

Prevalence of Malocclusion, its Association with Occlusal Interferences and Temporomandibular Disorders among the Saudi Sub-Population

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Abstract

Aims: Study was conducted to determine the incidence of malocclusion, occlusal interferences, temporomandibular Disorder (TMD) among the Saudi population and to evaluate the possible existence of an association between malocclusion, occlusal interferences and TMD.

Methods: 250 patients attending dental clinics in Abha city, Saudi Arabia for treatment was clinically examined for the degree of malocclusion. Patients were further evaluated for the presence of occlusal interferences and TMD. Data was evaluated by person's correlation and logistic regression to evaluate the association between malocclusion, occlusal interference and TMD.

Results: The results of the study indicate 42.8% of the evaluated subjects had a definitive degree of malocclusion. Among the occlusal interference observed, balancing side interferences were high (47.6%), followed by protrusive interferences (41.2%). The prevalence of TMD among the evaluated subjects was 41.6%, with mandibular deviation and joint sounds were most prevalent. Statistical Analysis (Pearson's correlation) showed the statistically significant correlation between malocclusion and centric slide ($p=0.030$), posterior missing teeth ($p=0.000$). The statistically significant correlation was observed between TMD and balanced side interferences ($p=0.000$), slide RCP-ICP ($p=0.001$), reduced occlusal contacts (0.033). Logistic regression analysis showed the strong association of TMD with anterior open bite, increased maxillary overjet, balanced side interferences, and centric slide.

Conclusion: The prevailing malocclusion and TMD among studied population is significantly higher. The preventive dental treatment and community dental education need to be more emphasized.

Key Words: Malocclusion, Traumatic dental occlusion, Temporomandibular joint disorders

Introduction

Healthy dentition is a prerequisite for good esthetics, phonetics and self-esteem of an individual [1]. The mal-relationship between the arches in any of the planes or anomalies in a tooth position beyond the normal limits is known as malocclusion [2]. WHO reports indicate the malocclusion is third most dental condition after caries and periodontal diseases [3]. Debilitating malocclusion imparts a great impact on the self-concept of an individual, thus plays the important role in self-esteem and social adjustment of an individual [4]. It has also shown to initiate dental caries and periodontal diseases in many patients [5].

Etiology of malocclusion is multifactorial, it includes genetic, environmental and local factors like tooth anomalies, oral habits, missing teeth etc., [6]. Studies have indicated the high prevalence of dental caries, and early loss of primary or permanent teeth among the young Saudi Arabian population [7,8]. These factors can predispose the greater number of population for higher incidence of malocclusion. Malocclusion can induce the occlusal interferences and they are considered to be one of the causative factors for temporomandibular disorders (TMD). The dental researchers are of contradictory in their opinion regarding the role of occlusal factors in the initiation of TMD. Turp et al. [9] concludes that the occlusal factors contribute to a small percentage to temporomandibular disorders. The malocclusion parameters like large skeletal discrepancies, anterior open-bite, excessive over jet and missing posterior teeth also predispose the patient for

TMD [10]. There are very few prevalence studies on the malocclusion and the extent of its association with TMD especially in the Saudi Arabian context. Different localities would have different demographic composition and therefore probably different incidence and prevalence of any disorder. The existing very few malocclusion prevalence studies are mostly done in the central area of the country, the studies in the other part will help to understand the overall picture of the disease prevalence. Determining malocclusion prevalence and its associated mastication disability due to TMD is of greater value for health planners. It will help them to understand the required resources, preventive measures and designing the health programs.

Aims

Hence, this study was planned to test the prevalence of malocclusion and its associated occlusal interferences, TMD among the Saudi patients visiting for the treatment in dental clinics, Abha, Kingdom of Saudi Arabia. A secondary objective was to evaluate the possible existence of correlation between malocclusion, occlusal interferences and TMD. The findings of the study will help in furthering the knowledge on TMD etiology and designing appropriate preventive, therapeutic treatment plan.

Methods

Sampling and data collection

Approval to conduct the study was obtained from Research

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committee, college of Dentistry, King Khalid University before the initiation of the study. Consent forms were completed and signed by each patient before participating in the study. This was a random cross-sectional study of Saudi national patients visiting dental clinics in Abha city, Kingdom of Saudi Arabia for the treatment. The Abha city has 20 government dental clinics, 4 clinics were selected by using simple random sampling procedures. The study samples were selected by systematic sampling procedures utilizing the appointment number. The study period was from February 2013 to May 2013. Total sample size of 250 patients was examined within an age group of 15-35 years. Exclusion criteria for the survey were the patient's undergone orthodontic correction of teeth, mixed dentition, known ear/eye problems and not willing to take part in the study. Oral examination was performed by Yewe-Dyer, Barocas and Karoly and Klages et al. [2-4]. The calibration of examiners included the theoretical explanation and clinical training by the first author. The 25 patients were examined by three investigators to assess inter-examiner reliability and Kappa values (aver: 0.85) was determined to confirm the good inter-examiners agreement. The examination was done on dental chairs, under good illumination. Dental mouth mirror, periodontal probe, caliper, articulating papers was used during examination.

Survey tools

Dental malocclusion: Dental Esthetic Index (DAI) survey forms were utilized for the evaluation of malocclusion. Oral examination was performed as described by WHO oral health surveys. All ten DAI parameters including the number of missing teeth, crowding/spacing in incisal segment, teeth irregularities and molar relationships were evaluated.

Occlusal interference evaluation: Occlusal interference's evaluation was done with the help of articulating papers, caliper and measuring scale. The patient was guided to centric relation by the Dawson's bimanual method, and petroleum jelly smeared double sided articulating paper was held between the teeth. The patient was requested to make protrusive, working and non-working side movements sequentially to document the existing occlusal interferences. Occlusion scheme and slide from the RCP (retruded condylar position) to ICP (intercuspal position) were also evaluated.

TMD evaluation: The patient was enquired about the medical history, headache, pain, discomfort, limitation, noise and trauma in TMJ. Routine eye and ear examination was as well carried out. The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) Axis-I was used as a guideline in clinical examination procedures [11]. In addition to standardization of TMD clinical diagnosis procedure, RDC/TMD facilitates the good intra and inter

examiner reliability [12]. Diagnostic criteria included the diagnosis of muscle disorders (Group I), disc displacement (Group II) and arthralgia, osteoarthritis, osteoarthrosis (Group III). Muscle disorders included the Myofascial pain with or without limited mouth opening. The pain, tenderness in temporomandibular joint, preauricular area and the muscles of mastication were recorded by gentle digital palpation in their respective area. The reported pain in three or more muscle sites, minimum of one tender area towards the side as the complaint of pain (Ia). The subjects were requested to open the mouth unassisted ≥ 40 mm and lateral movement ≥ 8 mm considered as normal (Ib). It was measured with sterilized stainless steel measuring scale from inter-incisal edges. The group II disc disorders consist of disc displacement with reduction (IIa), disc displacement without reduction in association (IIb) or absence (IIc) of limited mouth opening. The disc displacement with reduction individual was identified by the presence of reciprocal TMJ click in vertical, protrusive or lateral mandibular movement. The presence of clicking and crepitation was observed with clinical examination and stethoscope auscultation. The absence/presence of clicking with history of maximum unassisted opening <35 mm and lateral excursion of <7 mm with/without ipsilateral mandibular deviation was diagnosed as disc displacement without reduction with limited mouth opening. The presence of clicking with normal range of mandibular movement was considered as IIc subgroups. Deviation or deflection during mandibular opening was noted by visual observation.

Group III Arthralgia was diagnosed in the individual with absence of coarse crepitus, pain in joint site on palpation, self-reported pain during maximum unassisted mouth opening. Osteoarthritis and Osteoarthrosis of the TMJ in the patients were identified by the presence of coarse crepitus and radiological signs of arthrosis.

Statistical methods

The data collected for malocclusion was descriptively analysed to determine the prevailing percentage of malocclusion in the examined Saudi subpopulation. The related occlusal interferences and TMD with malocclusion data were statistically analyzed using Pearson test and logical regression for correlation and association by SPSS 19 (IBM Corporation, New York, USA).

Results

The important observation among the DAI components was 27.6% of the evaluated individuals had one or more missing anterior permanent teeth. Incompatible tooth and bone size resulted in 41.2% of the patients having incisal crowding, and midline diastema in 18.8% persons. Among the subjects evaluated, 60.1% and 36.2% of them had maxillary irregularity and mandibular irregularity respectively. The maxillary overjet more than 2mm was observed in 38.8%

Table 1. Distribution of subjects according to severity of malocclusion and treatment needs.

DAI score	Severity of malocclusion	Treatment needs	Frequency	Percentage
≤ 25	No/minor abnormality	No/slight treatment	90	36.0
>25 to 30	Definite malocclusion	Elective	53	21.2
>30 to 35	Severe malocclusion	Highly desirable	50	20
>35	Very severe malocclusion	Mandatory	57	22.8
Total 250	100			

of the individuals and 12.4% of the patients had the anterior open bite. A substantial number of the patients had irregular A-P molar relation, 31.2% of the patients had the half cusp irregularity, while 30.8% of them had the full cusp irregularity. Among the evaluated patients (*Table 1*), definite malocclusion (DAI grade, I) was observed in 21.2% of the patients. Severe malocclusion (DAI grade II) and very severe handicapping malocclusion (DAI grade III) was found with 20% and 22.8% individuals respectively. According to the results, 36% of the subjects require no treatment, definitive treatment was required for 42.8% of the patients examined.

The associated occlusal interferences with malocclusion were also evaluated. The Canine guided occlusion was observed in 58.8% of the patients, 41.2% patients had group function occlusion. The balancing, working, and protrusive interferences were recorded at 47.6%, 18.4%, 41.2% of the surveyed persons. The 8.6% of the patients had reduced occlusal contact, 47.6% of the evaluated patients had one or more missing posterior teeth.

Among the TMD components, mandibular deviation was found in 35.2% of the patients. Joint pain and clicking was observed in 9.6%, 24.8% of the patients respectively. The mandible movement restriction was noted in 2.8%, and only 7.6% of the patients exhibited pain in muscle of mastication on palpation. Among the evaluated subjects, one or more signs/symptoms of TMD were recorded in 41.6% of the patients.

Pearson Correlation analysis was carried out to understand the pattern of the existing relation between malocclusion, occlusal interferences and TMD. *Table 2* depicts the Pearson's correlation coefficient between mal occlusion and occlusal interferences. The statistically significant correlation was found between reduced occlusal contacts, posterior missing teeth and slide from RCP-ICP with malocclusion. The balancing, working and protrusive interferences showed the 'r' value of 0.080, 0.100 and 0.080 respectively. The statistical analysis by Pearson correlation between TMD and slide from RCP (retruded condylar position)-ICP (intercuspal position), balanced side occlusal interferences showed the 'r' value of 0.217, 0.249 with significance at the 0.01 level (*Table 3*). The Pearsons correlation coefficient of 0.135, 0.154 for reduced occlusal contact and missing posterior teeth at 0.05 level of statistical significance.

The pattern of relationship between malocclusion and TMD is more helpful to understand the risk factors associated with severe malocclusion. The notable Pearson correlation coefficient was observed in maxillary irregularity, increased maxillary overjet and anterior open-bite with 'r' value of 0.140, 0.126 and 0.143, respectively with statistical significance at a P value less than 0.05.

The outcome values were made into dichotomous values and independent variables were categorical in nature, the logistic regression analysis was conducted to predict the impact of multiple independent variables from mal occlusion and occlusal interferences on TMD initiation (*Table 4*). A test of the full model against a constant only model was statistically significant with chi square=52.648, $p < .000$, $df = 19$. Nagelkerke's R^2 of .257 indicated an average relationship between prediction and grouping, and prediction success overall was 69.5%. The Wald criterion demonstrated the malocclusion factors made a significant contribution towards

Table 2. Matrix of correlation between malocclusion and occlusal interferences.

Pearson correlation coefficients		
Malocclusion score versus	Pearson correlation	P value
Type of occlusion	-0.043	0.503
Slide RCP-ICP	0.138	0.030
Bal interference	0.080	0.207
Pro interference	0.080	0.210
Work interferences	0.100	0.115
Posterior missing teeth	0.196	0.002
Reduced contacts	0.263	0.000

Table 3. Matrix of correlation between TMD and occlusal interferences.

Pearson correlation coefficients		
TMD score versus	Pearson correlation	P vlaue
Type of occlusion	0.070	0.272
Slide RCP-ICP	0.217	0.001
Bal interference	0.249	0.000
Pro interference	0.070	0.271
Work interferences	0.054	0.392
Posterior missing teeth	0.154	0.015
Reduced contacts	0.135	0.033

Table 4. Multivariable Logistic Regression Analysis assessing the association of malocclusion parameter and occlusal interferences.

	OR	95% CI	P
Missing anterior teeth	1.151	0.592-2.238	0.678
Incisal crowding	1.837	0.871-3.873	0.110
Incisal spacing	1.782	1.031-3.080	0.039
Midline diastema	0.762	0.343-1.693	0.504
maxirregularity	1.203	0.648-2.234	0.558
Mandibular irregularity	1.182	0.590-2.365	0.637
Maxillary overjet	2.184	1.154-4.132	0.016
Mandibular ovejet	1.203	0.185-7.799	0.847
Anterior openbite	2.649	1.076-6.524	0.034
AP molar relation	0.897	0.463-1.736	0.746
Type of occlusion	1.409	0.874-2.271	0.159
Slide RCP-ICP	3.106	1.216-7.936	0.018
Bal interference	3.390	1.748-6.576	0.000
Pro interference	0.619	0.310-1.238	0.175
Work interferences	1.478	0.686-3.184	0.318
Post missing teeth	1.418	0.758-2.654	0.274
Reduced contacts	1.683	0.397-7.137	0.480

TMD initiation were incisal spacing ($p=.039$), increased maxillary overjet ($p=.016$), and anterior open-bite ($p=.034$). Malocclusion related occlusal interference factors found to be associated with TMD were balanced side interferences (adjusted OR-3.39, 95%CI-1.75 to 6.58, $P=0.000$), and slide from RCP-ICP (adjusted OR-3.10, 95%CI-1.22 to 7.94, $P=0.018$).

Discussion

The existence of strong influence of dental malocclusion on the initiation of dental caries, periodontal problem is well documented in the dental literature. It is also known to adversely affect the self-esteem and social adaptation of an individual. Many epidemiological studies are conducted utilizing different various indices to determine and quantify the prevailing malocclusion. DAI is unique, since it combines both socially accepted esthetic parameters and measurements

of occlusal components contributing to malocclusion. The most striking observation in the study was, 27.6% in the study population had missed one or more anterior teeth. Which is comparatively more than the studies conducted on other population [13,14]. Nadya et al. and Khan et al. [7,8] studies shows the Saudi Arabian population has the high prevalence of dental caries, which could be the main reason for the dental extraction. Non availability of specialized dental treatment can also be attributed to the increased numbers of tooth extraction. Patient's awareness on preventive measures to preserve the tooth and supportive structures need to be emphasized.

Arch continuity with approximate proximal contact is the requirement of normal occlusion. Incisal segment crowding or spacing result due to the amount of the space available between right and left canine is incompatible with the combined width of the incisors. In the study incisal crowding and spacing observed in 41.2%, 20.2% respectively. Among the study population examined, 18.8% had midline diastema. It is slightly lesser than results reported by Khalid and Al-Balkhi [15]. The dimensions of jaw and teeth are predominantly influenced by the genetics, race and ethnicity [16,17]. The difference in the results can also be attributed to para-functional habits like thumb sucking, tongue thrusting and mouth breathing. The results indicated that 38.6% of the patients showed maxillary overjet more than 2 mm, these results were higher than the other similar studies [17,18].

The Lack of overlap between opposing maxillary and mandibular incisors, leads to anterior open bite. The results of the present study indicated 12.4% of the study subjects had an anterior open bite. Developmental disturbances and parafunctional habits are main etiological factors for anterior open bite. The DAI score distribution for the present study indicates, severe malocclusion (DAI grade II) and very severe handicapping malocclusion (DAI grade III) was observed in 20% and 22.8% individuals. The results of the present study were in correlation with studies of Al-Emran et al. and Foster and Day [19,20] but slightly higher than the results on the other ethnic population [21,22]. The most concerning observation is 22.78% of the subjects had handicapping severe malocclusion. Though the etiology of tooth loss is multiple, the preventive dental care and community dental education are needed to be emphasized. Availability of specialized dental care also needed for preventive and therapeutic treatment of prevailing malocclusion in the society.

Functional malocclusion is more critical than morphological malocclusion for the mandibular dysfunction. The deleterious occlusal interferences in functional malocclusion are known to cause the TMD. The results of the present study indicated the majority of the patients had balanced occlusion (47.6%) followed by protrusive (41.2%) and working side (18.4%) interferences. The result in concurrence with other studies indicating the high prevalence of balanced side interferences [23]. The Pearson correlation results indicated the existence of strong relations between malocclusion and the loss of occlusal contact, posterior missing teeth; it is in conformance with other studies [24]. The results indicate the morphological malocclusion is also associated with components of functional malocclusions. Hence correction of the malocclusion is important for esthetic as well functional rehabilitation of the patient.

The present study has shown that the prevalence of a sign or symptoms TMD in the examined population at 41.6%. These results are in agreement with similar results reported by other studies on Saudi population [25-27]. The highest number of the subjects examined had mandibular deviation/deflection (35.2%) followed by joint clicking (24.8%). The findings are in concurrence with the results of the previous studies conducted by Grosfeld et al. [28]. The less percentage of results in the other studies can be attributed to lack of stethoscope use to record the joint clicking.

The Reported TMD frequency in the present study is higher than the similar studies [29-31], the difference in the TMD prevalence are due to different samples and examination methods. The temporomandibular disorders represent the heterogeneous group of pathologies affecting temporomandibular joint and muscles of mastication. The etiology of TMD is multifactorial; the specific etiology for TMD signs and symptoms is difficult to correlate. The researcher advises to observe the TMD under biopsychosocial framework. The TMD clinical signs and symptoms are influenced by biological, psychological and social factors. The complex etiopathogenesis make it extremely difficult to associate single cause to the initiation of TMD.

The published scientific data is inconclusive regarding the effect of occlusal interferences to the TMD. Hiltunen et al. [29] confirm the strong influence of occlusal interferences on TMD, while Deng et al. [30] disagree with the observation. The complex aetiopathogenesis and multiplicity of symptoms of TMD requires the standardized diagnostic system, hence RDC/TMD diagnostic criteria is helpful in enhancing reliability, clinical examination and evaluation of etiological factors.

Logistic regression analysis indicates the increased maxillary over jet ($p=.016$), anterior open bite ($p=.034$), and incisal spacing ($p=.039$) were associated with TMD. The increased maxillary over jet and the anterior open bite tend to significantly increase the vertical and lateral components of movement from postural position to intercuspal position [32]. These factors significantly increase the excursive disocclusion time. The EMG studies showed the prolonged and increased stress on masticatory muscles and articular disc ligaments due to extended disocclusion time [33]. The observations in the study are similar to the findings of the study conducted by Pullinger and Seligman and Tanne et al. [34,35].

The functional malocclusion components associated with TMD were balanced side interferences ($P=0.000$) and slide from RCP-ICP ($P=0.018$). The balanced side interferences are known to induce the deleterious forces due to the amount and direction of the force. EMG studies indicates the balanced side interferences increases the muscular activity, and detrimental to the neuromuscular system [36]. The musculoskeletally stable mandible is critical for healthy masticatory system [37]. The slide form RCP-ICP more than 2 mm lead to muscle bracing of mandible. The study confirms the multiple occlusal interferences will lead to mandibular dysfunction [38-40].

The review of the existing literature on the TMD etiological factors by Turp et al. [9], concludes that the influence of the occlusion on the initiation of TMD is low. The dentist should not assume mere association of the occlusal factors with the TMD as an etiological factor. The existing occlusal

interferences could be due to TMD pain induced altered mandibular movement [41]. The occlusal interference has found to be responsible in recurrence TMD in patients with a previous TMD history [42,43]. The researchers suggest to carefully consider the occlusal rehabilitation in long standing TMD patients [44,45], the total neglect ion of occlusal factors in TMD rehabilitation is not advised.

The morphological malocclusion is usually of aesthetic concern for the patients, but the study indicates their importance in the TMD rehabilitation. The routine functional malocclusion evaluation is strongly advised to identify the potential risk factors for TMD.

Conclusions

From the results of the study, it can be concluded that 42.8% of the study population had malocclusion ranging from definite to handicapping malocclusion. Among the functional

malocclusion parameters balanced side interferences were high (47.6%) followed by protrusive (41.2%). The prevalence of TMD signs and symptoms were observed in 41.6% of the subjects, with mandibular deviation and joint sounds were most prevalent. The morphological malocclusion parameters significantly associated with TMD were anterior open bite, increased max over jet and incisal spacing. The study also indicates the balanced side interferences and centric slide from RCP-ICP having strong association with TMD. The studied population is in greater need of pedodontic preventive dental treatment, community dental education with specialized therapeutic treatment for malocclusion and TMD

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