Original Article

Comparative time efficiency of aligner therapy and conventional edgewise braces

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ABSTRACT

Objective: To compare the time efficiency of aligner therapy (ALT) and conventional edgewise braces (CEB) based on large samples of patients treated by the same highly experienced orthodontist, with the same treatment goals for both groups of patients.

Materials and Methods: The retrospective portion of the study evaluated 150 CEB patients who were matched, based on mandibular crowding and number of rotated teeth, to 150 ALT patients. All records were obtained at one orthodontist's office. All of the patients had mild-to-moderate Class I malocclusions ($\leq$5 mm incisor crowding) and were treated nonextraction. Age, gender, total treatment time, total number of appointments, types of appointments, materials used, mandibular crowding, and number of rotated teeth were recorded from the patients' records. The prospective portion of the study timed the various types of appointments for both treatments with a stopwatch.

Results: Compared to ALT, CEB required significantly ($P < .01$) more visits (approximately 4.0), a longer treatment duration (5.5 months), more emergency visits (1.0), greater emergency chair time (7.0 minutes), and greater total chair time (93.4 minutes). However, ALT showed significantly ($P < .01$) greater total material costs and required significantly more total doctor time than CEB ($P < .01$).

Conclusions: Whether the greater time efficiency of ALT offsets the greater material costs and doctor time required depends on the experience of the orthodontist and the number of ALT case starts. (*Angle Orthod.* 2014;84:391–396.)

KEY WORDS: Efficiency; Aligner therapy; Chair time; Doctor time

INTRODUCTION

Time efficiency is an important outcome measure for private practice orthodontists because it often determines the type of treatment modality that is used. For example, self-ligating brackets have been shown to be more efficient than conventional edgewise brackets in terms of total chair time and treatment duration.[1–4] For the orthodontist, it is just as important to base treatment efficiency on total doctor time, total chair time, and material costs.

In 1999, Align Technology introduced a new form of treatment, which consists of a series of computer-generated, clear, and removable aligners.[5] Esthetics has been shown to be the major concern of patients who elect to undergo the clear aligner treatment (ALT).[6] Other benefits include the ability to remove the aligners to eat, the enhanced ability to brush and floss, and treatment that does not involve metal that can irritate the cheeks and gums.[7] The total number of appointments required for ALT cases, the percentages of patients requiring midcourse corrections, and the number of patients requiring fixed appliances all depend on the pretreatment complexity of the treatments.[8]

It is presently unclear how—in terms of treatment efficiency—ALT compares to conventional edgewise braces (CEB) treatment. The present study was designed to evaluate ALT and CEB based on patients treated by one highly experienced orthodontist, who had the same objectives for all patients. The study goes beyond previous evaluations of efficiency by (1)

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Table 1. Medians and Interquartile Ranges (IQR) of Total Chair Time and Doctor Time for the Four Types of Appointments, Along With Comparisons of Differences Between Aligner Therapy and Conventional Edgewise Braces

	Aligner Therapy					Conventional Braces					Group Differences	
		Chair		Doctor			Chair		Doctor		Chair	Doctor
	N	Median	IQR	Median	IQR	N	Median	IQR	Median	IQR	*P* Value	*P* Value
Initial	20	23.5	7.0	1.0	2.9	27	29.5	18.3	3.3	1.75	.058	.001
Routine	54	9.6	9.7	3.9	4.3	60	13.6	11.6	2.0	2.0	.005	<.001
Emergency	5	6.5	6.0	2.3	6.9	20	9.1	10.0	0.5	1.9	.946	.212
Final	54	9.6	9.7	3.9	4.3	20	27.4	10.5	3.1	1.3	<.001	.013

ensuring that the sample patients started treatment with similar levels of complexity and (2) evaluating the actual costs in terms of both materials used and the time spent during the various phases of each treatment.

MATERIALS AND METHODS

The study includes retrospective and prospective parts. The study was approved by the Institutional Review Board at Texas A&M University Baylor College of Dentistry. The retrospective part evaluated the records of 150 patients treated with CEB and 150 patients treated with ALT. All records were obtained at one orthodontist's office (DC). Consecutively treated patients, starting with the most recently completed, fulfilling the following selection criteria were included in the study: pretreatment Class I molar and canine relationships, nonextraction treatments, and mandibular crowding of 5 mm or less. Patient records were rejected if they had anterior or posterior crossbites, anterior or lateral open bites, or overjets exceeding 4 mm. ALT patients who went into braces were excluded from the study. The retrospective ALT sample was first identified, and the CEB sample was matched to the ALT sample based on mandibular crowding and number of rotated teeth. The CEB sample was treated with the Alexander Discipline prescription; the archwire sequence went from 0.016-inch nickel-titanium, to 0.016-inch stainless steel, and then to 0.016 × 0.022-inch stainless steel.

Patient Record Analysis

Each patient's record was reviewed to determine age, sex, mandibular crowding, number of teeth rotated more than 45° or displaced more than 2 mm, total treatment time, total number of appointments, and types of appointments. The types and number of materials used were also assessed based on the information provided on the patient records. Although the lab fee can vary depending on the number of cases treated by the orthodontist, the ALT lab fee used in the present study was $1549. For ALT patients, each impression cost the orthodontist $20.75, which includes the costs of Penta Putty (3M, St Paul Minn) fast-set impression material and Blu-Mouse (Parkell, Edgewood, NY). Each patient received one impression at the initial ALT appointment; if the patient required a midcourse correction, they received an additional impression at the same cost. For the patients with traditional braces, the material cost was calculated based on the number and types of wires, number of brackets used, bonding material, primer, flame tip bur, and an after-care kit.

The amount of crowding in the mandibular arch was assessed by a visual index of the mandibular occlusal photographs.[9] Patients were separated into five categories based on the amount of crowding present: group 1 = 0–1 mm, group 2 = 1–2 mm, group 3 = 2–3 mm, group 4 = 3–4 mm, and group 5 = 4–5 mm. To determine intraexaminer reliability of the mandibular crowding, 20 mandibular occlusal photographs were randomly selected, assessed, and reassessed 24 hours later. Cronbach alpha for crowding and rotation were 0.97 and 1.00, respectively.

Two investigators examined each patient record and tallied the number of appointments for each patient. Both groups had four different types of appointments. For the ALT patients, the appointments were classified as an initial impression appointment, routine appointments including aligner delivery and midcourse corrections, emergency appointments, and final ALT appointments. For the CEB patients, the appointments

Table 2. Comparisons of the Aligners and Conventional Edgewise Braces Patient Groups Prior to Treatment[a]

	Aligners		Conventional Braces		Group Differences
	Median	IQR	Median	IQR	*P* Value
Age	29.0	22.3	13.0	3.0	<.001
Crowding	3.0	2.0	3.0	2.0	.246
Rotations	0.0	1.0	1.0	1.0	.458

[a] IQR indicates interquartile range.

Table 3. Number of Visits and Treatment Duration for Aligner Therapy and Conventional Edgewise Braces[a]

		Aligner Therapy		Conventional Braces		Group Differences
Measure	Units	Median	IQR	Median	IQR	*P* Value
Appointments	N	8.0	5.0	12.0	4.0	<.001
Duration	Months	11.5	7.2	17.0	5.5	<.001

[a] IQR indicates interquartile range.

were classified as initial banding and bonding, routine appointments, emergency, or final debanding. Records appointments, consultations, and retainer appointments were not included in the analysis because they are the same for both the CEB and ALT patients.

Timing

The prospective part of the study determined the duration of chair and doctor time for each of the four types of appointment. Consecutive patients entering the office were timed with a stopwatch; the duration of each appointment was rounded to the nearest 15 seconds. Total chair time began when the patient sat in the chair and ended when they stood up to leave. Doctor time included the total amount of time the doctor spent with the patient, whether talking or working on them.

Because the times that were collected during the prospective phase of the study were not normally distributed, they were described in medians and interquartile ranges, and the groups were compared with Mann-Whitney *U*-tests.

RESULTS

Prospective Phase

A total of 133 ALT and 127 CEB visits were timed (Table 1). Median chair times were longest for initial appointments, followed by final, routine, and emergency appointments, respectively. Doctor times ranged from 4%–41% of chair time. Routine and final appointment chair times were significantly ($P < .05$) longer for CEB than ALT. Doctor time for the initial appointment was also significantly longer for CEB. In contrast, routine and final doctor times were significantly longer for ALT.

Retrospective Phase

The proportion of female patients in the ALT group was significantly ($P = .019$) higher than the proportion of female patients in the CEB group (65% vs 51%). The 150 patients treated with ALT were significantly older than the patients treated with CEB (Table 2). There were no statistically significant ($P > .05$) differences between the ALT and CEB groups in initial crowding and numbers of rotated and displaced teeth.

Compared to ALT, CEB required significantly ($P < .001$) more appointments (approximately 4) and 5.5 months longer treatment duration (Table 3). CEB also required significantly more chair time (93.4 minutes) than ALT, including longer (74.4 minutes) routine visits, longer (7 minutes) emergency visits, and longer (17.8 minutes) final visits (Table 4).

In contrast, ALT required significantly more doctor time than CEB, including longer routine visits, longer emergency visits, and longer final visits (Table 5). CEB required longer initial visits than ALT. ALT had significantly higher total material costs than traditional braces, $1569 vs $95.

DISCUSSION

Invisalign treatment duration was 67% shorter than CEB treatment. ALT patients were treated for 11.5 months, whereas CEB patients required 17 months. The duration for CEB was 2–14 months shorter than previously reported for nonextraction patients,[10–14] which was probably due to the fact that all the patients had mild-to-moderate Class I malocclusions. The fact that the ALT patients were significantly older than the CEB patients should have had no effect on treatment duration.[15] Treatment duration of the CEB patients compares more closely to the durations (15.8–18.3 months) reported for other

Table 4. Total Chair Times (Minutes) With Aligner Therapy and Conventional Edgewise Braces[a]

	Aligner Therapy		Conventional Braces		Group Differences
Measure	Median	IQR	Median	IQR	*P* Value
Initial	36.6	23.5	29.5	0	.066
Routine	48.0	28.6	122.4	41.2	<.001
Emergency	0.0	0.0	7.0	14.0	<.001
Final	9.6	0.0	27.4	0.0	<.001
Total	92.9	59.8	186.3	40.8	<.001

[a] IQR indicates interquartile range.

Table 5. Doctor Times (Minutes) With Aligner Therapy and Conventional Edgewise Braces

	Aligner Therapy		Conventional Braces		Group Differences
Measure	Median	IQR	Median	IQR	*P* Value
Initial	0	0	29.5	0	<.001
Routine	19.4	11.6	18.0	6.0	<.001
Emergency	0.0	0.0	0.0	0.0	<.001
Final	3.9	0.0	3.1	0.0	<.001
Total	24.4	13.4	24.4	6.0	.014

nonextraction patients with mild-to-moderate malocclusion treated with CEB.[4,16] The duration of ALT was shorter, most likely because it does not require a finishing or detailing phase, which can take up to 6 months for CEB.[2] The detailing phase is important for correcting minor occlusal discrepancies. A comparison of ALT and CEB based on the American Board of Orthodontics objective grading system showed that ALT did not correct malocclusions as well as conventional braces.[17] However, there is still much to learn regarding the biomechanics and efficacy of the ALT system.[18]

Even more important than duration, ALT patients had 67% fewer appointments than CEB patients. CEB patients had 12 appointments, which was four appointments fewer than previously reported for nonextraction treatments.[4,13] This difference can be explained by the time between visits, which was usually longer (1.4 months) for the patients in the present study. The duration of time between ALT appointments was also 1.4 months; there were fewer ALT appointments because treatment duration was shorter. ALT patients with good compliance were often seen at 10- to 12-week intervals, compared to a 6-week standard interval for conventional braces. Once again, the CEB patients required more appointment time due to the detailing and finishing phase of treatment.

ALT patients spent 50% less time in the chair than CEB patients. Total chair time was measured as the total time the patient was in the chair regardless of interaction from doctor or assistant. The total chair time for ALT patients was less due to fewer adjustment appointments during treatment. CEB patients required adjustments of archwires and/or brackets at each appointment, which significantly increased the total chair time. ALT trays are simply distributed to patients, in most instances with fewer appointments needing adjustments. During ALT treatment, patients often have a few appointments for interproximal reductions or the delivery of auxiliary attachments. However, the majority of the ALT appointments only involve distributing the next set of trays. Importantly, having 50% less chair time enables more patients to be seen by the orthodontist, which increases efficiency and profitability.

Emergency visits are not common with ALT treatment because there are few auxiliary parts that are likely to break. Although CEB patients had a significantly higher number of emergency visits, both groups had relatively few emergency appointments, probably due to the experience of the orthodontist and the compliance of the patients. The majority of ALT patients received standard trays made of a high-quality plastic. There were no bands and brackets that had the potential to break. Also, the ALT trays are removed during eating, which eliminates the risk of breaking trays during mastication. Patients with CEB were more likely to have emergency visits due to the many removable auxiliary components that attach to the brackets.

Doctor chair time is an important measure of treatment efficiency that has not been adequately investigated. While the median total doctor time was the same for the CEB and ALT patients, ALT doctor time was significantly longer due to greater variability. For example, 25% of the ALT sample had total doctor times that were greater than 33 minutes, compared to 26 minutes for traditional braces (Figure 1). For this particular study, the orthodontist (DC) purposefully spent extra time with the ALT patients, building rapport; he took pride in spending quality time with the patients to increase their satisfaction. He spent more time with the ALT patients when there was more down time in the practice. Many orthodontists spend less time with their patients and allow the assistants

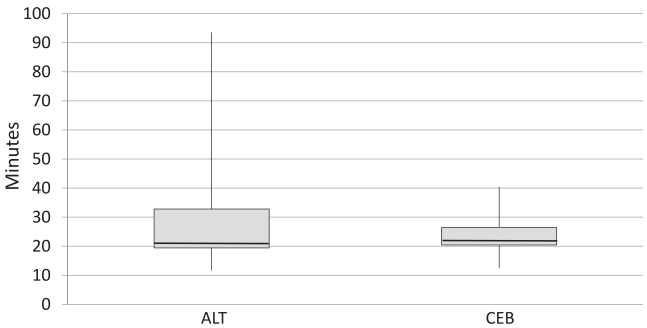

Figure 1. Total chair side doctor time for the treatment of mild-to-moderately crowded Class I patients with Aligner Therapy (ALT) and conventional edgewise brackets (CEB).

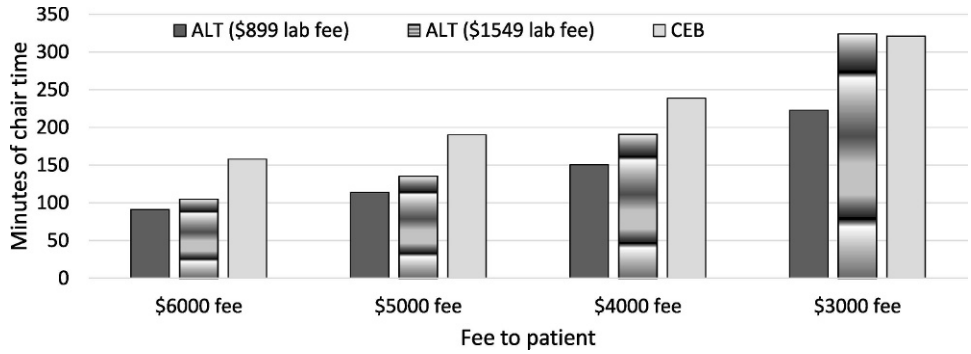

Figure 2. Minutes of chair time needed to generate $5000 after material costs for Aligner Therapy (ALT) and conventional edgewise brackets (CEB).

to deliver the aligners, which would have significantly decreased doctor time in the present study.

The actual doctor time in the present study was underestimated by approximately 20 minutes because it did not include the time required for ClinCheck© (Align Technology Inc., San Jose, CA). Prior to the initial appointment, the orthodontist had to provide a treatment plan for the ALT using ClinCheck software. The orthodontist first had to submit impressions and radiographs, which took approximately 5 minutes of doctor time. Once the ClinCheck came back to the orthodontist for review, it took approximately 15 minutes by this highly experienced orthodontist to analyze, modify, and accept the final images. Of course, these 20 minutes were spent away from patients, typically on breaks or in the evening.

Despite higher material costs, ALT can be cost effective. The standard ALT lab fees are $1549; the elite provider lab fee is $899 with a rebate. ALT determines elite provider status based on the number of case starts submitted per month. Currently, 50 semiannual patient starts are necessary in order to have elite provider status; 100 semiannual patient starts are needed to become a super elite provider, but these numbers could change over time. The total material cost for the CEB cases in the present study was only $94, which is considerably less than what even the elite ALT provider spends. For a treatment fee of $5000, an ALT elite provider would generate $4100 per case after material costs, and $3400 if he/she were not an elite provider, compared to $4906 for CEB treatment. At first glance, these costs appear to favor CEB, but chair time must also be considered. Based on the observed difference in total chair time, a CEB case would generate $4906 after material costs during 180 minutes of total chair time (Figure 2). In contrast, two ALT cases, which require the same 180 minutes of total chair time, would generate $8200 after material costs for a provider with elite status and $6800 for a provider without elite status. Based on the number of case starts needed to generate $5000, more ALT than CEB cases are needed to attain the same profit (Figure 3). The fact that ALT cases require considerably less chair time may offset the higher material costs. The elite provider fee reduces the number of cases needed in order to generate the same profit.

The actual numbers will vary greatly depending on practice dynamics that determine efficiency in a private practice setting. For example, an orthodontist with highly efficient assistants would be very profitable regardless of whether or not they use ALT due to the markedly lower material costs of CEB. Scheduling, patient management, and various other factors also affect the efficiency. Whether the greater time efficiency of ALT offsets the greater costs for materials

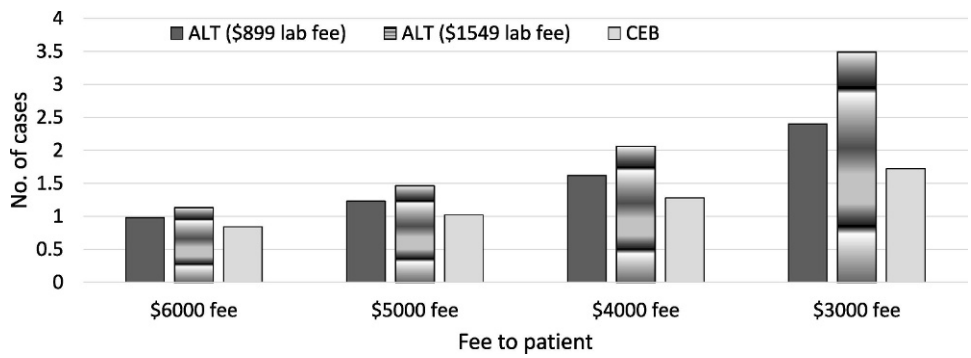

Figure 3. Number of cases needed to generate $5000 after material costs for Aligner Therapy (ALT) and conventional edgewise brackets (CEB).

required will ultimately depend on the experience of the orthodontist and the number of ALT case starts.

Patient compliance is absolutely imperative in order for ALT patients to be treated effectively and efficiently. The aligners are removable; whether or not they are worn depends on the responsibility of the patient. With braces, the orthodontist has greater control over the movement and therefore is more effective at treating the malocclusion and predicting the outcome. The efficiency and effectiveness of using ALT in practice is determined by how well patients comply with treatment.

CONCLUSION

- Whether the greater time efficiency of ALT offsets the greater material costs and doctor time required depends on the experience of the orthodontist and the number of ALT case starts.

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