



A Comparison of CBCT Soft Tissue with Bellus3D Facial Scan Superimposition

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INTRODUCTION

Bellus3D is a venture backed Silicon Valley startup founded in March 2015. It was created to drive the next generation of 3D face scanning hardware and software. One of their goals is to make realistic 3D face models that have dental applications. CT scanning does not provide surface detail and thus the photorealistic appearance of soft tissue cannot be recorded in this way.¹ Stereophotogrammetry is a more promising soft tissue imaging modality. It is a simple, fast, and accurate method which captures the face shape and texture in 3D.² Facial scanners allow for the recording of not only color but texture. Color and texture are important in treatment planning for orthodontics.³

OBJECTIVES

The objective of this project was to show if the Bellus3D scan can be a reliable representation in treatment planning by showing how closely it can be superimposed to CBCT soft tissue

METHODS

- CBCT scan was taken at Diagnostic Records appointment with an extended height field of view option and standardized KvP (kilovoltage peak)
- Bellus3D scan was also taken at Diagnostic Records appointment in same posture and facial expression position as CBCT
- CBCT and Bellus3D scan were imported into Dolphin Imaging software according to manufacturers instructions and procedures
- Facial image and CBCT was automatically superimposed using reference landmarks in Dolphin Imaging software
- Vertical and horizontal differences in position were measured for various sagittal, coronal, and axial landmarks

RESEARCH DESIGN

This study was a cross sectional comparison of 34 patients at the Roseman Orthodontic Clinic.

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INCLUSION & EXCLUSION CRITERIA

Inclusion Criteria:

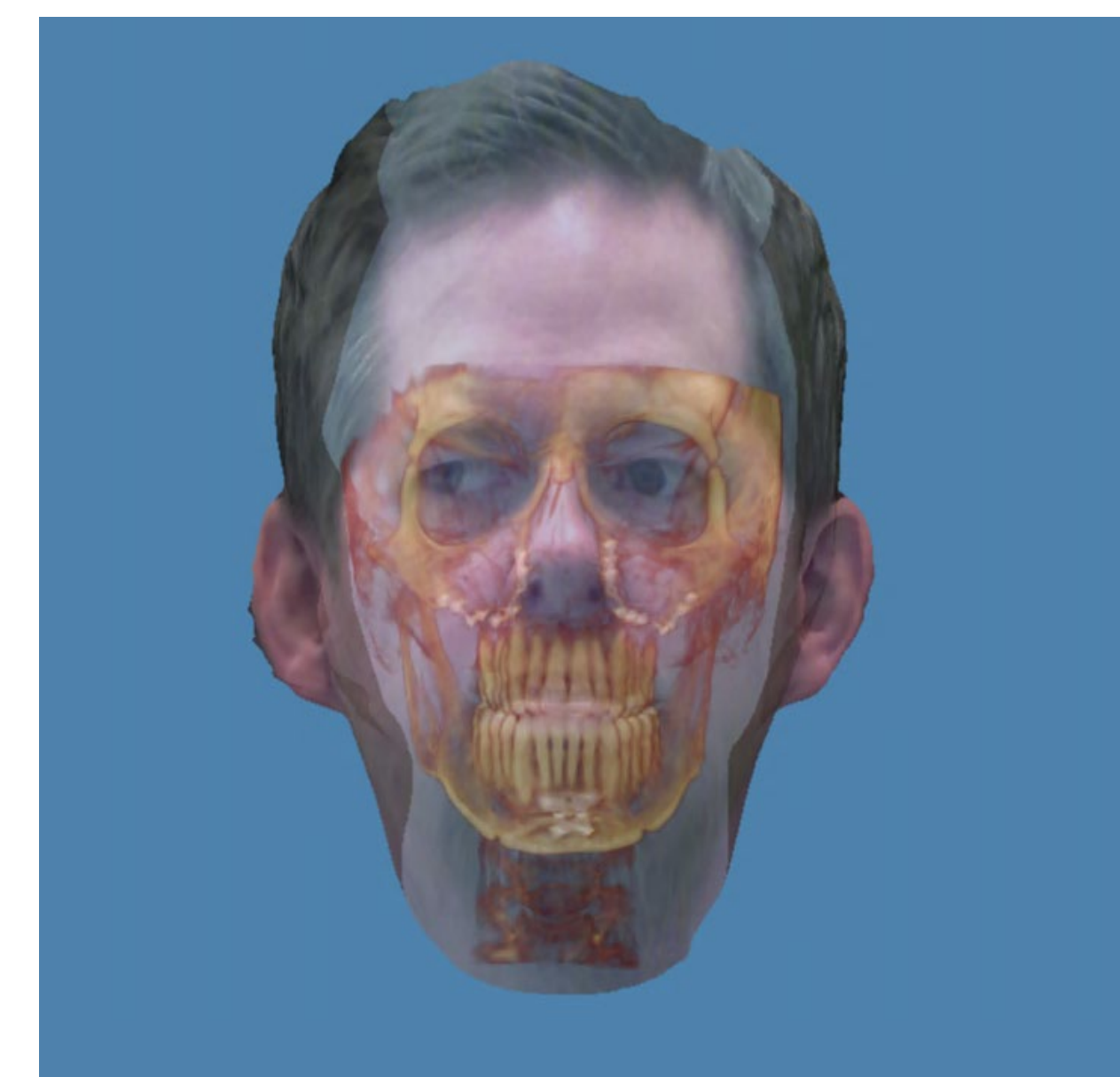
Any patient getting diagnostic records at Roseman Orthodontic Clinic with full FOV CBCT

Exclusion Criteria:

- Craniofacial Anomalies
- Birth defects or anomalies that could affect reproducible facial expressions for scans
- Excessive facial hair including beard or mustache
- Facial deformities such as severe scarring
- High degree of movement on the CBCT scan

ANALYSIS

- Data was analyzed using SPSS Version 26 Statistical Software
- A table was made recording the distance in mm between CBCT soft tissue and Bellus3D scan soft tissue for the designated anatomical landmarks in sagittal, axial and coronal view. CBCT soft tissue outline was the reference marker and set as "0". Bellus3D soft tissue outside reference soft tissue corresponded to a positive value and Bellus3D soft tissue inside reference soft tissue corresponded to a negative value. Values for the set markers and views were recorded.
- From data collection a One-Sample T Test was performed. Test Value "0"
- p-value of <0.05 was considered statistically significant.



RESULTS AND IMPLICATIONS

- A majority of the recorded anatomical landmarks fell within the CBCT soft tissue by less than 1mm and almost all data points were less than 2mm difference.
- Axial cuts of the tip of nose in the horizontal direction were the most accurate when comparing mean value only.
- Coronal cut of the zygomatic right was the least accurate when comparing the mean value only.
- 5 anatomical landmarks were statistically significant in that they did not have comparable landmarks of the Bellus3D measurements to the CBCT landmarks when using a p value at p=0.05. These observed values are different than the standard (which was 0 in this case). A statistically significant difference means that the apposition was not very good. 7 anatomical landmarks were not statistically significant in that the Bellus3D anatomical points were reproducible at p<0.05 meaning these anatomical points were close enough to be statistically insignificant. A value of 0 means that the apposition is perfect.
- 5 landmarks were statistically significant (p<0.05) and 7 landmarks were not statistically significant. Although the p value for these 5 landmarks were statistically significant due to being p<0.05 they were clinically insignificant with the difference for the anatomical points of the Bellus3D from the CBCT being less than 2 mm avg
- All measurements were very similar and comparable for the various anatomical landmarks
- Soft tissue analysis is an important diagnostic tool in treatment planning for orthodontic treatment. Texture and color give a more realistic data set for evaluation.
- Bellus3D is comparable in precision and accuracy with a lower price point when compared to its competitors.

REFERENCES

1. Ayoub AF, Xiao Y, Khambay B, Siebert JP, Hadley D. Towards building a photo-realistic virtual human face for craniomaxillofacial diagnosis and treatment planning. *Int J Oral maxillofac Surg* 2007;36:423-8.
2. Zhong, John. Bellus3D Depth and Face Scan Accuracy Report. Bellus3D, Inc
3. Jayaratne YSN, McGrath CPJ, Zwahlen RA (2012) How Accurate Are the Fusion of Cone-Beam CT and 3-D Stereophotographic Images? *PLoS ONE* 7(11):e49585. doi:10.1371/journal.pone.0049585
4. Naudi K.B., Benramadan R, Brocklebank L, Ju X, Khambay B, Ayoub A. The virtual human face: Superimposing the simultaneously captured 3D photorealistic skin surface of the face on the untextured skin image of the CBCT scan. *International Journal of ORAL & Maxillofacial Surgery*. 2013;42:393-400.
5. Khambay B, Nebel JC, Bowman J, Walker F, Hadley DM, Ayoub A, 3D stereophotogrammetric image superimposition onto 3D CT scan images: the future of orthognathic surgery. A pilot study *Int J Adult Orthodon Orthognathic Surg* 2002;17:331-41