# Managing Complex Cases with Digital Scanning Technology

## Flexibility in planning meets accuracy in execution

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Although it has been more than 20 years since the introduction of digital scanning technology, it is estimated that these devices are used in only 15% of general practitioners' offices today.[1] By now, dentists are likely well aware of the benefits of digital impression taking compared with traditional methods, including time savings, increased accuracy, more predictable results, and improved patient satisfaction. What is holding approximately 85% of dentists back from adopting a technology that offers such advantages?

### Drawbacks of Traditional Restorative Methods

Cost is one of the primary reasons cited by dentists for their decision to continue using traditional impression materials; however, viewed through a strictly monetary lens, the choice between digital and traditional impression taking is not as clear-cut as it may seem. Digital scanners have a higher purchase price than traditional impression-taking materials, and also require data plans to transmit cases to the laboratory and model manufacturers.

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However, the costs of traditional impression taking in terms of both time and materials are considerable. Ronald Perry, DMD, has estimated that for an office with a goal of $2500 of production per day, the total cost of a traditional impression, factoring in both time and materials, is $100. For the average dental practice, this amounts to $38 400 per year for traditional impression taking.[2] Costs increase if impressions must be taken a second time, which is common in complex cases.

There are also accuracy concerns with traditional impression taking, both in the dental office and the laboratory.[3] Even dentists who use good clinical technique cannot confirm that an impression is accurate on removal from the mouth. Once at the laboratory, the process of pouring and using the stone model introduces the potential for additional accuracy issues, such as the abrasion of the model or expansion or the contraction of the stone.

An additional objection to leaving traditional impressions behind may simply be fear of change. Once dentists become accustomed to certain tools and techniques, they may be hesitant to abandon them. Given the vital role that impression taking plays in the expensive and time-consuming restorative process, many dentists may have reached a point where they are comfortable enough with their method—even with the need for occasional retakes, adjustments, or remakes—that they are not interested in changing it.

### Capabilities of Digital Scanning

Recent advances in digital scanning technology, however, are causing some dentists to reconsider their choice to continue using traditional restoration processes. Although the implementation of these technologies requires that some adjustments be made in practices, the potential benefits are hard to ignore. Chief among these is the accuracy of restorations created with digital scanners. Because these devices provide instant feedback in the form of chairside displays, dentists can clearly see their digital impressions and review them for quality. There is no need for the dentist to wonder if an impression is accurate or complete before submitting it to the laboratory; instead, the impression can be reviewed in real time while the patient remains in the chair, and errors can be corrected before retakes or remakes are necessary. Research supports these benefits, showing that digitally scanned restorations exhibit a better marginal fit and better internal adaptation than crowns made with vinyl polysiloxane material.[4,5]

The time required for traditional impression taking can be significant, and digital scanning has the potential to reduce chairtime, both at the impression appointment and at final seating.[6] One study shows that digitally scanned restorations can be seated 33% faster than those made traditionally.[7]

Although the earliest digital scanning systems available on the market came bundled with in-office CAD/CAM systems, today, more flexible scanning workflows are providing dentists with additional choices when it comes to laboratory partners and restorative materials. Scanning technologies are available that let the dentist continue working with his or her preferred laboratory, or connect the scanner to an in-office milling system for same-day restorations. When collaborating with the laboratory, digital scanning also improves communication between parties, as both the dentist and technician can easily refer to the same digital record.

The patient experience is an important consideration as well, of course. Not only can digital scanning assist in co-diagnosis, but it has

also been shown to be preferred to traditional impression taking by the majority of patients.[7]

## Confidence in Challenging Cases

The improved accuracy of digital scanners may also give dentists more confidence when processing larger or more complex cases. Dentists who hope to use digital scanners for large cases should review the accuracy and consistency of different systems carefully before making a purchase, however. The accuracy of currently marketed systems varies up to approximately ±1%. To understand the importance of this figure, consider the following example. A gap in a restoration that is 50 µm or more—the width of a human hair—can be felt by a patient and seen by a dentist, and poses the potential for premature failure. In the case of a 5-mm crown, an accuracy error of 1% is 50 µm.[8]

Furthermore, the larger the restoration, the greater the accuracy required. Although the least accurate of the currently available systems may be adequate for a single-unit restoration, for larger cases, such as bridges, implant bars, multi-unit cases, or dentures, a system with greater accuracy is essential for a successful outcome. When equipped with a highly accurate scanner, dentists can deliver well-fitted restorations consistently, even in complex cases, as exemplified by the case described in the following section.

## Case Presentation

The patient presented to the office with a chief complaint concerning her bite, and stated that she was experiencing difficulty chewing. She was also interested in improving the overall appearance of her smile, stating that she had always been unhappy with and embarrassed by it. An examination revealed a worn dentition with edentulous areas on both sides of the upper arch, in addition to poor occlusion (Figure 1 and Figure 2). The patient was then wearing a transitional resin partial denture. Further examination showed that the patient did not have sufficient bone in the maxilla for placement of implants, and that her low sinus floor would require a sinus bone lift for posterior implant placement.

Two main treatment options were discussed with the patient. The first plan proposed was to perform a sinus bone lift and bone grafting on the upper arch in the edentulous areas, followed by placement of implants. The anterior teeth would also be restored with indirect porcelain restorations. The second option involved fabrication of a new partial denture to restore the edentulous areas, placement of a single implant in the space of tooth No. 11 (which did have sufficient bone to support the implant), and indirect porcelain restorations for the anterior. The patient opted for the second treatment plan due to its lower cost and greater simplicity.

A NobelActive® (Nobel Biocare, www.nobelbiocare.com) implant was placed in site No. 11; following the integration period, the patient returned to the office (Figure 3), at which point a zirconia abutment was placed on the implant and torqued to the manufacturer's specifications. A cotton pellet was placed in the opening





**CASE PRESENTATION (1.)** Preoperative view. **(2.)** Preoperative close-up view of anterior. **(3.)** Preoperative occlusal view showing implant and edentulous posterior. **(4.)** The digital scan of the upper arch preparations.

of the abutment followed by polytetrafluoroethylene thread seal (Teflon®) tape before digital scanning to close off the access to the abutment. The remaining eight teeth in the upper arch were then prepared to receive indirect porcelain restorations.

A light dusting of scanning powder was applied to the upper arch in approximately 30 seconds, and the 3M™ True Definition Scanner (3M ESPE, www.3mespe.com) was used to capture the digital impression (Figure 4). The lower arch was then dusted and scanned; this process was faster than that used for the upper arch because the focus was on capturing occlusal anatomy, not the preparation margins. A bite registration was also taken with the scanner.

After scanning was complete, the scans were reviewed on the chairside monitor to confirm clear margins on each preparation, as well as adequate capture of occlusion on the lower arch. A digital view of the articulated model was also reviewed, and the case was then submitted to the laboratory. Provisional restorations and a provisional partial denture were then adjusted, after which the appointment was concluded.

Once at the laboratory, the technician marked margins for each of the restorations and sent them to be milled with lithium disilicate. On completion of the restorations, the patient returned to the office for delivery. The restorations were tried in, beginning from the center of the mouth and working outward. This dry try-in step confirmed the excellent marginal fit of the restorations; due to the accuracy afforded by the digital scanner, no additional adjustments were necessary. Adper™ Scotchbond™ Multi-Purpose Adhesive (3M ESPE) was applied to the preparations, followed by RelyX™ Veneer Cement (3M ESPE), and the restorations were seated with a rapid veneer seating technique. Two curing lights were used to cure each restoration for 20 seconds, with one light positioned on the buccal side and one on the lingual side. On the zirconia implant abutment, Scotchbond™ Universal Adhesive (3M ESPE) and RelyX™ Ultimate Adhesive Resin Cement (3M ESPE) were used to seat the restoration (Figure 5).

Following seating of the restorations, the 3M True Definition Scanner was used again to scan the upper restored teeth, along with the upper palatal area and soft tissue. Although not a typical indication for a digital scanner, the accuracy of the 3M True Definition Scanner made it an ideal tool to capture the impression of the soft tissue without distorting it. Special instructions were given to the laboratory and the stereolithography (SLA) modeling facility to print a full-palate model for the fabrication of the final partial denture (Figure 6).

The laboratory completed the new partial denture using Itsoclear thermoplastic nylon clasps (Lincoln Dental, www.lincolndental.com) for more natural-looking esthetics. On the patient's return to the office, the partial denture was tried in and found to fit perfectly. The patient was very pleased with the


FIG. 5


FIG. 6


FIG. 7


FIG. 8

**CASE CONCLUSION (5.)** The final veneers. **(6.)** The removable partial denture on the stereolithography model. **(7.)** The removable partial denture seated in the mouth. Note the clear clasps that can be seen on teeth No. 4 and No. 12. **(8.)** Final smile with completed veneers, crown, and removable partial denture. Note the subtle appearance of the clasps.

improved esthetics and added function of her new smile (Figure 7 and Figure 8).

## Discussion

In this case, the cross-arch accuracy of the digital impressions enabled successful treatment in both the first treatment phase with the well-fitting indirect restorations, and also the second phase with the removable partial denture. The laboratory's ability to use a full-palate SLA model for creation of the partial denture contributed to the reliable fit of the finished appliance. Instead of using a model that abraded each time the denture was tried in and taken out, the laboratory was able to work confidently, knowing that the rigid and durable SLA model would not change at any point in the process.

Some dentists might argue that use of a provisional partial denture is an outdated style of treatment, but the truth is that many patients, especially today, simply cannot afford the expensive and complex process of implant dentistry for multiple teeth. This case demonstrates that a high level of esthetics, accuracy, and function can be delivered via an alternative and more affordable treatment plan. Use of today's digital scanning technology allows dentists to meet an array of patient needs, from basic treatment plans to those that are highly complex and esthetically demanding, with a greater assurance of outstanding efficiency and accuracy.

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