Evaluation of tooth angulation measured on cone beam computed tomography and panoramic radiographs

A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Clinical Dentistry

by

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2014

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Acknowledgments

I wish to express my appreciation and thanks to my supervisors: Professor Wayne Sampson, Associate Professor Craig Dreyer and Professor Lindsay Richards, for their expert advice, encouragement and editorial opinion throughout this project.

I would also like to extend my appreciation to the following people and organizations whom without this project would not have reached its results.

- Dr Michael J Rielly for his generous donation of dry human skull.
- Dr Joseph Moussa for opening his doors for me and making his practice and equipment available for this study.
- Professor Maciej Henneberg / Prof Anatomical Sciences - The University of Adelaide for his forensic identification insight.
- The Adelaide Dental Hospital for their technical support.
- Mr Don Chorley for his radiographic expertise input.
- Dr Stephen Langford and InCiDental Imaging for donating their time and equipments.
- Dr Paul Buchholz for donating his time and practice equipment.
- Mr Scott Vallance for his software insight.
- Ms Suzanne Edwards and DMAC, University of Adelaide for their statistical assistance.
- Dr Balya Sriram and Dr Eugene Twigge for their unconditional help.
- Mrs Lucy Hatch for her endless kindness and willingness to reach a hand whenever she was asked for help.
- Mr Eddie Sziller and Mr Jon Cor-Udy for laboratory technical assistance.
- My colleagues Dr Berna Kim and Dr Vandana Katyal for their friendship and collegiality during my time as a post-graduate student.
- My dear friends, near and far who have provided continuous encouragement and support during the last three years.

Finally, this thesis is dedicated to my mother Dr Suha Al-Farhan not just for being my mother who brought me to this world but also for being my closest friend, mentor and life role model showing me how hard work always pays off and even the sky is not the limit. Thanks Mum.

This project and the degree attached to it and all what perceived it of achievements in my life only exist because I had my wife, Dr Zainab Hamudi in my life. She is my motive to reach higher levels and my inspiration to keep developing my professional career. She is the kind face I return to after a hard day at work to keep reminding me what was all that about. I love you Zainab and I always will.

I am blessed to have all these people in my life and I thank my God for their existence.

Signed Statement

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

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Ed Karim

Summary

Panoramic radiographs have been used for decades in the field of dentistry and in orthodontics in particular. Panoramic radiography use in orthodontics includes (but is not limited to): pre-treatment dental assessment, dental age estimation, the detection of dental anomalies, the identification of missing and impacted teeth, the prognosis for unerupted teeth, periodontal tissue assessment and pre-finishing root parallelism. The determination and validity of root position has been debated by many authors and practitioners. Knowledge regarding the production of panoramic radiographs questions whether they are the best way of judging tooth angulation.

Aims: The main aim of this study was to assess dental angulation measurements generated by two panoramic x-ray machines. An attempt would be made to correct appraisal differences and, therefore, render the films more useful in providing the necessary diagnostic information to achieve optimal orthodontic treatment results.

Methods: A dry human skull with an inserted typodont was imaged using two different panoramic machines in addition to a CBCT machine. Teeth within the typodont had metal markers attached to their coronal and apical ends. The markers and therefore the long axes of the teeth were identified. Teeth were divided into 5 groups (Anterior-Anterior, Anterior-Premolar, Premolar-Premolar, Premolar-Molar and Molar-Molar). The angles between adjacent teeth were measured on an "OPG extrapolation" produced by tracing markers directly on panoramic radiographs. The same measurements were performed on "Focal Trough Specific extrapolations" which were produced by applying the panoramic machine-specific focal trough around the coordinates of the coronal and apical markers. Each machine had its own "OPG extrapolation" and "Focal Trough Specific extrapolation". The four extrapolations were compared.

Results: A wide range of variation in tooth angulation was found between the measurements of each machine. For the Carestream machine, the Premolar-Molar and Molar-Molar regions were represented poorly on panoramic radiographs. While for the Vatech machine, Premolar-Premolar and Anterior-Premolar were the groups represented least accurately on the panoramic radiographs.

Conclusion: Panoramic radiographs should be interpreted with caution when assessing tooth angulations. Panoramic x-ray machine manufacturers should be encouraged to provide a range of error values to help practitioners have a better understanding of the limitations of panoramic radiographic interpretation.