MRI Artifact Volume from Various Dental Implant Materials in Anterior Maxillary and Mandibular Regions: A Preliminary Study

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Abstract

Magnetic resonance imaging (MRI) is a radiation-free imaging modality widely used for diagnosis. However, dental implants often induce artifacts due to magnetic field inhomogeneity resulting from the mismatch between metal and biological tissues in MRI. These artifacts impede visualization in oral and maxillofacial MRI scans. Our study aimed to assess artifact volumes generated by commonly used implant dentistry materials across various MRI sequences. Different dental implants titanium (Ti), zirconium (Zr), titanium-zirconium (TiZr), and polyetheretherketone (PEEK) were placed individually in the edentulous maxillary and mandibular central incisal regions of a dried skull. These areas were then sealed in containers filled with water and gadolinium diethylenetriamine pentaacetic acid and scanned using a 1.5T MR scanner employing T1-weighted imaging (T1-WI), T2-WI, proton density weighted imaging (PDW), diffusion-weighted imaging (DWI), and ultrashort echo time (UTE) sequences. Artifact volumes were measured using Image software. Two-way ANOVA and Tukey statistical analyses were conducted to compare artifact volumes. In the maxillary region, Ti produced significantly larger artifacts in PDW and DWI sequences (range: 1756.67±464.76 to 2217.75±1109.07 mm^3). In the mandibular region, TiZr showed significantly major artifacts in T2-WI, PDW, and turbo spin-echo (TSE)-DWI sequences (range: 2050.20 ± 704.55 to 3433.33 ± 3313.46 mm^3), with PEEK displaying the least artifact volumes in both maxillary and mandibular sites ($p<0.05$). Notably, all materials demonstrated insignificant artifacts in the UTE sequence. Ti-based dental implants generated substantial artifacts, while UTE sequences exhibited fewer artifacts compared to other MRI sequences in the anterior maxillary and mandibular regions.

Keywords**:** *Dental Implant, Image Artifact, Magnetic Resonance Imaging, MRI*