Feasibility of Intraoral Scanning for Data Acquisition of Maxillectomy Defects

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Purpose: To assess the feasibility of using an intraoral scanner for data acquisition of maxillectomy defects. Materials and Methods: In 10 patients who had undergone a maxillectomy, the maxillectomy defects in dentate and edentulous maxillary arches were intraorally scanned. Intraoral photographs were also taken using a digital camera for comparison. Results: Adequate scanning was achieved for the nondefect side of the maxilla and for residual teeth. In some cases, it was impossible to scan the maxillectomy defect, especially the deep sites. Conclusion: Improved intraoral scanning technology will increase the feasibility of its use in maxillofacial prosthetics. Int J Prosthodont 2020;33:452–456. doi: 10.11607/ijp.6763

In maxillofacial prosthetics, creation of defect impressions is challenging for dentists. The conventional method of making impressions carries the associated risks of aspiration of the impression material, impaction of the material in the complicated structure of the defect, or damage to the frail tissue of the defect site.1 One method to overcome these problems is the use of digital impressions to avoid contact with the tissue or impression materials.

Dental computer-aided design/computer-assisted manufacturing (CAD/CAM) technology was introduced in prosthodontics in the 1970s. Since then, use of digital technology in fixed prosthodontics has increased and expanded in recent years to include the fabrication of removable dentures.2 Subsequently, edentulous jaw models were digitized using intraoral scanners.3 Maxillectomy models have also been used in several studies. Elbashiti et al digitized edentulous maxillectomy defect models using an intraoral scanner and concluded that this approach is feasible and accurate.4 Dentate maxillectomy models have been digitized as well to confirm the feasibility and accuracy of using an intraoral scanner.5 However, details about the actual use of intraoral scanners are still unclear, and it is necessary to obtain basic data for their application. Based on the results of these in vitro studies, this study investigated the feasibility of making digital impressions of maxillectomy defects in patients in an in vivo setting.

MATERIALS AND METHODS

The study participants were 10 patients who had undergone maxillectomy (6 men and 4 women, mean age 68.5 years). Sex, age, defect side, and number of residual teeth are shown in Table 1. This study was approved by the Ethics Committee of...
RESULTS

All scanning procedures were performed without error. Scan results were compared to the photographs for all 10 patients (Fig 1). Adequate scanning of the

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Sex</th>
<th>Age (y)</th>
<th>Defect side</th>
<th>No. of residual teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Female</td>
<td>83</td>
<td>Right</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>59</td>
<td>Right</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>75</td>
<td>Left</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>64</td>
<td>Left</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>55</td>
<td>Right</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>70</td>
<td>Left</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Female</td>
<td>68</td>
<td>Left</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>90</td>
<td>Left</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>53</td>
<td>Right</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>Female</td>
<td>68</td>
<td>Right</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 1  Participant Characteristics

Tokyo Medical and Dental University (approval number D2014-046). Study procedures and objectives were explained to the participants, and all provided written informed consent. An intraoral scanner (Trophy 3DI, Yoshida Dental) was used to make the digital impressions. The scanner probe measured $13 \times 13$ mm$^2$, with a field depth of $-2$ mm to $+12$ mm. The patients were relaxed and supine in a dental chair. The maxilla was dried with gentle air flow. For dentate participants, scanning began from the occlusal surfaces of the molars, followed by the buccal and palatal surfaces, and then the incisors. When all the residual teeth had been scanned, the probe was moved in circular motions to the mucosa of the defect. For patients who were edentulous, scanning moved from the mucosa of the nondefect side to the defect side. Also, intraoral two-dimensional photographs were taken with a digital camera (D7000, Nikon) for comparison. Scanned data were saved in polygon file format (PLY), observed using a 3D viewer (Trophy Mesh Viewer, Carestream Health), and then compared to the photographs.

Fig 1  Comparison of (a–b) scan results and (k–l) intraoral photographs of the 10 maxillectomy patients.
residual teeth, including some metal restorations, was achieved in all patients who were dentate. Scanning of the remnant edentulous arch was also possible, although it was sometimes slow when the probe was on the mucosa. However, digital impressions could not be obtained for the maxillectomy defects, especially the deeper sites, in most cases.

**DISCUSSION**

This study showed that image acquisition using an intra-oral scanner was inadequate for the entire maxillectomy defect area. This was likely due to the restricted size and angle of the scanner probe, as well as the field depth of the scanner limiting the scanning of the defect site.

Fig 1 Comparison of (c–e) scan results and (m–o) intraoral photographs of the 10 maxillectomy patients.
These results are different from those of in vitro studies using models,\textsuperscript{4,5} which enabled complete scanning of the defect site. Furthermore, data acquisition may have been affected by oral environmental factors, such as color, texture, and mucosal moisture, which interfere with probe insertion. From the perspective of obturator prosthesis fabrication, it is still required to combine digital technologies with conventional steps. Although most of the scans were not sufficiently complete, some proved feasible for fabricating a prosthesis—for example, when the altered cast technique was used at the defect site. It is expected that use of digital technology will reduce both laboratory working time and the need for dental materials.

Fig 1  Comparison of (f–h) scan results and (p–r) intraoral photographs of the 10 maxillectomy patients.
CONCLUSIONS

Using an intraoral scanner, digital impressions were acquired on the nondefect side of the maxilla, including the residual teeth and mucosa. Digitization was, however, not always successful for the defect side, especially for deeper sites. Improved intraoral scanning technology will increase the feasibility of its use for maxillofacial prosthetics in the future.

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REFERENCES