A Novel 3D Cone-Beam Imaging Device - The Influence of Patient Age and BMI on Image Quality
L.Ritter\textsuperscript{a}, T. Dreiseidler\textsuperscript{a}, E. Keeve\textsuperscript{a}, R.A. Mischkowski\textsuperscript{b}, J. Neugebauer\textsuperscript{b}, J.E. Zöller\textsuperscript{b}

\textsuperscript{a}Center of advanced european studies and research – caesar, Bonn, Germany
\textsuperscript{b}Clinic for Craniomaxillofacial Surgery, University of Cologne, Germany

Abstract. Cone Beam (CB) Imaging is used in maxillofacial imaging for various indications. Little is known about the patients influence on achievable image quality. In this paper we present a retrospective study, investigating the image quality of 50 CB datasets by four observers. Different views were offered and observers rated image quality on various anatomical structures in marks from 1 to 5. Scores were correlated to patient’s age and body-mass-index (BMI). In this study no strong correlations between patient age, BMI and image quality ratings were found. The strongest correlation found, was between age and overall image quality. Therefore high age or BMI are no contraindications for CB imaging.

Keywords: Cone Beam; image quality; maxillofacial imaging; multi-observer study

1. Introduction

Cone Beam (CB) imaging for the dento-maxillo-facial region was first introduced in 1998 and has become an established imaging method for various indications \cite{1} The basic concept of CB imaging relies on a x-ray source emitting rays in a cone-like shape, traversing the object to be imaged and finally being detected by an image intensifier or flat panel detector.

Today indications for CB scans include pre-surgical and diagnostic imaging for implant planning, trauma, orthognathic surgery, root resections, extraction of third molars, temporomandibular joint surgery and other cranio-maxillo facial interventions \cite{2,3,4,5,6,7,8}. Therefore CB imaging is indicated for a wide range of patients.

However, little is know about the influence of patients on image quality, possibly narrowing the indication for CB scanning.

The aim of this study was to evaluate whether or not patient age and body-mass-index has an influence on the image quality of CB images.

2. Materials and Methods

Four clinically experienced observers, two dentist and two maxillofacial surgeons, retrospectively evaluated 50 CB scans indicated for implantology (56,9%), cysts (13,7%), trauma (13,7%), impacted third molars (5,9%), or other (9,8%). Only observers who had no clinical contact with the patient were considered.

Rates were given from 1 to 5 (excellent, good, average, sufficient, not sufficient) for general image impression and image quality of relevant anatomical structures. The canalis mandibulars, foramen mentale, nasal floor, maxillary sinus floor and temperomandibular joint were evaluated as relevant anatomical structures. Additionally, image quality of the indicated diagnostic findings was evaluated.

All image evaluations took place on a calibrated and approved-for-diagnosis monitor using a software dedicated to the scanner under standardized ambience illumination. The computer used was equipped with a 3.4 GHz CPU, 1Gbyte RAM and a 400 MHz, 256MB graphics card.
Observers were able to visualize the scan in a exclusive panoramic view, featuring an inspection window permitting navigation through the three-dimensional data set, parallel to the given panoramic line at any given point in the panoramic view (see Figure 1). Simultaneously, transversal sections perpendicular to the inspection window are shown.

Fig. 1. Panoramic view offered to the observers. Note the inspection window marked yellow and the transversal slices indicated as orange lines on the axial view and inspection window

Alternatively, slice views in axial, frontal and sagittal orientation were offered along with a three-dimensional volume rendering of the dataset. All views were continuously adjustable in zoom, brightness and contrast.

50 scans from patients of the department were retrospectively collected. Patients were 42% male, and 58% female; mean age was 54.3 years (±12.9); mean BMI was 24.23 (±4.2).

A new CB scanner (Sirona, Bensheim, Germany) was used, producing a three-dimensional volume of 15 x 15 x 15 cm in size. Scanning time was 15 sec while patients were fixed with a bite block firmly attached to the scanner. Scanning parameters were 90 kV and 28mAs constantly for all patients.

Correlation was calculated for age and BMI against the various image quality ratings for all evaluated anatomical structures. Spearman’s rank correlation coefficient was used, due to the ordinal data from observer evaluations. Descriptive statistical analysis was performed for all evaluations.
3. Results

In this study no strong correlations between patient age, BMI and image quality ratings were found. The strongest correlation was found between age and overall image quality (Spearman-Rho 0.373).

Mean rating for the image quality of indicated diagnostic findings was between excellent and good (1.68; ±0.939), for general image quality mean rating was good (2.02; ±0.75). Mean rated image qualities for the anatomical structures were good for canalis mandibularis (1.97; ±0.823), between excellent and good for the foramen mentale (1.52; ±0.844) and the tempo-mandibular joint (1.64; ±0.738), and excellent for the nasal floor (1.38; ±0.605), foramen incisivum (1.49; ±0.919) and maxillary sinus floor (1.33; ±0.511).

4. Conclusion

Findings of this study indicate that with the used set of scanning parameters no significant influence from the patient’s age or BMI on the image quality exist. These findings have to be put in perspective to the relative small number of patients investigated. Moreover, age, imaging indications, sex and BMI were not equally distributed in this patient group, and may therefore not be statistically representative for all patients indicated for CB scanning.

Nevertheless, findings indicate that for most patients no specific parameters for CB scanning have to be tuned, and therefore handling of this image modality appears safe and fairly easy while excellent or good image quality can be achieved for relevant anatomical structures.

We further plan to investigate the influence of patient cooperation during the scan on image quality as well as the amount of dental metal restorations, as these might be additional factors of influence on image quality. We further plan to investigate a similar protocol with other CB imaging machines, since results may not be transferable from one model to another. Additionally, the evaluation protocol and anatomical structures investigated were not specifically selected for a dedicated indication, further investigations might be more focused and more detailed for a specific area of use.

CB imaging achieved excellent or good imaging quality for all investigated anatomical structures in the maxillofacial region. Overall image quality as well as image quality of the structures the scan was indicated for, was rated between good and excellent.

These findings could not be correlated to age or BMI of the scans investigated, indicating that with the used scanning parameters diagnostically usable images can be produced for most patients. Further investigations should focus on patient cooperation, amount of dental metallic restorations and different CB imaging machines.
5. References


