



Work around strategies for artifacts in the CBCT in a digital workflow.



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Introduction:

- Computer assisted implant surgery is a useful tool that has been found be highly accurate, reduces surgical time and patient discomfort.
- Intraoral scans, in the form of Standard tessellation language (STL) files, can be superimposed onto a cone beam computed tomography (CBCT) scan.
- Landmarks are used to accurately superimposed images. The clinical crowns are commonly used as landmarks in dentate patients. However, patients with several metal restorations have scans with radiographic artifacts like beam hardening scatter, which reduces the ability to accurately superimpose the STL file.
- Deviations will produce an inaccurate implant guide and implant placement.
- Previously, post-processing techniques have been used to reduce artifacts, however, it is quite expensive and the mathematics and pattern recognition to predict and replace corrupted portions of the image can introduce errors.
- Methods with radiographic templates and fiducial markers should be used.

Purpose:

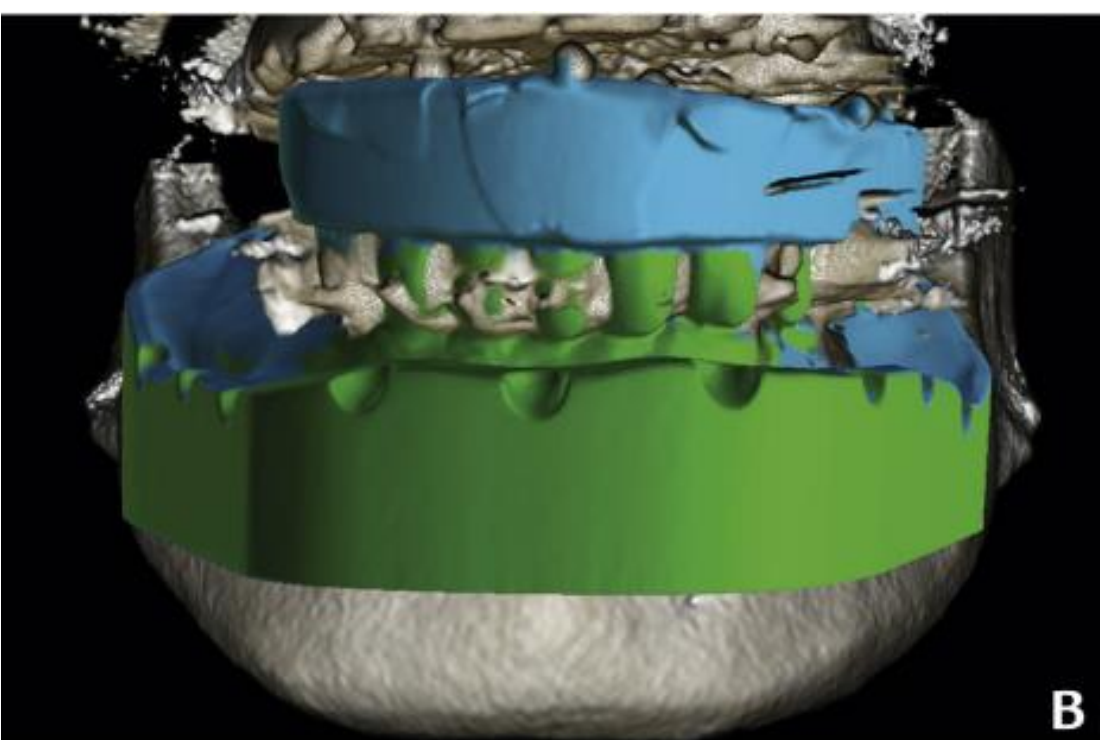
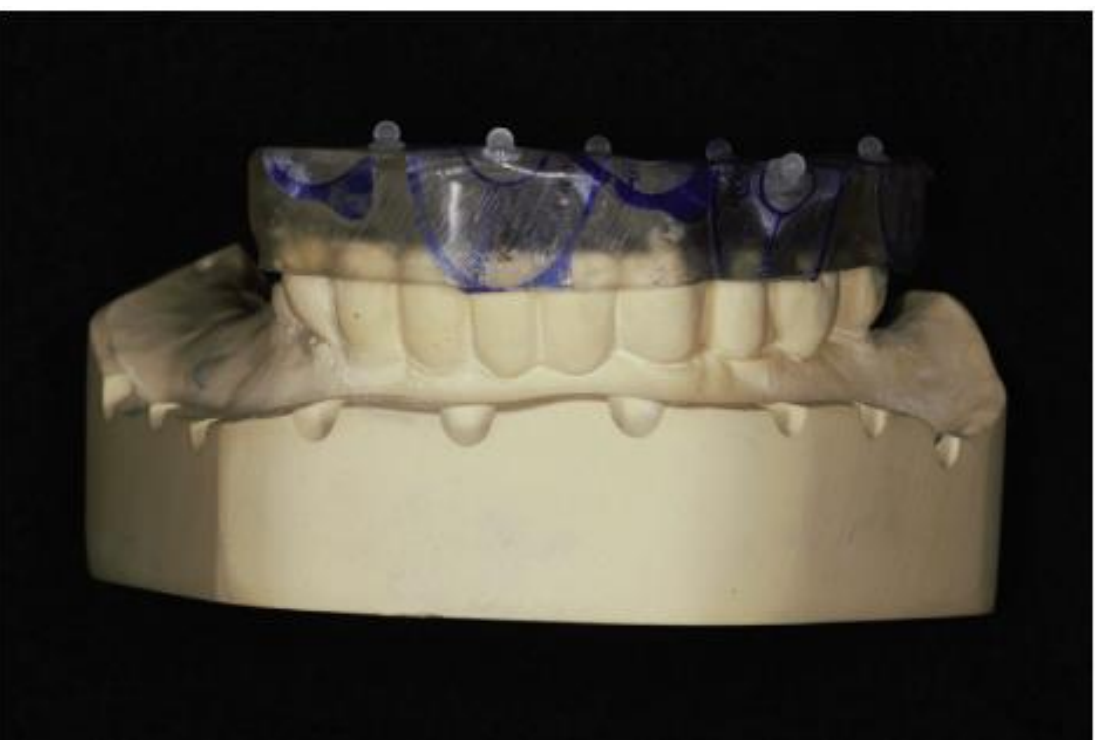
To identify strategies to work around artifacts while digitally planning implant placement.

Methodology:

The OSU digital library, PubMed and Embase were used to identify articles that can be used for this literature review. The chosen search terms or phrases were radiographic stent/template, implant planning, CBCT and artifacts. The articles selected were published in academic journals within the last ten years. If the articles mentioned artifacts, dental implant planning, use of a radiographic stent/template, and/or CBCT, it was included in this review.

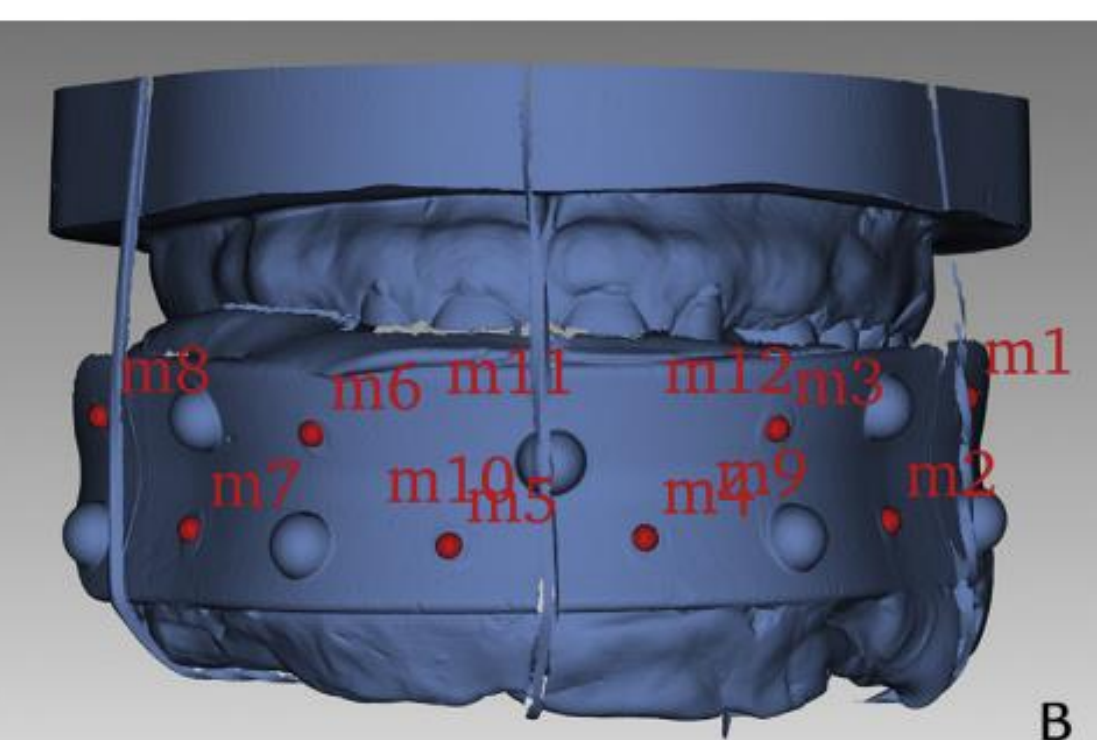
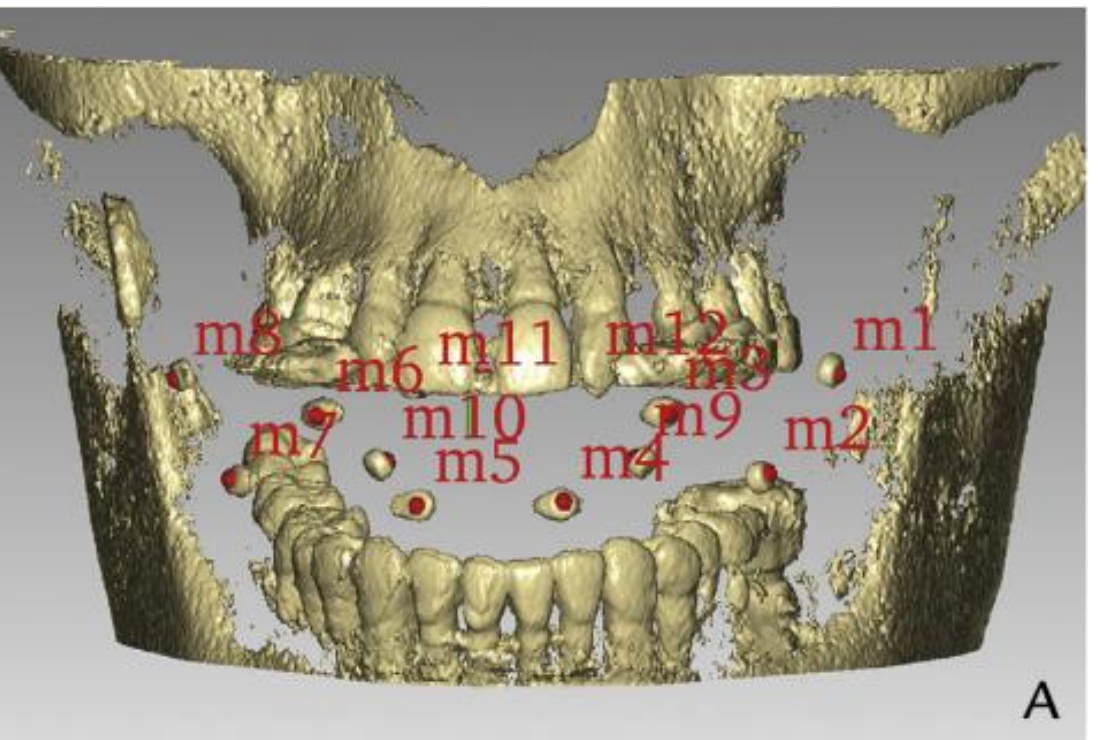
Technique #1

Make notches on the diagnostic cast of the patient. Make a device out of a thermoplastic polymer and polymethyl methacrylate resin. Apply fiducial markers. Allow patient to wear the device during CT scan. Place the device on the diagnostic cast and scan and align with CT scan.



Technique #2

Design and print trays. Select appropriate tray for patient. Add silicone elastomer and allow patient to occlude. Make impressions of the patient and pour casts. Wax up required teeth. Scan casts with wax, without wax, and with marked tray. Superimpose all scans.



Technique #3

3D print modified impression tray. Secure fiducial markers with flowable composite above the occlusal plane. Add polyvinyl siloxane to the tray and position on the model. Trim excess material and scan with buccal surfaces of teeth exposed.



Results:

- More teeth on the arch leads to more stability of the template. This method should not be used if teeth are mobile.
- Templates with fiducial markers are more accurate for cases with 4 or more crowns.
- Templates increase the distance between the radiographic markers and the metal restorations.
- Fiducial markers are seen above the scatter in the CBCT.
- These techniques are non-invasive and are cost effective.
- Little chair time is needed during these procedures.

Conclusions:

- Radiographic templates with fiducial markers should be considered for patients with multiple metallic restorations.

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