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ORIGINAL RESEARCH ARTICLE

Determination of gingival phenotype and gingival recession type in patients postorthodontic treatment

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Abstract

Purpose: Gingival recession is a commonly reported symptom following orthodontic treatment, for which identification is crucial to therapeutic management. This study aimed to determine the frequency of recession occurring after orthodontic treatment, assess the gingival phenotype in patients with recession, and investigate the various types of recession.
Materials and Methods: This study involved 80 patients aged 18-65 years who had completed fixed orthodontic treatment, and they were categorized into two groups based on the presence of gingival recession. Periodontal indices were obtained for all patients. Patients with gingival recession had assessments taken for gingival recession depth, gingival recession width, gingival tissue thickness, and keratinized gingival width. Statistical analyses were performed with a significance level of $p<0.05$ to compare participants with and without gingival recession.
Results: Patients with gingival recession exhibited significantly lower rates of gingivitis than those without gingival recession. Tooth number 31 exhibited the highest incidence of gingival recession, at 31.2%. Gingival recession was observed in 93.5% of Cairo Class 1 patients. Among the participants, 51.9% had a thin gingival phenotype, while 48.1% had a thick phenotype.
Conclusions: To minimize the risk of gingival recession and maintain periodontal health, the study highlights the need for careful evaluation and preventive actions throughout and following orthodontic treatment.

Key words: Gingival recession; gingivitis; orthodontics

Introduction

The apical displacement of the gingival margin concerning the cementoenamel junction is known as gingival recession.[1] Gingival recession during orthodontic tipping and translational motions might result from a narrowed mandibular symphysis, a narrower free gingival margin, inadequate plaque control, and aggressive tooth brushing.[2] The gingival phenotype, which includes the gingiva's thickness and the keratinized tissue's width, determines the periodontal phenotype. Gingival thickness can be assessed and classified as either thick or thin, based on direct measurements following the criteria established by Seibert and Lindhe.[3] Furthermore, maintaining at least 2 mm of keratinized gingiva and 1 mm of attached gingiva is essential for preserving periodontal health and stability.[4]

In order to arrange orthodontic therapy for any malocclusion, it is necessary to ascertain the kind and order of tooth movements. This can include comprehensive orthodontic treatment, which focuses on correcting the malocclusion completely, or adjunctive orthodontic treatment, which moves teeth to improve a particular aspect of the occlusion to support other dental procedures meant to control disease and restore function.[5] Orthodontic therapy can correct tooth misalignment resulting from periodontitis, but it may also have adverse consequences on periodontal soft tissues, including gingivitis, gingival enlargement, and gingival recession.[6] Applying too much pressure on the periodontal ligament might result in crushing, restricted blood flow, deterioration, and delayed movement of the tooth. Applying a moderate amount of force slows down the process of bone resorption caused by ligament strangling. On the other hand, applying a modest amount of force leads to reduced blood supply but still allows for both bone resorption and tooth movement to occur simultaneously.[5] During orthodontic therapy, gingival recession can be significantly influenced by the direction of tooth movement and the thickness of the gingiva.[7] The prevalence of gingival recession during orthodontic treatment is significantly related to gingival tissue biotype, the depth of attached tissue, pro-inclination, considerable maxillary expansion, and vestibular inclination tooth movement.[8] Dorfman et al. (1978) indicated that gingival recession is mostly noticed in teeth with a greater degree of inclination compared to teeth with a lesser degree of inclination.[9] Alterations in the position of the lower incisors, particularly an extreme forward inclination, following orthodontic treatment, might potentially contribute to the occurrence of

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gingival recession.[10] More severe gingival recession is more likely when there is incisor retroclination with mesial basal connections and a decrease in the sagittal intermaxillary angle.[11] Contrary to non-proclined teeth, mandibular incisors that are proclined did not exhibit a higher likelihood of gingival recession throughout a five-year period of observation.[12] Similarly, in another study, the change in lower incisor inclination during treatment did not affect the development of labial gingival recessions in a patient; similarly.[13] Irrespective of the orthodontic treatment approach, having more keratinized gingival height, a wider mandibular symphysis, and a larger intercanine width after treatment are linked to a lower likelihood of developing gingival recession. On the other hand, a greater arch depth is associated with a higher risk of gingival recession. Moreover, opting for nonextraction therapy is linked to a higher probability of experiencing gingival recession.[14] There was no association between gingival recession and pretreatment angle classification, ANB angle, overjet, overbite, arch width, or mandibular divergence.[15]

Orthodontic treatment has many consequences. The study's null hypothesis is that there is no relationship between posttreatment gingival phenotype and gingival recession and no differences among different types of gingival recession in patients who underwent orthodontic treatment. This study aimed to determine the posttreatment gingival recession status, gingival phenotype (if gingival recession was present), and type of recession in patients who underwent orthodontic treatment.

Material and Methods

Study settings

The Bolu Abant Izzet Baysal University Clinical Research Ethics Committee authorized the protocol (2022/167), and the study was carried out in compliance with the Declaration of Helsinki. Each participant was thoroughly informed about the study's aims, the questionnaire, and the principles of the Helsinki Declaration[16], and subsequently provided written informed consent. Information regarding compliance with the STROBE guidelines for cross-sectional studies is provided. The research focused on individuals with gingival recession and was conducted at the Periodontology Department of the Faculty of Dentistry from July 2022 to January 2024.

Study population calculations

The power analysis conducted using the G Power program (G * Power 3.1 software, Heinrich Heine University, Germany) for the t-test determined that a minimum of 80 participants in total, with 40 participants in each subgroup, were required to achieve a power level of 0.85 ($1-\beta$), an effect size of 0.60 (d), and a margin of error (α) of 0.05.

Eligibility criteria

Inclusion criteria

Patients aged 18-65 years who had completed fixed orthodontic treatment were included in the study.

Exclusion criteria

Exclusion criteria included uncontrolled diabetes, use of radiotherapy, chemotherapy, or immunosuppressants, tobacco use, pregnancy and lactation, and any etiology of gingival recession other than orthodontic treatment. The study did not include patients involved in Invisalign (Align Technology, Arizona, USA) functional or lingual fixed orthodontics.

Study design

The study comprised a cohort of eighty patients aged eighteen to sixty-five who had just completed treatment at the Orthodontic Clinic. The patients were categorized into two groups based on the presence of gingival recession: a group with gingival recession (n = 40) and a group without gingival recession (n = 40). Information about demographic characteristics (age, sex), anthropometric measurements (height and weight), and health status (systemic status and medication use) was obtained from the patients.

Measurement of periodontal status and gingival recession

A single calibrated examiner (T.S.) conducted the clinical oral examination, including teeth evaluation. The evaluation performed on all subjects included the following measurements: plaque index[17], gingival index[18], bleeding on probing[19], clinical attachment level, and probing pocket depth. The probing measurements were done using a manual UNC-15 periodontal probe (PCP15; Hu-Friedy, Chicago, IL, USA) at each tooth. The gingival and plaque indices were assessed using a scale ranging from zero to three. The occurrence or non-occurrence of bleeding was assessed for each tooth following probing. The probing depth, assessed at six locations in each tooth, is defined as the distance from the bottom of the gingival sulcus to the edge of the gingival margin. In the group with gingival recession, the Cairo classification[20], gingival thickness (mm), keratinized gingival width (mm), gingival recession depth (mm), gingival recession width (mm), presence/absence of enamel-cementum junction (+/-), and presence/absence of cervical step (+/-) were determined.

The gingiva was anesthetized using a topical anesthetic. An endodontic file size 06 with a rubber stop/caliper was inserted perpendicularly at a point centered between the gingival margin and the mucogingival junction. This measurement was taken with a periodontal probe. The width of the keratinized gingiva was determined by measuring the distance from the mucogingival junction to the free gingival margin, extending from the most apical point of the margin to the mucogingival edge.

Statistical method

The statistical analyses were conducted using IBM SPSS Statistics (Version 26.0, Armonk, NY: IBM Corp.). Categorical data were presented as numbers and percentages. Independent sample t-tests were used to compare measurement data, as well as age, height, and weight, between the two groups. Statistical significance was set at $p<0.05$.

Results

Demographic characteristics

The age, sex, height, and weight distribution were similar between the groups with and without gingival recession. A total of 27.5% of the patients were male, and 72.5% were female (Table 1).

Periodontal indices and condition

Patients with gingival recession had a significant difference in periodontal health and gingivitis compared to those without this condition ($p<0.05$). Patients without gingival recession had a higher rate of gingivitis compared to those with gingival recession.

A statistically significant difference was observed between the groups concerning the gingival index, bleeding on probing, gingival recession, and attachment loss ($p<0.05$). There was no statistically

Table 1. Demographic characteristics of patients

		f	%
Gender	**Male**	22	27.5
	Female	58	72.5
	N	**Median (Min./Max.)**	**Mean±S.d.**
Age	80	20(18/58)	21.28±6.35
Height	80	168(153/187)	167.83±8.44
Weight	80	58.5(42/100)	60.76±11.83

f: frequency, Frequency and descriptive analysis used for demographic characteristics of patients.

significant difference between the groups regarding the plaque index or probing depth (p>0.05) (Table 2).

Gingival recession status

In the gingival recession group, 77 teeth from 40 patients were examined. The results indicated that the highest number of teeth with recession were tooth 31 (31.2%), tooth 41 (20.8%), and tooth 42 (13%). When the seventy-seven teeth were evaluated using the Cairo Classification, 93.5% were in Cairo Class 1, 5.2% were in Cairo Class 2, and 1.3% were in Cairo Class 3. Assessment of gingival thickness showed that 51.9% of patients had a thickness of 1mm, 41.6% had a thickness of 2mm, 5.2% had a thickness of 3mm, and 1.3% had a thickness of 4mm. Upon evaluating the gingival biotype classification, 51.9% of the patients were categorized as having a thin biotype, while 48.1% had a thick biotype. Regarding the identifiable cemento-enamel junction classification, 84.4% of the patients fell into Category A, and 15.6% into Category B. When the root surface step was evaluated, 45.5% of the patients were in the plus category, and 54.5% were in the minus category (Table 3).

The mean gingival recession depth of the 77 teeth examined in patients with gingival recession was 1.55±1.10 mm. The mean gingival recession width was 2.79±0.86 mm. The mean width of the keratinized gingiva was 3.53±1.96 mm (Table 4).

Discussion

The objectives of this research were to determine the incidence of gingival recession following orthodontic treatment, evaluate the gingival phenotype in patients experiencing recession, and examine the different types of recession. The study's null hypothesis posits no association between post-treatment gingival phenotype and gingival recession, nor are there any differences among various types of gingival recession in patients who have undergone orthodontic treatment. In this study, gingival recession after orthodontics was mostly seen in teeth 31, 41, and 42, Cairo 1 classification, and a thin gingival phenotype.

Orthodontic treatment can adversely affect mucogingival conditions. Patients with a thin gingival phenotype may experience recession problems as a result of labial tooth movement, namely the forward positioning of mandibular incisors. Postorthodontic tooth position changes can arise from non-passive retention devices, leading to increased recession defects and root exposure.[21] A comprehensive analysis of seven trials revealed no association between the movement of the mandibular incisor teeth produced by dental appliances and the occurrence of gingival recession. Contributing factors to gingival recession following orthodontic tipping and translation movements include a thinner free gingival margin, a narrow mandibular symphysis, poor plaque control, and vigorous tooth brushing.[2] In their study, Rankeme et al. (2013) documented a rise in the occurrence of gingival recession on both the labial/buccal and lingual/palatinal of the teeth following orthodontic therapy.[22] Gebistorf et al. (2018) found that there was a rise in the occurrence of labial/buccal gingival recession after orthodontic treatment. Specifically, 54.5% of the participants reported at least one site of recession, while 10.2% had multiple recession sites following the treatment.[23] After undergoing treatment with fixed orthodontic appliances, two hundred fifty-one individuals had a significant increase in gingival recession in another study.[24] Sandhu et al. (2018) observed a notable rise in gingival recession among thirty-eight patients who underwent fixed orthodontic treatment.[25] In another study, the average gingival recession scores were 0.19 before and 0.383 after treatment.[26] After completing the therapy, adults saw a significant increase in the average levels of visible gingival inflammation and recession. On the other hand, teenagers exhibited similar increases in visible plaque and inflammation.[27] In addition, another study discovered that the occurrence of gingival recession after orthodontic treatment was 10.3%.[11] An analysis of sixteen research found that 10 of them documented a significant occurrence of gingival recession after orthodontic treatment.[15] However, there is insufficient evidence to suggest that fixed orthodontic treatment might cause or elevate the likelihood of gingival recession in another research investigation.[28] There was no noticeable rise in the average number of teeth experiencing gingival recession over the duration of therapy. Nevertheless, the frequency of gingival recession with a depth above 0.1 mm increased from 21% prior to treatment to 35% following the therapy. Only 2.8% of the participants had a gingival recession depth that was above 2 mm, while 5% of patients with previous gingival recession showed improvement.[29] In this study, gingival recession was observed in 77 teeth of the 80 patients.

Orthodontic therapy and the subsequent retention period provide a potential risk of developing labial gingival recession, with mandibular incisors being particularly vulnerable in individuals undergoing orthodontic treatment.[12] Gingival recession is most prevalent in the upper and lower teeth due to the majority of orthodontic tooth movements occurring in these regions.[30] Sawan et al. (2017) reported that 87% of patients exhibited gingival recession in at least one upper or lower anterior tooth following orthodontic expansion or extraction.[14] In a different study, maxillary and mandible canine teeth were observed to have the highest percentage of occurrence of gingival recession after orthodontic treatment.[24] This study showed that teeth numbers 31, 41, and 42 had the highest levels of gingival recession.

The inclination of the lower incisors at the end of treatment did not affect the occurrence of labial gingival recession or any changes in the height of the clinical crown in patients.[31] Studies on animals often demonstrate that incisors that are displaced show more gingival recession than control teeth. Clinical studies indicate that teeth that are more proclined than less proclined, untreated teeth, and incisors that relocate out the osseous membrane of the alveolar process may be related to a higher risk of gingival recession.[32] Gingival recession and tooth inclination were significantly correlated; gingival recession increased by around 0.2 mm for every 1° increase in labial tooth inclination.[33] In contrast to patients with normal incisor inclination, those whose lower incisors proclined more than 95° after orthodontic therapy showed an apical migration of the gingival zenith.[10] The degree of extent of proclination of the mandibular central incisors during fixed appliance therapy did not show any correlation with the gingival recession in this study.[11,34]

According to Sandhu et al. (2018), following fixed orthodontic treatment, the gingival biotype was unchanged.[25] Böke et al. (2014) conducted a study involving 251 patients with fixed orthodontic appliances, showing that orthodontic treatment had no significant impact on gingival biotype values.[24] The change in the values of gingival biotypes before and after treatment does not show a meaningful difference in another study.[27] Conversely, Kumar et al. (2020) observed that the gingival biotype was present in both the maxillary and mandibular arches, noting an increase in the thick gingival biotype and a decrease in the thin maxillary biotype.[26] When examining the gingival biotype categorization of patients

Table 2. Comparison of indices of patients according to groups

		N	Median (Min/Max)	Mean±S.D.	p
Plaque Index	No gingival recession	40	0.20 (0.0 /2.00)	0.30±0.45	0.441
	Gingival recession	40	0.10 (0.0/2.05)	0.23±0.38	
Gingival Index	No gingival recession	40	0.02 (0.0/2.00)	0.22±0.48	0.011*
	Gingival recession	40	0.00 (0.00/0.20)	0.02±0.04	
Probing Depth	No gingival recession	40	2.03 (0.04/2.90)	1.99±0.54	0.896
	Gingival recession	40	2.01 (0.20/3.00)	2.01±0.52	
Bleeding on Probing	No gingival recession	40	9.0% (0.0%/80.0%)	15.59%±17.85%	0.025*
	Gingival recession	39	3.0% (0.0%/58.0%)	7.67%±12.36%	
Clinical Attachment level	No gingival recession	40	2.01(0.0/2.90)	1.91±0.65	0.028*
	Gingival recession	40	2.04 (1.43/3.20)	2.17±0.37	

Min: minimum, Max: maximum, S.D.: standard deviation *:p<0.05 İndependent sample t test used for comparing the effects of the gingival recession on indices

Table 3. Assessment of gingival recession

		f	%
Tooth number	13	1	1.3
	14	1	1.3
	23	2	2.6
	26	2	2.6
	31	24	31.2
	32	6	7.8
	33	4	5.2
	34	1	1.3
	41	16	20.8
	42	10	13.0
	43	6	7.8
	44	2	2.6
	45	1	1.3
	46	1	1.3
Cairo classification	1	72	93.5
	2	4	5.2
	3	1	1.3
Gingival thickness	1	40	51.9
	2	32	41.6
	3	4	5.2
	4	1	1.3
Gingival biotype	Thin	40	51.9
	Thick	37	48.1
Cemento-enamel junction (A/B)	A	65	84.4
	B	12	15.6
Root surface step (+/-)	Plus	35	45.5
	Minus	42	54.5

f: frequency, Frequency analysis used for showing assessment of gingival recession

Table 4. Evaluation of the etiology of recession in patients with gingival recession

	Median (Min/Max)	Mean±S.D.
Gingival Recession Depth	1(0.5/8.0)	1.55±1.10
Gingival Recession Width	3(1/5)	2.79±0.86
Keratinized Gingival Width	3(0/8)	3.53±1.96

Min: minimum, Max: maximum, s.d.: standard deviation Descriptive analysis was used to evaluate the etiology of gingival recession in patients with this condition.

with gingival recession in this study, it was found that 51.9% had the thin biotype, whereas 48.1% had the thick biotype.

It has been argued that a minimum band of keratinized tissue (2 mm) may be essential for preventing gingival recession development/progression.[4] Dorfman et al. (1978) stated that gingival recession is mostly noticed in teeth that are more inclined forward compared to teeth that are less inclined forward.[9] In another study, a significant increase in the height of the keratinized gingiva was observed after treatment.[14] Abdelhafez et al. (2021) reported a difference in the amount of keratinized gingiva in patients who underwent orthodontic treatment compared to those who did not.[35] Contrary to these findings, there was no difference in the initial amount of keratinized gingiva between teeth that developed gingival recession and those with unchanged gingival margin positions (3.00 ± 0.61 mm and 3.5 ± 0.86 mm, respectively).[36] In this study, the mean keratinized gingival width was 3.53±1.96 mm.

Böke et al. (2014) reported a significant post-treatment increase in visible plaque and inflammation among patients with fixed orthodontic appliances.[24] After undergoing treatment with fixed orthodontic equipment, a considerable rise in visible plaque, visible inflammation, and gingival recession is observed in the patient. Specifically, visible plaque rose from 2.95 mm to 5.94 mm, and visible inflammation from 2.86 mm to 10.52 mm.[25] Some studies revealed that the average visible plaque and inflammation significantly increased during orthodontic treatment.[26,27] Furthermore, persons who had previously had orthodontic treatment had a lower prevalence of periodontitis.[37] Although fixed orthodontic treatment increases visible plaque and inflammation, gingival recession appears to correlate with lower gingival index values and reduced bleeding, possibly indicating a protective factor against periodontitis.

This study's limitations include being done at a single institution and having a very small sample size of 80 patients, which may limit the findings' generalizability. The cross-sectional design limits the ability to establish causal relationships, necessitating cautious interpretation of the results. Future studies should be designed as multi-center trials with larger sample sizes to enhance the generalizability and robustness of the findings.

Conclusion

This study underscores the significant impact of orthodontic treatment on periodontal health, gingival recession, and gingival biotype. These findings emphasize the need for diligent monitoring and preventive strategies during and after orthodontic therapy to reduce the risk of gingival recession and support periodontal health.

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Author Contributions

Found study idea/hypothesis : T.S.
Study design : T.S.
Collected data : T.S.
Analysis and/or interpretation of results : T.S.
Wrote article : T.S.
Critical review. : T.S.

Conflict of Interest

The authors declare that there is no conflict of interest.

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