Review Article

Factors affecting orthodontic treatment time and how to predict it

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ABSTRACT

Orthodontic treatment time has been associated with certain parameters that can affect the different aspects of treatment regards to the patient and orthodontist. Therefore, a large set of research has focused on studying these factors. Many factors have been proposed in the literature as significant predictors for prolonged orthodontic treatment duration. In general, these factors are related to the patient, orthodontist, procedure, and severity of the underlying condition. Acquiring more knowledge about these factors can help orthodontists speed up the treatment plan, which might enhance the treatment outcomes and enhance the levels of satisfaction. In the current study, we have provided updated evidence regarding the different factors affecting orthodontic treatment time according to evidence from studies in the literature. Many factors were reported, including factors related to the procedure and the underlying condition, and factors related to the patient and orthodontist. Increasing knowledge and experience of the orthodontist might increase the level of satisfaction as it has been reported to significantly reduce the treatment duration. However, this should be accompanied by adequate patient compliance, which was also reported to be a significant predictor for prolonged treatment duration. Investigating the application of recent modalities that can speed up the treatment plan is not adequately validated, indicating the need for future validating studies.

Keywords: Orthodontic, Treatment, Dentistry, Treatment time, Malocclusion

INTRODUCTION

Orthodontists and their patients have always been concerned about the duration of orthodontic treatment, which might have influenced the treatment outcomes related to patient satisfaction. Patients try to predict the treatment cost by making a correlation between the treatment duration and costs, sense of comfort, and quality of treatment.[1] On the other hand, reduced treatment duration is also beneficial to the orthodontist which might acquire further trust from their patients. Furthermore, some studies reported that root resorption was significantly associated with prolonged treatment procedures, indicating that shorter treatment procedures might intervene against the development of some treatment-related burdens.[2-4]

Many factors have been proposed in the literature as significant predictors for prolonged orthodontic treatment duration. In general, these factors are related to the patient, orthodontist, procedure, and severity of the underlying condition.[5,6] Acquiring more knowledge about these factors can help orthodontists speed up the treatment plan, which might enhance the treatment outcomes and enhance the levels of satisfaction. In the present literature review, we aim to discuss the different factors affecting orthodontic treatment time according to evidence from studies in the literature.

LITERATURE REVIEW

This literature review is based on an extensive literature search in Medline, Cochrane, and EMBASE databases which was performed on 3rd October 2021 using the medical subject headings (MeSH) or a combination of all possible related terms, according to the database. To avoid missing poetential studies, a further manual search for papers was done through Google Scholar and the reference lists of the initially included papers. Studies discussing the factors affecting orthodontic treatment time were screened for useful information, with no limitations posed on date, language, age of participants, or publication type.

DISCUSSION

Many factors have been proposed and validated as significant predictors that can affect orthodontic treatment time. Among these factors, the type of malocclusion was investigated by different investigations in the literature, and validated the associated treatment options. Studies show that the severity of malocclusion and complexity of the underlying case are significant predictors for prolonged orthodontic treatment.[7-9] Besides, the discrepancy index (DI) of the American board of orthodontics has reported that it is significantly correlated with the time of orthodontic treatment. For instance, it has been demonstrated that cases with ≤15 DI had a significantly reduced treatment time that is usually <22 months. On the other hand, cases with >15 DI had significantly prolonged orthodontic time that is usually >30 months. Accordingly, it has been demonstrated that the orthodontic treatment time is expected to be prolonged by 85% for more than 22 months if the estimated DI was >15.[7] Increased treatment time was also reported among previous investigations following premolar extractions.[1,9-14] However, evidence is still controversial about the significance of this association.[1,15,16] This correlation between premolar extraction and the orthodontic treatment time has been proposed because such procedures are usually performed for more complex cases, in addition to the need to perform a further surgical step to achieve adequate space closure. In this context, a previous investigation demonstrated that in these cases, the treatment time can be significantly shortened for up to 8 months if interproximal stripping was used to avoid performing an

extraction.[14] Evidence also shows that both class I and II had similar orthodontic treatment durations in the settings of first premolar extraction (28.95 and 28.10 months, respectively). However, it is worth mentioning that the authors also reported that the occlusal outcomes were significantly better among the included class I cases.[17]

Another factor that has been reported to predict treatment time is the number of extractions. In this context, a previous investigation reported that the estimated orthodontic treatment time was 26.18, 25, and 21.95 months for cases with four extractions, two extractions, and without extractions, respectively.[18] However, it should be noted that there are no solid conclusions about the duration that is usually prolonged following orthodontic time when performing different extractions, and it has been suggested that it might last from 1.4 to 7.8 months.[1,8] The tooth movement rate and the amount of space needing closure were previously proposed as significant factors that can predict and justify these variations. Studies also show that other factors should also be adequately assessed for adequate validation of these cases. For instance, age, planning, mechanics of choice, degree of crowding, degree of anterior retraction, number of extractions, and which teeth will be extracted were reported to be potential predictors of the orthodontic time.[11,12,14,17-19] Studies have also reported that treatment is usually prolonged for class II cases. Different studies have reported that the treatment of these cases is usually 5-7.4 months longer than class I cases.[7,8,13,16] Vertical pattern, overjet ≥5 mm, ANB angle, and molar relationship were all significant factors that can significantly prolong the treatment time for class II patients.[9,16,18]

Evidence also shows that orthodontic time can be significantly influenced by the approached correction method. For instance, increased orthodontic time for up to 6 months was significantly correlated with extraoral anchorage. Increased time for 8-9 months was also reported when Herbst appliances were used. A period of 3.4 months was also estimated when rapid maxillary expansion was approached based on previous investigations.[1,8,16] Increased time for class II cases was also attributed to the use of elastics.[16] In this context, it has been demonstrated that using Forsus was significantly associated with reduced treatment time in 2.5 months as compared to the use of elastics.[20] Furthermore, a previous investigation reported that there are no clinical differences between one and two-phase treatment of class II cases. Nevertheless, the treatment time seems to be longer with the latter, being ≥8 months in such cases.[1,15] The presence of extractions with the treatment of class II cases can also significantly prolong the treatment period.[11,12,18] In this context, some previous studies reported that shortened treatment time and better occlusal outcomes were significantly associated with two maxillary teeth extraction protocols of class II cases than the four-extraction protocol.[12,17] The latter has been reported to require more patient compliance, in addition

to the need for more complex mechanics.[17] The estimated periods for both protocols were found to be 28.12 and 23.52 months for class II cases with four and two extractions, respectively. An increased anterior retraction was also reported to increase the duration of treatment, and treatment was reported to significantly increase from 24.35 to 30.13 months.[12] On the other hand, it has been demonstrated that the presence of crowding can significantly shorten the treatment period because it reduces the amount of movement by minimizing spaces at the treatment onset. Regarding the treatment time of class III cases, no sufficient evidence has been provided in the literature. However, a previous investigation reported that a treatment duration of 30.27 months has been estimated for the non-surgical approaches.[8] Increased treatment time >30 months has also been significantly associated with having an SNB <75º.[9] Patient compliance also seems to be a significant predictor for the treatment duration of class III cases that is most probably attributable to the different treatment methods that are approached in these situations.

Although many controversies are present in the literature, an association was previously proposed between the duration of orthodontic treatment and performing orthognathic surgery. Based on the type of surgery, malocclusion severity, and skeletal disharmony, the duration of treatment can vary, and a previous study estimated that in average cases, the treatment duration is 18-36 months.[21-24] Estimates also show that the pre-and post-surgical usually last between 15-24 and 6-12 months, respectively.[23,24] Increased duration of the pre-surgical phase was also significantly associated with performing extractions.[24] Transverse corrections might also increase the time of orthodontic treatment. This has been attributed to increased frequency of relapse, increased time for stabilization, and to probably being associated with more severe cases.[21] In another context, previous studies have reported that the impact of socioeconomic status, age, and sex on the treatment duration is not well-evident.[7,9,13,25] For instance, some studies reported that age is not significantly correlated with the treatment duration, however, other investigations indicated that reduced treatment time was significant among older patients, which is probably attributable to the increased rate of compliance among these patients.[1,15,16,18] Nevertheless, other investigations demonstrated that age is not a significant predictor, but the time of dental development is. Therefore, evidence shows that a longer treatment time is usually associated with the presence of deciduous teeth at treatment at the onset of treatment approaches.[9]

Other factors that might increase the treatment time are related to the orthodontist and the patient. Studies show that experience and knowledge of the orthodontist are critical in determining the duration of orthodontic treatment. Level of quality, standards of care, and treatment planning by the orthodontist are also important factors and can significantly predict the treatment time.[1,15]

Accordingly, these factors can be used to explain the variations in treatment time among the different settings.[16] Planning and diagnostic mistakes can also increase the treatment duration, and therefore, current evidence indicates that the experience of the orthodontist is an essential factor that can significantly reduce or prolong the treatment time.[8,16,26] Reduced treatment time was associated with keeping short intervals among appointments or keeping frequent follow-up appointments, which has been reported to attribute to keeping treatment under control in the corresponding cases.[7,26,27] Patient satisfaction might also be associated with the enhanced outcomes, and the economic advantages that come secondary to the enhanced quality and reduced treatment duration. On the other hand, some orthodontists reported that reduced treatment time can also reduce the economic advantages.[21]

Factors related to patient compliance were also extensively studied in the literature. For instance, appliance breakage, insufficient oral hygiene, reduced use of accessory devices, and missing appointments were all reported factors that increase the treatment duration.[1,8,13,18,28] Each of these factors can add to the prolonged treatment time from 0.6 to 1.4 months to the total estimated time for the different orthodontic treatments.[1,13] In this context, a previous study indicated that urging the patient to comply with the treatment plan was significantly associated with reduced treatment duration.[28] Accordingly, it is recommended that the continued motivation of patients to comply with the proposed treatment plan is essential and should be practiced in these settings to enhance the associated outcomes. The effect of using different orthodontic appliances on the treatment duration was also investigated in the literature. Nevertheless, the expected favorable events from using new modalities were not adequately reported in the literature. For instance, studies demonstrated that based on the types of brackets that were used for the orthodontic treatment, no significant differences were noticed regarding the duration, irrespective of the clinical outcomes and other advantages that can be observed when using some types over others.[1,10,21,25,29] Additional studies also showed that alignment wire sequence, prescriptions, and slot dimensions are not significantly associated with the treatment duration.[30-32]

Although it has been evidenced that reduced adverse events are associated with the use of temporary anchorage devices, no effect was noticed on the treatment duration.[33] Validating the association between indirect bonding and treatment duration was not also adequate in the current literature, although it has been demonstrated that it can offer more comfort to the patient and reduce the appliance placement time.[34] Although fixed appliances are associated with better treatment outcomes, the treatment duration with these modalities was longer than the duration using aligners. The effect of the recent approaches to increase tooth movement on the treatment

time was also reported. Nonetheless, no sufficient evidence was validated for this association.[35] These approaches include different mechanical and physical methods that can speed up the tooth movements and facilitate the relevant surgical processes. For instance, a mild association between using laser therapy and treatment duration was found in the literature. In the same context, using vibration forces did not also influence the treatment duration, and therefore, further evidence is needed to adequately validate the impact of these factors.[36-38]

CONCLUSION

Increasing knowledge and experience of the orthodontist might increase the level of satisfaction as it has been reported to reduce the treatment duration significantly. However, this should be accompanied by adequate patient compliance, which was also reported to be a significant predictor for prolonged treatment duration. Investigating the application of recent modalities that can speed up the treatment plan is not adequately validated, indicating the need for future validating studies.

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