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Factors Influencing the Duration of Orthodontic Treatment at the Dento-Facial Orthopedics Department of the CCTD of Casablanca: A Descriptive Cross-Sectional Study

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Abstract

Objective: One of the main concerns for orthodontic patients is the overall duration of treatment, as they seek to achieve both esthetic and functional outcomes in the shortest time possible. The objective of this study was to evaluate the factors that may influence the duration of orthodontic treatment at the Orthodontics Department of the CCTD in Casablanca. **Materials and Methods:** This descriptive cross-sectional study included 116 patient records followed by residents in the Department of Dentofacial Orthopedics at the CCTD, Ibn Rochd University Hospital of Casablanca. A standardized data collection form was used to record socio-demographic, diagnostic, and therapeutic variables. Data were entered in Excel and analyzed using SPSS software (version 20) by the Epidemiology and Biostatistics Laboratory of the Faculty of Dentistry, Hassan II University of Casablanca. Bivariate analysis (one-way ANOVA) was used to test associations between treatment duration and candidate predictor variables. A p-value < 0.05 was considered statistically significant. **Results:** The mean treatment duration was 31.83 months. Patient-related factors (age, sex, socioeconomic status, oral hygiene, compliance) were associated with variations in treatment time, but none reached statistical significance. Patients with skeletal Class II malocclusion (48.3% of the sample) had the longest mean treatment duration (35.73 months), close to statistical significance ($p = 0.05$). Dental extractions, performed in 56% of cases, were associated with a mean prolongation of 8 months compared with non-extraction cases, a statistically significant difference ($p = 0.015$). **Conclusion:** Extraction was the only factor significantly associated with longer orthodontic treatment duration in this hospital-university population. Larger, prospective, multicenter studies that also account for operator-related factors are recommended to confirm and extend

these findings.

Subject Areas

Dentistry

Keywords

Orthodontic Treatment Duration, Malocclusion, Tooth Extraction, Treatment Efficiency, Resident Training, Retrospective Study, Risk Factors

1. Introduction

Patients beginning orthodontic treatment frequently ask how long they will need to wear their appliances. Accurately estimating treatment duration is essential for setting realistic expectations, supporting informed consent, planning costs, and maintaining patient motivation throughout therapy.

Prolonged orthodontic treatment is not a neutral outcome: it has been associated with a range of adverse effects on oral and periodontal health. Extended exposure to fixed appliances increases the risk of root resorption, white-spot lesion formation and demineralization, enamel decalcification, gingival inflammation, and loss of periodontal attachment, particularly when oral hygiene is suboptimal [1]. Beyond the biological cost, longer treatment is also associated with declining patient cooperation and motivation over time, higher cumulative cost of care, increased chair-time burden for the treating institution, a greater number of emergency visits for appliance breakage, and lower patient and parent satisfaction with the overall treatment experience. According to the American Board of Orthodontics, treatment outcomes tend to be less favorable when active treatment time is excessively prolonged, reinforcing the clinical relevance of identifying and addressing modifiable factors that extend treatment [2].

Before strategies to shorten treatment duration can be implemented, it is essential to first identify the factors that prolong it, particularly in a hospital-university setting where treatment is delivered by residents in training under supervision. These factors may be patient-related (cooperation, oral hygiene, appointment adherence, bracket or band debonding) or clinical/treatment-related (sex, type and severity of malocclusion, need for extractions, treatment modality, and number of treatment phases).

This study aims to evaluate and quantify the variables influencing orthodontic treatment duration within the Dentofacial Orthopedics Department of the CCTD Casablanca, CHU Ibn Rochd, through a retrospective analysis of treated cases.

2. Materials and Methods

This is a descriptive, retrospective, cross-sectional study conducted at the Dentofacial Orthopedics Department of the Consultation and Dental Treatment Cen-

ter (CCTD)-CHU Ibn Rochd, Casablanca, over a period of nine months, from April 2022 to January 2023.

The study population consisted of clinical records of patients treated by orthodontic residents within the department. A convenience sample of 116 patients was selected based on specific inclusion and exclusion criteria. Inclusion criteria required a complete orthodontic record, age over 10 years, and completed orthodontic treatment. Patients were treated with various techniques, including fixed appliances and clear aligners, and could have undergone a single-phase or two-phase approach (orthopedic treatment, orthodontics, or combined orthodontic-surgical treatment). Patients who received orthopedic treatment alone, who presented with syndromic conditions, or who had poor treatment follow-up due to general health issues (e.g., cleft lip and palate, intellectual disability) were excluded.

A single examiner collected the data, under the supervision of the thesis advisors, as part of a specialty thesis for the national diploma in odontological specialization. Data collection was carried out on the 116 retained patient records using a standardized, pre-tested data collection form completed for each record in the presence of the treating clinician.

2.1. Data Collection Form

The form was organized into three sections, combining dichotomous (yes/no) items and multiple-choice items:

- Socio-demographic section: sex, age at the start of treatment (categorized as <12, 12 - 18, and >18 years), and socioeconomic level (low, medium, high), estimated from parental occupation and the type of healthcare coverage declared in the record.
- Diagnostic section: skeletal classification in the three planes of space (antero-posterior, vertical, transverse), alveolo-dental (molar/canine) classification, IMPA value, and presence of associated dental anomalies (e.g., impacted canines, diastemas, agenesis).
- Treatment and compliance section: type of treatment plan (single-phase or two-phase, with or without extractions, with or without surgery), appliance activation frequency, number of missed appointments, and three compliance-related items recorded prospectively in the patient's chart at successive recall visits—1) oral hygiene status, assessed clinically by the treating resident at each visit using a three-level scale (satisfactory/average/poor) based on plaque and gingival indices documented in the record; 2) compliance with prescribed auxiliaries (intermaxillary elastics, headgear, or removable appliances), rated by the clinician as poor/average/good according to elastic wear and appliance-wear notes recorded at each appointment; and 3) the cumulative number of bracket or band debonding episodes documented over the course of treatment.

The identity of the treating resident was not captured as a distinct analytical variable in the original data collection form; this point is discussed further as a

limitation of the study below.

Treatment duration was calculated in months from the bonding/banding date to the debonding date recorded in the file.

2.2. Statistical Analysis

Data were entered into Excel and analyzed using SPSS software (version 20). Descriptive statistics (frequencies, means, standard deviations) were first calculated for all variables. Bivariate associations between treatment duration (continuous outcome) and each candidate predictor were then tested using one-way analysis of variance (ANOVA) for variables with two or more categories, since ANOVA is appropriate for comparing mean treatment duration across the levels of nominal or ordinal grouping variables. A p-value < 0.05 was considered statistically significant.

We acknowledge that this bivariate approach, while standard for an initial descriptive analysis, does not allow simultaneous adjustment for multiple covariates or assessment of interaction effects between predictors. A multivariate linear regression model, entering all variables associated with treatment duration at $p < 0.20$ in bivariate analysis, would provide a more robust assessment of the independent contribution of each factor while controlling for potential confounders; this analysis is identified as a priority for the next phase of this research (see Limitations).

The study protocol received approval from the Orthodontics Department of the Faculty of Dental Medicine, Casablanca, in collaboration with the thesis advisors and the Epidemiology Department. Ethical approval was granted by the department's scientific committee, acting as the institutional ethics board.

3. Results

The initial sample consisted of 126 records, of which 116 were retained; 10 records were excluded due to missing data.

The description of patient characteristics is presented in Table 1.

Table 1. Patient-related factors and treatment duration.

	Number of patients (%)	Mean treatment duration in months (SD)	p-value
Sex			**0.15**
Female	73 (62.1)	33.64 (20.14)	
Male	44 (37.1)	28.74 (12.21)	
Age			**0.96**
<12 years	14 (12.1)	31.29 (17.74)	
12 - 18 years	58 (50.8)	32.24 (18.03)	
>18 years	44 (37.9)	31.45 (17.33)	

Continued

Socioeconomic level			**0.55**
Low	36 (29.6)	32.14 (18.81)	
Medium	73 (62.9)	30.82 (18.81)	
High	7 (6.2)	31.00 (14.74)	
Oral hygiene			**0.55**
Satisfactory	26 (22.4)	29.86 (18.08)	
Average	80 (69)	32.81 (17.86)	
Poor	10 (8.6)	31.40 (14.79)	
Number of missed appointments			**0.21**
<5 missed appointments	80 (69)	30.46 (16.17)	
5 - 10 missed appointments	36 (31)	34.86 (20.69)	
Patient cooperation with auxiliaries			**0.87**
Poor	7 (6)	41.43 (18.31)	
Average	35 (30.2)	33.13 (18.92)	
Good	74 (63)	29.97 (17.07)	

3.1. Patient-Related Factors

Among the 116 patients, 62.1% were female, with a mean treatment duration of 33.6 months compared with 28.74 months for males, a difference that was not statistically significant. Adolescents aged 12 to 18 years represented 50.8% of the sample, with a mean treatment duration of 32.24 months ($p = 0.96$). Patients from a low socioeconomic background (29.6% of the sample) had a mean treatment duration of 34.94 months, with no significant difference ($p = 0.55$).

Poor oral hygiene, observed in 8.6% of patients, was associated with a treatment extension of 2.4 months on average. Non-compliance with prescribed auxiliaries affected 6% of patients, with a mean treatment duration of 41.43 months in this poorly compliant group, versus 29.97 months among patients rated as good compliers. Missing 5 to 10 appointments was associated with a mean treatment extension of approximately 2.3 months relative to patients with fewer missed appointments. None of these differences reached statistical significance.

Although not statistically significant, treatment duration tended to increase with the number of debonded brackets, reaching an average of 43.33 months when more than three brackets were debonded over the course of treatment (2.6% of patients) (see **Figure 1**).

3.2. Variables Related to Malocclusion Diagnosis (Table 2)

Skeletal diagnosis: In the anteroposterior direction, Class II patients had the longest mean treatment duration (35.73 months), followed by Class III (29.07 months)

and Class I (27.33 months); this difference approached but did not reach statistical significance (p = 0.05). In the vertical direction, hyperdivergent and normodivergent patients had similar treatment durations (32.37 - 32.48 months), while hypodivergent patients had a shorter mean duration (30.70 months). In the transverse direction, maxillary normognathism was associated with a mean duration of 31.57 months (see Figure 2).

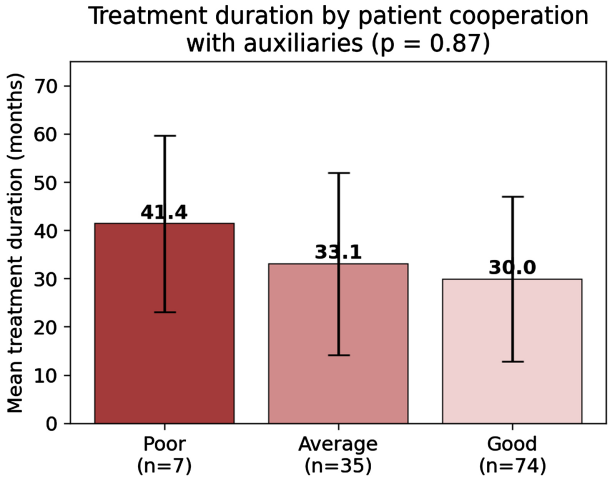

Figure 1. Mean treatment duration (months ± SD) according to patient cooperation with prescribed auxiliaries (p = 0.87).

Table 2. Average treatment duration based on diagnosis.

Diagnosis	Number of patients (%)	Mean treatment duration in months (SD)	p-value
Anteroposterior skeletal diagnosis			**0.05**
Class I	42 (26.7)	27.33 (12.23)	
Class II	59 (48.3)	35.75 (19.68)	
Class III	15 (12.5)	29.07 (17.19)	
Maxillary endognathism	9 (7.8)	31.49	
Vertical skeletal diagnosis			**0.47**
Normodivergent	35 (30.2)	32.27 (18.30)	
Hyperdivergent	71 (61.2)	32.48 (18.58)	
Hypodivergent	10 (8.6)	30.70 (14.03)	
Transversal skeletal diagnosis			-
Maxillary normotransversal	107 (92.2)	31.57	
Anterior-posterior alveolar diagnosis			**0.83**
Class 1	36 (31)	30.36 (14.67)	
Class 2	41 (29.6)	32.59 (18.32)	
Class 3	12 (10.3)	30.92 (19.64)	

Continued

IMPA value			**0.97**
Normoversion	65 (56)	31.41 (17.04)	
Proclination	38 (32.8)	32.17 (20.70)	
Retroclination	13 (11.2)	30.23 (16.55)	
Dental anomalies			**0.06**
No	97 (83.6)	33.08 (19.02)	
Yes	19 (16.4)	25.84 (12.94)	

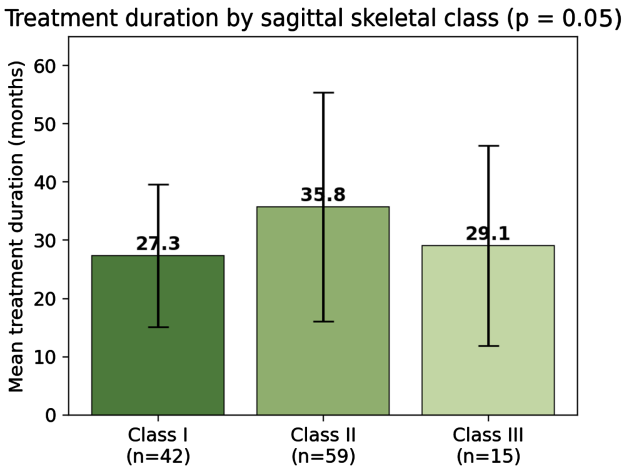

Figure 2. Mean treatment duration (months ± SD) according to sagittal skeletal classification (p = 0.05).

Alveolo-dental diagnosis: Class II molar patients had the longest mean treatment duration (32.59 months), followed by Class III (30.92 months) and Class I (30.36 months). IMPA value had minimal effect on treatment duration, with all three categories (normoversion, proclination, retroclination) showing similar durations (30.23 - 32.17 months).

Overall, no statistically significant association was found between malocclusion diagnostic factors and treatment duration.

3.3. Treatment Plan-Related Variables (Table 3)

The mean treatment duration for the whole sample was 31.83 months. Dental extractions were performed in 56% of cases and were associated with a mean increase in treatment duration of 8 months compared with non-extraction cases (35.34 vs. 27.35 months); this difference was statistically significant (p = 0.015) (see **Figure 3**)

A single phase of orthodontic treatment was used in 73.3% of patients, with a mean treatment duration of 30.73 months, with no statistically significant difference compared with two-phase approaches. Two-phase treatment combining orthodontics with minor surgery concerned 5.2% of patients and showed the longest mean duration (39.42 months), although the difference was not statistically significant.

Table 3. Treatment duration and factors related to the treatment plan.

	Number of patients	Mean treatment duration in months (SD)	p-value
Type of treatment (with or without extraction)			**0.015**
With dental extraction	65 (56)	35.34 (20.02)	
Without dental extraction	51 (44)	27.35 (13.15)	
Treatment phases			**0.47**
Single orthodontic phase	85 (73.3)	30.73 (17.16)	
2 phases: orthodontic + orthopedic	22 (18.9)	32.83 (19.96)	
2 phases: orthodontic + minor surgical treatment	6 (5.2)	39.42 (20.38)	
2 phases: orthodontic + orthognathic surgery	13 (11.2)	31.54 (18.27)	
Activation frequency			**0.89**
1 appointment every 4 weeks	81 (69.8)	31.06 (17.14)	
1 appointment every 6 weeks	33 (28.4)	32.67 (16.67)	
1 appointment every 8 weeks	2 (1.7)	27.00 (2.24)	

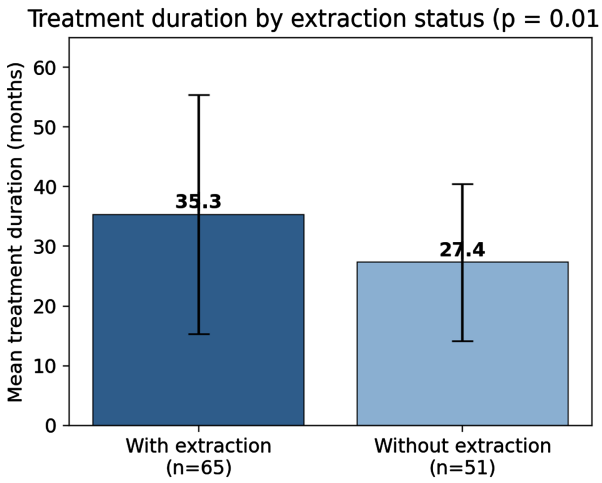

Figure 3. Mean treatment duration (months ± SD) with and without dental extraction (p = 0.015).

Regarding appliance activation frequency, mean treatment duration was 31.06, 32.67, and 27.00 months for activation intervals of 4, 6, and 8 weeks, respectively, with no statistically significant difference between groups.

4. Discussion

Many studies have focused on new techniques to accelerate orthodontic treatment, but it remains essential to also examine patient- and system-related factors

that may prolong it. A better understanding of these factors can help clinicians anticipate delays and counsel patients accordingly, since longer treatment times are often associated with less favorable outcomes according to the American Board of Orthodontics. Such prolongation may stem from a lack of patient cooperation, underscoring the importance of minimizing treatment duration to avoid patient fatigue and complications such as periodontal damage or dental decalcification [2].

This retrospective cross-sectional study aimed to evaluate the impact of various factors on orthodontic treatment duration. The mean treatment duration observed (31.83 months) was longer than the approximately 20 months commonly reported in the general literature [3]. This discrepancy may be explained by differences in patient characteristics, malocclusion severity, and treatment plans, but it is also very plausibly linked to the academic, resident-based setting in which this study was conducted, a point we examine in more detail below.

4.1. Patient Age, Sex, and Socioeconomic Status

Our study found a mean orthodontic treatment duration of 32.24 months among adolescents aged 12 to 18 years, with no statistically significant difference related to age. Findings on the influence of age on treatment duration are mixed in the literature. Some studies, such as those by Robb *et al.* and Moresca [4], found no significant effect of age, while others suggest that older patients may show better compliance. The American Association of Orthodontists Insurance Company reported that patients who can drive themselves to appointments tend to be less engaged in treatment, whereas Loke ST *et al.*, in Malaysia, found a significant difference in treatment duration across age groups [5]. Several authors propose that dental age at the start of treatment, rather than chronological age, may better predict tooth movement rate, while chronological age appears to act mainly through its influence on cooperation. Psychological maturity, rather than age per se, therefore seems to be the more relevant determinant.

We found no significant association between sex and treatment duration, which contrasts with some previous reports of longer treatment in male patients. This is consistent with the findings of Esteves *et al.* and others, who likewise reported no substantial difference in treatment duration between men and women [6]. While some studies suggest girls may be more cooperative, the evidence linking sex to compliance remains inconclusive.

Regarding socioeconomic status, patients from lower socioeconomic backgrounds in our sample had a longer mean treatment duration (34.94 months) than those from higher socioeconomic backgrounds (29.04 months), although the difference did not reach significance. Parental involvement is known to play an important role in treatment adherence, particularly for oral hygiene maintenance and elastic wear. However, the literature remains divided on the relationship between socioeconomic status and treatment duration, with no clear consensus on whether disadvantaged patients experience longer or shorter treatment [7].

4.2. Patient Compliance, Oral Hygiene, and Bracket Debonding

Compliance with removable appliances and prescribed auxiliaries had a marked, although not statistically significant, impact on treatment duration in our cohort, with poorly compliant patients showing treatment times more than 11 months longer on average than highly compliant patients. Common barriers to compliance reported in the literature include discomfort, forgetfulness, and esthetic or social concerns, particularly with extraoral appliances [2].

Previous studies confirm that non-compliance, especially with elastic wear, can prolong treatment by several months, and that strategies such as appointment reminders, parental involvement, and patient education on managing discomfort can improve adherence. Intraoral devices have also been reported to achieve higher compliance and shorter treatment times than extraoral appliances.

Bracket and band debonding can also meaningfully affect treatment duration. Debonding may result from inadequate bonding technique or isolation, occlusal interferences, or patient habits such as nail-biting or chewing on hard objects [8]. In our study, treatment duration increased with the cumulative number of debonding episodes, reaching 43.33 months on average when more than three brackets were lost; previous work suggests each debonding episode can extend treatment by up to two weeks, and losing two or more brackets within the first year of treatment may add 4 to 6 months overall [1]. Patient education on appliance care therefore remains an important, low-cost strategy for reducing avoidable delays.

Although our study found no statistically significant association between oral hygiene and treatment duration, prior studies indicate that good hygiene is generally associated with faster completion. Beckwith *et al.* reported that each visit with poor hygiene extended treatment by roughly three weeks, and Skidmore *et al.* found a three-month difference between patients with good versus poor hygiene; conversely, Loke ST *et al.* found only a weak correlation that was not retained in multivariate regression. Maintaining good oral hygiene throughout treatment remains nonetheless an important objective in its own right, independent of its effect on duration.

Patients who missed 5 to 10 appointments in our cohort had a mean treatment duration of 34.86 months, without reaching statistical significance, consistent with prior reports that each missed appointment can add approximately 0.8 to 1 month to active treatment time [9]. This reinforces the importance of patient education regarding appointment adherence, particularly in an academic setting where rescheduling delays tend to be longer than in private practice.

4.3. Malocclusion Severity and Treatment Plan

We found no statistically significant association between skeletal or alveolo-dental malocclusion type and treatment duration, although Class II patients showed the longest mean duration, approaching significance ($p = 0.05$). Previous studies have linked features such as maxillary crowding, increased overbite, and Class II molar

relationships to longer treatment, and an increased ANB angle has similarly been associated with prolonged treatment, while a more open mandibular plane angle has been linked to shorter treatment in some series [10]. Dental anomalies such as diastemas and impacted canines have also been associated with longer treatment in the literature, with patients presenting bilateral impacted canines reportedly requiring close to one additional year of treatment, and missed appointments appearing to have a particularly strong impact in Class II patients [11]. Overall, the relationship between malocclusion characteristics and treatment duration appears complex and is likely modulated by additional factors, including treatment mechanics and operator experience.

Treatment type, extraction decisions, the addition of surgery, and appointment scheduling all influenced duration in our cohort. Extraction cases took significantly longer to complete (35.34 vs. 27.35 months, $p = 0.015$), consistent with previous reports that extraction treatment generally requires additional space closure and anchorage management time [12]. Combined orthodontic-surgical treatment was associated with the longest mean duration overall (39.42 months for minor surgical procedures), reflecting the additional phases of presurgical and postsurgical orthodontics required in these cases. Appointment frequency also appeared to influence duration, with shorter intervals between activations associated with longer overall treatment in our sample; however, the very small number of patients seen at 8-week intervals ($n = 2$) limits the strength of this observation, and further studies with larger, more balanced groups are needed to clarify this relationship [13].

4.4. The Academic, Resident-Based Treatment Setting: A Likely Key Driver of Prolonged Duration

Beyond patient- and malocclusion-related variables, we believe that the hospital-university context in which this study was conducted is itself a major contributor to the longer treatment durations observed compared with the literature. Several mechanisms specific to teaching institutions plausibly act together to extend active treatment time. First, residents are, by definition, still acquiring clinical experience; a learning curve effect means that early-career operators may require more visits to achieve the same biomechanical objectives as experienced clinicians, a phenomenon previously suggested by work using treatment complexity indices to benchmark resident performance against expected duration [13]. Second, many records in our sample involved patients who were successively treated by more than one resident during the course of their care, as residents rotate through the department or graduate; each transition can introduce a reassessment period, adjustment of mechanics to a new operator's preferences, and occasional repetition of steps, all of which add chair-time. Third, the academic calendar itself imposes scheduling constraints—university holidays, examination periods, and reduced clinical availability—that are largely absent in private practice; because rescheduling intervals are typically longer in this setting, the consequence of a single missed appointment or a debonded bracket is proportionally magnified. Fourth, teaching

institutions often apply more conservative, closely supervised treatment protocols, with each clinical step requiring validation by a supervising consultant before proceeding, which by design adds time but is also intended to safeguard treatment quality and serves an essential pedagogical function.

These observations are consistent with prior comparisons between graduate-training and private-practice settings, which have generally reported longer treatment times in academic programs, attributed to similar combinations of operator inexperience, multi-operator continuity-of-care issues, and stricter procedural oversight [13]. From a clinical standpoint, this suggests that patients and parents seeking treatment in a teaching hospital should be counseled, at the time of informed consent, that treatment duration may be longer than typically reported in the general literature, while also being reassured about the additional layer of supervision this setting provides. From a research and training-program standpoint, our findings support the value of routinely recording operator-level variables (resident seniority, caseload, and number of operator changes per patient) in future audits, both to monitor and potentially shorten treatment times and to provide residents with structured feedback on their own efficiency as part of training.

4.5. Confounding by Operator Experience

As noted above, this study did not capture the seniority or experience level of the treating resident as a distinct variable, nor the number of different residents involved in a given patient's care, which represents an important limitation. Operator-related factors, including clinical experience and case complexity at intake, have previously been shown to influence treatment duration and outcome quality in graduate orthodontic clinics [13]. It is plausible that less experienced residents required more visits to complete comparable cases, and that this effect, rather than being a confounder of the patient- and malocclusion-related associations reported here, may in fact explain part of the overall elevated treatment duration observed across the whole cohort relative to the general literature. Because operator experience was not recorded, we were unable to statistically control for it in the present analysis. We recommend that future data collection in this department prospectively capture resident year of training, cumulative caseload, and number of operator changes per patient, so that multivariate models can formally test and adjust for this factor.

5. Limitations of the Study

Several limitations should be acknowledged. First, this was a retrospective study conducted in a hospital-university setting, based on records of patients treated by residents in training; as discussed above, operator-related factors (seniority, caseload, number of successive treating residents) were not systematically recorded and could not be statistically controlled for, despite their likely contribution to treatment duration.

Second, the academic calendar and scheduling constraints specific to this set-

ting—including longer rescheduling delays compared with private practice—likely magnified the impact of missed appointments and bracket debonding on overall duration, limiting direct comparison with studies conducted in private-practice settings.

Third, incomplete archiving of clinical records and missing data led to the exclusion of 10 of the 126 initially identified records, which limited the final sample size and may have introduced selection bias.

Fourth, the bivariate statistical approach used (one-way ANOVA for each candidate predictor) does not allow simultaneous adjustment for confounding variables or assessment of interactions between predictors; a multivariate regression model is needed to determine the independent predictors of treatment duration once patient-, malocclusion-, treatment-, and operator-related variables are considered together.

These limitations should be addressed in future prospective, ideally multicenter, studies with larger sample sizes, standardized recording of operator-level variables, and multivariate statistical modeling, in order to improve the validity, generalizability, and clinical applicability of the findings.

6. Conclusion

In this cohort of patients treated by residents in a hospital-university orthodontic department, dental extraction was the only variable significantly associated with longer treatment duration, prolonging treatment by an average of 8 months. Patient-related factors (age, sex, socioeconomic status, oral hygiene, compliance, bracket debonding) and malocclusion characteristics showed clinically plausible but statistically non-significant trends toward longer treatment, while the academic, resident-based treatment setting itself appears to be an important, currently unmeasured, contributor to the overall longer durations observed compared with the general literature. Larger, prospective, multicenter studies that also record operator-related variables and apply multivariate statistical modeling are needed to confirm these findings, better quantify the relative contribution of each factor, and inform strategies to optimize treatment efficiency in teaching institutions without compromising treatment quality.

Author Contributions

Conceptualization, H.B. and A.E.; methodology, H.B., S.A., and A.E.; software, H.B.; validation, S.A., Z.E., and A.E.; formal analysis, H.B.; investigation, H.B.; resources, A.E.; data curation, H.B.; writing—original draft preparation, H.B.; writing—review and editing, S.A., Z.E., and A.E.; supervision, A.E.; project administration, A.E. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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