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Long-term stability following edgewise fixed appliance therapy

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CHAPTER 5: DISCUSSION

This investigation evaluated static dental relationships only. Functional occlusion, aesthetic changes, periodontal status as well as radiographic cephalometric variations were not assessed. For the purposes of this report, it was not feasible to study in detail all of the dental features which may have had a bearing on the long term occlusal stability of the patients treated. It was therefore decided to use the nine point occlusal scoring analysis of Sadowsky and Sakols (1982), as well as the irregularity index as devised by Little (1975) to assess the post-treatment changes in these cases.

The scoring system employed in this study took into account not only the severity of the malocclusion, but also gave an indication of the stability of results obtained by orthodontic treatment. There is, however, an inherent problem with this system of occlusal evaluation where the total occlusion is assessed in terms of ideal and non-ideal relationships. When any one of the traits studied is judged non-ideal, there is a tendency to classify the entire case as being non-ideal.

Overall analysis indicated that a marked improvement occurred from the pretreatment to long-term stages. However, the group as a whole reflected some postretention relapse. The findings of this study indicated that 54.8 percent of the subjects who were all out of retention displayed one or more dental features that were judged to be outside the ideal range (Figure 4.2.4). Although high, this finding was, however, favourable compared with the observations of Sadowsky and Sakols (1982) who, in a long term study, recorded a 72 percent incidence of

malocclusion in their sample drawn from the patients of private orthodontists. The changes observed in the latter study were however recorded after a mean postretention period of 20 years. It is possible that the degree of relapse noted in the present study over a comparative time period might have increased in incidence and severity. The findings of this study also compare favourably with a previous investigation conducted in this same department by Seedat (1984), who showed 80 percent relapse of at least one variable following 5 years postretention .

In the present sample as a whole, the mean T3 malocclusion score (1.5) indicated an acceptably low prevalence of relapse, which also compared favourably with the malocclusion score in the Seedat (1984) study (4.79). When specific occlusal parameters were assessed in the pooled sample, the vast majority of cases not only met the demands of post-treatment stability when seen as complete cases, but also in terms of the criteria taken individually (Figures 4.2.5 and 4.2.6). If however, one of the criteria assessed according to the scoring system (Sadowsky and Sakols, 1982), was found to be outside the "ideal" range, then the case as a whole would be classified as "non-ideal". This is the reason why in the pooled sample at T3 almost 55 percent of the cases were found to be non-ideal, whereas in fact, this percentage indicated only the proportion of cases within the sample which showed one or more occlusal parameters which had undergone post-treatment change.

At T3, all the individual variables studied were close to "ideal" values (Figures 4.2.5 and 4.2.6), even though minor changes were observed. The individual variables were ranked according to how frequently they were affected by relapse. In decreasing order of frequency they were; deep bite/overbite (29 %), overjet (22.6 %), molar relationship (8.1 %), anterior and posterior crossbite, mandibular crowding and open bite (3.2 %) each. Canine relationship and maxillary

crowding in all cases showed no relapse at T3.

Variables which were considered to have severe values at the onset of treatment and which were treated to ideal relationships remained stable during and after the retention phase of treatment. The final outcome of mild to moderately irregular values of variables at the start of treatment on the other hand, were less predictable. They either became worse or for the most part remained the same at postretention. These findings were in agreement with those reported by Little, Wallen and Riedel (1981).

In the present study, an attempt was made to find a statistical relationship between relapse of all the variables examined at T2, including the irregularity index and inter-incisal angle, and changes in intercanine and intermolar widths, brought about by orthodontic treatment. Following statistical ordinary linear regression of each variable, no statistically significant predictors (at the 5 % significance level) were found for any of the response variables.

This study also found no statistically significant predictors (at the 5 percent level of significance) of postretention irregularity index, when ordinary linear regression was performed. This was not surprising as the mean increase in intercanine width during treatment was calculated to be 1.2 mm. This indicated that particular care was taken to ensure that the intercanine width was not increased during orthodontic treatment.

When dichotomizing the postretention irregularity index ($\leq$3 mm or >3 mm), and then performing statistical logistic regression the T2 intercanine (3-3) measurement for the whole

sample was found to be a statistically significant predictor ($p = 0.02$) of the probability of the irregularity index being less than or equal to three millimetres at T3. The negative association indicated that as the T2 3-3 width increased, the probability of an associated ideal irregularity index being present at T3, decreased. It seems therefore, based on this as well as previous studies (Little, Wallen and Riedel, 1981; Seedat, 1984), that expansion in the intercanine width during treatment may be responsible for the occurrence of lower incisor crowding at postretention.

Although the present study has quantified the change in post-treatment lower 3-3 (intercanine) width, and has then attempted to predict the amount of postretention irregularity index relapse, it must be pointed out that the behaviour of the lower 3-3 width in this study did not follow the pattern described previously in the literature. Regarding lower intercanine width, other studies have shown decreases at postretention both in treated samples (Gardner and Chaconas, 1976; Shapiro, 1974; Glenn, Sinclair and Alexander, 1987; McReynolds and Little, 1990; Mark, 1994), and untreated samples (Sinclair and Little, 1983; Moyers, 1976; Bishara et al, 1989). Furthermore, some of these studies (Glenn, Sinclair and Alexander, 1987; McReynolds and Little, 1990), have even reported a decrease in lower intercanine width even beyond their pretreatment width. These authors have suggested various reasons for this occurrence. Among these are that a decrease in the upper intercanine width or perhaps lower incisor crowding allowed the canines to drift mesially, thereby decreasing the lower intercanine width, or that this decrease may even be due to normal physiological tooth movement. Bishara et al (1989), stated that an untreated individual could expect a 0.2 mm decrease in intercanine width between the ages of 13 and 16. The present study showed a mean increase in lower intercanine width of 1.2 mm during treatment, followed by a further increase of 0.1 mm following retention. This not only indicated an acceptable amount of intercanine expansion during treatment, but also a high

rate of postretention stability, not only within its own measurement, but also the effect that this stability had on mandibular incisor crowding.

Upper intermolar width showed only minimal (mean 0.4 mm) decrease at T3. Previous studies have reported similar findings. Gardner and Chaconas (1976) and Mark (1994) found virtually no decrease in intermolar width, whereas Shapiro (1974) and McReynolds and Little (1990) reported minimal decreases of just over 1.0 mm. In other studies, untreated individuals have also shown intermolar width decreases. Bishara et al (1989) reported untreated individuals from age thirteen to twenty-six as showing an 0.5 mm decrease in the intermolar dimension.

In this study, the mean Irregularity Index (Little, 1975) increased by 2.2 mm following retention (Appendix B). All previous studies have reported a decrease of incisor irregularity with treatment, and an increase following retention. Postretention irregularity increases (1.0 mm to 3.0 mm on average) have been shown in previous reports (Little, Wallen and Riedel, 1981; Little, Riedel and Engst, 1990; McReynolds and Little, 1990; Mark, 1994). Untreated samples (Sinclair and Little, 1983), showed Irregularity Index increase of less than 1.0 mm. It must be considered, however, that the untreated sample was followed only to age 20. This was a lesser period than in the present study or the previous studies mentioned above.

The findings in this study are consistent with the data reported by Ades et al (1990), in their sample of 97 patients at least ten years out of retention. In their study, the comparison of findings between the subgroups in which mandibular third molars were impacted, had erupted into function, were congenitally absent, or had been extracted 10 years before postretention records,

revealed no significant differences between any of the subgroups for the parameters studied which included irregularity index, overbite and overjet. Richardson (1982), demonstrated a forward movement of the mandibular first molar which corresponded to an increase in lower arch

crowding in the 13 to 17 year age group which was, however, independent of impacted third molars. However, later studies regarding second molar extractions, (Richardson 1983; Richardson and Mills, 1990), did provide evidence of the effects of developing third molars on the anterior part of the arch. They showed a reduction in anterior mandibular crowding and distal movement of first molars in cases which underwent second molar extractions compared to non-extraction subjects.

This study found a statistically significant difference between the extraction and non-extraction groups regarding the inter-incisal angle and irregularity index in the manner in which they responded to treatment. As would be expected, patients with Class II division I malocclusion constituted the major percentage (75 percent) of the extraction sub-group, and one could anticipate these subjects would present with a large irregularity index combined with a less obtuse inter-incisal angle indicative of bimaxillary protrusion or proclined upper incisor teeth. It was therefore not surprising to find a statistically significant difference ($p = 0.04$) between these two groups regarding the change in the aforementioned variables from T1 to T3. The irregularity index showed an overall change of 3.2 mm for this time period, and the inter-incisal angle a difference of 8.2 degrees.

With respect to relapse, no variable, including the irregularity index, demonstrated any

statistically significant difference when the two groups were compared following retention. The two groups were not significant predictors of T3 malocclusion score ($p = 0.66$), ideal overjet ($p = 1.0$) or ideal overbite ($p = 0.15$). These findings compare favourably with studies at the University of Washington which concluded that extraction of premolar teeth has little effect on long-term postretention stability of lower incisor alignment. In Little, Wallen and Riedel's initial report (1981) of 65 first premolar extraction cases at least 10 years postretention, the overall success rate, defined as an irregularity index of less than 3.5 mm, was less than 30 percent with 20 percent showing marked crowding. The overall success rate deteriorated further to 10 percent at 20 years postretention in a further follow-up study (Little, Riedel and Artun, 1988). These findings were also in agreement with Uhde, Sadowsky and Begole (1983), who distinguished between cases treated by the extraction or non-extraction route in the long-term findings of Sadowsky and Sakols (1982) in their investigations. The latter authors concluded that no statistically significant difference in lower incisor irregularity 20 years out of retention could be found for the two groups. The method employed by Sadowsky and Sakols for measuring lower incisor crowding differed from that employed in the University of Washington studies. However, both investigations used a subjective approach to what was considered to be acceptable incisor alignment.

Interesting findings were reported by Sandusky (1983, cited by Nanda and Burstone, 1993) in his sample of 85 extraction cases treated by Tweed and Tweed foundation members. He reported less than 10 percent relapse of the lower incisors using Little's irregularity index. Similarly, the cases from the present study treated at the University of the Witwatersrand also showed minimal postretention irregularity index relapse.

Regarding treatment time for the whole sample, the overall change in irregularity index and mandibular crowding from pretreatment to postretention showed marginally significant difference ($p = 0.07$ and $p = 0.09$ respectively) in the two groups receiving treatment either less than or more than 25 months. This finding is not in agreement with the conclusions of the Washington studies (Little, 1999), or that of Freitas et al. (2004), who evaluated relapse in a sample comprising 40 patients treated in an orthodontic graduate clinic in Brazil.

In the present study, the pretreatment mandibular crowding ($p = 0.09$) also showed marginally different scores, and the overall finding suggests, not unexpectedly, that those patients who had the most mandibular crowding prior to treatment also took the longest time to treat, and then showed a higher prevalence of mandibular crowding relapse following retention. The Class II, division I subgroup also showed this same degree of significance ($p = 0.07$) between the change in mandibular crowding from pretreatment to postretention in the two treatment time groups although the two groups showed no significant difference in their scores prior to treatment ($p = 0.13$).

When dichotomizing the time period following retention, a marginally significant difference ($p = 0.07$) was noted between the two groups in the overall change from T1 to T3. This difference was recorded in the overbite variable and was seen in the Class II division I subgroup. Although this longer time period following retention ($\geq$ 158 months) had brought with it an overall greater change in overbite, this variation was primarily due to the change which occurred during treatment as the overbite relapse following retention for this longer treatment time group was

approximately half that of the other group.

The Class II division I subgroup also showed a marginally significant difference ($p = 0.07$) in irregularity index change following retention when the T1 inter-incisal angle was dichotomized.

Although the T1 irregularity index and mandibular crowding was larger in the group displaying the lower inter-incisal angle (pretreatment inter-incisal angle < 135 degrees), at T3 this group showed lower irregularity index score. In the whole sample, as well as in the Class II division I subgroup, the irregularity index change following retention also showed marginal significance only ($p = 0.07$). As a significant difference between the two groups ($p = 0.05$) was seen in the overbite prior to treatment, it is apparent that the prevalence of a deeper overbite and therefore also a larger inter-incisal angle at the onset of treatment was associated with more mandibular incisor crowding relapse following retention. This finding contrasts with the findings of Little (1999), where no association was found between any cephalometric data and postretention relapse.

When categorizing T1 inter-incisal angle further in the whole sample, a statistically significant difference ($p = 0.05$) was noted for molar relationship between the three groups. It was shown that the more the T1 inter-incisal angle varied from the Steiner norm of 131 degrees (± 4 degrees), the more stable the molar relationship would be following retention. This same relationship was found in the Class II division I subgroup which also demonstrated that the more "average" T1 inter-incisal angle group, although presenting with a lower T1 molar relationship score, exhibited higher total malocclusion scores at both subsequent time periods

(T2 and T3). It would thus seem to indicate that the further extreme pretreatment inter-incisal angle groups either responded better to treatment or were treated to a greater degree of perfection than the third group. In addition, the latter group also showed more of a tendency towards postretention relapse as its malocclusion score ranged between two and three more than the former two groups.

It is important to distinguish the significant results of this study by class and gender in order to highlight those features of treatment which may influence post-treatment stability. In the Class I subgroup, third molar teeth played no role in determining relapse. Mandibular crowding showed more stability following a longer period of post-treatment retention, in this study more than 158 months. Caution should be exercised when treating cases presenting with open bites prior to treatment. These cases consistently produced Class II molar relapse.

When evaluating Class II division I treatment, the patients in the extraction group showed a greater change in irregularity index as a result of orthodontic treatment (T1-T2). However, this should be seen in context as this group of patients presented with a larger irregularity index initially, and no difference was observed between the two groups irrespective of whether there had been extractions or not. Similarly, no difference was discerned between those who presented with third molar teeth prior to treatment and those who did not. Patients who presented with an open bite initially showed a low degree of mandibular crowding, a low irregularity index and Class I molar stability following retention. Of concern was the association of an increase in the irregularity index following retention as the overbite deepened. It may be advisable to complete

treatment of deep bite cases in this subgroup to minimal overbite, in order to prevent the concomitant irregularity index change. Relapse in this subgroup was independent of treatment time or time out of retention.

In the Class II division II category, the records of 2 patients (1 male and 1 female) were evaluated. These two patients were different in the categories defined concerning third molar teeth, treatment time and the amount of time out of retention. Both were treated to a post-

treatment malocclusion score of zero, and both maintained this score following retention.

When considering treatment by gender, females in the Class I and Class II division I subgroups, as well as males in the Class I subgroup who presented with open bites prior to treatment all displayed mandibular incisor irregularity stability following retention. However, there was a tendency for the females in these groups to present with Class II molar relationships following retention. Females in the Class II division I subgroup who presented with a deep bite prior to treatment also showed a tendency for higher irregularity index score following retention. No significance according to gender was determined for the third molar teeth, extractions, treatment time and time following retention categories defined.