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Health risk from occlusal interferences in females

Pentti Kirveskari and Tapio Jämsä
Institute of Dentistry, University of Turku, Finland

SUMMARY The purpose of the present study was to test the effect of elimination of occlusal interferences on the incidence of requests for treatment of symptoms in the head and cervicobrachial region. One hundred and twelve females 45 years of age or under, were randomly divided into a treatment group ($n = 54$) and a control group ($n = 58$). The former underwent occlusal adjustment and the latter grinding that did not affect occlusal contacts. The treatments were repeated every 12 months over a period of 4 years. The outcome variable was a spontaneous request for treatment. Statistical analyses included chi-square tests for categorical variables and a *t*- or Wilcoxon ranked sum test for continuous variables. Poisson regression was used to compare the risk of seeking treatment between the groups.

The cumulative incidence rate of treatment requests was 2/54 in the treatment group and 11/58 in the control group. The relative risk was 5.12. The 95 per cent confidence limits were 1.14 and 23.1, respectively. The difference between groups was statistically significant ($P = 0.0336$).

Systematic elimination of occlusal interferences significantly reduced the incidence of requests for treatment of symptoms in the head and cervicobrachial region. This is in contrast with the view that there is no, or at best, an insignificant health risk from occlusal interferences.

Introduction

Recent reviews of the effect of occlusal therapy on temporomandibular disorders (TMDs) emphasize the lack of evidence for a significant prophylactic or therapeutic effect of occlusal adjustment, or of a stabilization splint (Koh and Robinson, 2003; Al-Ani *et al.*, 2004). Nevertheless, the latter is considered acceptable, whereas the former is not recommended. Even ethical doubts about occlusal adjustment have been raised (Koh and Robinson, 2003), apparently due to its irreversibility. In spite of the predominantly negative opinion among researchers about occlusal adjustment, many clinicians continue to practise it, convinced of its beneficial effect on health.

The lack of statistical evidence for the effect of occlusal adjustment on various symptoms (Koh and Robinson, 2003) is not surprising nor is it conclusive evidence against the aetiological significance of occlusal factors. The symptom panorama presented by patients referred to treatment for functional disorders is wide (Carlsson *et al.*, 1982). Cervicobrachial and masticatory muscles are cofunctional (Eriksson *et al.*, 2000), and symptoms from these regions are associated (Kirveskari *et al.*, 1988). If occlusal factors are a part of causal complexes of functional disorders of the masticatory system, it is conceivable that they could also lower the threshold for seeking treatment for symptoms from any cofunctional region.

Many of the symptoms lack an identifiable link to the presumed causal factors. Many are also pain free and seldom the primary reason for seeking treatment. In the general populations, the incidence of single symptoms of TMD, or of other symptoms possibly associated with the function of the masticatory apparatus, is low (Marklund and Wänman, 2008). Significant associations between the incidence of single symptoms and occlusal factors, if any, can be expected only if the samples are large and the observation period long. However, a test of the possible health risk from occlusal factors should cover their total effect on health. In the absence of consensus on a single quantitative measure of the total effect, spontaneous requests for treatment of TMD related symptoms as the outcome variable in an earlier study on adolescents and young adults (Kirveskari *et al.*, 1998) were chosen. Requests for treatment were significantly more common in the control group than in the treatment group (Kirveskari *et al.*, 1998), while the differences in the incidence of single symptoms of TMD remained insignificant.

The aim of the present study was to test the effect of systematic elimination of occlusal interferences on the incidence of requests for treatment of symptoms in the head and cervicobrachial region in adult females at self-estimated risk of developing work-related cervicobrachial pain. The null hypothesis was that adult females in potentially stressful professions and with occlusal interferences do not differ significantly from those without occlusal interferences in terms of seeking treatment for symptoms in the head and cervicobrachial region.

Subjects and methods

The target population consisted of female employees, 45 years of age or under, who considered their work physically stressful to the cervicobrachial musculature. Information about the purpose, criteria for admission, the randomized method, possible benefits and risks, and the right to withdraw

from the study was distributed to female employees of the University of Turku, the Municipal Health Authority of Turku and the University Hospital of Turku, by the respective administrative personnel. In case one of the occlusal adjustment methods should prove significantly superior to the other, those with the inferior treatment were promised the superior treatment at the end of the study. The research was approved by the Ethical Committee of the Medical Faculty of the University of Turku and by the Ethical Committee of the Municipal Health Authority of Turku.

In all, 155 females volunteered and presented themselves for preliminary screening. The reasons for exclusion were manifest TMD requiring treatment, ongoing treatment for any general disease, clinical signs of temporomandibular joint (TMJ) pathology precluding pain-free manual loading of the joint, removable dentures, major morphological malocclusion, or an insufficient number of posterior teeth. The latter two factors were assessed in view of the possibility of establishing an interference-free occlusion by means of simple occlusal adjustment, with minimal loss of enamel. Sometimes, composite resins were used to build up tooth surfaces for favourable contact. The subjects fulfilling the admission criteria were encouraged to make an appointment for the first treatment session and bring along a signed informed consent form.

One hundred and thirty-four females fulfilled the inclusion criteria and volunteered to participate. The subjects answered a questionnaire covering background data and current symptoms in the head and cervicobrachial region (Table 1). They then underwent a standard clinical examination including palpation of the masticatory muscles and TMJs, and measurements of maximum jaw movements, by a blinded examiner (TJ). The same examiner also measured maximum head movements using the Myrin Goniometer (LIC Rehab AB, Linköping, Sweden). They were then assigned to either a treatment or control group, according to a sequence obtained from random number tables and known only to the operator (PK). After all baseline examinations had been carried out, a copy of the list of subjects and their group assignment was sealed in an envelope and mailed to the contact persons working for the three different employers, to be kept unopened until the end of the study.

Table 1 Baseline background and symptom data. Maximum head movements are group means in degrees. Stress level and symptom frequencies are group mean values of self-estimates on a one-to-five scale ranging from none or very low to very high.

	Treatment group, $n = 68$	Control group, $n = 66$
Mean age	36.9	36.5
Living alone	32%	21%
Basic education		
9 years	38%	30%
12 years	62%	70%
Maximum head movements		
Flexion	59	60
Extension	68	70
Lateroflexion, right	68	67
Lateroflexion, left	66	69
Rotation, right	73	61
Rotation, left	69	66
Work-related physical stress level	3.7	3.9
Psychosocial stress level	2.4	2.5
Headache frequency	2.8	3.0
Cervicobrachial pain frequency	3.2	3.3

The subjects in the treatment group underwent meticulous occlusal adjustment aimed at elimination of all interferences according to Dawson (1989), in accordance with an earlier study (Kirveskari *et al.*, 1998). At the end of the adjustment, the subjects had simultaneous bilateral post-canine contacts in centric relation without slide into the intercuspal position (IP) on clenching. However, no attempt was made to establish a point centric, i.e. to restrict the so-called freedom from centric. Only anterior contacts were present on both guided and unguided jaw excursions from the centric positions. Readjustment was carried out 1–3 weeks after the initial adjustment. Four subjects required a third session before an acceptable result (absence of interferences) was achieved. The first session lasted on average 15–30 minutes, re-adjustments 5–15 minutes.

The control group underwent similar treatment except that only the margins of restorations were ground and sharp edges in enamel or in fillings were lightly rounded off. On occasions, the shaft of the drill was allowed to rotate against the enamel to simulate the effect of grinding. The technique and instrumentation were the same as in the treatment group. The exact location of the IP contacts and interferences was continuously marked during the whole procedure. Re-adjustments were made once, 1–3 weeks later.

All subjects were told that the eventual effects of the adjustment, such as a feeling of a 'strange bite' and thermal sensitivity of the teeth, would normally last no more than a few days. They were also encouraged to contact should they wish treatment for symptoms possibly related to TMD or for cervicobrachial pain. The subjects filled in the questionnaires and underwent clinical examinations as well as occlusal re-adjustments at 12, 24, 36, and 48 months after the baseline examination. The final examination at 48 months included a questionnaire in which the subjects listed the effects ascribed to the occlusal adjustment.

Categorical variables were analyzed using chi-square or Fisher exact test when appropriate. Continuous variables were analyzed using a *t*- or Wilcoxon ranked sum test. Poisson regression was used to compare the risk [risk ratio (RR)] of seeking treatment between the groups. A P value less than 0.05 was considered significant.

Results

There were no statistically significant differences in the background data between the treatment and control group.

The same was true of the baseline frequency of headache and cervicobrachial symptoms (Table 1).

Twenty-two subjects withdrew from the study for the reasons listed in Table 2. Fourteen of these were in the treatment group and eight in the control group. Those who withdrew from the study were 3.2 years younger than those who completed it (34.0 versus 37.2 years, $P < 0.01$). Otherwise, their baseline background and symptom data yielded no significant differences. Thus, 54 subjects in the treatment group and 58 subjects in the control group completed the study.

Thirteen subjects requested treatment for symptoms in the head and cervicobrachial region during the 4 year study period (Table 3). Eleven of these were from the control group and two from the treatment group (Figure 1). The RR was 5.12 and the 95 per cent confidence limits for the RR were 1.14 and 23.1, respectively ($P = 0.0336$).

The effects attributed to the occlusal adjustment at the end of the study were with few exceptions either positive or neutral (Table 4). None of the negative effects prompted a request for treatment.

Discussion

The present study was limited to females at risk of developing work-related cervicobrachial symptoms in order to increase the probability of treatment requests. The fact that all the subjects had free health care provided by their employer was believed to lower the threshold to seek treatment. The sample and methods of the study were chosen for a test of occlusal interferences as a structural health risk for symptoms in the head and neck region, not for testing a causal relationship between occlusion and cervicobrachial symptoms.

Table 2 Withdrawals from study in the control (C) and treatment (T) groups.

ID	Group	Year of study	Reason
5	C	I	Moved from Turku
10	C	I	Quit job, new employer
24	T	II	Quit job, new employer
27	C	I	Symptoms after treatment
28	T	III	Moved from Turku
29	T	II	Quit job, new employer
37	C	II	Orthodontic treatment
43	T	III	Problems with general health
44	C	IV	Lack of time, father died
48	T	II	Quit job, new employer
52	T	I	Quit job, new employer
62	T	II	Facial trauma, litigation
67	T	III	Lack of time
77	C	II	Moved from Turku
90	C	II	Moved from Turku
98	T	III	Lack of time (maternity leave)
114	T	III	Problems with general health
118	T	I	Lack of time
115	C	II	No effect, not useful
119	T	II	No problems, not useful
124	T	III	Treatment not helpful
134	T	II	Lack of time

The aetiological significance of a suspected risk factor can be tested by comparing the incidence of its presumed effects on health in subjects exposed or unexposed to the risk factor. If the effects develop slowly, the observation period needs to be prolonged. If it is short, the risk of a false negative result is evident. The exposure to occlusal interferences starts at an early age. The subjects most susceptible to their effects are likely to be excluded from samples of 'healthy adults' because of earlier experience and treatment for a manifest disorder. Healthy adults may therefore represent a part of the population at large selected for resistance to the effects of the suspected occlusal risk factors (Le Bell *et al.*, 2002).

According to current mainstream thinking, the aetiological role of occlusal factors is limited to possible transient symptoms from the teeth and periodontium. If so, a systematic elimination of occlusal interferences (regardless of definition) in non-patients should not affect the incidence of requests for treatment of any non-dental symptoms. In a previous study (Kirveskari *et al.*, 1998) on adolescents and young adults, the outcome variable was a request for treatment of TMD, whereas requests for any non-dental symptoms from the head and cervicobrachial region were taken into account in the present investigation. The RR in the incidence of treatment requests for TMD was 8.06 (Kirveskari *et al.*, 1998) and in the present research, 5.12. There was little methodological difference between the two studies. The subjects in the present research were adult females and the time lapse between the re-adjustments was 12 months instead of 6. The latter difference involved an increased risk that occlusal interferences could partially recur (Hellsing, 1988), eliminating or weakening the effect of occlusal adjustment.

Since the operator cannot be blind to the group assignment, unconscious behavioural differences are a possible source of bias. Such effects can be minimized by neutral behaviour when working and communicating with the subjects. The effects attributed to treatment by the subjects (Table 4) suggest that there was a strong placebo effect with respect to change in occlusal contacts and no indication of significant bias favouring the treatment group. Another possible source of bias explaining the result would be a significant difference between the treatment and control group in distribution of background variables after randomization. There was also no indication of this (Table 1).

Occlusal adjustment entails no or only insignificant temporary inconvenience if correctly carried out (Dawson, 1989). The effects in the treatment group were either positive or neutral. Only one subject mentioned that the sensitivity of her teeth had increased permanently after the adjustments, but not to the extent that she would have

Table 3 Patients requesting treatment in the treatment (T) and control (C) groups for symptoms in the head and cervicobrachial region during the study.

ID	Age at baseline	Group	Months in study before onset	Symptoms prompting request	Clinical signs and reported symptoms at the annual examination preceding request for treatment
11	32	C	37	Headache, bruxing	Deviation on opening–closing
17	43	C	36	Facial pain, dental pain, ear pain	Headache, ear symptoms
22	45	C	27	Headache, cervicobrachial pain, ear symptoms	Deviation on opening–closing, headache, cervicobrachial pain, ear symptoms
33	32	C	6	Cervicobrachial pain	Pain on palpation, cervicobrachial pain
35	45	C	8	Facial pain	Pain on palpation, headache, cervicobrachial pain
51	33	T	43	Facial pain	Pain on palpation, headache, cervicobrachial pain, ear symptoms
69	31	C	6	Headache, cervicobrachial pain	Pain on palpation, headache, cervicobrachial pain
72	30	C	21	Cervicobrachial pain	Pain on palpation, headache, cervicobrachial pain
105	30	C	47	Migraine, cervicobrachial pain	Deviation on opening–closing, headache, cervicobrachial pain
108	45	C	36	Facial pain	Deviation on opening–closing, cervicobrachial pain
120	40	C	34	Jaw joint pain	Pain on palpation, cervicobrachial pain
125	41	C	10	Sensitivity of teeth, headache, cervicobrachial pain	Deviation on opening–closing, headache, cervicobrachial pain
135	38	T	6	Bruxism, headache, cervicobrachial pain	Pain on palpation, deviation on opening–closing, headache, cervicobrachial pain

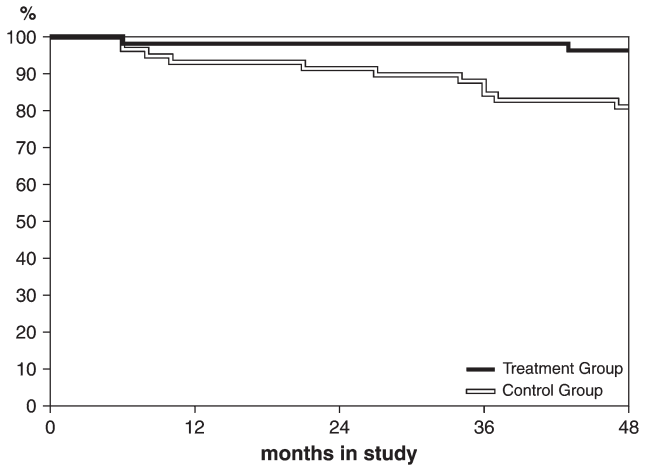

Figure 1 Survival in months of the female subjects in the study without a request for treatment of symptoms in the head and cervicobrachial region.

requested treatment. Her third molars were malpositioned, requiring relatively extensive grinding.

The assessments of the significance of occlusal factors have focused on methodological shortcomings and on the evidence of effects on a few TMD-related symptoms rather than on the total effect of occlusal factors on health. In the present study, cervicobrachial symptoms and headache were common reasons for requesting treatment (Table 3). However, all the patients had also listed other symptoms or exhibited signs typical of TMD. Limiting the analysis of the aetiological significance of occlusal factors to single (painful) symptoms may therefore lead to false negative results. The same risk applies to clinical trials on the effect of treatment in patients unless a carefully selected homogenous sample is studied (Karppinen *et al.*, 1999).

Many clinicians share the experience that TMD has a tendency to progression. The variation in progression is large, ranging from apparent, often temporary, regression to acute onset of painful symptoms not previously experienced. However, the patient history often reveals early symptoms recognized by the patient only if specifically asked about by the therapist. There is considerable fluctuation over time in the treatment need and diagnostic subgrouping of TMD (Kuttila *et al.*, 1997). The slow progression of painless clicking into joint pain has been reported in the literature (Brooke *et al.*, 1988).

The current de-emphasis of the aetiological significance of occlusion can be seen as a logical consequence of the concept of TMD underlying the Research Diagnostic Criteria (RDC), which characterize TMD as a chronic pain condition (Dworkin and LeResche, 1992). Adherence to these criteria in clinical studies leads to the assignment of subjects with painless or only mild symptoms and signs to the category of 'healthy'. Progression from mild symptoms to chronic pain and disability may take a long time, rendering a critical follow-up study impossible to carry out in practice.

Table 4 Effects attributed to occlusal adjustment at the end of the study. The numbers refer to the number of answers given, which varied between 1 and 4 per subject.

	Treatment group	Control group
No change	13	22
Bite more comfortable	35	18
Bite less comfortable	0	1
Decrease in sensitivity of teeth	8	4
Increase in sensitivity of teeth		
Short term	2	0
Long term	1	1
Other positive comments	9	6
Other negative comments	0	2

It has been shown that clinical signs of TMD are significantly associated with occlusal interferences in children when the study sample included subjects without or with just a few interferences (Kirveskari *et al.*, 1989, 1992). Moreover, systematic elimination of occlusal interferences in adolescent and young adult non-patients resulted in a reduced demand for treatment of TMD (Kirveskari *et al.*, 1998).

Unfortunately, there is no reliable way of identifying individuals at risk, best suited for studies of aetiology. Moreover, studies on the effect of occlusal therapy on TMD as defined in the RDC would include those in whom occlusal adjustment is clearly contraindicated, at least as an initial therapy. In patients seeking treatment for chronic cervicobrachial pain and headache, the combination of occlusal adjustment and physiotherapy proved superior to mock adjustment and physiotherapy at 12 and 60 months' follow-up (Karppinen *et al.*, 1999). Signs and symptoms of TMD were common in these patients although they had not prompted the treatment request. However, no patients with clinical signs of TMJ pathology were included in the study (Karppinen *et al.*, 1999).

The present investigation was designed to test the hypothesis of the effect on treatment requests of occlusal interferences as defined by Dawson (1989). The absence or weakness of an association between occlusal interferences and TMD in epidemiological studies may be a consequence of the application of definitions of interference which are crude in comparison with that of Dawson (1989). The almost total lack of functional tooth wear accords with Dawson's (1989) argument that metrically small details in occlusal anatomy can act as interference. Such interferences are practically universal in populations subsisting on soft diets. As a result, association between interferences and TMD is not easy to determine. The weak association found in some studies probably reflects the quantitative effect of interferences.

As the null hypothesis was rejected, the result permits no conclusions as to the feasibility of prophylactic elimination of occlusal interferences. The practically universal presence of interferences alone makes a meaningful selection of candidates for prophylaxis impossible. However, it appears advisable to aim at an interference-free occlusion whenever orthodontic or dental treatment affecting the occlusion is planned.

Conclusion

Maintaining the dental occlusion free from interferences reduced the demand for treatment of symptoms in the head and cervicobrachial regions, in adult females. The finding is concordant with the argument that occlusal interferences are a health risk.

Address for correspondence

Pentti Kirveskari
Tået 115
FIN-21600 Parainen
Finland
E-mail: penkir@utu.fi

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