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Long-term stability following edgewise fixed appliance therapy

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CHAPTER 3: MATERIALS AND METHODS

3.1 SAMPLE

This investigation was carried out on records of orthodontic patients treated by post-graduate students in the Department of Orthodontics at the University of the Witwatersrand, Johannesburg. The sample comprised patients who had completed treatment ten years previously. The orthodontic treatment had been undertaken by six post-graduate students who all used similar edgewise treatment mechanics in treating the patients. Supervision was carried out by the same group of staff members, all of whom were experienced orthodontic consultants.

Permission was granted by the Committee for Research on Human Subjects, University of the Witwatersrand, Johannesburg, Protocol number MOO/2/24, to conduct this study.

Thirty-one subjects who had reached the end of the retention period at least ten years previously were available to participate in the study. It was assumed for the purpose of the investigation that the sample represented a random selection of patients. Bias may, however, have crept into the study in that the patients who agreed to having their records taken, may have represented a more motivated sector of the hospital patients.

3.2 METHOD

The hospital records made available all the descriptive data for each patient including age, sex, treatment procedures, type of malocclusions and retention appliances used. At recall, a set of maxillary and mandibular impressions were taken for each patient together with a wax-registration bite in centric relation (Roth, 1981).

The impressions were cast in high quality orthodontic stone by an orthodontic laboratory technician. A minimal time delay between the taking of the impressions and the pouring of models was ensured. Each study model was examined by the author to ensure that it conformed to the high standards required for an investigation of this nature. This implied that the finest detail possible was required in each study model. Those with flaws, e.g. porosity and air bubbles, were discarded and new impressions were taken.

For the purpose of this study, only static occlusal traits were investigated. By assessing study models taken prior to treatment (pretreatment), at the end of treatment (post-treatment), and following retention (postretention), it was possible to study the occlusal changes which had taken place during and following treatment. Eleven parameters were measured and recorded according to a scoring system proposed by Sadowsky and Sakols (1982). In each instance, when the parameter was considered to exhibit ideal relationships, a score of zero (0) was allocated. The parameters studied were:

1. The molar and canine relationships on the right and left sides of each set of study models. These were recorded according to the criteria established by Angle (1899). The variables, when presenting less than half a cusp deviation from a Class I relationship, were regarded as being ideal and were given a score of zero (0). A Class II relationship obtained a score of 2 and a Class III relationship scored 3.

2. Incisor overjet was measured in millimetres as the distance from the labial aspect of the incisal edge of the most labially positioned upper incisor to the labial incisal edge of the corresponding lower incisor. The ideal range of incisor overjet was considered to be between 0 to 3.0 mm. A measurement between 3.5 and 6 mm was allocated a score of 2, between 6.5 and 9 mm scored 3, and a measurement larger than 9.5 mm obtained a score of 4.

3. Incisor overbite was defined as the vertical overlap of the upper left central incisor over the corresponding lower incisor and was measured in millimetres. The normal, ideal range (score = zero), was considered to be between 0 to 3.0 mm. A measurement between 3.5 and 5 mm scored 2 and any measurement larger than 5 mm scored 3.

4. Anterior open bite, when present, was measured in millimetres as the amount of space between lower incisors and upper incisors or palatal mucosa when the models were in centric occlusion without the wax bite. The ideal score (zero) for this parameter was 0 mm. When the presence of an overbite accompanied the open bite (i.e. horizontal with a vertical discrepancy), a score of 1 was allocated . An open bite between 0 and 3 mm scored 2, and open bites larger than 3.5 mm scored 3.

5. Anterior cross bite, when present, was recorded according to the system which recognised three sub-categories according to the number of teeth affected. When no teeth were in cross bite this was regarded as being ideal. One or 2 teeth in crossbite scored 1, and 3 or 4 teeth in crossbite obtained a score of 2.

6. Posterior cross bite was recorded as 0 when this feature was absent, unilateral (1), or bilateral (2). No consideration was given to the actual number of teeth involved or the presence of a functional shift.

7. Maxillary anterior crowding was measured in millimetres as the difference between the space available in the dental arch to accommodate a tooth or teeth and the sum of the mesiodistal widths of the six anterior teeth (Nordeval, Wisth and Boe, 1975). This difference was given a score value which represented the degree of crowding present. The ideal range of 0 to 3.0 mm of space shortage was regarded as acceptable and normal, and obtained a score of 0. Crowding between 3.5 and 6 mm scored 1, and crowding exceeding 6 mm was given a score of 2.

8. Mandibular anterior crowding was recorded in the same way as maxillary anterior crowding.

9. Mandibular intercanine width was measured in millimetres at the deepest point of the gingival margin on the labial surfaces of the canines. Maxillary intermolar widths were measured in millimetres at the most apical point on the gingival margin corresponding to the mesiopalatal cusps of the first molars present in the upper arch.

The above procedures were used to study and to quantify all of the variables under review. These procedures were performed on each of the sets of study models in the three stages of treatment. A total malocclusion score was obtained for each study model by calculating the algebraic sum of all the scores of the variables for that model. The total malocclusion scores thus indicated the severity of the malocclusion present in each study model. Therefore, a total score of zero indicated "ideal" or normal occlusion (Sadowsky and Sakols, 1982), and any total score greater than zero indicated deviations from the ideal as described above.

A further examination of each of the study models was carried out measuring the linear distance from one anatomic contact point to the adjacent anatomic contact point for each of the six mandibular anterior teeth (Figure 3.2.1). The sum of these 5 measurements provided the Irregularity Index as devised by Little (1975). Little (Little, Wallen and Riedel, 1981), later arbitrarily grouped mandibular irregularity into minimal (< 3.5 mm), moderate (3.5 to 6.5 mm), and severe (> 6.5 mm).

Linear measurements were made of occlusal parameters by using the method proposed by Kinaan and Burke (1981). These assessments were performed using a digital vernier caliper calibrated to the nearest 0,05mm, as well as a straight-edge ruler and a pair of dividers. Prior to the evaluation of the study models, each set of models was allocated a random reference number. This task was carried out by a dental student who was not involved in the study. In this manner it was planned to eliminate, in so far as was possible, any knowledge of which stage of treatment, i.e. pretreatment, posttreatment or postretention was represented by a particular set of records. At the completion of

the evaluation the numbers on each of the study models were used to confirm that the features observed on the study models corresponded with the appropriate patient's records. This procedure was followed to ensure that the data were not recorded incorrectly.

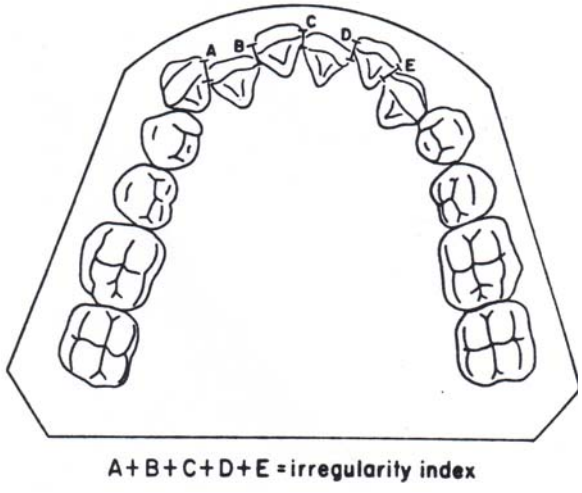

Figure 3.2.1 Little's Irregularity Index.

(From: Little, Wallen and Riedel, 1981)

3.3 STATISTICS

Summary statistics for each stage of treatment, i.e. mean, median, standard deviation, range, frequencies and percentages, conducted at the Institute of Biostatistics, of the South African Medical Research Council, were used to describe the observed parameters (APPENDIX A, B).

These parameters were analysed jointly using Hotelling's T^2 test which is a multivariate analysis, and once significance was achieved, the Student T test was employed to assess the measurements individually. Parameters measured on the nominal/ordinal scale were analysed using the chi-square test, Fisher's exact test and kappa statistics. All testing was done at the 0.05 level of significance.

The malocclusion scores for each patient at each of the three stages of treatment were determined. It was also decided which occlusal traits tended to be stable as well as the number of cases which were considered ideal following retention.

In all the above analyses, when data did not comply with the assumptions of the proposed tests, non-parametric procedures e.g. Wilcoxon's matched pairs test, the Mann-Whitney U test and Spearman's rank correlation test were employed.

Changes in the intercanine and intermolar widths were correlated with overbite, overjet and anterior mandibular crowding parameters. Similarly, lower intercanine widths were correlated with upper intermolar widths at the three stages of treatment.

3.3.1 Error of Method

In order to determine the intra-examiner variability, twenty study models were randomly selected and analysed on two separate occasions, one week apart, using the criteria for repeatability adopted as the British Standard i.e. 2 standard deviations of the differences.

3.3.1.1 Intra-Examiner Accuracy of Measurements

To determine intra-examiner variability, measurements of the irregularity index were recorded on three separate study models, twice a day, for ten consecutive days. Associations between these measurements were assessed in correlation and regression analyses.