (72.8%) of patients had no spacing. Hummayani FM *et al.* [26] conducted another study which suggested an overall prevalence of spacing to be (16.1%). Moreover, a study conducted in Asser Region of Saudi Arabia by AlQarni MA *et al.* [9] reported that spacing prevalence was (42%) which was slightly different that other studies conducted in Saudi Arabia. Precisely, Albakri FM *et al.* [18] concluded the prevalence of spacing in Saudi population to be (11.6%) in maxilla and (8.8%) in mandible.

F- Treatment needs

Hassan AH *et al.* [24] stated that several indices were developed to evaluate malocclusion, such as the IOTN, PAR (Peer Assessment Rating Index) and ICON (Index of Complexity, outcome and Need). IOTN has been used extensively in literature to evaluate actual and perceptive treatment needs in different ethnic backgrounds and it seems to be a more popular research tool compared to other indices. It is a scoring system for malocclusion, developed by Brook & Shaw (1989) [28]. It consists of two independent components; the dental health component (DHC), which is a five-grade index that records the dental health need for orthodontic treatment, and aesthetic component (AC) that records the aesthetic need for orthodontic treatment using a ten-grade standardized ranking scale of colored photographs showing different levels of dental attractiveness. A study conducted in Jeddah, Saudi Arabia by Hassan AH *et al.* [24] reporting that (60.6%) expressed no or slight need for treatment, (23.3%) expressed moderate to borderline need and only (16.1%) thought they needed orthodontic treatment. Comparing these estimates to professional judgments, only (15.2%) conformed to little or no need for treatment, (13.2%) were assessed as in borderline need and (71.6%) were assessed as in need for treatment. Another study conducted by Al- Emran S *et al.* [29] concluding that about 40% were found to need treatment with fixed appliances, and for 33% extraction of permanent teeth would be part of the treatment. Only about 2.5% would benefit from treatment with simple removable appliances. Al-Jobair Am *et al.* [30] conducted a study investigating orthodontic treatment need which suggested that (9.7%) had no/slight need, (13.3%) had moderate/borderline need, and (77%) had severe/extreme need.

Discussion

We aimed in the study to review malocclusion statuses in Saudi Arabia, by summarizing what is reported in literature using its fundamental components such as Angle classification, facial profiles, overbite, overjet, crossbite, scissor bite, crowding, spacing, and treatment needs. Various studies have been reported in the literature from various countries describing the prevalence and types of malocclusion. In spite of this, comparisons of the observation from these studies are difficult because of the variations in the age and size of the study samples and the methodology adapted to record occlusal relationships. The prevalence of malocclusion is reported to vary by country, age and sex. Many studies have been conducted in Saudi Arabia to assess the prevalence of malocclusion [9, 12, 18]. In Saudi Arabia, Class I angle's malocclusion was the most common type of malocclusion [9]. In comparison, in Nigeria 76.5% [31] and

Turkey 74%^[32], a higher percentage of Angle's Class I malocclusion was observed, while in Pakistan, a higher percentage of Angle's Class II malocclusion was found among orthodontic patients 70.5%^[33]. In regard to facial profile in Saudi Arabia, straight facial profile showed to be the most common type. Compared to European population, Saudi population generally had increased facial convexity associated with retruded mandible, more obtuse lower face-throat angle, increased bimaxillary lip protrusion, greater mentolabial sulcus, decreased vertical lip-chin ratio, and increased maxillary incisor exposure than European population^[15]. In Saudi Arabia, the majority of the subjects 76% had overbite with 1-3 mm overlap, while 6.52% showed 4-6 mm overlap and only 0.16% with more than 6 mm overbite^[17]. In Iranian population, normal overbite was observed in 60.4%, while 34.5% had an increased and 2.2% a very deep overbite^[34]. Also, 67% had overjet between 1-3 mm, 15% had overjet between 4-6 mm, and only 1.2% had overjet of more than 6 mm^[17]. In Iranian population, overjet of at least 3.5 mm or more was present in 28.1%; an overjet of more than 6 mm in 3.6%, and 4.2% had a reverse overjet^[34]. In relevance to crossbite, and according to reported studies, Saudi population presented anterior crossbite in 2.8% to 4.8% and posterior crossbite was present in 6% to 9.4%^[18, 12]. Anterior cross bite showed lesser values among Icelandic^[35] and Croatian^[36] populations. Much higher values were recorded in Iran^[34], Colombia^[37] and Germany^[38]. Unilateral posterior crossbite showed higher values among Turkish^[39], Iranian^[34], Croatian^[36], Hungarian^[40], Colombian^[37] and German^[38] populations. Bilateral posterior crossbite showed Lesser values among Iranian^[34], Hungarian^[40], Colombian^[37] and Caucasians^[41]. In addition, Scissor bite was prevalent in Saudi Arabia as 5% to 10.9%^[9, 24]. Studies conducted in Turkey and Finland shows less prevalent scissor bite 0.3% and 1.1%, respectively compared to Saudi population^[39, 42]. In Saudi Arabia, crowding is prevalent as 40% to 48.8%^[9, 26]. Crowding in Saudi population is considered higher than other reported studies in other countries such as Pakistan which suggested crowding to be present in only 26.4% of the population^[26]. Additionally, spacing was reported in Saudi population to be from 16.1% to 42%^[26, 9]. It has higher than reported in other countries such as in Icelandic^[35], and Croatian^[36] populations, and lesser than that found among Hungarian^[40], Colombian^[37] and Iranian^[34]. In respect to treatment needs, In Saudi population 15.2% conformed to little or no need for treatment, 13.2% were assessed as in borderline need and 71.6% were assessed as in need for treatment^[24]. A study conducted in India showed a less prevalence of treatment need 32.8% compared to Saudi population^[43]. There is a significant difference between studies in Saudi Arabia and other countries. Also, there is a noticeable some lack of literature concerning malocclusion in Saudi Arabia. More studies and research should be conducted to improve our understanding of the problem in order to provide the optimum treatment possible.

Conclusion

To sum up, malocclusion is considered to be the third highest prevalence among oral pathologies. In Saudi Arabia, various studies investigated malocclusion and its various components. In this study, we reviewed malocclusion and its different components in Saudi Arabia. Angle's classifications were reviewed showing Class I angle's malocclusion to be the most common type of malocclusion. Facial profiles were investigated which presented straight facial profile to be the

most common type of facial profile. Overbite and overjet were revised in literature concluding the norms and abnormalities, which showed different results. Crossbite and Scissor bite were studied identifying their prevalence, which presented variable findings. Crowding and spacing were reviewed recognizing their commonness, which disclosed their high prevalence and impact. Lastly, treatment needs were investigated which presented severe or extreme need to be the most prevalent category of orthodontic treatment needs.

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