Dental filling therapy as a possible etiological factor regarding mandibular dysfunction

A comparative anamnestic and clinical study

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A group of 29 individuals, 17–23 years old, with intact teeth, has been compared with a control group with respect to occurrence of mandibular dysfunction. A statistically significant difference between the groups, with a lower frequency and degree of dysfunction among the intact individuals was established. The results suggest that filling therapy per se may be a possible etiological factor in the mandibular dysfunction. Disorders in the masticatory neuromuscular system may arise from an abnormal tactile response to contacts on fillings, inducing an abnormal pattern of mandibular movement, possibly exceeding the tolerance level of the system. □ *Temporomandibular joint; intact dentitions; operative dentistry*

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Many investigators of stomatognathic physiology consider functional disturbances of the masticatory system to be of a complex origin with many different etiological components (2, 8, 10). Much attention has been paid to occlusal interferences of different kinds. Mediotrusional interferences, and interferences causing a lateral slide between the retruded contact position (RCP) and the intercuspal position (IP), have been looked upon as especially grave (19).

Occlusally overextended dental fillings (20), and occlusally underextended fillings, which secondarily may cause interferences (3, 19), have also been mentioned as etiologically significant. There are however, hardly any studies on the problem of a 'correct' dental filling therapy as a possible etiological factor regarding mandibular dysfunction. As far as we know, that question has been touched upon in one single paper by Kloprogge & Griethuysen (14). In an EMG study these investigators showed that muscular disturbances ensue on lateral forces loaded on filled teeth but not on intact teeth. The authors form a hypothesis that stimuli from the periodontal mechanoreceptors will be modified following dental restoration and that this could cause a disturbance in the pattern of neuromuscular activity of the masticatory apparatus.

An important factor in the neuromuscular system of the jaws is the tactility of the teeth. On biting in the intercuspal position (IP) an individual can feel objects of just a few hundredths of a millimeter, placed between the occluding teeth (24, 25).

Robinson (21) has shown that load on the lateral walls of a cavity can cause pain. Loewenstein & Rathkamp (16) have shown that the axial load tactility will diminish following a root canal treatment or full crown restoration on a vital tooth, which indicates that not only the nerves of the periodontium, but also those of the pulp form part of the tactile system. It is not known what will happen to the tactility of a vital tooth following a simple filling therapy with amalgam or composite.

The aim of the present study was to establish whether there is a difference with regard to mandibular dysfunction between a group of individuals without restorations and a control group of individuals with normally treated dentitions. Clinical observations on individual patients indicate that also correctly formed restorations may induce mandibular dysfunction.

Table 1. Occurrence of symptoms and parafunctional habits in the symptom history. Number of individuals and relative frequency

	Intact group (n = 29)		Control group (n = 34)		Difference between the groups, statist. signif.
	Abs. freq.	%	Abs. freq.	%	
A. General symptoms					
Aching neck, throat, back and shoulders,	5	17	18	53	**
of which occasionally (once/month)	5	17	13	38	
of which frequently (once-twice/week)	0	0	5	15	*
Aching muscles and joints other than TMJ,	1	3	7	21	*
of which occasionally (once/month)	1	3	5	15	
of which frequently (once-twice/week)	0	0	2	6	
Catching cold frequently	2	7	7	21	
Allergies	8	27	8	24	
Mental stress in school or at work	7	24	7	21	
Headache occasionally (once/month)	15	52	15	44	
or frequently (once-twice/week)	1	3	7	21	*
B. Local symptoms					
Pain in the face	0	0	2	6	
Fatigue in the jaws	1	3	7	21	*
Stiffness in the jaws in the morning	0	0	1	3	
TM joint pain	0	0	3	9	
Joint sounds, clicking and crepitations	2	7	9	26	*
Locking of bite	0	0	1	3	
Feeling of unevenness of occlusion	0	0	5	15	*
Swallowing difficulties	0	0	2	6	
Chewing side principally left or right*	9	33	18	58	
C. Parafunctional habits					
Tooth clenching	1	3	5	15	
Tooth grinding	2	7	8	24	
Clenching and/or grinding	3	10	11	32	*

* Merely 27 and 31 individuals, respectively.

Material and methods

The study material was a group consisting of individuals with intact, unrepaired dentitions and a control group.

The 'intact' test population was defined as all individuals responding to the following criteria:

1. Intact unrepaired dentitions.
2. Living in the towns of Falun excl. Svärdsjö/Enviken, Borlänge and Avesta excl. By, County of Kopparberg, Sweden (principally urban districts).
3. Listed at the public dental clinics in the chosen districts.
4. 17 years of age or older.

After a possible non-response of five individuals (one mentally retarded was not called upon, four individuals did not respond to the invitation), the examined intact group consisted of 17 males and 12 females, aged 17–23 years (mean, 18 years 6 months; median, 18 years 0 months).

The control population was defined as individuals aged 17–20 years, living in the same area as the 'intact' test subjects. A systematic sample of every hundredth individual drafted from the population register of the County board, County of Kopparberg, Sweden, gave 60 individuals in the three towns. Eight of these had moved from the area and could not be summoned, three did not answer the invitation and 15 did not want to participate. The remaining 34 individuals, 16 males and 18 females, were available for clinical examination (mean age, 18 years 11 months; median, 18 years 9 months).

At the time of invitations, the individuals wanted as participants in the study received information about the aim of the study and a questionnaire with past dental history questions, which should be answered before the appointment, at which the answers were examined and completed. The questionnaire was composed of simple questions corresponding to the symptoms reported in Table 1. From the answers an anamnestic index according to Helkimo (12) was calculated.

The test subjects were examined according to the method described by Krogh-Poulsen (15) and Carlsson & Helkimo (6):

1. Palpation of the masticatory muscles and muscles in the neck, throat and shoulder region. Totally 13 muscle pairs were examined.

2. Palpation of the temporomandibular joint (TMJ) laterally and posteriorly.

The observations were judged according to a 3-step scale: 0 = no tenderness, (x) = minor tenderness or some difference between left and right side and X = obvious reaction, i.e. palpebral reflect or clear-cut difference between right and left side. In calculating the sum of muscle symptoms only the obvious ones were counted. The palpations were in all cases carried out by the same observer without his having looked into the mouth of the test subjects before the intraoral palpations. In 36 cases the palpations were repeated by more than one observer. When the observers could not reach agreement the symptom mark was put in a bracket.

3. Movement ability examination.

a) The opening and closing movement was studied, and deviations laterally, zig-zag patterns, pain, limited range of movement, locking and TM joint sounds were noted.

b) Maximal opening, lateral movement and protrusion were measured in whole millimeters according to Agerberg (1). In the measure the overbite and overjet respectively were included. Pain in the extreme positions was noted.

4. Registration of interferences.

a) Interferences in the retruded contact position (RCP). The retruded position was registered according to Ingervall (13) first without and then with wax (Kerr Occlusal Indicator). Interference was noted at unilateral contact.

b) Interferences causing a lateral slide of the mandible between the retruded contact position (RCP) and the intercuspal position (IP). Interference was noted at a lateral slide more than or equal to 0.5 mm.

c) Mediotrusional interferences.
Interference was marked at contacts on the mediotrusional side, when making an obstacle to contact on the laterotrusional side of the jaws.

Statistical methods

For significance analysis of differences between the groups the chi-square test and Fisher's exact test have been used (22). Observed differences that give a significance on the 5% significance level are considered statistically significant.

In the tables statistical significance on the 5%, 1% and 0.1% level is marked with one, two or three asterisks, respectively.

The validity of the results was statistically analyzed on the basis of the Ai and Di indices. The analysis was carried out in two steps. In the first step the non-responders were added to the control group and in the second step the *possible* five non-responders were added to the intact group, in both steps with extreme postulations regarding the Ai and the Di indices of those individuals.

Furthermore, the possible distorting effect of the nonresponse in the control sample was studied by comparing the control group to the nonresponse with regard to four background variables, viz age, sex, caries prevalence and occurrence of orthodontic treatment. Case records of 15 non-responding individuals were available for the purpose.

Results

Symptom history

The distribution of various symptoms compiled from the questionnaire is shown in Tables 1A, 1B and 1C.

A higher frequency in the control group was found for 'aching neck, throat, back and shoulders' ($p = 0.004$), 'pain in other joints

Table 2. Distribution of test subjects with regard to the anamnestic dysfunction index (Ai 0–II)

Anamnestic index	Intact group (n = 29) Abs. freq.	%	Control group (n = 34) Abs. freq.	%	Difference between the groups statist. signif.
0	22	76	17	50	
I	7	24	10	29	
II	0	0	7	21	**

** Ai 0–I versus Ai II.

(than TMJ) and muscles' ($p = 0.045$) and 'frequent headache' ($p = 0.045$).

There was no difference between the groups as to the registered occurrence of mental stress in school or at work.

With regard to local symptoms statistically significant differences, with a higher frequency in the control group, were settled for 'fatigue in the jaws' ($p = 0.045$), 'clicking and crepitation in the joint' ($p = 0.041$) and 'feeling of unevenness of occlusion' ($p = 0.040$).

A significantly higher frequency of grinding and clenching teeth was found in the control group ($p = 0.035$).

Distribution with regard to an anamnestic dysfunctional index, calculated according to Helkimo (12), is shown in Table 2. The significance analysis has been made, after combining index classes AiO and AiI, in a four-field table. Higher values of the index were found to be significantly more common among the controls than among the intact test subjects ($p = 0.010$). The highest dysfunction class, AiII, included only individuals of the control group.

Clinical examination

Distribution of the test subjects with regard to the various clinically recorded variables is shown in Table 3.

Significant differences ($p < 0.001$) between the groups were found for the examination variables 'number of muscle symptoms', 'palpational tenderness of the TM joint laterally' and 'pain in extreme movements'.

Table 3. Occurrence of various clinical symptoms. Numbers of individuals and relative frequency

Symptoms	Intact group (n = 29) Abs. freq.	%	Control group (n = 34) Abs. freq.	%	Difference between the groups statist. signif.
Muscle tenderness					
No symptoms	19	65	1	3	
1–3 muscles	8	28	1	3	
4–9 muscles	2	7	21	62	***†
10 muscles	0	0	11	32	
Clicking in TMJ	3	10	10	29	
Crepitation in TMJ	0	0	0	0	
Tenderness of TMJ to palpation					
Laterally	0	0	19	56	***
Posteriorly	0	0	4	12	
Pain at extreme movements	0	0	11	32	***

† 0–3 versus 4– symptom marks.

Table 4. Distribution of test subjects with regard to the clinical dysfunction index (Di 0–III)

Dysfunction Index	Intact group (N = 29) Abs. freq.	%	Control group (n = 34) Abs. freq.	%	Difference Between the groups statist. signif.
0	13	45	1	3	
I	16	55	12	35	
					***†
II	0	0	15	44	
III	0	0	6	18	

† Di 0–I versus Di II–III

There were no obvious differences between the groups with regard to the opening/closing or to the range of movement.

Distribution of the test subjects with regard to a clinical dysfunction index, calculated according to Helkimo (12), is shown in Table 4. No individual in the intact group was represented in the two highest dysfunction classes DiII and DiIII. The statistical analysis was made on the basis of a four-field table after combining DiO-I and DiII-III, respectively. The difference between the groups is highly significant ($p < 0.001$).

Occurrence of different kinds of occlusal interferences are shown in Table 5. A significantly higher frequency of mediotrusional interferences was found among the controls than among the intact test subjects ($p = 0.019$).

Correlation between anamnestic and clinical dysfunction index

In the intact group there was no individual in the dysfunction classes AiII or DiII-III, thus correlating the findings of the anamnestic and the clinical examination.

On analyzing the correlation of the indices in the control group, index classes AiI-II, DiO-I and DiII-III have been combined respectively and cross-tabulated, after which a chi-square test for independence has been made. A dependence was established, with significance on the 1% level (chi-square test-obs = 10.09, 1 df).

Influence of background variables sex and age

Distribution of the test subjects in the control group with regard to sex, age group and index classes has been tabulated in cross-tables and analyzed in order to find out if the two background variables have any influence on the result. The younger part of the group had a significantly higher frequency of more severe clinical dysfunction ($p = 0.033$) than the older part. No other difference was statistically significant.

Table 5. Occurrence of interferences. Number of individuals with positive findings and relative frequency.

	Intact group (n = 28) Abs. freq.	%	Control group (n = 34) Abs. freq.	%	Difference between the groups statist. signif.
Interference in the RCP	18	64	19	56	
Mediotrusional interference	4	14	14	41	*
Interferences causing a lateral slide between RCP ≥ 0.5 mm	8	28	15	44	

Non-response analysis

The statistical analysis of possible distorting effects of the non-response gives no indications of any systematic differences between the examined and the non-responding part of the control sample as to the four studied variables age, sex, caries prevalence and occurrence of orthodontic treatment.

The statistical analysis on the possible effect on the distribution with regard to the Ai and Di indices showed in step one (see Statistical methods) significant difference on the 5% level as to the Ai index and on the 0.1% level as to the Di index. In step two the difference as to the Ai index showed nonsignificance, while the difference as to the Di index still showed statistical significance on the 1% level.

The analysis indicates a difference between the intact group and the control population as a whole, with a lower degree of mandibular dysfunction among the individuals of the intact group.

Discussion

The non-response analysis gives no indication that there should exist a systematic difference between the examined and the non-responders of the control sample.

This fact does not guarantee, however, that differences with regard to other influencing background variables did not exist.

The possible effect of the non-response was analyzed by means of adding this to the examined, after which statistical significance was tested (see Statistical methods). In the second step of the analysis the difference with regard to the Ai distribution showed non-significance. It must be pointed out however, that the postulations that all the control non-responders had a low dysfunction score and the intact group non-responders had a high dysfunction score, contrary to the tendency of the results, are highly hypothetical and unlikely. Furthermore, the size of the non-response of the intact group is not known and is probably less than five individuals.

The method of measuring the degree of mandibular dysfunction applied here was the one suggested by Krogh-Poulsen (15) and Carlsson & Helkimo (6). The balancing together of various clinically recorded part symptoms to an index that will cover and quantify the concept 'mandibular dysfunction' is very difficult because the relative value of the part symptoms will be fortuitous. The construction of the index admits very well however, comparisons between groups of individuals. The same can be said about the anamnestic dysfunction index suggested by Helkimo (11).

The use of the clinical dysfunction index is simple since no complicated measuring devices are necessary. The reliability of the method, however, is affected by the inherent limitations of clinical studies—systematic registrational differences between different observers. Thus criticism has been directed against using muscle palpation in order to study hyperactivity of the musculature. Svebak et al. (23) consider this method to be too subjective. An investigation by Carlsson et al. (5) has shown, however, that registrational differences between different observers are no greater at muscle palpation than at other examination methods in dentistry. The symptom score in itself is less important in this study than the necessity of uniform scoring in all individuals throughout the examinations. To secure this the chosen examiner was experienced in making diagnostic muscle palpation, and furthermore the palpations were repeated by one more observer and the findings discussed. There was a variation between the examiners regarding the score of muscle symptoms but the extent of this did not exceed the variations reported by Carlsson et al. (5) in the study quoted above. Among the individuals of the intact group recording differed very little between the observers.

By calculating the anamnestic dysfunction index and correlating it to the clinical dysfunction index a valuable guarantee is achieved against distortion of the results through possible expectations on part of the observers. As a whole the method used, with its inherent limitations, is considered acceptable regarding the validity and reliability and useful with respect to the aim of the study.

An interesting result of this study is the

obvious difference with regard to dysfunctional symptoms between the group of caries-intact individuals and the control group. The frequencies of various past dental history symptoms registered in the control group correspond rather well with those shown in investigations by Helkimo (12), Agerberg & Carlsson (2) and Molin et al. (18), despite differences between the studied populations and despite some lack of uniform examination criteria. In Molin et al.'s study (18) for instance only significant subjective symptoms were marked.

Signs of clinical mandibular dysfunction were observed in 97% of the control subjects, which confirms the high frequencies reported in various epidemiological surveys (10). Helkimo (12) found a frequency of 88% in a Finnish Lapp population, and Hansson & Nilner (9) noted clinical dysfunction in 79% of the individuals in a study on employees in a shipyard in southern Sweden. Molin et al. (18) found dysfunction in only 28% of Swedish draftees, probably due to the above-mentioned more severe criteria for marking symptoms.

The differences between various surveys can be explained from the fact that the groups studied are incongruent with regard to background variables like sex and age and socioeconomic status. There are also differences in the criteria of estimating the clinical dysfunction. Particularly delicate in this respect is probably the muscle palpation. The present investigation showed a higher frequency of dysfunction than was noted by Helkimo (12). This difference is mainly due to difference in the muscle tenderness, which may suggest a certain overrating of the symptoms in the present investigation. If this is the case, this overrating must have been done throughout the examinations, considering the precautions taken against bias at palpation. It is also possible that a more symptom searching palpation technique has been used (5). It is, however, obvious that considerably more muscle tenderness was found among the control subjects, who averaged 8.0 positive findings versus 0.86 in the individuals of the intact group.

In the findings concerning the other part symptoms of the clinical examination there was a rather good conformity between the control group and the youngest group of Helkimo's (12) regarding more severe symptoms.

An interesting finding is the difference between the groups established for the occurrence of mediotrusional interferences. The reliability of the registrational method is uncertain; control studies should therefore be made. If the finding can be confirmed, it might be concluded that mediotrusional interferences can not only induce disturbances in the neuromuscular system of the masticatory apparatus, but can also be induced by such disturbances. The explanation could be that at an increased level of tension the muscles will not let down the mediotrusional side of the mandible in lateral gliding sufficiently to avoid interfering contacts on this side. The difference shown would, according to this explanation, not be due to anatomical differences, but to differences on the neuromuscular basis.

The symptom history, as well as the clinical findings, show distinct differences as to the degree and frequency of mandibular dysfunction between the group of individuals without dental restorations and the control group, in which all individuals were treated with fillings. Occurrence of fillings is not the only possible explanatory variable, as other variables separating the groups may exist. There may for instance exist differences in genetic and environmental psychosocial respect, which may make individuals more or less susceptible to mandibular dysfunction. Thus it might be possible that the intact group represented an elite also in other respects than the absence of the dental caries disease. The study indicates, however, that the possible role of dental restorations, as an etiological factor in functional disturbances of the masticatory apparatus, has been unsufficiently investigated and is worth more consideration and more extensive research.

The basis of that research could be the hypothesis suggested by Kloprogge & Griethuysen (14) that fillings in the teeth interfere with the neuromuscular reflexis pattern of the masticatory system. This hypothesis might be expanded with a theoretical description of the mechanisms that give rise

to the disturbances, and so give suggestions to additional studies, which could eventually establish the etiological value of dental restorations in the syndrome.

A hypothetical description of the causal chain could be as follows. When a filling is introduced into a so far intact and harmoniously functioning dentition, an occlusal force upon this filling will be overrated by the neuromuscular system of the masticatory apparatus, which then will react by avoiding contact with the filling and instead try to find a movement pattern that gives the most possible occlusal contacts on natural tooth surfaces. The changes in muscular tonus which will arise from this can in certain muscle groups exceed the tolerance level with contractures as a result. In case there are fillings in the molars, the dorsal part of the mandible will lower itself reflexively and the main chewing function migrates anteriorly. Unilateral disturbing contacts will introduce still more complicated movement patterns. During sleep parafunctional forces will be put in effect to restore equilibrium in the system, leading to a vicious circle and eventually to a manifest dysfunctional state, in some cases causing secondary effects like overload injuries.

To test the causal correlation additional analysis of the collected material in the patient examinations will be done. A treatment method based on the hypotheses will also be tested.

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