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Maxillary retention: is longer better?

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SUMMARY Two different maxillary retention regimes were compared to ascertain if differences in post-treatment relapse existed. The patient pool was derived from subjects being treated at two orthodontic departments in the west of Scotland. Group 1 (20 patients) followed a 6 month regime using removable upper Hawley retainers for a period of 3 months full time and 3 months nights only. Group 2 (18 patients) followed a 1 year regime of 6 months full time and 6 months nights only.

The results revealed that maxillary incisor alignment, as determined by Little's irregularity index, had relapsed by an average of 50 per cent of the end of retention value 3 months out of retention in Group 1 but only 23 per cent in Group 2. Although the actual mean values for relapse were 0.77 and 0.23 mm, respectively, seven subjects in Group 1 showed relapse of more than 3 mm as compared with only one in Group 2. This suggests that retaining a case for 1 year rather than 6 months is clinically beneficial.

Introduction

To date, orthodontists are unable to formulate the equation for post-treatment stability. Oppenheim (1934) stated that, 'Retention is the most difficult problem in orthodontia; in fact, it is the problem'.

It is well known that the aetiology of post-treatment relapse is multi-factorial and subject to individual variation. As a result, it is almost impossible to guarantee absolute post-treatment stability.

The three primary factors contributing to the development of orthodontic relapse are growth of the skeletal bases, the soft tissue matrix, and the periodontium (Profitt and Fields, 2000). Their interaction results in intra-arch crowding and inter-arch occlusal changes. To counteract relapse, the following are often recommended:

1. Lengthier retention periods (Parker, 1989; Nanda and Nanda, 1992).
2. Elimination of the causes of malocclusion—for example, habits (Joondeph, 2000).
3. Over-correction of the malocclusion (Reitan, 1967).
4. Accomplishment of treatment during growth (Vaden *et al.*, 1994; Harris *et al.*, 1999).
5. Moving teeth into a position of stable static equilibrium where they exist in a state of minimum potential energy (Salzmann, 1965).
6. Maintenance of the original arch form (Steadman, 1961).
7. Gingival surgery to transect supracrestal fibres in rotated teeth (Edwards, 1993).
8. Surgical removal of excessive tissue folds at the gingival papillae (Edwards, 1993).
9. Reshaping of incisors and restoration of contacts (Peck and Peck, 1972; Watson, 1979).
10. Correct root torque to ensure root parallelism (Watson, 1979; Heasman *et al.*, 1996).
11. Occlusal equilibrium (Kahl-Nieke *et al.*, 1995).

The literature is lacking in studies, which have attempted to investigate the effects of the length of retention on the stability of the maxillary arch. It is, however, generally accepted that a period of reorganization of socket architecture is required following tooth movement to minimize relapse. This is thought to take around 6 months, with the exception of the gingivally attached fibres, which may remain distorted 1 year after movement has ceased (Reitan, 1967).

The alignment of the maxillary arch was chosen for this study as the measure of post-retention relapse because it is less subject to the multiplicity of forces which affect the mandibular arch, and also because patients tend to judge the success of their treatment mainly by the alignment of their anterior maxillary teeth. Berg (1979) examined 264 treated cases, and obtained the opinions of both the orthodontist and the patient post-retention. Fifty seven per cent of practitioners deemed their results to be less than optimal, based on orthodontic criteria. However, less than 2 per cent of patients were dissatisfied with their results. The success of treatment, from the patients' point of view, appeared to be almost entirely related to the maxillary anterior teeth, with good alignment and antero-posterior position being the most important judging criteria.

The aim of this study was to determine whether a longer retention period will allow for more complete healing, and superior recovery of the teeth and their surrounding tissues, such that a decrease in the relapse potential and greater stability will result.

Materials and methods

Two orthodontists with contrasting retention regimes working in the same area of the west of Scotland were identified from a survey of consultant orthodontists working in Scotland. Maxillary arch study models were assessed from each of two groups.

Group 1 consisted of 20 patients (five male, 15 female) who followed a regime of upper Hawley retainer wear, 3 months full time and 3 months nights only. The total retention time for this group was therefore 6 months. Nine were treated by extraction and 11 non-extraction. Group 2 consisted of 18 patients (six male, 12 female) who followed a regime of upper Hawley retainer wear, 6 months full time and 6 months nights only post-treatment. The total retention time for this group was therefore 1 year. Thirteen were treated by extraction and five non-extraction. The age range for the whole sample at the start of treatment was from 11 to 19 years. The sample was confined to subjects with Class I or Class II malocclusions, who exhibited anterior maxillary crowding or tooth contact point displacements. The subjects were enrolled in the study as they completed active treatment if their initial malocclusion met the above criteria.

All subjects were treated with pre-adjusted edgewise mechanics, Roth prescription brackets (Group 1, 3M Unitek Bradford, Yorkshire; Group 2, American Orthodontics, Marlow, Bucks). Co-operation with retention regimes was judged to be similar in both groups.

Maxillary arch study models of both groups were measured with digital callipers for the following linear variables (Figures 1 and 2):

1. Incisor irregularity (Little, 1975).
2. Inter-canine width.
3. Inter-molar width.
4. Arch length.

Measurements were made at the following time points: T1 = the commencement of orthodontic treatment, T2 = the end of active treatment (de-bond) and start of retention, T3 = the end of retention, and T4 = 3 months out of retention.

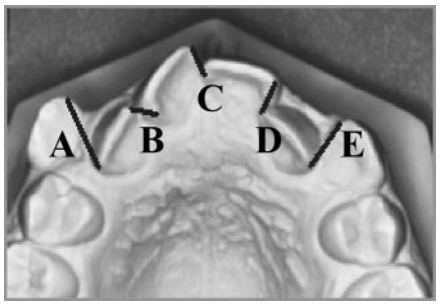

Figure 1 Incisor irregularity = sum of contact point displacements A + B + C + D + E.

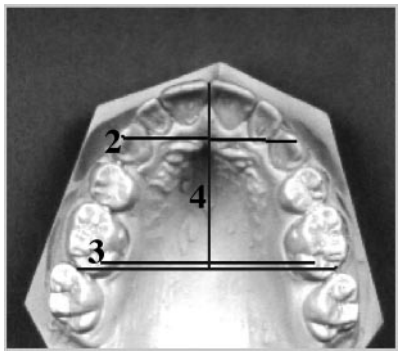

Figure 2 Inter-canine width (2), inter-molar width (3), and arch length (4).

Maxillary dental arch measurements:

1. Irregularity index. The summed labio-lingual displacement of the five linear distances from one anatomical contact point to the adjacent contact point of the anterior teeth (Little, 1975).
2. Inter-canine width. The distance between cusp tip points of the right and left canines.
3. Inter-molar width. The distance between the disto-lingual cusp tips of the right and left first permanent molar.
4. Arch length. A point measured midway between the incisal edges of the central incisors, bisecting the line connecting the distal marginal ridges of the right and left first permanent molars.

Statistical analysis methods

Error of the method calculations was performed to determine the reproducibility and reliability of the study model measurements. Measurements for 20 casts were replicated after 2 weeks and agreement was found to be excellent according to the method of Houston (1983). The index of reliability for all variables was 0.99 and none of the *P* values between standard deviations was significant.

Standard descriptive statistics, including the mean, standard deviation, and minimum and maximum values were used to compare the linear variables of the two groups at T1, T2, T3, and T4. These were then tested for statistical significance.

Pearson correlation coefficients were used to assess the relationships of the irregularity index at the different times.

To determine whether relapse differences existed between the two groups for the irregularity index, Pearson correlation coefficients were calculated, and a two-sample *t*-test was carried out.

Standard descriptive statistics were also used to compare the irregularity index differences between cases treated with and without premolar extractions to determine whether the irregularity index relapse differences of the two groups could be related to the extraction pattern. This was necessary to ensure that the differences between the two groups reflected the retention regime, and not another contributing factor.

Results

Both groups showed a significant decrease in the irregularity index from T1 to T2, with an increase from T2 to T3 to T4 (Figure 3). The high standard deviations, especially in Group 1, indicated tendencies for individual variation (Table 1). For both Groups 1 and 2, the extraction and non-extraction groups relapsed by similar amounts from T3 to T4.

Significant correlations between irregularity indices at different time points were found only for Group 1 (Table 2). Specifically, a relationship existed between the T1 and T4 irregularity index with a correlation of 0.8, and a suggestion that a possible relationship existed between the irregularity index at T1 and the irregularity index relapse change from T3 to T4, with a modest correlation of –0.63. There was also a suggestion of a possible relationship between the irregularity index change between T1 and T2 (treatment), and the irregularity index from T3 to T4 (post-retention relapse) with a modest correlation of –0.66.

There were no significant correlations between change in the irregularity index and change in inter-molar width, inter-canine width, or arch length for either group. The actual widths and lengths, which showed no significant changes from T1 to T4, are shown in Table 3.

There was a borderline statistical difference between the two groups at T4 ($P = 0.059$) (Table 1), which suggested that there might be a clinical difference between them. The average difference, in terms of relapse, during retention (T2–T3) was 0.18 mm and following the cessation of retention (T3–T4) was 0.54 mm (Figure 3).

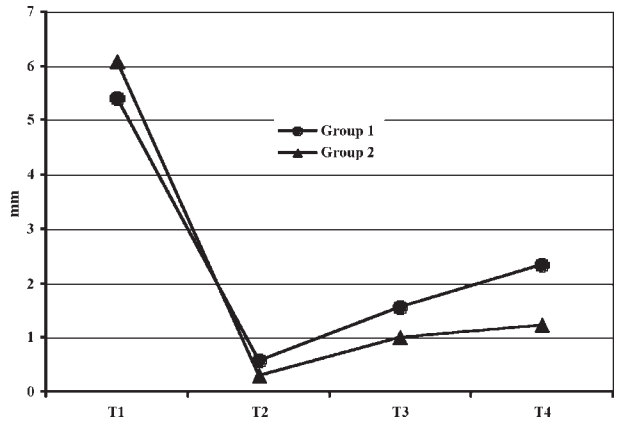

Figure 3 Inter-group comparison of average irregularity index from T1 to T4.

Discussion

The number of subjects enrolled in this study was relatively small and the post-retention follow-up was short. Trends between the two groups, only, have been elicited. For Group 1, a relationship existed between the T1 and T4 irregularity index with a high correlation of 0.8, implying that the values for T4 approached those of T1. This can be interpreted as the occurrence of relapse, as displacement irregularities reappeared with values proportional to those pre-treatment. This finding is important, as it lends support to the shorter-term retention group demonstrating more relapse than the longer-term retention group. The lack of any significant correlation between the T1 and T4 irregularity index for Group 2 supports the fact that the T4 values were consistently low, and could not be correlated with the higher pre-treatment values.

Although the pre-treatment irregularity index for Group 1 was lower than that for Group 2, the average value at de-bond was higher. The degree of relapse was also greater in this group. The irregularity index increased by almost 50 per cent of its end of retention value by 3 months out of retention in Group 1 (1.56–2.33 mm) compared with 23 per cent in Group 2 (1.0–1.23 mm) The absolute values for displacement irregularities at T2, T3, and T4 were all higher for Group 1. This was despite the pre-treatment irregularity index being higher for Group 2.

Table 1 Irregularity index T1–T4 for each group.

Irregularity index (mm)	T1		T2		T3		T4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Mean	5.42	6.1	0.57	0.29	1.56	1.00	2.33*	1.23*
SD	3.17	2.9	0.66	0.27	1.5	0.89	2.26	1.02
Maximum	11.5	12	2.33	0.8	5.34	3.95	8.29	4.3
Minimum	0.2	1.02	0	0	0	0.34	0	0.4

*T4, $P = 0.059$.

Table 2 Correlations between irregularity indices for each group.

Correlations	T1 versus T4	T1 versus (T3–T4)	(T1–T2) versus (T3–T4)
Group 1	0.8	–0.631	–0.660
Group 2	0.1	–0.040	–0.031

It was interesting that both groups experienced some relapse during the retention period. Hawley retainers, although durable and popular retention appliances, will permit some movement of the upper anterior teeth, unlike for example Essix retainers (Sheridan *et al*., 1993). The fact that more relapse was experienced by the shorter retention regime patients during this period may be explained by the fact that full-time retention, and consequently the maximum control afforded by the retention appliance, was reduced by half.

Overall, Group 1 experienced a 57 per cent improvement in displacement irregularities, while Group 2 improved by 80 per cent from T1 to T4.

In Group 1, seven patients out of 20 (35 per cent) showed relapse at T4 greater than 3 mm [according to Sadowsky and Sakols (1982), less than 3 mm is within a clinically acceptable range]. Five of those were treated with premolar extractions, and two were treated non-extraction.

In Group 2, one (5.6 per cent) patient, treated by premolar extractions, out of 18 showed relapse at T4 greater than 3 mm.

Consequently, notwithstanding the fact some of the differences in relapse tendency between the groups may be attributable to differences in the standard of finishing of cases by two different orthodontists, there is evidence to support the theory that longer retention is better than shorter. As there appeared to be no relationship between changes in arch dimensions and increase in incisor irregularity one can only speculate that the redefining of stable socket architecture may be the critical factor and that this takes more than 6 months to be established. However, it is yet to be determined whether there is a linear relationship between the length of retention and stability, or whether a threshold exists beyond which no benefit is to be derived by continuing the process.

Conclusions

Subjects who experienced an overall retention regime of 1 year with an upper Hawley retainer showed less post-treatment irregularity index relapse of the maxillary anterior dentition than subjects who experienced an overall retention regime of 6 months ($P = 0.059$).

The differences in post-retention irregularity indices could not be accounted for by the extraction or non-extraction of premolar units, nor by changes in arch dimensions.

The results suggest that retaining a case for 1 year rather than 6 months is clinically beneficial.

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Table 3 Arch dimensions, T1–T4 for each group.

	T1		T2		T3		T4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Inter-canine width	34.33	33.71	35.02	35.03	34.9	35.02	34.8	34.82
Inter-molar width	40.79	40.56	40.24	38.49	40.24	38.75	40.35	38.84
Arch length	36.37	37.43	35.4	35.23	35.04	35.08	34.97	35.12

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