CHAPTER 2: LITERATURE REVIEW

Although numerous factors have been reported to play a role in post-treatment relapse, no definite conclusions regarding the relative contribution of these factors have been reached. Regarding retention and stability in orthodontics, the ‘occlusion school of thought’, the proponents of which include Andrews (1972), Chaconas and Gardner (1976) and Roth (1981), advocated the establishment of an optimal functional occlusion. Many years previously Angle (1907) had emphasised the importance of the mandibular arch as a “controlling influence over the form of the upper arch and the position of the teeth therein”. McCauley (1944) later suggested that intercanine width and intermolar width should be maintained as originally presented to minimize relapse problems, a theory with which Strang (1959) was in agreement. Furthermore, the mandibular incisor school, headed by Grieve (1944), and Tweed (1944, 1952), emphasized their belief that the mandibular incisors should be kept upright and over basal bone to minimize relapse.

Shapiro and Kokich (1981), stated that all dentitions, whether orthodontically treated or not, exhibit dimensional changes with increasing age. According to these authors, all dimensions (lengths and widths) of the maxillary and mandibular arches decrease with age. These changes are said to be more marked in the mandibular than in the maxillary arches. Various authors concur with Shapiro and Kokich regarding these dimensional changes (Brown and Daugaard-Jensen, 1951; Humerfelt and Slagsvold, 1972; DeKock, 1972; Sinclair and Little, 1983; Bishara et al, 1989; Moorrees et al, 1990). During normal development, a moderate increase in arch width is seen until permanent cuspid eruption (Moorrees, 1959), which is followed by a reduction in intercanine width (Moorrees et al, 1969; Sinclair and Little, 1983, 1985). The intermolar width remains stable from 13-20 years (Moorrees, 1959; Moyers, 1973; Sinclair and Little, 1983, 1985), and there is a reduction in the antero-posterior dimension of the mandibular arch with time (Moorrees, 1959; Vego, 1962; Fisk, 1966; Little, 1975; Sinclair and Little, 1983, 1985; Allred, 1986).

Other authors are also in agreement regarding the changes that manifest in the mandibular arch irrespective of the type of treatment (McCauley, 1944; Riedel, 1960; Shapiro, 1974, Chaconas and Gardner, 1976, Sondhi, Cleall and BeGole, 1980). Allowing for individual variation, these authors suggested that there is a decrease in the mandibular arch width after removal of orthodontic appliances and following intercanine treatment expansion. This inviolability of intercanine width had been suggested years ago by McCauley (1944) and Strang (1952), and had also been documented by Riedel (1960). In order to limit the degree of lower incisor crowding there would thus seem to be merit in maintaining the original pre-treatment arch dimensions and particularly the intercanine and intermolar widths (Riedel, 1960; Shapiro, 1974).

Further studies also have highlighted the high incidence of reduction in arch length post-retention (Stein, 1974; Little, Riedel and Stein, 1990; Amott, 1962). Moussa, O'Reilly and Close (1995), showed good stability for upper intercanine and upper and lower intermolar widths in their sample of 55 patients 8 years post-retention who had undergone rapid palatal expansion in conjunction with edgewise mechanotherapy. Stability of the mandibular intercanine width, however, was poor, with the post-treatment position closely approximating the pre-treatment position. These findings corroborate well with those of Glenn, Sinclair and Alexander (1987), who studied the stability of non extraction orthodontic treatment in 28 patients a minimum of 3 years following retention. The findings of the studies of Sadowsky et al., (1994) and Elms, Buschang and Alexander (1996) showed minimal postretention mandibular incisor irregularity. It was however felt by Blake and Bibby (1998) that the post-retention period in both these studies was short, and that the stability may well have been reduced if this post-retention period had been extended. Sadowsky et al, (1994), concluded that the prolonged mandibular retention in their own study may have played a role in their findings and Elms, Buschang and Alexander (1996) attributed the stability in their own study to the following factors:

- Application of proper mechanics,
- Patient co-operation,
- Favourable downward and forward mandibular growth.

Not all arch expansions resulting from orthodontic treatment have been associated with relapse. This may be due to the fact that post-treatment changes, such as crowding, are in many instances too small to be of clinical significance (Shapiro and Kokich, 1981). Mills (1966), reported on the findings of a study in which the dimensions of the mandibular arch were increased by proclination of the lower incisors. He found that there was a tendency in these cases towards incisor retroclination following treatment. This was, however, not always the case in individuals who, prior to treatment, presented with Class II division II malocclusion, thumb sucking, and those with habits involving the lower lip. A common feature present in these groups of individuals was a pre-treatment retroclination of the lower incisors. Proclination of the lower incisors, as a means to increase the size of the lower arch, may thus be stable in patients who exhibit retroclination of these teeth at the inception of treatment. Artun, Krogstad and Little (1990), agreed that proclination may be successful provided that the lower incisors are initially retroclined, a reason for the retroclination determined, and the cause eliminated during treatment.

Various post-treatment studies have been carried out to determine the long-term stability of orthodontically induced changes in maxillary and mandibular arch form. De La Cruz et al (1995), concluded in their post-retention study of 87 patients that the patient’s pre-treatment arch form appeared to be the best guide to future stability. Minimizing treatment change around the pre-treatment arch form, however, did not guarantee post-retention stability.

The findings of studies by Haas (1980) and Sandstrom, Klapper and Papaconstantinou (1988) on the maintenance of expanded intercanine and intermolar widths following retention, however, are quite misleading. Haas’ study was based on 10 cases only, and primary canines were present in the initial records of two of these. Extrapolation is questionable on the amount of canine expansion recorded, when in 20 percent of this small sample the permanent canines had not yet erupted at the time of the original records. Sandstrom’s statement that mandibular incisor stability is increased when the mandibular intercanine width is expanded in conjunction with maxillary expansion is based on a sample of 17 patients, and only 2 years following retention.

Post-orthodontic mandibular incisor crowding is of major concern. Its occurrence is often interpreted as an indication of failure in the execution of orthodontic treatment. It is thus not surprising that a number of factors have been suggested which may be responsible for this phenomenon. Despite careful pre-treatment planning, it is impossible to guarantee post-treatment stability of the lower incisors following orthodontic treatment (Shapiro and Kokich, 1981). According to these authors, the incidence of lower incisor crowding is high, particularly if preceded by dental arch expansion during orthodontic treatment. It is therefore essential for the clinician to plan for retention of the mandibular incisor teeth as part of his treatment regime.

Subtelny and Sakuda (1966) in their study of 50 patients found a strong tendency for the intercanine width to return to its original dimension following orthodontic treatment. The cases which presented prior to treatment with crowding and a narrow intercanine width, returned to their original values following treatment expansion.

In an extensive review of the retention problem, Riedel (1960) concurred that expansion of the intermolar and intercanine widths is likely to result in lower incisor crowding. This was however less likely to occur if the expansion took place during an active period of growth.

Bjork and Skieller (1976), blamed relapse on late mandibular growth. They based this hypothesis on findings from a longitudinal study of Swedish children in the age group 12 to 16 years of age. Relapse due to late mandibular growth has also been suggested in a study by Lande (1952).

Lower incisor crowding has also been attributed to pressure arising from developing third molars (Salzman, 1965). The role of third molars in lower incisor crowding has been debated for more than a century. Opinion is divided almost equally. A recent study by Kahl-Nieke, Fischbach and Schwarze (1995), indicated a statistically significant but not clinically significant role that third molars play in post-retention crowding. One theory commonly reported is that of third molars creating space to erupt by causing anterior teeth to crowd (Dewey, 1917; Bergstrom and Jensen, 1961; Vego, 1962; Shenaman, 1968; Kaplan, 1974; Lindqvist and Thilander, 1982). Woodside

(1970), postulated that in the absence of third molars, the dentition could settle distally in response to forces generated by growth changes or soft tissue pressures therefore implying a passive role by third molars in the development of late crowding by hindering this adjustment.

Broadbent (1941), was one of the early researchers who highlighted the insignificant role played by third molars in late lower incisor crowding. Several studies since then have shown a reduction in arch length and an increase in crowding with age, but no difference in incisor crowding could be found in groups with impacted, erupted, missing or extracted wisdom teeth (Shanley, 1962; Lundstrom, 1969; Kaplan, 1974; Ades et al., 1990). Richardson (1980, 1982), found a correlation between significant forward movement of first molars between the ages of 13-17 years and an increase in lower arch crowding that occurred during the same period. There was no difference, however, in the forward movement of the first molar in cases with or without impacted third molars. This was a finding which was confirmed in a study of 42 patients by Richardson in 1996. Richardson (1997) further suggested that impacted third molars are unlikely to exert much mesial force. However, third molars that erupt or attempt to erupt in reduced space cause crowding problems. Furthermore, second molar extraction studies (Richardson, 1983; Richardson and Mills, 1990), have reinforced the view that mesial migration of mandibular teeth is greater in the presence of a developing third molar. These studies concluded that the reduction in crowding and the distal movement of first molars in patients whose second molars have been extracted compared with the increase in crowding and mesial movement of first molars in non-extraction subjects provided convincing evidence of the effects of developing third molars on the anterior part of the arch.

Southard, Southard and Weeda (1991), stated that removal of unerupted third molars for the exclusive purpose of relieving interdental pressure and thereby preventing mandibular incisor crowding appears to be unwarranted. In addition, Ades et al (1990) and Harradine, Pearson and Toth (1998), agreed that no basis for recommending third molar extractions to alleviate or prevent mandibular incisor crowding exists.

Bergstrom and Jensen (1961), concluded from a study of 30 dental students that the presence of a third molar appeared to exert some influence on the development of the dental arch but not to the extent that would justify either the removal of the tooth germ or the extraction of the third molars. Vego (1962), in his study on 65 individuals, found that the decrease in arch perimeter between 13 and 19 years was comparatively less in subjects who presented without lower third molars. He concluded that the erupting lower third molars can exert a mesial force on the adjacent teeth. Following a study of 75 patients, Kaplan (1974) concluded that the presence of third molars does not produce a greater degree of lower anterior crowding or rotational relapse after cessation of retention. Lifshitz (1982), concluded that there was a significant decrease in arch length in all the groups he evaluated, but this was irrespective of whether third molars were present or missing. According to McHorris (1979), incisor crowding can be attributed to a discrepancy between centric relation and centric occlusion. This author postulated that when centric occlusion and centric relation do not coincide the mandibular condyles must assume an eccentric posture to accommodate the teeth in occlusion. Each time closure is attempted, the condyles would exert a mechanical force to the distal inclines of the posterior teeth, which in time would result in a mesial movement of the lower teeth and subsequent crowding of the lower anterior teeth.

A tooth size discrepancy may also play a part in relapse in the lower incisor region (White, 1982). Following a study of 45 untreated normal occlusions, Peck and Peck (1972), advocated a reduction of mandibular incisors to a given facio-lingual \ mesiodistal ratio to increase stability. Their rationale was however criticised by Blake and Bibby (1998), as Peck and Peck's recommendations were based on a study involving untreated rather than treated cases, and on young patients with ideal lower incisor alignment. Gilmore and Little (1984) studied 134 treated and 30 control cases at least 10 years out of retention to evaluate whether the Peck and Peck ratio had long-term value. They showed a weak association between long-term irregularity and either incisor width or the facio-lingual \ mesiodistal ratio. These findings were also confirmed in other studies (Mills, 1964; Keane and Engle, 1979; Smith, Davidson and Gripe, 1982; Puneky, Sadowsky and BeGole, 1984; Glenn, Sinclair and Alexander, 1987; and Richardson, 1995), which all suggest that tooth structure plays only a minor role (if any) in the aetiology of late mandibular crowding.

The concept of lower incisor reproximation was introduced by Boese (1980) in order to provide broader contact points and increase the available arch space in the mandibular anterior region. In a 4 to 9 year follow-up study of 40 patients treated with four premolar extractions followed by interproximal reduction and supracrestal fiberotomy, he showed good post-retention stability. However, his retrospective study involved continued intervention during the retention period, even in the presence of minor relapse. Therefore, the results of his study were not comparable to other retention studies.

All the previous studies highlight one or another cause-effect relationship which could be linked to mandibular incisor relapse. It would seem, however, that a combination of factors may be responsible for this form of relapse (Little, Wallen and Riedel, 1981). According to these authors, most studies dealing with incisor relapse have certain inherent shortcomings which create difficulty in the drawing of definite conclusions.

Post-orthodontic relapse is not only confined to changes in width and length of the dental arches. A number of other features of a malocclusion also tend to recur at the end of orthodontic therapy. The results of most studies concerning the stability of overbite correction indicate a decrease in overbite during treatment followed by an increase in overbite in the post-retention phase. Berg (1983), found that only 40 percent of overbite correction was maintained following retention, whereas Dake and Sinclair (1989) noted overbite relapse of between 20 and 40 percent. Simons and Joondeph (1973), found that patients with an initially deep overbite had the deepest overbite 10 years post-retention and that protrusion of incisors was correlated with overbite relapse.

Studies have also attempted to relate the stability of deep overbite correction to other factors such as extraction pattern. Cole (1948), observed that with extraction therapy, the post-retention overbite was deeper than in the original malocclusion. Hernandez (1969), studied 83 Class II, division I, patients out of retention for a minimum of six months and found more overbite relapse in those patients who had undergone extractions. Walter (1953), studied 34 patients treated without extractions and found a 2,72mm overbite decrease with a post-treatment relapse of 0,71mm. Simons and Joondeph (1973), stated that post-retention relapse was not related to extractions having been performed. Riedel (1960), stated that an upright incisor with a large interincisal angle was more likely to relapse. Simons and Joondeph (1973), believed that occlusal plane changes during treatment tended to relapse to their original angulations, and that this correlated with deep bite relapse. They concluded that mandibular growth with a vertical component was correlated with overbite stability.

Burzin and Nanda studied 26 patients in 1993. Their sample comprised extraction and non-extraction cases and the post-treatment observation period was two years. Overbite showed a mean reduction of 3,3mm (57 percent) during treatment, and a mean relapse of 0,8mm (24 percent) was observed during the post-treatment period. The findings indicated that the more the overbite was corrected, the more it tended to relapse during the post-treatment period. In supporting the view of Riedel (1960), these authors also suggested that good axial inclinations of the incisor teeth at the end of treatment may be a factor in the stability of the final result. According to Riedel (1960), the size of the interincisal angle has a direct bearing on relapse of overbite, i.e. the larger the interincisal angle at the commencement of correction of an increased overbite, the greater the tendency for this feature of a malocclusion to relapse. Simons and Joondeph (1973), were not in agreement with Riedel, as they found no correlation between the size of the interincisal angle and the degree of overbite relapse. They found a correlation between overbite relapse and the degree of lower incisor protrusion. They suggested that undue proclination of lower incisors should be avoided during orthodontic treatment in order to enhance the long-term stability of orthodontically treated dentitions.

In a study of 55 patients at least 6,5 years post-retention, Lenz and Woods (1999) concluded that incisal positions and angulations tend to change in the long-term following routine, comprehensive orthodontic treatment, but that on average, these changes are small. They suggested that recommended absolute goals for end-of-treatment incisal positions be used more as general functional and aesthetic clinical guides, rather than as predictors of stability.

Burzin and Nanda (1993), found no difference in stability between the extraction and non-extraction groups, supporting the findings of Simons and Joondeph (1973), and their observations suggest that deep overbite correction with intrusive mechanics is equally stable in both extraction and non-extraction treatment. However, Little, Wallen and Riedel (1981) found a statistically significant increase in overbite during the post-retention period for 65 first premolar extraction patients. The increase in this study was only 0,76mm, which although demonstrating statistical significance, may not be clinically significant.

Sadowsky and Sakols (1982) reported on 96 patients with an average post-retention period of 20 years. They noted that the overbite showed the least improvement over the long term when compared with pretreatment values. An excessive overbite was present in 56 percent of cases before treatment, and in 41 percent of cases at the long-term stage. The trend to return to the pre-treatment condition was readily apparent in both extraction and non-extraction patients.

Seedat (1984), using the same methodology as Sadowsky and Sakols, also demonstrated an 80 percent prevalence of cases displaying at least one non-ideal occlusal relationship following retention. He examined 35 patients on average 3,4 years post-retention. In decreasing order of prevalence of relapse, the following variables accounted for the non-ideal, post-retention occlusal relationships: class II canine relationship (41,4%), overjet (34,3%), mandibular incisor crowding

(25,7%) and overbite (22,9%).

The correction of an increased incisor overbite thus presents orthodontists with problems which are not only difficult to treat, but which have a tendency to relapse (Magill, 1960; Bishara, Chadha and Potter, 1973; Simons and Joondeph, 1973). Although overbite increase following retention is related to the amount reduced during treatment, generally 30% to 50% of the correction is retained (Little, Wallen and Riedel, 1981; Shields, Little and Chapko, 1985). Overbite relapse post-retention is important as it has been shown that the correct amount of incisor overbite provides incisal guidance which is necessary for adequate function and continued oral health (Magill, 1960). Although the tendency for incisal overbite to relapse has been extensively investigated by several researchers (Magill, 1960; Bishara, Chadha and Potter, 1973; Simons and Joondeph, 1973; Sadowsky and Sakols, 1982), and despite the use of retention devices, the tendency for overbite to relapse still exists. Magill (1960) reported that the most significant relapse in incisor overbite occurred in the first two years after removal of the retention appliances, and that this was then followed by relative stability of the incisor overbite.

The role of growth in post-treatment changes is controversial. Riedel (1960), reflected on the fact that growth may aid in the correction of orthodontic problems but may also cause relapse in treated cases for example as late mandibular growth in patients who presented with a Class III skeletal pattern. Nanda and Nanda (1992) agreed with this stating that any skeletal changes that occur during retention may attenuate, exaggerate, or maintain the dento- skeletal relationship. Payne (1964) suggested a mechanism whereby late condylar growth following orthodontic treatment affects not only the mandibular plane angle, but also causes a closing rotation of the mandible thereby increasing the incisor overbite. The findings of Bjork and Skieller (1983), contradict the observations of Payne in that they (Bjork and Skieller) observed a decrease in the incisor overbite with age. They suggested that orthodontic procedures which rotate the mandible may initiate remodelling of the lower border of the mandible, therefore maintaining the existing incisor overbite. Nanda (1988), found that in patients with a skeletal deep bite the pubertal growth spurt occurred on average 1,5 to 2 years later than in patients with open bites. This was because the patterns of development of the open- and deep-bite faces, as demonstrated by both cumulative and percentile growth curves, were different. This study was performed on a sample of 32 subjects to determine the timing of the peak of the pubertal spurts for five facial dimensions in open and deep bite subjects. The outcome of this study was that a longer retention period for the skeletal deep bite patients was advocated to counteract the continuing effect of dentofacial growth after the completion of orthodontic treatment.

The stability of anterior open bites was evaluated by Lopez-Gavito et al (1985), in a study of 41 patients in which the average pre-treatment openbite of 5mm was reduced to 3mm positive overbite during appliance therapy. Forty percent of the sample showed marked relapse averaging 4,5mm, while the remaining 60 percent showed stability of the result following a minimum of 9 years and 6 months postretention. The relapse subgroup showed a greater increase in lower anterior face height during the postretention period than did the stable group. These authors felt it would have been desirable to obtain reliable pretreatment predictors of future open-bite stability. However, no set of pretreatment variables could be found in their study to satisfy this objective.

Among the studies reported from Seattle, (Little, Wallen and Riedel, 1981; Shields, Little and Chapko, 1985; and Little, Riedel and Artun, 1988), no characteristic such as Angle classification has been of value in predicting long-term stability or relapse. These authors also reported that postretention changes of cephalometric variables failed to explain mandibular incisor crowding. Other studies are in agreement, and have shown that there is not a higher prevalence of relapse in patients with Class II division I malocclusion compared with other malocclusion groups (Ades et al., 1990; Bishara, Chadha and Potter, 1973; Bresonis and Grewe, 1974; Elms, Buschang and Alexander, 1996). A slight change in overjet toward pre-treatment values was demonstrated in all malocclusion groups.

Another type of relapse which merits discussion is that of recurring crossbite of corrected transverse relationships. Deviations from the normal transverse relationships of the teeth may be identified as unilateral or bilateral crossbites of single or multiple dental units (Andersen and Dewey, 1942). The correction of bilateral occlusal abnormalities is difficult and there is a tendency to relapse after treatment. Rapid maxillary expansion (Haas, 1961) is often used to correct bilateral crossbites which are due to a maxillary transverse deficiency. Patients who have undergone this form of treatment require a long period of retention in order to allow the mid-palatine suture to achieve structural stability. Some clinicians (Cotton, 1978; Hicks, 1978), have suggested that a reduction in the rate of maxillary expansion may result in a more stable outcome of the treatment due to a longer period of time being allowed for skeletal adjustment to occur. Unilateral, and / or single tooth crossbite relapse has also been attributed to inadequate retention, a lack of intercuspation, and to the contraction of supragingival periodontal fibres (Shapiro and Kokich, 1981).

The relationships of the lower incisors to the oral musculature also received attention (Rogers, 1922; Strang, 1952). These authors felt that there was a need to position the lower incisors, and for that matter all the teeth, in a “neutral zone”. In this zone, there was believed to be a balance of forces ensuring that the teeth were not displaced in any one direction to the exclusion of all others. It follows then that at the end of orthodontic treatment all teeth should be positioned in the neutral zone and that any tooth, or teeth, left outside this region would be in conflict with the muscles and thus would be prone to relapse. Weinstein et al. (1963) and Mills (1966) agreed that the lower incisors are positioned in a narrow zone of stability in equilibrium between opposing muscular forces, and they were of the opinion that the pre-treatment labiolingual position of the incisors should be accepted and not altered by orthodontic treatment. In two separate studies, (Shields, Little and Chapko, 1985 and Houston and Edler, 1990), the pre-treatment position of the lower incisors was shown to provide the best guide to the position of stability. In over 50 percent of cases the lower incisors ultimately stabilised at a point between the pre-treatment and post-treatment positions.

The controversy regarding the role of extractions in preventing relapse of orthodontic treatment still exists. Those who advocated non-extraction felt that a full complement of teeth was essential to produce the “best balance, best harmony” and a “normal occlusion” (Angle, 1907). Others (Brodie, 1934; Schaeffer, 1949) maintained that teeth were the active agents for the promotion of jaw growth and that their loss imposed a severe retardation on such growth. The extraction school of thought, on the other hand, maintained that arch widening as a means of gaining space in non-extraction orthodontic treatment was prone to more relapse (Tweed, 1936). Accordingly, this group advocated extractions to be the treatment of choice in cases where inherent crowding existed and ideal aesthetics needed to be achieved (Tweed, 1936; Tulley, 1962; Cookson, 1971).

Little, Wallen and Riedel (1981), reported on 65 patients at least 10 years following retention who had undergone first premolar extractions. Mandibular arch shortening was seen in over 90 percent of cases. The overall success rate when taking post-retention crowding into consideration was less than 30 percent. In a follow-up study at 20 years by Little, Riedel and Artun (1988), the overall post-retention success rate had deteriorated to 10 percent. They concluded that the only way to ensure satisfactory alignment after treatment is the use of fixed or removable retention for life.

In a 20 year post-retention study, Sadowsky and Sakols (1982), showed that 15 percent of the 96 cases treated had crowding beyond 3mm, and only 1 percent had crowding of 6,5mm or more at the long-term stage. In a later report by Uhde, Sadowsky and BeGole (1983), the sample was broken down into 45 non-extraction and 27 extraction cases. The extraction sample showed more severe crowding at the beginning of treatment and a smaller percentage of relapse post-retention.

Glenn, Sinclair and Alexander (1987) studied 28 cases of non-extraction treatment an average of eight years following retention and found a slight increase in incisor irregularity which was about half the severity of those seen in Little's studies (Little, Riedel and Artun, 1988; Little, Wallen and Riedel, 1981). Class II malocclusions with large ANB differences showed the most lower incisor post-retention relapse. The severity of relapse seemed to bear a direct relationship to the severity of the original malocclusion.

Sandusky (1983, cited by Nanda and Burstone, 1993), reported on post-retention stability in 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. Tweed spoke in a 1968 interview about a study he was conducting with 100 extraction and 100 non-extraction cases examined 25 years out of retention. While no scientific data are available, Tweed's conclusion was that the extraction cases were more stable. Davis (1971, cited by Nanda and Burstone, 1993), reported that extraction cases experienced less mandibular incisor crowding and were more stable than non-extraction cases three to five years following retention.

Kuftinic and Strom (1975) examined 30 extraction and 20 non-extraction cases four months or more after discontinuing retention. The patients all presented with Class I malocclusion with varying degrees of bi-maxillary protrusion. They found that lower incisor relapse was three times more prevalent in the non-extraction cases.

Orthodontic correction of tooth rotations leads to stretching of the supracrestal periodontal fibres. These stretched fibres have been implicated in causing relapse by pulling teeth back towards their pre-treatment rotated positions (Reitan, 1958; Edwards, 1968). Brain (1969) and Edwards (1970), advocated circumferential supracrestal fiberotomy (csf) to enhance the stability in dentitions where crossbites and rotations have been corrected in the course of treatment. Following corrected tooth rotation, this gingival fiber surgery would allow for the release of soft tissue tension and the reattachment of the fibers in a passive orientation. Edwards (1988) reported on the findings of a prospective study conducted on patients up to 14 years post-retention following csf. No significant loss of attachment or other periodontal abnormalities were reported between the control and treatment groups. This finding has been confirmed by other authors (Boese, 1980; Fricke and Rankine, 1990). Following their analysis of canine gingival tissue samples, Redlich et al. (1996), questioned the theory of stretched collagen fibers as the cause of rotational relapse. They concluded that rotational relapse is not due to "stretched" collagen fibers as previously believed, but rather that it may originate from the elastic properties of the whole gingival tissue.

This study was undertaken to assess the post-treatment stability of cases treated in the Department of Orthodontics, University of the Witwatersrand, Johannesburg, and to compare these changes with similar studies that have previously been reported. The parameters evaluated were:

a) Molar relationships

b) Canine relationships

c) Incisor overjet

d) Incisor overbite

e) Anterior open bite

f) Anterior cross bite

g) Posterior cross bite

h) Maxillary anterior crowding

i) Mandibular anterior crowding

j) Mandibular intercanine width

k) Maxillary intermolar width

l) Irregularity index.