Implementation of the digital impression system iTero in undergraduate dental clinic

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by

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Invitation.
This document was developed to assist decision-making in the McGill University Faculty of Dentistry. All are welcome to make use of it. However, to help us estimate its impact, it would be deeply appreciated if potential users could inform us whether it has influenced policy decisions in any way.
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Dr. Jeffrey Myers, Director of Dental Clinics, MGH.

Report requested on September 7, 2010, by Dr. Jeffrey Myers, Associate Dean (Clinical Affairs)

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Abbreviations and Acronyms

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<th>Definition</th>
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<td>MGH</td>
<td>Montreal General Hospital</td>
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<td>OHTAU</td>
<td>Oral Health Technology Assessment Unit</td>
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<tr>
<td>PVS</td>
<td>Poly Vinyl Silixane</td>
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<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
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<tr>
<td>CAM</td>
<td>Computer Aided Manufacturing</td>
</tr>
<tr>
<td>CEREC</td>
<td>CERamic REConstruction</td>
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Tables

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**Background**

In early 2010 the dental clinic at the MGH received a request by a dental laboratory to take on a digital impression system iTero at no cost. On September 7, 2010 the OHTAU was requested by Dr. Jeffrey Myers to undertake the evaluation of iTero system for its suitability at the MGH dental clinic.

**Introduction**

The conventional method of making dental impressions with polyether and Poly vinyl siloxane (PVS) is well established. The proper use/manipulation of these materials can almost guarantee no misfit restoration. With the push toward digitalization in dental practices, the new wave of digital impression systems are emerging. The proponents of digital impressions claim that it will soon eliminate all the challenges now observed with conventional elastomer impressions.

Almost all digital impression systems in dentistry use the computer-aided design/computer-aided manufacturing (CAD/CAM) system, some with more limitations than others. The term CAD/CAM implies that one can use the system both for designing a product and for controlling manufacturing processes. For example, once a design has been produced with the CAD component, the design itself can control the machines that construct the part. In September 1985 at the University of Zurich Dental School, Mörmann placed the first chair-side ceramic restoration with the CEREC 1 system by using computer-aided design/computer-aided manufacturing (CAD/ CAM) technology (1).

In contemplating an entry into the digital dental world, one essentially needs to decide whether one likes a technology that captures a digital impression or a technology that both captures a digital impression and fabricates a single-unit restoration (since most CAM system can only make a single unit restoration)(2).

The reader should be made aware the systems reviewed in this report all primarily operate within the in-office environment. Many CAD/CAM systems are available for the laboratory environment (i.e., NobelProcera Scanner) which was beyond the scope of this report.

**Methods**

We performed a systematic search of the literature covering the Medline and Pubmed in all languages covering the period up to September 2010. Only peer reviewed journals were considered.
Results
There are no randomized controlled trials. Published in peer reviewed literature there were only three articles based on expert opinions, mainly by a same individual (3-5). No reported case series were found.

Cost analysis
Cost analysis demands the development of a “cost model” prior to use in practical applications towards determining cost outcomes. In general, a high attention to detail when building the cost model leads to precision in predictive values under various operational scenarios.

In order to define a cost model for the use of a digital imaging system, one needs to determine firstly the fixed capital equipment purchase costs and secondly a standard operational procedure on how the digital imagineing system should be used. This procedure should be sketched out step by step, built up from personal clinical experience and case reports on the usage of the digital imaging system (Table 1). From this, one can determine materials, human capital requirements and associated costs.

Safety
There are no safety concerns reported in the literature for using this device.
The fixed and variable costs associated with the standard operational procedure are then built into a cost model whereby number of impressions, patient visits and breakeven points may be determined. Presently, the detailed cost items for its use in dental student clinic are not determined.
Efficacy of digital imaging systems

Using a digital imaging system for impressions can reduce the costs associated with impression materials purchases, clean up, and final restoration adjustment times. Regardless, as in conventional impressions, the soft tissue must be managed and teeth must be prepared appropriately prior to scanning (Table 2).

Discussion

Based on literature evidence, there is insufficient evidence to indicate that the use of this device is superior to the conventional impression techniques with elastomeric materials and impression trays. However, there are indications that the technique is a relatively simple procedure and can be rapidly carried out, with relatively low complication rates by inexperienced operators. Its use can familiarize dental student with the concept of CAD/CAM in dentistry.

There is no precedent in using the device at MGH dental clinics. Therefore, no previous local experience can contribute to acquisition/utilization of this device. The device is being offered at no cost to the undergraduate dental clinic by the laboratory that presently fabricates almost all prostheses made by all trainees. The director of MGH dental clinic, Dr. Myers in his personal communications with other dental faculties has questioned their experience in using this device or other similar technologies. The results of these communications in their entirety are presented in Table 4 as transmitted to us by Dr. Myers.

Conclusions

- The iTero device is a reliable digital image acquisition device that can be used for traditional crown and bridge dentistry.
- In the context of an institution in which there is no need to purchase the device, the use of iTero can be cost saving (saving of a minimum of $10 per impressions guestimated)
- The cost saving measure can be extended onto the cost of impression material, clinicians’ operating time as well as the patients’ time on the chair.
- However, case selection is essential and critical for its success. Operators must manage the soft tissue properly.
**Recommendations**

Though promising, evidence of the benefit of iTero is insufficiently strong to justify a recommendation that it should be used on a permanent ongoing basis. However, the evidence of possible benefit and the likelihood that it may lower faculty’s costs enough to largely offset the costs of its use strongly suggests that an effort to procure better evidence would be justified. On the basis that the acquisition of this technology is free of charge, this technology should be acquired by the MGH clinic.
References

1- Mörmann WH. The evolution of the CEREC system; JADA 2006;137(9 suppl):7S–13S.

2- Kachalia PR, Geissberger MJ; CDA journal, vol 38, no 5 323-30.

3- Christenson G. The challenge of conventional impressions; JADA, Vol. 139 pg 347

4- Christenson G. Will digital impressions eliminate the current problems with conventional impressions?; JADA, Vol. 139 pg 761

5- Christenson G. Impressions are changing; JADA, Vol. 140 pg 130
Table 2. Conventional versus digital dental impression

<table>
<thead>
<tr>
<th></th>
<th>Conventional impressions</th>
<th>Digital impressions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In favor</strong></td>
<td></td>
<td></td>
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<tr>
<td>Technique is well established (dentists are relatively satisfied with conventional impression techniques)</td>
<td>Requires assisted manipulation and clean-up</td>
<td></td>
</tr>
<tr>
<td>Simple manipulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost range is low to moderate (Alginate of a full arch impression = $0.90 and PVS of a full arch impression = $20 &quot;data from 2007&quot;)</td>
<td>Possible inaccuracies due to air bubbles or debris</td>
<td></td>
</tr>
<tr>
<td>Accurate if impression materials are used properly and tissue is prepared properly</td>
<td>Must keep a stock of impression materials and trays</td>
<td></td>
</tr>
<tr>
<td>Relatively simple clinical technique</td>
<td>Remakes of impressions are rarely possible</td>
<td></td>
</tr>
<tr>
<td><strong>Constraints</strong></td>
<td></td>
<td></td>
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<td></td>
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</table>

**Conventional impressions**

- Technique is well established (dentists are relatively satisfied with conventional impression techniques)
- Requires assisted manipulation and clean-up
- Simple manipulation
- Certain discomfort for patient
- Cost range is low to moderate (Alginate of a full arch impression = $0.90 and PVS of a full arch impression = $20 "data from 2007")
- Possible inaccuracies due to air bubbles or debris
- Accurate if impression materials are used properly and tissue is prepared properly
- Must keep a stock of impression materials and trays
- Relatively simple clinical technique
- Remakes of impressions are rarely possible

**Digital impressions**

- Comparative accuracy between restorations fabricated using a digital imaging system and conventional impression materials
- Dentists are less familiar with the concept of digital impression system
- Simplicity (following the learning curve, digital imaging becomes simpler than conventional impression taking)
- Dentists are limited to the use of laboratories that are equipped and trained with these systems
- Less inventory needed
- More maintenance needed
- Patient is more comfortable
- Complexity (a learning curve is associated with the use of digital impression systems)
- No inaccuracies due to bubbles or debris but tissue and teeth must still be prepared properly prior to a scan.
- Cost of Purchase and upkeep
- Reduction in number of impression remakes and final restoration adjustment times are reduced
- High initial cost. May require many years for improved cost-effectiveness
- No need to disinfect the restorations...
- More prone to break down
- Infinitely long-term storage possible
- More compatible with future digital environment
- More environmentally friendly due to reduced waste production
Table 3. Most common digital impression systems on the dental market

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
<th>Possible Restorations</th>
<th>Acquisition Method</th>
<th>Contrast Medium Required</th>
<th>Milling Capabilities Option</th>
<th>Scanning Unit</th>
<th>Scan cost to operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadent iTero</td>
<td>Cadent</td>
<td>• All Restoration Types Can Be Completed</td>
<td>Parallel Confocal Laser Scanner</td>
<td>None Required</td>
<td>N/A</td>
<td>$28,000</td>
<td>$25-$35 per scan</td>
</tr>
<tr>
<td>Lava Chairside Oral Scanner</td>
<td>3M ESPE</td>
<td>• Crowns • Inlays • Onlays of All Types • 3-4 unit bridges • multiple adjacent units</td>
<td>Contains an optical system comprised of multiple lenses and blue LED cells</td>
<td>Titanium Dioxide powder</td>
<td>N/A</td>
<td>$26,900</td>
<td>$16-$20 per scan + $2 for each additional prepared tooth</td>
</tr>
<tr>
<td>CEREC Bluecam</td>
<td>Sirona Dental Systems</td>
<td>• Inlays • Onlays • Partial Crowns • Full Crowns • Veneers • Provisional Bridges</td>
<td>Blue Light Emitting Diode (LED) Camera with automatic capture</td>
<td>OptiSpray</td>
<td>Yes</td>
<td>$119,995 w/ (MCXL milling unit) $89,995 (compact milling unit)</td>
<td>$24.95 per scan, unlimited plan is available with increased upfront cost</td>
</tr>
<tr>
<td>E4D Dentist System</td>
<td>D4D Technologies</td>
<td>• Single Unit Restorations • Veneers • Inlays • Crowns • Onlays</td>
<td>IntraOral Digitizer Laser - Complete Coverage</td>
<td>Yes</td>
<td>$116,500</td>
<td>$41,100</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Prices are in U$

*see Appendix 1
Table 4. The current stand of other Canadian dental Faculties on digital impressions.

<table>
<thead>
<tr>
<th>Other Canadian dental faculties</th>
<th>Are your undergrad students using CEREC, E4D or any of the other CAD/CAM systems?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Do you have the whole system or only the optical scanner?</td>
</tr>
<tr>
<td></td>
<td>Has anyone looked at the digital impression unit from iTero?</td>
</tr>
<tr>
<td>Dalhousie</td>
<td>“We are not using any of the CAD/CAM systems in the clinic with UG students and have no plan to add it to the curriculum at this time.”</td>
</tr>
<tr>
<td>Toronto</td>
<td>“At U of T the UG’s are not using optical scanners yet for impressions. We are in the process of acquiring the iTero system for our grad prosthodontic department.”</td>
</tr>
<tr>
<td>Manitoba</td>
<td>“We have all components of the E4D. It is used in the D2 pre-clinical Lab and also in the D3 clinical portion of Operative Dentistry.”</td>
</tr>
<tr>
<td>Alberta</td>
<td>“Our undergraduate students are not using CAD/CAM. We have a fully functional CEREC system which is used by our general practice residents. There is no plan to incorporate digital impressions until after we are into our new clinic (2013?”)</td>
</tr>
<tr>
<td>Western</td>
<td>“We have CEREC units and we use them for inlays and onlays and are just starting out on crowns. However the technology requires an instructor constantly with the student and due to manpower issues we are unable to support it, so we have changed the protocol with it. What we do is get the student to prep and take a normal impression. An opposing impression is also made, the patient is then sent home. The student then sits with the lab technician and scans the models and makes the restoration using the CEREC unit and then brings the patient back in for another appointment to insert the prosthesis. With our ongoing curriculum renewal we are in the process of implementing an elective in CAD/CAM dentistry and will be able to utilize the CEREC protocol of a restoration at the same appointment when we implement the elective program next year. As a note we use E-Max blocks with our CEREC units and have custom shades to finalize the restoration. We looked at the iTero unit as well but felt no benefit in getting it at this time as it is not able to replicate any lateral movements. The school works with 2 implant companies Straumann and Nobel both the companies have CADCAM options and their scanners for the Straumann-Etkon and Nobel-Picolo are located within the school. We scan abutments and crowns and they are milled at the companies’ respective offices in Dallas and New Jersey they then come back to us for the application of porcelain.”</td>
</tr>
<tr>
<td>British Columbia</td>
<td>“Here at UBC, we have the CEREC complete system and it is used as with an elective with the undergraduate program. We are currently looking into have different systems with the Grad Pros implementation.”</td>
</tr>
</tbody>
</table>
Appendix 1

**Lava C.O.S** a 3D digital image / video capture system

**Summary**
- Price to purchase = $29,900
- 3M engineering service fee = $16 to 20 / case (volume discounts available)
- 3M SLA model = $20 / model
- + you local Laboratory fees to fabricate the various restorations
- the service agreement costs $150 / months or $1800 / year after the first year
- Consumables such as contrast medium

**Price to purchase = $29,900**
- Includes the cart, wand, and software
- Promotions are often available and in many instances University discounts for $25,900
- Training provided

**Laboratory costs**
3M engineering service fee = $16 to 20 / case (volume discounts available)
3M SLA model = $20 / model
+ you local Laboratory fees to fabricate the various restorations

- Digital imaging is captured and sent to 3M laboratory and your local laboratory (if they have the required software)
- The 3M laboratory engineers the digital images and mills the SLA model which is sent to the local laboratory of your choice
- The local laboratory builds the final restoration on the SLA model (the local laboratory "if they choose" can get free 3M software enabling them to mark the margins themselves "they become a 3M partner laboratory")

**Includes a 1-year service agreement covering:**
- Software upgrades, patches, new indications
- Service calls
- Service on site visits
- After first year – the service agreement costs $150 / months or $1800 / year after the first year

**Parts**
- Parts are covered only in the first year
- The wand insurance policy – if the wand is damaged, they will replace at 1/4 to 1/3 of wand price (about $2,000 to 3,000)

**Consumables**
- Light coating of titanium dioxide is required as a contrast medium
- Disposable wand tip covers – you can purchase these but they have a cleaning protocol

These prices and information are based out of the United States