Accuracy of Three Cone Beam Computed Tomography Systems in the Detection of Implant-Abutment Misfit

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Purpose: To assess the accuracy of three cone beam computed tomography (CBCT) systems in misfit detection at the implant-abutment joint. Materials and Methods: A total of 32 implants were placed in dry human mandibles. Porcelain-fused-to-metal crowns, both with and without a 200-μm-thick gap at the implant-abutment joint, were placed and then scanned using three CBCT systems: Picasso Trio (PT), OP300 (OP), and Scanora 3D (SC). Images were assessed, and area under the receiver operating characteristic curve (Az) values were compared (a = .05). Results: Az values obtained with PT (0.86) were significantly higher than with OP (0.63) and SC (0.64) (P < .05). Conclusion: Images acquired with PT allowed for more accurate misfit detection at the implant-abutment joint due to higher contrast resolution. Int J Prosthodont 2019;32:198–200. doi: 10.11607/ijp.6127

Misfit at the implant-abutment joint (IAJ) may cause irregular stress distribution along the components and consequent bone loss due to important micro-movement.1 Cone beam computed tomography (CBCT) is currently restricted in the postoperative assessment of dental implants to postsurgical complications due to the artifacts induced by titanium implants.2 The aim of the present study was to evaluate the accuracy of three CBCT systems for detecting misfit at the IAJ, as well as to clarify whether misfit at the IAJ should be assessed in existing CBCT volumes, since the literature has limited information regarding this topic.3 The hypothesis was that the CBCT systems used would result in different diagnostic accuracies.

MATERIALS AND METHODS

A total of 32 3.75 × 9 mm implants with an external hexagon connection (TitamaxTi, Neodent) were placed in the molar and premolar regions of eight dried human mandibles (n = 4 per mandible). Porcelain-fused-to-metal crowns were manufactured over the implant abutments with metal collars (CoCr; Neodent) and tightened to 32 Ncm. Standardized 200-μm-thick gaps were simulated between the implant platform and the bottom of the abutment according to the methodology of a previous study.4 To ensure a reference standard, the specimens were inspected using scanning electron microscopy (JSL- 6610LV; Jeol) with ×750 magnification (Fig 1).
DISCUSSION

The use of the PT system resulted in Az values 20% higher than those provided by OP and SC. Kappa values were also higher for images acquired with PT, indicating more consistent responses. When assessing the images acquired with PT, the visualization of the IAJ was enhanced when brightness and contrast were adjusted by the observers (Fig 3).

RESULTS

In general, intra- and interevaluator reproducibility were higher for the PT than for the OP and SC systems (Table 1). The comparisons among ROC curves (Table 2; Fig 2) showed that Az values obtained with PT (0.86) were significantly higher in comparison to OP (0.63) and SC (0.64) (P < .05), which did not differ significantly (P ≥ .05) between each other.

Table 1 Mean (Standard Deviation) Kappa Values of Intra- and Interevaluator Reproducibility for the Three CBCT Systems

<table>
<thead>
<tr>
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<th>Intraevaluator</th>
<th>Interevaluator</th>
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<tbody>
<tr>
<td>PT</td>
<td>0.77 (± 0.24)</td>
<td>0.63 (± 0.22)</td>
</tr>
<tr>
<td>OP</td>
<td>0.53 (± 0.15)</td>
<td>0.64 (± 0.19)</td>
</tr>
<tr>
<td>SC</td>
<td>0.53 (± 0.24)</td>
<td>0.40 (± 0.15)</td>
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PT = Picasso Trio; OP = Orthopantomograph OP300; SC = Scanora 3D.

All specimens were randomly scanned in both conditions: with and without simulated gap. CBCT images were acquired using three systems: Picasso Trio (PT; E-WOO Technology); Orthopantomograph OP300 (OP; Instrumentarium Dental); and Scanora 3D (SC; Soredex). The machines were preset as similar as possible in order to avoid possible bias in misfit detection related to exposure factors: PT = 10 mA, 85 kVp, 8 × 5 cm field-of-view (FOV), and 0.2-mm voxel size; OP = 10 mA, 90 kVp, 8 × 6 cm FOV, and 0.2-mm voxel size; and SC = 10 mA, 85 kVp, 10 × 7.5 cm FOV, and 0.2-mm voxel size.

Two oral radiologists, an implantologist and a prosthodontist, dynamically evaluated the CBCT volumes. They were allowed to adjust brightness and contrast and to use the zoom tool. After 30 days, 20% of the images were re-evaluated in order to verify intra- and interevaluator reproducibility, both calculated using the Kappa test. The values of areas under the receiver operating characteristic curves (Az) were compared using Epidat 3.1 software (Conselleria de Sanidade de Xunta de Galicia Health and Pan American Health Organization) (α = .05).

Table 2 Area Under Receiver Operating Characteristic Curves (Az) for Evaluated CBCT Systems

<table>
<thead>
<tr>
<th>CBCT</th>
<th>Az</th>
<th>SD</th>
<th>95% CI</th>
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<tr>
<td>PT</td>
<td>0.86ª</td>
<td>0.02</td>
<td>0.82–0.91</td>
</tr>
<tr>
<td>OP</td>
<td>0.63b</td>
<td>0.03</td>
<td>0.57–0.70</td>
</tr>
<tr>
<td>SC</td>
<td>0.64b</td>
<td>0.03</td>
<td>0.57–0.71</td>
</tr>
</tbody>
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PT = Picasso Trio; OP = Orthopantomograph OP300; SC = Scanora 3D; SD = standard deviation; CI = confidence interval. Different superscript letters in the same column indicate statistically significant differences (P < .05).

Fig 1 Scanning electron microscopy image (original magnification ×750) of control group without simulated gap at the implant-abutment joint.

Fig 2 Receiver operating characteristic curves for Picasso Trio (PT), Orthopantomograph OP300 (OP), and Scanora 3D (SC).
CONCLUSIONS

In comparison to OP and SC systems, images acquired with the PT system allowed for more accurate misfit detection at the IAJ, and this may be attributed to greater contrast resolution. In addition, while radiographs continue to be the imaging modality of choice for evaluating the marginal adaptation between implants and prostheses, the present authors advocate that the IAJ can also be assessed in existing CBCT volumes with high-contrast resolution.

ACKNOWLEDGMENTS

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REFERENCES


To better comprehend the results, the quantity of the gray tones was measured in each CBCT volume, and it was found that PT had a mean of 21,701 (± 780.77) gray tones, while OP and SC had 4,096 (± 0). As more gray tones were available in the PT, it is suggested that volumetric distortion (blooming artifacts) at the IAJ were minimized, and, as a consequence, misfit was more accurately detected. Accordingly, Pauwels et al demonstrated that the contrast resolution of CBCT systems (ie, the amount of gray tones available) may have an influence on image quality and the distinction of fine details.5

**Fig 3** Examples of CBCT images after brightness and contrast adjustment (white arrows indicate misfits). (a) Picasso Trio without adjustment. (b) OP300 without adjustment. (c) Scanora 3D without adjustment. (d) Picasso Trio after adjustment. (e) OP300 after adjustment. (f) Scanora 3D after adjustment.

**Assessing the Role of *Porphyromonas gingivalis* in Periodontitis to Determine a Causative Relationship with Alzheimer’s Disease**

Chronic periodontitis of a 10-year duration is reported to become a two-fold risk factor for the development of Alzheimer disease (AD). Periodontitis is modifiable, and this fits with the current action plan for preventing AD. However, until periodontitis becomes acknowledged as a firm risk factor for AD, this risk will continue. Here, the authors put forward their own argument based on the current literature for in vivo infection-mediated periodontal disease models supporting the antimicrobial protection hypothesis of AD and interventional studies supporting the causal links. Oral infections with *Porphyromonas gingivalis* or introduction of its lipopolysaccharide (LPS) in various mouse models has demonstrated the development of key neuropathologic hallmark lesions defining AD: extracellular amyloid-beta plaques, phosphorylated tau, neurofibrillary tangles, widespread acute and chronic inflammation, and blood-brain barrier defects, as well as a clinical phenotype showing impaired learning and spatial memory. Live *P. gingivalis* and its LPS (commercial or from “microbullets”) are powerful peripheral and intracerebral inflammatory signaling initiators, and this has direct implications on memory and lesion development. Maintaining a healthy oral microbiome and managing periodontal disease with regular surveillance and good oral hygiene throughout life is likely to reduce the unnecessary burden of AD in some individuals.

Singhrao SK, Olsen I. J Oral Microbiol 2019;11:1563405. References: 81. Reprints: Sim K. Singhrao, Singhrao@uclan.ac.uk —Steven Sadowsky, USA