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ORIGINAL ARTICLE

Subjective reactions to intervention with artificial interferences in subjects with and without a history of temporomandibular disorders

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Abstract
In a previous double-blind randomized controlled study, subjects with a history of temporomandibular disorder (TMD) reacted to artificial interference with more signs of TMD than did subjects with no TMD history. In the present study, we analysed the subjective reactions of these individuals on several symptom scales. Every day during the 2-week follow-up period, the subjects rated the intensity of their symptoms on 9 VAS scales (occlusal discomfort, chewing difficulties, tender teeth, fatigue in the jaws, headache, facial pain, opening difficulty, bruxism, ear symptoms). Subjects with a history of TMD and true interferences reported stronger symptoms than subjects with no TMD history and placebo interferences. The most prominent symptoms were occlusal discomfort and chewing difficulties. The difference in outcome between the groups with and without a TMD history suggests that there are individual differences in vulnerability to occlusal interferences. It is likely that the etiological role of occlusal interferences in TMD has not been correctly addressed in previous studies on artificial interferences.

Key Words: *Artificial interferences, occlusion, randomized controlled studies, temporomandibular disorders*

Introduction

The role of occlusal interferences as a causative factor has long been hotly debated. While some researchers deny that the occlusion has any significant role [1–3], others defend the theory of disturbing interferences as a causative factor [4–6]. Kirveskari et al. [6] investigated the etiological role of occlusal interferences. Healthy children and adolescents ($n = 146$) were randomly assigned to real adjustment or mock adjustment groups. Adjustments were repeated every 6 months over a period of 4 years. The outcome variable was the incidence of TMD, which in the real adjustment group was 1/60 and in the mock adjustment group 9/67, resulting in a statistically significant difference between the groups ($p = 0.019$). Another way of studying whether occlusal interferences are detrimental is through short-term intervention studies with experimental interferences, which has been regarded as a powerful experimental design for studying this question [7]. There have been few high-quality randomized controlled studies (RCTs) in this field, however [8].

Studies on artificial interferences in subjects with no TMD history have mostly shown adaptation to the interferences within a fairly short period of time [8]. Consequently, the role of occlusal factors in the etiology of TMD has been questioned [8,9]. It is possible, however, that a selection bias is hidden in these studies [10,11]. Most reports explain in the Subjects and Methods section that the subjects were healthy and free of signs or symptoms of TMD at baseline [12–25]. However, "healthy" in this context can mean that the selected subjects adapt well to their naturally occurring interferences and are therefore able to adapt to artificial interferences. Those who were unable to adapt to the natural interferences (i.e. TMD subjects) were excluded from the study. The results might have been different if subjects with a prior TMD history had been included in the study groups.

In our earlier double-blind RCT study [26], we tested the hypothesis that the effect of artificial interferences on the development of signs and symptoms of TMD is different between subjects with and those without a history of TMD. In that

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study set-up it was possible to compare the occurrences of signs and symptoms of TMD in four subgroups: subjects with and without a history of TMD, both groups with true or placebo interferences. The results showed that subjects with a previous TMD history reacted differently in terms of TMD signs to artificial interferences than subjects with no earlier TMD history. Those with a history of TMD and true interferences showed a significant increase in clinical signs compared to the other groups, while subjects with no TMD history showed fairly good adaptation to the interferences. In that study, a daily diary including nine symptom dimensions was used to continuously assess TMD-related subjective symptoms of the subjects during the intervention period.

In the present study, the symptom dimensions of the diary during the intervention period were analysed. The null hypothesis was that there were no differences between the groups with or without TMD history regarding recorded daily symptoms.

Subjects and methods

Healthy women with no history of TMD ($n=26$, mean age 24 years) as well as women with an earlier TMD history ($n=21$, mean age 32 years) [26] were included in the study. Both groups were divided into true and placebo interference groups. Artificial interferences were introduced in the true interference groups and simulated in the placebo groups. The subjects were followed for 2 weeks, after which time the interferences were removed [26].

Daily diary of symptoms

Every day during the 2-week follow-up period the subjects rated the intensity of 9 symptom dimensions on a VAS scale: occlusal discomfort, chewing difficulties, sensitivity of teeth, fatigue of the jaw, headache, facial pain, opening difficulty, bruxism, and ear symptoms. Every morning after awakening, the subjects were instructed to mark on a solid line (10 cm) the number that best corresponded to their current condition (0 = not at all, 10 = intolerable).

Prior to the main analysis, baseline values of reported symptoms in the different groups were checked using cumulative logistic regression models. No specific differences between the groups were observed. The intensity of symptoms as expressed by VAS scores in the four groups was studied as well. The means of the registrations of different symptoms in the four study groups during 2 weeks were calculated separately and also together to form a composite score of 9 symptoms.

Data analyses and statistical methods

The changes in response over time (change n = day n − baseline, $n=1, \ldots, 14$), i.e. regarding composite score of symptoms as well as separate symptoms of the four groups, were analyzed using a repeated measures model of three factors (TMD history, type of intervention, and time), with baseline values used as the covariate. The mean level of the response regarding composite score of symptoms, as well as separate symptoms of the four different groups during the intervention period, was analyzed using a general linear model of two factors (TMD history, type of intervention). Baseline values were again used as covariates.

The analyses were performed using SAS Statistical Software version 8.2. (SAS Institute Inc., Cary, N.C., USA). Cumulative logistic regression analyses were performed using the GENMOD procedure. Analyses of repeated measures were done using the MIXED procedure. A first-order autoregressive correlation structure was chosen for each model. The MIXED procedure was also chosen for general linear models (ANCOVAs).

Results

A great majority (94.3%) of all registered VAS figures ($n=6345$) on any of the 9 symptom scales during the intervention period were between 0 and 3 on the VAS scale. In the group with TMD history and true interferences ($n=10$), 7 subjects (70%) registered a value of 4 or more at least once, corresponding to 2/3 of all reported high values during the intervention period (Table I). In the group with no TMD history and placebo interferences, 6 out of 14 subjects (43%) registered 4 or higher on the VAS a total of 17 times (5%).

Table I. Subjects of the four study groups reporting and the number of reported values of 4 or above (at least once on any of the 9 VAS scale 0–10) during the intervention period

Group	Subjects reporting values 4 or higher	No. of reported values 4 or higher during the intervention period
TMD history, true interferences ($n=10$)	7/10	239 (67%)
No TMD history, true interferences ($n=12$)	7/12	76 (21%)
TMD history, placebo ($n=11$)	5/11	27 (7%)
No TMD history, placebo ($n=14$)	6/14	17 (5%)
Total		359 (100%)

Table II. Statistical significance of changes in response over time and mean levels of response (2-week VAS scores) for composite score and separate symptoms. "Group" indicates differences between subjects with or without TMD history and "Type of intervention" subjects with true or placebo interferences

Symptom	Changes in response over time			Mean level of response	
	Group	Type of intervention	Time	Group	Type of intervention
Composite score of symptoms	<0.001	0.015	*	0.037	<0.001
Occlusal discomfort		0.029[1]		0.001	0.002
Chewing difficulties		0.072[1]		0.020	0.001
Fatigue of jaws	<0.001	*	*		0.046[2]
Facial pain	0.026	0.050	*	0.001	0.049
Sensitivity of teeth	0.005	0.006	*	0.009	0.006
Headache	0.002	0.058	*	0.017	*
Opening capacity	0.014	*	*	0.072	*
Ear symptoms	0.088	*	*	*	*
Bruxism	0.024	0.093	*	0.043	*

[1]Interaction effect group*type of intervention*time.
[2]Interaction effect group*type of intervention.
**p*-value >0.1.

Perceived symptoms

The composite score of symptoms was statistically significantly associated with the TMD group (TMD history versus no TMD history) and with type of intervention (true interference versus placebo interference) regarding changes in response over time and mean level of response (Table II). Subjects with a TMD history reported stronger symptoms than subjects with no TMD history (Figure 1). Subjects with true interferences reacted with stronger symptoms than those with placebo interferences (Figure 1). The level of symptoms of subjects with TMD history and true interferences remained higher than baseline throughout the follow-up period and showed no adaptation, while the subjects with no TMD history showed a decreasing level of symptoms and an adaptation over time when the baseline was taken into account (Figure 2).

The most prominent separate symptoms were occlusal discomfort (Table II, Figure 3) and chewing difficulties (not shown). An interaction was observed in both symptoms (Table II). In the group with TMD history and true interferences there was an immediate increase in the VAS scores, after which some decrease was observed, but the scores remained higher than baseline until the end of the intervention period (Figure 3). The profile for the subjects without TMD but with true interferences was similar but showed decreasing scores towards the end of the observation time. The interaction seen in this symptom dimension can be explained by the group with TMD history and placebo interferences showing an increase of response intensity towards the end, and the group without TMD and placebo interferences showing an immediate decrease at the beginning. The profile concerning chewing difficulties showed a similar shape (not shown). Again, the differences between the groups regarding the changes over time were seen in the analysis as an interaction (Table II).

Most other single symptoms, e.g. fatigue of jaw (Figure 4), showed a similar profile over time as the composite score of symptoms (Figure 1); at the beginning there were no clear immediate reactions. Subjects with a TMD history reported stronger symptoms, while those with no TMD history and placebo interferences experienced only minimal symptoms. However, an interaction was observed regarding fatigue of the jaw (Table II), which was explained by the group of TMD placebo reporting higher values than the group of TMD with true interferences, since the group means were adjusted by taking the baseline values as covariate into account.

Discussion

The VAS scale used for monitoring the level of nine symptom dimensions is widely used in all studies of

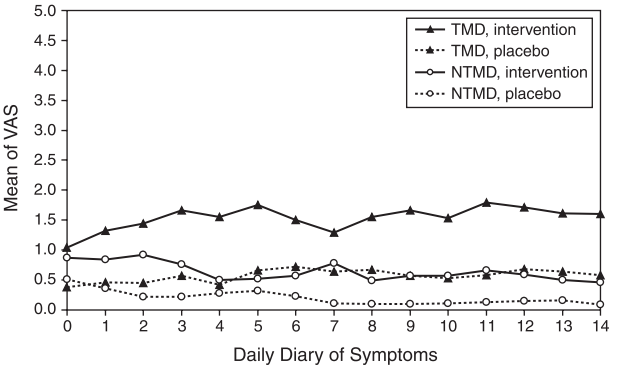

Figure 1. Mean level of response intensity (VAS) of composite scores of symptoms in the four different study groups. TMD, intervention = group with previous TMD history and true interferences. TMD, placebo = group with TMD history and placebo interferences. NTMD, intervention = group without TMD history and true interferences. NTMD, placebo = group without TMD history and placebo interferences.

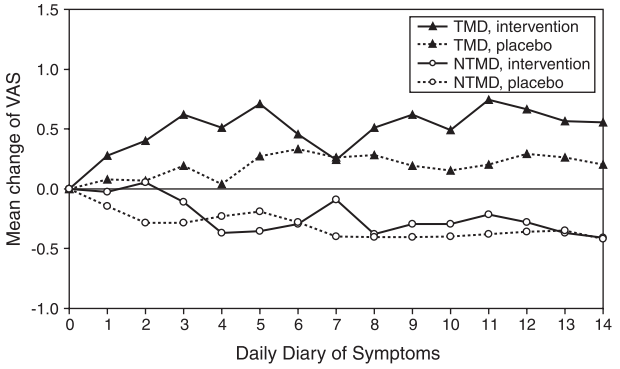

Figure 2. Mean changes in response intensity over time of composite scores of symptoms.

pain. Some researchers have suggested that the VAS scale is a valid tool and have reported high precision [27,28], while others have reported low precision and difficulty in understanding and using the scale [29,30]. We used self-reported daily VAS scores during the entire intervention period of 14 days. Repeated measures are regarded as more indicative than measurements at one time point. This type of measurement reflects true changes in symptoms [31]. In our experiment, the VAS was sensitive in catching the response of the subjects facing the true interferences.

The subjective response was in accordance with our earlier report on the clinical findings [26]. Subjects with a TMD history and true interferences reported strong reactions immediately, and did not adapt as well over time as subjects with no TMD history. The VAS levels of this group were always higher than those of subjects with no TMD history and placebo interferences. The different reaction patterns of the groups were revealed in the observed interaction in some symptom dimensions. Such clear differences in reaction patterns have not been observed in earlier studies on experimental interferences including only healthy subjects without previous TMD history [9].

Occlusal discomfort and chewing problems were the most sensitive single symptoms in our study. TMD history was strongly associated with these symptom dimensions. In subjects with no

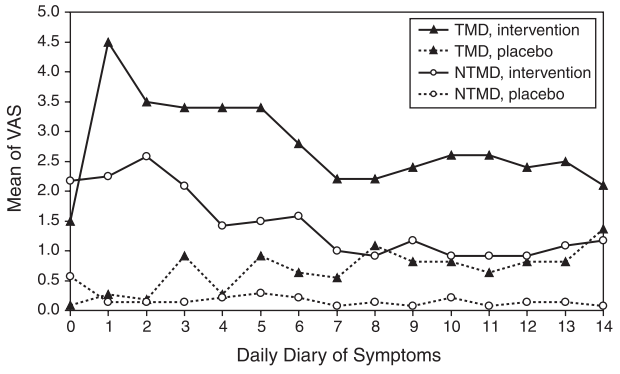

Figure 3. Mean level of response intensity of occlusal discomfort.

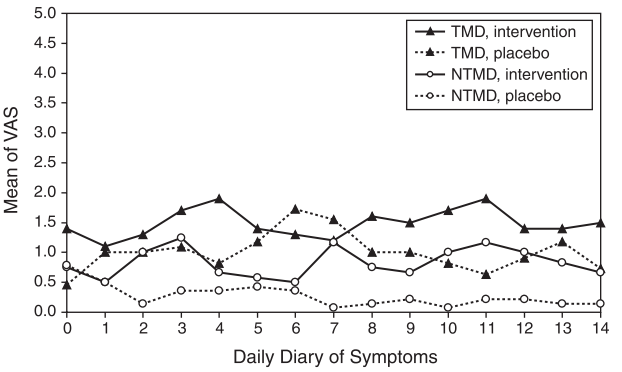

Figure 4. Mean level of response intensity of fatigue of jaw.

TMD history and true interferences, adaptation to these symptom dimensions seemed to occur over time. The results are much in line with those of Magnusson & Enbom [19], who also found that difficulties in chewing were indicative at the beginning, but the symptoms diminished after a few days indicating an adaptation to the new situation. However, in the present study, chewing problems persisted throughout the 2-week observation period in the subjects with TMD history and true interferences.

The subjects with no history of TMD showed consistently fewer symptoms and better adaptation compared to the subjects with TMD history. This is in line with the previously reported observations on clinical signs [26] and also with several earlier studies on experimental interferences including only healthy subjects without TMD history showing only transient symptoms and adaptation over time [8,9]. However, the results of the subjective symptoms were different when including subjects with TMD history in the study set up. We therefore consider it justifiable to conclude: the difference in outcome between the groups with and without a TMD history suggests that there are differences in vulnerability to occlusal interferences. It is likely that the etiological role of occlusal interferences in TMD has not been correctly addressed in previous studies on artificial interferences.

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