

I hereby declare that this is my own work, and that it has not been submitted or incorporated in any other research report, thesis or dissertation for any other degree.

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This ----- day of ----- 2008.

Dedication

This work is dedicated to my beloved husband Dr Riaz Fadal, my children Imaan Az-Zahra and Muhammad, my parents Professor and Mrs Green-Thompson and my mother in law, Haseena Fadal.

ABSTRACT

‘He who sees things grow from the beginning will have the best view of them’

Aristotle

Comprehensive and accurate diagnosis and treatment planning is crucial in successful orthodontics. An essential part of the diagnostic exercise is to determine whether there is a tooth size/arch length discrepancy (Bishara, 2001). The mixed dentition space analysis is one method of determining this (Moyers, 1973). The procedure requires the measurement of the anteroposterior dimension of the crowns of erupted teeth and the prediction of the size of the crowns of the unerupted permanent canine and premolar teeth. The comparison of tooth sizes enables the calculation of the ‘*leeway space*’, which may provide for the transition to the full intercuspation of the first permanent first molars as well as the relief of a certain amount of crowding in the arch (Gianelly, 1995). To date, the application of data of methods of measuring and estimating tooth size have been limited by the relative complexities of the method (Paredes et al, 2006), and the application of the data has been limited by the demographic profile of the patient (Schirmer and Wiltshire, 1997; Khan, 2006).

The aim of this study is to develop a technique of precisely measuring the mesiodistal tooth size of the crowns of teeth from computerized images of panoramic x-rays, using the Leica QWin© System of Image Analysis (*Leica, UK(Pty) Ltd*). Ideally, this method would be accurate, reproducible and easy to use by a clinician.

Thirty sets of study casts and the corresponding panoramic radiographs of patients in the mixed dentition stage of dental development were chosen, according to specific criteria, from the archived records of the Undergraduate Clinic at The School of Oral Health Sciences, University of the Witwatersrand. On the study casts, the mesio-distal widths of the second deciduous molar ('e') and of the first permanent molar ('6') teeth in each quadrant were measured with a digital vernier caliper. The corresponding radiographs were digitally photographed at a fixed distance, and uploaded onto the computer programme. A magnification factor was determined using the image of a premeasured object. The images of the 'e' and the '6', together with the image of the unerupted second premolar tooth ('5') were measured with the calibrated linear function of the Leica QWin© System. The data was thus corrected for by the relevant magnification factor. The size differential between the 'e' and the '5', representative of the leeway space, was then calculated.

A calculation of the intra-examiner repeatability demonstrated a low co-efficient of variation of the measurements recorded on both the study casts and on the computer. The measurements of the teeth taken on the study casts were compared with the corrected measurements of the same teeth taken from the computer images of the teeth. Tooth size measurements taken with the Leica QWin© System were greater than those taken with the vernier calipers. In both methods the sizes of the teeth were larger in the mandible than in the maxilla. This observation was also reported by Kraus et al (1969). The values for leeway space were calculated in both jaws. The mean values of leeway space in the maxilla were 0.81mm on the left hand side and 1.08mm on the right hand side, and 2.43mm on the left hand side and 2.59mm on the right hand side in the mandible. These values were similar to

those recorded by Nance (1947) and by Bishara et al (1988) who also found that values of leeway space were smaller in the maxilla than in the mandible.

The accuracy of the measurements taken with the proposed method was found to be dependent upon correct patient positioning in the focal trough of the machine at the time of panoramic radiographic exposure, the use of a marker known in size placed at the site to be measured in order to correct measurements for magnification and the definition of corresponding mesio-distal points on the teeth from which measurements would be taken on both sets of records.

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