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Measuring and predicting leeway space in the mixed dentition on panoramic radiographs using computer imaging analysis

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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.

NADIA FARRAH GREEN-THOMPSON

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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TABLE OF CONTENTS

DECLARATION **i**

DEDICATION **ii**

ABSTRACT **iii**

ACKNOWLEDGEMENTS **vi**

TABLE OF CONTENTS **vii**

LIST OF FIGURES **xii**

LIST OF TABLES **xiv**

LIST OF APPENDICES **xvii**

CHAPTER ONE: INTRODUCTION **1**

CHAPTER TWO: LITERATURE REVIEW **4**

2.1 DEVELOPMENT OF THE HUMAN DENTITION 4

2.2 THE MIXED DENTITION STAGE 7

2.2.1 OCCLUSAL CHANGES 8

2.2.2 LEEWAY SPACE 9

2.2.3 DENTAL ARCH CROWDING 11

2.2.4 SPACE ANALYSIS IN THE MIXED DENTITION 13

2.2.4.1 MEASUREMENT OF TOOTH SIZE 14

A) STUDY CAST MEASUREMENTS 14

B) PANORAMIC RADIOGRAPHS 17

2.2.4.2 PREDICTION OF TOOTH SIZE 20

A) RADIOGRAPHIC METHOD 20

B) NON- RADIOGRAPHIC METHOD 24

2.2.5 COMPARISON OF METHODS OF SPACE PREDICTION 28

2.2.6 FACTORS AFFECTING PREDICTION TABLES 29

2.2.6.1 GENETIC FACTORS 29

2.2.6.2 GENDER 30

2.2.6.3 RACE GROUP 32

2.2.6.4 CLEFT LIP AND PALATE 33

2.2.7 PROS AND CONS OF EXISTING PREDICTION METHODS 33

2.3 TECHNOLOGY: IMPROVED METHODS OF MEASURING TOOTH DIMENSIONS 34

CHAPTER THREE: MATERIALS AND METHOD

3.1 SAMPLE GROUP 36

3.2 EXPERIMENTAL DESIGN 37

3.2.1. STUDY MODELS 37

3.2.1.1 INSTRUMENTATION USED 39

A) THE VERNIER CALIPER 39

B) PAIR OF DIVIDERS 40

3.2.1.2 MEASUREMENT PARAMETERS 40

3.2.2 RADIOGRAPHS 42

3.2.2.1 BACKGROUND TO LEICA QWIN© SYSTEM OF IMAGE ANALYSIS 34

3.2.2.2 MEASUREMENT PARAMETERS ON THE RADIOGRAPHS 43

3.2.2.3 CALIBRATION OF THE LEICA QWIN© MEASURING TOOL 46

3.2.2.4 MEASUREMENT TECHNIQUE 49

A) INTRA EXAMINER RELIABILITY - REPRODUCIBILITY

OF MEASUREMENTS 50

B) CO-EFFICIENT OF VARIATION 51

3.3 STATISTICAL ANALYSIS 57

CHAPTER FOUR: RESULTS 58

4.1 MEASUREMENTS 58

4.2 FIRST PERMANENT MOLAR 59

4.2.1. VERNIER CALIPER MEASUREMENTS 59

A) MAXILLA 59

B) MANDIBLE 59

4.2.2 LEICA QWIN© MEASUREMENTS 61

A) MAXILLA 61

B) MANDIBLE 61

4.3. SECOND DECIDUOUS MOLAR TOOTH 63

4.3.1 VERNIER CALIPER MEASUREMENTS 63

A) MAXILLA 63

B) MANDIBLE 63

4.3.2 LEICA QWIN© MEASUREMENTS 64

A) MAXILLA 65

B) MANDIBLE 65

4.4 SECOND PREMOLAR TOOTH 66

4.4.1 LEICA QWIN© MEASUREMENTS 67

A) MAXILLA 67

B) MANDIBLE 67

4.5 LEEWAY SPACE MEASUREMENTS 68

A) MAXILLA 69

B) MANDIBLE 69

4.6 MEAN DIFFERENCES BETWEEN ALL THE MEASUREMENTS TAKEN 70

4.6.1 FIRST PERMANENT MOLAR TOOTH 71

4.6.2 SECOND DECIDUOUS MOLAR TOOTH 71

A) MAXILLA 71

B) MANDIBLE 72

4.6.3 LEEWAY SPACE 73

A) MAXILLA 73

B) MANDIBLE 74

CHAPTER FIVE: DISCUSSION 76

5.1 FINDINGS OF THE STUDY 76

5.2 METHODS OF MEASURING TOOTH DIMENSION 77

5.2.1 CALIBRATION FOR CORRECTION OF MEASUREMENTS 78

5.2.2 COMPARISON WITH OTHER METHODS 79

5.2.3 PROBLEMS ENCOUNTERED WHILE MEASURING 83

5.2.3.1 FACTORS INFLUENCING ACCURACY OF MEASUREMENTS 83

5.3. FUTURE RESEARCH 85

CHAPTER SIX: CONCLUSIONS **86**

APPENDICES **89**

REFERENCES **97**

ETHICS CLEARANCE LETTER **109**

LIST OF FIGURES

Figure 2.1	Angle's classification of occlusion according to molar position	6
Figure 2.2	Schematic view of the mixed dentition	7
Figure 2.3	The terminal plane relationship of the deciduous molars	8
Figure 2.4	Diagram illustrating leeway space	9
Figure 2.5	Representation of the image layer	17
Figure 2.6	Standard error of estimation for predicted widths of teeth.	22
Figure 3.1	Example of a set of study casts of a patient in the sample group- maxillary cast and mandibular cast.	38
Figure 3.2	Digital vernier caliper and a pair of manual dividers	39
Figure 3.3	The measurement sites on the occlusal surfaces of the teeth	41
Figure 3.4	Measurement of tooth width with digital caliper	41

Figure 3.5 Panorex radiograph illuminated on the viewing light box 44

Figure 3.6 Mounted camera and radiograph on the viewing box 44

Figure 3.7 Measurement sites taken with the Leica QWin© System 46

Figure 3.8 ‘R’ and ‘L’ digital markers on panorex cassette 48

Figure 3.9 ‘R’ and ‘L’ digital markers on panorex radiograph 48

Figure 3.10 Variety of lead markers: ‘R’ and ’L’ 49

LIST OF TABLES

Table 2.1	Combined mesiodistal widths of deciduous teeth, and their permanent successors	10
Table 2.2	Prediction tables for estimated and actual means of the widths of the permanent canine and premolar teeth	22
Table 2.3	Moyers probability charts for calculation of size of the unerupted canine and premolars	27
Table 2.4	Tanaka and Johnston Prediction Method	28
Table 3.1	Mesio distal measurements on study cast and computer of the first permanent molar tooth with left and right sides combined	52
Table 3.2	General linear model (GLM) analysis for mesio distal measurement of the left and right sides combined.	53
Table 3.3	Mesiodistal measurement for first permanent molar tooth measured separated by jaw and side.	54
Table 3.4	General linear model (GLM) analysis for length of the left marker.	55

Table 3.5	Measurements for width and length of left and right markers on cassette, light box and on computer	56
Table 4.1	Summary of measurements (mm) of first permanent molar width using the Vernier caliper	60
Table 4.2	Summary of measurements (mm) of first permanent molar width using the Leica QWin© image analysing system	62
Table 4.3	Summary of measurements (mm) of second deciduous molar width using the Vernier caliper on study casts	64
Table 4.4	Summary of measurements (mm) of second deciduous molar width using the Leica QWin© image analysing system on the computer	66
Table 4.5	Summary of measurements (mm) of second premolar width using the Leica QWin© Image analysing system	68
Table 4.6	Summary of measurements (mm) of leeway space using the Leica QWin© Image Analysis System.	70
Table 4.7	General Linear Model (GLM) results for first permanent molar width	71

Table 4.8 General Linear Model (GLM) results for second deciduous molar width - Maxilla 72

Table 4.9 General Linear Model (GLM) results for second deciduous molar width - Mandible 73

Table 4.10 General Linear Model (GLM) results for leeway space measurement - Maxilla 74

Table 4.11 General Linear Model (GLM) results for leeway space measurement - Mandible 75

LIST OF APPENDICES

Appendix One

Table A.1. Nolla's stages of tooth calcification 89

Appendix Two

Table A.2.1. Norms for maturation of permanent teeth for boys (Nolla). 90

Table A.2.2. Norms for maturation of permanent teeth for girls (Nolla). 91

Appendix Three

Table A.3.1. Percentages of ultimate root length by ages in girls 92

Table A.3.2. Percentage of ultimate root length by ages in boys 92

Appendix Four

Table A.4.1. Percentages of eruption achieved at each age for boys 93

Table A.4.2. Percentages of eruption achieved at each age for girls 93

Appendix Five

Table A.5.1. Average mesio-distal widths of the mandibular permanent molar teeth 94

Table A.5.2. Average mesio-distal widths of the maxillary permanent molar teeth 94

Table A.5.3. Average mesio-distal widths of the deciduous molar teeth in the maxilla and mandible 96

Appendix Six

Table A6.1. Proposed probability tables for black subjects of African descent for predicting the mesiodistal widths of the unerupted maxillary canine and premolar teeth 96

Table A6.2. Proposed probability tables for black subjects of African descent for predicting the mesiodistal widths of the unerupted mandibular canine and premolar teeth 96