# Self-reported temporomandibular disorder symptoms and severity of malocclusion in prospective orthognathic-surgical patients

Running head: Symptoms of TMD and malocclusion

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ABSTRACT

*Objective:* To analyze the association between self-reported symptoms of temporomandibular joint disorder (TMD) and the severity of malocclusion in prospective orthognathic-surgical patients. *Material and methods:* The subjects consisted of 50 consecutive patients (13 males, 37 females) referred to two university clinics for assessment of orthodontic-surgical treatment need. Data considering self-reported TMD symptoms were gathered using a semi-structured diary. At the first appointment, all patients rated the importance of treatment (on a scale of 1–10) and assessed self-perceived dental appearance using a VAS scale. The scale was anchored with photographs 1 and 10 from the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN). Study models were assessed by an experienced orthodontic specialist using the Peer Assessment Rating (PAR) index and the Index of Complexity, Outcome and Need (ICON). Association between the PAR and ICON scores and the number of reported symptoms was analyzed statistically. *Results:* 71% of patients reported experiencing TMD symptoms. The most prevalent symptoms were pain in the head and/or neck region and fatigue in the TMJ region. The number of symptoms was highest in the morning. 90% of males and 86% of females rated the importance of treatment as high; males experiencing TMD symptoms tended to rate surgery as more important compared to males with no symptoms (p=0.056). *Conclusions:* In this sample, the results cannot unambiguously confirm an association between self-reported symptoms of TMD and objectively defined severity of malocclusion.

*Key words:* Index of Complexity Outcome and Need, Peer Assessment Rating, self-perception

# INTRODUCTION

Temporomandibular disorder (TMD) incorporates numerous signs and symptoms involving masticatory musculature, temporomandibular joints (TMJs) and associated structures. TMD has been found to be a major cause of non-dental pain in the orofacial region [1]. The most frequent symptoms are pain in masticatory muscles and in TMJs, TMJ sounds, and limitations in mandibular movements [2,3]. Several predisposing, triggering and sustaining factors for TMD have been identified: female gender [4-7], mandibular instability [4], depression [8], and parafunctional habits [4,6]. In a recent study by Sierwald et al. [9], TMD patients reported two to three times higher percentages of both daytime and nighttime bruxism than controls. Although these two types of bruxism reflect various backgrounds [10-12], both types are regarded as contributing to the development of TMD [9].

TMD has previously been linked with strong evidence to malocclusion, e.g. open bite, deep bite and cross bite [2,4,6,13]. However, there are also studies that have not considered malocclusion a risk factor [5,14] or that have suggested that it should only be considered a contributing factor in the multifactorial etiology of TMD [15]. In Finland, three out of four patients seeking orthodontic-surgical treatment suffer from TMD symptoms [16,17]. After combined orthodontic-surgical treatment, a significant reduction has been found especially in TMD-related headaches. Even other symptoms, such as TMJ crepitation and muscle soreness, have been found to decrease [17-20]. The results are, however, somewhat ambiguous: in 4–41% of patients, the subjective symptoms have been found to increase post-operatively [2,16,18,21], or there has been no significant change between pre- and postoperative symptoms [22,23]. It has been suggested that patients suffering from preoperative TMD and undergoing orthognathic surgery have an increased risk for postoperative worsening of the symptoms [21].

The aim of this study was to analyze the association between self-reported symptoms of TMD and the severity of malocclusion in prospective orthognathic-surgical patients. The hypothesis suggested a correlation between self-reported TMD symptoms and the severity of malocclusion.

## MATERIAL AND METHODS

The subjects comprised 50 consecutive patients (13 males and 37 females, mean age 33.6 years, age range 18–61 years) referred to two university clinics for assessment of orthognathic-surgical treatment need.

Data considering TMD symptoms were gathered using a semi-structured diary that included seven statements with two response alternatives, yes and no: (1) I have pain in my head and/or neck region, (2) I have pain in the area of my jaw joint, (3) I hear sounds like clicking or crepitation from my jaw joint, (4) My jaws feel tired or stiff, (5) I have difficulties in opening my mouth, (6) I suffer from teeth clenching or grinding, (7) I have difficulties in chewing, (8) Some other problem, please explain. Statements 1–7 were selected from the Research Diagnostic Criteria for Temporomandibular Disorder (RDC-TMD) History Questionnaire [24] and the Diagnostic Criteria for Temporomandibular Disorder (DC/TMD) Symptom Questionnaire [25]. They were slightly modified to focus on the patient's current experience. The respondents were instructed to fill in the diaries during one working day and one day off work as soon as possible following the appointment. The diaries were to be filled in four times a day: a) after waking up or at 8 a.m., b) after lunch or at noon, c) after work or at 4 p.m. and d) when going to sleep or at 8 p.m. [26]. Prior to the study, the diary was tested among eight students for possible revision. However, no amendments were needed.

In the clinical examination, patients were asked to rate the importance of treatment on a scale from 1 (not important) to 10 (extremely important). Further, they were asked to assess

self-perceived dental appearance on a visual analogue scale (VAS) anchored with two color photographs: number 1 (no aesthetically based treatment need) and number 10 (definite treatment need) from the Aesthetic Component (AC) of the Index of Orthodontic Treatment Need (IOTN) [27].

Impressions for study models were taken and the study models were assessed by an experienced, calibrated orthodontic specialist using the Peer Assessment Rating (PAR) index [28] and the Index of Complexity, Outcome and Need (ICON) [29]. The PAR scores five occlusal components: 1) relationship between dental midlines in upper and lower jaw, 2) overjet, 3) overbite, 4) alignment in upper and lower anterior segments, and 5) sagittal, vertical and transversal relationships on the left and right sides. Individual scores are weighted with coefficients from 1 to 6, depending on the component. The weighted scores are added up to give a total PAR score. Similarly, the ICON includes five assessments: 1) overbite, 2) upper arch crowding and spacing, 3) quality of buccal segment interdigitation (both sides), 4) transversal relationship between upper and lower dental arch and 5) assessment of dental appearance using the AC. In evaluation of study models, dental appearance is assessed using the black and white AC scale. In the ICON, the weightings range from 3 to 7 and the weighted sub-scores comprise the final ICON score. Seventeen of the study models (34%) were rescored using both PAR and ICON. The intra-examiner reliability was good (the intraclass correlation coefficients were 0.86 and 0.89, respectively).

The study protocol was approved by the Ethics Review Committees of the Hospital District of South-West Finland and the Joint Municipal Authority of the Pirkanmaa Hospital District. All patients signed an informed consent form before the study.

*Statistical analyses*

To describe prevalence, TMD symptoms were analyzed according to the replies, i.e., symptoms/no symptoms. Moreover, a new sum score variable describing the number of

symptoms was calculated by adding up the answers for all of the different symptoms. Because all patients did not indicate which of the diaries were filled in during a working day or a day off, the responses in the two diaries were combined and the mean values were used in further analyses. The importance of treatment was analyzed using both continuous and dichotomized values (scale 1–10, values 1–6 "not important" and values 7–10 "important"). AC and VAS values of 1–4 were interpreted as "no treatment need", values of 5–7 as "borderline" and values of 8–10 as "definite treatment need." In addition, the ratings were dichotomized into two categories, "no aesthetic treatment need" (values 1–4) and "aesthetic treatment need" (values 5–10).

The differences in the number of symptoms, importance of treatment, self-perceived dental aesthetics and PAR, ICON and AC scores between females and males were evaluated using the Mann-Whitney U test. Differences in the prevalence of symptoms, dichotomized importance of treatment and dental aesthetics were evaluated with the chi square test. Changes in the frequency of symptoms during the day were analyzed using general linear modeling for repeated measures using Huynh-Feldt correction ($\varepsilon > 0.75$). Associations between the PAR, ICON and AC scores and between age, AC scores and number of TMD symptoms were evaluated with Spearman correlation coefficients. P-values of $< 0.05$ were interpreted as statistically significant. The analyses were conducted using the SPSS Statistical Package (IBM SPSS Statistics, V22.0, Armonk, NY).

## RESULTS

A total of 71% of patients (76% of females, 55% of males, p=0.163) reported TMD symptoms. The total number of symptoms was highest in the morning and decreased during the day (p= 0.001). The most prevalent symptom was pain in the head and/or neck region, followed by fatigue or stiffness in the TMJ region, difficulties in chewing, and joint sounds.

The prevalence details of the different symptoms are given in Table I. The mean PAR score was 26.46 and the mean ICON score 62.42. There were no statistically significant associations between PAR or ICON scores and the number of self-reported TMD symptoms (Table II).

The majority of all respondents (86% of females and 90% of males) rated the importance of treatment as 7 or higher. Males reporting TMD symptoms tended to rate treatment as more important than males with no symptoms (p=0.056). Subjective assessment of dental appearance was 5 or more in 66% of females and 64% of males (p=0.905), while 59% of females and 69% of males were assessed as having AC scores of 5 or more by the orthodontic professional (p=0.532). The professionally assessed AC scores were lower (indicating a more pleasing dental appearance and lower treatment need) among males with TMD symptoms than among males without symptoms (mean 4.5, range 3–7 vs. mean 6.6, range 4–9) (p=0.078). Further, ICON scores were lower among males with TMD symptoms than among males without symptoms (mean 52.2, range 35–71 vs. mean 70.4, range 53–92) (p=0.100).

Respondents' age was not correlated with the number of TMD symptoms or with the professionally defined AC (scale 1–10). Correlation between the PAR and ICON scores was 0.763 (p<0.001), and 0.782 (p<0.001) between the PAR and AC scores. By gender, statistically significant differences were found neither in the PAR, ICON or AC scores, nor in the number of symptoms, importance of treatment or self-perceived dental aesthetics (Table II).

## DISCUSSION

In line with previous studies, the most frequently reported symptoms of TMD included pain, joint sounds and functional limitations [2,3,7]. The finding that these symptoms and the

severity of objectively assessed malocclusions had no obvious association is in accordance with the results by Sipilä et al. [30], who also found no association between facial pain and occlusal traits assessed using the PAR. However, Mohlin et al. [31] analyzed the association between TMD and occlusal features, and reported that young adults with TMD had significantly higher PAR scores than controls. This difference is presumably due to the fact that in the two former studies, comparisons were made using subjective symptoms of TMD, while Mohlin et al. [31] compared clinically determined, objective signs and occlusal characteristics.

A total of 71% of subjects reported TMD symptoms, which is in line with earlier reports [16,17]. A higher number of symptoms was reported in the morning than at other times of day. Also Nishiyama et al. found that the number of symptoms decreased during the day [32]. They concluded that habitual behavioral factors, such as sleep bruxism, exert a strong effect on TMD-related symptoms. In the current sample, however, only a few patients reported teeth clenching/grinding, emphasizing the need to further analyze temporal differences in the prevalence of various symptoms.

The majority of the patients rated orthognathic-surgical treatment as highly important. Given that the condition-specific quality of life has been found to be lower in preoperative orthodontic-surgical patients with TMD than in controls [33], it is not surprising that males reporting TMD symptoms rated the treatment as more important than did their symptom-free counterparts. In females, the difference was negligible. The difference between male and female patients may be explained by the finding that in males, occlusal traits have been shown to be directly associated with health-related quality of life, while in females the association is indirect [34].

The present study had some limitations. First, the sample size was small, especially in terms of the number of males. However, the numbers were comparable to another recent

study investigating the effects of orthodontic and orthodontic-surgical treatments on severe malocclusion [35]. It is possible that the low participation rate of males reflects previous findings that females experience TMD symptoms more frequently than males [4,7,36]. Therefore, the threshold for seeking treatment may be lower among women [34]. Despite the small number, the difference in self-rated importance of orthognathic-surgical treatment almost reached statistical importance when comparing symptomatic and asymptomatic males.

The second limitation was related to the diary. It included selected questions from the RDC/TMD History Questionnaire [24] and the DC/TMD Symptom Questionnaire [25]. The RDC/TMD diagnostic system has been a widely used method, and its application has been recommended [37]. Among the history-taking questions, attention has been paid especially to self-reported pain, limitations in mouth opening, and joint sounds [7,37]. In the present study, we used slightly modified symptom-related statements focusing exactly on a patient's most recent experiences. Although the reliability and validity of the original questionnaires has been tested, it is possible that application of the current subset has affected these values. Therefore, the results should be interpreted with some reservation.

Although PAR and ICON have been proposed as suitable in evaluating occlusion in orthognathic-surgical patients [38], it should be kept in mind that their focus is in static occlusion. Assessment of functional factors is not incorporated, even though they are a primary reason for seeking orthognathic-surgical treatment [39]. PAR emphasizes especially overjet and deviation of dental midlines [28] while ICON's highest weightings focus on dental appearance and crowding [29]. It is possible that some of the patients referred for assessment of orthognathic-surgical treatment need already have aligned dental arches. Therefore, they may not get high scores according to the indices (Table II). To obtain a more comprehensive view on the dimensions of severe malocclusion, the index scores should be complemented by patients' own assessment of pain and other everyday consequences.

To summarize, the small sample size and the fact that not all respondents reported symptoms prevent definitive conclusions. The results cannot unambiguously confirm an association between self-reported symptoms of TMD and objectively defined severity of malocclusion.

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Table I. The prevalence of different symptoms in 34 females and 11 males who replied to symptom statements. A total of 26 females and 6 males reported symptoms.

|  |  | Morning | Noon | Afternoon | Evening |
|---|---|---|---|---|---|
| Pain in the head and/or neck region | Day 1 | **20** | 12 | 12 | 10 |
|  | Day 2 | 13 | 9 | 8 | 10 |
| Fatigue and/or stiffness in TMJ region | Day 1 | **19** | 9 | 11 | 10 |
|  | Day 2 | 12 | 8 | 5 | 11 |
| Difficulty chewing | Day 1 | **13** | 8 | 10 | 8 |
|  | Day 2 | 6 | 5 | 6 | 6 |
| TMJ sounds | Day 1 | **13** | 6 | 5 | 2 |
|  | Day 2 | 5 | 4 | 5 | 2 |
| Pain in the area of TMJ | Day 1 | **12** | 8 | 9 | 8 |
|  | Day 2 | 6 | 4 | 4 | 6 |
| Teeth clenching or grinding | Day 1 | **9** | 2 | 3 | 3 |
|  | Day 2 | 3 | 0 | 1 | 2 |
| Difficulty opening mouth | Day 1 | **7** | 5 | 3 | 3 |
|  | Day 2 | 4 | 2 | 2 | 3 |
| Some other reason | Day 1 | **3** | 2 | 1 | 2 |
|  | Day 2 | 1 | 4 | 1 | 1 |
| Number of those reporting symptoms | Day 1 | 27 | 14 | 14 | 12 |
|  | Day 2 | 18 | 13 | 13 | 16 |

The highest prevalences given in bold.

TMJ = temporomandibular joint

Table II. Descriptive statistics for the distribution of TMD-symptoms, self-rated importance of surgery and self-perceived dental aesthetics among all patients (37 females and 13 males), and separately among those patients who reported symptoms (26 females and 6 males).

| | | All patients | | | Patients with symptoms | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Median | Range | Mean | Median | Range |
| Mean number of symptoms | Females | 1.8 | 1.5 | 0–7 | 2.3 | 2 | 0–7 |
| in the morning* | Males | 1.0 | 0.25 | 0–3.5 | 1.7 | 1.5 | 0–3.5 |
| Mean number of symptoms | Females | 1.1 | 0 | 0–7 | 1.5 | 0.75 | 0–7 |
| at noon* | Males | 0.7 | 0 | 0–3 | 1.3 | 1.25 | 0–3 |
| Mean number of symptoms | Females | 1.2 | 0 | 0–7 | 1.5 | 1 | 0–7 |
| in the afternoon* | Males | 0.6 | 0 | 0–3 | 1.2 | 0.75 | 0–3 |
| Mean number of symptoms | Females | 1.1 | 0 | 0–4.5 | 1.3 | 1 | 0–4.5 |
| in the evening* | Males | 0.8 | 0.25 | 0–3 | 1.5 | 1.25 | 0–3 |
| Mean number of all | Females | 1.3 | 0.5 | 0–5.8 | 1.7 | 1 | 0.3–5.8 |
| symptoms* | Males | 0.8 | 0.25 | 0–3 | 1.4 | 1.1 | 0.1–3.0 |
| Importance of treatment | Females | 8.4 | 9 | 5–10 | 8.8 | 9 | 6–10 |
| (scale 1–10) | Males | 8.1 | 8 | 6–10 | 9.3 | 9.5 | 8–10 |
| Subjective dental aesthetics | Females | 5.3 | 5.5 | 1–9 | 5.3 | 6 | 1–9 |
| (scale 1–10 ) | Males | 5.0 | 5 | 3–8 | 5.2 | 5 | 3–8 |
| PAR score | Females | 26.4 | 29 | 6–42 | 27.5 | 29.5 | 14–42 |
| | Males | 26.5 | 28 | 8–43 | 23.2 | 21.5 | 8–39 |
| ICON score | Females | 62.7 | 63 | 13–94 | 62.3 | 64.5 | 25–94 |
| | Males | 61.6 | 60 | 35–92 | 52.2 | 53 | 35–71 |
| AC of the IOTN | Females | 5.9 | 6 | 1–10 | 6.0 | 6.5 | 2–10 |
| | Males | 5.7 | 5 | 3–9 | 4.5 | 4.5 | 3–7 |

* To questions about symptoms, only 34 females and 11 males replied.

No statistically significant differences were observed between males and females.