Correlation between oral parafunction and temporomandibular disorders and emotional status among Saudi children

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Studies on association between temporomandibular disorders and oral parafunction in preschool children are few. The aim of the present study is to investigate the relationship between the subjective and objective signs and symptoms of temporomandibular disorders (TMD), oral parafunction and emotional status in preschool children. The study is based on a clinical examination and questionnaire. Five hundred and two Saudi children aged 3 to 7 years were examined for different signs and symptoms of TMD. In addition, the parents of the children were given a questionnaire to investigate the existence of oral parafunction and evaluate the emotional status of children. The results of the study showed significant association between attrition and temporomandibular joint (TMJ) pain, muscle tenderness and restricted opening, (P Values were 0.008, 0.019, 0.037 respectively). Significant association was found between habit of grinding and pain, while eating or opening the mouth (P< 0.012). Significant association was found between emotional status and multiple signs and symptoms of TMJ tenderness, TMJ pain and muscle tenderness (P <0.042). Significant association was found between emotional status and pain, while eating or opening of the mouth (P<0.048). Close to positive association was found between oral parafunction and jaw lock. The association between TMD and oral parafunction as well as emotional status should direct the attention of the dentist to the importance of considering the emotional status, oral parafunction and TMD when examining and formulating treatment plan for the child patient.

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INTRODUCTION

Several studies have been presented in the literature investigating the etiology of TMD. Most of the studies have reported the multifactorial nature of the disorders.[1-5] Malocclusion, oral parafunction, emotional status and trauma are the known etiological factors with oral parafunction playing a significant role.[6] Temporomandibular dysfunction has been described as a group of disorders characterized by pain in the periaucular area, the temporomandibular joint (TMJ) and the muscles of mastication, limitation or deviations in the mandibular range of motion and noises in the TMJ during function.[7]

The prevalence of TMD and oral parafunction has been the subject to many studies in adult population and in children,[2,8,11] but relatively few of the subjects belonged to the preschooler group.[12-15] Some studies have reported association between TMD and oral parafunction,[4,8,16-20] however, fewer studies reported no association.[21-24] Thus, there is a need for more information about the prevalence of TMD and oral parafunction in the young age group. The aim of the present study is to investigate the relationship between the subjective and objective signs and symptoms of TMD, oral parafunction and emotional status in preschool children.

MATERIALS AND METHODS

The study is based on a clinical examination and a questionnaire.

Subjects

Five hundreds and two children, aged 3 to 7 years, living in the city of Jeddah, Saudi Arabia, were examined. The subjects were selected from public schools located in four geographical areas (north, east, south and west) of the city. A total of 8 schools, 2 from each area, were selected using a stratified selection technique. The final selection included 6 nursery and 2 elementary schools. When a school was selected, the entire student population of the school was examined. The parents and the children were informed regarding the purpose of the study and their consents were obtained.

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Children with systemic diseases, uncooperative behavior, and history of trauma or dental pain were excluded. Oral hygiene instruction were given at the end of the examination and a letter was sent to the parents encouraging the children to visit the dentist either for further check-up or for treatment as the case may be.

Clinical examination

The examination was done by two examiners from the Department of Pediatric Dentistry, King Abdulaziz University. Prior to the start of the survey, the two examiners held series of sessions to standardize data collection technique and methodology. Both intra-examiner and inter-examiner reliability tests were performed by examining a cohort of 20 children at two different times, one week apart, for TMD signs and symptoms. The result was subjected to Cohen's Kappa statistics.

All children were examined at the school using two chairs. Since head position can be an important factor in TMD diagnosis, the child was seated upright during the examination. The examination included all the following objective signs and symptoms: TMJ sounds, the associated muscle disorders including (a) TMJ tenderness (b) muscle tenderness, TMJ pain on movement, maximum vertical opening, and opening deviation.[14] Attrition was registered in the primary dentition as whole. Dental wear was assessed using a five point scale.[25]

Questionnaire

Parents were given a questionnaire specially constructed to permit reliable answers about the existence of subjective symptoms of TMD and oral parafunction in the children. A total of 502 questionnaires were distributed among the parents.

The questionnaire was designed to obtain information about oral parafunction habits such as lip and cheek biting, nail biting, grinding of teeth and sucking habits. Parents were asked to determine the frequency of sucking habits, whether during day or night, when upset or others. The questionnaire also contained questions about subjective symptoms of TMD such as headaches, pain during eating or opening the mouth, difficulty in opening the mouth, joint sound and incidence of joint lock upon opening. The symptoms were written in the questionnaire, and the parents had to choose between yes or no. In case of positive response for pain, the parents were asked to determine the affected area, e.g. in the ear area, area in front the cheek area or the teeth.

The emotional status of children was determined from the questionnaire as the child being calm or nervous.

STATISTICAL ANALYSIS

The collected data were entered in a data base file using Dbase IV, cleaned and checked for outliers. Statistical analyses were done using SPSS. Data comparisons were done with t-test, Chi-square and Fisher Exact test, where appropriate. Inter and Intra observer reliability between the two examiners were 0.97, 0.94 respectively. The level of significance was set at $P<0.05$ using Kappa Test.

RESULTS

Table 1 shows the age and sex distribution of the children with primary dentition. Five hundred and two children, aged 3 to 7 years, 235 (46.81%) males and 267 (53.19%) females, were examined. Respondents of the questionnaire were 267 out of 502 (128 females and 139 males). Subjects with injury or surgery of the jaw or neck (8) and with dental pain (27) were excluded from study. Only one child was using orthodontic appliance. Subjects rated as calm, were 80 and those rated as nervous or tense were 176. Response of 11 parents whose analysis answers did not fall in those two categories were excluded from the analysis.

The prevalence of objective signs and symptoms of TMD, subjective symptoms of TMD and prevalence of oral parafunction and attrition were presented in a previously published article.[14,26,27,28]

When attrition was associated with each of the signs and symptoms of temporomandibular disorders (TMD) significant correlation was found between attrition and each sign of TMJ pain, muscle tenderness and restricted opening and the P values were 0.008, 0.019 and 0.037 respectively. Table 2.

Associations between signs and symptoms of attrition and subjective signs and symptoms of TMD were presented in Table 3, results showed no association.

Similarly no associations was found between the objective signs and symptoms of TMD and subjective signs and symptoms of oral parafunction Table 4.

The associations between opening deviation and restricted opening with the subjective symptoms of oral parafunction: were presented in Table 5. There was high association between the habit of lip and cheek biting as well as the habit of grinding of teeth with the restricted opening, although the result was not significant.

Associations between objective TMJ clicking, TMJ crepitus, muscle tenderness, TMJ pain on opening, TMJ tenderness and oral parafunction are presented in Table 6. The results showed no association.

Association between oral parafunction and the subjective symptoms of TMD, difficulty in opening, joint sound, joint lock during opening, headache and pain are presented in Table 7. Again, high association was found between the habit of grinding of teeth and difficulty in opening. Also high association was found between the habit of nail biting and the habit of grinding the teeth, joint sound and jaw lock respectively. Also between headache and the habit of nail biting. However, the result was not statistically significance. The only significant association was found between habit of grinding the teeth and subjective pain ($P<0.012$).

Table 1. Percentage distribution of children with primary dentition by age and sex (n=502).

Sex	Age (Years)											
	3		4		5		6		7		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Male	6	54.5	97	54.8	103	55.7	26	31.0	3	15.78	235	46.81
Female	5	45.5	80	45.2	82	44.3	84	69.0	16	84.21	267	53.19
Total	11	2.2	177	35.2	185	36.9	110	21.9	19	3.78	502	100.00

Table 2. Association between the objective signs and symptoms of TMD and attrition.

Subjective signs & symptoms of TMD	Attrition		Total	P Value*
	with N=167	without N=335	N=502	
	n=(%)	n=(%)	n=(%)	
Tl	14 (8.4)	24 (7.2)	38 (7.6)	NS**
Tp	9 (5.4)	4 (1.2)	13(2.6)	.008
Mt	12 (7.2)	9 (2.7)	21 (4.2)	.019
Tt	6 (3.6)	7 (2.1)	13 (2.6)	NS**
To	1 (.6)	12 (3.6)	13 (2.6)	.037
Td	5 (3)	12 (3.6)	17 (3.4)	NS**

Tl = TMJ Clicking
Tp = TMJ Pain on Opening
Mt = Muscle Tenderness
Tt = TMJ Tenderness
To = Restrictive Opening
Td = Opening Deviation
*** = P value using Fisher's Exact Test**
**** = Not significant**

Table 3. Association between attrition and subjective symptoms of TMD.

Subjective TMD	Attrition		Total	P Value*
	with N=78	without N=185	N=263	
	n=(%)	n= (%)		
1. Pain while eating or opening the mouth	7 (9)	20 (10.8)	27 (10.3)	NS
2. Frequent Headache	0 (0)	3 (1.6)	3 (1.1)	NS
3. Difficulty in opening the mouth	0 (0)	4 (2.2)	4 (1.51)	NS
4. Joint Sounds	0 (0)	3 (1.6)	3 (1.1)	NS
5. Jaw lock in opening	0 (0)	5 (2.7)	5 (1.9)	NS

NS Not significant

Table 4. The association between objective signs and symptoms of combined TMD and oral parafunction.

Oral Parafunction	With Objective TMD N=45	Without Objective TMD N=217	Total N=262	P Value
	n=(%)	n=(%)	n=(%)	
1. Habit of lip/cheek biting	2 (4.4)	9 (4.1)	11 (4.2)	NS
2. Habit of nail biting	8 (17.7)	50 (23.0)	58 (22.1)	NS
3. Habit of grinding the teeth	5 (11.1)	17 (7.8)	22 (8.4)	NS
4. Habit of sucking fingers	6 (13.0)	28 (12.9)	34 (12.9)	NS

NS Not significant

Table 5. Association between opening deviation and restricted opening with oral parafunction.

Oral Parafunction	Opening Deviation With Td N =10	Opening Deviation Without Td N=252	Total N=262	Restricted Opening With To N =7	Restricted Opening Without To N=255	Total	P Value
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	
1. Habit of lip /cheek biting	1 (10.0)	10 (4)	11 (4.2)	1 (14.3)	10 (3.9)	11 (4.2)	NS
2. Habit of nail biting	2 (20)	56 (22.2)	58 (22.1)	1 (14.3)	57 (22.4)	58 (22.1)	NS
3. Habit of grinding the teeth	1 (10.0)	21 (8.3)	22 (8.4)	1 (14.3)	21 (8.2)	22 (8.4)	NS
4. Habit of sucking the fingers	1 (10.0)	33 (13.0)	34 (12.9)	1 (14.3)	33 (12.9)	34 (12.9)	NS

Td = Opening Deviation
To = Restricted Opening
NS = Not significant

Table 6. Association between objective Tp, Mt, Tt and Tl, Tc and oral parafunction.

Oral Parafunction	Tp + Mt + Tt		Total	Tl + Tc		Total	P Value
	With N=19	Without N=244	N=262	With N=22	Without N=240	N=262	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
1. Habit of lip & cheek biting	1 (5.3)	10 (4.1)	11 (4.2)	1 (4.6)	10 (4.1)	11 (4.2)	NS
2. Habit of nail biting	3 (15.8)	55 (22.5)	58 (22.1)	2 (9.1)	56 (23.3)	58 (22.1)	NS
3. Habit of grinding the teeth	3 (15.8)	19 (7.9)	22 (8.4)	2 (9.1)	32 (13.3)	34 (13)	NS
4. Habit of sucking finger	4 (21.1)	30 (12.2)	34 (12.9)	0 (0)	22 (9.2)	22 (8.4)	NS

NS = Not significant
Tl = TMJ Clicking
Tc = TMJ Crepitus
Tt = TMJ Tenderness
Mt = Muscle Tenderness
Tp = TMJ Pain on Opening
NS = not significant

Table 7. Association between subjective TMD and oral parafunction.

Oral Parafunction		Difficulty in Opening N=4	Joint Sound N=2	Jaw Lock N=5	Headache N=3	Pain N=26
		n(%)	n(%)	n(%)	n(%)	n(5)
1. Habit of lip/ cheek biting	N=11	0 (0)	0 (0)	1 (20.0)	1 (33.3)	0 (0)
2. Habit of nail biting	N=58	1 (25.0)	1 (50.0)	2 (40.0)	2 (66.7)	4(15.4)
3. Habit of grinding of teeth	N=22	1 (25.0)	1 (50.0)	1 (20.0)	0 (0)	6 (23)*
4. Habit of sucking fingers	N=34	(0)	0 (0)	0 (0)	0 (0)	4(15.4)
Total		**256**	**256**	**260**	**259**	**257**

Total = Total sample
n = Number of subjects with oral parafunction and subjective symptoms of TMD
*** = Significant P value using Fisher's Exact Test (P< .012)**

Table 8. Association between emotional status and multiple objective signs and symptoms of TMD.

Objective TMD	Emotional Status		Total	P Value*
	Calm N=80	Nervous N=176	N=256	
	n (%)	n (%)	n (%)	
Tt + Mt + Tp	2 (2.5)	16 (9.1)	18 (7.0)	.042*
Tl + Tc	8 (10)	12 (6.8)	20 (7.8)	NS
Tt + Tp + Tl + Tc	8 (10)	15 (8.5)	23 (9)	NS

Tt = TMJ Tenderness
Mt = Muscle Tenderness
Pt = TMJ Pain on Opening
Tl = TMJ Clicking
Tc = TMJ Crepitus
*** = significant P value using Fisher's Exact Test**
NS = not significant

Table 9. Association between emotional status and objective signs and symptoms of TMD.

TMD	Emotional Status		Total	P Value*
	Calm N=80	Nervous N=176	N=256	
	n (%)	n (%)	n (%)	
Tl	8 (10.0)	12 (6.8)	20 (7.8)	NS
Tp	1 (1.3)	7 (4.0)	8 (3.1)	NS
Mt	2 (2.5)	11 (6.3)	13 (5.1)	NS
Tt1	(1.3)	5 (2.8)	6 (2.3)	NS
To	0 (0)5	(2.8)	5 (2.0)	NS
Td	2 (2.5)	8 (4.5)	10 (3.9)	NS

Tl = TMJ Clicking
Tp = TMJ Pain on Opening
Mt = Muscle Tenderness
Tt = TMJ Tenderness
To = Restricted Opening
Td = Opening Deviation
NS = not significant

Association between the emotional status and signs and symptoms of TMD were presented in Table 8. Result showed significant association between nervous children and multiple TMJ pain, muscle tenderness and TMJ tenderness ($P < 0.042$).

However, no association was found between emotional status classified as calm or nervous and each of the signs and symptoms of TMD (Table 9). Also when signs and symptoms of TMD were combined no association with emotional status was recorded.

Table 10 presents the result of the emotional status and the relationship with the subjective signs and symptoms of TMD. Results showed an association between pain while eating or opening of the mouth with the nervous status of children ($P<0.048$). Table 11 showed no association between emotional status of the child whether calm or nervous and the presence of oral parafunction.

Table 10. Association between emotional status and subjective signs and symptoms of TMD.

Subjective TMD	Emotional Status		Total	P Value*
	Calm N=80	Nervous N=176	N=256	
	n (%)	n (%)	n (%)	
1. Pain while eating or opening the mouth	4 (5.1)	22 (12.6)	26 (10.3)	0.048*
2. Frequent Headache	0 (0)	3 (1.7)	3 (1.2)	NS
3. Difficult in opening the mouth	1 (1.3)	2 (1.2)	3 (1.2)	NS
4. Joint Sound	0 (0)	2 (1.2)	2 (.8)	NS
5. Jaw Lock in opening	0 (0)	4 (2.3)	4 (1.6)	NS

*** = significant P value using Fisher's Exact Test**
NS = not significant

Table 11. Association between emotional status and oral parafunction.

Oral Parafunction	Emotional Status		Total	P Value*
	Calm N=80	Nervous N=176	N=256	
	n (%)	n (%)	n (%)	
1. Habit of lip/cheek biting	1 (1.3)	9 (5.1)	10 (3.9)	NS
2. Habit of nail biting	14 (18.2)	40 (23.5)	54 (21)	NS
3. Habit of grinding of teeth	4 (5.1)	17 (9.7)	21 (8.2)	NS
4. Habit of sucking fingers	11(13.8)	23 (13.1)	34 (13.2)	NS

NS = not significant

DISCUSSION

Association between objective TMD and oral parafunction

The present study showed an association between attrition and TMD. A significant association was found between attrition on one hand and TMJ pain, muscle tenderness and restricted opening. Our study contradicted other studies, which reported no association.[13,22,29]

However, Lindqvist 1974[19] reported association between muscle tenderness and bruxism. Similarly Vanderas 1995[16] reported association between muscle tenderness, clicking, pain and difficulty in opening wide and oral parafunction such as grinding, clenching and lip biting in the calm group. Also the study done by Egermark Ericsson and others[8] showed through conducting a questionnaire that a correlation existed between bruxism and clinical signs of dysfunction.

Although the present information collected through the questionnaire showed high association between each of sucking habits, lip biting, cheek biting as well as grinding of teeth with restricted opening, this association was not statistically significant. These results are similar to those of Vanderas,[16] who reported close to significant association between clicking and lip / cheek biting and between muscle tenderness and grinding of teeth. However, Vanderas sample was from children with unpleasant emotional status. Widmalm *et al*.[20] reported association between bruxism, nail biting, thumb sucking and most of the craniomandibular disorders (CMD) signs and symptoms. He concluded that bruxism, nail biting and thumb sucking are of clinical interest in the diagnosis of TMD indicating that those parafunctions are risk factors,[18,20] a conclusion which is supported by the following studies.

The study by Lindqvist[19] on 117 pair of twins reported a significant association between muscle tenderness and bruxism in a group of children aged 10 to 14 years. Also the study of Kritsineli,[17] reported an association between bruxism and clicking and between clicking and thumb/finger sucking in the primary dentition. Kampe and Hanner,[30] also reported an association between bruxism and headache and between tongue / cheek biting and dysfunction index. Nilner[4] reported an association between tenderness on palpation and tooth grinding and clenching. Geering - Gaerny and Rakosi[31] found a high frequency of lip/cheek biting and patient with initial symptoms of function disturbance in the mastication compared with a control group. Steel *et al*.[32] reported that temporomandibular joint tenderness or pain history, masticatory muscle tenderness and known clenching or grinding habits were found to occur at significant increasing levels in the migraine sufferers, a finding that supports an etiological role of nocturnal tooth clenching or grinding in migraine.

On the contrary, some studies did not find any indication that oral parafunction produce TMD.[21-24] Lack of significant value between some of the oral parafunction and the multiple signs and symptoms of TMD can be attributed to the lower number of the respondents to the questionnaire obtained from the parent, the differences in methodology and the different age group of the sample studied.

Association between subjective symptoms of TMD and oral parafunction

Significant association was found between grinding of teeth and pain during eating or opening the mouth as obtained from the questionnaire. Also close to positive association was found between grinding of teeth and difficulty in opening though was not significant.

Our study showed high association between almost all the variables of oral parafunction and jaw lock, however, this was not statistically significant. Also high association was found between headache and lip/cheek biting as well as nail biting although it was not high enough to reach significance. This could be attributed to the improper interpretation of the questionnaire given to the parents suggesting the importance of interviewing the parents in the presence of their child. No association was found between attrition and symptoms of TMD, or between finding difficulty in opening the mouth, joint sound, jaw lock during opening, and headache with the various symptoms of oral parafunction obtained from the questionnaire.

Similarly, a number of studies failed to prove such an association and therefore are in accordance with the present study findings. A study by Bernal and Tsamtsouris[13] reported no association between oral / facial parafunction and symptoms of the stomatogentic system. A study by Egemark, Ericsson,[8] also reported no association between bruxism and subjective symptom TMJ sound, tenderness in the jaw and face, difficulty in mouth opening. Rugh and Orbach[33] reported that oral parafunction such as bruxism, cheek and tongue biting, thumbsucking, nail biting, gum chewing etc. are common and usually do not harm the stomatognathic apparatus.

However, when the activity exceeds the physiological tolerance the system begins to alter and the initiative breakdown is seen in the tissue with the lowest structural tolerance.[34] Also the study of Michalowicz *et al*.[35] reported no association between history of joint area pain and clenching, grinding and joint noise among a group of 49 twins and proved that genetic factors do not influence these traits in the population.

On the other hand, some other studies documented the association between oral parafunction and TMD symptoms. The study of Vanderas[16] showed an association between grinding and finding difficulty in opening wide in the calm group as well as between nail biting and the habit of grinding the teeth and the presence of joint sound. Also Widmalm *et al*.[20] reported significant association between TMJ pain and bruxism based on a questionnaire. The present results are also different from those of the study done by Nilner[4] on 222 subjects aged 7 to 14, who reported an association between nail / lip / cheek biting and pain in the temple region and recurrent headaches.

While the existence of such an association seems to be controversial, oral parafunction is still highlighted as a potential risk factor in TMD etiology and according to Widmalm[18] it is evident as early as 5 years of age. This belief is still held by many dentists and warrants contemporary research of the issue.

Association between emotional status and objective and subjective signs and symptoms of TMD

Association was found between multiple signs and symptoms of TMD (TMJ Tenderness + Muscle Tenderness + TMJ Pain on Opening) and nervous children. Also significant association was found between being nervous and subjective pain while eating or opening the mouth. Both objective and subjective signs and symptoms of pain presented from the clinical examination and the questionnaire reflect the influence of emotional status on pain.

It appears that pain in the TMD is influenced by the emotional status of children and that emotional status increases tension in muscle and later lead to pain and dysfunction of TMD. Similarly a study by Farsi[36,37] reported that children with emotional status have higher risk to develop TMD. Also it was suggested that pain and dysfunction arise from increased muscle tension caused by emotional factors.[38] This is in agreement with our results, which suggests that the emotional factor should be taken into consideration when examining a patient with signs and symptoms of TMD.

Association between emotional status and oral parafunction

Our data showed no association, between emotional status and oral parafunction. The present results are different from those of Vanderas,[16] who reported association between frequent grinding and clenching and emotional status. The effect of emotional factors on the masticatory system have been explained by two mechanisms. First, the emotional factor that increased the frequency of parafunction activity, second, pain and dysfunction arising from increased muscle tension as a result of the emotional factor.[1,38,39,40]

It was mentioned previously.[1,41-44] that oral parafunction and or muscle tension varies greatly from individual to individual and was correlated with the stress level. The lack of association between emotional status and oral parafunction can be explained by the different age group of the sample studied an older age group would have shown higher association. Also the parents interpretation of the questionnaire and the fewer number of respondents might have influenced the results.

CONCLUSION

Our study showed the following significant association between oral parafunction and TMD:

1. Significant associations between attrition and TMJ pain, muscle tenderness and restricted opening.
2. Significant association between the habit of grinding and pain while eating or opening the mouth.
3. Significant associations between emotional status and multiple signs and symptoms of TMD.
4. Significant association between emotional status and pain while eating or opening the mouth.
5. Close to significant association between oral parafunction and Jaw lock.

The association between some of the objective and subjective signs and symptoms of TMD and oral parafunction as well as the association between some of the subjective and objective signs and symptoms of TMD and emotional status would direct one attention to the importance of evaluating oral parafunction when examining and formulating a treatment plan for the child patient.

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REFERENCES

1. Rugh JD, Solberg WK. Psychological implications in temporomandibular pain and dysfunction. Oral Science Rev 1: 13-20, 1976.
2. Egermark Eriksson I. Mandibular dysfunction in children and individuals with duct bites. Swed Dental J (suppl) 10:1-45, 1982.
3. Vanderas AP. Prevalence of craniomandibular dysfunction in white children with different emotional states. Part II: Not calm group. J Dent child 56: 348-352, 1989.
4. Nilner M. Relationship between oral parafunction and functional disturbances and diseases of the stomatognathic system among children aged 7-14 years. Acta odontol Scand 41: 167-172, 1983.
5. Vanderas AP. Epidemiologic approach to the etiologic factor of craniomandibular dysfunction in children and adolescents. The host-agent model. J Craniomand Pract 6: 172-178, 1988.
6. Ash MM. Current concepts in the etiology, diagnosis and treatment of TMJ and muscle dysfunction. J Oral Rehab 13: 1-20, 1986.
7. Laskin D, Greenfield W, Gale E et al, eds. The president's conference on the examination, diagnosis and management of temporomandibular disorders. Chicago, American Dental Association 106: 75-77, 1983.
8. Egermark Eriksson I, Carlsson GE, Ingervall B. Prevalence of mandibular dysfunction and orofacial parafunction in 7-, 11- and 15-year-old Swedish children. European J Orthod 3: 163-172, 1981.
9. Egermark Eriksson I. Prevalence of headaches in Swedish children. Acta Pediatrica Scandinavian 71: 135-140, 1982.
10. Helkimo M. Studies on function and dysfunction of the masticatory system. I. An epidemiologic investigation of symptoms of dysfunction in Lapps in the north Finland. Finn Dent Soc 70: 37-49, 1974.
11. Nilner M, Kopp S. Distribution by age and sex of functional disturbances and diseases of the stomatognathic system in 7-18 years olds. Swedish Dental Journal 7: 191-198, 1983.
12. Widmalm SE, Christiansen RL, Gunn SM, Hawley LM. Prevalence of signs and symptoms of cranionmandibular disorders and orofacial parafunction in 4-6 years old African-American and Caucasian children. J Oral Rehab 22: 87-93, 1995.
13. Bernal M, Tsamtsouris A. Signs and symptoms of temporomandibular joint dysfunction in 3 to 5 year old children. J Pedodont 12: 37-40, 1986.
14. Alamoudi N, Farsi N, Salako NO, Feteih R. Temporomandibular disorders among school children. J Clin Pediatr Dent 22: 323-328, 1998.
15. Nilner M, Lassing SA. Prevalence of functional disturbances and diseases of the stomatognathic system in 7-14 years olds. Swedish Dent J 5: 173-178, 1981.
16. Vanderas AP. Relationship between cranionmandibular dysfunction and oral parafunction in Caucasian children with and without unpleasant life events. J Oral Rahab 22: 289-294, 1995.
17. Kritsinali M, Shim YS. Malocclusion, body posture and temporomandibular disorders in children with primary mixed dentition. J Clin Pediatr Dent 16: 86-93, 1992.
18. Widmalm SE, Christiansen RL, Gunn SM. Oral parafunction and temporomandibular disorders risk factors in children. Cranio 13: 242-246, 1995.
19. Lindqvist B. Bruxism in twins. Acta Odontal Scand 32: 177-187, 1974.
20. Widmalm SE, Gunn SM, Christiansen RL, Hawley LM. Association between CMD signs and symptoms, oral parafunction, race and sex in 4-6 year-old African, American and Caucasian children. J Oral Rahab 22: 95-100, 1995.
21. Barone A, Sbordone L, Ramaglia L. Craniomandibular disorders and orthodontic treatment need in children. J Oral Rehab 24: 2-7, 1997.
22. Goho C, Jones HL. Association between primary dentition wear and clinical temporomandibular dysfunction signs. Ped Dent 13: 263-266, 1991.
23. Kieser JA, Groeneveld HT. Relationship between juvenile bruxing and cramandibular dysfunction. J Oral Rehabilitation 9: 662 – 665, 1988.

24. Gavish A, Halachmi M, Winocur E, Gazit E. Signs and symptoms of temporomandibular disorders in adolescent girls. J Oral Rehab 27: 22-32, 2000.
25. Egermark Eriksson I, Ingervall B, Carlsson GE. The independence of mandibular dysfunction in children on functional and morphologic malocclusion. Am J Orthod 83: 187-194, 1983.
26. Alamoudi N. The prevalence of crowding, attrition, midline discrepancies and permanent tooth in the primary dentition of children in Jeddah, Saudi Arabia. J Clinical Pediatr Dent 24: 53-58, 1999.
27. Alamoudi N. The prevalence of oral parafunction and subjective temporomandibular disorders among school children in Saudi Arabia. Accepted for publication April 2001 Alexandria Dent J.
28. Alamoudi N. The correlation between occlusal characteristics and temporomandibular dysfunction in Saudi Arabian children. J Clinical Pediatr Dent 24: 229-236, 2000.
29. Droukas B, Lindee C, Carlsson GE. Relationship between occlusion factors and signs and symptoms of mandibular dysfunction clinical study of 48 dental students. Acta Odontal Scand 42: 277-283, 1984.
30. Kampe T, Hannerz H. Five year longitudinal study of adolescents with intact and restored dentitions: signs and symptoms of temporomandibular dysfunction and functional recordings. J Oral Rehab 18: 387-398, 1991.
31. Geering-Gaerny M, Rakosi T. Ininial symptome von Kiefergelenkstorungen bel Kindern im Alter von 8-14 Jahren. Schweiz. Montasschr. Zahnheilkd. 81: 691-712, 1971.
32. Steel JG, Lamey PJ, Sharkey SW, Smith GM. Occlusal abnormalities, pericranial muscle and joint tenderness and tooth wear in a group of migrains patients. J Oral Rehab 18: 453-458, 1991.
33. Rugh JD, Ohrabach R. Occlusal parafunction. In: A textbook of occlusion. Quintessence Publishing Co. Ed, Mohl, GA Zarb, GE Carlsson, JD Rugh, pp. 249-261, 1988.
34. Okeson JP. Temporomandibular disorders in children. Pediatr Dent 11: 325-329, 1989.
35. Micholowicz BS, Pihlstrom BL, Hodges JS, Bouchard TJ. No heritabilty of temporomandibular joint signs and symptoms. J Dent Res 79: 1573-1578, 2000.
36. Farsi N. Temporomandibular dysfunction and the emotional status of 6-14 years old Saudi children. Saudi Dent J 11: 114-119, 1999.
37. Vanderas AP. Prevalence of craniomandibular dysfunction in white children with different emotional states Part III. A comparative study. J Dent Child 59: 23-26, 1992.
38. Yemm R. Neuro physiological studies of temporomandibular joint dysfunction. Oral Sci Rev 1: 31-53, 1976.
39. Solberg WK, Rugh JD. The use of biofeedback devices in the treatment of bruxism. J South Calif Dent Assoc 40: 852-853, 1972.
40. Rug JD, Solberg WK. The identification of stressful stimuli in natural environments using a portable biofeedback cent. Res Soc Biofeedback Proc, Colorado Springs, Colorado, 1974.
41. Veslegaarg Christensen L. Facial pain and internal pressure of masseter muscle in experimental bruxism in man. Arch oral Biol 9: 1021-1031, 1971.
42. Rugh JD, Solberg WK. Electromyographic studies of bruxist behavior before and after treatment. (Abstr) J Dent Res 54: L563, 1975.
43. Perry HT, Lammie GA, Main J, Teuscher GW. Occlusion in a stress situation. J A D A 60: 626-633, 1960.
44. Yemm R. Variations in the electrical activity of the human masseter muscles accruing in association with emotional stress. Arch oral Biol 14: 873-879, 1969.