Original Article

Prevalence and severity of vestibular recession in mandibular incisors after orthodontic treatment

A case-control retrospective study

Gisela Vasconcelos[a]; Kristian Kjellsen[b]; Hans Preus[c]; Vaska Vandevska-Radunovic[d]; Bjørn Frode Hansen[e]

ABSTRACT

Objective: To assess the prevalence and severity of vestibular gingival recession of mandibular incisors after orthodontic treatment and to evaluate possible contributing factors.

Materials and Methods: From the record pool of patients who completed orthodontic treatment from 1999–2006 at the Department of Orthodontics, University of Oslo, Norway, 588 patients fulfilled the inclusion criteria. Intraoral color slides were used for the evaluation of gingival recessions (based on Miller classification), presence of visible plaque, and gingival inflammation. Cephalometric radiographs were used to assess the sagittal intermaxillary relation, mandibular and intermaxillary angles, and the position of the lower incisors. A control group was drawn from the same pool of 588 patients. All statistical analyses were performed using SPSS.

Results: The prevalence of gingival recessions after orthodontic treatment was 10.3%. Most (8.6%) were classified as Miller Class I, and 1.7% were classified as Miller Class II. Gingival recession was predominantly found on central incisors. Reduction of the sagittal intermaxillary angle and retroclination of the lower incisors was correlated with the development of a more severe gingival recession.

Conclusions: The present study indicates that vestibular gingival recession of mandibular incisors after orthodontic treatment is of minor prevalence and severity. The presence of gingival recession or retroclination of the incisors with mesial basal relations increases the risk of more severe gingival recession. (*Angle Orthod.* 2012;82:42–47.)

KEY WORDS: Gingival recession; Orthodontic treatment

INTRODUCTION

Gingival recession is usually defined as a displacement of the gingival margin apically to the cemento-enamel junction.[1] The buccal surfaces of central mandibular incisors and maxillary molars are the most frequently affected sites.[2] The prevalence of gingival recession is gender and population dependent, increases with age,[2,3] and is shown to be associated with malocclusions and individually malpositioned teeth.[4] The etiology of gingival recession is considered to be multifactorial. Both developmental factors, such as fenestration of the alveolar bone, ectopic tooth eruption, or position in the dental arch, and/or acquired factors, such as injury, piercing, or tooth brushing, may influence the development of gingival recessions.[5] Orthodontic therapy may result in small detrimental effects to the periodontium,[4,6,7] but the clinical significance of these findings is questionable. On the other hand, long-term evaluation of orthodontic treatment shows no discernible effect on later periodontal health.[8]

Among orthodontists, it is generally accepted that proclination of, in particular, lower incisors may be a

[a] Specialist in Orthodontics, Department of Orthodontics, Faculty of Dentistry, University of Oslo, Oslo, Norway.
[b] Specialist in Periodontics, Department of Periodontology, Faculty of Dentistry, University of Oslo, Oslo, Norway.
[c] Professor, Department of Periodontology, Faculty of Dentistry, University of Oslo, Oslo, Norway.
[d] Professor, Department of Orthodontics, Faculty of Dentistry, University of Oslo, Oslo, Norway.
[e] Professor, Department of Periodontology, Faculty of Dentistry, University of Oslo, Oslo, Norway.
Corresponding author: Dr Bjørn Frode Hansen, Department of Periodontology, Faculty of Dentistry, Postbox 1109 Blindern, 0317 Oslo, Norway
(e-mail: b.f.hansen@odont.uio.no)

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risk factor for progressive bone loss and development of gingival recession. However, the findings in the literature are controversial. While some authors report on labial bone dehiscence and retraction of the gingival margin after excessive proclination of mandibular incisors in adults,[9,10] other studies find no correlation between the amount of proclination of these teeth and gingival recession.[11–13] Moreover, a correlation has been found between gingival recession and retroclined mandibular incisors in untreated adults with mandibular prognathism.[14]

The aim of the present study was to assess the prevalence and severity of labial gingival recession of mandibular incisors before and after orthodontic treatment. Furthermore, the aim was to evaluate the possible effect of skeletal and dental variables on the occurrence of gingival recession and to evaluate the influence of the presence or absence of visible plaque and gingival inflammation before and after orthodontic treatment. The null hypothesis is that proclination of mandibular incisors is not a risk factor for vestibular gingival recession.

MATERIALS AND METHODS

The study protocol has been approved by the Regional Committee for Medical Research in Norway, Norwegian Social Science Data Services, and Norwegian Directorate of Health.

Subjects

From the pools of 1825 records of patients who have completed orthodontic treatment from 1999–2006 at the Department of Orthodontics, Faculty of Dentistry, University of Oslo, Norway, 588 patients fulfilled the criteria to be included in the study. In addition to having complete sets of pretreatment and posttreatment clinical intraoral slides and cephalograms of good quality, they had to be younger than 30 years at the end of orthodontic treatment and all four permanent mandibular incisors had to be present with no restorations or history of previous periodontal treatment. Only color slides in which the frontal area (teeth, gingival, and upper part of the oral mucosa) in the mandibular region could be identified were included. If, for instance, the lower lip covered the gingiva, the slide was considered not readable. Patients with systemic diseases or medications associated with gingival changes or who were diagnosed with syndromes were excluded. After assessing the number of subjects with gingival recessions (n = 57), a control group of the same size was randomly drawn from the same pool of 588 patient records after the cases with lower incisor recessions were taken out.

Color Slide Examination

Each intraoral color photographic slide was analyzed on a radiograph viewer, and the following observations were recorded: (1) presence or absence of labial gingival recession on mandibular incisors before and after orthodontic treatment, (2) presence or absence of visible plaque on one or more mandibular incisors before and after orthodontic treatment, and (3) presence or absence of visible inflammation at the buccal gingiva on one or more mandibular incisors before and after orthodontic treatment.

The gingival recessions were classified according to the Miller Classification[15] as assessed on color slides. If one patient had more than one gingival recession, the tooth with the most severe recession diagnosis was used. All registrations were performed simultaneously by two persons after a calibration period.

Radiographic Assessment

All lateral cephalograms were scanned and transferred for digital cephalometric analysis (FACAD, Ilexis AB, Linköping, Sweden), and corrections were made for linear enlargement. Twenty lateral cephalograms, chosen at random from the control group and from the study group, were traced and digitized on two separate occasions more than 4 weeks apart to estimate reliability. The intraclass correlation coefficient showed an acceptable reliability for all of the variables. The cephalometric analyses were done by one author using the angular and linear measurements given in Figure 1.

Statistical Methods

Data from all variables were transferred to the statistical program SPSS Base 16.0 (SPSS Inc, Chicago, Ill). Arithmetic means of the cephalometric variables in the recession group and control group were compared using the Student's *t*-test for independent samples. When comparing means within a group, a paired *t*-test was used. When comparing frequencies in two groups, a chi-square test was used. Test-retest reliability was evaluated by using the intraclass correlation coefficient. When the aim was to adjust a mean difference for age, linear regression analysis was applied. A significance level of 5% was used.

RESULTS

The prevalence of gingival recessions after orthodontic treatment as recorded on color slides was 10.3% (22 males and 35 females). Most (8.6%) were classified as Miller Class I, and 1.7% were classified as Miller Class II. There were no recessions classified as Miller Class III or Class IV. The average age for this

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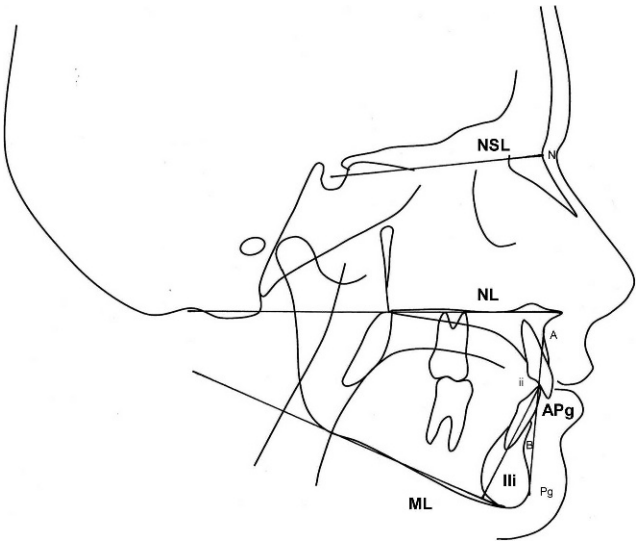

Figure 1. ANB: Expression of the sagittal relationship between the maxilla and the mandible. Normal value: 2°–3°. ML/NSL: The angle between the mandibular line and the nasion-sella line. Expression of the tilting of the mandible relative to the anterior cranial base. Normal value: 33° ± 4°. ML/NL: Expression of the vertical relationship between the maxilla and the mandible. Normal value: 26°. Ili/ML: The angle between the long axis of the lower incisors and the mandibular line. Expression of the inclination of the lower incisors relative to the mandible. Normal value: 94° ± 4.5°. Ili/Apg: The angle between the long axis of the lower incisor and the A-pg line. Expresses the proclination of the lower incisors. Normal value: 22° ± 4°. Ii⊥A-Pg: The shortest distance from incision inferior to the line from A-point to pogonion. Expresses the protrusion of the upper incisors. Normal value: 1 ± 2 mm.

group was 13.1 ± 4.4 years. Miller Class I was registered in 47 subjects (29 females and 18 males; mean age, 12.3 ± 2.9 years), and 10 patients were classified as Miller Class II (6 females and 4 males; mean age, 17 ± 7.5 years). The control group consisted of 57 subjects (35 females and 22 males; mean age, 14 ± 4.8 years).

The prevalence of gingival recession prior to orthodontic treatment in the group with gingival recession was 51%. In the Miller Class I group, 47% of the patients had recession before treatment, while in the Miller Class II group, 70% had recession before treatment. No statistically significant differences were found between the Miller Class I and Miller Class II groups when comparing the presence of gingival recession prior to treatment. In the recession group, 228 teeth were evaluated. Of these, 32 teeth had Miller Class I gingival recession before treatment and 63 teeth had Miller Class I gingival recession after treatment. Miller Class II gingival recessions were observed on 11 teeth before treatment and on 14 teeth after treatment. Gingival recession was predominantly found on central incisors. Of 77 teeth affected with gingival recession after treatment, 67 teeth were central incisors.

No statistically significant differences were found in age before treatment or presence of visible plaque before and after treatment between the recession and the control groups (Table 1). In the control group, the pretreatment gingival inflammation was significantly higher than in the recession group. In the recession group, the posttreatment gingival inflammation was slightly higher than in the control group, but this difference was not statistically significant (Table 1).

In the Miller Class II group, the age of the patients was significantly higher than in the Miller Class I group (Table 2). The pretreatment gingival inflammation in the Miller Class II group was also significantly higher, but the duration of the treatment in the Miller Class I group was significantly longer (Table 2).

The linear and angular cephalometric measurements pretreatment did not differ significantly between the groups. However, posttreatment, the ANB angle and the mandibular incisor inclination were significantly smaller in the Miller Class II group (Table 3). When adjusting for age, the linear regression analysis shows significant differences for ANB and post Ili/ML (Table 3). In values of angle ANB less than 1.45° and values of angle Ili/ML less than 92.6°, the chance of developing a more severe recession increased four times (Tables 4 and 5).

DISCUSSION

In the present study, 10.4% of the patients demonstrated gingival recessions on at least one of the mandibular incisors after orthodontic treatment. Most (8.7%) were classified as Miller Class I, and only 1.7% were classified as Miller Class II recessions. None of the subjects had Miller Class III or IV recessions. Most studies that investigate gingival recessions in adolescents after orthodontic treatment report similar findings,[6,12,16] but the

Table 1. Comparison of the Investigated Variables Between the Recession and the Control Groups

Variable	Recession (n = 57)	Control (n = 57)	*P* Value
Age, mean ± SD, y	13.1 ± 4.4	14.0 ± 4.8	.3
Visible plaque pretreatment, n (%)	16 (28%)	9 (16%)	.11
Visible plaque posttreatment, n (%)	16 (28%)	10 (18%)	.18
Gingival inflammation pretreatment, n (%)	9 (16%)	18 (32%)	.05
Gingival inflammation posttreatment, n (%)	10 (18%)	4 (7%)	.09
Duration of treatment, mean ± SD, mo	28.5 ± 9.7	30.9 ± 11.2	.23

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Table 2. Comparison of the Investigated Variables between the Miller Class I and Miller Class II Groups

Variable	Miller I (n = 47)	Miller II (n = 10)	*P* Value
Age, mean ± SD, y	12.3 ± 2.9	17.0 ± 7.5	.00
Visible plaque pretreatment, n (%)	12 (26%)	4 (40%)	.35
Visible plaque posttreatment, n (%)	13 (28%)	3 (30%)	.88
Gingival inflammation pretreatment, n (%)	5 (11%)	4 (40%)	.02
Gingival inflammation posttreatment, n (%)	8 (17%)	2 (20%)	.82
Duration of treatment, mean ± SD, mo	29.7 ± 9.3	23.2 ± 10	.05

prevalence is higher in adult orthodontic patients.[13] This is not unexpected as the prevalence and severity of gingival recessions are shown to increase with age, even in untreated individuals.[17,18] In an attempt to minimize the effect of this natural development, the age limit in our study was set at 30 years at the end of orthodontic treatment. Nevertheless, subjects demonstrating Miller Class I recessions were on average 5 years younger than the subjects with more severe recessions, and this difference was significant. It seems that the periodontal tissue in younger patients has a more favorable response to orthodontic treatment than in older adolescents and adults.[19]

The evaluation of gingival recessions in this study was carried out only on color slides according to the Miller classification. This method proved to be reliable, reproducible, and informative. The severity of gingival recessions could also have been evaluated on available study casts or measured intraorally and presented in millimeters. Assessment on intraoral slides has already been shown to be a preferable method to measurements on study casts because of the number of unreadable teeth due to poor impressions and hence unreliable data.[20] Before the start of this study, we had planned to recall all patients for intraoral measurements of the recessions some time after the end of orthodontic treatment. At the time the photos were taken, subjects with Miller Class I and Class II recessions had no need for corrective periodontal treatment. It would have been of great interest to observe the development of these recessions on a long-term basis after treatment. However, recall of patients proved to be difficult, as the response rate was extremely low.

The central mandibular incisors were the teeth with the highest prevalence of gingival recession. This is in agreement with other studies.[2,21] Usually, the lateral incisors maintain a more lingual position to the central incisors during eruption. A more pronounced labial position of the central incisors might result in a thin labial bone plate and apical migration of the marginal gingiva. The developmental position of the teeth also seems to be important as a predisposing factor to local gingival recession.[21–23]

Proclination of the lower incisors during orthodontic treatment has been considered to be detrimental to periodontal health.[9,24,25] In a recent review article, it was concluded that more proclined teeth had a higher occurrence or severity of gingival recession compared with less proclined or untreated teeth. However, the differences were small and the clinical consequences questionable.[26] The results from our study are in contrast to this notion. They show that the risk of getting more severe gingival recession is increased in cases with retroclined mandibular incisors and a mesial basal relationship of the jaws. In a previous study, Sperry et al.[27] compared orthodontically treated adults with Angle Class III to patients with Angle Class I and Class II malocclusions. They observed that patients having excessive dental compensations in the Angle Class III group had more than three times as many teeth with labial gingival recession as the patients in the Angle Class I and Class II groups after orthodontic treatment. Most of these teeth were mandibular incisors. A correlation between labial gingival recession and retroclination of incisors has also been found in untreated adults.[28] In our study,

Table 3. Comparison of the Cephalometric Variables Between the Miller Class I and Miller Class II Groups (Mean ± SD)

Cephalometric Variable	Miller I (n = 47)	Miller II (n = 10)	*P* Value
Pre AnB, °	4.5 ± 2.4	3.8 ± 1.5	.37
Post AnB, °	3.1 ± 2.3	1.5 ± 2.2	.04
Pre ML/NL, °	26.5 ± 5.6	30.0 ± 7.0	.095
Post ML/NL, °	26.0 ± 5.6	29.3 ± 8.0	.13
Pre Ili/Apg, °	23.3 ± 5.5	24.0 ± 7.5	.73
Post Ili/Apg, °	26.1 ± 4.6	24.8 ± 7.0	.45
Pre Ii$^{\perp}$A-Pg, mm	3.4 ± 3.8	2.0 ± 2.4	.15
Post Ii$^{\perp}$A-Pg, mm	2.6 ± 2.2	4.0 ± 4.5	.14
Pre Ili/ML, °	95.5 ± 6.5	92.2 ± 8.1	.17
Post Ili/ML, °	96.4 ± 6.6	90.5 ± 9.4	.02
Pre ML/NSL, °	33.6 ± 5.8	35.7 ± 6.5	.32
Post ML/NSL, °	33.5 ± 5.5	34.1 ± 6.8	.76

Table 4. Distribution of Miller Class II Gingival Recession in Relation to the Posttreatment Values of the ANB Angle

ANB	n	Miller Class II
≤1.446°	14	6 (42.9%)
1.447°–2.831°	14	0
2.832°–4.601°	13	3 (23.1%)
≥4.602°	16	1 (6.2%)
Total	57	10

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Table 5. Distribution of Miller Class II Gingival Recession in Relation to the Posttreatment Values of the Ili/ML

Ili/ML	n	Miller Class II
≤92.58°	14	6 (42.9%)
92.59°–96.03°	15	1 (6.7%)
96.04°–99.84°	14	2 (14.3%)
≥99.85°	14	1 (7.1%)
Total	57	10

teeth that were proclined (Ili/ML >98.5°) did not reveal an increased occurrence of gingival retraction. Therefore, the general concern among orthodontists that proclination of the lower incisors might compromise periodontal health seems to be unsubstantiated.

The evaluation of gingival inflammation and plaque on color slides compared with a gold standard clinical evaluation is questionable, but all slides were evaluated by both examiners on two different occasions more than 4 weeks apart. In addition, it has been shown that there are no statistically significant differences between measurements from carefully taken intraoral slides and measurements taken from patients.[29] Because of the uncertainty of measuring the width of keratinized gingiva due to the lack of calibration of the images evaluated, gingival biotype (the width of gingiva) was not evaluated in this study.

All subjects in this study were treated at the orthodontic department in Oslo and received the standard maintenance program that consists of written and oral information about orthodontics and oral hygiene in addition to the necessary material to guarantee good plaque control during orthodontic treatment. The presence of pretreatment inflammation was significantly higher in the recession group compared with the control group. When patients with Miller Class I recessions were compared with patients having Miller Class II recessions, there was significantly more inflammation in the Miller Class II group pretreatment. Posttreatment, there was more inflammation in the recession group compared with the control group, but the difference was not significant. Melsen and Allais[13] concluded that visual plaque and inflammation are useful predictors of gingival recession. These observations indicate the importance of having good plaque control during orthodontic treatment. However, the results should be interpreted with care, and more studies are needed before a final conclusion can be made on these issues.

CONCLUSIONS

- The present study indicates that vestibular gingival recession of mandibular incisors after orthodontic treatment is of minor prevalence and severity.
- In the presence of gingival recession, retroclination of the mandibular incisors in cases of mesial basal relation (Angle Class III) seems to increase the risk of a more severe gingival recession.
- Keeping the gingiva in the mandibular frontal area as healthy as possible during orthodontic treatment appears to be the determinant in the development of gingival recession. Inflammation seems to be a contributory factor for this condition. A careful examination of the buccal gingiva in the lower incisors, before deciding the amount of movement of these teeth, seems important.

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