# Signs and symptoms of mandibular dysfunction after introduction of experimental balancing-side interferences

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A double-blind study was performed in two groups of young, healthy women without signs or symptoms of mandibular dysfunction. Each group contained 12 individuals. In one of the groups, balancing-side interferences were applied bilaterally, whereas the application was simulated in the other group. The participants were re-examined after 2 weeks. Ten individuals in the experimental group reported one or more subjective symptoms during the 2 weeks, whereas seven exhibited clinical signs of dysfunction. The commonest symptom was headache, and the commonest clinical sign was muscles tender to palpation. In the control group, three individuals reported subjective symptoms, and three had clinical signs of dysfunction. One week after elimination of the interferences, all signs and symptoms had disappeared in all individuals but two. In these two subjects it took 6 weeks before pre-experimental conditions were restored. It is concluded that there is no simple relationship between interferences and signs and symptoms of dysfunction. How the individual reacts to local factors depends on his or her psychic condition. In some individuals addition of balancing-side interferences is sufficient to create dysfunction. The findings thus underline the importance of local factors in the etiology of mandibular dysfunction but show that a relationship is not obligatory.
☐ *Experimental clinical study; interferences; mandibular dysfunction*

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Over the years various opinions about the etiology of mandibular dysfunction have been presented in the literature. Some authors claim that occlusal factors are of great importance (1), whereas others stress the influence of central factors (2, 3). Most authors, however, are of the opinion that the etiology is multifactorial and that the magnitude of the influence of local and central factors varies from individual to individual (4).

Of the local factors, attention has been focused on occlusal interferences, especially in the retruded position (RP) and on the balancing side (5, 6). Ramfjord (7) concluded that occlusal interferences on the balancing side had the most disturbing effect on the contraction pattern of the muscles and that removal of occlusal disharmonies was followed by a reduction in muscle tone and alleviation or elimination of bruxism. Other authors (8, 9) have not been able to find any change in the electromyographic (EMG) pattern after insertion of a balancing-side interference, nor did Ingervall & Carlsson (10) find any gross influence of natural balancing-side interferences on the EMG pattern in 13 individuals. Nevertheless, in their study six out of eight subjects with a clinical dysfunction score had a reduced score after occlusal adjustment. Epidemiological studies have also demonstrated correlations between signs and symptoms of mandibular dysfunction and balancing-side interferences (11, 12) and interferences in RP (13).

Clinical studies of the effect of occlusal interferences on signs and symptoms are rare. In a study by Randow et al. (14), seven out of eight subjects developed subjective symptoms after creation of an interference in both RP and the intercuspal position (IP).

Six exhibited one or more clinical signs of dysfunction, and all subjects had considerable changes in the EMG recordings.

The aim of this investigation was to determine whether incorporation of bilateral balancing-side interferences in a group of young, healthy women would lead to the development of clinical signs and/or subjective symptoms of mandibular dysfunction and to compare them with a control group who was told that they received the same type of occlusal interferences.

## Subjects and methods

All the students at the Dental Nurses' and Dental Hygienists' School in Luleå, Sweden, were informed that we planned an investigation of the effects of occlusal interferences and that we wanted volunteers with a natural, full dentition in normal occlusion and with no known symtoms of mandibular dysfunction. They were told that we intended to incorporate a minor occlusal disturbance in their bite during a period of 2 weeks and that symptoms might occur in the head, face, or jaws, but the symptoms were not specified. It was stressed to all who participated that they were free to interrupt the experiment at any time if they wanted to.

The volunteers were subjected to a standardized clinical examination (15), and a thorough history, including questions about previous or present symptoms from the stomatognathic system and questions about previous and present general health, was taken. The clinical examination comprised measurement of the range of movement of the mandible, function of the temporomandibular joints (TMJs), palpation of the TMJs and masticatory musculature, and examination of the subjects for pain on movement of the mandible. From these registrations, a clinical dysfunction index, $D_i$, in accordance with Helkimo (16), was determined. Maximal laterotrusion, protrusion, and opening of the mouth were measured to the nearest millimeter. Measurement of maximal opening of the mouth included vertical overbite. In the examination of the function of the TMJs, notes were made of deviation of the path of movement of the mandible by 2 mm or more during opening of the mouth and of any joint sounds, locking, or luxation. Tenderness of the masticatory musculature was recorded if the patient clearly reported such tenderness or when a palpebral reflex was elicited. The muscles palpated were the superficial and profound masseter, the lateral and medial pterygoid muscles, and the origins and insertions of the temporal muscles. The TMJs were palpated from the side (lateral) and from behind (via the auditory meatus). As in the recordings of the number of painful mandibular movements, recordings were made only when such symptoms were clearly reported by the subjects or when a palpebral reflex was elicited. The clinical examination also included examination of the relation between the upper and lower jaw in IP and registration of interferences in RP or on the balancing side.

When the history was taken, the participants were asked whether they had ever had any of the following symptoms: joint sounds, fatigue of the jaws, locking or luxation, difficulty in opening the mouth wide, pain on movement of the mandible, and pain in the face or jaws. From these answers, an anamnestic index, $A_i$, in accordance with Helkimo (16), was determined. The participants were also asked whether they were aware of any occlusal parafunction or chewing difficulties, if their teeth were ever tender, and if they had recurrent headaches. The histories were taken and the clinical examinations performed by the same examiner (examiner A).

The collection of participants continued until 24 women were included (16 dental nurses and 8 dental hygienists) with a normal occlusion, no missing teeth (loss of third molars was accepted), no severe occlusal interferences, no clinical signs of dysfunction (minor joint sounds and deviation on opening the mouth wide were accepted in three and two cases, respectively), no subjective symptoms from the stomatognathic system (minor joint sounds were accepted in five cases), and no history of recurrent headaches with a frequency of more than once a month.

In eight cases minor interferences were accepted, five with unilateral tooth contact in RP and three with balancing-side interferences in maximal lateral excursions. At the first examination their interferences were eliminated by occlusal grinding. All the participants were re-examined by examiner A 1 week later to ascertain whether there was any spontaneous fluctuation of signs and/or symptoms or whether the occlusal grinding had resulted in any change in the situation.

After that, the women were divided into two groups, each containing 12 subjects. The two groups were matched with respect to age, educational level, and presence of minor signs or symptoms so that they were as equal as possible. The age range was 16–33 years (mean = 22) in the experimental group and 18–34 years (mean =23) in the control group. In the experimental group (henceforth called EG), examiner B introduced balancing-side interferences bilaterally by the addition of composite material to the buccal surfaces of the palatal cusps of the maxillary first molars, using an acid-etch technique. The occlusion was then adjusted so that there was no interference in IP or RP but contact only with the contralateral interference in lateral excursions of the mandible of up to at least 3 mm, measured in the frontal region. In the control group (CG) the application of the interference was only simulated. Instead of acid-etch, sterile water was used, and the composite material was never applied to the tooth surface. To prevent the possibility of the participants influencing one another, they were told not to discuss their symptoms, if any, during the experimental period. Examiner A did not know which women belonged to the EG and which belonged to the CG. One week after application of the interferences, both groups were examined by examiner B to check that the interferences were still present. Another week later, the clinical examination was repeated by examiner A, and the participants were asked whether they had had any symptoms during the 2 weeks. After that, the interferences were removed in the individuals in the experimental group, and those subjects in the two groups who had signs and/or symptoms were then seen weekly until the signs and symptoms had disappeared.

### *Statistical methods*

Non-parametric analytical methods such as the sign test, Fisher's permutation test, and Spearman rank correlation analysis ($r_s$) were used for tests of significant differences between the groups and examinations and for testing correlations between variables (17). Values of $p < 0.05$ were considered statistically significant in two-tailed tests.

## Results

### *Constancy of clinical and anamnestic findings*

When the examination was repeated after 1 week to measure the normal fluctuations and any effects of the occlusal grinding (performed in eight individuals), all signs and symptoms were consistent except for the mandibular movements, in which differences of up to 2 mm were occasionally noted.

### *Findings after the experimental period*

Two subjects in the EG contacted examiner B after 8 and 9 days, respectively, because of severe discomfort. One complained of tooth grinding, chewing difficulties, constant pain in the cheeks, and frequent headaches. The other clenched her teeth, experienced fatigue and stiffness in the jaws, had pain from her right TM joint, and had a constant, dull headache. Both had obvious clinical signs of dysfunction. Their interferences were removed.

When the other subjects were examined at the end of experiment, one participant in the EG and two in the CG reported grinding during the experimental period. Two and four, respectively, reported clenching. Ten subjects in the EG and three in the CG reported one or more subjective symptoms (Table 1). The commonest symptom was headache (Table 2). Both headache and tender teeth were reported significantly more often in the EG than in the CG. The change in the anamnestic index is shown in Table

Table 1. Number of reported symptoms in 24 subjects during the experiment

| No. of symptoms | No. of subjects | | |
|---|---|---|---|
| | Experimental group | Control group | Total |
| 0 | 2 | 9 | 11 |
| 1 | 3 | 2 | 5 |
| 2 | 3 | 1 | 4 |
| 3 | 2 | | 2 |
| 4 | 1 | | 1 |
| 5 | | | |
| 6 | 1 | | 1 |

Table 2. Reports of new subjective symptoms during the experiment

| Symptom | No. of reports | |
|---|---|---|
| | Experimental group | Control group |
| Headache | 7 | 2 |
| Tender teeth | 4 | |
| Fatigue in the jaws* | 4 | 1 |
| Difficulty in chewing | 3 | |
| Pain in face or jaws* | 3 | 1 |
| Joint sounds* | 2 | |
| Difficulty in opening the mouth* | 1 | |
| Ear symptoms | 1 | |

* Symptoms included in the anamnestic index

3. At the second examination the anamnestic index was significantly higher in the EG.

An increase in the clinical dysfunction index was recorded in seven subjects in the EG, whereas three in the CG had an increase and one a decrease (Table 4). The change in the clinical dysfunction index in the EG was statistically significant, and it was now significantly higher than in the CG. The clinical findings are listed in Table 5. There was a statistically significant difference in the prevalence of muscles tender to palpation between the two groups. The correlation between the clinical and anamnestic dysfunction index in the EG was fairly strong ($r_s = 0.57$, $p < 0.05$).

In all cases but two, the clinical signs and subjective symptoms disappeared within a week after the interferences had been removed. In two cases, one from each group, it took 6 weeks before pre-experimental conditions were restored.

## Discussion

Since both the patient and the clinician must be checked, the establishment of reliability in clinical examinations is a difficult task (18). In this investigation we have tried to minimize the influence of any expectations, on the part of the examiner and/or partici-

Table 3. Anamnestic dysfunction index ($A_i$) in the two groups at the first and second examination

| $A_i$ | Experimental group | | | Control group | | |
|---|---|---|---|---|---|---|
| | 0 | I | II | 0 | I | II |
| First examination | 9 | 3 | | 10 | 2 | |
| Second examination | 5 | 4 | 3 | 10 | 1 | 1 |

Table 4. Clinical dysfunction index ($D_i$) in the two groups at the first and second examination

| $D_i$ | Experimental group | | | | Control | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | I | II | III | 0 | I | II | III |
| First examination | 9 | 3 | | | 10 | 2 | | |
| Second examination | 2 | 4 | 6 | | 8 | 2 | 1 | 1 |

Table 5. New clinical findings after the experimental period

| Sign | No. of reports | |
|---|---|---|
| | Experimental group | Control group |
| ⩾ 3 muscles tender to palpation | 6 | 2 |
| Deviation ⩾ 2 mm | 3 | 1 |
| Impaired mandibular mobility | 2 | |
| Joint sounds | 1 | |
| TMJ pain on palpation laterally | 1 | 2 |
| TMJ pain on palpation posteriorly | | 1 |
| 1–3 muscles tender to palpation | 1 | |

pants, that signs and symptoms will occur by adopting a double-blind procedure. It might of course be seriously questioned whether the subjects in the control group really believed that interferences had been introduced in their occlusion. This is an important reservation when analyzing the results. However, several individuals in the CG complained of severe discomfort after the simulated application of interferences. Furthermore, most of the participants in the CG were surprised when they were told that no change had been made in their occlusion, whereas one subject in the experimental group was convinced that no interference had been applied. The spontaneous reactions from the participants convinced us that the method used was sufficiently reliable for evaluation of the effects of balancing-side interferences in a double-blind test.

When participants for this investigation were collected, 23 individuals were rejected, in most cases because of signs and symptoms of mandibular dysfunction. That signs and symptoms of dysfunction are a common finding has been shown in several epidemiological investigations (13, 19, 20).

Before the experiment the participants were examined twice with an interval of 1 week. Except for small differences when measuring the mandibular movements, which can be explained by the error of measurement (21), we found no changes in signs or symptoms during the week. This indicates a high intra-observer constancy (22) and a high constancy of the signs and symptoms present.

When this investigation was planned, the ethical aspect was discussed, but since the participants were allowed to interrupt the experiment at any time, we judged it fair to carry out the experiment. Two participants wanted to discontinue the experiment during the 2 weeks, and their interferences were immediately eliminated.

In seven subjects in the EG new clinical signs developed during the experiment, whereas there was no change in five. Three subjects in the CG had an increase and one a decrease in the clinical dysfunction index. In the light of our opinions concerning the etiology of signs and symptoms of mandibular dysfunction, the finding was not surprising. There is no simple and dramatic relationship between interference and signs and symptoms of mandbular dysfunction (23). In many cases psychic factors play an important role in the etiology. Malocclusion and interferences can act as an aggravating or initiating factor. How the individual reacts to local factors depends on his or her psychic condition. In five cases in the EG, the interferences were not enough to create dysfunction, whereas the belief that they had an interference or other stress factors during the experimental period was enough to create dysfunction in three individuals in the CG. It is notable that the highest dysfunction index after the experimental period was registered in a subject in the CG.

There was a good correlation between the clinical and anamnestic index. This has also been found in other studies (24, 25) and demonstrates the validity of the indices.

In both groups some individuals reported grinding or clenching during the experiment. This may be due to increased awareness of the presence of any parafunction, but it may

also indicate an increase in parafunction activity. An increase in the frequency of eccentric contacts on balancing-side interferences has been demonstrated (8, 9), and this may explain why four individuals reported tender teeth.

Three subjects in the EG reported difficulty in chewing, but all three said that difficulties diminished after a few days, which indicates that the chewing pattern adapts to the new situation.

Headache was the commonest symptom reported. Both subjects in the CG and two out of seven in the EG who reported headache reported a single attack, and this low frequency can be explained by factors other than the experiment. In five cases, however, the headaches were frequent or constant during the 2 weeks. Since none of these subjects had a history of headaches more than once a month, it seems reasonable to assume that their headaches were caused by the experiment. A correlation between headache and mandibular dysfunction has been found in numerous investigations, and it has been suggested that headache should be included in the symptom panorama of mandibular dusfunction (26).

One week after the interferences had been removed, the situation had returned to normal in all individuals but two. Alleviation of signs and symptoms a short time after elimination of interferences in patients with mandibular dysfunction has recently been reported (27). In two subjects, one from each group, it took 6 weeks for the signs and symptoms to disappear, and this might indicate that factors other than the interferences were the main cause of the dysfunction in these subjects, or that when the signs and symptoms were established, they might remain despite the removal of the cause (28).

To summarize, this investigation shows that addition of balancing-side interferences is sufficient to cause signs and symptoms of dysfunction in many, but not all, individuals. This underlines the importance of local factors in the etiology of mandibular dysfunction but shows that a relationship is not obligatory. In combination with psychic factors, local factors might be of etiological importance, but if the psychic factors are strong enough, mandibular dysfunction may develop without the existence of occlusal interferences.

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