Orthodontic treatment effect on gingival recessions

Guoste Antanaviciene (guoste.baseviciute@gmail.com)
lithuanian university of health sciences https://orcid.org/0000-0002-5987-2749

Dalia Smailiene
Lithuanian university of health sciences

Nomeda Baseviciene
Lithuanian university of health sciences

Egle Zasciurinskiene
Lithuanian university of health sciences

Research article

Keywords: gingival recession, orthodontic treatment

Posted Date: January 28th, 2020

DOI: https://doi.org/10.21203/rs.2.22064/v1

Abstract

Background The occurrence of gingival recessions (GR) after orthodontic treatment (OT) is well described in the literature. However, there is a lack of information about changes to pre-existing GR during OT. Methods The aim of this retrospective study was to examine the change of GR before and after OT. Intraoral photographs of 993 patients treated with fixed appliances between 2005 and 2017 were evaluated. Patients who had at least one GR on the vestibular surface of maxillary/mandibular teeth mesial to first molars were included. GR was measured on good quality plaster models before and after OT. The change of GR (T0-T1) was categorised into the three groups: worsened, did not change and improved (this group consisted of GR, which became better but did not disappear, and fully healed, which disappeared after OT)). The change by ≥0.5 mm was recorded. Statistical analysis was performed using SPSS Statistics (Version 22.0. Armonk, NY). Results Fifty-one (5.1%) patient had ≥1 GR before OT. Of them, 37 (72.5%) patients were included in the final analysis according to the inclusion criteria. GR before OT was found on 114 buccal/labial surfaces. The mean GR improvement was 0.51 (95% CI: 0.40, 0.63) mm (p<0.001). GR improved in 71 teeth (62.3%), did not change in 37 (32.4%), and worsened in 6 (5.3%). Of the 71 GR, which improved, full healing was observed in 15 (21.1%) teeth. GR had a greater chance of improvement in cases with a thick/normal gingival biotype compared with the thin biotype (OR 2.4; 95% CI: 1.07; 5.28) (p=0.03). There was a lower chance for GR improvement in cases with pre-treatment open bite (OR 3.29; 95% CI: 1.10; 9.81) (p=0.03) and Class III patients (OR 2.79; 95% CI: 1.14; 6.83) (p=0.03). Conclusions Based on the results of this retrospective study, we conclude that orthodontic treatment may change and even influence the healing of GR.

Background

Gingival recession (GR) is described as gingival atrophy resulting in apical movement of the gingival margin and exposure of the root of the tooth (1). The prevalence of GR affecting at least one tooth ranges from 11–90% in the adult population, being more frequent in adults aged 50 years and above (2,3,4). The severity of GR has been observed to increase with age (2,5). GR is more prevalent on vestibular surfaces and in mandibular teeth (3). It is usually observed on one or several teeth; however, GR can be more widespread when the gingiva of multiple teeth is damaged (6). Although the pathogenesis of gingival recession remains unclear, there are several predisposing and precipitating factors such as coronally attached frenulum and muscles, abnormal tooth position, overhanging restorations, proclination of teeth, fenestration, dehiscence, thin mandibular alveolar bone or injuries (7). Orthodontic treatment (OT) has been also found to be one of the factors causing GR, and was related to a difficulty in plaque control during treatment as well as transverse/labial expansion (7). It has been found that the possibility of the appearance of GR grows by 9.7% with each year after OT (8). Canines, first premolars and first molars are most prone to GR after OT in the maxilla, while the highest risk of GR in the mandible was observed on the central incisors and first premolars (8). The consequences of GR include: tooth sensitivity, root caries, hypermobility of the affected tooth and poor aesthetics (9). Those occurring in the aesthetic zone are the most challenging (9).

The management of GR involves the elimination of aetiological factors, frenectomy and if needed, surgical root coverage (7, 9).

As untreated malocclusions have been found to lead to mucogingival problems, orthodontic therapy could be one of the preventive factors (10). However, literature about the prevalence of gingival recession before orthodontic treatment and the changes during orthodontic tooth movement is scarce.

The aim of this retrospective study was to examine the change in pre-existing gingival recessions during orthodontic treatment.

Null hypothesis: Gingival recessions may be changed during orthodontic tooth movement.

Methods

Selection

This was a retrospective clinical study. Ethical approval for the study was obtained (No. BEC-OF-67). Intraoral photographs of 993 patients treated between January 2005 and November 2017 were analysed. Patients were treated by two orthodontists (author EZ and DS) in the Department of Orthodontics, Faculty of Odontology at Lithuanian University of Health Sciences (LUHS) and the private practice in Kaunas, Lithuania. The presence of GR was identified on frontal, right and left buccal intraoral photographs (in occlusion) by one investigator, who was blinded (GA). The diagnosis was confirmed on patients' records and then measured on plaster models. The presence of gingival recession was confirmed if the marginal border of the attached gingiva was apical to the cement-enamel junction. Patients with ≥1 GR before OT were selected and included in the study (selection criteria are shown in Table 1). Only patients with recorded good oral hygiene, without bleeding on probing (BoP), were included. Professional oral hygiene was performed every 3-6 months during OT for all patients.

Measurements

Patient records

- General data: age (years), gender (male, female), duration of orthodontic treatment (months).
- Tooth extraction (no extraction, extractions in maxillary or mandibular dental arch, or extractions in both dental arches).

Plaster models

All measurements were performed on plaster models before (T0) and after (T1) OT.

- Extent of gingival recession was measured in millimetres, using "Meritt B" periodontal probe (Hu-Friedy Mfg. Co., LLC) before (T0) and after (T1) OT. The probe was placed in the middle of the crown parallel to the root of the tooth.

- The change in GR (T0-T1) was categorised into three groups (worsened, did not change, improved (this group consists of healed GR- which became better but did not disappeared, and fully healed- which disappeared after OT)). The change by 0.5 mm and more was stated as improvement or
- Overbite (OB), measured in millimetres before OT. OB values were categorised into three groups (<1mm; 1–3 mm; >3 mm).
- Overjet (OJ) was measured in millimetres before OT. Data were categorised into two groups (<4 mm; ≥ 4 mm).
- Sagittal relationship (between maxillary and mandibular canines). Class I was considered when upper canine displacement from ideal position was less than 1 mm.

Intraoral photographs:

- Gingival biotype (normal/thick, thin) was determined according to intraoral photographs before OT. The gingiva was identified as thin when the contours of teeth roots and the capillary network were easily visible (11). The gingiva was recorded as thick/normal when the contours of teeth roots and the capillary network were not visible.

The primary outcome variable was the change in the extent of gingival recession in relation to cemento-enamel junction (CEJ) from before to after OT (T0–T1).

Data preparation

Firstly, analyses were performed on the patient as the unit of measure. Measurement analysis included all GRs at patient (cluster) level. GR change T0–T1 was evaluated by the mean change in millimetres. Later, the analysis was performed at tooth (individual) level, taking into account possible clustering effects, to find out the number of changed GRs within the patient during the treatment (12).

Also analyses were performed at tooth level, where three groups were created according to the change of GR: 1) improved - when the most apical point of GR approached cement-enamel junction (the distance between the most apical point of GR and cement-enamel junction decreased by at least 0.5 mm; 2) did not change - when the distance between the most apical point of GR and cement-enamel junction remained the same; 3) worsened - when the distance between the most apical point of GR and cement-enamel junction increased.

Statistical analysis

Statistical analysis was performed using SPSS Statistics (Version 22.0. Armonk, NY).

The interdependence of qualitative characteristics was evaluated using chi squared (χ^2) criterion. The Kolmogorov-Smirnov test was used in the investigation of hypotheses about the normality of the parameter distribution. If variable distribution met the distribution normality assumption, Student’s (t) criterion was applied to compare the quantitative sizes of two independent groups. When the variable did not meet the distribution normality condition, a significance level was verified by the Mann-Whitney U nonparametric method. For quantitative dependent variables, we used the paired test when distribution was normal, and the Wilcoxon nonparametric test when the test of normality of the investigated variables was denied.

The probability of the event given a certain risk factor was calculated using univariate and multivariate logistic regression analysis, including an odds ratio (OR) and its confidence interval (95% CI).

The difference between groups was considered as statistically significant when $p<0.05$.

The intra-examiner error was estimated by performing recession measurements twice with 1-week interval on plaster models before (T0) and after (T1) OT. Measurement error ranged between 0.14 and 0.33mm. For the assessment of reproducibility of the measurements made by two investigators (GA and EZ), the inter-class correlation coefficient (ICC) was calculated. ICC revealed high agreement between 2 investigators (0.96; 95% CI: 0.94; 0.98, $p = 0.0001$).

Results

Baseline data

Fifty-one (5.1%) patient of the 993 assessed treated by 2 orthodontists during 12 years had at least one vestibular GR before OT. Of those, 37 (72.5%) patients, 8 males (21.6%) and 29 females (78.4%), were included in the final analysis according to the inclusion criteria. The mean age of the included patients was 28.7 (95% CI: 26.01, 31.40) years. Orthodontic treatment lasted for a mean of 21.4 (95% CI: 18.99, 23.82) months. The characteristics of the included patients are presented in Table 2. Number of teeth with GR in 37 patients before OT is shown in Figure 1.

Significant improvement of GR was found between T0-T1 at patient level (0.41 mm, 95% CI: 0.24, 0.57), $p<0.001$. Number of improved GR in 37 patients is shown in Figure 2.

At tooth level, 718 teeth mesial to molars in 37 patients were evaluated before and after OT; of these, 114 (15.9%) teeth had GR on the vestibular surfaces. The prevalence of gingival recessions before orthodontic treatment in different groups of teeth is presented in Figure 3. The mean GR improvement was 0.51 (95% CI: 0.40, 0.63) mm ($p<0.001$), with 42 (36.9%) gingival recessions improving by ≥1mm. GR improved in 62.3% (n=71), did not change in 32.4% (n=37), and worsened in 5.3% (n=6) teeth. GR changes in different groups of teeth are presented in Table 3. Of the 71 gingival recessions, which improved, full healing was observed in 21.1% (n=15) teeth (Figure 4).

Mean gingival recession change in the different groups of teeth is presented in Figure 5. The percentage of improved GR was highest on maxillary canines (84.6%); however, the highest amount of GR improvement in millimetres was observed on maxillary incisors and maxillary premolars. Healing of GR was mostly observed on maxillary incisors (43.8%). No recession was completely healed on mandibular incisors.

As significant changes in GR were found, the influence of specific factors was analysed.

Patient-related factors

Univariate binary logistic regression analysis revealed a statistically significant association between gingival recession improvement and:

1. Gingival biotype: GR had a greater chance for improvement in cases with a thick/normal gingival biotype compared with the thin biotype (OR 2.4; 95% CI: 1.07, 5.28; p=0.03).
2. Overbite (OB): A significant change in the amount of GR (median 1.0 mm; Q1, Q3: 0, 1.0), as well as percentage of recession improvement (83.3%) was found in cases with normal or deep bite (OB >1mm), in comparison with overbite <1mm (median 0 mm; Q1, Q3: 0, 0.5) (p<0.001). Odds ratio for the GR improvement was 4.69 (95% CI: 63, 13.55; p=0.004) greater if the pre-treatment overbite was >1mm in comparison to OB ≤1mm.
3. Overjet (OJ): A greater improvement of GR (median 1.0 mm; Q1, Q3: 0, 1.0) was observed in cases with large pre-treatment overjet (OJ ≥4mm), in comparison with an OJ <4mm (median 0.5 mm; Q1, Q3: 0, 1.0) (p=0.017). The odds ratio for the GR improvement was also greater (OR 1.81; 95% CI: 0.75, 4.40; p=0.19) in the presence of a larger pre-treatment overjet (OJ ≥4mm).
4. Sagittal dental discrepancy: GR showed less tendency for healing in dental Angle Class III patients on one or both sides (p=0.006). Also odds ratio for the GR improvement was 3.2 times less (95% CI: 37, 7.54, p=0.007) in cases with dental Class III.

Multilevel regression analysis showed a lower chance for GR improvement in cases with pre-treatment OB≤1 (OR 3.29; 95% CI: 1.10, 9.81; p=0.03) and dental Class III patients (OR 2.79; 95% CI: 1.14, 6.83; p=0.03).

Changes in gingival recessions during orthodontic treatment were not influenced by: gender and/or age, (p=0.42, p=0.88).

Treatment-related factors

The results showed that the duration of orthodontic treatment (p=0.08) and tooth extraction (p=0.77) did not influence changes in GR.

Since 62.3% (n=71) of gingival recessions improved and 21.1% (n=15) were completely healed, the null hypothesis was accepted.

Discussion

As the focus on mucogingival factors in the orthodontic literature is increasing, it is important to analyse whether the improvement in gingival recession (GR) may be influenced by orthodontic treatment (OT). Previous studies were more focused on the influence of factors, which induce the development of recessions rather than changes (14, 15). The aim of the present retrospective study was to evaluate the change of GRs, which were present before OT. Only 5.1% of patients with pre-existing GR were identified from the 12-year clinical material of 2 orthodontists. The included patients were different in the type of malocclusion, number of recessions and other variables, partly explaining the current scarcity of the prospective studies (Table 2, Figure 1). The mean age of the included patients was relatively high (28.7 years), suggesting that GRs are more prevalent in adult patients, and was similar to that described in the literature (5). GRs in teenagers have been described to be associated with atypical tooth position (13). The present study analysed the change of 114 gingival recessions in 37 patients after OT. The results revealed a positive impact of OT on the change in GR (62.3% GRs improved). The mean change of GRs was similar at patient (0.4 mm) and tooth (0.5 mm) levels confirming the positive impact of OT. The high percentage of improved GRs could be influenced by gingival enlargement during OT. However, gingival enlargement is mostly prevalent in teenagers with compromised oral hygiene and this study comprised mostly adults with good oral hygiene, therefore the influence of this factor is not discussed (16). Tooth group was found to be important in GR changes. The present study showed the greatest GR improvement in millimetres in maxillary incisors and maxillary premolars (Table 3). The study by Melsen et al. (2005) showed equal amounts of improved and worsened gingival recessions (42.3%) (18). It is worth mentioning that these authors examined recessions only on mandibular incisors, which did not improve in our study. Mandibular incisors might be described most frequently because of the highest prevalence of new GRs after OT on their labial surfaces. The result that GRs in the mandibular incisors did not improve in the present study may be explained by the fact that the labial alveolar bone is anatomically very thin already before OT and therefore may predispose the development of dehiscences and fenestrations after orthodontic movement of these teeth (19). The percentage of improved GRs in the present study was largest on maxillary canines (84.6%), which is in contrast to the results found by Boke et al. (2014), where only worsening of GR after orthodontic treatment was registered (11). That could be influenced by negative torque, which is usual in Roth prescription of canine brackets, leading to greater labial movement of canine root. In the present study, all patients were treated with maxillary canine torque of 0° or +7°. The careful selection of torque for the treatment of GR, bearing in mind the position of the root in the alveolus, could be have influenced our results. However, this is only a speculation, as the present study had a retrospective design.

As the study patients were different in malocclusions, we found it important to analyse factors, which could have influenced GR change. OT of increased overbite showed positively influence on the GR improvement. This is in line with the results by Zimmer et al. (2007), where an average improvement of 2 mm in gingival recessions was observed in maxillary incisors (17). The sample of the aforementioned study consisted mainly of patients with traumatic deep bite. Therefore, a significant improvement in GR was related to elimination of the causative factor - mechanical load. Based on the results of the present study and earlier studies it may be expected that the treatment of deep bite may favour an improvement of GR. In the study by Zimmer et al. (2007), changes in GRs were measured by changes in the clinical height of the crown before and after the treatment, while we measured the distance between the marginal gingival contour and cementoenamel junction. We chose this method because many patients had undergone restorations of the incisal edge during OT, therefore GR measurements of clinical height of the crown would be inaccurate. Enhos et al. (2012) also found that patients with hypo-divergent vertical growth pattern (deep bite) have a lower prevalence of dehiscence than those with a normo-divergent or hyper-divergent (open bite) growth pattern (20). In cases of GR caused by traumatic occlusal contacts, especially due to deep bite, it was found that orthodontic correction may influence positive changes (17). GR improvement in the present study was also associated with the treatment of increased overjet (≥4 mm). This was also found by Boke et al. (2014), where a decreased incisor proclination had a positive effect on gingival recessions (11). Later studies by Kamak et al. (2015) and Morris et al. (2017) did not find such an association (21, 15). Gingival biotype in the univariate analysis was associated with GR improvement; however, in the multivariate analysis, this factor was not significant. In the study by Boke et al. (2014), there was also no association between GR change and gingival biotype reported (11). GR improvement in teeth with the thin gingival biotype was rare in the present study. These findings support the suggestion that GR is less likely to be improved after OT in cases with thin biotype (22). Most of the previous studies show that the extent of GR may be increased when mandibular incisors are retroclined, especially in Class III cases (14). Sperry et al. (1977) observed that Class III patients with excessive dental compensations had more than three times as many teeth with labial GRs after OT in comparison to patients with Class I or Class II (23). The results of the present study support these findings. Patients who had a Class III canine relationship had 3.2-times less chance of GR improvement than those with Class I or II. This can be explained by the anatomically thin buccal cortical plate, and the presence of dehiscences and fenestrations in the mandibular incisor region found in all types of untreated sagittal malocclusions. Therefore, lingual movement of the crowns, in order to compensate Class III malocclusion, may push the incisor roots buccally thereby causing or worsening gingival recession (24). Maxillary anterior teeth usually undergo proclination due to dentoalveolar compensation in Class III patients, which has also been found to induce the occurrence or worsening of GR (22). Therefore, the net effect is that Class III patients have a risk of worsening of GR during orthodontic therapy.

The clinical relevance of the present study is that the tendency of gingival recessions to be improved was noted in deep bite cases, however more in maxillary teeth. Recessions in mandibular, especially anterior, teeth, if present prior OT, may need to be treated periodontally in order to prevent their worsening as their improvement during OT was not observed. Class III cases, especially in planned camouflage movements, might also need periodontal treatment before OT due to the risk of GR worsening.

Limitations

The present study was of retrospective design and the measurements were made on plaster models also the sample size is small. The need for prospective studies is warranted to confirm these results.

Conclusions

Based on the findings of the present retrospective study, it may be concluded that orthodontic treatment induces changes in gingival recessions. In more than half of the teeth, the improvement in gingival recession was observed. Deep bite was positively associated with GR healing; however, Class III malocclusion had a negative impact on GR improvement. No improvement in gingival recession was found on mandibular incisors.

List Of Abbreviations

GR - gingival recession

OT – orthodontic treatment

OB – overbite

OJ – overjet

Declarations

Ethics approval and consent to participate

Ethical approval for the study was received by Bioethics Center at Lithuanian University of Health Sciences (No. BEC-OF-67).

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no competing interests.

Funding

Not applicable.

Authors' contributions

Authors EZ and DS were treating patients. The presence of GR was identified on intraoral photographs by GA. Measurements made by two investigators (GA and EZ). All authors read and approved the final manuscript.

Acknowledgements

Authors acknowledge help and support of colleagues in private dental centres “Odontologijos praktikos centras”, “Lazerinės odontologijos centras” and “& SMILE” while collecting data for this sudy. Authors also acknowledge Irena Nedzelskiene for the help of statistical analysis.

References

1. Manson JD, Eley BM. Mucogingival problems and their treatment. In: Manson JD, Eley BM. Outline of Periodontics., Fourth edition, Wright, London, UK; 2000. p. 314-334.
2. Löe H, Ånerud Å, Boysen H. The natural history of periodontal disease in man: prevalence, severity, and extent of gingival recession. J Periodontol 1992;63:489–95.
3. Marini MG, Greghi SL, Passanezi E, Sant'ana AC. Gingival recession: prevalence, extension and severity in adults. J. Appl. Oral Sci. 2004;12(3):250-5.
4. Sarfati A, Bourgeois D, Katsahian S, Mora F, Bouchard P. Risk assessment for buccal gingival recession defects in an adult population. J Periodontol. 2010;81(10):1419-25.
5. Mythri S, Arunkumar SM, Hegde S, Rajesh SK, Munaz M, Ashwin D. Etiology and occurrence of gingival recession - An epidemiological study. J Indian Soc Periodontol. 2015;19(6):671-5.
6. Jati AS, Furquim LZ, Consolaro A. Gingival recession: its causes and types, and the importance of orthodontic treatment. Dental Press J Orthod. 2016;21(3): 18–29.
7. Kassab MM, Cohen RE. The etiology and prevalence of gingival recession. J Am Dent Assoc. 2003;134(2):220-5.
8. Renkema AM, Fudalej PS, Renkema A, Kiekens R, Katsaros C. Development of labial gingival recessions in orthodontically treated patients. Am J Orthod Dentofacial Orthop. 2013;143(2):206-12.
9. Tugnait A, Clerehugh V. Gingival recession-its significance and management. J Dent. 2001;29(6):381-94.
10. Renkema AM, Fudalej PS, Renkema AA, Abbas F, Bronkhorst E, Katsaros C. Gingival labial recessions in orthodontically treated and untreated individuals: a case - control study. J Clin Periodontol. 2013;40(6):631-7.
11. Boke F, Gazioglu C, Akkaya S, Akkaya M. Relationship between orthodontic treatment and gingival health: A retrospective study. Eur J Dent. 2014;8(3):373-80.
12. Koletsi D, Pandis N, Polychronopoulou A, and Eliades T. Does published orthodontic research account for clustering effects during statistical data analysis? European Journal of Orthodontics. 2012;34:287-292.

13. Chrysanthakopoulos NA. Gingival recession: prevalence and risk indicators among young greek adults. J Clin Exp Dent. 2014;6(3):e243-9.
14. Vasconcelos G, Kjellsen K, Preus H, Vandevska-Radunovic V, Hansen BF. Prevalence and severity of vestibular recession in mandibular incisors after orthodontic treatment. Angle Orthod. 2012;82(1):42-7.
15. Morris JW, Campbell PM, Tadlock LP, Boley J, Buschang PH. Prevalence of gingival recession after orthodontic tooth movements. Am J Orthod Dentofacial Orthop. 2017;151(5):851-859.
16. Daley TD, Wysocki GP, Day C. Clinical and pharmacologic correlations in cyclosporine-induced gingival hyperplasia. Oral Surg Oral Med Oral Pathol. 1986;62(4):417-21.
17. Zimmer B, Seifi-Shirvandeh N. Changes in gingival recession related to orthodontic treatment of traumatic deep bites in adults. J Orofac Orthop. 2007;68(3):232-44.
18. Melsen B, Allais D. Factors of importance for the development of dehiscences during labial movement of mandibular incisors: A retrospective study of adult orthodontic patients. Am J Orthod Dentofacial Orthop. 2005;127(5):552-61.
19. Slutzkey S, Levin L. Gingival recession in young adults: occurrence, severity, and relationship to past orthodontic treatment and oral piercing. Am J Orthod Dentofacial Orthop. 2008;134(5):652-6.
20. Enhos S, Uysal T, Yagci A, Veli I, Ucar FI, Ozer T. Dehiscence and fenestration in patients with different vertical growth patterns assessed with cone-beam computed tomography. Angle Orthod. 82(5):868-74.
21. Kamak G, Kamak H, Keklik H, Gurel HG. The Effect of Changes in Lower Incisor Inclination on Gingival Recession. Scientific World Journal. 2015;2015: 193206.
22. Joss-Vassalli I, Grebenstein C, Topouzelis N, Sculean A, Katsaros C. Orthodontic therapy and gingival recession: a systematic review. Orthod Craniofac Res. 2010;13:127–141.
23. Sperry TP, Speidel TM, Isaacson RJ, Worms FW. The role of dental compensations in the orthodontic treatment of mandibular prognathism. Angle Orthod. 1977;47:293–299.
24. Yagci A, Veli I, Tancan U, Ucar FI, Ozer T, Enhos S. Dehiscence and fenestration in skeletal Class I, II and III malloclusions assessed with cone-beam computed tomography. Angle Orthod. 2012;82:67-74.

Tables

Table 1. Selection criteria.

Inclusion criteria	Exclusion criteria
1. ≥1 GR before OT on labial surfaces of maxillary/mandibular teeth mesial to first molars; 2. Dual arch OT with fixed orthodontic appliances; 3. High quality plaster models available before and after OT.	1. Periodontal disease; 2. OT without fixed orthodontic appliances; 3. Systemic disease or medication that could influence treatment outcome; 4. Combined orthodontic-orthognathic treatment; 5. Surgical treatment of GR during OT.

OT – orthodontic treatment; GR – gingival recession.

Table 2. Characteristics of included patients at baseline.

Variable	
Age at T0 (years),	
Mean (SD):	28.7 (8.1)
Gender, n (%)	
male	8 (21.6)
female	29 (78.4)
Duration of orthodontic treatment, (months)	
Mean (SD)	21.41 (7.23)
Gingival biotype, n (%)	
normal/thick	22 (59.5)
thin	15 (40.5)
Overjet, n (%)	
<4 mm	30 (81.1)
≥4 mm	7 (18.9)
Overbite, n (%)	
<1 mm	6 (16.2)
1-3 mm	15 (40.5)
>3 mm	16 (43.3)
Angle class of canines at T0, n (%)	
I	14 (37.8)
II	14 (37.8)
III	9 (24.4)
Extraction treatment, n (%)	
Maxillary dental arch	2 (5.4)
Mandibular dental arch	2 (5.4)
Both arches	15 (40.5)
Non-extraction	18 (48.7)

Table 3. Change of gingival recession in different groups of teeth.

Tooth group	Change of gingival recession			
	Improved n (%)	No change n (%)	Became worse n (%)	Total n (100%)
Maxillary incisors	12 (75.1)	3 (18.8)	1 (6.3)	16
Maxillary canines	11 (84.6)	2 (15.4)	0 (0.0)	13
Maxillary premolars	17 (60.7)	10 (35.7)	1 (3.6)	28
Mandibular incisors	7 (58.3)	5 (41.7)	0 (0.0)	12
Mandibular canines	11 (57.9)	7 (36.8)	1 (5.3)	19
Mandibular premolars	13 (50.0)	10 (38.5)	3 (11.5)	26
Total	71 (62.3)	37 (32.4)	6 (5.3)	114

p=0.01.

Figures

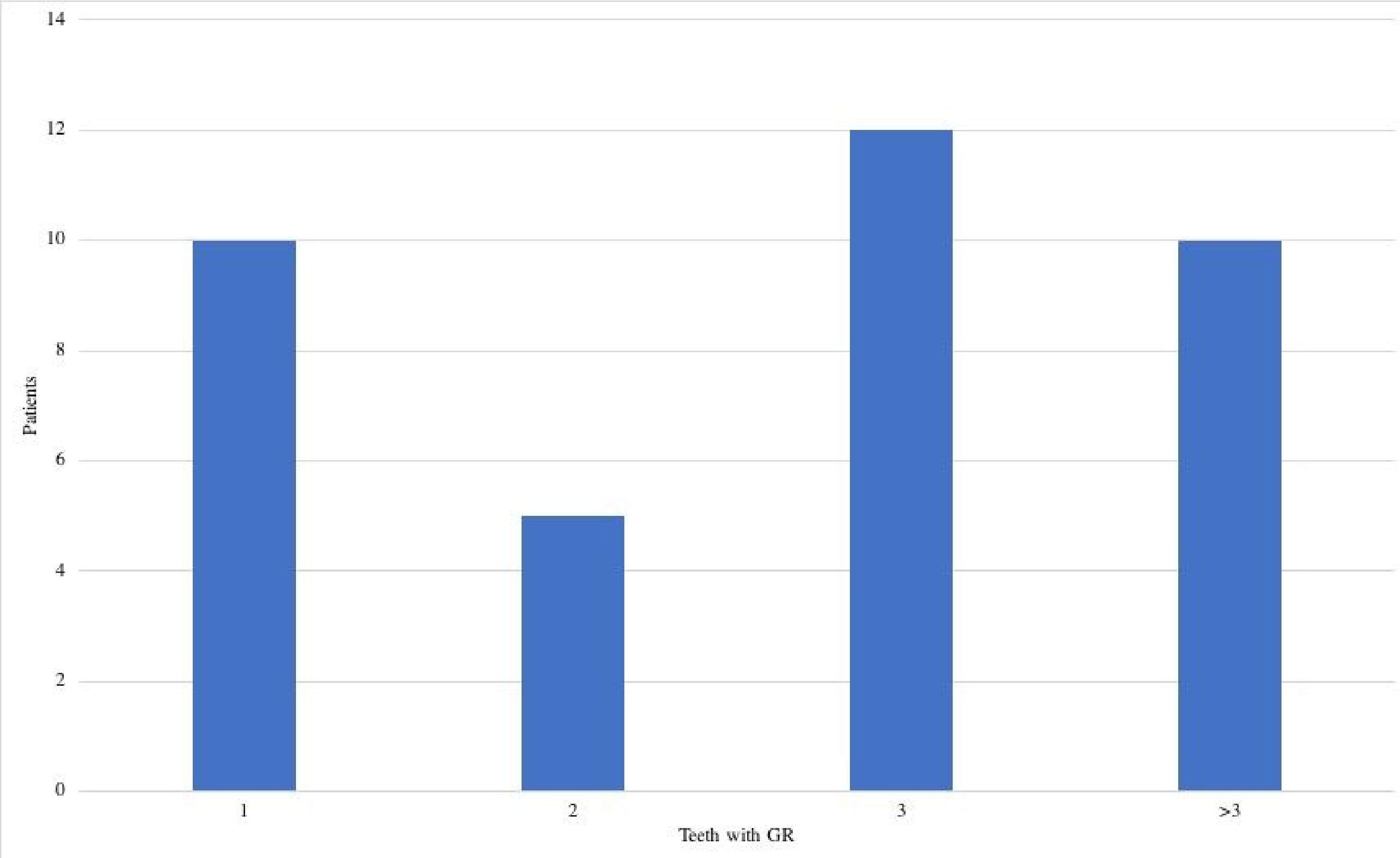

Figure 1

Number of teeth with gingival recessions in 37 patients before orthodontic treatment.

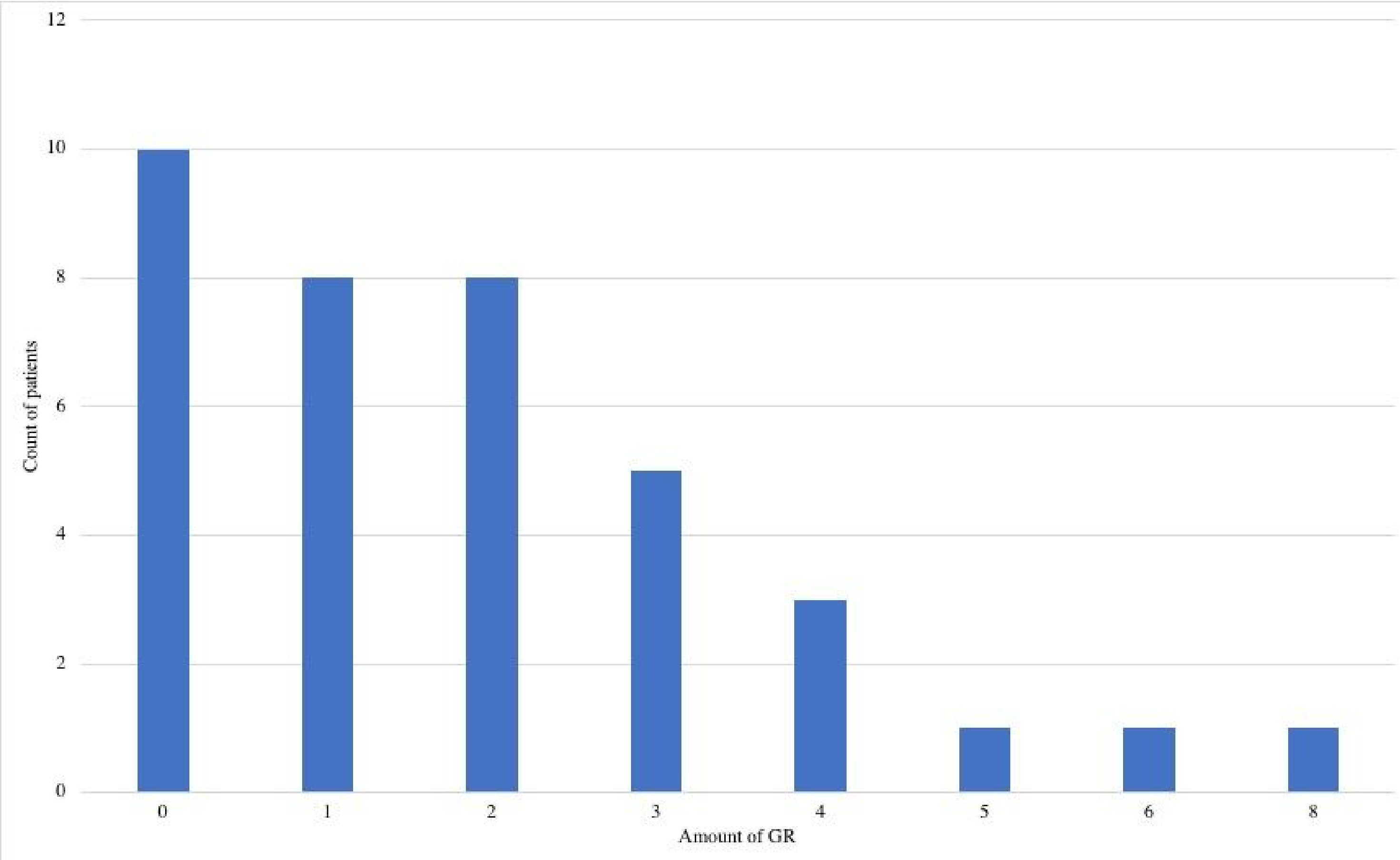

Figure 2

Number of improved gingival recessions in 37 patients.

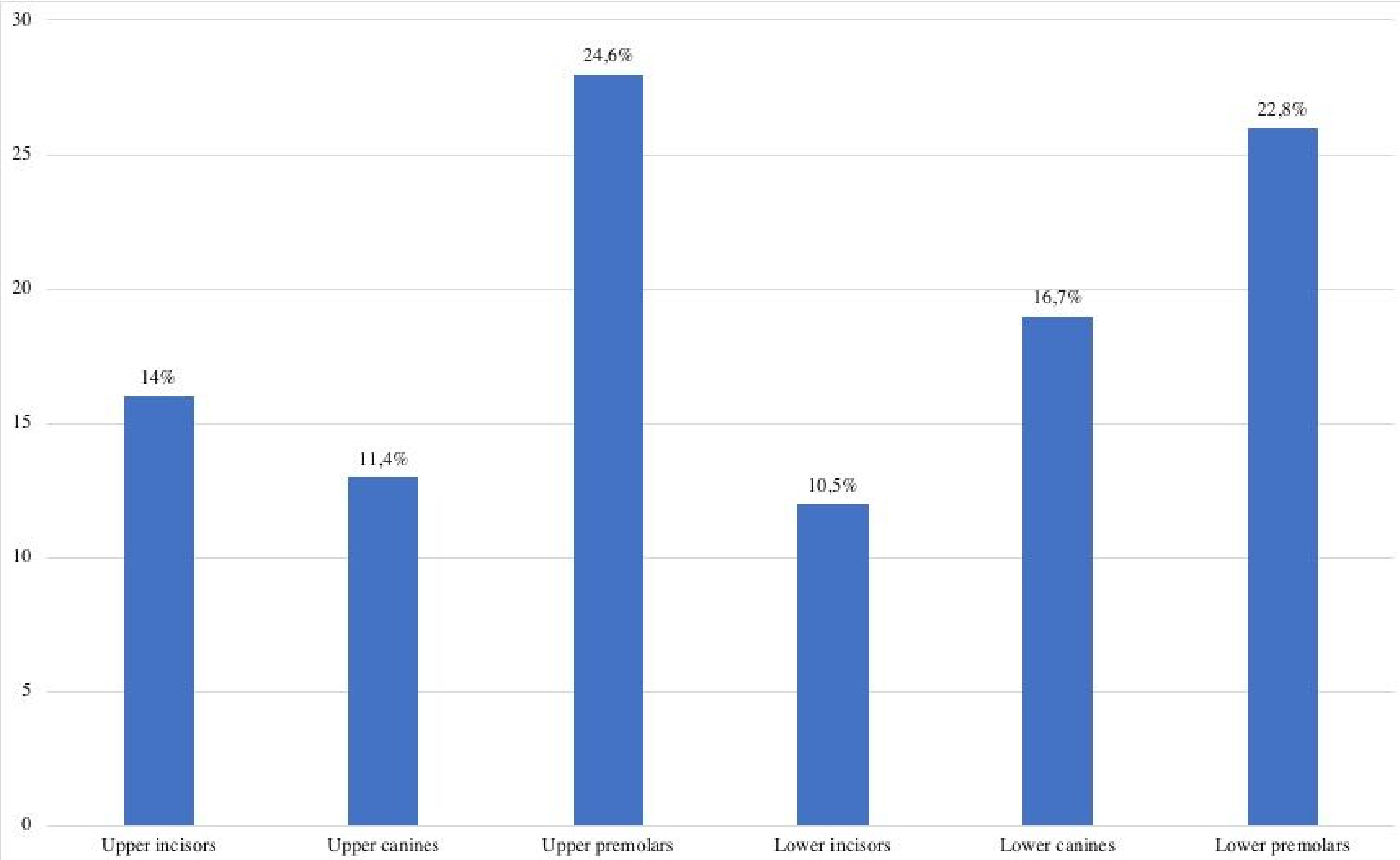

Figure 3

The prevalence of gingival recessions before orthodontic treatment in different groups of teeth.

Figure 4

a-c: change of gingival recession when deep overbite of tooth 23 is corrected; d-f: change of gingival recession of tooth 23 before, during and after orthodontic treatment; g-j: change of gingival recessions before and after orthodontic treatment of teeth 13, 31, 33 and 43.

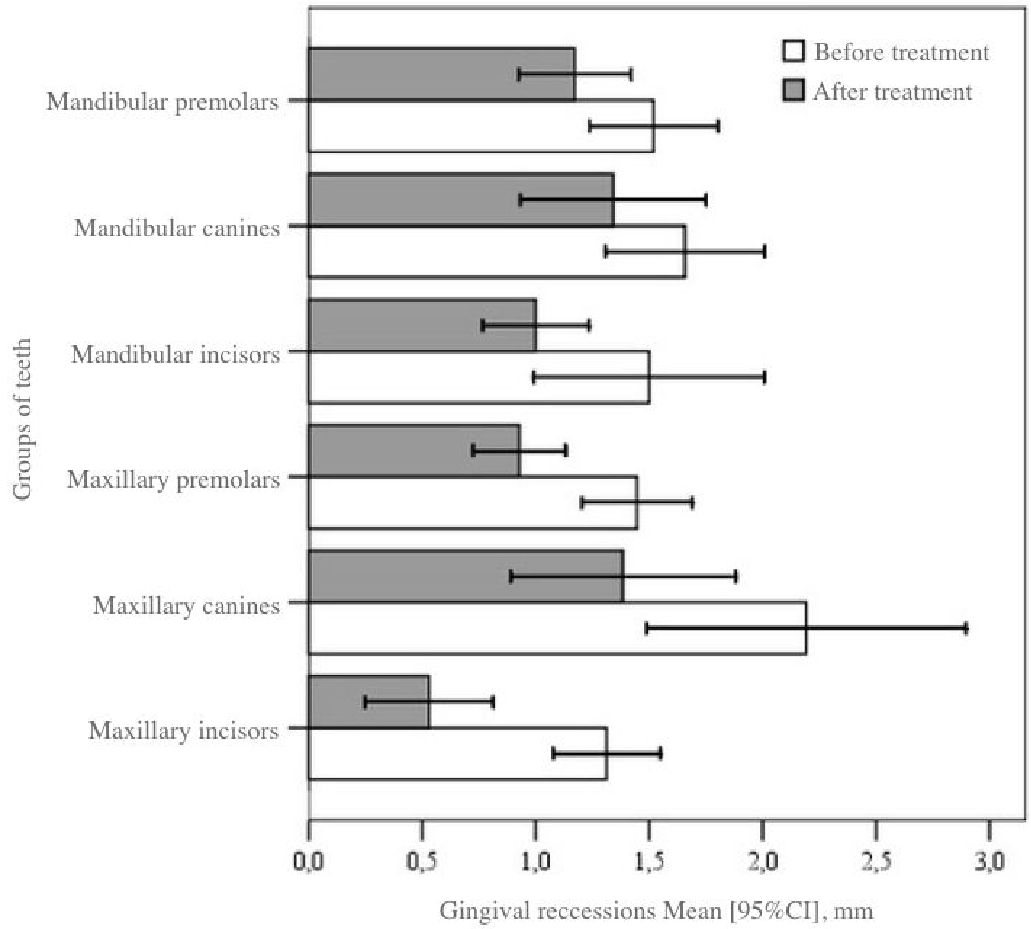

Figure 5

Mean gingival recession change in the different groups of teeth.