Author’s response to reviews

Title: Effect of exposure parameters of cone beam computed tomography on metal artifact reduction around the dental implants in various bone densities

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Reviewer reports:
Claire Chalopin (Reviewer 1):

The authors present in this paper the influence of metal dental implants on the amount of artifacts in images of the mandible generated by cone beam computed tomography (CBCT) system. In particular they evaluated the impact of different values of two parameters of the system: the field of view (FOV) and the electrical current (in mA). Moreover, they evaluated the amount of artifacts on different bone densities.

The goal of this paper is to provide advices to obtain images with lower artifacts. The paper does not include any technological innovation but is relevant for clinical practice. Such evaluations were already presented in the past by other clinical teams. However, the novelty of the paper concerns the evaluation approach: the amount of artifacts is quantitatively measured and different bone densities were used. In general, the paper is well written and clear, the experiments were correctly conducted. However, more details and justifications are requested about the choice of the imaging parameters used in the evaluation approach. Moreover, I am not competent to check the statistical methods and results. Therefore, I would recommend the paper for publications after improvement.
Abstract:

* P. 2 l. 33-34: In the paragraph "Results", the word "was" is missing in the last sentence.

Answer: this sentence was corrected.

“Difference between type 1 and type 2,3 was not significant (p>0.05)”

Background:

* The medical problem and the aim of the paper are clear.

Methods:

* The authors mention that different parameters of the CBCT system can influence the amount of artifacts. Why do the authors evaluate only the FOV and the electrical current? Why only two different FOV and current values were evaluated? The authors partly answered in the conclusion. However, could you comment these points in more details and provide an explanation for the choice of your approach, also in comparison with similar evaluation studies in the literature, already at the beginning of the paper?

Answer:

Various parameters such as device type, voltage (KVP), field of view (FOV), milliampere (mA) and time can affect the amount of metal artifact created by the dental implant in the CBCT images. The effect of time and mA on creating metal artifacts in the CBCT images is similar. On the other hand, to minimize artifacts from patient movement (motion blur), time should be set at the minimum; For this reason, only the effect of mA has been studied in this study. Also, in all devices, the voltage is set to 90 to 95 kV and is constant, this is due to the minimization of scattered radiation.

Also, on all devices, the field of view is selected based on the area requested by the doctor and mA based on the patient's size. Because This study aimed to assess the effect of exposure parameters such as milliampere (mA) and field of view (FOV) of cone beam computed tomography (CBCT) on metal artifact of dental implants placed in different bone densities.

* Also, only one model of dental implant was evaluated. Please, mention the reason for that.

Answer: thanks a lot from you for this comment.
The type and size of the dental implant will definitely affect the amount of metal artifacts created in the CBCT images. The purpose of this study was to investigate the effect of various exposure parameters on the creation of metal artifact around dental implants and if the type of implant was considered as a variable, there was a disturbing effect on the results of the study and it was difficult to diagnose that the artifact created was due to alteration of the exposure parameters or because of changes in the type of implant. For this reason, the type and size of dental implant in this study was stable.

* P. 6 l. 45-53: Since the value of the electrical voltage remains constant for each experiment, it is enough to mention the value used only once.

Answer:
In all devices, the voltage is set to 90 to 95 kV and is constant, this is due to the minimization of scattered radiation.

* P. 7: The measurements for the bone density and the amount of artifacts are not clearly explained. Which measure is used? Only the mean intensity in ROI? The evaluation performed by the radiologists is little explained. Please, mention that the task is the manual delineation of similar ROI at same positions in the bone before and after implant placement.

Answer:
For the scanning, the study models were positioned on the supporting plate provided by the manufacturer with the occlusal plane parallel to the horizontal plane and thereafter positioned in the center of the field of view (FOV) using the laser orientation beams. The CBCT scans were obtained.

Axial reconstructions perpendicular to the implant’s longitudinal axis were used for the data evaluation. The dimensions of the region of interest (ROI) were set at 0.25 mm 9 0.25 mm in the axial plane a 4 mm in the implant longitudinal axis, resulting in a total ROI of 16 voxels . Along the implant axis, ROI extended from 3 to 7 mm apically to the implant shoulder. Xray attenuation expressed as gray value (GV) was recorded in buccal surface of bone blocks.

To facilitate the reproducibility of the measurement, a transparent acetate foil with the printed implant and ROI outlines was placed over the CBCT images on the computer monitor. The software provided one mean GV for each ROI. Subsequently, cone-beam computed tomography images of the control models without implants were assessed. Anatomical landmarks on the model’s surface (e.g. teeth and alveolar ridge) were used to identify volumes corresponding to those containing implants in the test models. These volumes were labeled using the previously
described acetate foil with printed implant outline. Thereafter, GV were measured in the ROI corresponding to those assessed in the test models with implants.

Results:

\* Tables 1 and 2: the minimum and maximum intensity values are not commented in the text. If this information is not used by the authors in the evaluation, please remove it from the tables. If the information is important to deeper understand the amount of artifacts, please mention it in the text.

Answer: The minimum and maximum intensity values were removed from tables.

\* Table 2: Although each set includes 9 mandible sample of a same bone density, the total number of samples reported in the table is 27, right? Please correct n=27 instead of n=9 in the table caption.

Answer: the number of samples was n=27 and it was corrected in table 2.

\* Unfortunately I am not competent to estimate the relevance of the statistical approach and to evaluate the results, especially those reported in Table 3. However, the performance of statistics on a limited number of samples is always questionable.

Answer: Thanks for your valuable comments. This comment was not clear for us. Please more description, if it needs any response.

\* The resolution of figures 2 and 3 is not enough to read the values of the intensities. Please improve it.

Answer: We re-change the figures.

\* Fig. 3: although the images a and b were obtained with the same FOV they are represented with different scaling. It would me more relevant to present them with the same scaling to prevent any confusion for the reader.
Answer: The images re-corrected.

* Why the results obtained with a bone density of type 4 are only depicted with 4 mA value (Fig. 6). Would it be not relevant to show the results obtained with 10 mA?

Answer: We had no this figure.

Discussion:

* What is the impact of the processing of the image (p. 7 l. 24-31) on the measurement of the amount of artifacts? Please, comment this point.

Answer:

The projection modification method has been increasingly favored in recent years because of its simplicity. In the projection modification approach, the metal shadows in the raw projection data caused by the X-ray passing through the metallic implants are first segmented and then replaced using some estimated values.

Boguslaw Tomanek (Reviewer 2): The authors describe the effects of exposure parameters (mA, FOV) on CBCT metal artifact in dental implants in vitro with different (27) densities.

They concluded, that smaller FOV gives less artifacts irrespective of bone densities and mA

It is a simple, well written yet an interesting ms.

I have only one comment: I suggest removing a word "taking" in the figure captures. Simply write: "CBCT scans of…"

Answer:

We deleted "taking".