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Occlusal interferences in orthodontic patients before and after treatment, and in subjects with minor orthodontic treatment need

Martin Olsson* and Berit Lindqvist**
*Orthodontic Clinic, Public Health Services, and **Department of Orthodontics, Faculty of Odontology, University of Umeå, Sweden

SUMMARY Different opinions have been expressed concerning the effect of orthodontic treatment on mandibular function. One factor discussed is occlusal interferences. The aim of this study was to establish the prevalence of occlusal interferences in 210 orthodontic patients before (mean age 12 years 8 months) and after (mean age 16 years 10 months) treatment and to compare them with subjects with minor orthodontic treatment need.

The results showed a decrease in retruded contact position/intercuspal position (RCP/ICP) interferences in all morphological deviations, age, and gender groups. The prevalence of mediotrusion interferences decreased in some types of malocclusions whilst in others there was no change. One reason for this is that treatment was started when the majority of the patients had no second or third molars erupted. At the final registration, the second molars were erupted in all patients, and the third molars were erupted in approximately 25 per cent.

Mediotrusion interferences were more consistent with basal morphological deviations, for example, Class III relationships and anterior open bite were more consistent in the same person, and more difficult to eliminate than RCP/ICP interferences. RCP/ICP interferences, often caused by dental deviation in position, size, and shape, were easier to correct.

Optimal orthodontic treatment, if necessary, including selective grinding, will decrease the prevalence of occlusal interferences.

Introduction

Many authors have discussed the aetiology of temporomandibular disorders (TMD) and also the impact of orthodontic treatment on TMD. They have shown that it is difficult to highlight one particular factor, and suggest a multifactorial cause with structure, general health, and stress being major factors (Farrar, 1983; De Laat *et al.*, 1986; Okeson, 1989). For review, see Tallents *et al.* (1991) and Luther (1998a, b).

A relationship between morphology and TMD has been shown (Mohlin *et al.*, 1980; Egermark-Eriksson *et al.*, 1983; Mohlin and Thilander, 1984; Olsson and Lindqvist, 1992, 1995; Sonnesen *et al.*, 1998; Legrell, 1999). Occlusal interferences seem to be associated with functional disorders (Ingervall, 1976; Kirveskari *et al.*, 1992). Kirveskari and Alanen (1993) stated that available data relevant to the causal question do not permit the exclusion of occlusal factors from effective causal complexes of craniomandibular dysfunction. Egermark-Eriksson *et al.* (1983) stated that functional malocclusion (occlusal interference) is more important than morphological malocclusion in explaining the existence of mandibular dysfunction. Wänman and Agerberg (1986) reported that the number of masticatory muscles tender to palpation was significantly related to mediotrusion interferences.

However, the association between occlusal interferences and TMD has been questioned

(Droukas *et al.*, 1984; De Laat *et al.*, 1986; Seligman *et al.*, 1988; Kirveskari *et al.*, 1989). Other authors have stated that a consistent relationship between morphological malocclusion and TMD has not been established (Clark, 1991; Seligman and Pullinger, 1991). Greene and Marbach (1982) suggested that signs of TMD are mainly an expression of normal variation.

Magnusson and Enbom (1984) experimentally introduced balancing side interferences in 50 per cent of a group of healthy women, without signs or symptoms of mandibular dysfunction. After 2 weeks, 10 of the 12 subjects with the introduced interferences had symptoms and, in seven subjects, signs of TMD appeared. After removing the interferences the signs and symptoms disappeared. In the control group, without introduced interferences, three individuals reported subjective symptoms and three signs of dysfunction. Christensen and Rassouli (1995) found similar results. However, they were unable to establish that the changes had specific long-term detrimental effects. Clinically, in many patients, eliminating interferences by occlusal equilibration and/or occlusal splints have been successful TMD therapeutic measures (Okeson, 1989).

Several studies have shown an increase in prevalence of signs and symptoms of TMD with age (Magnusson *et al.*, 1986; Egermark-Eriksson *et al.*, 1987; Heikinheimo *et al.*, 1989, 1990; Olsson and Lindqvist, 1992; Pilley *et al.*, 1992). An increase in prevalence of occlusal interferences between the ages of 12 and 15 years has been reported by Heikinheimo *et al.* (1990).

The aims of this study were (1) to determine the variation in prevalence of occlusal interferences in age and gender groups, orthodontic patients, and subjects with minor orthodontic treatment need; and (2) to determine the effect of optimal orthodontic treatment, if necessary, including selective grinding, on the prevalence of occlusal interferences.

Subjects and methods

Two hundred and forty-five consecutive orthodontic patients, each with a control with minor orthodontic treatment need matched for gender, age and residence, were examined before the start of orthodontic treatment. The group with minor orthodontic treatment need had, according to the Index of the Swedish Medical Health Board (1966), a treatment need of less than grade two and were not entitled to free orthodontic treatment.

The mean age of the patients at the start of treatment and of the controls was 12 years 8 months (7.1–20.5 years). After a drop out of 35 patients (Olsson and Lindqvist, 1995), this study was based on the remaining 210 patients and their matched controls. The subjects were divided into groups according to age (<13 and ≥13 years) and gender. The patients <13 years old at the start of treatment were still included in their original group at the final registration at the mean age of 16 years and 10 months.

The registration of mandibular positions was made according to Zarb *et al.* (1978) and the functional examination according to Carlsson and Helkimo (1972) and Helkimo (1974). The anterior distance between retruded contact position (RCP) (centric relation) and intercuspal position (ICP) (centric occlusion) was first measured and, if a lateral slide RCP/ICP was present, registered as a RCP/ICP interference. Mediotrusion interferences, also called non-working or balancing side interferences, were assessed according to Agerberg and Sandström (1988). Working side interferences are not considered detrimental and were not registered in this study. The ranges for anterior and lateral slide RCP/ICP were 0.1–0.4, 0.5–0.8, 0.9–1.2, and more than or equal to 1.3 mm. The assessments were made by comparing the change between anatomical characteristics in antagonist teeth in the upper and lower arches. The contact relationships were registered at a lateral slide of 3, 6, and 9 mm and at maximum lateral slide, if more than 9 mm.

The prevalence of mediotrusion interferences was also assessed for different morphological deviations in the range of a lateral slide 3 mm from ICP up to maximum lateral slide. If a subject had a mediotrusion interference at a lateral slide of 3, 6, and 9 mm, it was registered as one interference at 3 mm and one at maximum lateral slide. If there was an interference only

at 6 mm lateral slide, it was registered as a maximum lateral slide.

In order to determine the validity of the registrations, an inter-observer study was undertaken with an experienced specialist from the Department of Clinical Oral Physiology, University of Umeå (Olsson and Lindqvist, 1992).

The aim of treatment was to create an occlusion according to 'the six keys to normal occlusion' (Andrews, 1972), with an anterior RCP/ICP distance in the range 0.1–0.8 mm and without RCP/ICP or mediotrusion interferences.

In some cases selective grinding was carried out. In these a follow-up was carried out every 6 months, and new grindings were performed, until the subject was free from interferences 18 months after the last grinding (Olsson and Lindqvist, 1995).

Results

After orthodontic treatment, registration was made of the morphological and functional relationships, and assessment of the degree to which the aims were achieved. After active treatment, 52.4 per cent of the patients had some kind of interference, which it was not possible to correct by orthodontic treatment. In those subjects where selective grinding was undertaken, 13.8 per cent of cases had morphological relapses and these cases had to be excluded from the aim to have no interferences (Olsson and Lindqvist, 1995). In 8.6 per cent of these relapses there was reappearance of RCP/ICP interferences and in 6.2 per cent mediotrusion interferences at a lateral slide of 3 mm, which could not be eliminated, although selective grinding was performed up to six times. In 1.0 per cent of these subjects there was both an RCP/ICP and a mediotrusion interference. The total prevalence of mediotrusion interferences decreased from 35.8 per cent pre-treatment to 28.5 per cent post-treatment.

Of the subjects with minor orthodontic treatment need, 79.5 per cent had an anterior slide in the range of 0.1–0.8 mm compared with 43.8 per cent of the orthodontic patients pre-treatment. There was no anterior slide RCP/ICP, a 'locked bite', in 35.7 per cent of the patients, and in 0.5 per cent of the controls (Table 1). There was no difference in anterior slide between boys and girls or the two age groups. After treatment, 82.3 per cent of the patients had an anterior slide in the range of 0.1–0.8 mm. In 9.5 per cent there was still no anterior slide RCP/ICP.

A lateral slide RCP/ICP was found in 46.6 per cent of the patients pre- and in 8.6 per cent post-treatment, and in 23.8 per cent of the controls. In 3.3 per cent of the patients with no RCP/ICP interference pre-treatment, such interference was registered post-treatment. Small differences were found post-treatment between age and gender groups. The patients had a slightly higher prevalence of lateral slide to the right than to the left before the start of treatment. There was no difference in the patients post-treatment or in the controls. For this reason and because of the low prevalence of RCP/ICP interferences post-treatment, the prevalence of a slide to the right and left were combined (Table 2).

There was a small difference in the prevalence of mediotrusion interferences between all the age and gender groups, except for the younger boy group, where the prevalence was 50 per cent lower (Table 3). The largest difference

Table 1 Anterior distance RCP/ICP before (B) and after (A) treatment and in controls (percentage).

	Anterior distance (mm)				
	0	0.1–0.4	0.5–0.8	0.9–1.2	≥1.3
Patients (n = 210)					
A	35.7	18.6	25.2	7.6	12.9
B	9.5	42.8	39.5	6.7	1.4
Controls (n = 210)	0.5	41.9	37.6	15.7	4.3

Table 2 The prevalence of lateral slide RCP/ICP in patients before (B) and after (A) orthodontic treatment and in controls (percentage).

	Lateral slide (mm)				
	0	0.1–0.4	0.5–0.8	0.9–1.2	≤1.3
Patients					
Before (right + left)	53.4	23.3, 11.4	7.1, 3.8	0.5, 0	0.5, 0
After (right + left)	91.4	6.3	1.8	0.5	0
Controls (right + left)	76.2	8.1, 10.9	3.4, 1.4	0, 0	0, 0
Right + left slide					
Girls					
B <13 years (n = 63)	53.2	30.2	14.3	3.3	0
A	87.3	11.1	1.6	0	0
B ≥13 years (n = 53)	47.2	43.4	9.4	0	0
A	86.8	11.3	1.9	0	0
Boys					
B <13 years (n = 55)	54.5	34.5	11.0	0	0
A	94.5	3.6	0	1.9	0
B >13 years (n = 39)	48.7	35.9	15.4	0	0
A	89.8	5.1	5.1	0	0

Table 3 The prevalence of mediotrusion interferences in patients before (B) and after (A) orthodontic treatment and in controls, first interference at lateral slide of right + left (percentage).

	Lateral slide (mm)				
	0–3	3–6	6–9	>9	Total
Patients (n = 210)					
B	11.9	11.0	11.0	1.9	35.8
A	6.2	11.9	9.0	1.4	28.5
Controls	3.3	11.9	6.7	0	21.9
Girls					
B <13 years (n = 63)	12.7	14.3	12.7	0	39.7
A	9.5	17.3	12.7	1.6	41.1
B ≥13 years (n = 53)	17.0	11.3	9.4	1.9	39.6
A	1.9	17.0	3.8	0	22.7
Boys					
B <13 years (n = 55)	5.5	7.3	7.3	0	20.1
A	3.6	3.6	12.7	3.6	23.5
B ≥13 years (n = 39)	12.8	10.3	0	7.7	30.8
A	10.3	7.7	5.1	0	23.1

in the prevalence of mediotrusion interferences between patients and controls was seen in the range from RCP to a lateral movement of 3 mm.

Before treatment, 19 patients had an anterior open bite (AOB). Of these, nine (47.4 per cent) had a mediotrusion interference at a lateral slide of 3 mm. After treatment, eight (42.1 per cent) still had this interference. Only two subjects with an AOB before treatment still had a negative overbite after treatment. However, some had an edge-to-edge relationship and some minimal overbites.

A combination of RCP/ICP and mediotrusion interference was found in 36 subjects (17.2 per cent) before and four (1.9 per cent)

Table 4 The prevalence of patients, before (B) and after (A) orthodontic treatment and controls with both a RCP/ICP and a mediotrusion interference (percentage).

	Mediotrusion interference at a lateral slide of			
	0–3 mm	3–6 mm	6–9 mm	Total
Patients (n = 210)				
B	6.2	4.8	6.2	17.2
A	1.0	1.0	0	1.9
Controls	0	2.4	1.9	4.3
Girls				
B <13 years (n = 63)	8.0	6.4	8.0	22.3
A	1.6	1.6	0	3.2
B ≥13 years (n = 53)	5.7	5.7	7.6	19.0
A	0	1.9	0	1.9
Boys				
B <13 years (n = 55)	5.5	1.8	3.7	11.0
A	0	0	0	0
B ≥13 years (n = 39)	5.1	5.1	5.1	15.3
A	2.6	0	0	2.6

Table 5 The prevalence of interferences in Class I cases before (B) and after (A) orthodontic treatment.

	Interferences					
	RCP/ICP		Mediotrusion			
Lateral slide			3 mm		Maximum	
	n	%	n	%	n	%
Anterior relationship						
Normal (n = 95)						
B	38	40.0	5	5.3	36	37.9
A	5	5.3	3	3.1	28	29.5
Deep bite (n = 28)						
B	10	35.7	2	7.1	7	25.0
A	1	3.6	1	3.6	8	28.6
Open bite (n = 9)						
B	6	66.7	4	44.4	7	77.7
A	1	11.1	3	33.3	6	66.6
Total (n = 132)						
B	54	40.9	11	8.3	50	37.9
A	7	5.3	7	5.3	42	31.8

after treatment and in nine controls (4.3 per cent). This combination was higher in girls than in boys in the patient group. The lowest prevalence pre- and post-treatment was found in the younger boy group (Table 4). Of the 36 patients with both an RCP/ICP and mediotrusion interference before treatment, 23 had a Class I (17.4 per cent of the Class I cases), six a Class II (9.7 per cent of the Class II cases), and seven a Class III relationship (43.8 per cent of the Class III cases). Of these 36 patients, 18 had a transversal deviation.

The 95 Class I subjects with a normal vertical relationship still had the same relationship after

Table 6 The prevalence of interferences in Class II cases before (B) and after (A) orthodontic treatment.

	Interferences					
	RCP/ICP		Mediotrusion			
Lateral slide			3 mm		Maximum	
	n	%	*n*	%	*n*	%
Anterior relationship						
Normal (*n* = 22)						
B	11	50.0	3	13.6	8	36.4
A	2	9.1	1	4.5	1	4.5
Deep bite (*n* = 32)						
B	15	46.9	2	6.3	2	6.3
A	3	9.4	0	0	2	6.3
Open bite (*n* = 8)						
B	3	37.5	3	37.5	4	50.0
A	0	0	3	37.5	6	37.5
Total (*n* = 62)						
B	29	46.8	8	12.9	14	22.6
A	5	8.1	4	6.5	6	9.7

treatment, except for a change in two to a deep bite and in three to an AOB. Of the 28 Class I patients with a deep bite at the start, 21 were corrected to a normal anterior vertical relationship. Of the nine Class I AOB cases before treatment, eight were corrected to an edge-to-edge or a small overbite. The prevalence of RCP/ICP interferences decreased markedly after treatment. The prevalence of mediotrusion interferences showed a small decrease (Table 5). The prevalence of mediotrusion interferences was low in the Class I cases with an anterior deep bite pre-treatment; correction to a normal anterior vertical relationships in these subjects did not change the prevalence.

Of the 50 Class I patients with a mediotrusion interference pre-treatment, 42 still had the same interference post-treatment. Post-treatment there was a decrease in the total number of patients with mediotrusion interferences from 74 to 58, and RCP/ICP interferences from 88 to 14 (Tables 5–7). Pre-treatment, 54 (40.9 per cent) of the 132 Class I cases had an RCP/ICP interference and post-treatment this had decreased to seven (5.3 per cent). In five patients (3.8 per cent) the lateral slide was in the same direction pre- and post-treatment (Table 5).

Of the 62 patients with a Class II relationship, 29 (46.8 per cent) had an RCP/ICP interference before treatment (Table 6), and this was still present in five subjects (8.1 per cent) post-treatment.

The Class III group was small (Table 7). However, the results show the same pattern as the Class I and Class II cases, with a reduction of RCP/ICP interferences and minor change in the number of mediotrusion interferences.

The prevalence of RCP/ICP interferences was higher in subjects with a unilateral crossbite than in the other types of bites with transverse deviation (Table 8). In those with bilateral crossbites there was a higher prevalence of mediotrusion interferences than in other transversal deviations. In subjects with unilateral and bilateral scissors bites, the prevalence of interferences was lower than in those with crossbites, especially concerning mediotrusion interferences.

The post-treatment prevalence of interferences was generally lower than in the controls.

Discussion

The aetiology of TMD is multifactorial. The effect of each factor probably has a different

Table 7 The prevalence of interferences in Class III cases before (B) and after (A) treatment.

	Interferences					
	RCP/ICP		Mediotrusion			
Lateral slide			3 mm		Maximum	
	n	%	*n*	%	*n*	%
Anterior relationship						
Normal (*n* = 11)						
B	3	27.3	3	27.3	5	45.5
A	2	18.2	3	27.3	8	72.7
Deep bite (*n* = 3)						
B	1	33.3	2	66.7	3	100
A	0	0	0	0	2	66.7
Open bite (*n* = 2)						
B	1	50.0	2	100	2	100
A	0	0	2	100	0	0
Total (*n* = 16)						
B	5	31.3	7	43.8	10	62.5
A	2	12.5	5	31.3	10	62.5

Table 8 The prevalence of interferences in cases with a transverse deviation before (B) and after (A) orthodontic treatment.

	Interferences					
	RCP/ICP		Mediotrusion			
Lateral slide			3 mm		Maximum	
	n	%	*n*	%	*n*	%
Transversal relationship						
Crossbite						
Unilateral (*n* = 32)						
B	20	62.5	5	15.6	19	59.4
A	4	112.5	6	18.8	19	59.4
Bilateral (*n* = 20)						
B	10	50.0	8	640	14	70.0
A	1	5.0	4	20	11	55.0
Scissors bite						
Unilateral (*n* = 14)						
B	6	42.9	0	0	2	14.3
A	1	7.1	0	0	1	7.1
Bilateral (*n* = 5)						
B	2	40.0	0	0	1	20.0
A	1	20.0	0	0	0	0
Total (*n* = 71)						
B	38	53.5	13	18.3	36	50.7
A	7	9.9	10	14.1	31	43.7

impact in different subjects and changes with time in the same individual (Laan *et al*., 1988). This could explain the inconsistent nature of signs and symptoms of TMD. However, each aetiological factor that can be eliminated should decrease the risk of developing TMD. Therefore, it is important to know the prevalence and the impact of different aetiological factors. One of the few factors that it is possible to register accurately is the type of occlusal interference. However, many reports question the role of interferences. One reason for these differences in opinion is the variation in definitions between different studies. Clark and Evans (1998) examined 37 orthodontic patients 1 week after debonding. Twenty-four subjects (65 per cent) had a unilateral contact on initial closure on the retruded axis, an RCP/ICP interference. They registered a lateral slide of less than 0.5 mm in 51 per cent and more than 0.5 mm in 22 per cent of the subjects post-treatment. They stated that, based on current concepts of functional occlusion, this group did not exhibit ideal occlusal relationships. Milosevic and Samuels (1998) found that the frequency of 'non-ideal' functional occlusal contacts was significantly higher in subjects treated by post-graduate students compared with those treated by orthodontists.

What is optimal orthodontic treatment? In most studies, subjects are reported just as orthodontically treated or as untreated cross-sectional groups. When studying the effect of orthodontic treatment on mandibular function, it is important that the procedure is controlled as far as possible (Alpern *et al*., 1988; Kirveskari and Alanen, 1993). The treatment goals should be carefully defined (Alpern *et al*., 1988). It should also be noted that eliminated occlusal interferences have a tendency to reappear (Kirveskari and Alanen, 1993). In this study, new interferences were removed until on three occasions there was a 6-month interval without new interferences appearing.

Treatment in all subjects should be completed according to the six keys of normal occlusion (Andrews, 1972), with no RCP/ICP or balancing side interferences (Alpern *et al*., 1988) and an anterior distance RCP/ICP not exceeding 0.8 mm. After selective grinding, interferences remained in 13.8 per cent of the subjects (Olsson and Lindqvist, 1995). This prevalence is low, compared with most studies. If all teeth are in the correct position, there should be no detrimental forces moving the teeth. In a 20-year follow-up study of these subjects, the PAR index assessments show that the post-treatment PAR score had decreased 20 per cent (data not yet published). The functional assessments show the same trend.

The aim of treatment in this study was to create a functionally optimal occlusion with the RCP/ICP slide not exceeding 0.8 mm. The reason for choosing this range was that 79.5 per cent of the controls in this investigation were considered to have a good occlusion, with an anterior slide of 0.1–0.8 mm. Wänman (1987) found that 92 per cent of adolescents had an anterior slide of less than 1 mm. Mohlin *et al*. (1980) stated that an anterior slide of more than 2 mm was an interference. In the patient group, 43.8 per cent had an anterior slide in the range 0.1–0.8 mm pre-treatment, and 82.3 per cent post-treatment. It is therefore considered that for anterior distance the treatment result was good.

A higher prevalence of RCP/ICP slide (right more than left side) was found in the patients before treatment than in the controls. Post-treatment, the prevalence of RCP/ICP interferences was lower than in the controls, with no difference between sides. A similar decrease in the prevalence of signs and symptoms of TMD was found in the same group post-treatment (Olsson and Lindqvist, 1995).

The results in girls show a small difference between the age groups in the prevalence of interferences before treatment. In the two groups of boys, the prevalence of mediotrusion interferences was almost 50 per cent greater in the older compared with the younger group. The same relationships were found in signs and symptoms of TMD (Olsson and Linsqvist, 1995). The difference in age between the groups at the start of treatment was small. As boys mature more slowly than girls, the result is in agreement with many other studies, showing an increase in interferences and signs and symptoms of TMD with age (for example, see Heikinheimo *et al.*, 1989, 1990).

The prevalence of mediotrusion interferences did not decrease to the same extent in spite of orthodontic treatment and selective grinding. In this study, treatment in more than 50 per cent of the cases was started before the eruption of the second molars, the teeth that, together with the third molars, are the cause of the majority of mediotrusion interferences. Although the patients were 4 years older post-treatment than at the start of treatment, with all second and approximately 25 per cent of third molars erupted, the prevalence of mediotrusion interferences had decreased, except in some of the Class III subjects. This must be taken into consideration when comparing the prevalence before and after orthodontic treatment.

A mediotrusion interference is probably a more severe aetiological factor in the range of 0–3 mm lateral slide than at a longer distance from RCP (Agerberg and Sandström, 1988). For this reason, attempts were made to eliminate interferences at least up to a 3 mm lateral slide. The results show that it is more difficult to eliminate mediotrusion interferences in subjects with an AOB. This is in agreement with the findings of Milosevic and Samuels (1998) that an overbite greater than 2.4 mm results in a highly significant reduction in the occurrence of non-working side contacts and posterior protrusive contacts. (The number of subjects with AOB bites in this study was small.)

Mediotrusion interferences were found to be more consistent in the same person than RCP/ICP interferences. This could be explained by the fact that mediotrusion interferences are more connected with basal deviations, for example, Class III relationships and AOB. An association between altered craniofacial morphology and localized TMJ disturbances was also reported by Nebbe *et al.* (1997) and Legrell (1999), and the difference between right and left sides in adolescents by Nebbe *et al.* (1997).

In this study, the total prevalence of interferences was almost the same in subjects with uni- and bilateral crossbites (Table 8). There was a higher prevalence of RCP/ICP interferences in those with unilateral crossbites, and of mediotrusion interferences in subjects with bilateral crossbites. A higher prevalence of symptoms was also found pre-treatment in subjects with unilateral crossbites (Olsson and Lindqvist, 1995). Is an RCP/ICP interference a more important aetiological factor than a mediotrusion?

Is it necessary to perform selective grinding after orthodontic treatment, or will grinding damage intact teeth? Careful selective grinding of a tooth in a good position removes less than 0.2 mm of an approximately 3-mm thick enamel layer from the cusps. Elimination of interferences by occlusal equilibration and/or occlusal splints was shown to be successful in the treatment of TMD (Okeson, 1989; Kirveskari, 1997; Karpinen *et al*., 1999).

After orthodontic treatment, interferences were found in 52.4 per cent of the subjects in the present study. In all of these selective grinding was performed. At the final registration, after several grindings in some subjects, the total prevalence of interferences was 13.8 per cent. The number of subjects with interferences was thus reduced from 110 to 29. Following orthodontic treatment, although teeth are moved into new positions, differences in tooth size and shape still exist. For this reason it is often necessary to finish treatment with selective grinding. Kirveskari (1997) found that the short-term response to selective grinding and the mock adjustment group were equally good, but at 12 and 60 months follow-up, the treatment group was significantly better than the placebo group with respect to almost all of the outcome variables.

In a 2-year longitudinal follow-up of the effects of occlusal grinding, Vallon and Nilner (1997) found that the improvement could partly be explained by selective grinding. They also stated that only individual patients improved with counselling alone, and a few more improved if one additional treatment, for example, occlusal adjustment was added, but the majority required a comprehensive treatment programme.

The results of the present study, together with the findings of Olsson and Lindqvist (1995), indicate that optimal orthodontic treatment in children should include selective grinding if necessary. Selective grinding results in stability

only if there is an optimal tooth position/occlusion. However, 'The criteria which are thought to denote an ideal functional occlusion may represent an onerous task for the orthodontist to achieve' (Clark and Evans, 1998).

Conclusions

1. Optimal orthodontic treatment including, in some cases, selective grinding, will decrease the prevalence of occlusal interferences.
2. RCP/ICP interferences are often caused by dental variations in position, size, and shape, which are easier to eliminate orthodontically than mediotrusion interferences.
3. Mediotrusion interferences are more associated with basal morphological deviations.

Address for correspondence

Martin Olsson
Orthodontic Clinic
Public Health Services
SE-901 85 Umeå
Sweden

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