Improving Accuracy, Efficiency and Cost-Effectiveness with Digital Implant Impressions





by Siamak Abai, DDS, MMedSc; Timothy F. Kosinski, DDS, MAGD; and Paresh B. Patel, DDS

Practitioners have much to gain from using an intraoral scanner to capture the final impression for implant restorations. Intraoral scanners are highly accurate and eliminate the need to send physical impressions to the lab, providing the patient with a better-fitting crown in less time. Besides saving costs on shipping, it isn't necessary to purchase impression materials, trays and adhesives. There is no potential for "pulling" of the impression material, and voids, tears and other distortions are avoided. Further, at Glidewell Laboratories, restorations produced from digital impressions are offered at significantly reduced fees. And because the digital impression is submitted electronically with the push of a button, the design of the restoration can begin immediately, decreasing the in-lab working time.

Digital impressions represent cutting-edge technology that allows dentists to create a virtual, computer-generated replica of the hard and soft tissues. In addition to being more efficient than traditional impressions, the restorative workflow initiated by an intraoral scanner leaves less room for error because, already in a digital format, the case proceeds directly to CAD/CAM design and fabrication, without the intermediary steps and time required to pour and scan stone models. This results in a more accurate fit for the CAD/CAM-produced restoration.[1–3] The high degree of precision minimizes the need for chairside adjustments and can thus reduce the time it takes to deliver the final restoration.

The digital technology captures clear, highly detailed impression data in minutes, without the need for traditional elastomeric materials, which some patients — especially those with

a sensitive gag reflex — find inconvenient and messy. In addition to the increased comfort, patients are often pleased to see that their dentist is working with the latest, most efficient technology.

To create a digital impression, a scanning abutment, which is the digital version of a traditional transfer coping, is connected to the implant. The practitioner then performs a series of intraoral scans, including the area of treatment, opposing dentition and bite. The intraoral scanner records the topographical characteristics of the patient's oral anatomy, including the contours of the edentulous space, adjacent and opposing dentition, and surrounding soft tissue. After completing the scans, the clinician need only verify the digital impression, enter the patient's information, and fill out the online Rx, indicating the implant system, size and desired restoration.

The lab receives the impression as a virtual model upon which the restoration can be digitally designed, avoiding the inaccuracies that can occur as the dental stone used to fabricate traditional casts expands. Because the digital impression produces a direct representation of the mouth, without the potential for distortion, the lab is able to create custom abutments and implant-retained restorations with ideal contours, interproximal contacts and occlusion.

The following three cases will demonstrate how, whatever the practitioner's preferred intraoral scanner, digital impressions offer an efficient, highly accurate and cost-effective means of providing patients with CAD/CAM-produced implant restorations.

CASE 1: TRIOS®

Clinical Dentistry by Siamak Abai, DDS, MMedSc

A male patient in generally good dental health presented with an edentulous space in the area of tooth #30. A treatment plan for a single-implant restoration was accepted by the patient, and at the next appointment, a 5.0 mm x 11.5 mm Hahn™ Tapered Implant was placed. Three months later, the patient returned for evaluation, and favorable soft-tissue health and implant integration were observed. The final impression was taken with a TRIOS® intraoral scanner (3Shape North America; Warren, N.J.), which created a highly accurate rendition of the implant site, surrounding dentition and gingival contours.

After verifying the digital impression generated by the scans, a digital Rx was completed and the case was submitted to the lab. Because the implant angulation was favorable, a screw-retained crown was selected for the final restoration. The final monolithic restoration was designed directly on the virtual model generated by the intraoral scanner, resulting in a faster turnaround time.

At the final delivery appointment, the BruxZir® crown was seated without the need for any adjustments. The prosthetic screw was tightened and the access channel was sealed with composite, completing a predictable, esthetic restoration for the patient, who was pleased with the efficiency and convenience of the digital restoration process.

Figure 1: *Preoperative occlusal view of edentulous space in the area of tooth #30.*

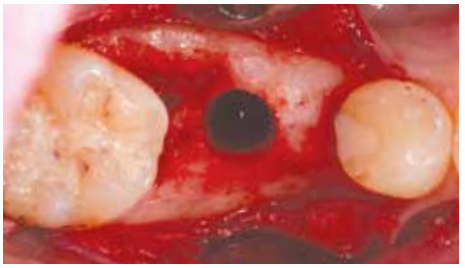

Figure 2: *Implant site following completion of osteotomy.*

Figure 3: *A 5.0 mm x 11.5 mm Hahn Tapered Implant was initially threaded into place with a handpiece.*

Figure 4: *The healing abutment was placed and the prosthetic screw tightened.*

Figure 5: *Occlusal view following delivery of the healing abutment and suturing of the surgical flap.*

Figure 6: *Postoperative radiograph illustrates optimal positioning of the Hahn Tapered Implant.*

Figure 7: *After three months, the healing abutment was removed, revealing healthy tissue around the implant.*

Figure 8: *A scanning abutment was connected to the implant using a hand driver.*

Figure 9: *Complete seating of the scanning abutment was verified with a periapical X-ray.*

Figure 10: *A digital final impression was taken with the TRIOS intraoral scanner.*

Figure 11: *The quality of the digital impression was verified, and the case was electronically submitted to the lab.*

Figure 12: *Upon receiving the digital impression, the lab proceeded directly to the virtual design of the screw-retained crown, without the need to pour and scan a stone cast.*

Figure 13: *The screw-retained BruxZir crown was seated and exhibited a precise fit. The prosthetic screw was tightened with a torque wrench.*

Figure 14: *Occlusal view of the final restoration.*

Figure 15: *Final radiograph illustrates full seating of the screw-retained crown and crestal bone preservation at the implant site.*

Figure 16: *Buccal view of the final restoration shows optimal contacts and gingival margins.*

CASE 2: 3M™ TRUE DEFINITION

Clinical Dentistry by Timothy F. Kosinski, DDS, MAGD

A 64-year-old male presented for restorative treatment six months after having his first and second molars extracted and the socket sites grafted. Radiographic and intraoral evaluation indicated ample vertical bone and a fairly wide edentulous ridge with adequate attached gingiva on the facial aspect. The patient agreed to have the edentulous span in the area of tooth #18 and #19 replaced with dental implants.

At the surgical appointment, two 4.3-mm-diameter Hahn Tapered Implants were placed following the standard protocol. Healing abutments were connected to the implants.

After approximately three months of integration, the healing abutments were removed, illustrating healthy tissue cuffs. Scanning abutments were threaded into the conical internal hex prosthetic connection of the Hahn Tapered Implant. A digital impression was easily and accurately made using a 3M™ True Definition intraoral scanner (3M ESPE; St. Paul, Minn.), precisely capturing the oral and dental anatomy surrounding the two edentulous spaces. After confirming accuracy, the scan was approved and the prescription submitted for fabrication of custom abutments and implant-retained crowns.

The custom abutments were designed to align precisely with the gingival margins, support the soft tissue, and establish ideal emergence profiles for the final crowns. After seating the custom abutments without complication, the prosthetic screws were tightened. The final BruxZir crowns were cemented over the abutments, the occlusion was verified, and final radiographs were made. The efficient, highly accurate workflow used in this case resulted in superb function and emergence profile esthetics for the final restorations.

Figure 1: *Occlusal view of edentulous site. Note the adequate amount of attached gingiva present.*

Figure 2: *Periapical radiograph of edentulous mandibular first and second molar area.*

Figure 3: *The MD Guide (Golden Dental Solutions; Detroit, Mich.) helped determine proper mesial-distal spacing and visualize the final emergence profiles of the molar crowns during creation of the initial osteotomies. The guides have 6-mm-long and 2-mm-diameter pilot drills.*

Figure 4: *A periapical radiograph of the 4.3-mm-diameter osteotomy bur in place indicates nice position at the crest of the edentulous ridge.*

Figure 5: *The deep, angled threads of the Hahn Tapered Implant would help maximize initial stability.*

Figure 6: *The 4.3-mm-diameter implant was placed into the prepared osteotomy site.*

Figure 7: *After verifying adequate primary stability, 3-mm-tall healing abutments were connected to the implants.*

Figure 8: *Digital radiograph of Hahn Tapered Implants in proper position and healing abutments in place.*

Figure 9: *Tissue healing following approximately three months of integration was remarkable.*

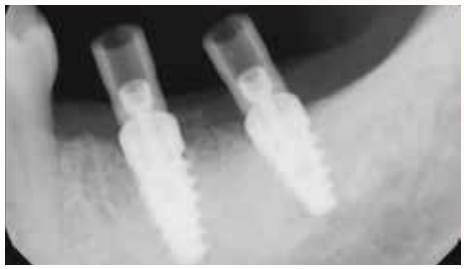

Figure 10: *Scanning abutments designed for the Hahn Tapered Implant System were positioned, and a radiograph was used to verify complete seating.*

Figure 11: *Buccal view of final impression generated by the 3M True Definition digital scanner.*

Figure 12: *Occlusal view of digital impression.*

Figure 13: *The lab created virtual casts directly from the digital impression so Inclusive® Custom Abutments and implant-retained mandibular molar crowns could be designed using CAD software.*

Figure 14: *Custom titanium abutments with gold-tone surfaces and ideally contoured margins were fabricated by the lab along with the final BruxZir crowns.*

Figure 15: *The abutments were seated and the prosthetic screws tightened to the manufacturer-recommended torque.*

Figure 16: *Note the position of the margins, which are at or just slightly subgingival in order to allow easy cement removal and maintain ideal periodontal health.*

Figure 17: *The BruxZir crowns were cemented over the custom abutments.*

Figure 18: *Buccal view of BruxZir crowns in place.*

CASE 3: ITERO®

Clinical Dentistry by Paresh B. Patel, DDS

A female patient in her early 20s presented for initial consultation with a congenitally missing maxillary lateral incisor. The initial patient examination, including measurements of bone volume with ridge calipers, determined that, although the ridge was thin, there was sufficient facial-palatal bone volume and mesial-distal space to accommodate a 3.0 mm Hahn Tapered Implant, which excels at fitting within tight anatomical spaces. This implant would also prove advantageous because it could be restored using a custom zirconia hybrid abutment, which was important considering the restoration's location in the esthetic zone.

The patient agreed to the treatment plan and returned for the implant placement appointment. After placing the Hahn Tapered Implant to depth, a cover screw was inserted and the implant site sutured.

After healing for 17 weeks, the patient returned for final impressions. An intraoral scanner was used in order to provide the patient with a highly accurate implant crown in as little time as possible. The final digital impression was taken with the iTero® intraoral scanner (Align Technology, Inc.; San Jose, Calif.) and submitted to the lab along with the parameters for the restoration, without the need for physical paperwork or shipping.

Using the virtual model generated by the digital impression, an Inclusive Custom Abutment was designed with CAD software to optimize the emergence profile and esthetics of the BruxZir Anterior restoration. At the final restoration appointment, the custom abutment and implant crown were seated and established the desired form, function and esthetics without the need for any chairside adjustments.

An intraoral scanner was used … to provide the patient with a highly accurate implant crown in as little time as possible.

Figure 1: *The patient presented for treatment with a flipper appliance in the area of her maxillary right lateral incisor.*

Figure 2: *Initial condition of edentulous space.*

Figure 3: *Occlusal view of edentulous area shows facial-palatal resorption of the ridge.*

Figure 4: *Caliper measurements indicated ridge width of approximately 5.5 millimeters, which was sufficient for the placement of a 3.0-mm-diameter Hahn Tapered Implant.*

Figure 5: *A surgical flap was reflected to visualize the bone crest.*

Figure 6: *Treatment area after full seating of the 3.0 mm x 16 mm Hahn Tapered Implant.*

Figure 7: *Postoperative radiograph verified that the implant was fully seated and didn't impinge upon the periodontal ligament spaces of the adjacent teeth.*

Figure 8: *Condition of patient after 17 weeks of healing.*

Figure 9: *A tissue punch was used to expose the implant.*

Figure 10: *A scanning abutment was attached so a digital impression could be taken.*

Figure 11: *Radiography verified complete seating of the scanning abutment.*

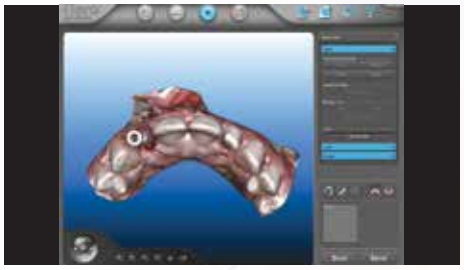

Figure 12: *The iTero intraoral scanner was used to create the final digital impression and submit the case to the lab for restoration.*

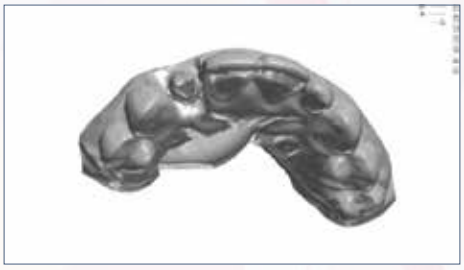

Figure 13: *The lab digitally designed the Inclusive Custom Abutment without having to wait for a physical impression or pour a stone model.*

Figure 14: *The final crown was designed in concert with the custom abutment to optimize the gingival margins and emergence profile.*

Figure 15: *To maximize esthetics in the smile zone, the final restoration consisted of a BruxZir Anterior crown over an Inclusive Custom Zirconia Abutment with titanium base.*

Figure 16: *Complete seating of the custom abutment was confirmed with a periapical X-ray.*

Figure 17: *The custom abutment fit perfectly, establishing margins just below the soft tissue. Teflon tape was placed over the fixation screw.*

Figure 18: *The final crown was cemented over the custom abutment.*

Figure 19: *The patient was very happy with the final restoration, which exhibited a lifelike appearance among the patient's natural teeth.*

CONCLUSION

Intraoral scanners streamline the restorative process by producing a highly accurate final impression that can be immediately used by the lab to design and fabricate custom abutments and monolithic implant crowns. Note that, in addition to the scanners utilized above, dental CAD software is compatible with any system that can produce impressions in the standardized STL file format, allowing virtually any clinician with an intraoral scanner to take advantage of digital implant restorations. No matter the clinician's system of choice, digital impressions reduce the cost of the restoration, result in a precise fit, and minimize the time the patient spends without a tooth. **IM**

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