

Fixed appliance orthodontic treatment duration in Brunei Darussalam

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ABSTRACT

Introduction: Fixed appliance orthodontic treatment (braces) is routinely used to address malpositions of teeth and create esthetic smiles. Although it is desirable that treatment not exceed two years but, in practice, duration of up to two-and-a-half years is deemed acceptable. This review was undertaken to determine treatment duration for routine state-funded fixed appliance treatment in Brunei Darussalam and identify possible influencing factors. **Materials and Methods:** 100 consecutive cases (Malocclusion class I [29%], II [51%] and III [20%]) of completed routine, single-phase fixed appliance treatment treated at the National Dental Centre, Bandar Seri Begawan, selected retrospectively from 31st December 2008 were reviewed for treatment duration including possible factors affecting this parameter. **Results:** Only 19% had desirable treatment duration (≤ 2 years) and 41% had acceptable treatment duration (2.01 to 2.5 years). Forty percent had treatment duration in excess of 2.5 years. Excess time due to accumulative non-optimal visit intervals, and number of adjustment visits showed significant high correlation coefficient values to treatment duration ($p < 0.01$). Extractions showed low but significant correlation to treatment duration while age revealed low negative correlation to treatment duration ($p < 0.05$). The lowest incidence of repairs occurred in those whose treatment did not exceed two years whilst the highest incidence of broken appointments was observed in those who had treatment duration in excess of three years. **Conclusions:** This retrospective review indicates that treatment duration for most of our sample is longer than desirable. The accumulative effect of non-optimal visit intervals, increased number of adjustment visits, age at start of treatment, high proportion of extraction cases, increased incidence of repairs and broken appointments may be contributory. Further investigations including prospective studies are required.

Keywords: Malocclusion, orthodontic appliances, orthodontic corrective

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INTRODUCTION

Fixed appliance orthodontic treatment (braces) is used to address problems related to malpositions of teeth (Figure 1a). By using various attachments and special wires

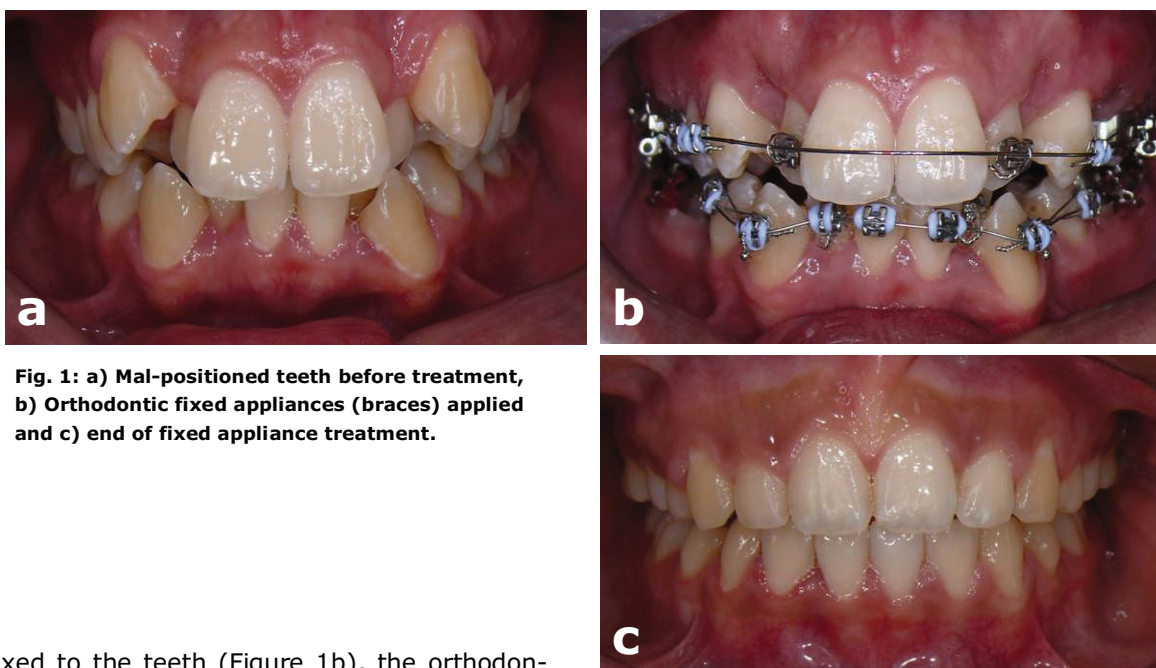


Fig. 1: a) Mal-positioned teeth before treatment, b) Orthodontic fixed appliances (braces) applied and c) end of fixed appliance treatment.

fixed to the teeth (Figure 1b), the orthodontist is able to move teeth that are out of line to achieve the desired result (Figure 1c).

Since public funded orthodontic services started in the late 1980's, demand for this service has outpaced our capability to provide and has resulted in a waiting list to start fixed appliance treatment. As the waiting period increases (minimum of 3 years in 2010), there have been repeated queries from both the public and authorities on treatment duration. Conventionally, one-and-a-half to two years^{1, 2} is usually quoted but actual treatment duration can vary considerably from practice to practice.^{1, 3-7} Although it is preferable that fixed appliance treatment not exceed two years, an acceptable upper limit can be two-and-a-half years.⁸

This study was undertaken to determine treatment duration for routine state-funded fixed appliance treatment in Brunei Darussalam and identify possible local influencing factors.

MATERIALS AND METHODS

Three orthodontists and one clinical assistant from the National Dental Centre, Ministry of Health, Brunei Darussalam, each contributed their last 25 consecutively completed upper and lower fixed appliance cases, selected retrospectively from 31st December 2008. Cases that had been started elsewhere, clefts, those who required orthodontic preparation for jaw surgery, extrusion of un-erupted teeth or multiple stage orthodontic treatment were excluded, resulting in 100 subjects who had undergone routine fixed appliance treatment.

Age at start of treatment, whether extractions were required as part of treatment, malocclusion type,⁹ number of adjustment visits to complete each case, period intervals between appointments, treatment duration, incidences of broken appointments and repairs were extracted from treatment records. Broken appointments were recorded when it was noted that the subject had failed to attend or had cancelled at late notice.

Where the records indicated that repairs to the appliances had been effected at a particular visit (due to loose attachment), this was recorded as an incidence of repair.

Definition

'**Treatment Duration**' was calculated for each subject, from when fixed appliances were fitted to when they were removed. The period between appointments was initially calculated in weeks. In order for treatment to progress after appliances are fitted, orthodontists conventionally arrange for monthly visits,³ so the optimal appointment interval for adjustment of the fixed appliances was designated as four weeks. However, there were nine subjects who had required prior adjunctive treatment to widen the upper dental arch (Figure 2) before the full set of fixed braces were fitted. Thus, for the subjects who required this adjunctive procedure (as the expansion appliance continues to work over two months), the optimal appointment interval during the period of expansion was designated as eight weeks. Any excess period from the designated optimal appointment interval was calculated for each case and totaled, then converted into years (divided by 52 weeks) and is termed as '**Excess Time**'.



Fig. 2: Adjunctive appliance to expand upper dental arch.

'**Possible Treatment Duration**' for each subject was estimated by subtracting the individual '**Excess Time**' from the actual recorded '**Treatment Duration**' for that particular subject.

Descriptive statistics were calculated for the following variables: '**Treatment Duration**', age at start of treatment, whether extractions were required for treatment or not, malocclusion type, number of adjustment visits required, '**Excess Time**' due to non-optimal appointment intervals and '**Possible Treatment Duration**'. In order to study the possible relationships between the variables noted and Treatment Duration, scatter-plot graphs and correlation coefficients were calculated using Microsoft Excel 2007 and SPSS (Statistical Package for the Social Sciences) version 13, Chicago, IL, USA.

The relationship between the incidence of repairs and broken appointments on treatment duration was inferred using Edwards and Spary's¹⁰ methods. In an audit to determine various factors influencing orthodontic treatment duration, total incidences of repairs and broken appointments were noted for subjects categorised into three treatment duration groups '**short**', '**average**' and '**extended**'. 'Incidence per subject' was calculated for each group by dividing the respective 'total incidences' by the 'number of subjects'. This allowed for easy comparison of these variables among the groups.

RESULTS

Only nineteen percent had completed treatment within two years while forty-one percent had treatment duration in the acceptable range of 2.01 to 2.5 years (Figure 3). Forty

Number of patients

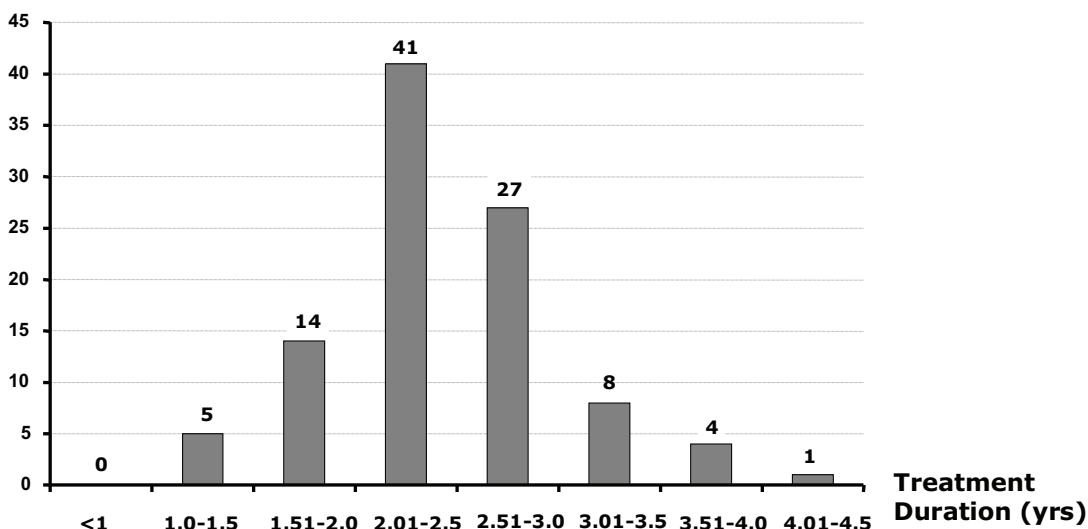


Fig. 3: Distribution of Treatment Duration for the entire sample.

percent however, revealed extended treatment duration of more than two-and-a-half years.

Table 1 shows that the average age at start of treatment was 18.09 years whilst an average of 18.88 adjustment visits were required to complete treatment. There was a wide range to treatment duration with overall mean at 2.44 years, standard deviation 0.57 and median 2.42 years. There was also a wide range to the Excess Time due to non-optimal visit intervals, revealing a mean of

0.95 years excess time, standard deviation 0.37 and median 0.87. Possible Treatment Duration revealed a mean of 1.5 years, standard deviation 0.33 and median 1.56 years. There were also inter-operator differences with operator C showing highest treatment duration values.

Distribution for the malocclusion types is shown in Figure 4. Class II malocclusions (Figure 5a) made up the majority of the sample (51%) with Class I (Figure 5b) and Class III malocclusions (Figure 5c) accounting for

Table 1: Results for Mean, Median, Standard Deviation (SD) and range.

	Sample number	Mean	Median	SD	Range
Age (years)	100	18.09	17	4.56	11.92-33.25
Adjustment visits	100	18.88	19.5	4.36	8-28
Treatment Duration	100	2.44	2.42	0.57	1.11-4.29
Excess Time	100	0.95	0.87	0.37	0.25 - 2.25
Possible Treatment Duration	100	1.50	1.56	0.33	0.55-2.11
Operator A	25	2.16	2.23	0.46	1.35-2.87
Operator B	25	2.27	2.28	0.22	1.8-2.53
Operator C	25	2.96	2.87	0.54	2.08-4.29
Operator D	25	2.39	2.43	0.62	1.11-3.72

All measurement of time is in years
Operators A, B, C are orthodontists and Operator D was the orthodontic clinical assistant who treated subjects under the supervision of the orthodontists.

Table 2: Incidence of repairs and broken appointments in various Treatments Duration (TD) groups according to Edwards and Spary's method ¹⁰ .

	Overall	Desirable TD ≤ 2 years	Acceptable TD 2.01-2.5 years	Extended TD 2.51-3 years	Much extended TD >3 years
No of subjects	100	19	41	27	13
Repairs*	0.73	0.32	0.85	0.78	0.85
Broken appointments*	1.67	1.42	1.37	1.41	3.54

* = incidence per subject, calculated as number of occurrence divided by number of subjects

29% and 20% respectively. Dental extractions as part of their treatment were required in 92% and only eight percent had been treated without extractions (Figure 4).

The number of adjustment visits and excess time were significantly highly correlated with actual Treatment Duration ($p < 0.01$). Excess Time showed the highest correlation coefficient value at 0.836. A weak but significant correlation $r = -0.21$, $p < 0.05$) was observed for age, malocclusion class, and extractions ($r = 0.36$, $p < 0.01$) with treatment duration. The scatter-plot graphs are shown in Figure 6.

An adaptation of Edwards and Spary's ¹⁰ methods is shown in Table 2 with four treatment duration groups represented. The

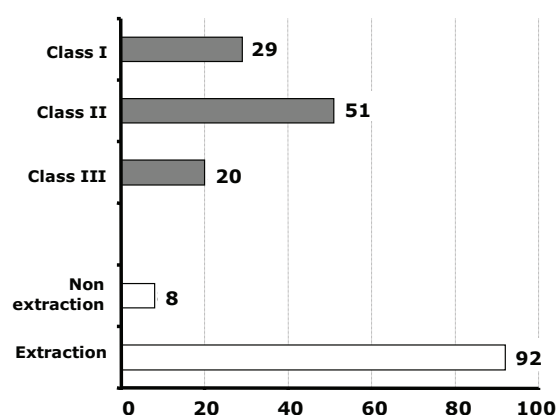
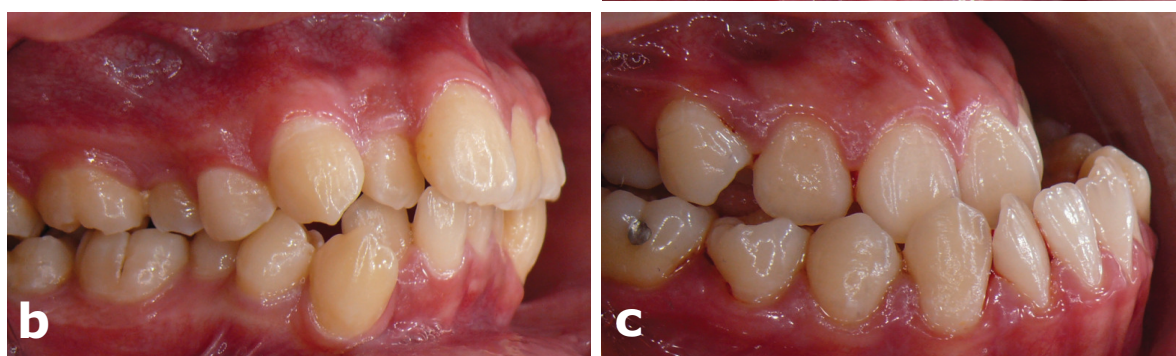


Fig. 4: Sample Distribution based on malocclusion class and extractions (n=100).

Fig. 5: Types of malocclusions, a) Class I, b) Class II and c) Class III.



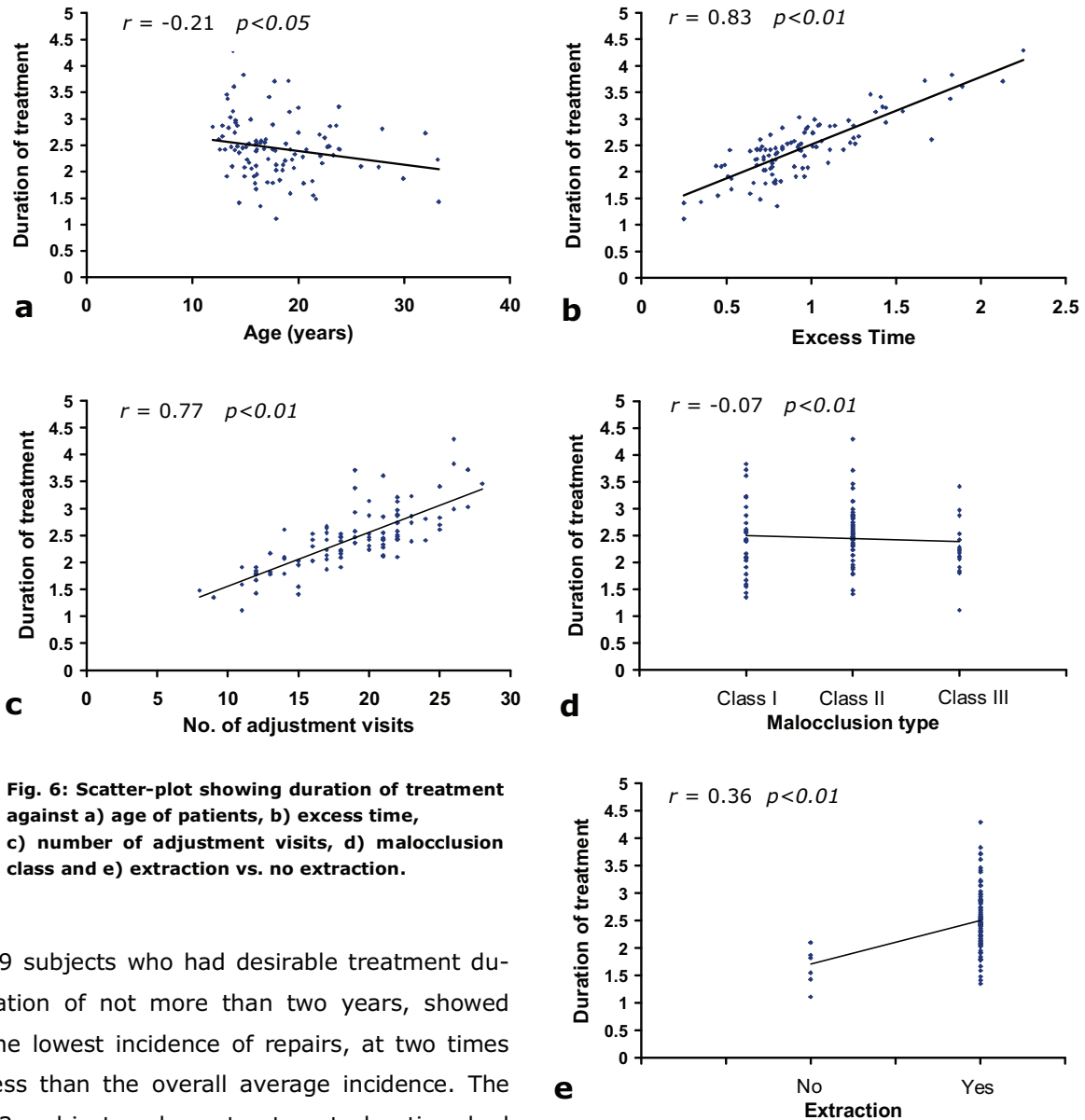


Fig. 6: Scatter-plot showing duration of treatment against a) age of patients, b) excess time, c) number of adjustment visits, d) malocclusion class and e) extraction vs. no extraction.

19 subjects who had desirable treatment duration of not more than two years, showed the lowest incidence of repairs, at two times less than the overall average incidence. The 13 subjects where treatment duration had been more than three years revealed the highest incidence of broken appointments, which was more than twice the overall average incidence.

DISCUSSIONS

In a systematic review of factors affecting orthodontic treatment, Mavreas and Athanasiou¹¹ had summarised multiple factors with varying unpredictable contributions in different practice environments. Our review sought to filter confounding variables by focusing on

routine fixed appliance cases in our practice.

Some authors have suggested that older patients,¹² Class II and III malocclusions^{5, 7} and extractions^{1, 3, 7} can extend treatment duration. The traditional assumption is that older subjects may require longer periods for tooth movement when compared to children, but some authors^{6, 13} have found that age at start of treatment does not affect treatment duration as long as treatment is

carried out in the permanent dentition.

Class II and III malocclusions differ from Class I in that besides having to align teeth within the form of the dental arch (which occurs in Class I malocclusions), for the Class II and III, the orthodontist also has to move the anterior teeth in the antero-posterior plane. This implies that more tooth movement is required in Class II and III types of malocclusions, and hence treatment may take longer. Mavreas and Athanasiou however, found little evidence to support the role of malocclusion class in treatment duration.¹¹ Extractions are usually required as part of orthodontic treatment in order to create space so that teeth may be aligned. In order to maintain symmetry and esthetics, extractions have to be performed on both sides of the arch, and since the whole tooth has to be extracted, this may result in much excess space being created. In these circumstances therefore, in addition to the time required to align teeth within the dental arch, additional time is also then required to close any residual space that can remain after alignment of teeth has been achieved. Treatment time is thus further extended if the space achieved from the extractions much exceeds that which was required for alignment of teeth. On the other hand, where the amount of space required to align teeth matches the space created from the prescribed extractions, once alignment is achieved, little to no residual space remains so treatment is not prolonged in these instances.

Thus, reports on the effect of age, malocclusion type and extractions on treatment duration are conflicting.^{6, 11, 12} For our sample, the results suggest that our younger

subjects may be very slightly (but significantly) correlated with longer treatment duration. The results also indicate a weak but statistically significant correlation between extractions and increased treatment duration. Treatment duration showed wide ranges in relation to the younger ages and extraction cases, which may help to explain the low correlation values obtained. Malocclusion class did not reveal much correlation with treatment duration. Further studies into the relationship of age, extractions and malocclusion class need to be carried out with larger sample sizes.

Our results revealed that number of adjustment visits, and Excess Time due to non-optimal visit intervals show high and significant correlation to treatment duration. Skidmore had reported that adjustment visits of more than or equal to 20 were related to extended treatment duration in her sample.⁷ Increased adjustment visits indicate that more time was required to achieve the desired result and thus understandably, has a direct relationship to treatment duration. Reasons for increased adjustment visits could not be extrapolated from our records.

Popowich found in 237 patients a significant association between longer average inter-appointment intervals with increased treatment duration and concluded that the accumulative effect of increased inter-appointment intervals on treatment duration can be quite substantial in some cases.⁵ In our situation it appears that our multiple non-optimal visit intervals can result in unacceptably high accumulative excess periods as indicated by our mean Excess Time (0.95 years). Our results for Possible Treatment Duration

seem to imply that, had our adjustment visits been scheduled consistently at more optimal intervals, it is possible that most of our cases could have been completed within the desirable period of two years. This would appear to suggest that, even with the increased number of adjustment visits in some subjects, had the visit intervals been more optimal, treatment duration could have been within acceptable limits. While the occasional non-optimal appointment interval should not affect treatment duration much, the accumulative period of multiple non-optimal intervals can be quite substantial.

Due to the heavy demand on our services, our clinics are fully booked up such that it is common for the next available appointment to be more than four weeks ahead, resulting in non-optimal intervals. When appointments are broken, the already non-optimal intervals between adjustment visits are further extended.

Edwards and Spary categorised treatment duration into 'Short', 'Average' and 'Extended'.¹⁰ Repairs and broken appointments were then represented as incidence per subject, in the three respective groups to allow for comparisons of these factors between the groups. They reported that those who had extended treatment duration had greater incidence of repairs and broken appointments. Other authors had also found that higher incidence of repairs and broken appointments were related to extended treatment duration.^{3, 6, 7, 11, 13} When repairs are required, it usually means additional treatment time. Beckwith reported that each broken appointment resulted in more than a month of additional treatment time.¹³

In our adaptation of Edwards and Spary's method, we calculated the incidence of repairs and broken appointments, in four treatment duration groups because we had an additional group of 13 subjects with 'much extended treatment duration' (more than three years). Our sample indicates that the incidence of repairs in our 'desirable treatment duration' group was two times less than the overall average, suggesting that higher incidence of repairs may contribute towards longer treatment duration. Those who had treatment duration longer than three years showed two times higher than the overall average for incidence of broken appointments. Each broken appointment then results in increased interval periods in between adjustment visits. Further studies need to be carried out to look into reasons for repairs and broken appointments.

Orthodontic fixed appliance therapy requires monthly adjustments for each case until completion, so it is important to maintain optimal appointment intervals and minimize late changes to appointment scheduling. Ideally, we should not take on more patients than can be managed each month in order to ensure that those already under treatment will receive optimal management. Perhaps the cooperative and dependable patient may be pre-booked for a few appointments each time to ensure optimal appointment intervals for these selected patients.

While it is inevitable that appointments will occasionally be changed, the cumulative effect of non-optimal visit intervals can be quite substantial in our situation. The importance of honoring scheduled orthodontic appointments, avoiding cancellations and

being more flexible in availability to attend need to be further explained at consultation, with due emphasis on the negative consequences impacting the treatment of the patient. In addition, operators should be organised and avoid canceling or postponing patient appointments. Unfortunately, there will be occasional unforeseen circumstances which may require cancellation of scheduled appointments and are beyond one's control.

This study is limited in that it is retrospective such that data and information gathered does not provide sufficient detail for further study and that there may have been omissions in record keeping. It is possible that not all incidences of repairs and broken appointments had been recorded. Reasons for non-optimal visit intervals, increased adjustment visits, repairs and broken appointments cannot be extrapolated from the records. Results should thus be interpreted with caution.

In conclusion, this study indicates for most of our sample, treatment duration is longer than desirable. The accumulative effect of non-optimal visit intervals, increased number of adjustment visits, younger age at start of treatment, high proportion of extraction cases, increased incidence of repairs and broken appointments may have been contributory. Further prospective studies with larger sample sizes are required. Meanwhile, each operator should critically re-examine his/her management of cases with the aim to shorten treatment duration without compromising standards.

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