Artifacts Generated by Pediatric Stainless Steel and Zirconia Crowns on MR and CT Head and Neck Imaging

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Background

- Pediatric patients with orthopedic, neurologic, or hematologic concerns require frequent 3D images for medical purposes; MRI and CT are standard forms of 3D imaging.[1,11]
- Physicians often request placement or removal of specific dental materials to reduce beam hardening effects that result in distortion of the 3D imaging.[2-4,5,6]
- Stainless steel crowns (SSCs) are recommended in children with extensive carious lesions and/or are classified as high caries risk, however, metals are known to produce artifacts in both MRI and CT images.[3,4,6,8-9,11-12]
- Preformed zirconia crowns (PZCs) are often requested in pediatric dentistry in an effort to reduce distortion of the image; however previous research on zirconia implants were shown to produce artifact, consistent with its high atomic number and radiopaque appearance. [4,12]

Purpose

- The aim of this study is to examine the production of artifacts on head and neck MRI and CT images produced by SSCs and PZCs; it is hypothesized that PZCs will generate significantly greater artifact than SSCs on CT and MR imaging.

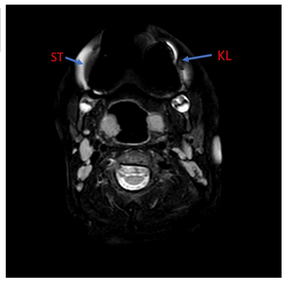
Methods

- IRB approval granted: #0041-24-EP
- 478 patient charts were screened to identify patients who meet our inclusion criteria:
  - Seen at Children's Nebraska for head and neck MR and/or CT imaging post full mouth oral rehabilitation (FMOR) between 01/01/2013 – 12/20/2023
  - Age 19 or younger at the time of imaging
- Exclusion criteria:
  - Patients who do not have both a PZC or SSC present were excluded from the study.
- A subjective artifact assessment of mild or severe was completed by a practicing radiologist at Children's Nebraska.
- When assessing MRI imaging, the radiologist chose the T2 axial sequence to view artifact, because that gives the least artifact and best chance of distinguishing maxillary vs mandibular teeth.

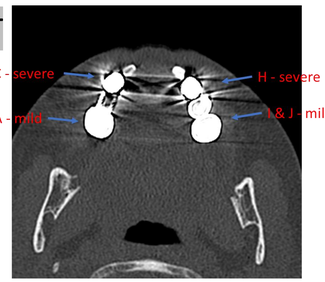
Results

- Of the 478 patient charts, only 13 charts met the appropriate criteria of having either MRI or CT imaging following FMOR with both PZCs and SSCs present.
  - PZC sample size = 13
  - SSC sample size = 15.
- Artifact from PZCs and SSCs within the same patient were compared descriptively. To be able to see differences in artifact by image type, artifacts were assessed by image type separately for each crown type using Fisher's Exact tests.

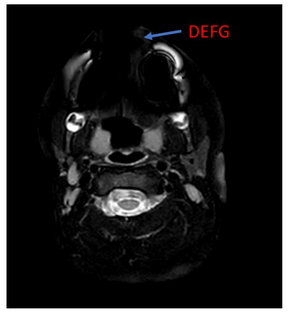
MRI



CT



MRI



CT

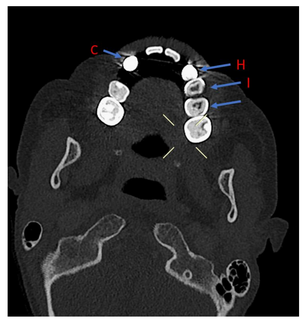


Table of image by SSC			
image(image)	SSC		
Frequency Row Pct	Mild	Severe	Total
CT	6 100.00	0 0.00	6
MRI	0 0.00	9 100.00	9
Total	6	9	15

Table of image by Zirconia			
image(image)	Zirconia		
Frequency Row Pct	Mild	Severe	Total
CT	0 0.00	6 100.00	6
MRI	7 100.00	0 0.00	7
Total	7	6	13
Frequency Missing = 2			

Conclusions

- PZCs generated significantly greater artifact on CT imaging (100%), compared to MR imaging (0%).
  - $p<0.001$.
- SSCs generated significantly greater artifact on MR imaging (100%), compared to CT imaging (0%).
  - $p<0.001$.
- The results of this study found that dependent on the 3D imaging modality used, MR or CT imaging, artifact was present with both crown types.
  - With CT imaging, it was found that PZCs generated greater artifact therefore patients undergoing frequent head and neck CT imaging would be best with placement of SSCs.
  - With MR imaging, it was found that SSCs generated greater artifact, therefore patients undergoing frequent head and neck MR imaging would be best with placement of PZCs.
- Ultimately, this could change healthcare providers decisions on replacement of restorations to reduce distortion of an image. This could reduce amount of treatment children and adolescents may undergo.
- Each type of crown was typically found in an area that differed from the other style of crown, making direct comparisons between crowns difficult.

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