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Malocclusion and the need for orthodontic treatment in patients with temporomandibular dysfunction

Eliis Kaselo, Triin Jagomägi, Ülle Voog

SUMMARY

Objective. The aim of the study was to investigate the signs and symptoms of temporomandibular disorders (TMD) as well as the relationships between TMD, malocclusion and the need for orthodontic treatment. Material and methods. Forty consecutive patients (36 F, 4 M) with a median age of 35 (IQR 18) years. Eighteen patients had Class I, 22 patients Class II malocclusion. A rating scale for the influence of TMJ pain/discomfort on the activities of daily living (ADL) was used simultaneously with clinical examination. Helkimo's Dysfunction Index (D_i) and the Index of Orthodontic Treatment Need (IOTN) were determined for each participant. Results. Pain/discomfort in the TMJ area was positively correlated with interferences in laterotrusion (p=0.021), pain on palpation over the posterior aspects of TMJ (p=0.012) and pain in the masticatory muscles (p=0.023).

The impact of TMJ pain/discomfort was greatest on the performance of a yawn and on opening the mouth wide. There was no statistically significant correlation between malocclusion, D_i and IOTN. A comparison of Class I malocclusion patients to those with Class II malocclusion revealed no statistically relevant differences in D_i and ADL.

Conclusion. In patients with malocclusion, pain from TMJ has a significant negative impact on activities of daily living. No significant differences were observed between Angle Class I and Class II groups of patients with respect to TMD. Orthodontic treatment was required for both groups.

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Key words: ADL, IOTN, malocclusion, pain, TMJ.

INTRODUCTION

Temporomandibular dysfunctions (TMD) cause numerous limitations in our everyday life activities.

The theory of TMD development is multifactorial, often citing malocclusion and occlusal interferences as contributing factors [1-3]. At the same time many authors have shown no connection or at most a weak connection between malocclusion and TMD [4-7].

*Department of Stomatology, Faculty of Medicine, University of Tartu, Estonia
Eliis Kaselo * – D.D.S.
Triin Jagomägi * – D.D.S., MSc., MOrthRCSEd, assist. prof.
Ülle Voog * – D.D.S., Lic.Med., Dr.Med, assoc. prof.

Address correspondence to: Eliis Kaselo, Nõva 2a-5, Tartu 50104, Estonia.
E-mail: eliiskaselo@hot.ee

Malocclusion itself is a product of multiple factors influencing craniomandibular growth and development and exerts a significant influence on the patient's quality of life [8-9].

Occlusal interferences may play an important role in the development of TMD through non-working side interferences as well as discrepancy between the intercuspal position and the retruded contact position [10].

The Index of Orthodontic Treatment Need is widely used for scoring malocclusion and occlusal interference which, in turn, constitute important aspects of TMD development [11]. The Activities of Daily Living (ADL) scale is intended to give a semi-quantitative assessment of the patient's overall function. The scale has been specifically modified for use in patients with TMD [12].

It is well accepted that traditional orthodontic treatment does not increase the prevalence of TMD [13-14]. Several malocclusion types such as anterior open bite, cross bite and increased overjet may signify an increased likelihood of developing TMD [2-3, 15-16]. Yet it has not been settled clinically whether malocclusion causes TMD or vice versa.

An interesting question is whether there is a connection between morphologically or functionally unacceptable occlusion and temporomandibular dysfunction. Therefore the aim of this study was to evaluate the impact of TMJ signs and symptoms as well as malocclusion on daily living activities of patients with TMD and assess their need for orthodontic treatment.

METHODS

Patients

The study included forty consecutive patients (36 females and four men) with a mean age of 35 years. Seven of the patients had been diagnosed with systemic inflammatory disease. The patients were referred to the TMJ specialist at the Clinic of Stomatology by the general dentist or oral surgeon during the period of May 2005 to December 2005. None of the patients had received any TMJ treatment during the previous six months. Patients under 18 were excluded from the study.

Table 1. Distribution of the Index of Orthodontic Treatment Need (IOTN), Helkimo´s Dysfunction Index (D_i), pain at rest, the pressure pain threshold (PPT) at reference point (Ref), asymptomatic and symptomatic side, muscle tenderness

Pat	IOTN	D_i	Pain at rest	Pain at MVM	PPT/ Ref	PPT/ Asympt	PPT/ Sympt	Muscles
A	3	I	0	1	429	363	124	1
B	3	II	0	0	172	121	101	4
C	4	I	0	0	218	218	168	0
D	4	I	0	0	167	176	140	0
E	3	III	0	1	224	122	82	2
F	3	I	0	1	304	205	183	2
G	1	II	0	1	508	346	230	0
H	3	II	0	1	273	198	123	2
I	4	I	0	0	409	352	261	0
J	3	I	0	0	204	216	200	2
K	3	I	0	1	335	288	198	0
L	4	III	2	2	238	106	98	1
M	1	I	0	0	186	187	184	1
N	2	II	0	2	181	140	132	0
O	1	II	1	1	223	226	218	3
P	3	III	0	1	354	181	167	0
Q	3	II	0	0	270	250	146	1
R	1	I	1	1	361	259	177	2
S	2	II	0	1	334	193	188	0
T	4	I	0	0	278	322	308	0
U	2	I	0	0	305	261	196	0
V	4	I	0	0	254	208	204	1
W	4	I	0	0	418	272	234	2
X	2	I	0	1	498	293	249	0
Y	1	II	0	0	308	220	178	5
Z	3	I	0	0	317	299	226	1
AA	2	II	2	0	MD	MD	MD	2
AB	1	II	0	1	MD	MD	MD	2
AC	4	0	0	0	MD	MD	MD	0
AD	4	II	0	0	MD	MD	MD	0
AE	2	II	0	1	MD	189	107	1
AF	2	I	0	0	MD	MD	MD	0
AG	4	II	1	1	MD	263	204	0
AH	2	I	0	1	226	182	110	0
AI	2	I	0	0	229	132	120	0
AJ	2	III	0	0	358	318	300	4
AK	2	II	0	0	318	174	153	0
AL	5	I	0	0	254	180	137	0
AM	1	II	0	0	268	216	210	1
AN	3	III	1	2	181	124	82	10
Mean	3				291	223	175	1
IQR	2				111	87	79	2

PPT – mean of the pressure pain threshold (kPa) over the lateral aspect of the TMJ.
PPT/Ref – referents point, PPT/Asympt – asymptomatic side of the TMJ.
PPT/Sympt – symptomatic side of the TMJ.
Muscles – pain/tenderness of masticatory muscles, 0 – no pain/tendernes.
14 – pain/tenderness in all palpated areas, MD – missing data.

The Activities of Daily Living (ADL) scale

The patients were asked to evaluate the influence of pain/discomfort in the TMJ on their daily activities. They were instructed to use a rating scale based on methods generally employed in medical and behavioural science, as modified by List and Helkimo [12] for assessment of daily activities in patients with temporomandibular disorders. The scale had already

Table 2. The prevalence of malocclusion traits, Index of Orthodontic Treatment Need (IOTN), Helkimo's Dysfunction Index (D_i)

	Prevalence	Total
AI	45.0	18
AII	55.0	22
OJ>= 6mm	20.0	8
OB>= 5mm	40.0	16
PCB	22.5	9
VOB	10.0	4
IOTN 1	17.5	7
IOTN 2	27.5	11
IOTN 3	27.5	11
IOTN 4	25.0	10
IOTN 5	2.5	1
D_i0, D_iI	50.0	20
D_iII	37.5	15
D_iIII	12.5	5

n = 40

AI – Angle I malocclusion, AII – Angle II malocclusion. OJ – overjet, OB – overbite, PCB – posterior crossbite, VOB – vertical open bite.
IOTN 1 – Grade 1 (None), IOTN 2 – Grade 2 (Slight), IOTN 3 – Grade 3 (Borderline need), IOTN 4 – Grade 4 (Need treatment), IOTN 5 – Grade 5 (Need treatment).
D_i0 – clinically symptom-free, D_iI – mild symptoms, D_iII – moderate symptoms, D_iIII – severe symptoms.

been translated from English into Estonian and used in a previous study [17]. Compared to the original, the modified scale excluded one question which had been shown by List and Helkimo to be inadequate [12]. The scoring in the scale ranged from 0 (activity without any pain/discomfort in the TMJ) to 10 (activity impossible due to pain/discomfort in the TMJ). The patients were told to select the score value that best described their present ability to perform each of the scale activities. The questions appearing in the modified scale are as follows:

If you feel pain/discomfort in the area of TMJ are you able to:

1) socialize with family and close friends?

2) perform daily work?

3) perform daily household chores (preparing meals, cleaning, taking care of small children)?

4) sit in a company or participate in other social activities (e.g. parties)?

5) exercise (walk, bicycle, jogging, etc)?

6) perform hobbies (read, fish, knit, play an instrument)?

7) sleep at night?

8) concentrate?

9) eat (chew, swallow)?

10) yawn, open mouth wide?

11) how much does the pain/discomfort affect your daily activities?

Clinical examination

All patients were examined in the dental chair in the supine position. The movement capacity of the mandible at maximum opening, protrusion, retrusion and laterotrusion was measured in millimeters. The pain in the TMJ area was registered at rest and during the above measurements. The results were recorded as 0 – no pain, 1 – pain in one side, 2 – pain in both sides and added up to provide an index sum.

Assessment of tenderness to digital palpation

The tenderness to digital palpation was assessed on the lateral and posterior aspects of the TMJ. The results were recorded as 0 – no pain, 1 – pain in one side, 2 – pain in both sides and added up to provide an index sum.

Palpation of masticatory muscles

Pain in the masticatory muscles was registered by digital palpation of both sides. The palpation sites were the anterior part of the temporal muscle, the posterior part of the temporal muscle, the attachment of the temporal muscle, the profound masseter muscle, the superficial masseter muscle, the medial pterygoid muscle and the lateral pterygoid muscle. The patients' scoring of pain (out of a maximum of 14) on digital palpation of each of these muscles was added up to provide an index sum.

TMJ sounds

The TMJ sounds (clicking and crepitation) were investigated on opening and closing the mouth on both sides by lateral and posterior palpation. The scores of the sounds (out of a maximum of 8) were added up to provide an index sum.

Helkimo's Dysfunction Index

The Clinical Dysfunction Index (D_i) was calculated according to Helkimo [4]. The index is based on five groups of symptoms: impaired range of movement of the mandible, impaired function of the TMJ, pain on movement of the mandible, pain in the temporomandibular joint, pain in the masticatory muscles. D_i can be divided into four groups: clinically symptom-free (D_i0), mild symptoms (D_iI), moderate symptoms (D_iII), and severe symptoms (D_iIII).

Occlusion

Occlusion was registered according to Angle malocclusion classes based on the occlusal

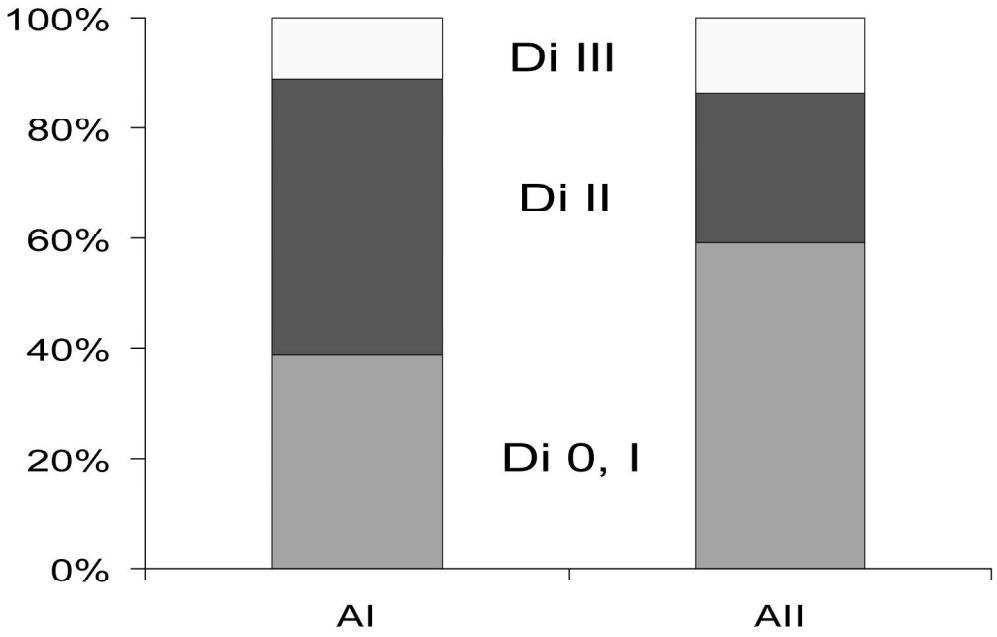

Fig. Distribution of Helkimo´s Dysfunction Index

relationship of the first molars. The patients involved in the study had either Angle Class I or Angle Class II malocclusion.

Contacts in laterotrusion on non-working side and in protrusion between posterior teeth were considered as occlusal interferences.

Orthodontic treatment need was determined according to the Index of Orthodontic Treatment Need [11]. The Dental Health Component of the index was assessed as follows: grade 1 (none), grade 2 (slight need), grade 3 (borderline need), grade 4 (need treatment), grade 5 (need treatment).

Statistics

T-test and chi-square test were used to compare the differences between Angle Class I and Angle Class II malocclusion groups. The significance of correlations was tested by Spearman rank correlation test. A probability level of less than 0.05 was considered as significant.

RESULTS

The prevalence of malocclusion traits, D_i and IOTN among the participants is shown in Table 1 and Table 2.

Pain/discomfort

Pain/discomfort in the TMJ area at rest was positively correlated with interferences in laterotrusion (r_s=0.32; n=40; p=0.02) and the total pain score from the masticatory muscles (r_s=0.32; n=40; p=0.02).

Maximum mouth opening was positively correlated with TMJ sounds (r_s=0.51, n=40; p<0.001).

ADL scale

The scores of ADL scale are presented in Table 3.

The impact of TMJ pain/discomfort was greatest on performing a yawn and on opening the mouth wide (5.62) and smallest on performing

Table 3. The mean scores of the ADL scale

ADL	1	2	3	4	5	6	7	8	9	10	11	12
Mean total	3.44	3.62	3.54	4.03	3.59	2.78	3.90	3.85	4.72	3.95	5.62	4.14
Mean AI	3.76	3.94	3.47	4.24	3.88	3.19	3.76	3.82	4.82	3.76	5.76	3.94
Mean AII	3.18	3.36	3.59	3.86	3.36	2.48	4.00	3.86	4.64	4.09	5.50	4.32
IQR	4	4,5	4	4	4	3	4	4	4	4,5	4,5	4
%pos	85	82	85	85	79	75	90	82	92	87	92	87

Angle I group: n=17.
Angle AII group: n=22.
IQR – interquartile range, % pos – percentage of observations exceeding zero,
n.a. – not applicable.

hobbies (2.78). The impact of TMJ pain/discomfort on performing a yawn and on opening the mouth wide was positively correlated with pain/discomfort in the TMJ area at rest (r_s=0.38, n=39, p=0.008), pain at maximum opening (r_s=0.41, n=39, p=0.005) and negatively correlated with maximum mouth opening (r_s=-0.36, n=39, p=0.01).

There were no statistically relevant correlations between morphological malocclusion, D_i and IOTN.

Comparison between Angle Class I and Class II groups

Comparing the Angle Class I and Angle Class II malocclusion groups revealed that they were statistically heterogeneous in terms of interferences in protrusion (p=0.005) and homogeneous in IOTN (p<0.001) and protrusion (p=0.03).

Severe symptoms of TMD (D_i III) were distributed similarly in Angle Class I and Angle Class II malocclusion groups (Figure).

DISCUSSION

According to the results of the present investigation, pain from TMJ in patients with malocclusion has a significant negative impact on their activities of daily living. This finding is in accordance with the results of a previous study by the same authors in which rheumatoid arthritis patients with TMJ involvement were asked to assess the impact of TMD on their daily living activities [17]. The impact of TMJ pain/discomfort was found in that study to vary between activities and individuals. However, the fact that the impact in general was expressed in a mean score of 4 out of 10 suggests a significant influence on daily life. The impact on opening the mouth, eating and yawning, which are all relatively frequent daily activities can be explained by the pain/discomfort originating from the TMJ area. On the other hand, a very low mean score of 2 in relation to performing hobbies suggests that a pleasant activity helps to forget about the sensation of pain/discomfort. Of course, it is also possible that the patients had changed their selected hobbies, preferring those with lower associated TMJ pain levels. In our study the correlation found between yawning and pain on maximum mouth opening was to be expected, while this type of pain can be considered mechanically induced. In this respect the results of the present study largely overlap with those of the previous one [17]. The correlation with pain at rest would apply on another entity of pain as a form of subjectively perceived spontaneous pain [19]. These two aspects of pain differ from one another but are both likely due to the peripheral sensitization of nociceptive nerve fibers, to central sensitization or a combination of the two and reflect the cumulative effect of pain.

The negative correlation between yawning and reduced mouth opening capacity probably constitutes an indirect indicator of the presence of pain, although other causes of restricted movements such as adhesions in the joint may also be involved. These findings suggest the need for patients to avoid any excessive excursions of the TMJ in order to prevent TMD development.

TMJ sounds are caused by non-coordinated movement of the disc and the mandibular caput. In more advanced stages of TMD, they may also arise from the destruction of the connecting articular surfaces.

The pain originating from masticatory muscles is often related to TMJ pain. Interferences in laterotrusion could result in pain/discomfort in the TMJ area at rest as well. It is known that interferences in TMJ function affect normal muscular action. Although the mechanisms behind muscle pain are not fully understood yet, it appears plausible that symptoms of pain and fatigue in masticatory muscles could be due to malocclusion and stress. This is amongst other things indicated by the fact that patients with more severe and extensive dysfunction of the mandibular muscles demonstrate a decrease of muscular control of the movement of the condyle and disc in the TMJ [20].

According to the results of the present study there were no differences between Angle Class I and Class II patients in relation to orthodontic treatment need. This implies that the morphological and functional malocclusions evidenced by the study participants cannot be considered the sole cause of their TMD. Other factors that may also be of importance include previous emotional or physical childhood traumas or current emotional stress. Systemic inflammatory disease can also be an important factor contributing to the development of TMD. The present investigation involved a total of 18% of patients with that condition. Since this is a relatively low figure and the corresponding variable was almost equally distributed between the two investigated groups (Angle Class I and Class II patients), it should not affect the results obtained.

As regards the comparability of the present study with other studies dealing with the same

questions, besides more prevalent younger age groups [2-3, 21] the latter have also been performed on a number of adult groups [1, 7]. Furthermore, it is known that changes in the TMJ due to age tend to appear only after 41 years of age [22]. The findings of this study cannot be affected by the age of participants, since the study involved consecutive patients with a mean age of 35 years (relatively young participants). All of the above indicates good comparability with other studies in the field.

The results of the present study showed that morphological malocclusion and the Index of Orthodontic Treatment Need had no significant impact on Helkimo´s Clinical Dysfunction Index. This may be due to the limited number of patients in the group studied (type II error).

According to Olsson and Lindquist [23] orthodontic patients appear to be at greater risk of developing a craniomandibular disorder than individuals who only need minor treatment. In other studies TMD was associated with midline displacement, posterior crossbite, anterior open bite, Angle Class III malocclusion, and extreme maxillary overjet [2-3, 7, 11]. In a 20-year follow-up of subjects with and without orthodontic treatment in childhood the correlations between signs and symptoms of TMD and different types of malocclusion were mainly weak, although sometimes statistically significant [7]. A population-based study in adult patients showed that only a bilateral open bite of up to three mm appeared to be clinically relevant and was associated with TMD signs [1]. This and other population-based studies [24] indicate that malocclusions and factors of functional occlusion should be seen as merely contributory to developing temporomandibular dysfunctions.

There was no difference in distribution of most of the TMD signs and symptoms between the malocclusion groups established among participants according to Angle malocclusion classification. A similar distribution was found in IOTN and protrusion. An explanation of this similarity could lie in the fact that Angle malocclusion classes describe malocclusion in the sagittal plane only. Different distributions of interferences in protrusion and overbite indicate that in Class II malocclusion the bite is usually deeper and as a result of pronounced incisor guidance involves less interference in protrusion.

The findings of the present study reinforce the importance of simultaneously administering a clinical examination and a self-reporting questionnaire.

CONCLUSION

Pain from the TMJ in patients with malocclusion has a significant negative impact on activities of daily living. There were no differences between Angle Class I and Angle Class II malocclusion patients regarding TMD and IOTN. Orthodontic treatment was required for both groups.

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