Sleep bruxism

Associations and comorbid conditions

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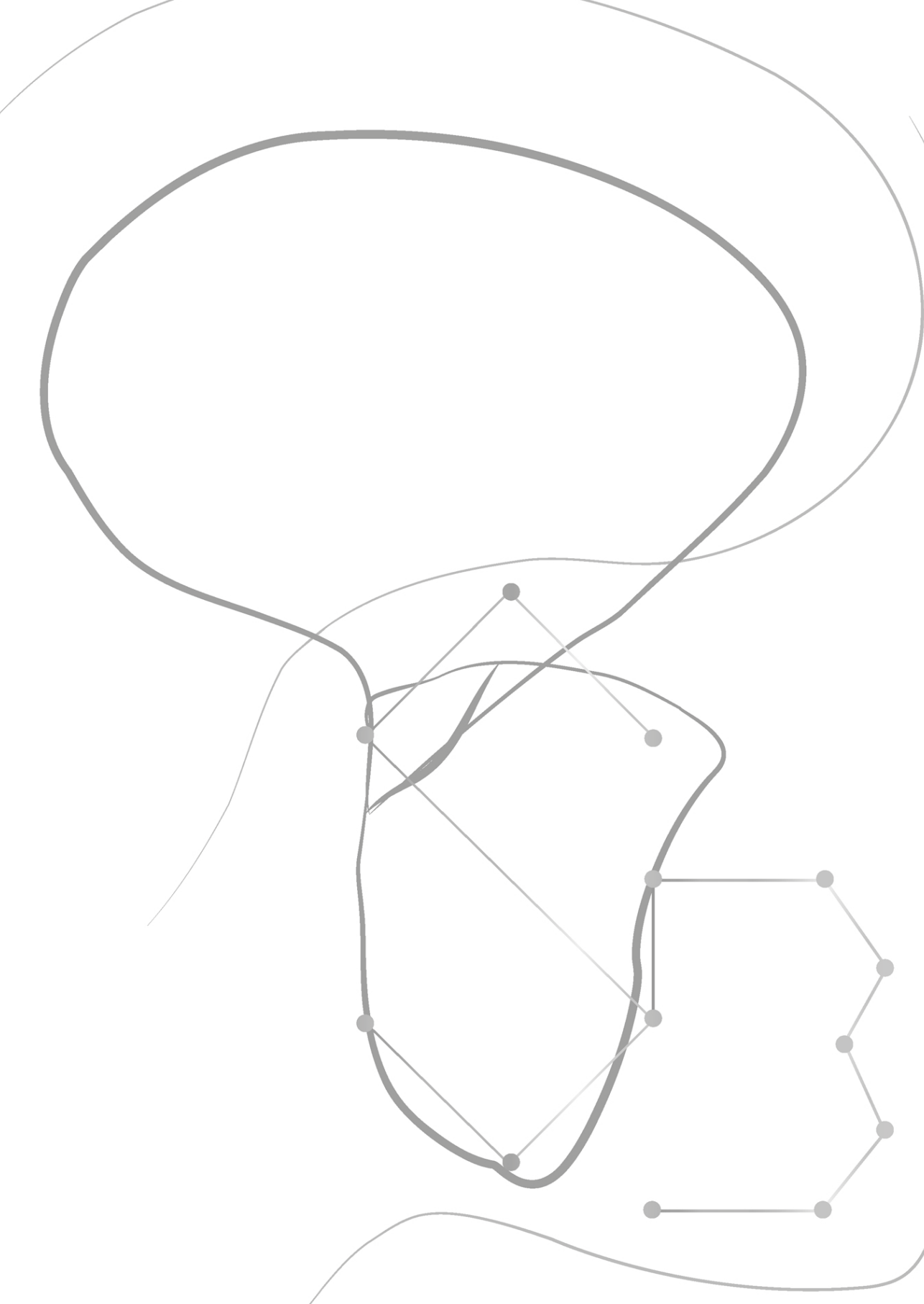

CHAPTER 4

CHANGES OF SELF-REPORTED SLEEP AND AWAKE BRUXISM IN RELATION TO THE MANAGEMENT OF TEMPOROMANDIBULAR DISORDERS ("CARE AS USUAL") IN A SPECIALTY CLINIC POPULATION

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ABSTRACT

Background: Sleep bruxism (SB) and awake bruxism (AB) are associated with temporomandibular disorders (TMD). In addition, SB, AB, and TMD are associated with psychosocial factors. TMD treatment strategies often include the management of SB and/or AB. However, very few studies have investigated how self-reports of SB and AB (i.e., possible bruxism) change after the start of interventions that aim at reducing these masticatory muscle activities in TMD patients. This study aims to investigate the association between type of TMD treatment and psychosocial factors on the one hand and the changes of possible SB and/or AB on the other hand.

Methods: 68 TMD patients were included in this prospective cohort study. Every patient received counselling. 33 patients received other treatments besides counselling, i.e., physical therapy, psychological therapy, and/or occlusal splint. The changes of SB and AB, i.e., not improved vs. improved, were assessed at week 6 after receiving treatment. Type of treatment, i.e., counselling vs. counselling plus any other treatment, and psychosocial factors, i.e., anxiety, depression, and somatization scores, were included in univariate analyses (viz., chi-square or Mann-Whitney U tests) to pre-screen for significant variables before including them in binary logistic regression analyses. The dependent variables in these analyses were the changes of SB and of three types of AB (i.e., AB-grinding, AB-clenching, and AB-bracing) as well as of the maximum frequency of all AB types combined (i.e., AB-combined).

Results: There were no significant associations of SB, AB-grinding, and AB-clenching with other variables in the univariate analyses. Binary logistic regression analysis showed that, compared with patients who did not improve in their frequency of AB-combined, patients with counselling and any other treatment had a lower chance of improving their AB-combined frequency than patients with counselling alone (OR = 0.218, 95% CI 0.055-0.871, p = 0.031). The type of treatment was not associated with the improvement of AB-bracing frequency in binary logistic regression analysis.

Conclusions: The type of TMD treatment was associated with the change of AB frequency but not with the change of SB frequency.

Keywords: sleep bruxism, awake bruxism, temporomandibular disorders, treatment, follow-up

1. INTRODUCTION

Sleep bruxism (SB) is a masticatory muscle activity during sleep, characterized by rhythming or non-rhythmic movement that is not movement disorder.[1] Awake bruxism (AB) is a repetitive masticatory muscle activity during wakefulness, and it is characterized by tooth contact and/or by bracing or thrusting of the lower jaw.[1] SB and AB have been found to be associated with psychosocial factors, such as stress, depression, and anxiety.[2] Moreover, SB and AB are often investigated for their associations with temporomandibular disorders (TMD). TMD is a group of conditions related to temporomandibular joint (TMJ), masticatory muscles, and associated structures.[3] Common symptoms of TMD are pain, joint sounds, and limited jaw movement.[3] TMD pain has been found to be associated with possible and definite AB.[4] As for SB, possible SB has found to be associated with TMD pain and pain interference with daily life activities,[5] but the association between definite SB and TMD pain is inconsistent.[4,6]

TMD is a multifactorial condition, and is associated with psychological factors (e.g., depression, anxiety, and stress), sleep quality, and decreased quality of life (QoL).[7,8] In addition, pain and fear of jaw movements have been associated to the decision to seek care for TMD pain.[9] Management of TMD includes multidisciplinary non-invasive treatments, such as counselling, physical therapy, medication, and oral appliance therapy. Invasive treatments, such as surgery of the TMJ, are less common, and only performed in selected cases.[3,10] The goals of treatment are pain reduction and recovery of jaw function.[3] Given the longstanding notion that SB and AB are viewed as masticatory muscle activities that can overload the masticatory system and contribute to the persistence of TMD pain, TMD treatment strategies often involve management of SB and/or AB.[10-12] Counselling, including education and behavioral modification, can be implemented to reduce AB[13] and has been shown to reduce TMD pain and improve jaw function.[10,12,13] In addition, awareness of having AB could improve pain reduction.[12] SB is managed through oral appliances, which aim to reduce the loading of the masticatory system due to forces exerted while bruxing.[14] Biofeedback treatments have been investigated and could reduce jaw muscle activity during sleep[15,16] as well as during wakefulness,[12] but have not yet been implemented as part of routine treatment for TMD pain.[17] Even though SB and AB are common targets in the management of TMD, very few studies have investigated how self-reports of SB and AB change after the start of interventions that aim at reducing these masticatory muscle activities in TMD patients.[13,18]

Patient-reported outcome measures (PROMs) focus on patients' perspective of their health, symptoms, effectiveness of treatments, and satisfaction with treatments.[19] PROMs aim to measure health status or patient's health-related quality of life (QoL),

and have been used in a variety of clinical fields.[19,20] Through PROMs, the patient's perspective regarding the course of treatment can be collected, which can contribute to a more active involvement of the patients in the clinical decision making process.[21] However, very few studies have used PROMs in dentistry.[22]

This study aimed to investigate the association between the type of TMD treatment and psychosocial factors on the one hand and the changes of possible SB and/or AB on the other hand. The changes of self-reported SB and AB were assessed between baseline and six weeks after start of treatment. We hypothesized that the changes of possible SB and/or AB are associated with psychosocial factors. More specifically, we hypothesized that participants with lower psychosocial scores will tend to improve SB and AB more than the ones with higher psychosocial scores. In addition, we hypothesized that counselling with any other treatment may improve SB and AB more than counselling alone.

2. METHODS

2.1 Study sample

A prospective cohort study was performed in the specialty Clinic for Orofacial Pain and Dysfunction of the Academic Centre for Dentistry Amsterdam (ACTA), Amsterdam, The Netherlands, from July 2021 until April 2023.

Patients who were referred to the Clinic for Orofacial Pain and Dysfunction of ACTA were eligible to enroll in the study if they met the following inclusion criteria:
(1) at least 18 years old;
(2) having a diagnosis of TMD pain and/or dysfunction based on the Diagnostic Criteria for Temporomandibular Dysfunction (DC/TMD), for which treatment will be initiated; and
(3) signed informed consent.
There was no exclusion for medical or dental reasons. This study was approved by the ACTA Ethics Committee (ref. no. 2021-64846).

2.2 Study procedures

Baseline
As part of usual care, all patients completed a set of diagnostic questionnaires before their first visit to the clinic. These questionnaires included demographic variables, i.e., age and gender, as well as average facial pain intensity from the graded chronic pain scale (GCPS) questionnaire,[23] depression from the Patient Health Questionnaire-9 (PHQ-9),[24] somatization from the Patient Health Questionnaire-15 (PHQ-15),[25] and anxiety from the Generalized Anxiety Disorder-7 (GAD-7).[26] These questionnaires are part of the

DC/TMD.[27] During the first visit to the clinic, intra- and extraoral inspection as well as a clinical examination according to the DC/TMD were performed. The DC/TMD diagnosis was collected and grouped into 3 groups, i.e., 1) pain, 2) dysfunction, and 3) combined pain and dysfunction.

Treatment

The type of TMD treatment which patients received was decided based on the DC/TMD diagnosis, relevant comorbidities, the preference of patients, and the professional judgment of the clinician and/or the multidisciplinary team of the clinic. Every patient received counselling. In addition, patients could receive one or more other treatments, i.e., physical therapy, psychological therapy, and/or occlusal splint. For the purpose of analysis in this study, type of treatment was categorized into two groups, i.e., 1) counselling and 2) counselling and any other treatment.

Follow-up

The change of SB, AB, and TMD pain and dysfunction symptoms after start of treatment was assessed during the follow-up period by PROMs. PROMs included 11 questions which evaluate three domains, namely 1) pain and dysfunction[28]; 2) patient complaints through the patient-specific approach (PSA)[29] and a complaint improvement question; and 3) frequency of possible SB and AB.[30] The questions were included because of their reliability, validity, interpretability, and feasibility to use.[19] Patients would receive PROMs through email every 6 weeks after their initial visit to the clinic, until week 24, or until the end of treatment if they finished the treatment earlier than 24 weeks. The analyses in this study focus on baseline (t_0) and 6 weeks after initial visit (t_1).

Frequency of possible SB and AB was assessed through the oral behavioral checklist (OBC) questions no. 1, 3, 4, and 6.[30] SB was assessed by OBC question 1, i.e., 'clench or grind teeth when asleep, based on any information you may have'. The five answer options were: never, <1 night/month, 1-3 nights/month, 1-3 nights/week, and 4-7 nights/week. AB was assessed by OBC items 3, 4, and 6, i.e., 'grind teeth together during waking hours' for AB-grinding type, 'clench teeth together during waking hours' for AB-clenching type, and 'hold, tighten, or tense muscles without clenching or bringing teeth together' for AB-bracing type. The answer options ranged from 0 (never) to 4 (always). The highest frequency among these three questions was used as the maximum frequency of all AB types combined, i.e., AB-combined. In this study, the changes of self-reported SB and AB between t_0 and t_1 were scored as., 1) Not improved, if the SB or AB frequency at t_1 was higher than or equal to the frequency at t_0; and 2) Improved, if the SB or AB frequency at t_1 was lower than the frequency at t_0.

2.3 Statistical analysis

Age, average facial pain intensity score, anxiety, depression, and somatization scores were checked for data distribution, using the Shapiro-Wilk test. TMD diagnoses were described with descriptive analysis. Wilcoxon signed-rank test was used to compare average pain intensity and the frequency of SB and AB between t_0 and t_1.

To investigate the association between the changes of SB and AB on one hand, and type of TMD treatment and psychosocial factors on the other hand, we used chi-square test and Mann-Whitney U test, respectively. The variables that had a p-value <0.1 were included in the subsequent multivariable binary logistic regression analyses to predict the changes of SB, AB-combined, AB-grinding, AB-clenching, and AB-bracing. The reference category was 'Not improved'.

In addition, subsequent analyses were done with chi-square and Mann-Whitney U test to compare the distribution of TMD diagnosis, average facial pain intensity at t_0 and t_1, and psychosocial factors between patients who received counselling alone and those who received counselling and any other treatment. McNemar test was used to investigate the proportion of the presence and absence of SB and AB at t_0 and t_1 in patients with counselling alone and in those who received counselling and any other treatment.

The Castor electronic data capture (EDC) program (Ciwit B.V., Amsterdam, the Netherlands) was used for collection of study data, and data analysis was performed with SPSS Statistics 27 software (IBM Corp, Armonk, NY, USA).

3. RESULTS

There were 107 patients who completed at least one PROM. From these, 11 patients without a DC/TMD diagnosis, 27 patients who did not complete a PROM at week 6 (t_1), and one patient who did not receive counselling treatment were excluded. Hence. in total, there were 68 patients included in this study. There was no significantly difference in average facial pain intensity and the frequency of SB and AB between t_0 and t_1 (average facial pain intensity p = .076; SB p = .781; AB-combined p = .180; AB-grinding p = .853; AB-clenching p = .739; and AB-bracing p = .110). Descriptive data were calculated for all variables (**Table 1**).

Table 1 Descriptive statistics of demographic and independent variables

Variable (min-max)	Mean ± SD/Median (IQR)	N (n=68)
Sex		
Female		57 (83.8%)
Male		11 (16.2%)
DC/TMD diagnosis		
Pain		17 (25.0%)
Dysfunction		8 (11.8%)
Combined pain and dysfunction		43 (63.2%)
Age (18-86)	47.9 ± 15.4	
Anxiety (0-18)	4 (7)	
Depression (0-21)	5 (9)	
Somatization (0-18)	9 (9)	
Average facial pain intensity at baseline (t_0) (0-10)	5 (4)	
Type of treatment		
Counselling only		35 (51.5%)
Counselling and any other treatment		33 (48.5%)
Physical treatment		13
Occlusal splint		8
Splint + physical treatment		3
Splint + physical +psychological treatment		2
Psychological treatment		2
Splint + psychological treatment		1
Physical + psychological treatment		1
Physical treatment + GrindCare		1
Physical treatment + Brux app		1
Medication		1
Week 6		
Average facial pain intensity at week 6 (t_1) (0-9)	6 (3)	
Improvement of patient's complaints		
much deteriorated		5 (7.4%)
somewhat deteriorated		11 (16.2%)
remained stable		32 (47.1%)
slightly improved		18 (26.5%)
much improved		2 (2.9%)

Table 1 Continued

Variable (min-max)	Mean ± SD/Median (IQR)	N (n=68)
Changes of SB frequency		
Not improved		53 (77.9%)
Improved		15 (22.1%)
Changes of AB-combined frequency		
Not improved		54 (79.4%)
Improved		14 (20.6%)
Changes of AB-grinding frequency		
Not improved		53 (77.9%)
Improved		15 (22.1%)
Changes of AB-clenching frequency		
Not improved		47 (69.1%)
Improved		21 (30.9%)
Changes of AB-bracing frequency		
Not improved		53 (77.9%)
Improved		15 (22.1%)

Abbreviations: SD, standard deviation; IQR, interquartile range

Table 2 Univariate analyses of independent variables in participants with not-improved and improved frequency of SB, AB, AB-grinding, AB-clenching, and AB-bracing.

Independent variables	SB			AB-combined		
	Not-improved	Improved	P	Not-improved	Improved	P
Somatization[a]	9 (10)	8 (7)	.573	10 (9)	6.5 (9)	.280
Depression[a]	6 (8)	4 (11)	.733	6 (8)	3.5 (7)	.130
Anxiety[a]	5 (7)	3 (12)	.727	5 (9)	3.5 (4)	.307
Type of treatment[b]			.314			.023*
Counselling	29 (54.7%)	6 (40%)		24 (44.4%)	11 (78.6%)	
Counselling and any other treatment	24 (45.3%)	9 (60%)		30 (55.6%)	3 (21.4%)	

Abbreviations: [a] Mann-Whitney U test, median (IQR); [b] chi-square test, n (%).
*Significant at 0.1

There were no significant associations of SB, AB-grinding, and AB-clenching with other variables in the univariate analysis (**Table 2**). In addition, there was no difference in psychosocial scores between patients who improved and those who did not improve their frequency of SB, AB-combined, AB-grinding, AB-clenching, and AB-bracing (**Table 2**). Binary logistic regression analyses showed that, compared with patients who did not improve in their frequency of AB-combined, patients with counselling and any other treatment had a lower chance of improving their AB-combined frequency than patients with counselling alone (OR = .218, 95%CI .055-.871, p = .031) (**Table 3**). **Table 4** shows that the type of treatment was not associated with the improvement of AB-bracing frequency.

The subsequent analysis compared the characteristics of patients who received counselling alone and those who received counselling and any other treatment. There was no difference in either TMD diagnosis, TMD pain scores at baseline and six weeks after starting treatments, or psychosocial scores between patients who received counselling alone and those who received counselling and any other treatment (**Table 5**).

Table 2 Continued

AB-grinding			**AB-clenching**			**AB-bracing**		
Not-improved	**Improved**	**P**	**Not-improved**	**Improved**	**P**	**Not-improved**	**Improved**	**P**
8 (9)	11 (9)	.519	10 (10)	9 (8)	.489	9 (9)	8 (11)	.656
5 (9)	5 (4)	.876	6 (8)	4 (7)	.181	5 (9)	4 (7)	.807
4 (7)	5 (8)	.911	6 (6)	3 (6)	.324	5 (9)	3 (4)	.444
		.870			.250			.055*
27 (50.9%)	8 (53.3%)		22 (46.8%)	13 (61.9%)		24 (45.3%)	11 (73.3%)	
26 (49.1%)	7 (46.7%)		25 (53.2%)	8 (38.1%)		29 (54.7%)	4 (26.7%)	

Table 3 Binary logistic regression model of independent variables in participants with not-improved and improved frequency of AB-combined.

	Not-improved vs Improved frequency of AB-combined			
Independent variables	**B(SE)**	**OR**	**95%CI**	**P**
Intercept	-.780 (.364)	.458		.032
Type of treatment				
Counselling	reference			
Counselling and any other treatment	-1.522 (.707)	.218	.055-.871	.031*

Abbreviations: Not Improve = reference; B = regression coefficient; SE = standard error; OR= odds ratio; CI = confidence interval.
*Significant at 0.05

Table 4 Binary logistic regression model of independent variables in participants with not-improved and improved frequency of AB-bracing.

	Not-improved vs Improved frequency of AB-bracing			
Independent variables	**B(SE)**	**OR**	**95%CI**	**P**
Intercept	-.780 (.364)	.458		.032
Type of treatment				
Counselling	reference			
Counselling and any other treatment	-1.201 (.646)	.301	.085-1.067	.063

Abbreviations: Not improve = reference; B = regression coefficient; SE = standard error; OR= odds ratio; CI = confidence interval

Table 5 Characteristics of counselling group and counselling and any other treatment group at t_0 and t_1

Variables		**Counselling**	**Counselling and any other treatment**	**P**
DC/TMD diagnosis	Pain	9 (25.7%)	8 (24.2%)	.770[a]
	Dysfunction	5 (14.3%)	3 (9.1%)	
	Combined pain and dysfunction	21 (60%)	22 (66.7%)	
Average facial pain intensity at baseline (t_0)		5 (5)	6 (3)	.129[b]
Average facial pain intensity at week 6 (t_1)		6 (3)	6 (4)	.700[b]
Somatization		9 (9)	9 (8)	.188[b]
Depression		5 (8)	5 (7)	.379[b]
Anxiety		5 (6)	3 (7)	.206[b]

Abbreviations: [a] chi-square test, n (%); [b] Mann-Whitney U test, median (IQR)

Table 6 The proportion of the presence and absence of SB and AB at baseline (t_0) and six weeks after receiving treatment (t_1) in patients with counselling alone (n=35) and patients with counselling and any other treatment (n=33), McNemar test.

		Counselling alone (n=35)			Counselling and any other treatment (n=33)		
	Week 6 (t_1) / Baseline (t_0)	Absence	Presence	p-value	Absence	Presence	p-value
SB	Absence	5	7	.070	3	4	1.000
	Presence	1	22		4	22	
AB-combined	Absence	1	1	1.000	0	6	.031*
	Presence	1	32		0	27	
AB-grinding	Absence	14	5	1.000	17	5	.453
	Presence	5	11		2	9	
AB-clenching	Absence	2	5	.727	0	8	.109
	Presence	3	25		2	23	
AB-bracing	Absence	2	2	.453	1	8	.039*
	Presence	5	26		1	23	

*Significant at 0.05

Table 6 shows that there were significant differences in the proportion of the presence and absence of AB-combined and AB-bracing between t_0 and t_1 (p= .039 and .031, respectively) in patients with counselling and any other treatment. On the other hand, in patients with counselling alone, there was no significant difference in the proportion of the presence and absence of SB/AB between t_0 and t_1. **Figure 1** shows a descriptive result that patients with counselling and any other treatment reported not having AB-combined and AB-bracing for at t_0 more than at t_1.

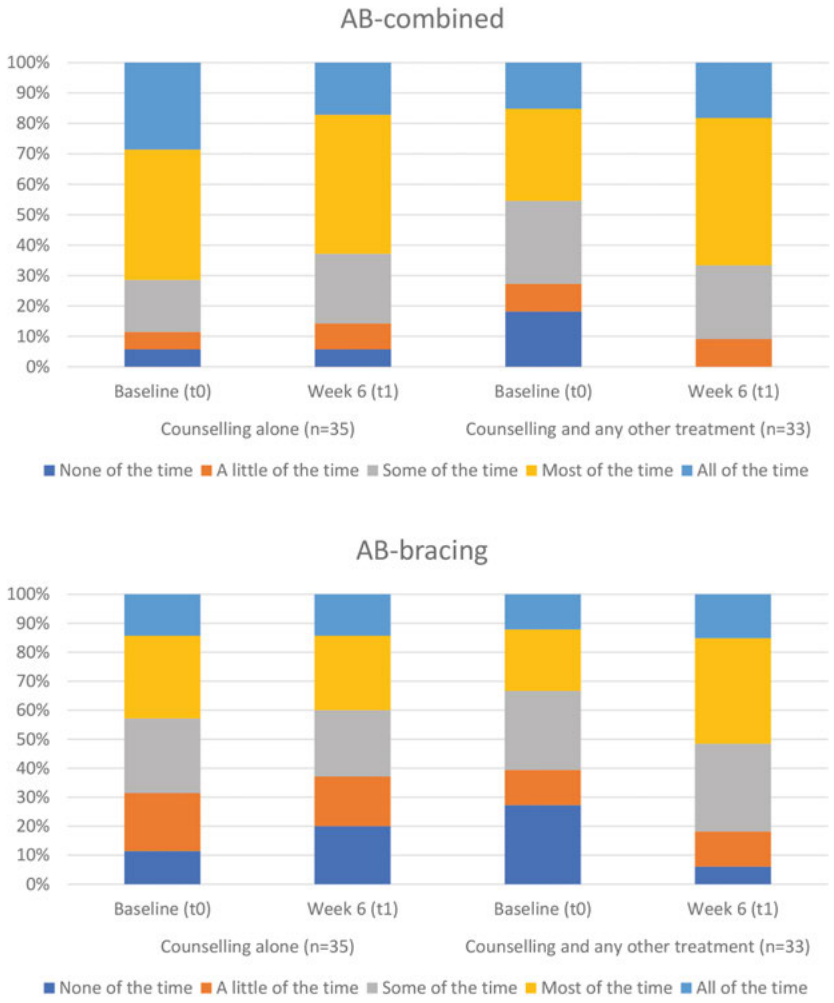

Figure 1 The frequency of AB-combined and AB-bracing at baseline (t_0) and six weeks after receiving treatment (t_1) in patients with counselling alone and patients with counselling and any other treatment.

4. DISCUSSION

The present study aimed to investigate the association between type of TMD treatment and psychosocial factors on the one hand and the changes of possible SB and/or AB on the other. The results showed that patients with counselling and any other treatments tended to have a lower chance of improving AB-combined frequency than patients with counselling alone.

A previous study found that patients who believe that jaw-overuse behaviours like AB can cause jaw pain, tend to report a higher frequency of these behaviours compared to those who believe that other reasons cause jaw pain.[31] In the present study, 60.6% of patients with counselling and any other treatment received physical therapy, which could indicate that multiple treatments may increase awareness of having those AB activities in patients who received these treatments. When patients receive multiple treatments, they may recall and recognize more AB events than before receiving those treatments. This is in contrast with a previous study finding that counselling and self-management strategies, likes self-relaxation, self-massage, stretching exercises, and warm/cold compression, reduced masticatory muscle pain and AB activity measured with surface electromyography (EMG) in female TMD patients after eight weeks of receiving treatment.[32] Meanwhile, usual-care TMD management did not improve self-reported SB in a brief (6-week) period, compared to AB. This is in accordance with a previous study that sleep hygiene instruction and relaxation techniques did not improve SB activity measured with polysomnography when compared between baseline and four weeks after the implementation of these techniques.[33] It might be difficult for patients to recognize their SB events without a report from their sleep partner. However, the present study shows that usual-care TMD treatment can affect AB in a brief period after receiving those treatments.

The present study found that the type of TMD treatment was associated with the improvement of AB. It was found that, after six weeks of receiving treatment, 78.6% of patients who reported less AB-combined and 73.3% of patients who reported less AB-bracing frequency are the patients who received counselling alone. On the other hand, the frequencies of SB, AB-grinding, and AB-clenching were comparable between patients who received different types of treatment and between those who improved or did not improve the abovementioned behaviours. Patients who received multiple treatments may have different characteristics from patients who received counselling alone. Nevertheless, the subsequent analyses showed no difference in psychosocial factors between patients who received counselling alone and who received multiple treatments. Since patients with counselling and any other treatment may increase their

awareness on AB, these patients may improve their AB activity when we continue monitoring over a longer period than 6 weeks.

In this study, there was no significant difference in the average facial pain intensity score between baseline and six weeks after receiving treatment. In contrast, a study by Donnarumma et al. showed that counselling and self-management strategy can reduce TMD pain after 8 weeks of receiving treatments, even though TMD pain was not significantly different between baseline and after 4 weeks of receiving treatment.[32] Similarly, eight weeks of exercise treatments showed the improvement of TMD pain.[34] Thus, it is suggested that a longer period than 6 weeks is required to monitor the improvement of TMD pain.

Even though there was a limited sample size, we found that there were some changes between the time patients received treatment and before the end of treatment. It is recommended to apply PROMs in regular care to monitor the changes in TMD complaints and oral behaviours, even though there were unexpected trends in the changes in AB in this study. It is a benefit to have a standardized protocol to monitor these factors, i.e., SB, AB, TMD, and psychosocial factors, along the treatment process, as we are doing in usual care.

The present study did not find any significant association between the changes in SB and AB frequency and psychosocial factors. Previous studies found that higher EMG activity during AB was found in a high trait anxiety group than in intermediate and low trait anxiety groups, but there was no difference in tooth clenching episodes between trait anxiety groups.[35] It may be plausible that psychosocial factors may be associated with the intensity of AB but not with its frequency. However, further research on the association between psychosocial factors and the intensity, frequency, and duration of SB and AB events is needed.

The strength of this study is that, first, we assessed self-reported SB and AB at baseline and six weeks after starting treatment. To the best of our knowledge, no study has observed the effect of TMD treatment over a brief period on changes in self-reported SB and AB. A practice-based research network study found that 96% and 46% of dental practitioners consider occlusal appliance and occlusal adjustment, respectively, as appropriate bruxism management.[36] The present study may encourage clinicians to incorporate other treatments, like counselling and physical therapy, for patients. Clinicians should inform patients that they may become more aware of their AB activity after receiving physical therapy, and patients should subsequently alleviate their AB activity. Moreover, we used a part of the OBC questionnaire to assess AB, by which

we assessed not only the maximum frequency of AB but also different aspects of AB activity, i.e., grinding, clenching, and jaw bracing.

There are some limitations to this study. First, some patients did not fill out every PROM, which is a follow-up questionnaire for every six weeks after the treatments started. Consequently, we had to include only PROM1, which is 6 weeks after the treatments started. Even though previous study found that biofeedback can reduce SB and AB events measured with EMG in three weeks,[37] confirming the cause-and-effect relationship between TMD treatment and SB and/or AB self-report changes may require a longer period of time. Even though six weeks is a short period for a longitudinal study, it has clinical relevance as a usual duration for follow-up. Second, we did not measure psychosocial factors after receiving treatment, so we could not monitor the changes in psychosocial status, especially in patients who receive psychological treatment—that is, six out out of 33 participants who received multiple treatments.

5. CONCLUSION

Counselling with any other treatment tends to decrease the frequency of AB less than counselling alone. However, regular TMD management for a brief period can improve AB, but it does not affect the change in SB frequency.

Competing interests: The authors declare that they have no competing interests.

Ethics approval and consent to participate: This study was approved by the ACTA Ethics Committee (ref. no. 2021-64846).

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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