

Article

Comparison of Clear Aligner Treatment in First-Treatment and Re-Treatment Patients: A Retrospective Cohort Study

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Abstract: This retrospective real-world study aimed to evaluate the outcomes of clear aligner treatment (CAT) and patient demographics of patients seeking orthodontic re-treatment who had previously received orthodontic treatment in childhood or adolescence. The study was conducted using anonymized data from DrSmile (Berlin, Germany), a CAT provider in Europe. Data were collected from a total of 2080 patients in Germany (71.5% female, 28.5% male, ranging from 18–70 years, median 29.0 years), who completed their CAT between 1 June and 30 June 2022. Patients were divided into two groups: adult first-treatment patients ($n = 1587$) and adult re-treatment patients ($n = 493$). Results showed that re-treatment patients had a shorter treatment duration ($p < 0.05$), required fewer interproximal reductions (IPR) ($p < 0.001$), and had fewer clinical visits (mean 2.96 versus 4.14 visits) than first-treatment patients ($p < 0.001$). Data collected from adult orthodontic re-treatment and first-treatment patients indicated that the demographic characteristics of these two groups were very similar. No significant differences were found between re-treatment patients and first-treatment patients in terms of motives for orthodontic treatment ($p = 0.068$), types of insurance ($p = 0.615$), and treatment satisfaction ($p = 0.673$). The study highlights the need for orthodontists and dentists to provide adequate information to patients about long-term retention and decision-making for orthodontic treatment, especially for re-treatment.



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Keywords: orthodontics; re-treatment; clear aligners; malocclusion; motivation; orthodontic appliances; digital technology

1. Introduction

Clear aligners are a popular orthodontic treatment option that involves wearing a series of custom-made, clear plastic trays that gradually shift teeth into their desired position. The use of clear aligners has been increasing in recent years, particularly among adults.

According to a representative study, about one-third of children and adolescents received orthodontic treatment [1]. The frequency of orthodontic treatment depends largely on gender, with girls being treated more frequently than boys [1,2]. Despite the standard of orthodontic treatment and the generally very good rate of patient improvement [3], relapse may occur due to retention protocols [4,5]. Additionally, a small group of patients may be dissatisfied with the results of their initial treatment [6]. While it is recommended that orthodontic patients wear their retainers permanently to achieve lifelong stable results [7], it has been reported that some patients are not well informed about the type and duration of orthodontic retention [8].

Historically, orthodontic treatment has been predominantly utilized by children and adolescents. However, the prevalence of adult patients seeking orthodontic treatment to improve aesthetics and function has seen a significant rise in recent times due to the population's improved health status and expectations. As the number of adult orthodontic patients

increases, many orthodontic patients are likely to have already undergone orthodontic treatment as adolescents and are commonly referred to as re-treatment patients [9].

Lack of cooperation during the first orthodontic treatment leading to an unsatisfactory outcome, and increasing patient perception of dental aesthetics, are possible reasons for re-treatment [10,11]. Patients with previous orthodontic treatment show greater dental awareness, strong motivation, and objective treatment needs, and are more likely to request orthodontic re-treatment [12,13]. However, patients with a history of orthodontic treatment have been shown to be less likely to adhere to orthodontic wear protocols than first-time patients [14].

There is limited data available on adult orthodontic re-treatment, particularly on what motivates patients to seek re-treatment, how previous orthodontic treatment and retention protocols affect CAT outcomes, and how orthodontic re-treatment differs from first treatment in terms of required interproximal reduction (IPR), number of clinical visits, and treatment duration. This lack of knowledge about the differences between re-treatment and first treatment could lead to inadequate patient care and decision-making for orthodontic treatment.

This retrospective cohort study aimed to evaluate the outcomes of clear aligner treatment (CAT) and patient demographics of patients seeking orthodontic re-treatment who had previously received orthodontic treatment in childhood or adolescence. The primary outcomes of this study included a comparison of treatment procedures and associated socio-demographic or other covariates of first-treatment, and re-treatment, patients. In addition, this study examined how previous orthodontic treatment and retention protocols affect CAT treatment duration, including treatment progression in terms of IPR, patient satisfaction, and clinical visits. By using real-world data and a retrospective study design, this study aimed to provide insight into real-world scenarios and may be able to provide short-term, large-sample results and support clinical decision-making.

2. Methods

2.1. Study Design

The study was designed to assess clear aligner treatment outcomes and patient demographics of patients seeking orthodontic re-treatment. The study was conducted with anonymized data provided by DrSmile, a brand of Urban Technology GmbH (Berlin, Germany), a large CAT provider operating a partner network of local dentists and orthodontists throughout Europe. DrSmile provides a dental operating system that centrally stores patient data and information and ensures that all dentists are adequately trained to conduct CAT and a standardized clinical examination to ensure a suitable selection of patient cases and adequate treatment care, as described by Baxmann et al. [15]. To ensure the quality of diagnostic models for evaluation, protocols from previous studies on the accuracy of 3D data for printing were applied [16,17].

Data from all patients in Germany aged 18–70 years who finished their clear aligner therapy between 1 June 2022 and 30 June 2022 were available for analysis (see subsection: Participants).

Patients with no previous orthodontic history and older than 18 years of age were classified as adult first-treatment patients. Patients with previous orthodontic treatment of any form were classified as adult re-treatment patients. The first-treatment patients served as a control group, consistent with other re-treatment studies [9,18].

Routinely collected pseudonymized electronic dental records and patient medical forms were used to collect data on sociodemographic parameters, primary motivating factors for clear aligner treatment, IPR appointment necessity and attendance, total clinical visits, and planned treatment duration. These data were anonymized for health research purposes in accordance with the Landeskrankenhausgesetz Berlin (Berlin State Hospital Act) and the Datenschutz und IT-Sicherheit im Gesundheitswesen (DIG) task force of the German Association for Medical Informatics, Biometry, and Epidemiology (GMDS). This

study was conducted in agreement with the Declaration of Helsinki and was reported following the STROBE guideline [18].

2.2. Participants

The study included a comprehensive sample of patients who completed aligner treatment between 1 June 2022 and 30 June 2022. Patients were included regardless of previous orthodontic treatment. The first-treatment patient group was matched only by the period of completed treatment and was included as the control group.

2.3. Data Collection and Variables

All patients completed medical forms and the questionnaire immediately before their initial examination. At the initial visit, they were examined and consulted in the dental office [15,16].

In addition, during routine treatment, all patients completed medical forms and a questionnaire that included questions about the patient's motivation for the first treatment or re-treatment, previous orthodontic treatment, and current retention measures after initial treatment.

Data on treatment duration and the number of IPR sessions in the clinic were available from the initial treatment plan for both groups.

During treatment, patients were regularly monitored, and all clinical visits were documented in a centralized DrSmile operating system that allowed dentists to store patient records, medical forms and information, and prescriptions. Furthermore, patients were requested to rate their satisfaction at the beginning of treatment, particularly with regard to the quality of the dental consultation and treatment care, and several times during treatment using a 6-point Likert scale from 0–5 (0 = very dissatisfied, 5 = very satisfied).

2.4. Orthodontic Treatment Protocol

As part of the treatment protocol, each patient was instructed to wear the aligners for at least 22 h each day, except for oral hygiene, meals, and hot and/or sugary drinks. The wear protocol recommended 14 days of wear per aligner. The treatment protocol consisted of sequential aligner steps that varied according to the complexity of the case.

The dentist checked the fit of the aligners and the treatment progress every two aligner steps, either remotely or on-site. Patients were educated about IPR as needed and were regularly reminded via email and the DrSmile mobile application to schedule appointments for IPR and/or engagers. IPR was performed in the clinic at the originally scheduled aligner steps if the treatment course was as planned after a check-up at that time.

Long-term use of retainers after treatment was explained and encouraged on several occasions: at the initial clinic visit and consultation, several times during treatment, with reminder emails, and at the end of treatment.

2.5. Treatment Follow-Up

Patients had regular clinical visits for IPR, engagers (if needed), as well as remote and on-site clinical check-ups. Patients were additionally instructed to use the DrSmile mobile app to receive reminders for aligner changes, IPR and engager appointments, to send in regular photos, and to schedule IPR, engager and other follow-up appointments.

2.6. Bias

Selecting DrSmile patients for recruitment carries the risk of selection bias; however, we populated our sample from all patients with the same treatment completion date to provide a complete representation.

2.7. Statistical Analysis

Descriptive statistics were performed, and two-sided chi-squared tests were used for statistical analysis. All p -values < 0.05 were regarded as statistically significant. JASP

0.16.3 (University of Amsterdam, Amsterdam, The Netherlands) was used to conduct all calculations.

3. Results

3.1. Sample Characteristics

Data from all patients who completed treatment between 1 June and 30 June 2022 (2080 patients) were available for analysis without exclusion (comprehensive sample). Of the 2080 patients, 1488 (71.5%) were female and 592 (28.5%) were male, with a median age of 29.0 years ranging between 18–70. The least predominant age group was those over 55 years old with only 18 patients (0.9%), followed by middle-aged adults ranging between 36–55 years old with 447 patients (21.5%). The majority of the group was young adults (18–35 years, $n = 1611$, 77.6%).

Of all patients, 493/2080 (23.7%) reported previous orthodontic treatment, and 1587/2080 (76.3%) reported no previous orthodontic treatment. Notably, only 10/493 (2.0%) of the patients with previous orthodontic treatment reported wearing fixed retainers at the time of the initial consultation for re-treatment.

A total of 468/2080 (32.6%) patients indicated “crowding” as the most important motivating factor for seeking CAT, whereas 465/2080 (32.4%) patients indicated “protruding teeth”, 271/2080 (18.9%) patients indicated “tooth spacing”, and 233/2080 (16.2%) patients indicated “other functional or dental health” motives.

The majority of all patients (90.5%, 1883/2080) had public insurance, 190/2080 (9.1%) had private insurance, and 7/2080 (0.3%) did not answer the question.

The average planned treatment duration was 19.8 weeks (with a range of 4–56). During CAT, interproximal enamel reduction (IPR) was planned and performed in the majority of patients (66.8%, 1389/2080), while 691/2080 (33.2%) patients did not require IPR during treatment. Of all patients treated with IPR, most patients (566/1389, 40.8%) had 2 IPR sessions, followed by patients (417/1389, 30.0%) with 1 IPR session, while 406/1389 (29.2%) had >2 IPR sessions during treatment.

On average, patients had 3.86 (SD = 2.32) clinical visits during treatment. Patients were asked several times during treatment to rate their satisfaction with treatment on a 6-point Likert scale from 0–5. Three different surveys were sent out: at the beginning of treatment, after clinical visits, and during treatment. At the beginning of the treatment, 525/2080 (25.2%) patients responded to the survey, while 1555/2080 (74.8%) did not respond. The mean score for this survey was 4.36. Of the survey sent after clinical visits, 930/2080 (44.7%) responded and 1150/2080 (55.3%) did not respond to the survey. The mean score was 4.42. Patients were re-surveyed during the course of treatment. 681/2080 (32.7%) responded and 1399/2080 (67.3%) did not respond to the survey. The mean score was 4.07.

3.2. Comparison between First-Time and Re-Treatment Patients

3.2.1. Sociodemographic Characteristics

The median age of patients with previous orthodontic treatment was 29.0 years (range 18–65) and the median age of first-time patients was 29.0 years (range 18–70). There were no significant differences in the age distribution between the two groups ($p = 0.926$). In addition, the age groups showed no significant differences between the two groups ($p = 0.825$). In both cohorts, the smallest age group was older adults, followed by middle-aged adults, and the largest age group was young adults (Table 1).

Table 1. Distributions of age groups by previous orthodontic treatment.

	Age Group <i>n</i> (%)		Chi-Square
	Previous Orthodontic Treatment		
	Yes	No	
18–35 years	382 (77.5%)	1229 (77.4%)	$\chi^2 (2, n = 2080) = 0.384$ $p = 0.825$
36–55 years	107 (21.7%)	340 (21.4%)	
>55 years	4 (0.8%)	18 (1.1%)	
Total	493 (100.0%)	1587 (100.0%)	

A significant difference was found in the gender distribution ($p = 0.020, <0.05$). The group of female patients in the re-treatment group was significantly larger than the group of female patients in the first-treatment group, with the highest proportion of females in both groups. In the re-treatment group, 373/493 (75.7%) patients were female and 120/493 (24.3%) were male. In the first-treatment group, 1115/1587 (70.3%) patients were female, and 472/1587 (29.7%) patients were male.

3.2.2. Motivations for Seeking CAT

No significant differences were found in the motivation for seeking CAT ($p = 0.068$) (Table 2). A total of 309/944 (32.7%) first-time patients and a total of 159/493 (32.3%) re-treatment patients indicated “crowding” as an important motivating factor for seeking CAT, whereas 286/944 (30.3%) orthodontically untreated patients and 179/493 (36.3%) orthodontically treated patients indicated “protruding teeth” as a motive, 192/2080 (20.3%) and 79/493 (16.0%) patients indicated “tooth spacing” and 157/2080 (16.6%) patients and 76/493 (15.4%) patients indicated “other functional or dental motives”. A total of 643/1587 (40.5%) first-time patients did not answer this question.

Table 2. Patient self-motivation by previous orthodontic treatment.

	Self-Motivation <i>n</i> (%)		Chi-Square
	Previous Orthodontic Treatment		
	Yes	No	
Crowding	159 (32.3%)	309 (32.7%)	$\chi^2 (3, n = 1437) = 7.132$ $p = 0.068$
Other, Dental health/functional	76 (15.4%)	157 (16.6%)	
Protruding teeth	179 (36.3%)	286 (30.3%)	
Spacing	79 (16.0%)	192 (20.3%)	
Total	493 (100.0%)	944 (100.0%)	

3.2.3. Insurance Type

The majority of patients (1883/2073, 90.8%) had public health insurance while a smaller amount (190/2073, 9.2%) had private health insurance; comparisons between the two showed no statistically significant difference ($p = 0.615$). Furthermore, 7/2080 (0.3%) did not respond to the question about their insurance type.

3.2.4. Need for IPR and the Number of IPR Sessions

A significant difference was found between the need for IPR during CAT ($p = 0.015, p < 0.05$) (Table 3). The need for IPR was significantly lower in the re-treatment group than in the first-treatment group, with most of the patients in both groups requiring IPR. In the re-treatment group, 307/493 (62.3%) of patients required IPR, whereas 186/493 (37.7%) did not, while in the first-time seeker group, 1082/1587 (68.2%) required IPR and 505/1587 (31.8%) did not.

Table 3. Need for interproximal reduction (IPR) by previous orthodontic treatment.

	IPR Needed <i>n</i> (%)			Chi-Square
	Previous Orthodontic Treatment			
	Yes	No		
No	186 (37.7%)	505 (31.8%)	$\chi^2 (1, n = 2080) = 5.916$ $p = 0.015 (<0.05)$	
Yes	307 (62.3%)	1082 (68.2%)		
Total	493 (100.0%)	1587 (100.0%)		

A significant difference was also found in the number of IPR visits ($p < 0.001$), with the majority of patients with previous orthodontic treatment requiring only one IPR session and a very small proportion requiring >2 IPR sessions, while the majority of first-time patients required two IPR sessions and a large proportion requiring >2 IPR sessions (Table A1).

3.2.5. Treatment Duration

The planned treatment duration in the initial prescription varied significantly between re-treatment and first-time patient groups ($p < 0.001$) (Table A2). For re-treatment patients, the planned treatment duration was shorter than for first-treatment patients. The mean treatment duration was 19.9 weeks (with a range of 4–56 weeks) in the first-time treatment group and 19.4 weeks (with a range of 4–38 weeks) in the re-treatment group.

3.2.6. Number of Clinical Visits

There was also a significant difference in the number of clinical visits required between the re-treatment and first-time patient groups ($p < 0.001$). The mean number of clinical visits in the re-treatment group was 2.96 and in the first-time patient group, the mean number of clinical visits was 4.14.

In the re-treatment group, 363/493 (73.6%) of the patients had ≤ 3 clinical visits, 111/493 (22.5%) had 4–5 clinical visits, 16/493 (3.2%) had 6–7 clinical visits and 3/493 (0.6%) had ≥ 8 clinical visits. In the first-treatment group, 826/1587 (52.0%) of the patients had ≤ 3 clinical visits, 386/1587 (24.3%) had 4–5 clinical visits, 213/1587 (13.4%) had 6–7 clinical visits and 162/1587 (10.2%) had ≥ 8 clinical visits (Table 4).

Table 4. Number of clinical visits by previous orthodontic treatment.

	Clinical Visits <i>n</i> (%)		Chi Square
	Previous Orthodontic Treatment		
	Yes	No	
≤ 3 clinical visits	363 (73.60%)	826 (52.00%)	$\chi^2 (3, n = 2080) = 110.241$ $p < 0.001$
4–5 clinical visits	111 (22.50%)	386 (24.30%)	
6–7 clinical visits	16 (3.20%)	213 (13.40%)	
≥ 8 clinical visits	3 (0.60%)	162 (10.20%)	
Total	493 (100.00%)	1587 (100.00%)	

3.2.7. Patient Satisfaction

In all three surveys, no significant differences in patient satisfaction during the CAT were found between these two groups ($p = 0.673$, $p = 0.385$, and $p = 0.115$, respectively), although in all three surveys, patients with previous orthodontic treatment tended to score higher (Table 5).

Table 5. Treatment satisfaction scores by previous orthodontic treatment.

	Beginning of Treatment		After Clinical Visit		During Treatment Course	
	Previous Orthodontic Treatment					
	YES	NO	YES	NO	YES	NO
Mean Score	4.38	4.35	4.56	4.39	4.2	4.04

Of the patients without a history of previous orthodontic treatment, at the beginning of the treatment, 423/1587 (26.7%) patients responded to the survey, while 1164/1587 (73.3%) did not respond. The average score for this survey was 4.35. Of the survey sent after clinical visits, 759/1587 (47.8%) responded and 828/1587 (52.2%) did not respond to the survey. The average score was 4.39. Patients were re-surveyed during the course of the treatment. 518/1587 (32.6%) responded and 1069/1587 (67.4%) did not respond to the survey. The mean score was 4.04.

Of the patients with a history of previous orthodontic treatment, at the beginning of the treatment, 102/493 (20.7%) patients responded to the survey and 391/493 (79.3%) did not respond. The average score for this survey was 4.38.

Of the surveys sent after clinical visits, 171/493 (34.7%) responded and 322/493 (65.3%) did not respond to the survey. The average score was 4.56. During the course of the treatment, 163/493 (33.1%) responded and 330/493 (66.9%) did not. The mean score was 4.20.

4. Discussion

There has been a noticeable increase in the number of adults undergoing orthodontic treatment, particularly CAT, in recent years due to rising health standards and expectations of the adult population. A significant proportion of adults seeking orthodontic treatment have had already undergone orthodontic treatment in their childhood and adolescence. A thorough clinical assessment and treatment planning are required prior to CAT, including understanding the patient's motivation for seeking CAT, their medical history, reviewing orthodontic findings and assessing the need for treatment procedures such as IPR. To date, little research has examined whether patients' motivations for seeking CAT, sociodemographic parameters, and treatment planning and duration differ between first-time and re-treatment patients with a history of orthodontic treatment.

The aim of this study was to evaluate the outcomes of CAT and patient demographics of patients seeking orthodontic re-treatment who had previously received orthodontic treatment in childhood or adolescence. It aimed to compare CAT on a sample size comprised of 2080 patients (493 were re-treatment patients and 1587 were first-time patients) in terms of treatment duration, patient profiles, associated socio-demographic or other variables, and patient satisfaction. Although the two groups were not matched for gender and age, statistical analysis showed that both the re-treatment and first-treatment groups were well-matched for age and age group distribution.

To the authors' knowledge, this is the first real-world study to compare clear aligner treatment of re-treatment patients with a control group on a larger scale. Using real-world data and a retrospective design, we aimed to provide insight into real-world scenarios to support clinical decision-making.

Our findings require detailed discussion and interpretation within the limitations. First, in the present sample, it was found that patients in both patient groups were on average under 30 years of age and the majority were female. In particular, the proportion of females in the re-treatment group was significantly higher than in the first-treatment group, with a higher proportion of females undergoing re-treatment than males. In line with previous research, gender was found to be associated with the likelihood of seeking re-treatment, with a higher percentage of females seeking re-treatment than males [12]. Furthermore, it has been reported that females consider straight teeth to be more important than males, leading them to opt for re-treatment to improve their self-perception of dental

appearance [19,20]. In addition, girls have been found to be treated more frequently than boys in childhood [1,2], which may lead to more females experiencing orthodontic relapse due to the frequency of previous orthodontic treatment.

Second, the results of the present study suggest that the main motives for undergoing CAT and patient satisfaction during CAT did not differ between re-treatment and first-time patients. Most of the patients indicated that crowding was the primary motive for seeking CAT, followed by protruding teeth in both groups. Accordingly, crowding was found to be the most common malocclusion trait in both genders. For example, Cenzato et al. [21] reported that a high percentage of patients presented with dental crowding, with a prevalence of up to 84.4%. Furthermore, crowding has been found to be one of the malocclusion traits that significantly relapsed in the short and long term [22,23], possibly resulting in previously treated patients with crowding being more affected by re-treatment. In particular, Chow et al. [9] reported that crooked or crowded teeth were the most common motivating factor in both re-treatment and first-time control groups. Their results showed no significant differences in motivation levels between these two groups [24].

Third, the distribution of insurance types of patients undergoing re-treatment and first treatment was found to be similar, with the majority of patients having public insurance. Krey et al. [1] reported high rates of children and adolescents receiving orthodontic treatment at public health insurance expense. Thus, the high prevalence of publicly insured patients in re-treatments may be an effect of insurance systems on the frequency of initial orthodontic treatments. The high prevalence of publicly insured patients at initial treatment may result in more patients being publicly insured at re-treatment, although in our study population, the majority of patients paid for CAT out of pocket. Notably, only 2.0% of the re-treatment patients were wearing a fixed retainer at the time of the initial assessment, whereas the presence of a fixed retainer has been shown to have a positive effect on the PAR score, indicating a lower severity of relapse [25]. Recent studies recommend lifetime retention after orthodontic treatment [26–28], while previously it was reported that half of the patients considered retention for less than three years to be sufficient and less than 50% were aware of the need for retention at the beginning of orthodontic treatment [28]. Consequently, dentists and orthodontists play a crucial role in educating patients about long-term retention. In a digitally enabled CAT context, this could mean using electronic reminders to educate the patient about the consequences of poor retention at the end of treatment. Electronic reminders have been shown to significantly improve patient compliance [29]. The efficacy of these methods needs further investigation.

Fourth, an interesting finding was that CAT differed significantly between the re-treatment and control groups, with significant differences in the need for IPR, number of IPR sessions, number of clinical visits, and treatment duration. Patients in the re-treatment group required fewer IPR visits, required significantly less IPR, and had a shorter treatment duration than patients in the first-treatment group. Weir et al. [30] reported a high prevalence of IPR at the initial prescription of up to 71%, particularly in the lower anterior region, which is significantly more prone to relapse [23], which could lead to a reduced need for IPR as well as limitations due to residual tooth size. In particular, the differences between the need for IPR and treatment duration are consistent with the findings of Chow et al. [9] who reported that most re-treatment patients had either mild or low treatment complexity, whereas the control group had a significantly higher complexity score.

The present study has several limitations. First, the sample size of adults over the age of 55 is relatively small, but the age distribution of the re-treatment and control group is very similar and therefore likely to be comparable. Similarly, significant differences in mean age at the choice of the orthodontic appliance have been reported, with clear aligner patients being significantly younger than lingual and ceramic braces patients [31]. Second, treatment duration and procedures for CAT were only assessed within one provider's treatment area, so no conclusions should be drawn about other orthodontic appliances. Third, the sample included only patients who self-paid for orthodontic treatment without insurance coverage. The information gathered from the patients who underwent orthodontic re-treatment was

limited to examining the retention appliance present at the initial consultation, but not the type of orthodontic appliance used and the duration of its use in the past, which may have an impact on orthodontic relapse and re-treatment. Therefore, generalizations to other populations could not be made due to the limited population selection and scope of treatment. Last, given the retrospective study design, more in-depth data analysis and possibly confirmation by large prospective or randomized trials are needed to examine these limitations in detail. However, some important characteristics of patients who underwent re-treatment were examined that could inform future research.

5. Conclusions

Patients seeking orthodontic re-treatment after initial treatment in the past exhibit a number of characteristics. Most of the patients are female. The majority of re-treatment patients did not have a retention appliance at the time of consultation.

The data collected from adult orthodontic re-treatment and first-time patients indicated that the profiles of these two groups are very similar. This suggests that the characteristics that lead a patient to seek orthodontic treatment are consistent regardless of whether they are first-time patients or seeking re-treatment. Crowding and protruding teeth were the main reasons patients sought treatment. The need for IPR and the planned treatment duration were significantly lower in the re-treatment patient group. Lack of long-term retention appeared to be the main reason for the relapse or failure of the initial treatment. The results highlight the need for orthodontists and dentists to provide adequate information to patients about long-term retention, especially for re-treatment.

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Institutional Review Board Statement: This research was conducted in accordance with the guidelines of the Declaration of Helsinki. The data was obtained as part of the treatment and anonymized for research purposes, which does not require approval from an ethics committee as per the recommendations in the Berlin State Hospital Act (Landeskrankenhausgesetz Berlin) and also according to the Datenschutz und IT-Sicherheit im Gesundheitswesen (DIG) task force of the German Association for Medical Informatics, Biometry, and Epidemiology (GMDS).

Informed Consent Statement: The data were obtained as part of routine treatment and anonymized for health research, which does not require informed consent according to the Berlin State Hospital Act (Landeskrankenhausgesetz Berlin) and the recommendations of the Datenschutz und IT-Sicherheit im Gesundheitswesen (DIG) task force of the German Association for Medical Informatics, Biometry, and Epidemiology (GMDS).

Data Availability Statement: The data are available on reasonable request due to privacy restrictions.

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Conflicts of Interest: Lan Huong Timm declares gainful employment by the DZK Zahnklinik GmbH and is the Chief Medical Officer of the DrSmile Group. Martin Baxmann and Ralf Rößler were previously members of the Scientific Board of the Sunshine Smile GmbH.

Appendix A

Table A1. Number of IPR sessions by previous orthodontic treatment.

	IPR Sessions <i>n</i> (%)		Chi-Square
	Previous Orthodontic Treatment		
	Yes	No	
0	171 (35.80%)	505 (31.80%)	$\chi^2 (9, n = 2080) = 78.516$ $p < 0.001$
1	118 (24.70%)	299 (18.80%)	
2	160 (33.50%)	406 (25.60%)	
3	20 (4.20%)	202 (12.70%)	
4	7 (1.50%)	95 (6.00%)	
5	2 (0.40%)	48 (3.00%)	
6	0 (0.00%)	19 (1.20%)	
7	0 (0.00%)	7 (0.40%)	
8	0 (0.00%)	4 (0.30%)	
9	0 (0.00%)	2 (0.10%)	
Total	478 (100.00%)	1587 (100.00%)	

Table A2. Distribution of planned treatment duration (in weeks) by previous orthodontic treatment.

Treatment Duration (in Weeks)	Treatment Duration (in Weeks) <i>n</i> (%)		Chi-Square
	Previous Orthodontic Treatment		
	Yes	No	
4	1 (0.10%)	1 (0.20%)	$\chi^2 (21, n = 2080) = 151.195$ $p < 0.001$
6	33 (2.10%)	1 (0.20%)	
8	114 (7.20%)	11 (2.20%)	
10	102 (6.40%)	8 (1.60%)	
12	134 (8.40%)	31 (6.30%)	
14	71 (4.50%)	24 (4.90%)	
16	207 (13.00%)	122 (24.70%)	
18	46 (2.90%)	17 (3.40%)	
20	238 (15.00%)	127 (25.80%)	
22	36 (2.30%)	10 (2.00%)	
24	213 (13.40%)	88 (17.90%)	

Table A2. Cont.

Treatment Duration (in Weeks)	Treatment Duration (in Weeks) <i>n</i> (%)		Chi-Square
	Previous Orthodontic Treatment		
	Yes	No	
26	42 (2.60%)	8 (1.60%)	
28	140 (8.80%)	31 (6.30%)	
30	43 (2.70%)	4 (0.80%)	
32	81 (5.10%)	3 (0.60%)	
34	13 (0.80%)	0 (0.00%)	
36	21 (1.30%)	0 (0.00%)	
38	44 (2.80%)	7 (1.40%)	
40	4 (0.30%)	0 (0.00%)	
42	1 (0.10%)	0 (0.00%)	
44	2 (0.10%)	0 (0.00%)	
56	1 (0.06%)	0 (0.00%)	
Total	1587 (100.00%)	493 (100.00%)	

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