Modern-Day Considerations for Complete Denture Impressions

Provision of accurately fitting, functional and comfortable complete dentures is one of the most difficult objectives to accomplish in all of dentistry. To date, the production of complete dentures remains an indirect, laboratory-based process. As such, analogues of the edentulous ridges are required. Making accurate impressions early in therapy is extremely challenging, but essential if a desirable outcome is to be achieved. An update on impression materials and techniques will assist practitioners in modern-day impression-making for optimal treatment of edentulous patients. This issue of Prosthodontics Newsletter explores the challenges, techniques and outcomes of edentulous impression-making.

Dentures Made from Silicone or Alginate Impressions: A Comparison

Despite progress in the use of implants to treat edentulous patients, a significant number of these patients do not qualify for implant therapy. Thus, high-quality research into the best methods of producing traditional prosthetic devices continues. In the United Kingdom, the majority of dentists make definitive impressions for complete dentures with alginate; in the United States, silicone is the preferred material.

Hyde et al from the University of Leeds, United Kingdom, conducted a double-blind randomized controlled crossover clinical trial to determine whether patients preferred dentures fabricated from 1 of the 2 different materials. The trial also studied the impact of the different dentures on oral health–related quality of life (OHRQoL) using the Oral Health Impact Profile for edentulous patients (OHIP-EDENT), comfort, stability and chewing efficiency, and patients’ experience of having impressions made using the 2 materials. Each patient received 2 sets of dentures:

➤ 1 set from alginate impressions
➤ 1 set from silicone impressions

During the first 2 weeks after delivery, 78 patients in the study followed a structured program alternating the set of dentures worn; (continued on next page)
71 of these patients completed the protocol by wearing each set of dentures for 2 subsequent periods of 8 weeks each. Which set of dentures was worn first in each phase of the trial was determined by blind randomization.

In the first stage of the study, 53 patients (67.9%) preferred the dentures made from the silicone impressions; 14 patients (17.9%) preferred the dentures made from the alginate impressions. The remaining patients found the dentures equally satisfactory (4 patients) or equally unsatisfactory (7 patients). Patients also found the dentures made from silicone impressions to be more comfortable, more stable and more efficient for chewing.

After the second stage of the study, there was a 33.8% difference in preference favoring the dentures made from the silicone impressions, and £363.18 (approximately U.S.$590) for the dentures made from alginate impressions, a significant difference. The costs associated with creating the dentures, including the initial assessment, taking the impressions and postdelivery adjustments, were similar for both types of dentures; the cost differential between groups was almost entirely the result of the price of the 2 materials (£35.26 per silicone impression and £4.84 per alginate impression).

Change in EQ-5D scores and, therefore, QALY scores, differed minimally between the 2 groups. However, the OHIP-EDENT scores improved by 15.56 points in the silicone impression group compared with an improvement of 7.90 points in the alginate impression group, a significant difference.

Comment
These studies found that silicone impressions produced complete dentures that led to an improved OHRQoL. However, the increased cost of the silicone impressions and the lack of difference in overall QoL scores suggested that further study is necessary before any definite conclusions can be drawn.


Patient Satisfaction with Dentures Made by Different Methods

Although the accepted conventional method for the fabrication of complete dentures involves obtaining 2 dental impressions (preliminary and final), many general practitioners use a simplified method employing a single alginate impression. No significant evidence exists to show whether a second impression (using silicone impression materials in border molded custom trays) improves outcomes. Jo et al from Tokyo Medical and Dental University, Japan, conducted a single-blind randomized controlled crossover clinical trial to determine the efficacy of taking a final impression of the mandible when fabricating complete dentures.

Participants recruited for the study were fully edentulous denture-wearing patients who required complete replacement dentures. Both preliminary impressions using alginate in stock trays and final impressions using silicone in border molded cus-
tom trays were obtained for both jaws from all 24 participants. For each patient, 2 sets of mandibular dentures were fabricated,

➤ 1 using the conventional method (2 impressions)
➤ 1 using the simplified method (1 impression)

After randomization, 13 patients received the dentures fabricated by the conventional method first; the remaining 11 patients received dentures fabricated by the simplified method first. After 4 adjustments followed by a washout period of 1 month, the patients received the other dentures.

Primary outcome was general patient satisfaction measured by a 100-mm visual analog scale (VAS), with 0 equaling completely dissatisfied and 100 equaling completely satisfied. Secondary outcome was oral health-related quality of life (OHRQoL) measured by the Japanese version of the Oral Health Impact Profile for edentulous patients (OHIP-EDENT-J).

Patients were significantly more satisfied with the dentures made by the conventional method than with the dentures made by the simplified method. However, no difference in OHRQoL scores was found between dentures made by the 2 methods (Table 1).

### Table 1. Median results for general patient satisfaction and OHRQoL

<table>
<thead>
<tr>
<th></th>
<th>Conventional method</th>
<th>Simplified method</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient satisfactiona</td>
<td>91.0</td>
<td>84.5</td>
<td>.04</td>
</tr>
<tr>
<td>OHRQoLb</td>
<td>19.5</td>
<td>19.0</td>
<td>.22</td>
</tr>
</tbody>
</table>

a VAS score 0 to 100 (higher scores equal greater satisfaction).
b OHIP-EDENT-J score 0 to 76 (lower scores equal greater OHRQoL).

Patzelt et al from the University of Maryland evaluated the use of computer-aided impression techniques with intraoral scanners to capture accurate digital impressions of edentulous jaws. Four intraoral scanners were tested:

➤ **Scanner 1:** using a parallel confocal imaging technique combined with a red laser light beam

➤ **Scanner 2:** based on confocal microscopy using blue light-emitting diodes (LEDs)

➤ **Scanner 3:** using a smart pixel sensor based on confocal microscopy combined with moiré effect detection

➤ **Scanner 4:** using active wavefront sampling, blue LEDs and charge-coupled device sensors

Two edentulous study models (1 maxillary, 1 mandibular) were digitized using a tabletop scanner as a reference and each of the 4 intraoral scanners; the data were then loaded into 3D evaluation software. Results were evaluated for trueness (comparison between a reference data set and a test data set) and precision (reproducibility of data sets obtained from the same object).

Mean trueness values ranged from 44.1 µm for the mandibular scan obtained by scanner 4 to 591.8 µm for the maxillary scan obtained by scanner 2. Mean precision values ranged from 21.6 µm for the mandibular scan obtained by scanner 4 to 698.0 µm for the mandibular scan obtained by scanner 2 (Table 2). Two of these scanners required the use of a powder on the surfaces being scanned, which created potential practical problems.

### Obtaining Accurate Digital Images of Edentulous Jaws

Although advances in technology over the past few decades have revolutionized restorative dentistry, practitioners still rely on conventional methods to obtain impressions of edentulous jaws. Replacing conventional methodology with a reliable computer-aided impression technique would be a welcome advance. Intraoral scanners have been shown to be accurate for taking 3-dimensional (3D) digital impressions of abutment teeth; however, their efficacy in creating restorations for edentulous jaws remains unproven.

Comment

Given the crossover design of this study, long-term results could not be determined. However, short-term results showed that patients preferred the complete dentures made using the conventional method.

Saliva may wash away some of the powder during the scanning time, while inhalation of the powder may have adverse health effects.

**Comment**

The difficulty in tracing smooth surfaces, system vibration and lack of supporting structures for the digitizer handpiece may have led to the high levels of inaccuracy found in this study. The ability to obtain accurate digital scans of edentulous jaws in vivo remains a goal that has not yet been achieved.


### Ingestion of Impression Material Related To Small Bowel Obstruction

Small bowel obstruction, which results in >300,000 operations annually, is primarily seen as a complication of previous abdominal surgery. A small percentage of small bowel obstructions, however, are caused by ingestion of foreign bodies (e.g., endoscopy capsules, internal flanges of gastroscope tubes). Murphy et al from the David Grant U.S. Air Force Medical Center, California, reported the case of a patient who developed a small bowel obstruction after swallowing polysulfide impression material.

A 74-year-old man with a stable abdominal aortic aneurysm, chronic obstructive pulmonary disease (COPD) and reflux disease visited the emergency department complaining of worsening non-radiating, colicky, periumbilical pain. A computed tomography scan revealed a radiopaque material in the small bowel; further investigation showed that 4 days earlier the patient had been at a dental appointment where he had undergone final impressions for complete dentures.

After 4 days of in-patient supportive therapy consisting of intravenous fluids and intravenous pain management during which the patient failed to pass the foreign body, the patient underwent an exploratory laparotomy, at which time the foreign body was removed. A pathologist identified the foreign body as an acellular granular substance consistent with polysulfide impression material. The postoperative course was complicated by an exacerbation of the patient’s COPD and much later by development of a methicillin-resistant *Staphylococcus aureus* (MRSA) infection.

**Comment**

While small bowel obstruction subsequent to the ingestion of dental materials is a rare complication, practitioners need to be cognizant of the possibility, especially when using low-viscosity impression materials such as polysulfide. Although such materials have many benefits in the dental setting, their chemical makeup prevents their degradation in the intestinal tract, making any ingestion potentially hazardous to the patient’s health.


### Table 2. Mean absolute trueness and precision values for scans of edentulous maxillary and mandibular jaws

<table>
<thead>
<tr>
<th>Scanner</th>
<th>Mean ± SD trueness (µm)</th>
<th>Mean ± SD precision (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>144.2 ± 72.7</td>
<td>191.5 ± 120.6</td>
</tr>
<tr>
<td></td>
<td>178.5 ± 90.5</td>
<td>197.9 ± 108.0</td>
</tr>
<tr>
<td>2</td>
<td>591.8 ± 377.9</td>
<td>558.4 ± 616.2</td>
</tr>
<tr>
<td></td>
<td>332.4 ± 183.3</td>
<td>698.0 ± 585.5</td>
</tr>
<tr>
<td>3</td>
<td>283.8 ± 187.3</td>
<td>253.8 ± 127.1</td>
</tr>
<tr>
<td></td>
<td>425.3 ± 278.6</td>
<td>319.4 ± 127.5</td>
</tr>
<tr>
<td>4</td>
<td>52.9 ± 23.8</td>
<td>44.1 ± 5.0</td>
</tr>
<tr>
<td></td>
<td>30.8 ± 17.0</td>
<td>21.6 ± 10.1</td>
</tr>
</tbody>
</table>

The higher the value, the greater the mismatch between the reference data set and the test data set (trueness) or among the multiple test data sets of the intraoral scanner (precision).

SD, standard deviation.