Do Oral Parafunctional Behaviors Relate to the Natural Course of Self-healing of Temporomandibular Disorder? An 8-month Prospective Study

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Abstract

The assessment of parafunctional behaviors is an essential baseline examination because those behaviors can cause repetitive trauma to the masticatory system. The purpose of this study was to examine whether changes in oral parafunctional behaviors are related to the natural course of temporomandibular disorder (TMD). The parafunctional behaviors were assessed by the Oral Behavior Checklist (OBC), a subjective list of 21 parafunctional behaviors. Symptoms of TMD were assessed by a self-reporting diagnostic tool, the symptoms questionnaire (SQ). The OBC and SQ questionnaires were administered to 112 students (71 males and 41 females, mean age 22.91 ± 1.99 years) at baseline (BL) and after an 8-month follow-up (FU) period. The chi-squared test was performed to test the null hypothesis that there would be no change in prevalence between symptoms at BL and symptoms at FU.

The null hypothesis, which was that the natural course of the variety of the OBC tertile group (a group shift to a lower score tertile group, a group shift to a higher score tertile group, and the absence of a group shift after the 8-month FU period) would not be associated with the natural course of TMD symptoms, was rejected. There was a statistically significant association between the participants who shifted tertile groups and the natural course of TMD, with respect to pain (p = 0.013) and noise (p > 0.00).

Introduction

The term “oral parafunction” refers to jaw behaviors outside of normal function, such as clenching, grinding, tongue pushing, and biting nails (1, 2). The assessment of common parafunctional behaviors is considered essential because these behaviors can cause repetitive trauma to the masticatory system. Trauma-related muscle inflammation by the release of neurotransmitters, such as calcitonin gene-related peptide and substance P, generate pain and cause symptoms in patients (3, 4).

Previous studies have reported an association between parafunctional activities (e.g., sleep clenching, sleep grinding, chewing on one side only, gum chewing behavior, and playing musical instruments with oral organs) and symptoms of temporomandibular disorder (TMD) (5–8). However, these studies showed varying results, because they used questionnaires developed by different researchers. Moreover, TMD is a disorder that frequently spontaneously resolves. However, the specific conditions and underlying mechanism that enable self-healing are not clear. The effects of the natural course of TMD symptoms should be clarified with respect to self-healing.

The Oral Behavior Checklist (OBC) is a standardized research questionnaire that is used to assess parafunctional behaviors. The OBC is a part of a group of established diagnostic tools, known as the Diagnostic Criteria of Temporomandibular Disorder (DC/TMD) (9–12). The DC/TMD comprises two sections: Axis I and Axis II. OBC constitutes Axis II, which assesses psychosocial aspects; a preliminary study of the OBC with electromyographic assessment of jaw muscle activity demonstrated the validity
The OBC has been used in correlational studies, which showed that subjects with higher tertile scores (i.e., those exhibiting parafunctional behaviors) at baseline exhibited elevated TMD incidence (16). Another cross-sectional study assessed parafunctional behaviors, using the OBC, in the context of symptoms of TMD; the results of that study showed that the incidence of TMD was elevated among subjects in the upper tertile, compared with those in the lowest tertile (17). However, no prospective study has analyzed the OBC results and the natural course of TMD. The objective of this study was to assess the relationship between OBC results and symptoms of TMD prior to the prospective observations, and then clarify whether parafunctional behaviors affect the natural course of TMD. A clear understanding of this relationship will enable assessment of parafunctional behaviors using the OBC, which can be a clinical tool to assess diagnosis and predict self-healing of TMD over an 8-month period.

**Materials and Methods**

**Participants**

One hundred twenty-nine third-year dental students, the group that most often reports TMD (18), from the Nihon University School of Dentistry at Matsudo were the target population of the study. The subjects completed the DC/TMD symptom questionnaire (SQ) and OBC on a computer-based response system at the beginning of the TMD and orofacial pain classes (baseline (BL)). As a second assessment, a follow-up survey (FU) was performed 8 months after baseline, after the students had completed an examination regarding TMD and orofacial pain. The 8-month period was used to ensure sufficient follow-up, in order to observe reduced symptoms of TMD without any intervention (19).

One hundred twelve subjects (71 males and 41 females, mean age 22.91 ± 1.99 years, response rate 86.9%) completed both BL and FU questionnaires. This protocol was approved by the Ethics Committee of Nihon University School of Dentistry at Matsudo (EC 14–14–016–1).

**Questionnaire**

**SQ**

Axis I of the DC/TMD was used to assess the symptoms of TMD over the prior 30 days. Two questions were used from the SQ. Pain: “In the last 30 days, which of the following best describes any pain in your jaw, temple, in the air, or in front of the ear on either side?” Noise: “In the last 30 days, have you had any jaw joint noise(s) when you move or used your jaw?”

When the participant answered “pain comes and goes” or “pain always present” for the question regarding pain, the participant was assumed to have pain as a symptom. When the participant answered “yes” for the question regarding noise, the participant was assumed to have noise as a symptom. All questions were translated to Japanese directly from the original text.

On the basis of the natural course of symptoms from BL to FU, participants were divided into 2 groups: the incident group (no pain to pain, no noise to noise) and the release group (pain to no pain, no noise to noise).

**OBC**

The OBC instrument was used to assess the presence and frequency of oral parafunctional behaviors for the prior 30 days (Table 1). All questions were translated into Japanese directly from the original text. Five response options in OBC were scored as follows. Score 0: “none of the time”; score 1: “<1 night/month” and “a little of the time”; score 2: “1–3 nights/month” and “most of the time”; score 3: “1–3 nights/week” and “most of the time”; score 4: “4–7 nights/week” and “all of the time” (16, 17). The total scores of all 21 items of the OBC were calculated individually. Participants were placed into 3 groups (tertiles), on the basis of prior findings (16, 17): the low-score group (less oral behavior), the middle-score group, and the high-score group (more oral behavior) using FU score.

**Statistical analysis**

The natural course of the variety of OBC tertile group from BL to FU was tested to determine whether it relates to an incident group and release group. The variety in prevalence between BL symptoms and FU symptoms was tested by using the chi-squared test. The chi-squared test was also used to evaluate the null hypothesis that the natural course of the variety of OBC tertile group (a group shift to a lower score tertile group, a group shift to higher score group, and the absence of a group shift after the 8-month FU period) would not be associated with the natural course of TMD symptoms.

The level of statistical significance was set at 0.05 for all tests. Data from questionnaires were processed using a
Results

SQ
Both pain and noise significantly increased from BL to FU (pain: 7.4% to 11.5%, \( p = 0.033 \); noise: 4.9% to 18.9%, \( p = 0.045 \). The prevalence of “no pain” at BL and “pain” at FU was 9.0%. The “pain” at BL and “no pain” at FU was reported in 4.9% of participants. The prevalence of “no noise” at BL and “pain” at FU was 16.4%, and “noise” at BL and “no noise” at FU was reported in 2.5% of participants (Fig. 1).

OBC
Table 1 shows the prevalence of 21 oral behaviors and their frequencies at BL and FU, as determined by the OBC. At both BL and FU, the participants whose scores were 0 to 9 were grouped as the “low-score tertile group,” those whose scores were 10 to 19 were grouped as the “middle-score tertile group,” and those whose scores were 20 to 77 were grouped as the “high-score tertile group.”

The natural course of SQ and OBC
Table 2 shows the results of the chi-squared test. The null hypothesis, which was that the natural course of the variety of the OBC tertile group (a group shift to a lower score tertile group, a group shift to a higher score tertile group, and the absence of a group shift after the 8-month FU period) would not be associated with the natural course of TMD symptoms, was rejected. There was a statistically significant association between the participants who shifted tertile groups and the natural course of TMD, with respect to pain (\( p = 0.013 \)) and noise (\( p > 0.00 \)).

Discussion

This prospective study was planned to determine whether changes in oral parafunctional behavior can be a factor in self-healing of TMD over an 8-month period. The results showed a positive association between changes in oral parafunctional behavior and the natural course of symptoms of TMD over the duration of the study: participants who had more oral parafunctional behavior exhibited an association with TMD symptoms. In contrast, participants who had less oral parafunctional behavior showed relief from TMD symptoms.

The clinical implication of this study is that, to prevent the onset of TMD, a patient’s parafunctional behavior must be kept low, or should be reduced when high, as scored by the OBC.

A previous study showed changes in the clinical findings of participants with anterior disk displacement that had not been reduced at 6 months. The noise decreased by 2.2%, tenderness in the temporomandibular joint decreased by 45.5%, and tenderness in the masticatory muscle decreased by 25.0% (19). Our study also showed that the rate of natural healing, of noise was 2.5%. All participants who exhibited symptom alleviation were in a lower tertile group at FU than at BL. No participants who showed symptom release maintained the same level of oral behavior or increased oral behavior. In regard to noise, our study found that the release rate of pain was 4.9%; 83.3% of participants were in a lower noise tertile at FU.

Based on our findings, a method to reduce oral parafunctional behavior should be the primary concern of both patients with TMD and doctors who treat TMD. The OBC can assess both the type of oral parafunctional behavior and its frequency of occurrence. A high score in OBC indicates either a large number of different types of behaviors or a

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Statistical software package (SPSS Ver. 18.0).
### Table 1. The percentage distributions of 21 oral behaviors and their frequencies, as measured by the Oral Behavior Checklist (%)

| Activities During Sleep | None of the Time | 1-3 Night/Month | 1-3 Night/Week | 4-7 Night/Week | BL | FU | BL | FU | BL | FU | BL | FU | BL | FU | BL | FU |
|-------------------------|------------------|-----------------|---------------|----------------|----|----|----|----|----|----|----|----|----|----|----|----|
| 1. Clench or grind teeth when asleep, based on any information you may have | 82.8 | 62.3 | 4.1 | 13.9 | 5.7 | 8.2 | 5.7 | 1.6 | 0.8 | 5.7 |
| 2. Sleep in a position that puts pressure on the jaw (for example, on stomach, on the side) | 30.3 | 37.7 | 4.1 | 13.9 | 17.2 | 9.0 | 14.8 | 10.7 | 32.8 | 19.7 |

| Activities During Waking Hours | None of the Time | A Little of the Time | Some of the Time | Ost of the Time | All of the Time | BL | FU | BL | FU | BL | FU | BL | FU | BL | FU | BL | FU |
|--------------------------------|------------------|---------------------|-----------------|----------------|----------------|----|----|----|----|----|----|----|----|----|----|----|----|
| 3. Grind teeth together during waking hours | 86.9 | 68.0 | 7.4 | 14.8 | 4.9 | 7.4 | 0.0 | 0.8 | 0.0 | 0.0 |
| 4. Clench teeth together during waking hours | 64.8 | 47.5 | 18.9 | 27.0 | 13.1 | 14.8 | 2.5 | 0.8 | 0.0 | 0.8 |
| 5. Press, touch, or hold teeth together other than while eating (that is, contact between upper and lower teeth) | 40.2 | 32.0 | 36.9 | 33.6 | 16.4 | 16.4 | 5.7 | 7.4 | 0.0 | 1.6 |
| 6. Hold, tighten, or tense muscle without clenching or bringing teeth together | 78.7 | 48.4 | 15.6 | 27.9 | 4.1 | 13.9 | 0.8 | 0.8 | 0.0 | 0.0 |
| 7. Hold or jerk jaw forward or to the side | 86.9 | 50.0 | 9.8 | 36.3 | 2.5 | 8.2 | 0.0 | 2.5 | 0.0 | 0.0 |
| 8. Press tongue forcibly against teeth | 66.4 | 52.5 | 16.4 | 26.2 | 13.1 | 8.2 | 2.5 | 4.1 | 0.0 | 0.0 |
| 9. Place tongue between teeth | 68.9 | 47.5 | 17.2 | 26.2 | 8.2 | 11.5 | 4.1 | 4.9 | 0.8 | 0.8 |
| 10. Bite, chew, or play with tongue, cheeks or lips | 44.3 | 30.3 | 31.1 | 30.3 | 15.6 | 21.3 | 6.6 | 8.2 | 1.6 | 0.8 |
| 11. Hold jaw in rigid or tense position, such as to brace or protect the jaw | 91.8 | 59.8 | 3.3 | 21.3 | 2.5 | 7.4 | 1.6 | 1.6 | 0.0 | 0.8 |
| 12. Hold between the teeth or bite objects such as hair, pipe, pencil, pens, fingers, fingernails, etc | 79.5 | 54.1 | 9.8 | 23.8 | 4.1 | 11.5 | 3.3 | 0.8 | 2.5 | 0.8 |
| 13. Use chewing gum | 27.9 | 29.5 | 19.7 | 36.3 | 27.9 | 24.6 | 16.4 | 5.7 | 8.2 | 0.8 |
| 14. Play musical instrument that involves use of mouth or jaw (for example, woodwind, brass, string instruments) | 95.1 | 77.0 | 2.5 | 9.0 | 0.8 | 4.1 | 0.8 | 0.0 | 0.0 | 0.8 |
| 15. Lean with the hand on the jaw, such as cupping or resting the chin in the hand | 22.1 | 19.7 | 21.3 | 24.6 | 30.3 | 31.1 | 18.9 | 13.1 | 7.4 | 2.5 |
| 16. Chew food on one side only | 40.2 | 29.5 | 24.6 | 20.3 | 18.9 | 24.6 | 7.4 | 7.4 | 8.2 | 9.0 |
| 17. Eating between meals (that is, food that require chewing) | 18.9 | 13.1 | 31.1 | 21.3 | 27.9 | 29.5 | 15.6 | 21.3 | 6.6 | 5.7 |
| 18. Sustained talking (for example, teaching, sales, customer services) | 63.9 | 28.7 | 26.2 | 21.3 | 5.7 | 27.9 | 1.6 | 6.6 | 2.5 | 5.7 |
| 19. Singing | 45.1 | 19.7 | 30.3 | 31.1 | 17.2 | 17.2 | 3.3 | 13.1 | 4.1 | 10.7 |
| 20. Yawning | 12.3 | 9.0 | 25.4 | 20.5 | 27.0 | 29.5 | 27.0 | 23.0 | 8.2 | 9.0 |
| 21. Hold telephone between your head and shoulders | 82.0 | 45.9 | 13.9 | 24.6 | 2.5 | 13.1 | 0.8 | 4.9 | 0.0 | 2.5 |
very high frequency of a few specific behaviors. Glaros et al. reported that habit reversal training consists of three main steps: increased patient awareness, development of an alternative to the unwanted behavior, and substitution of the alternative behavior for the unwanted behavior (20). However, a previous study reported that electromyographic masticatory muscle activity was nearly three-fold higher while playing piano than while eating (6), indicating that habit awareness is difficult. The physical and psychosocial demands of the performance, together with the increased levels of concentration, stress, and anxiety, were factors that caused increased masticatory muscle activity while playing the piano. Thus, oral parafunctional behavior occurs for complex reasons, which makes it difficult to determine the type of parafunctional behavior in a patient and the conditions associated with its occurrence. Biofeedback and cognitive behavioral therapy is an effective method to interfere with such behaviors (21, 22). Administering the OBC during treatment can also provide a useful tool to increase patient awareness of the listed habits, because simply reading the OBC may inform a patient of behaviors they have not previously noticed.

The 8-month incidence rates were 9.0% for pain and 16.0% for noise; these were higher than previously reported (3.5-10%) (23, 24). The primary reason for this may be related to study population. In this study, dental students were the study sample, and previous research has shown that chronic musculoskeletal pain outside the jaw and face appeared early in a dental student sample, then increased during dental education (25). This suggests that dental students are exposed to factors that facilitate the development of musculoskeletal pain. The participants in the present study attended TMD classes during the study; gaining further knowledge of the pathophysiology and mechanisms underlying the onset and progression of TMD contributed to increased self-awareness and self-diagnosis of the disease. Another reason for our discrepant results may be that the present study was performed with a self-reported questionnaire. In analyses of joint clicking, specialists reported that two- to three-fold more subjects had joint clicking during the clinical examination, compared with the number determined via self-reported joint clicking (23, 26). Additionally, TMD is considered multifactorial, and is influenced by a combination of psychological, physiological, structural, and genetic factors (27). At FU, the subjects exhibited psychological factors, in that they showed significant stress due to the final examination of the course (21, 28).

This study had three limitations. First, it used self-reported questionnaires for subjective assessment of the participants. It is difficult to assess the frequency of oral behavior precisely because these behaviors generally occur outside the context of conscious awareness, as previously noted in this paper. Second, this study used direct Japanese translations of the SQ and OBC. At the time of our study, the SQ and OBC forms were officially published only in English by the International Network for Orofacial Pain and Related Disorders Methodology. However, these forms will soon be available in 29 languages; this might change the impression and score of the present study. Finally, we followed the approach described in a previous report, using tertiles to assess the OBC score. The tertile borders may change based on the outlier score of a single participant, thereby affecting the tertile group in which other participants are placed. Here, we used the FU score to identify tertile groups for both BL and FU, because FU scores were much less frequently within a low-score tertile group, compared with

| Pain       | incident group | release group |
|------------|----------------|---------------|
| +          | 7 (63.7%)      | 1 (16.7%)     |
| ±          | 0 (0%)         | 0 (0%)        |
| −          | 4 (36.3%)      | 5 (83.3%)     |
| total      | 11 (100%)      | 6 (100%)      |

$(p=0.013)$

| Noise     | incident group | release group |
|-----------|----------------|---------------|
| +         | 12 (63.2%)     | 0 (0%)        |
| ±         | 2 (10.5%)      | 0 (0%)        |
| −         | 5 (26.3%)      | 3 (100%)      |
| total     | 19 (100%)      | 3 (100%)      |

$(p>0.00)$

+: OBC score shifted to higher tertile group at FU
±: No change in OBC score at FU
−: OBC score shifted to lower tertile group at FU
BL scores. However, if we used BL scores, the results would have been different. The validity and specificity should be clear for use of this approach in future studies.

This study rejected the null hypothesis that the natural course of a variety of OBC tertiary group is not associated with the natural course of TMD symptoms. In the future, we plan to use the official form in the Japanese language for a follow-up study, which will investigate changes in behaviors and the prevalence and development of TMD symptoms, in order to obtain more reliable data for comparison with the results of our present study.

Conclusion
Parafunctional changes that occur over time affect the natural course of symptoms of TMD. Participants who exhibited more oral parafunctional behavior showed TMD symptoms. In contrast, participants who exhibited less oral parafunctional behavior showed relief from TMD symptoms. This study indicates the clinical importance of reducing oral behavior to prevent the onset of symptoms of TMD.

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