Effect of artificial occlusal interferences depends on previous experience of temporomandibular disorders

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Studies on artificial interferences in subjects with no temporomandibular (TMD) history have shown adaptation to the interference within a fairly short period of time. The role of occlusal factors in the etiology of TMD has therefore been questioned. The results might have been different, however, if subjects with a prior TMD history had been included in the study groups. To test this assumption in a randomized double-blind clinical set-up, we included healthy women without ($n = 26$) as well as with ($n = 21$) an earlier TMD history. Both groups were randomly 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 the interferences were removed. The subjects without a TMD history showed fairly good adaptation to the interferences, but the subjects with a TMD history and true interferences showed a significant increase in clinical signs compared to the other groups. We suggest that the etiological role of occlusal interferences in TMD may not have been correctly addressed in previous studies with artificial interferences and allow no conclusions as regards TMD etiology.
☐ *Adaptation; artificial interferences; occlusion; temporomandibular disorders*

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After 70 years of studies, the debate on the etiology of temporomandibular disorders (TMD) is still continuing. In particular, the role of occlusal interferences as a causative factor has been hotly debated. Some researchers deny the occlusion any significant role (1–3), while others defend the theory of disturbing interferences as a causative factor (4, 5), or claim that there is no evidence to refute the occlusal theory (6–10). The number of high quality randomized controlled studies (RCTs) in this field, however, is small (11).

According to Tsuykiyama et al. (12), the most powerful experimental design on the question whether occlusal interferences are deleterious is the experimentally induced occlusal interference study. Recently, a thorough review article on experimental occlusal interferences was published by Clark et al. (13). Data from 18 human and 10 animal studies were reviewed. Many human studies have shown that after the placement of interferences, some minor transient signs and symptoms of TMD may occur, but most subjects are able to adapt quite well to the added interferences. The conclusion was that the preponderance of data does not prove that occlusal interferences are causally related to TMD. De Boever et al. (11) came to much the same conclusion.

It is possible, however, that a selection bias is hidden in these studies (6, 9). Most reports explain in Subjects and Methods that the subjects were healthy and free from any sign and symptom of TMD at baseline (14–27). This is a routine requirement for a study addressing a causal question. However, 'healthy' in this context may mean that the selected subjects have adapted well to their naturally occurring interferences. The result that such subjects were able to adapt also to the artificial interferences is, therefore, no great surprise. Those who had not been able to adapt to the natural interferences (i.e. TMD subjects) had been excluded from the study. Accordingly, there is reason to believe that these experimental studies may have yielded a false-negative result.

The present study was planned to test the hypothesis that the effect of artificial interferences on the development of signs and symptoms of TMD is different in subjects with than without a TMD history. In this set-up, the occurrence of signs and symptoms of TMD can be compared in 4 subgroups: subjects with and without a TMD history, both groups with true or placebo interferences.

Subjects and methods

The study plan was approved by the Ethics Committee of the Medical Faculty of the University of Turku and was designed as a double-blind, randomized, controlled trial (RCT). The subjects were not paid for participating and all were women ranging in age between 19 and 42 years.

Subjects without TMD history

Female students ($n = 31$) from a Nursing School and from the Institute of Dentistry in Turku, Finland, volunteered to participate. The inclusion criteria were

Table 1. Recorded TMD signs and symptoms

Symptoms	Clinical signs
Joint sounds	Jaw mobility
Tiredness or stiffness of the mandible	Pain during maximal opening
Intermittent locking of the mandible	Pain during jaw movements
Continuous difficulties in opening the mouth	Tenderness on palpation of following muscles:
Pain on opening wide	M. masseter deep portion, left, right
Luxation of the mandible	M. masseter superficial portion, left, right
Pain during mastication in joints, muscles, teeth	M. temporalis anterior and posterior, left, right
Headache twice a month or more often	M. temporalis insertion, left, right
Ear symptoms	M. pterygoideus medialis, left, right
Clenching/Bruxism	M. digastrius posterior, left, right
	M. pterygoideus lateralis, left, right
	TMJ sounds, clicking and crepitation, left, right
	TMJ tenderness on palpation, laterally and posteriorly, left, right

good general health, absence of TMD history and morphologically normal dentition allowing corrections by simple occlusal adjustment. Mild palpatory tenderness (verbal report only) of the masticatory muscles was accepted, but no moderate (palpebral reflex) or severe (withdrawal) tenderness.

The volunteers were informed at a general level about TMD and its treatment principles, and also about the study. Throughout the study, all the information was given in an identical way to everybody. The double-blind arrangements were explained by informing subjects that some changes might be introduced in their occlusion. All subjects signed a written consent and underwent an occlusal adjustment (4) to eliminate interferences.

The trial started 3–6 months later, when a total of 5 subjects withdrew because of lack of time or interest. Throughout the study, highest priority was given to the blinding of examiners and subjects. The clinicians did not know at any stage which group the subjects belonged to. An experienced clinician (TJ) interviewed and examined the subjects using a standardized questionnaire regarding subjective symptoms related to TMD (Table 1). A standardized clinical examination of jaw mobility, masticatory muscles (8 sites bilaterally) and TMJs was performed (Table 1). The subjects were then randomly allocated into placebo or true interference groups by applying a random number table. The placebo interference group therefore consisted of 14 subjects, mean age 24 years (range 19–33) and the true interference group of 12 subjects, mean age 24 years (range 19–30). The mean number of signs and symptoms of the subjects before intervention is given in Table 2.

Subjects with TMD history

The group of healthy female subjects with TMD history consisted of 21 subjects who had been referred to the Institute of Dentistry, University of Turku, because of myogenous TMD. Subjects were excluded if arthrogenous problems were diagnosed clinically (clicking, crepitation, locking) or radiographically. The patients had been successfully treated according to departmental routines with counselling ($n = 21$), stabilization splints (15), physical training (3), and occlusal adjustment (21) according to Dawson (4).

On average 5 months (range 2–16 months) after the treatment period, the subjects were invited to participate in the intervention study. Exactly the same study set-up as for subjects without a TMD history was used. In general, the number of signs and symptoms of the former patients was slightly higher compared with the subjects without a TMD history (Table 2), but all subjects felt healthy compared to the situation when they had sought treatment. The subjects were randomly assigned to placebo or true interference groups. The placebo group consisted of 11 subjects, mean age 30 years (range 23–41) and the true interference group of 10 subjects, mean age 33 years (range 26–42).

Intervention

For the subjects in the 2 true interference groups, a blinded experienced specialist (SK) introduced centric relation and balancing-side interferences bilaterally by adding composite resin to the palatal cusps of the maxillary second molars (21). The interferences opened the bite by

Table 2. Mean number of TMD signs and symptoms at baseline in placebo and true interference groups without and with a TMD history

	No TMD history		TMD history	
Group	Placebo ($n = 14$)	Interference ($n = 12$)	Placebo ($n = 11$)	Interference ($n = 10$)
Symptoms	0.4 (range 0–2)	0.5 (range 0–4)	2.1 (range 0–6)	1.7 (range 0–3)
Signs	0.6 (range 0–4)	0.5 (range 0–5)	3.5 (range 0–8)	2.9 (range 0–5)

Table 3. Number of subjects showing changes in TMD signs or symptoms after 2 weeks' presence of true or placebo interference in groups without a TMD history. The groups did not differ significantly from each other (χ^2 test)

	Placebo ($n = 14$)				True interference ($n = 12$)		
Group	Increase	No change	Decrease	*P*	Increase	No change	Decrease
Symptoms	2	8	4	n.s.	4	6	2
Signs	2	10	2	n.s.	6	5	1

n.s. = non significant.

0.3 mm at the centric relation position measured in front with a leaf-gauge between the incisors. The interference did not affect the intercuspal contact position. In lateral jaw excursions, there was a clear mediotrusion contact but also a simultaneous contact on the laterotrusion canine, i.e. the mediotrusion contact was never the only contact during the slide. For the subjects in the 2 placebo groups, the application of interference was only simulated. All subjects were assured that they were free to withdraw at any time. After 2 weeks, the interview and clinical examination were repeated by the first investigator (TJ), who did not examine the occlusion in order to maintain the blinding. The interferences were then removed and the occlusion adjusted (SK). This procedure was simulated in the placebo interference group. The subjects were re-checked after 2 weeks and 6 months.

Statistics

The chi-square test was used when comparing the groups.

Results

Subjects without TMD history

There were no statistically significant differences in number of signs and symptoms between the true interference and placebo groups (Table 3). Increases, no changes, and decreases were observed.

Subjects with TMD history

The results in the subjects with a TMD history were different. In general, the signs and symptoms in the true interference group were more severe and the subjects did not adapt to the interferences as well as those without a TMD history. All the subjects in the true interference group showed an increase in number of clinical signs compared to baseline (Table 4). The result was statistically significant compared both to the placebo group of subjects with TMD history (χ^2 9.54, $P = 0.008$) and to the true interference group of subjects without TMD history (χ^2 6.87, $P = 0.032$, test not shown in Table 4). The changes in subjective symptoms were in the same direction, but were not statistically significant (Table 4).

Two weeks after the removal of the interferences, as well as 6 months later, all subjects were coping well.

Discussion

The present study was the first to include subjects with a TMD history in this kind of trial. Thus, we had no pre-existing data suggesting what the outcome might be. Therefore, when planning this investigation, the ethical aspects were carefully discussed and explained to the Ethics Committee of the Faculty of Medicine. We also assured the subjects that they could leave the study at any time. According to the original plan, we wanted to have more than 10 subjects in all 4 groups. The strict inclusion criteria made the collection of subjects extremely laborious. Those with a TMD history had to be treated first and they had to match the controls as closely as possible. For this reason, in order to control possible confounders and to make the groups as comparable as possible, we excluded all subjects with clinical or radiographic signs of possible arthrogenous problems. As a result, the number of subjects was not as high as one would have wished. The mean age of those with a TMD history was also higher than in the other group. However, earlier studies do not suggest age-dependent differences within the ranges of our study subjects.

In order to reach maximal blinding and randomization, three independent researchers were involved. One treated

Table 4. Number of subjects showing changes in TMD signs or symptoms after 2 weeks' presence of true or placebo interference in groups with TMD history. The groups differed significantly regarding signs but not symptoms (χ^2-test)

	Placebo ($n = 11$)				True interference ($n = 10$)		
Group	Increase	No change	Decrease	*P*	Increase	No change	Decrease
Symptoms	4	2	5	n.s.[a]	6	2	2
Signs	4	2	5	0.008	10	0	0

the patients (YLB), one performed all examinations (TJ) and one carried out the intervention (SK), all without knowing the observations of the other researchers. It might of course be questioned whether blinding in subjects was successful. However, as in an earlier study (21), some of the placebo subjects complained of discomfort, although nothing had been changed in their occlusion. Therefore, we could be quite sure of successful blinding.

We carefully tried to standardize the height of the artificial interferences with the aid of leaf gauge measurement in the front. We used a small interference with simultaneous contact on laterotrusion canine. This was done because we aimed at as 'natural' interferences as possible. The small size of the interference may be one explanation why the healthy subjects without a TMD history reported only some discomfort. It may also explain why all our subjects coped well afterwards, in contrast to an earlier study (21).

The subjects with a TMD history had more sites tender to palpation at baseline than had those with no TMD history. It is possible that TMD or its treatment can affect the subject's sensitivity to and awareness of the occlusion. However, the subjects felt healthy at baseline and the range of variation in muscle tenderness did not differ from observations in non-patient populations.

We found that the results of the group consisting of subjects without TMD history were in line with earlier studies concluding that these subjects may adapt well to experimental interferences. However, with a more critical study design, i.e. by including former TMD patients in the study set-up, the results changed. The difference between the groups with and without a TMD history suggests that the etiological role of occlusal interferences in TMD may not have been correctly addressed in previous studies on artificial interferences.

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