

Occlusal contacts following orthodontic treatment: a follow-up study

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During the retention and postretention stages of orthodontic treatment, the number of occlusal contacts in maximum intercuspation may increase, remain unchanged, or decrease. An increase in the number of occlusal contacts after a three-month retention period has been reported by Durbin and Sadowsky,¹ and after one year by Gazit and Lieberman² and Lindner.³

In addition to recording actual contacts as in previous studies, near contacts and the location of contacts were also recorded in the present study. Near contacts, as well as actual contacts, should probably be considered as contributing to a desirable occlusal relationship during mastication. The biting force also influences the number of tooth contacts,⁴ prompting an evaluation of near contacts. The evaluation of near contacts also allowed comparisons to be made with results reported in the literature,² using a different methodology for recording occlusal contacts. This is a follow-up study to the

previous study of Durbin and Sadowsky,¹ designed to evaluate the continued settling of the occlusion.

Materials and methods

The sample used in this study was from the postgraduate orthodontic clinic at the University of Illinois College of Dentistry. The criteria for patient selection were the same as those used by Durbin and Sadowsky,¹ since many of the patients from the earlier study were used in the present study.

1. All patients were treated with fixed banded and/or bonded edgewise appliances with or without auxiliary appliances;
2. Cases must have been treated to an optimum occlusion with the treatment objectives satisfied, usually involving overcorrection. Cases in which treatment was discontinued before case completion because of poor patient compliance were not included;
3. Cases requiring prosthetic treatment of missing teeth were not included;

Abstract

Occlusal contacts in maximum intercuspation were examined in a sample of 40 patients at the end of active orthodontic treatment and again an average of 21 months later. An increase in the total number of contacts was due to more actual and near contacts on all posterior teeth and more near contacts on anterior teeth. When the results were compared to a previous short term study, continued settling of the occlusion occurred beyond an initial three months of retention. Few contacts changed their location between the occlusal inclined planes and central grooves, suggesting minimal settling of the occlusion in a buccolingual direction.

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Key Words

Orthodontic therapy • Occlusal contacts • Maximum intercuspation

4. Patient availability for the one- to two-year follow-up recordings was important.

Only 28 of the 38 patients from the previous study were available for the present follow-up recordings. Twelve additional patients were included which increased the sample to 40 subjects. There were 15 males and 25 females, with an average age of 18 years, 3 months (standard deviation 2 years 11 months). The sample was almost equally divided between non-extraction (19 subjects) and extraction (21 subjects) treatment strategies. There were 19 subjects with Class I malocclusions pretreatment, 14 with Class II division 1, three with Class II division 2, and four with Class III malocclusions. Twenty-eight patients had a maxillary Hawley and a mandibular fixed lingual retainer during the period of this study. Three patients had a combination of a tooth positioner followed by a maxillary Hawley retainer. Eight patients had maxillary and mandibular Hawley retainers, and one patient had only a maxillary Hawley retainer. Removable retainers were generally worn full time for six to 12 months, followed by nights only for the period of this study.

Occlusal records were gathered on all patients at two points in time. The first set of records was gathered within two hours after removal of orthodontic appliances (T1); the second set was obtained during the retention period approximately 21 months later (T2). The time between the two records (T1 to T2) ranged from 11 to 28 months, with a mean of 20.9 months. The records included alginate impressions for producing study models, and a minimum of two interocclusal registrations using a method similar to that described by Lindner³ and Ziebert and Donegan.⁵ With the patient seated upright, Ramitec* polyether rubber impression material was injected onto the occlusal surfaces of all mandibular teeth and the patients were instructed to "bite firmly on your back teeth and hold the position" for approximately two minutes. Another registration was then obtained and compared with the first registration for reproducibility. In almost all instances, the two registrations appeared similar; in a few cases a third registration was made, which confirmed one of the two previous registrations. The first of the two similar interocclusal Ramitec checkbites was then positioned on a radiographic viewing screen in a dark room. Areas of actual contact were identified as perforations in the polyether interocclusal registrations and were transferred onto the study models with a red marker. The interocclusal registration was placed onto the upper

and then the lower model and each model was marked through the perforated registration perpendicular to the occlusal plane. Areas of near contact were identified by a change in color of the Ramitec material from yellow to a transparent white. The centers of these white transparencies were transferred onto the study models with a black marker.

The following variables were recorded from maxillary and mandibular study models at each of the two time points: total number of teeth in contact and total number of contacts (actual and near contacts combined); number of actual contacts on second molars, first molars, premolars, canines and incisors; number of near contacts on the second molars, first molars, premolars, canines, and incisors.

Actual and near contacts were combined for the qualitative evaluation of their migration during retention. Only the molars were evaluated. The change in the location of a particular contact was recorded if the contact moved at least one third of the cusp height up or down the inclined planes; the same contact had to be present at both stages of treatment. Three variables were recorded: number of contacts that did not migrate; number of contacts that migrated towards the fossa; number of contacts that migrated away from the fossa.

The variables were recorded at the end of active treatment (T1) on average 21 months into the retention phase (T2). The data were analyzed using the Statistical Analysis System** at the Academic Computer Center, University of Illinois at Chicago. Frequencies, means and their standard deviations were computed. Differences between the means at T1 and T2 were evaluated using paired *t*-tests, with $\alpha=0.05$.

Error of method

For ten randomly selected patients, the two similar polyether registrations obtained at the clinical examination were analyzed to determine methodologic error. A paired *t*-test analysis revealed no statistically significant differences ($p>0.05$) in the mean number of contacts recorded using the two sets of registrations.

Results

Changes in the number of contacts for the total sample

Table 1 shows that the mean number of teeth in contact (actual and near contacts combined) increased from 17.5 to 20.7 which was statistically significant ($p<0.01$). The number of anterior teeth in contact increased by an average of 1.9 ($p<0.01$), and the number of posterior

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Table 1
OCCLUSAL CONTACTS AT RETENTION (T1), AT 21 MONTHS FOLLOW-UP (T-2),
AND CHANGE OVER TIME (T2-T1)
(NC=Near Contacts; AC=Actual Contacts)

Variable	Mean (T1)	Mean (T2)	Difference (T2-T1)	SD (T2-T1)	t-value
Teeth in Contact	17.5	20.7	3.2	4.9	4.15**
Anterior Teeth	5.2	7.2	1.9	4.3	2.85**
Posterior Teeth	12.3	13.5	1.2	2.0	3.79**
Total Contacts	36.6	58.2	21.6	16.4	8.33***
NC Second Molars	4.8	7.2	2.4	4.5	3.43**
AC Second Molars	6.0	10.0	3.9	4.4	5.66***
NC First Molars	5.5	10.3	4.8	6.4	4.78***
AC First Molars	6.1	8.9	2.8	4.7	3.78**
NC Premolars	3.9	6.8	2.8	5.9	3.05**
AC Premolars	4.1	5.8	1.6	4.8	2.20*
NC Canines	1.6	2.0	0.4	2.4	1.05
AC Canines	1.4	1.9	0.5	2.0	1.62
NC Incisors	1.3	3.1	1.8	3.7	3.08**
AC Incisors	1.5	1.6	0.1	2.7	0.29

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

teeth in contact increased by an average of 1.2 ($p < 0.01$).

The mean number of contacts (actual and near contacts combined) increased from 36.6 to 58.2 between the two stages ($p < 0.001$). The increase in the number of actual and near contacts on posterior teeth, and the increase in the number of near contacts on incisors, accounted for this increase. The increased occurrence of actual and near contacts on the canines and actual contacts on the incisors was not statistically significant ($p > 0.05$).

Distribution of cases showing changes in contacts over time

There was a higher percentage of cases showing an increase in either the number of teeth in contact or the number of contacts (Table 2). An increase in the total number of teeth in contact was found in 70 percent of cases, with more cases showing an increase in the number of anterior teeth (62.5 percent) than posterior teeth (45 percent) in contact. An increase in the total

number of contacts was found in 92.5 percent of cases. This increase was reflected in all areas of the mouth, except for the number of actual contacts on the incisors which was almost equally divided among cases showing an increase, those showing a decrease, and those remaining unchanged. The variability was large for the change in the number of teeth in contact and the number of contacts. Ranges were from a loss of seven teeth in contact to a gain of 17 teeth in contact; also from a loss of 19 contacts to a gain of 59 contacts.

Changes in location of contacts

The majority of the contacts (actual and/or near) did not migrate from the position they were in at the end of active treatment (Table 3). The mean number of contacts which did not migrate was 21.1 (standard deviation of 8.34), with a range between 5 and 44. The mean number of contacts which migrated towards the fossa was only 1.2 (standard deviation of 1.91), with a range from 0 to 5. The mean number of

Table 2
RELATIVE DISTRIBUTION OF TREATED CASES SHOWING
CHANGES IN OCCLUSAL CONTACTS OVER TIME
(NC=Near Contacts; AC=Actual Contacts)

Variable	Percent Decreased	Percent Unchanged	Percent Increased	Range*	
				lost	gained
Teeth in Contact	15.0	15.0	70.0	7	17
Anterior Teeth	25.0	12.5	62.5	8	12
Posterior Teeth	10.0	45.0	45.0	2	7
Total Contacts	5.0	2.5	92.5	19	59
NC Second Molars	25.0	12.5	62.5	9	13
AC Second Molars	12.5	5.0	82.5	6	13
NC First Molars	25.0	2.5	72.5	6	24
AC First Molars	17.5	10.0	72.5	7	16
NC Premolars	32.5	2.5	65.0	15	22
AC Premolars	30.0	22.5	47.5	7	18
NC Canines	35.0	15.0	50.0	5	4
AC Canines	25.0	32.5	42.5	4	3
NC Incisors	20.0	25.0	55.0	8	14
AC Incisors	35.0	32.5	32.5	6	6

*Ranges are reported as absolute, rather than relative, numbers.

contacts which migrated away from the fossa was 0.3 (standard deviation of 0.64), with a range from 0 to 2.

Discussion

The records for 34 patients in this study were taken in the morning to minimize the effects of diurnal variations in occlusal contacts.⁶ Records for the remaining six subjects were taken in the afternoon due to the patient's availability. To minimize the effect of different biting forces, the same instructions were given to all patients at both stages of this investigation.⁴ It has been reported that occlusal contacts in maximum intercuspation can be recorded repeatedly with little error^{1,3,4} using a similar methodology. In this study, no significant differences were found between two consecutive interocclusal registrations.

The total number of teeth in contact, and the total number of actual and near contacts in this sample of 40 treated patients, increased significantly ($p < 0.001$) over an average of 20.9 months

following the active phase of orthodontic treatment. This was due to an increase in actual and near contacts on all posterior teeth (premolars and molars). In the anterior region, only near, and not actual, contacts on incisors increased significantly. The contribution from the canine region was not significant. These changes were much greater than those shown in the study by Durbin and Sadowsky,¹ indicating a settling of the occlusion up to an average of 21 months posttreatment. Similar conclusions were made by Gazit and Lieberman,² who also recorded actual and near contacts, but used the photo-occlusion technique.⁷ They followed a sample of 12 orthodontically treated Class II division 1 patients and reported variable changes one month into the retentive phase and a significant increase in number of contacts one year after removal of active appliances.

The findings of the present study, which showed a mean of 58.2 contacts at 21 months posttreatment, are in contrast to those of Hell-

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man⁸ who described 138 actual contacts, and to those of Ricketts⁹ who reported 48 actual contacts as an "ideal" number of contacts in maximum intercuspation.

Durbin and Sadowsky¹ did not show an increase in the number of actual contacts on anterior teeth over the three-months retention period. They explained it by assumptions of overcorrection of the overbite and overjet, incomplete correction of an overjet, and interferences from the retainers. Even though the increase in the actual contacts on anterior teeth was found to be insignificant, agreeing with the findings of Durbin and Sadowsky,¹ the present study demonstrated an increase in the mean number of near contacts in the incisor region and an increase in the mean number of incisors and canines in contact. The findings agree with reports that have described an "ideal" occlusion as having 0.5 millimeters clearance (or "near contact" in our terms) between the incisors in centric occlusion.¹⁰⁻¹²

The locations of the majority of contacts did not change from the positions they were left in at the time of appliance removal. On average, only 1.5 contacts migrated either away from or towards the central fossa. This suggests that if contacts are left on inclines, they should not be expected to settle towards the central groove. Therefore, rather than anticipating a settling of the occlusion towards the central groove, an

Table 3
ABSOLUTE CHANGES
IN LOCATION OF OCCLUSAL CONTACTS
(ACTUAL AND NEAR CONTACTS OF MOLARS COMBINED)

Variable	Mean	SD	Range
No Migration	21.1	8.3	5 to 44
Migration toward fossa	1.2	1.9	0 to 5
Migration away from fossa	0.3	0.6	0 to 2

occlusion should be established that is as "ideal" as possible at the time active appliances are removed. However, in some cases it may be advisable to overcorrect buccolingual relationships in order to avoid relapse of posterior crossbites.

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