CONE-BEAM CT IMAGE QUALITY, DIAGNOSTIC EFFICACY AND ACCURACY OF MEASUREMENTS: A COMPARISON BETWEEN 4 CBCT SCANNERS

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Aim

The goal of this in vitro investigation was to compare 4 different cone-beam CT scanners by means of image quality, diagnostic efficacy and accuracy of measurements.

Methods

28 (15 in the posterior and 13 anterior) edentulous, potential implant sites from 4 cadaveric mandibles were included in this study. In preparation for the study, the mandibular specimens were degloved from soft tissue which was replaced by a soft tissue equivalent material during the image acquisition process. The proposed implant sites (test locations) were identified by fine radiopaque markers placed on an acrylic radiographic guide, an approach which is almost the standard in pre-implant assessment *(Figure-1).*

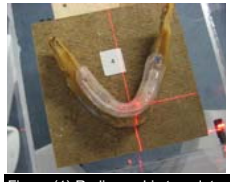
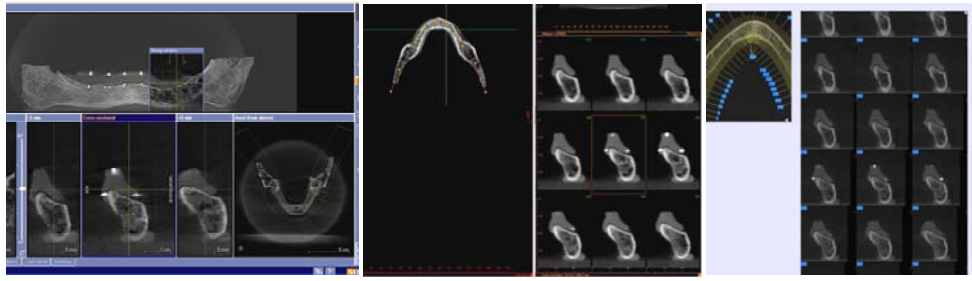


Figure (1):Radiographic template with markers

The cadaveric mandibles were scanned with 4 different CBCT scanners (I-CAT-Imaging Sciences International, PROMAX 3D-Planmeca, NEWTOM 3G-AFP Imaging and GALILEOS-Sirona) under standardized conditions using a variety of imaging protocols available by the scanners (Figure-2). Resultant cross-sectional images of the different CBCT scanners were compared for subjective image quality, diagnostic efficacy (identification of the MC) and accuracy of measurements (bone height estimation) by 2 experienced and calibrated observers, independently, in 4 different sessions; the order of the images in each evaluation session as well as the group of images, was randomized.

Figure (2): CBCT scanners tested: (From left to right), GALILEOS-Sirona, I-CAT-Imaging Sciences International, NEWTOM-AFP Imaging, PROMAX 3D-Planmeca

All images were evaluated with each scanner's original software *(Figure-3)* on a portable PC for standardization purposes. 5 raters evaluated all images in 4 different sessions: The mandibles were sectioned and measured at the sites of the radiographic markers for use as the "gold standard." *(Figure-4)*



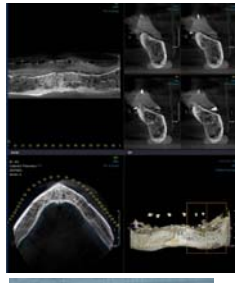


Figure (3): Screen shots of the original software of each one of the CBCT scanners tested: GALILEOS (Upper left), I-CAT (upper middle), NEWTOM (upper right), PROMAX 3D (left); all images show the same posterior mandibular site

Figure (4):Gold standard

Results

CBCT scanner	GALILEOS	I-CAT	NEWTOM	PROMAX-3D
Image quality	8.3	7.4	7.5	6.4

Table (1): *Subjective image quality assessment (for both observers); the observers rated the various images using a 10 point rating scale (1: very poor quality, 10: excellent image quality). The sharpness of the image, appearance of the cortical and cancelous bone, anatomical structures and presence of artifacts were considered for evaluation.*

CBCT scanner	GALILEOS	I-CAT	NEWTOM	PROMAX-3D
Diagnostic eff.	2.4	2.2	2.3	2.4

Table (2): *Diagnostic efficacy of the various CBCT systems (identification of the mandibular canal) using a 4-point (1-3) rating scale (0: MC not identifiable, 1: MC partially identifiable-<50% certainty for identification, 2: MC partially identifiable > 50% certainty for identification, but not absolute certainty, 3: MC clearly identified).*

CBCT scanner	GALILEOS	I-CAT	NEWTOM	PROMAX-3D
Mean error (post)	1.1(0.1-2.9)	0.9(0-4.6)	1.1(0-2.6)	0.9(0-2.7)
Mean error (ant)	0.8(0-1.2)	0.8(0-1.4)	0.7(0-1.7)	0.7(0.1-1.6)

Table (3): *Mean error on estimated alveolar bone height for posterior and anterior locations for both observers.*

Discussion Although the scanners tested differ widely in their software functions, the differences in their performance were small. Differences in viewer-perceived image quality did not have a major impact on measurement outcomes.