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QUANTIFICATION OF RADIOLOGICAL CHANGES AROUND DENTAL IMPLANTS: A CBCT IMAGE ANALYSIS WORKFLOW

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Summary: The last decades, the use of cone-beam computed tomography (CBCT) for maxillofacial imaging has increased rapidly. However, application-specific image analysis methods for extracting quantitative information remain to be developed.
Long-term tooth loss near the maxillary sinus may lead to a decrease in alveolar bone. Hence, a sinus lift surgery may be needed to increase the amount of bone to support dental implants. The functionality of dental implants depends on stability and bone integration, which is related to bone volume. The number of previous studies, where bone formation after sinus lift has been quantified in 3D, are limited. Furthermore, the image analysis methods in existing studies are often based on manual segmentation[1]. Consequently, available image analysis steps such as registration and semi-automatic segmentation would highly improve these evaluations. The present study aims to develop an image analysis workflow to quantify the bone volume around implants after a graftless sinus lift surgery.
The study was made retrospectively on six patients. All scans were made with the same CBCT (J.Morita, Kyoto, Japan). The patients were scanned preoperatively, at baseline (closely after surgery) and 6 months postoperatively. The workflow was solely based on the baseline and postoperative scans (generally patients are only scanned at these time-points). The preoperative scans were only used for validation. The image analysis contained metal artefact reduction, registration and a standardized protocol for semi-automatic segmentation. Validations of different steps of the method were conducted by comparing scans from all three time-points. Comparison of constant volumes (e.g. screws, bony parts not subjected to change) was used to validate the registration and segmentation. Additionally, the dice similarity coefficient (DSC) was used.
The DSC showed accurate results with values >0.92. Furthermore, no significant differences were found for the constant volumes between the different scanning time-points.
In the present study, a robust and objective workflow was successfully developed to determine the volume of new bone formed after a sinus lift. This methodology can also be applied to other research questions in dental CBCT images, e.g. to compare grafting materials or surgical strategies.

References

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