



ORIGINAL ARTICLE

# Evaluation of Effects of Orthodontic Malocclusions on Duration of Treatment with Regard to the Labor/Cost Concept

Mustafa Ersöz, Ebubekir Toy, Ezgi Çakır

Department of Orthodontics, İnönü University School of Dentistry, Malatya, Turkey

## ABSTRACT

**Objective:** The purpose of this study was to compare the treatment duration and fees of Angle Class I, II, and III malocclusions.

**Methods:** In this retrospective study, the samples were selected from the files of 450 patients treated at the Department of Orthodontics, İnönü University. The files of patients whose treatments were completed as planned were included in the study. In total, 387 patients (137 males and 250 females) met this criterion (mean age: 14.65 years). Patients were divided into three groups: treatment duration less than 20 months (group A), between 20–30 months (group B), and more than 30 months (group C). Analysis of variance (ANOVA) and *t*-tests were conducted to determine the difference in treatment duration between the groups and sexes.

**Results:** From the 387 patients, 78 (20.2%) had Class I, 254 (65.6%) had Class II, and 55 (14.2%) had Class III malocclusion. The average treatment duration was 27.82 months (males: 31.82 months, females: 29.33 months). There were no statistically significant differences between the sexes according to the treatment duration. The average treatment duration according to malocclusions was 26.24 months for Class I, 28.22 months for Class II, and 28.21 months for Class III. The distribution of the groups according to treatment duration was as follows: Group A: 72 (18.6%), Group B: 173 (44.7%), and Group C: 142 (36.7%) patients. The relationship between the treatment durations and Angle classifications was not statistically significant ( $p=0.216$ ).

**Conclusion:** This study showed that there were severe anomalies and problematic malformations within each Angle classification because no statistically significant difference among the malocclusion classes in terms of the duration of treatment was found. Therefore, besides the anomaly type, the treatment duration and effort put into the work should also be taken into consideration in determining the treatment charge.

**Keywords:** Orthodontic treatment, malocclusion, treatment duration, treatment cost

## INTRODUCTION

Staying healthy has always been one of the most significant purposes for humanity. To attain this goal, different scientific fields have been developed and utilized. Orthodontics, which has been developed during the recent centuries, was part of this historical process. Experimental studies on orthodontic dental movements were begun by Sandstedt<sup>1,2</sup> in 1904 and have continued to date with further developments.

Angle conducted the initial study on the determination and standardization of orthodontic anomalies in 1907.<sup>3</sup> Angle, in his study published in 1907, basically divided malocclusions into three classes (Angle Class I, Class II, and Class III). Angle classification is accepted worldwide in the determination of orthodontic anomalies and their treatment planning.

There are several prevalence studies conducted in Turkey on the determination of orthodontic anomalies based on Angle classifications.<sup>4-6</sup> The findings demonstrated that, although the orthodontic problems in Turkey vary depending on the regions, most patients who applied for treatment (to the orthodontic clinics in universities) had Angle class II anomalies.<sup>6</sup> Angle classification is considered for the treatment plans of the patients as well as when determining the prices for treatment. In general, the Angle Class I patients receive the lowest invoice, while

Class III patients receive the highest one from the orthodontic prices determined by the Ministry of Health and supplied by the official insurance company.

Angle classification, a simple and explanatory system, forms the basis for diagnosis and treatment planning in the beginning of treatment and for the evaluation of outcomes in the post-treatment period. Furthermore, the determination of orthodontic treatment prices in health expenditures and its insurance payments to the clinics is conducted on the basis of this classification.

Orthodontic therapy takes a longer time than other dental treatments (prosthesis, surgery, endodontics, and others), and more labor and cost are spent for patient treatment. This study aims to determine the duration of treatment for patients who applied to our orthodontic clinic based on their malocclusions (Angle Class I, II, and III) and to evaluate the labor/cost balance expended for the treatment of malocclusions.

## METHODS

In this retrospective study, the sample was selected from the 450 patients treated and finalized during 2010-2014 in the Inonu University Department of Orthodontics. Study models, photographs, and files of the samples were evaluated. For 387 patients out of 450, the treatment was completed as planned; however, in 63 patients, the treatment was terminated before the planned period due to various reasons (moving to another city, poor oral hygiene, pregnancy, etc.). Thus, only 387 patients were considered for cost and time of determination. All patients were evaluated for their duration of treatment, malocclusion type, applied treatment procedures, age, and sex.

Among the 387 patients, 137 (35.4%) were male and 250 (64.6%) were female. The average age at the beginning of treatment was 14.65 years (range: 7-43 years). According to the malocclusion classification, 78 had Class I (20.2%), 254 had Class II (65.6%), and 55 had Class III (14.2%) malocclusions (Table 1).

Based on the treatment period accepted by Fischer et al.<sup>7</sup>, the patients with a duration of treatment less than 20 months were classified as Group A; with a duration of treatment of between 20 and 30 months as Group B; and with more than 30 months as Group C.

For statistical evaluation, one-way analysis of variance (ANOVA) and independent samples *t*-tests were used to determine the difference in treatment periods on the basis of groups and sexes.

## RESULTS

The average treatment period for the 387 patients treated in our clinic was found to be 27.82 months. When the duration of treatment was scrutinized on the basis of the sex, the average was 31.82 months for males and 29.33 months for females. Independent samples *t*-test implemented to compare the differences between the sexes in the duration of treatment demonstrated that there was no statistically significant difference.

The average treatment periods based on the malocclusion were 26.24 months for Class I patients; 28.22 months for Class II pa-

**Table 1.** Distribution of patients according to Angle Classification and sex

Angle Classification	Male		Female		Total	
	n	%	n	%	n	%
Class I	30	22.0	48	19.2	78	20.2
Class II	87	63.5	167	66.8	254	65.6
Class III	20	14.5	35	14.0	55	14.2
Total	137	100.0	250	100.0	387	100.0

**Table 2.** Distribution of patients according to the treatment duration

Treatment duration	Patients	
	(n)	%
Group A (<20 months)	72	18.6
Group B (20–30 months)	173	44.7
Group C (>30 months)	142	36.7
Total	387	100

tients; and 28.21 months for Class III patients. There were 72 patients (18.6%) in Group A, 173 patients (44.7%) in Group B, and 142 patients (36.7%) in Group C (Table 2).

Based on the classification of malocclusions, a one-way ANOVA test showed that there was no statistically significant difference among three classes in terms of the duration of treatment. When the average treatment periods for patients with Class I malocclusion were compared with Class II or III malocclusions, no statistically significant difference was observed on the basis of the duration of treatment.

## DISCUSSION

Health services presented to the orthodontic patients have been continuously advancing and changing. Approaches in orthodontic treatment renew itself in accordance with these advancements and changes to provide the best service for the people seeking treatment.

Orthodontic problem incidence in the population differs from the patients' esthetic insight and patients' perception about orthodontic malocclusions.<sup>8,9</sup> Many studies have showed that orthodontic problem incidences in patient orthodontic anomalies that applied to the university hospitals were higher.<sup>8-12</sup> That is why these patients usually have moderate or severe orthodontic problems and are aware of their problems, or are referred by a practitioner because of the complicated anomalies.

Type, severity, and treatment duration of the orthodontic anomalies can be different due to individual characteristics.<sup>7,13</sup> Many studies have been conducted on malocclusion classification and have reported that the duration of treatment generally differed depending on the treatment approach.<sup>13-16</sup> However, studies that compared the duration of treatment on the basis of Angle classifications were usually poster abstracts presented at conferences and there were no detailed studies available.<sup>13</sup>

In this study, the average treatment period for 387 patients was found as 27.8 months. Fischer et al.<sup>7</sup> conducted a study with 400 patients between the ages of 9 and 18, and classified the treatments that lasted 20 months or less as 'short' and treatments that lasted 30 months or more as 'long'. However, no information was provided if there was a price difference between short and long treatments. Furthermore, they found the average treatment period as 25.3 months. In their study, which was close to the number of patients in this study, similar findings were observed despite the fact that the average duration of treatment was slightly shorter than this study. Another study showing a similarity with this one on the treatment period is the study by Beckwith et al.<sup>14</sup> They conducted a study in five different orthodontic clinics with 140 patients. In that retrospective study, the average treatment period was found to be 28.6 months, a little longer than the findings of our study. Similarly, Fink and Smith<sup>15</sup> demonstrated the average duration of treatment for 118 patients treated in an orthodontic clinic as 23.1 months. There was a significant difference between our findings and those of Haralabakis et al.<sup>16</sup>, who found that the average duration of treatment to be 19.9 months in their study. The reason of this difference may result from the fact that most patients were treated without extraction.

Haralabakis et al.<sup>16</sup> found that the age of the patient, molar relation based on Angle classification, and the number of tooth extractions affected the duration of treatment significantly. In our study, the average age of Angle Class I patients was 14.73 years; in Angle Class II patients, it was 14.70 years; and in Angle Class III patients, it was 14.25 years. The fact that there was no significant difference among groups based on the average age of patients enabled us to separate the age factor from other variables. Thus, in comparing the treatment periods of the 3 groups, the age factor was easily eliminated.

Out of 387 patients, with similar average age and duration of treatment, who finished the orthodontic treatment and were divided into three groups on the basis of the Angle classification, 78 patients had Class I (20.2%), 254 patients had Class II (65.6%), and 55 patients had Class III malocclusions (14.2%). This finding shows similarities with the study by Gelgor et al.<sup>6</sup> conducted with 2329 patients (12-17 years, average age: 14.6 years). Conducted in 2007, that study confirmed Class I malocclusion in 812 (34.9%) patients, Class II in 1041 (44.7%) patients, and Class III in 240 (10.3%) patients. Even though the most common malocclusion type witnessed in that study was observed as Class II malocclusion, there was no significant difference when compared to the lesser prevalent Class I and Class III malocclusions.

Kamak et al.<sup>17</sup> evaluated the need for orthodontic treatment and various variables using the ICON index on patients who applied for orthodontic treatment. They observed that the need for treatment of Angle Class I and Class II anomalies was alike. Furthermore, in that study like ours, Class II cases were the most common in the selected patient population. However, in certain prevalence studies, it has been reported that Class I malocclusions were the most common malocclusion type.<sup>17</sup> In a prevalence study by Sayin and Turkkahraman<sup>18</sup>, conducted with 1356 patients in 2003, 64% had Class I, 24% had Class II, and 12% had Class III malocclusions. The reason for that difference could be explained by the fact that, in our study the patient group was

lected from the patients treated in the orthodontics clinic; while in the other study, the patients were selected from the total patients who applied to the hospital and had not been treated yet.

The prevalence of malocclusions differed between different populations or ethnic groups, and the treatment durations differed as well based on the severity of these malocclusions. Even though the most prevalent malocclusion type appeared to be Class II malocclusion, when compared on the basis of the duration of treatment, there was no significant difference found between Class II and the lesser observed Class I and Class III malocclusions. It could be argued that the factors affecting the duration of treatment such as transversal maxillary insufficiency, extreme crowding cases requiring extraction, orthognathic surgery cases, or patient coordination defects (missing appointments, poor oral hygiene, bracket failure etc.) could be observed in any classification.<sup>14, 19</sup> Furthermore, many simple cases in the population were usually accepted to the treatment by dentists, private orthodontists, and in the Oral and Dental Health Centers of the Ministry of Health in Turkey. This also means that more difficult cases in the population (Angle Class I, II, III) were treated in the university clinics. Thus, most of the patients who applied to university clinics were already difficult and problematic cases (Angle Class I, II, III).

The pricing (the payments made by the public sector to the institutions) in Turkey is calculated on the basis of Angle classification (Class I, II, III). In terms of payments, Angle Class I anomalies are considered as simple, Class II anomalies as medium, and Class III anomalies as hard cases. The degree of difficulty of the cases, labor, and time spent are not considered. Our study demonstrated that there was no difference between the classes (Angle Class I, II, III) in relation to the duration of treatment.

The lack of a significant difference between the duration of treatment of the patients with Class I malocclusions and those of patients with Class II and III malocclusions should imply that each classification could contain different malformations in varying severities. Extraction treatment of an Angle Class I patient with anterior crowding could be similar in terms of duration and labor with the treatment of a Class II or Class III patient with only a well-leveled skeletal problem. Studies have conferred that treatments with extraction lasted longer than those without extraction, and single-phase treatments shorten the duration of treatment.<sup>13, 16</sup> Furthermore, independent of the malocclusion, the existence of a unilaterally or bilaterally impacted canine could lengthen the duration of the treatment.<sup>20, 21</sup> As per such examples and the findings of this study, it could be determined that a pricing solely based on classification is not sufficient, or fair, with respect to the labor/cost balance.

Orthodontists working in private practice, or in foreign countries, set their variable prices according to the severity of malocclusions and the time that will be spent on treatment.<sup>22</sup> Many irregularities that could be resolved by extraction or by widening the dental arch and midline deviation, or extreme overjet, require more difficult corrections. These malformations could make progress difficult in the orthodontic treatment.<sup>23</sup> In cases where an additional appliance is needed to shorten the duration of treatment, causing an increase in the price, it has been reported that 20% of the orthodontists replying to a survey stated that they increased

the price and their patients approved this increase.<sup>24</sup> This finding demonstrates that the use of high-priced appliances satisfying the need for short-term treatment becomes popular.

When evaluated for labor/cost and prices in orthodontic treatment, it can be observed that the scientific foundation of treatment charging based on Angle classifications (Angle Class I, II and III) is rather inadequate for the orthodontists' salary as determined by the Ministry of Health, and supplied by the official insurance company. In our opinion, the salary of clinicians giving orthodontic treatment services is not at a satisfying level. Furthermore, institutional payments are made in sums and retention treatments are excluded. When the labor and time spent for a retention treatment (a process that requires at least 1 year follow-up) are considered, most cases could be classified as a difficult case since the durations of treatment for the patients (Angle Class I, II, and III) treated in this, or other faculty hospitals, would increase considerably.

In light of the information presented above, payments are made on the basis of the malocclusion type and not based on the labor spent. As a result, Class I patients generate the lowest invoices, while Class III patients generate the highest one. Besides this, the retention treatment was also included in the sum paid to the hospitals. However, the duration of treatment and the effort spent can differ depend on the severity of the malocclusion, not on the type of the malocclusion.<sup>13, 14, 16</sup> As the difficulty and severity increases, the duration of treatment extends and the labor spent multiplies.

When the charge of orthodontic treatment services is determined, efforts spent (time) should be evaluated with objective (fair) criteria. A labor/cost balance should be provided through similar studies and the amount of institutional dues should be made according to these scientific facts. To establish this balance will be an important milestone in increasing the motivation of clinicians, improving the quality of service for the patients, and sustaining efficient healthcare services to ensure patient satisfaction.

## CONCLUSION

In this study, it has been observed that a large majority of the patients that applied to our orthodontics clinic (65.6%) had Angle Class II malocclusion.

- Duration of orthodontic treatment lasted between 20 and 30 months (44.7%) or over 30 months (36.7%) (Excluding the retention period).
- In this study, when the average treatment periods of the patients with Angle Class I malocclusions were compared with those of Class II and Class III malocclusions, no significant difference was found related to the duration of treatment.
- Within each classification, there could be severe anomalies (showing the need for treatment) and problematic malformations in the highest degree.
- Determination of pricing on the basis of scientific data and establishment of labor/cost balance accordingly is of importance in sustaining institutional achievement and in the compensation of efforts spent.

## REFERENCES

1. Reitan K. Clinical and histologic observations on tooth movement during and after orthodontic treatment. *Am J Orthod* 1967; 53: 721-45. [\[CrossRef\]](#)
2. Steigman S, Michaeli Y, Weinreb M. Structural changes in the dental and periodontal tissues of the rat incisor following application of orthodontic loads. *Am J Orthod Dentofacial Orthop* 1987; 91: 41-56. [\[CrossRef\]](#)
3. Angle EH. Treatment of malocclusion of the teeth. Angle's system. 7th edition. Philadelphia, S.S. White Company, 1907.
4. Celikoglu M, Akpınar S, Yavuz I. The pattern of malocclusion in a sample of orthodontic patients from Turkey. *Med Oral Patol Oral Cir Bucal* 2010; 15: 791-6. [\[CrossRef\]](#)
5. Uslu O, Akcam MO, Evirgen S, Cebeci I. Prevalence of dental anomalies in different orthodontic malocclusions. *Am J Orthod Dentofacial Orthop* 2009; 135: 328-35. [\[CrossRef\]](#)
6. Gelgor IE, Karaman AI, Ercan E. Prevalence of malocclusion among adolescents in central anatolia. *Eur J Dent* 2007; 1: 125-31.
7. Fisher MA, Wenger RM, Hans MG. Pretreatment characteristics associated with orthodontic treatment duration. *Am J Orthod Dentofacial Orthop* 2010; 137: 178-86. [\[CrossRef\]](#)
8. Tausche E, Luck O, Harzer W. Prevalence of malocclusion in the early mixed dentition and orthodontic treatment need. *Eur J Orthod* 2004; 25: 237-44. [\[CrossRef\]](#)
9. Hamdan AM. The relationship between patient, parent and clinician perceived need and normative orthodontic treatment need. *Eur J Orthod* 2004; 26: 265-71. [\[CrossRef\]](#)
10. Güray E, Orhan M, Ertas E, Doruk C. Konya Yoresi ilkokul çocuklarında treatment priority index (tpi) uygulaması (epidemiolojik çalışma). *Turk Ortodonti Derg* 1994; 7: 195-200. [\[CrossRef\]](#)
11. Ugur T, Ciger S, Aksoy A, Telli A. An epidemiologic survey using the Treatment Priority Index (TPI). *Eur J Orthod* 1998; 20: 189-93. [\[CrossRef\]](#)
12. Ucuncu N, Ertugay E. The use of the index of orthodontic treatment need (IOTN) in a school population and referred population. *J Orthod* 2001; 28: 45-52. [\[CrossRef\]](#)
13. Mavreas D, Athanasiou AE. Factors affecting the duration of orthodontic treatment: A systematic review. *Eur J Orthod* 2008; 30: 386-95. [\[CrossRef\]](#)
14. Beckwith FR, Ackerman RJ, Cobb CM, Tira DE. An evaluation of factors affecting duration of orthodontic treatment. *Am J Orthod Dentofacial Orthop* 1999; 115: 439-47. [\[CrossRef\]](#)
15. Fink DF, Smith RJ. The duration of orthodontic treatment. *Am J Orthod Dentofacial Orthop* 1992; 102: 45-51. [\[CrossRef\]](#)
16. Haralabakis NB, Tsiliagkou K. The effect of six variables and their interrelation on the duration of orthodontic treatment. *Hell Orthod Rev* 2004; 7: 45-57.
17. Kamak H, Gelgor IE, Keklik H. Determination of orthodontic treatment need for individuals in pubertal growth period and effects of different variables on the treatment needs with using the ICON Index. *Turkish J Orthod* 2012; 25: 113-21. [\[CrossRef\]](#)
18. Sayin OM, Turkkahraman H. Malocclusion and crowding in an orthodontically referred Turkish population. *Angle Orthod* 2004; 74: 635-9.
19. Skidmore KJ, Brook KJ, Thomson WM, Harding WJ. Factors influencing treatment time in orthodontic patients. *Am J Orthod Dentofacial Orthop* 2006; 129: 230-8. [\[CrossRef\]](#)
20. Stewart JA, Heo G, Glover KE, Williamson PC, Lam EW, Major PW. Factors that relate to treatment duration for patients with palatally impacted maxillary canines. *Am J Orthod Dentofacial Orthop* 2001; 119: 216-25. [\[CrossRef\]](#)
21. Iramaneerat S, Cunningham SJ, Horrocks EN. The effect of two alternative methods of canine exposure upon subsequent duration of orthodontic treatment. *Int J Pediatr Dent* 1998; 8: 123-9. [\[CrossRef\]](#)
22. Petrone J, Fishell J, Berk NW, Kapur R, Sciote J, Weyant RJ. Relationship of malocclusion severity and treatment fee to consumer's expectation of treatment outcome. *Am J Orthod Dentofacial Orthop* 2003; 124: 41-5. [\[CrossRef\]](#)
23. De Guzman L, Bahiraei D, Vig KWL, Vig PS, Weyant RJ, O'Brien K. The validation of the Peer Assessment Rating Index for malocclusion severity and treatment difficulty. *Am J Orthod Dentofacial Orthop* 1995; 107: 172-6. [\[CrossRef\]](#)
24. Uribe F, Padala S, Allareddy V, Nanda R. Patients', parents', and orthodontists' perceptions of the need for and costs of additional procedures to reduce treatment time. *Am J Orthod Dentofacial Orthop* 2014; 145: 65-73. [\[CrossRef\]](#)