Original Article

Prevalence, magnitude, and incidence of labial gingival recession with Herbst-multibracket appliance treatment: *A retrospective cohort study*

Niko C. Bock^a; Julia Ruehl^b; Sabine Ruf^c

ABSTRACT

Objective: To assess the prevalence and magnitude of labial gingival recession (LGR) before and after as well as the incidence during Class II:1 Herbst-Multibracket appliance (Herbst-MBA) treatment (Tx) plus retention in a retrospective cohort study.

Materials and Methods: Records of Class II:1 patients who completed Herbst-MBA Tx (mean pre-Tx age 14.4 years) at Department of Orthodontics, University of Giessen, Giessen, Germany were analyzed. Tx consisted of a Herbst phase (mean 8.1 months) and a subsequent MBA phase (mean 16.1 months). Study casts from before and after Herbst-MBA Tx plus \geq 24 months of retention were evaluated.

Results: A total of 460 pre-Tx and 222 postretention study casts were available (total observation period: 59.2 ± 14.8 months). The overall prevalence for teeth with LGR ≥ 0.5 mm was 1.1% pre-Tx and 5.3% postretention. The highest prevalence of up to 5.3% (pre-Tx) and 16.4% (postretention) were seen for the lower incisors. Overall, the median magnitude of LGR was 0.0 mm pre-Tx/ postretention (mean: 0.05 mm/0.08 mm). Incidence values of 4.0% (all teeth) and 10.0% to 11.4% (lower central incisors) were calculated for LGR ≥ 0.5 mm.

Conclusions: The prevalence of LGR \geq 0.5 mm increased from, on average, 1.1% to 5.3% during \approx 6 years of Herbst-MBA Tx plus retention. The highest incidence was seen in lower incisors (10.0%–11.4%). However, because of the overall mean magnitude of 0.08 mm postretention, the clinical relevance can be considered as insignificant. (*Angle Orthod.* 2019;89:535–543.)

KEY WORDS: Herbst; Gingival recession

INTRODUCTION

The knowledge on whether and to what extent the development of labial gingival recession (LGR) can be attributed to orthodontic treatment (Tx) is controversial. Already in the 1970s it was discussed that the pronounced labial movement of teeth may predispose to the development of LGR as a result of orthodonti-

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cally induced bone dehiscences and periodontal attachment loss.^{1,2} Even today, no consensus can be found in literature.

There are controversial systematic reviews testifying both little to no clinically relevant effect³ and small detrimental effects⁴ of orthodontic therapy on periodontal health. However, other studies determined a higher prevalence for LGR in orthodontically treated patients when compared with untreated controls.^{5,6} Particularly the proclination of lower incisors has been described as a risk factor.⁷ This, however, was not confirmed in a recent trial in which patients were assessed 5 years after fixed appliance Tx and bonded retainer wear.⁸

A rather large amount of lower incisor proclination is known to occur during Class II correction using a Herbst appliance.^{9–11} Three-dimensional radiographic evaluations determined alveolar bone loss on the buccal surface of the lower incisors after Herbst Tx by \leq 0.2 mm.¹² This undesired side effect has been shown to be unpredictable on the individual level even when using additional skeletal anchorage.¹³ Neverthe-



Figure 1. Herbst appliance. Cast splints in both arches connected by telescoping mechanisms between upper six and lower four establishing an incisal edge-to-edge relationship. A lingual arch connects the lower lateral segments.

less, so far, no investigation has found a clinically significant negative short- or long-term effect of Herbst appliance Tx on periodontal health,^{9,14} nor could a direct relationship of the amount of proclination on the prevalence/incidence of LGR be established.¹¹ However, none of the previously mentioned studies assessed other teeth than the lower incisors. In addition, most studies used only selected patient





Figure 2. Measurement of the distance between the cementoenamel junction and the deepest point of the gingival margin using a manual caliper.

samples fulfilling specific, rather strict, inclusion criteria instead of an unselected sample.

Therefore, the aim of the present investigation was to assess a large, unselected (in terms of Tx outcome) sample of consecutive Class II:1 patients treated with a Herbst-multibracket appliance (MBA) for the prevalence, incidence, and magnitude of LGR on all permanent teeth.

MATERIALS AND METHODS

After obtaining ethical approval (no. 80/14), the records of all patients who had been treated with a Herbst-MBA since the introduction of this Tx approach in 1986 at the Department of Orthodontics, University of Giessen (Giessen, Germany) were assessed using the following inclusion criteria:

- · Class II:1
- Tx completed by January 1, 2015
- Study casts available from before Tx (T0) and/or \geq 24 months after Herbst-MBA Tx and retention (T1)

Tx had consisted of a Herbst phase (Figure 1, castsplint Herbst appliance, Dentaurum GmbH, Ispringen, Germany) and a subsequent MBA phase (different types of labial straight-wire MBAs) including Class II elastics.

The study casts from T0 and T1 were evaluated for LGR on all fully erupted teeth except the third molars. The distance between the cementoenamel junction and the deepest point of the gingival margin was assessed and, in case of a positive value, defined as LGR (Figure 2). Measurements were performed using a manual caliper (HSL247-52, Karl Hammacher GmbH, Solingen, Germany) and were rounded to the nearest 0.5 mm. Descriptive statistics were performed separately for each kind of tooth.



Figure 3. Patient flow chart. The numbers of Class II:1 patients who started/completed Herbst- multibracket appliance treatment and a retention period \geq 24 months are given as well as the numbers of included pre- and postretention study casts.

All measurements were performed by a single operator (J.R.). To assess observer reliability, all study casts of patients 1 to 20 were evaluated. The method error (Dahlberg formula) was calculated as 0.03 \pm 0.07, and Kendall's τ correlation coefficient amounted to 0.71, which corresponded to a high consistency.¹⁵

Although the prevalence (%) and magnitude (mm) were assessed for the entire study sample at T0 and T1, the incidence (%) for LGR during T0 to T1 was analyzed for patients with available study casts from both occasions (T0 and T1) only.

All statistical analyses were performed using SPSS Statistics Version 21 software (IBM Corporation, Armonk, N.Y.). Because of the explorative character of the study, only a post-hoc power calculation was performed. The data of patients with study casts available from both T0 and T1 were compared first in terms of LGR prevalence (McNemar test, power 0.7 \pm 0.30) and, second, in terms of LGR magnitude (Wilcoxon signed-rank test, power 0.6 \pm 0.29). The level of significance was set at *P* < .05.

RESULTS

Although a total of 526 patients (53% females, 47% males) with a pre-Tx age of 14.4 \pm 3.4 years (range 9.8–44.4) had received Herbst-MBA Tx between 1986 and 2015, Tx was completed in 508 patients (Figure 3). The mean active Tx duration was 24.2 \pm 7.8 months (range 8.5–54.7). From T0 to T1, the overjet changed from 7.0 \pm 2.3 to 2.7 \pm 0.9 mm and the molar relationship from 0.7 \pm 0.4 cusp widths (Class II) to 0.0 \pm 0.3 (Class I). For retention, upper and/or lower bonded canine-to-canine retainers, removable upper

and/or lower retention plates, or a combination of both were used and still worn at follow-up by the majority of patients. For 48 of the 508 patients, however, the pre-Tx study casts had to be excluded because of the gingival situation looking somewhat "altered" (showing marked swelling, air blows, or other artefacts) thus preventing reliable measurement. Therefore, respective study casts (T0) were available for 460 patients. A total of 240 patients fulfilled a retention period \geq 24 months (mean duration 32.6 \pm 15.9 months), respective study casts with an "unaltered" gingival situation were available for 222 of these 240 patients (mean total observation period 59.2 \pm 14.8 months). A set of both T0 and T1 study casts were available for 187 patients (mean total observation period 60.0 \pm 15.1 months).

Overall Prevalence and Magnitude of LGR (T0, n = 460; T1, n = 222)

Overall, at T0, the prevalence for LGR (magnitude \geq 0.5 mm) was 1.1% for all 12,573 teeth assessed (Figure 4) and revealed a median magnitude of 0.0 mm (mean, 0.05 mm; minimum, 0.0 mm; maximum, 2.5 mm; Table 1). The highest prevalence (5.1%–5.3%) was seen for the lower central incisors (Figure 4), of which 0.7% to 0.9% exhibited LGR with a magnitude \geq 2.0 mm.

After T1, 5.3% of all 6131 teeth assessed exhibited LGR (magnitude \geq 0.5 mm). The median magnitude was 0.0 mm (mean, 0.08 mm; minimum, 0.0 mm; maximum, 4.0 mm; Table 1). The lower central and lateral incisors were most frequently affected (LGR prevalence, 12.5%–16.4%; Figure 4). However, only 1.4% to 3.7% of the incisors exhibited LGR \geq 2.0 mm.



Figure 4. Prevalence (%) of labial gingival recession for teeth 17 to 47 before treatment (T0) and after Herbst-multibracket appliance treatment and a retention period \geq 24 months (T1) for magnitude \geq 0.5 mm (a), \geq 1.0 mm (b), \geq 2.0 mm (c) in all included study casts (T0, *n* = 460; T1, *n* = 222).

In addition, LGR values of \geq 2.0 mm were relatively more frequent (prevalence >1.0%) in the upper right lateral/left central incisors (1.4%; maximum, 2.0/2.5 mm), upper left canines/first premolars (2.3/2.4%; maximum, 3.0 mm), and lower right/left canines (2.3/ 2.7%; maximum, 2.0/3.0 mm).

Incidence of LGR (T0 and T1, n = 187)

Examining the patients with available study casts from both occasions (T0 and T1), an overall LGR incidence (magnitude \geq 0.5 mm) of 4.0% was seen for all teeth during the average observation period of approximately 5.5 years (T0–T1). For LGR \geq 2.0 mm, a respective value of 0.7% was determined.

The highest incidence was seen for lower central incisors, which presented an incidence rate of 10.4% to 11.4% for LGR (magnitude \geq 0.5 mm), whereas LGR \geq 2.0 mm developed in only 0.5% to 1.7% (Table 2).

Even if the mean increase (T0–T1) was \leq 0.1 mm for each separate type of tooth, *P* values \leq .05 were seen for the majority of teeth when comparing the pre- and post-Tx data for both LGR prevalence (Table 2) and magnitude (Table 3).

DISCUSSION

The present investigation was the first to evaluate the prevalence and magnitude of LGR in all teeth (17– 47) before and after as well as the incidence during Class II:1 Herbst-MBA Tx and retention.

Patients

The investigation was based on the assessment of study casts of all Class II:1 patients who were treated with a Herbst-MBA at one single study center during a period of 28 years. As a result of the retrospective study design, it was not possible to control all variables that might have contributed to the multifactorial incident LGR development (ie, amount of mandibular advancement, crowding, patient compliance, and periodontal morphology/susceptibility to gingival recession). However, the patient sample was homogenous regarding the underlying malocclusion and the general Tx approach, which was nonextraction in all but a few individual cases. Although the fact that Tx had been performed by several practitioners using different types of straight-wire MBAs might have had an impact on torque, it should not interfere with the investigation's objective to assess the effect of Herbst-MBA Tx on the prevalence and magnitude of LGR. As severe gingival swelling/hyperplasia is often present upon debonding, it was decided not to assess the study casts from immediately after debonding but those from the subsequent occasion (after retention) where marked

Max		0.0	-1.0	-2.0	-2.0	-1.0	-1.0	-1.0	-2.0	-1.0	-2.0	-2.0	-2.5	-2.0	-2.0	-2.0	-2.0	-1.5	-2.0	-0.5	-3.0	-2.0	-3.0	-1.0	-2.0	-2.0	-2.0	0.0	-1.0
Min		0.0																010											
Median	m mm 0.0																												
SD		0.00	0.07	0.11	0.15	0.10	0.17	0.11	0.30	0.06	0.24	0.13	0.35	0.11	0.24	0.14	0.30	0.11	0.31	0.02	0.42	0.13	0.39	0.10	0.24	0.11	0.18	0.00	0.07
Mean		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
Occasi	on	Т0	T1	Т0	T1	Т0	T1	Т0	T1	Т0	T1	Т0	T1	Т0	T1	Т0	T1												
		1	7	1	6	1	5	1	4	1	3	1	2	1	1	2	1	2	2	2	3	2	4	2	5	2	6	2	27
										Tooth																			
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		4	7	4	6	4	5	4	4	4	3	4	2	4	10	3	1	3	2	3	3	3	4	3	5	3	6	3	57
Occasi	on	4 T0	7 T1	4 T0	6 T1	4 T0	5 T1	4 T0	4 T1	4 T0	3 T1	4 T0	2 T1	4 T0	10 1 T1	отп 3 Т0	1 T1	3 T0	2 T1	3 T0	3 T1	3 T0	4 T1	3 T0	5 T1	3 T0	6 T1	3 T0	7 T1
Occasi Mean	on	4 T0 0.0	7 T1 0.0	4 T0 0.0	6 T1 0.0	4 T0 0.0	5 T1 0.0	4 T0 0.0	4 T1 0.0	4 T0 0.0	3 T1 0.1	4 T0 0.0	2 T1 0.1	4 T0 0.1	10 1 1 0.2	3 T0 0.1	1 T1 0.2	3 T0 0.0	2 T1 0.2	3 T0 0.0	3 T1 0.1	3 T0 0.0	4 T1 0.0	3 T0 0.0	5 T1 0.0	3 T0 0.0	6 T1 0.0	3 T0 0.0	7 T1 0.0
Occasi Mean SD	on	4 T0 0.0 0.00	7 T1 0.0 0.00	4 T0 0.0 0.00	6 T1 0.0 0.03	4 T0 0.0 0.06	5 T1 0.0 0.27	4 T0 0.0 0.12	4 T1 0.0 0.14	4 T0 0.0 0.05	3 T1 0.1 0.34	4 T0 0.0 0.11	2 T1 0.1 0.39	4 T0 0.1 0.25	1 T1 0.2 0.51	3 T0 0.1 0.25	1 T1 0.2 0.47	3 T0 0.0 0.15	2 T1 0.2 0.46	3 T0 0.0 0.16	3 T1 0.1 0.41	3 T0 0.0 0.09	4 T1 0.0 0.13	3 T0 0.0 0.03	5 T1 0.0 0.08	3 T0 0.0 0.00	6 T1 0.0 0.00	3 T0 0.0 0.00	7 T1 0.0 0.00
Occasi Mean SD Median	on mm	4 T0 0.0 0.00	7 T1 0.0 0.00	4 T0 0.0 0.00	6 T1 0.0 0.03	4 T0 0.0 0.06	5 T1 0.0 0.27	4 T0 0.0 0.12	4 T1 0.0 0.14	4 T0 0.0 0.05	3 T1 0.1 0.34	4 T0 0.0 0.11	2 T1 0.1 0.39	4 T0 0.1 0.25	10 11 11 0.2 0.51	3 T0 0.1 0.25	1 T1 0.2 0.47	3 T0 0.0 0.15	T1 0.2 0.46	3 T0 0.0 0.16	3 T1 0.1 0.41	3 T0 0.0 0.09	4 T1 0.0 0.13	3 T0 0.0 0.03	5 T1 0.0 0.08	3 T0 0.0 0.00	6 T1 0.0 0.00	3 T0 0.0 0.00	7 T1 0.0 0.00
Occasi Mean SD Median Min	on mm	4 T0 0.0 0.00	7 T1 0.0 0.00	4 T0 0.0 0.00	6 T1 0.0 0.03	4 T0 0.0 0.06	5 T1 0.0 0.27	4 T0 0.0 0.12	4 T1 0.0 0.14	4 T0 0.0 0.05	3 T1 0.1 0.34	4 T0 0.0 0.11	2 T1 0.1 0.39	4 T0 0.1 0.25	10 11 11 0.2 0.51 0 0	3 T0 0.1 0.25 .0	1 T1 0.2 0.47	3 T0 0.0 0.15	2 T1 0.2 0.46	3 T0 0.0 0.16	3 T1 0.1 0.41	3 T0 0.0 0.09	4 T1 0.0 0.13	3 T0 0.0 0.03	5 T1 0.0 0.08	3 T0 0.0 0.00	6 T1 0.0 0.00	3 T0 0.0 0.00	7 T1 0.0 0.00

Table 1. Overall Magnitude (mm) of Labial Gingival Recession for Teeth 17 to 47 at T0 (Before Treatment) and T1 (After Herbst-Multibracket Appliance Treatment and a Retention Period of \geq 24 Months) in All Included Study Casts^a

^a The mean value and standard deviation as well as the median, minimum (Min), and maximum (Max) values are given. T0, *n* = 460; T1, *n* = 222.

swelling is less frequent. Nevertheless, the inclusion of patients was performed irrespective of Tx outcome.

Method

Linear measurements of the distance between the cemento-enamel junction and the deepest point of the gingival margin/recession were performed on all fully erupted teeth. All study casts were assessed by one single investigator showing a low method error (0.03 \pm 0.07) and high consistency (Kendall's $\tau=0.71$). Therefore, the generated data could be considered objective.

Although respective measurements performed on study casts were found to show a high correlation with those made clinically,¹⁶ factors such as gingival swelling and artefacts emerging during study cast preparation might have had an impact on the accuracy of the measurements. However, in a similar investigation (assessment of pre- and post-Tx study casts, partially by two observers) an intraobserver reliability of 0.80 to 1.00 and an interobserver agreement of 0.67 to 1.00 (study casts 2 years post-Tx) were determined and demonstrate the method to be reliable.¹⁷

Results: Prevalence

Few data on the prevalence of LGR in young adolescents are available in literature. However, the pre-Tx overall LGR prevalence of 1.1% in the present investigation for 12,573 teeth is consistent with the value of 1.7% determined pre-Tx (also by assessing study

casts) in a comparable sample of 210 similarly aged orthodontic patients¹⁷ and lower than the prevalence of 5.6% given for a nonorthodontic sample (n = 100) of 12-year-old Finns after clinical examination.¹⁸ Whether these differences were the result of the assessment method or a basic population difference is unknown.

Looking at the overall postretention prevalence, a total value of 5.3% was determined (n = 6131 teeth, LGR > 0.5 mm) in the present sample after approximately 5 years of Tx and retention. In the literature, a value of 20.2% was described for a sample of 210 patients also after 5 years of Tx and retention.¹⁷ However, the much higher LGR prevalence for lower incisors (12.5%–16.5%) in the present investigation cannot be confirmed by the literature (7.0%).¹⁷ A possible explanation for this difference might be the use of different Tx protocols/mechanics (Herbst-MBA vs MBA only) or a difference in the underlying malocclusions (Class II:1 vs a mix of 82% Class II, 17% Class I, 1% Class III), even if the proclination during Herbst-MBA has not been shown to be a longterm risk factor for LGR so far¹¹ as it is also true for proclination in general.^{8,19}

For mainly untreated samples of corresponding age, overall LGR prevalence values ranged between 1.6% and 13.8% in the literature (Table 4).^{6,18,20-24} In contrast to the present investigation, these articles showed lower LGR prevalence values for the lower incisors and did not identify them as the teeth with the highest prevalence values of the respective dentitions (Table 4).^{6,17,22,24}

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L	None		100.0	99.5	99.5	98.5	98.9	95.2	98.9	92.9	99.5	94.7	98.4	93.5	99.5	95.6	100.0	95.2	99.0	94.6	99.5	93.6	98.4	91.1	98.4	93.6	99.0	97.8	100.0	99.5
G R	(<0.5mm)		p=1	.000	p=0.	500	p=0.	016	p=0	.001	p=0	.008	p=0	.004	p=0	.016	p=0.	008	p=0	.008	p=0	.003	p=0	.000	p=0	0.012	p=0	.500	p=1	.000
	≥0.5 - <1.0]	0.0	0.0	0.0	0.5	0.0	1.6	0.0	1.6	0.0	0.5	0.0	0.0	0.0	2.2	0.0	1.6	0.5	0.6	0.5	0.0	1.1	20	0.5	2.1	0.0	0.0	0.0	0.0
p	mm		0.0	0.0	0.0	0.5	0.0	1.0	0.0	1.0	0.0	0.5	0.0	0.0	0.0	2.2	0.0	1.0	0.5	0.0	0.5	0.0	1.1	2.8	0.5	2.1	0.0	0.0	0.0	0.0
r e	≥1.0 - <2.0		0.0	0.5	0.0	0.5	1.1	2.2	1.1		0.5	4.2	1.6	5.4	0.5	2.2	0.0	2.1	0.5	2.7		4.2				2.0	0.5	17	0.0	0.5
v	mm	70	0.0	0.5	0.0	0.5	1.1	3.2	1.1	4.4	0.5	4.5	1.0	5.4	0.5	2.2	0.0	2.1	0.5	3.7	0.0	4.5	0.0	3.5	1.1	3.8	0.5	1.7	0.0	0.5
a 1	≥ 2.0		0.0	0.0	0.5	0.5	0.0	0.0	0.0	1.1	0.0	0.5	0.0	1.1	0.0	0.0	0.0	1.1	0.0	1.1	0.0	0.1	0.5	2.0	0.0	0.5	0.5	0.5	0.0	0.0
e	mm		0.0	0.0	0.5	0.5	0.0	0.0	0.0	1.1	0.0	0.5	0.0	1.1	0.0	0.0	0.0	1.1	0.0	1.1	0.0	2.1	0.5	2.8	0.0	0.5	0.5	0.5	0.0	0.0
n	T. (. 1		0.0	0.5	0.5	1.5	1.1	4.0	1.1	7.1	0.5	5.2	1.6	(5	0.5	4.4	0.0	10	1.0	5.4	0.5	6.4	1.6		1.6	()	1.0	2.2	0.0	0.5
e	Total		0.0	0.5	0.5	1.5	1.1	4.0	1.1	/.1	0.5	5.5	1.0	0.3	0.5	4.4	0.0	4.0	1.0	5.4	0.5	0.4	1.0	0.9	1.0	0.4	1.0	2.2	0.0	0.5
	Occasion		Т0	T1	Т0	T1	Т0	T1	T0	T1	T0	T1	T0	T1	Т0	T1	Т0	T1	Т0	T1	T0	T1	T0	T1	Т0	T1	Т0	T1	Т0	T1
			1	7	1	6	1:	5	1	4	1	.3	1	2	1	1	2	1	2	2	2	3	2	4	2	25	2	6	2	7
																Τc	oth													
			4	7	4	6	4:	5	4	4	4	13	4	2	4	Тс 1	oth 3	1	3	2	3	3	3	4	3	35	3	6	3	7
	Occasion		4 T0	7 T1	4 T0	6 T1	4: T0	5 T1	4 T0	4 T1	4 T0	3 T1	4 T0	2 T1	4 T0	Тс 1 Т1	oth 3 T0	1 T1	3 T0	2 T1	3 T0	3 T1	3 T0	4 T1	3 T0	35 T1	3 T0	6 T1	3 T0	7 T1
LG	Occasion Total		4 T0 0.0	7 T1 0.0	40 T0 0.0	6 T1 0.5	4: T0 0.0	5 T1 3.3	4 T0 1.1	4 T1 2.8	4 T0 1.0	3 T1 5.9	4 T0 2.2	2 T1 12.2	4 T0 4.4	To 1 11 14.8	3 T0 5.4	1 T1 16.8	3 T0 3.8	2 T1 14.1	3 T0 1.0	3 T1 4.9	3 T0 1.2	4 T1 3.4	3 T0 0.5	35 T1 1.6	3 T0 0.0	6 T1 0.0	3 T0 0.0	7 T1 0.0
L G R	Occasion Total ≥ 2.0		4 T0 0.0	7 T1 0.0	40 T0 0.0	6 T1 0.5	4: T0 0.0	5 T1 3.3	4 T0 1.1	4 T1 2.8	4 T0 1.0	3 T1 5.9	4 T0 2.2	2 T1 12.2	4 T0 4.4	To 11 14.8	3 T0 5.4	1 T1 16.8	3 T0 3.8	2 T1 14.1	3 T0 1.0	3 T1 4.9	3 T0 1.2	4 T1 3.4	3 T0 0.5	35 T1 1.6	3 T0 0.0	6 T1 0.0	3 T0 0.0	7 T1 0.0
L G R	Occasion Total ≥ 2.0 mm		4 T0 0.0	7 T1 0.0 0.0	4 T0 0.0 0.0	6 T1 0.5 0.0	49 T0 0.0 0.0	5 T1 3.3 1.1	4 T0 1.1 0.0	4 T1 2.8 0.0	4 T0 1.0 0.0	3 T1 5.9 2.1	4 T0 2.2 0.0	2 T1 12.2 2.2	4 T0 4.4 1.6	To 11 14.8 3.3	3 TO 5.4 1.1	1 T1 16.8 1.6	3 T0 3.8 0.0	2 T1 14.1 1.1	3 T0 1.0 0.5	3 T1 4.9	3 T0 1.2 0.0	4 T1 3.4 0.0	3 T0 0.5 0.0	5 T1 1.6 0.0	3 T0 0.0 0.0	6 T1 0.0 0.0	3 T0 0.0 0.0	7 T1 0.0 0.0
L G R P r e	Occasion Total ≥ 2.0 mm ≥1.0 - <2.0		4 T0 0.0 0.0	7 T1 0.0 0.0	40 T0 0.0 0.0	6 T1 0.5 0.0	4: T0 0.0 0.0	5 T1 3.3 1.1	4 T0 1.1 0.0	4 T1 2.8 0.0	4 T0 1.0 0.0	3 T1 5.9 2.1	4 T0 2.2 0.0	2 T1 12.2 2.2	4 T0 4.4 1.6	To 11 14.8 3.3	31 T0 5.4 1.1	1 T1 16.8 1.6	3 T0 3.8 0.0	2 T1 14.1 1.1	3 T0 1.0 0.5	3 T1 4.9	3 T0 1.2 0.0	4 T1 3.4 0.0	3 T0 0.5 0.0	35 T1 1.6 0.0	3 T0 0.0 0.0	6 T1 0.0 0.0	3 T0 0.0 0.0	7 T1 0.0 0.0
L G R P r e v	Occasion Total ≥ 2.0 mm ≥1.0 - <2.0 mm	%	4 T0 0.0 0.0	7 T1 0.0 0.0 0.0	40 T0 0.0 0.0	6 T1 0.5 0.0 0.0	43 T0 0.0 0.0 0.0	5 T1 3.3 1.1 1.7	4 T0 1.1 0.0	4 T1 2.8 0.0 1.7	4 T0 1.0 0.0 0.5	3 T1 5.9 2.1 2.2	4 T0 2.2 0.0	2 T1 12.2 2.2 6.6	4 T0 4.4 1.6 1.7	To 11 14.8 3.3 8.2	31 T0 5.4 1.1 2.7	1 T1 16.8 1.6 9.8	3 T0 3.8 0.0 2.2	2 T1 14.1 1.1 7.1	3 T0 1.0 0.5 0.5	3 T1 4.9 1.1 2.7	3 T0 1.2 0.0 0.6	4 T1 3.4 0.0	3 T0 0.5 0.0	 T1 1.6 0.0 0.5 	3 T0 0.0 0.0 0.0	6 T1 0.0 0.0 0.0	3 T0 0.0 0.0 0.0	7 T1 0.0 0.0 0.0
LGR preval	Occasion Total ≥ 2.0 mm ≥1.0 - <2.0 mm ≥0.5 - <1.0	%	4 T0 0.0 0.0	7 T1 0.0 0.0 0.0	40 T0 0.0 0.0 0.0	6 T1 0.5 0.0 0.0	4: T0 0.0 0.0 0.0	5 T1 3.3 1.1 1.7	4 T0 1.1 0.0	4 T1 2.8 0.0 1.7	4 T0 1.0 0.0 0.5	3 T1 5.9 2.1 2.2	4 T0 2.2 0.0 1.1	2 T1 12.2 2.2 6.6	4 T0 4.4 1.6 1.7	To 1 T1 14.8 3.3 8.2 2.2	3 T0 5.4 1.1 2.7	1 T1 16.8 1.6 9.8	3 T0 3.8 0.0 2.2	2 T1 14.1 1.1 7.1	3 T0 1.0 0.5 0.5	3 T1 4.9 1.1 2.7	3 T0 1.2 0.0 0.6	4 T1 3.4 0.0 1.7	3 T0 0.5 0.0 0.0	 T1 1.6 0.0 0.5 	3 T0 0.0 0.0 0.0	6 T1 0.0 0.0 0.0	3 T0 0.0 0.0 0.0	7 T1 0.0 0.0 0.0
L G R P r e v a l e	Occasion Total ≥ 2.0 mm ≥1.0 - <2.0 mm ≥0.5 - <1.0 mm	%	4 T0 0.0 0.0 0.0	T1 0.0 0.0 0.0 0.0	44 T0 0.0 0.0 0.0 0.0	6 T1 0.5 0.0 0.0 0.5	4: T0 0.0 0.0 0.0 0.0	5 T1 3.3 1.1 1.7 0.5	4 T0 1.1 0.0 1.1	4 T1 2.8 0.0 1.7 1.1	4 T0 1.0 0.0 0.5 0.5	3 T1 5.9 2.1 2.2 1.6	4 T0 2.2 0.0 1.1	2 T1 12.2 2.2 6.6 3.4	4 T0 4.4 1.6 1.7	To 1 T1 14.8 3.3 8.2 3.3	3 T0 5.4 1.1 2.7 1.6	1 T1 16.8 1.6 9.8 5.4	3.8 3.8 0.0 2.2 1.6	2 T1 14.1 1.1 7.1 5.9	3 T0 1.0 0.5 0.5 0.0	3 T1 4.9 1.1 2.7 1.1	3 T0 1.2 0.0 0.6	4 T1 3.4 0.0 1.7 1.7	3 T0 0.5 0.0 0.0	 T1 1.6 0.0 0.5 1.1 	3 TO 0.0 0.0 0.0 0.0 0.0	6 T1 0.0 0.0 0.0 0.0	3 TO 0.0 0.0 0.0 0.0 0.0	7 T1 0.0 0.0 0.0 0.0
LGR prevalenc	Occasion Total ≥ 2.0 mm ≥1.0 - <2.0 mm ≥0.5 - <1.0 mm None	%	4 T0 0.0 0.0 0.0 0.0 100.0	T1 0.0 0.0 0.0 0.0 100.0	40 TO 0.0 0.0 0.0 100.0	6 T1 0.5 0.0 0.0 0.5 99.5	4: TO 0.0 0.0 0.0 100.0	5 T1 3.3 1.1 1.7 0.5 96.7	4 T0 1.1 0.0 1.1 0.0 98.9	4 T1 2.8 0.0 1.7 1.1 97.2	4 T0 1.0 0.0 0.5 0.5 99.0	3 T1 5.9 2.1 2.2 1.6 94.1	4 T0 2.2 0.0 1.1 1.1 97.8	2 T1 12.2 2.2 6.6 3.4 87.8	4 T0 4.4 1.6 1.7 1.1 95.6	Tc 1 T1 14.8 3.3 8.2 3.3 85.2	3 TO 5.4 1.1 2.7 1.6 94.6	1 T1 16.8 1.6 9.8 5.4 83.2	3 T0 3.8 0.0 2.2 1.6 96.2	2 T1 14.1 1.1 5.9 85.9	3 T0 1.0 0.5 0.5 0.0 98.9	3 T1 4.9 1.1 2.7 1.1 95.1	3 T0 1.2 0.0 0.6 98.8	4 T1 3.4 0.0 1.7 1.7 96.6	3 T0 0.5 0.0 0.0 0.5 99.5	 35 T1 1.6 0.0 0.5 1.1 98.4 	3 T0 0.0 0.0 0.0 0.0 100.0	6 T1 0.0 0.0 0.0 0.0 100.0	3 T0 0.0 0.0 0.0 0.0 100.0	7 T1 0.0 0.0 0.0 0.0 100.0

Table 2. Prevalence (%) of Labial Gingival Recession (LGR) for Teeth 17 to 47 Before Treatment (T0) and After Herbst-Multibracket ApplianceTreatment and a Retention Period of \geq 24 Months (T1) in 187 Individuals^a

^a LGR categorized by magnitude: none (<0.5 mm), 0.5 to 0.9 mm, 1.0 to 1.9 mm, \geq 2.0 mm. In addition, the *P* value of the statistical comparison (T0 vs T1) is shown for the category none (<0.5 mm).

Results: Magnitude

In terms of mean postretention LGR magnitude, the data from the present investigation (0.1 \pm 0.1 mm) were similar to other orthodontic patients (0.1 \pm 0.3 mm, n = 64; 4.6 years post-Tx at 18–26 years)²⁵ and even smaller than described for untreated populations (1.2/2.0 mm, untreated Norwegians aged 20–21-years/ Sri Lankans aged 18–19 years).²⁰

Looking specifically at the lower incisors, few data have been published so far. However, the current postretention magnitude (mean, 0.1-0.2 mm; maximum, 4.0 mm) was lower than the corresponding values reported for an untreated sample (mean, 1.0-1.2 mm; maximum, 3.0 mm).²⁴

Results: Incidence

In terms of incidence of LGR (magnitude \geq 0.5 mm), an overall value of 4.0% was calculated for those cases where both pre-Tx and postretention study casts were available during the observation period of

approximately 5.5 years. In the literature, overall LGR incidence rates of 10% (orthodontically treated adults, n = 150)¹⁹ and 8% (untreated adolescents aged 12–17 years, n = 100)¹⁸ were reported.

For the lower central incisors, an overall incidence of 10.4% to 11.4% for LGR (magnitude \geq 0.5 mm) was determined, which corresponded to data in the literature of 7.0% to 10.0% (adult patients).¹⁹ The same was true for respective magnitude data, which exhibited a mean increase of 0.1 mm for all incisors in the current investigation and ranged between \approx 0.6 mm,²⁶ 0.6 to 1.1 mm,⁸ and 0.9 to 1.0 mm²⁷ in the literature for patients who were orthodontically treated and observed for 4 to 9 years afterward.

Therefore, regarding the present findings and the data available in the literature, Herbst-MBA Tx cannot be considered as a general risk factor for LGR development, at least not to a clinically relevant extent. Of course, individual patients might develop lesions beyond average, but this is probably true for any kind of orthodontic Tx and in concordance with

Table 3. Magnitude (mm) of Labial Gingival Recession for Teeth 17 to 47 Before Treatment (T0) and After Herbst-Multibracket Appliance Treatment and a Retention Period of \geq 24 Months (T1) in 187 Individuals^a

р		0.3	17	0.1	80	0.0	015	0.0	003	0.0	007	0.0	007	0.0)15	0.0	011	0.0	007	0.0	002	0.0	001	0.0	17	0.1	57	0.3	17
Max		0.0	-1.0	-2.0	-2.0	-1.0	-1.0	-1.0	-2.0	-1.0	-2.0	-1.0	-2.5	-1.0	-1.0	0.0	-2.0	-1.5	-2.0	-0.5	-3.0	-2.0	-3.0	-1.0	-2.0	-2.0	-2.0	0.0	-1.0
Min			0.0																										
Median	mm														0	.0													
SD		0.00	0.07	0.15	0.17	0.10	0.19	0.10	0.31	0.08	0.25	0.13	0.34	0.07	0.16	0.00	0.26	0.12	0.30	0.04	0.40	0.16	0.42	0.11	0.25	0.16	0.19	0.00	0.07
Mean		0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0
Occasi	on	Т0	T1	T0	T1																								
		1	7	1	6	1	5	1	4	1	3	1	2	1	1	2	1	2	2	2	3	2	4	2	5	2	6	2	7
															To	oth													
		4	7	4	6	4	15	4	4	4	3	4	2	4	1	3	1	3	2	3	3	3	54	3	5	3	6	3	7
Occasi	on	Т0	T1	T0	T1	T0	T1																						
Mean		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.2	-0.1	-0.2	0.0	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD		0.00	0.00	0.00	0.04	0.00	0.30	0.11	0.14	0.08	0.34	0.12	0.39	0.29	0.51	0.27	0.49	0.16	0.36	0.16	0.28	0.08	0.14	0.04	0.90	0.00	0.00	0.00	0.00
Median	mm														0	.0													
Min															0	.0													
Max		0.0	0.0	0.0	-0.5	0.0	-3.0	-1.0	-1.0	-1.0	-2.0	-1.0	-2.0	-2.0	-4.0	-2.0	-4.0	-1.0	-2.0	-2.0	-2.0	-1.0	-1.0	-0.5	-1.0	0.0	0.0	0.0	0.0
р		1.0	000	0.3	317	0.0)26	0.3	334	0.0	010	0.0	000	0.0	001	0.0	001	0.0	000	0.0)83	0.0)63	0.1	80	1.0	000	1.0	000

^a The mean value and standard deviation as well as the median, minimum, and maximum values are given. In addition, the *P* value of the statistical comparison (T0 vs T1) is given for each kind of tooth.

the finding that recession probably is not only induced by a single factor.^{14,20,28–30} Although some studies in the literature concluded that orthodontic tooth movement might increase the risk for LGR development,^{5,6,25,31,32} the data of the present investigation, including a comparison to the previous literature, seem to disprove this suspicion for Herbst-MBA Tx.

Table 4. LGR Prevalence Data Available in the Literature^a

		LGR Prevalence				
Reference	Origin	Orthodontic Treatment	п	Mean Age, y	Type of Teeth	%
6	Israel	27.4% treated	303	18–22	17–47	1.6
					31, 41	4.5-6.8
					14, 24, 34, 44	6.8–13.5
17	The Netherlands	100.0% treated	302	19	17–47	20.2
					32–42	≈0.5–4.0
					14, 24, 34, 44	≈4.0–6.5
					16, 26	≈1.0–2.5
					36, 46	≈1.5–2.8
18	Finland	No information	100	17	17–47	13.8
20	Norway	No information	Not available	20–21	17–47	5.8
	Sri Lanka	No information	Not available	18–19	17–47	1.6
21	Brazil	No information	263	14–19	17–47	2.9
22	Sweden	No information	Not available	18–29	17–47	7.0
					32-42	≈2.0–6.0
					14, 24, 34, 44	≈10.0–16.0
					16, 26	≈12.0–24.0
					36, 46	≈4.0–6.0
23	United States	No information	77	16–25	17–27	9.5
24	France	No information	100	19–26	17–27	11.9
					32-42	5.0-9.1
					14, 24, 34, 44	28.1–40.2
					16, 26	3.1–10.3
					36, 46	3.3–6.5

^a The reference number, sample characteristics, and LGR prevalence values (%) of comparable samples (age) are provided. LGR indicates labial gingival recession.

Limitations

The limited numbers of postretention study casts (when compared with the pre-Tx sample) as well as patients with complete sets of study casts certainly were a limitation. This was also true for the retrospective study design resulting in a lack of well-matching data from treated/untreated controls and the fact that only study casts were analyzed, limiting the reliability. However, because of the low overall incidence of LGR, this issue seems to be negligible.

CONCLUSIONS

- During Class II:1 correction, the prevalence of teeth with LGR $\geq\!0.5\,$ mm increased from, on average, 1.1% before Tx to 5.3% after 24 months of Herbst-MBA Tx and a retention phase of 33 months.
- The highest prevalence of LGR after retention was found for the lower incisors (12.5%–16.4%).
- However, because of the overall mean LGR magnitude of 0.08 mm after Herbst-MBA Tx plus retention, the clinical relevance can be considered as insignificant.

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