Determining the accuracy of implant treatment planning with CBCT

Hunter Jolicoeur, Gerard Camargo, Tamara Stephenson, Wenjian Zhang

Greenville, North Carolina, United States

Introduction

Implants are commonly used amongst dentists to replace teeth or address edentulous regions. The American Academy of Oral & Maxillofacial Radiology (AAOMR) recommend that cone beam computed tomography (CBCT) is used to assist in planning dental implants.

CBCT provides:

- **Cross-sectional imaging**
- **3D volumetric measurements (alveolar ridge height & width)**

These 3D cross-sectional images provide a method for dentists to project the length & width of potential implants.

This study was conducted in order to evaluate the accuracy of CBCT measurements to corresponding implants that were placed.

Methods

- **Retrospective case-control study.**
- Data was taken from **2017-2022,** from 9 locations: Ross Hall and 8 ECU SoDM CSLCs
- Compared CBCT scan measurements & implants sizes from 4 sites: **Central incisor, Canine, 1st premolar, and 1st molar (Maxillary and Mandibular)**
- # of implants cases analyzed: **N = 544**
  - Females: **N = 256**
  - Males: **N = 288**
  - Age range: **19-86 years old (Peak age of 61-70)**
- One-way analysis of variance determined the average sizes for alveolar ridges/implants.
- Pearson correlation analysis determined the accuracy of CBCT based implant treatment planning.

Results

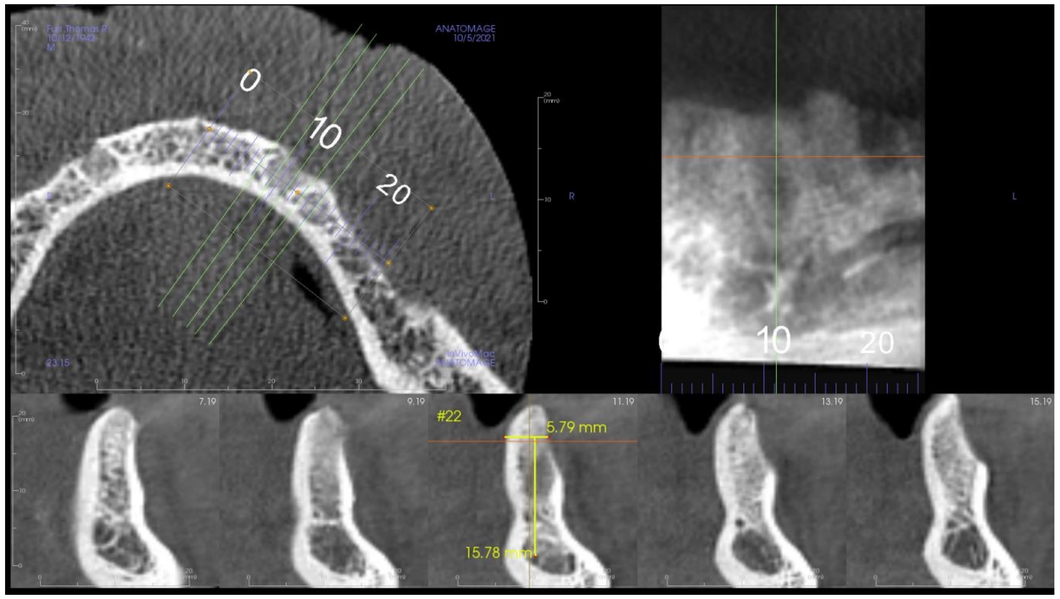
- On average, **implants had diameters of 4.17±0.38 mm & lengths of 10.05±1.17mm**
- Alveolar widths & heights were **3.74mm & 4.31mm larger** than implant diameters & lengths.
- Implants placed at the **mandibular 1st molar, maxillary 1st premolar, and mandibular canine** demonstrated significant correlations with sizes of edentulous regions. **(P< 0.05).**

Table 1. Implant sizes and edentulous alveolar ridge dimension measurements.

Tooth locations	Sample sizes	Implant widths	Ridge widths	Width differences	Implant Lengths	Ridge heights	Length differences
	(N)	Mean ± SD (mm)	Mean ± SD (mm)	(mm)	Mean ± SD (mm)	Mean ± SD (mm)	(mm)
#19, 30	131	4.61±0.43	9.62±2.09	5.01	9.62±1.20	12.55±2.45	2.93
#3, 14	56	4.78±0.54	8.29±2.38	3.51	9.34±1.25	9.80±3.43	0.46
#21, 28	20	4.01±0.34	8.07±2.30	4.06	9.75±1.01	19.65±9.71	9.9
#5, 12	75	3.95±0.38	7.41±1.69	3.46	10.38±1.36	13.70±3.46	3.32
#22, 27	116	3.95±0.36	7.40±1.61	3.45	10.45±1.06	14.92±3.31	4.47
#6, 11	42	3.91±0.29	7.25±1.85	3.34	10.45±1.21	15.62±3.54	5.17
#8, 9	26	3.98±0.30	7.36±1.70	3.38	10.37±1.11	14.30±3.81	3.93
Average		4.17±0.38	7.91±2.22	3.74	10.05±1.17	14.36±4.85	4.31

Table 2. Pearson correlation coefficients (r) and P values.

Tooth locations	Imp vs. Rid Width r	Imp vs. Rid Width P	Imp vs. Rid Length r	Imp vs. Rid Length P
#19, 30	0.375	<.0001 *	0.449	<.0001 *
#3, 14	0.006	0.966	0.206	0.127
#21, 28	0.002	0.995	0.119	0.617
#5, 12	0.307	0.007 *	0.421	0.0002 *
#22, 27	0.290	0.002 *	0.178	0.05 *
#6, 11	0.141	0.374	0.261	0.096
#8, 9	0.408	0.060	0.028	0.890



CBCT based measurements demonstrate sufficient accuracy when predicting implant sizes

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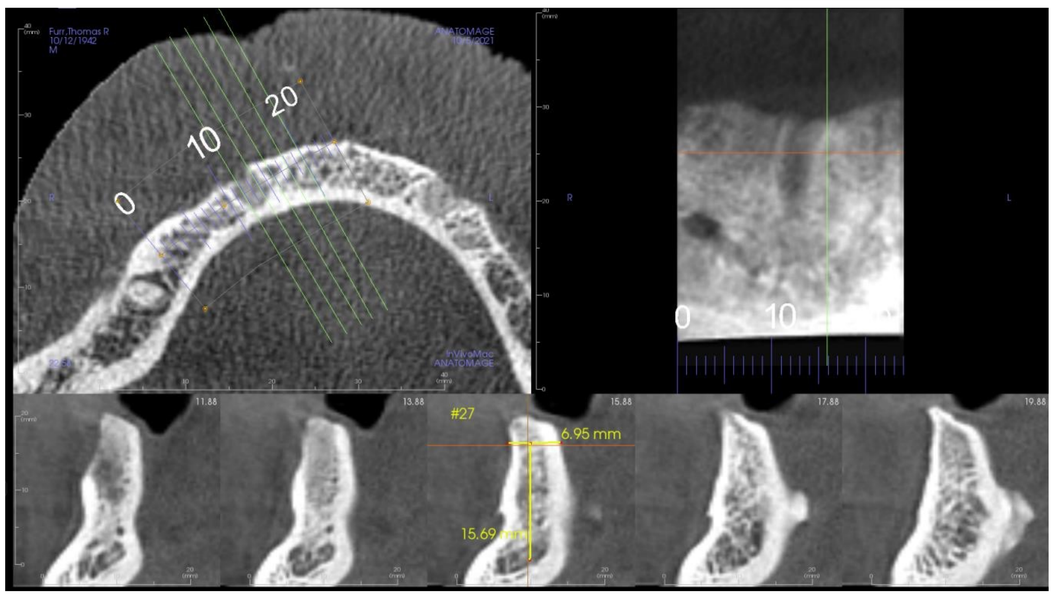

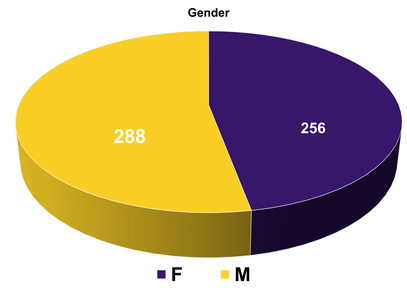

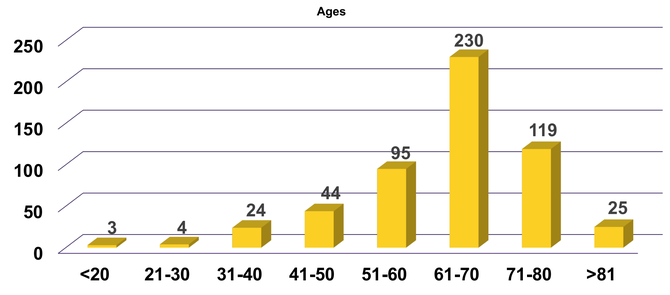

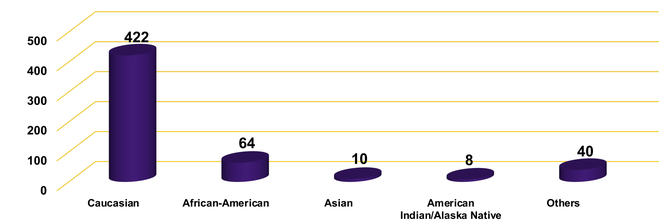

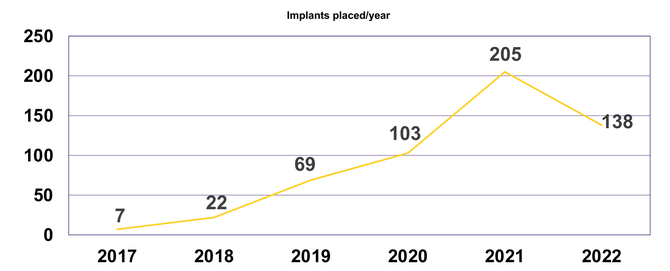

Conclusions

Generally, CBCT based alveolar ridge measurements have been demonstrated as a reliable index to predict future implant sizes. However, its accuracy may be limited by anatomic factors, such as edentulous ridges and proximity to vital anatomic landmarks.

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