

3M[™] True Definition Scanner

Clinical Applications

June 2015 Collection

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USING A DIGITAL SCANNER AS THE GATEWAY TO A MODEL-FREE Workflow

Bruce Cooper, DDS

Recent advances in digital dentistry have eliminated many of the traditional steps of the restorative procedure. With the ongoing adoption of in-office digital impression systems, more and more dentists have been able to skip the time-consuming steps of capturing a traditional impression, disinfecting it, and shipping it to the laboratory. Dentists are likely familiar with these advantages, but what's new lately is the added efficiency that is possible once the digital scan reaches the lab. Today's technology allows some restorations to be designed, milled and finished completely without the use of a model. Model-free crown fabrication not only enables significant timesavings, but also reduces labor, materials and the time the patient spends in a temporary restoration.

To understand how crowns can be made accurately without the old standby of a model, it's important to review the available data on the accuracy of digital scanners. The most commonly used digital scanners in dental offices today are manufactured by Sirona, Align, D4D, and 3M. Use of any of these digital scanners gives dentists an important tool in combating one of the top complaints of labs-inaccurate impressions. Data has shown that 70 percent of labs state that inaccurate PVS impressions are their biggest difficulty in providing quality outcomes. There are simply too many variables in the traditional impression-taking procedure-between material choice, technique, and personnel-for dentists to be able to be confident in the outcome 100 percent of the time. With a digital scanner, however, the dentist gets instant feedback on the quality of an impression, before dismissing the patient from the chair, and before submitting it to the laboratory. If a digital impression

shows any inadequacies, the team can identify the problem immediately and the area can simply be rescanned during the appointment.

This immediate feedback results in impressions with great detail and accuracy. The crowns that are then fabricated from these digital impressions are also



Once the field is prepared, an adept user can scan a full diagnostic arch in as little as 60 seconds with the new $3M^{TM}$ True Definition Scanner.

excellent, demonstrating more accurate interproximal contacts, more precise occlusion, better margins and better fit and stability than crowns that have been made from a traditional impression. The better overall fit of crowns made from a digital scan has brought the remake rate due to marginal fit for these crowns 80 percent below the industry average. Additionally, data shows that seating times for single-unit crowns made from a digital impression average 41 percent less than seating times for crowns made from a conventional impression. The digital scanner used in the case shown here, the 3M[™] True Definition Scanner, has, in my experience, been very accurate. This makes it especially useful for large or complex cases, or, as seen here, model-free workflows.

Old and New Workflows

In the typical workflow using a digital scan, the digital file is sent to both the laboratory and a model manufacturing facility, where a model is printed using a stereolithography apparatus. The model is then shipped to the laboratory, where it is used in the subsequent stages of the crown production. In many cases, the laboratory can design and mill the crown before the arrival of the model, and simply use the model for final confirmation of fit before sending the case back to the dental office. This workflow is already more efficient than the traditional process of pouring stone models in the laboratory, but the accuracy of digital scans enables even greater efficiency for some cases.

With the assistance of a qualified laboratory, dentists may now consider "going model-free" for single-unit cases using monolithic restorations. Depending on the capabilities of the laboratory, a model-free workflow may be possible in even more situations (Ziemek Dental Lab, for instance, does not limit the practice to only monolithic materials), but the conservative approach may be the most appropriate to begin with. Using the model-free workflow, the dentist simply sends the digital scan file to the lab, where the restoration is digitally designed and milled, then sent back to the dentist.

This workflow is, of course, a departure from the security of using a model to confirm the fit of a restoration, but dentists and labs will find that if they can get over the mental hurdle of needing the model, the accuracy of the digital scan and the CAD software will help ensure optimal results. In-office CAD/ CAM technologies such as chairside design and milling have already introduced many dentists to the idea of not having a model; this is simply an extension of that concept to the laboratory. The case shown here will highlight the timesaving and streamlining capabilities of this new workflow. It should be noted that this case was my very first attempt at working with the laboratory to create a model-free crown.

CASE STUDY

The patient had required root canal therapy on No. 13 due to a fracture in the tooth and the nerve becoming symptomatic (Fig. 1). The tooth had previously had a mesial-occlusal composite restoration, so upon completion of the root canal the tooth was temporarily restored with an intermediate restorative material (Figs. 2-3). This was replaced with a new composite filling prior to scanning and placement of a new crown.

The tooth was prepped with a standard all-ceramic preparation, with care taken to ensure a clear and distinct margin all the way around the tooth (Figs. 4-5). Retraction cords were placed for tissue management to ensure easy readability of the margins. In prepping for a digital scan, dentists should use the same care that they use for a traditional impression, as clear margins are equally important. In the state of Washington, expanded function assistants are qualified to perform impression taking, so after the area was prepped and retraction cords were placed, the assistant captured the digital scan using the 3M True Definition Scanner (Fig. 6). I returned following the scan capture to confirm proper capture of the margins and bite, and to review the occlusal relief on the preparation (Fig. 7). The prescription form was completed on the touchscreen and the case was submitted to the laboratory.

At the lab, the digital file was used to design the crown. Because this was the first collaboration between the dentist and laboratory on a model-free crown, both parties agreed to err on the side of slightly overbuilding the crown during the design phase in order to minimise the chances of a remake. If the crown were underbuilt it may have been necessary to send the case back to the lab, inconveniencing the patient.

The crown was milled using 3MTM ESPE TM LavaTM Ultimate Restorative, which is a resin nano ceramic (classified as a porcelain/ceramic in the CDT's code) that can be easily adjusted in the dental office. Because this restorative material requires no staining or glazing, restorations can be completed very quickly, requiring just a polishing step for finishing. Using this material, any necessary adjustments could be completed chairside.

After milling of the crown, it was polished and sent back to the dental office. The crown was received in the box shown, with no accompanying model (Fig. 8). Try-in confirmed excellent margins and contours, and minor adjustments were made to the contacts. The amount of adjustment necessary was well within expectations, especially given the communication between the dentist and lab regarding allowance of extra material for insurance.

The crown was seated using 3MTM ESPETM ScotchbondTM Universal Adhesive and 3MTM ESPETM RelyXTM Ultimate Adhesive Resin Cement, which are designed to work together as part of the Trifecta Method. The adhesive was rubbed onto the prep for 20 seconds and briefly air-dried, and the cement was dispensed into the crown, which was then seated on the tooth. After seating, excess cement was removed and final polishing was then completed (Figs. 9-12).











Fig. 1: Preoperative radiograph. **Fig. 2:** Preoperative view showing intermediate restorative placed following root canal.

Fig. 3: Preoperative view.Fig. 4: The completed prep with clear margins.Fig. 5: Buccal view of the prep.









Fig. 6: The assistant capturing the scan. Fig. 7: Review of the scan to confirm proper capture. Fig. 8: Model-free crowns arrive in simple packaging from the lab. Fig. 9: Final result. Fig. 10: Excellent fit of the final crown. Fig. 11: Postoperative buccal view. Fig. 12: Post-operative radiograph.

Discussion

Model-free crown fabrication has the potential to bring many advantages to the industry. It can enable significant timesavings by eliminating any wait for a model to be produced. There is also a potential for cost-savings, thanks to the reduction in labor and materials. If the final crown can be produced and seated more quickly, then there is also the benefit of reducing the time that a patient relies on a temporary. Dentists who are able to provide this service may have a new selling point for patients with the ability to deliver final restorations that are faster than competitors.

One of the biggest hurdles to overcome in acceptance of this technique is simply a mental one, for both dentists and lab technicians. Both parties must rely on the accuracy of the digital information to establish the contacts and occlusion for a restoration. On the laboratory design side, this information must be trusted to work with the lab's settings and design parameters to create a crown that fits-and the lab must ship it back to the dentist without a final check on the model. It takes an investment of time and effort for a lab to adapt to the model-free process, but by closely communicating with dentists using the process, labs can quickly get up to speed.

Traditional laboratory procedures have been very laterally driven, with a rigid order to the work that requires the technician to first build a model, then create the coping, then complete the finishing steps. As seen here, however, the increasing digitisation of the workflow has allowed the process to become more and more vertical. The promise of the model-free procedure is that the laboratory can now begin fabrication of the restoration almost immediately upon receipt of the dentist's digital file, offering significant timesavings. Furthermore, the extreme accuracy made possible with these digital tools makes a truly amazing difference for the dentist, laboratory, and the patient.









A native Washingtonian, Dr. Bruce Cooper obtained his B.S. degree in biology from Pacific Lutheran University. In 1986, he completed his dental training at Creighton University in Omaha,

Nebraska, and then moved to Olympia and began practicing general dentistry. Dr. Cooper also teaches dentists in the Pacific Northwest on the use of modern clinical techniques and practices.

Dr. Cooper is a member of the American Dental Association, the Washington State Dental Association, the Thurston-Mason Counties Dental Society and the Academy of Computerised Dentistry. Over his ca-reer, he has served as an officer and leader within these professional organisations.

Dr. Cooper has received honoraria from 3M ESPE Dental.



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MAXIMISING EFFICIENCY AND FLEXIBILITY WITH AN OPEN-ARCHITECTURE SCANNER

Nick Marongiu, DDS

In recent years, dentistry has seen a dramatic increase in the number and capabilities of digital impression systems. While they were originally used for relatively simple cases like single unit restorations, inlays or onlays, today's systems are capable of serving as a starting point for a much broader number of workflows, including clear aligners and other orthodontics, implant abutments, and both chairside and lab mills. But to take advantage of this variety, as well as position themselves to continue adapting in the future, dentists should keep one thing in mind when selecting a digital scanning system-open architecture.

For those who are not familiar with the term, digital impression devices can be divided into two categories—openand closed-architecture systems. The distinction is based on the way they do (or do not) share data with other systems. In a closed system, a manufacturer tightly controls the CAD and CAM components of the restorative process, and a digital impression made with the system's scanner can only be used to produce restorations with that same manufacturer's system.

The advantage to this approach is that the manufacturer should be able to guarantee a smooth interface between the technology components involved. It can also be useful for a dentist who would like a high level of "hand-holding" in the transition to digital dentistry, as the number of technologies and capabilities to learn is limited.

However, that limitation is one of the things that makes a closed system unattractive to many dentists. As the capabilities of digital scanners continue to expand, those who are locked into a closed system may watch as their peers are able to use scanners for a wider variety of indications, while they may have to wait for their system to add the new capabilities—if they are added at all.

A hybrid between open and closed architecture is a "selectively open" system. With this approach, the manufacturer of a scanner enables the data to be used by a pre-approved list of outside companies. Typically, the scanner manufacturer will thoroughly vet these workflows prior to approving them so there is less chance for the dentist to encounter problems. While this type of system clearly offers more flexibility than a strictly closed system, dentists may still face limited choices outside of the manufacturer's own solutions.

Finally, open architecture represents the opposite end of the spectrum from closed architecture. With an open system, the scanner generates STL files that can be sent to any lab or manufacturing partner. These files will work with any system that can read them, regardless of the manufacturer. This type of system gives dentists maximum flexibility to take advantage of their scanner in conjunction with the broadest range of workflows and products. As the list of manufacturing processes that utilise STL files continues to grow, dentists with these types of systems will have the most choice in the manufacturers and materials they work with.

As noted, one of the advantages to working with a closed or selectively open system is that dentists get some sense of assurance that the workflows they want to use have been thoroughly tested and proven. Therefore it may seem upon first glance that dentists using an open system forego this security. However, there are open systems that strike a convenient balance between providing the flexibility to take files anywhere, and the assurance of working with a proven workflow.



The system's new wand handles like a traditional dental handpiece with a narrow, angled tip providing easy access to the posterior.

Open Architecture with Added Security

My office has worked with an open system, the 3MTM True Definition Scanner, for two and a half years. Prior to that, we used its predecessor, the 3MTM ESPETM LavaTM Chairside Oral Scanner C.O.S. This experience has made digital scanning an everyday part of our practice, and the open architecture of the system is a key part of that.

While providing the flexibility of STL files that can be used with virtually any open CAD/CAM system, the 3M True Definition Scanner also has "Trusted Connections," meaning these systems have been technically and clinically validated to work smoothly with the scanner and deliver high accuracy. With this model of open architecture, users of the scanner get both the proven connections of working with a closed system, along with the flexibility of an open system.

Choosing a system with open architecture was very important for my practice, as we did not want any restrictions placed on what we could or could not do with our digital scans. We currently use our scanner as the entry point for Invisalign® and Clear Correct clear aligners, partial and complete dentures, the IOS Technologies TS150TM In-Office Milling Solution, and several types of lab-manufactured restorations. In addition, we also use our scanner to print SLA models and fabricate night guards and snore guards. In the future we are considering expanding to the E4D Chairside Mill as well as some advanced implant workflows with Straumann®.

For any of these workflows, the digital scanner enables a level of efficiency and accuracy that simply would not be possible otherwise. The example shown here illustrates just how quickly a case can be completed with the scanner and its Trusted Connection to a chairside mill.

CASE STUDY

The patient presented with a lingual fracture on no. 13 with recurrent decay under the existing composite restoration (Fig. 1). The composite and decay were removed (Fig. 2), and it was determined that an inlay would be the best treatment option, given the ability to control the emergence and design the most appropriate interproximal contact.

To prepare for scanning, a lip retractor was placed and a small amount of retraction paste was dispensed in the gingival sulcus on the distal of no. 13. The retraction paste was then rinsed and the area was dried and lightly powdered with titanium dioxide (Fig. 3). The 3M True Definition Scanner was used to capture the digital impression, with the prep scan taking approximately one minute, the opposing scan captured in about 40 seconds, and the bite scan taking approximately 10 seconds (Fig. 4).

Following capture of the scan, the file was imported into the IOS

Technologies FastDesignTM CAD Station, and the software was used to design the inlay (Fig. 5). The data was then sent to the TS150TM Mill and the inlay was milled from 3MTM ESPETM LavaTM Ultimate Restorative (Fig. 6). The material selected for this case enabled extra time savings due to the fact that it does not require firing.

Once milling was completed, a dry fit was done to confirm the fit of the inlay and the interproximal contact between 13 and 14 (Fig. 7). After verifying this, the inlay was polished and prepared for bonding. A selective etch was done on the enamel surfaces of the prep, and 3MTM ESPETM ScotchbondTM Universal Adhesive and 3MTM ESPETM RelyXTM Ultimate Adhesive Resin Cement were then used for final seating (Fig. 8).

The entire case was completed in approximately one hour, and the patient was very satisfied with the final result, as well as the fact that the procedure was completed in one office visit.









Fig. 1: No. 13 had a fractured lingual and recurrent decay under the existing composite restoration. Fig. 2: The prepped tooth. Fig. 3: The area was lightly powdered for scanning. Fig. 4: Scanning was completed in minutes. Fig. 5: The scan data is easily transferred to the IOS Technologies FastDe-signTM CAD Station to quickly design the restoration. Fig. 6: The inlay was then milled from Lava Ultimate Restorative using the TS150 mill.





Fig. 7: Dry fit of the inlay. Fig. 8: Final result.

Conclusion

The workflow shown here is only one example of the efficiency that is made possible with an open architecture scanner. In this case, the scanner's Trusted Connection to the design and milling system helped create a very seamless restorative process. Whether we are utilising workflows with Trusted Connections or simply sending STL files to the lab or a manufacturer, the flexibility of an open system is something that is invaluable to our practice. We look forward to the continued expansion of workflows for our system and the added efficiency it will bring to everyday dental procedures.



Dr. Nick Marongiu graduated from the University of California, San Diego, with a Bachelor of Science in Animal Physiology and Neuroscience. He earned his Doctorate from Loma Linda

University School of Dentistry where he served as President of the Dental Student Association and Chair of the California Dental Association Student Delegation. He graduated with Honours in Implant Dentistry and was recipient of several awards, most notably, Clinical Excellence Award, Student Excellence Award, Prosthodontic Scholar Award, and Excellence in Cosmetic Dentistry Award.

Following graduation, he completed a general practice residency at the West Los Angeles Wadsworth Veterans Association Hospital and post graduate training at University of California, Los Angeles, School of Dentistry.

He currently practices full-time and is a co-owner and director at the Scripps Center for Dental Care. He serves on the board of directors of the AACD, is on the medical staff of the Scripps Memorial Hospital, and is also an adjunct faculty at the University of California, San Diego, School of Medicine.



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STAYING AHEAD OF THE CURVE: INTEGRATING A DIGITAL SCANNER INTO YOUR IMPLANT WORKFLOW

Dr. John Weston, DDS

It's no secret that technology is finding its way into almost every facet of our lives, and the dental world is seeing this first hand with the advent of digital oral scanners. As dentists, we owe it to our patients to be up-to-date on the latest technology trends and to begin implementing new pieces of technology into our everyday practices. Although the thought of learning a new process and investing in new equipment can be scary, it's even scarier to think that if you don't invest in cutting edge equipment, you could be holding your practice back. By breaking out of the technology comfort zone and investing in a digital oral scanner, a practice can become a pioneer in all-digital workflows and grow with the technology as it moves forward.

To stay ahead of the curve, my practice began integrating the 3MTM True Definition Scanner into our workflows over five years ago, and we haven't looked back. Recently, with the availability of the Straumann® CARES® System as a Trusted Connection, we have been able to implement an all-digital workflow to our implant procedures as well. With the Straumann Trusted Connection, patients now have the prospect to receive their crowns sooner with less time in the chair for the procedure, which can often be a key aspect of case acceptance. This connection means one less analog procedure holding us back from fully integrating digital scanning into every procedure we do - which is the ultimate goal for efficiency and predictable outcomes.

Choosing the Right Scanner for Your Practice

The act of choosing which digital oral scanner to purchase can be stressful, but determining what features your practice will utilise most can help guide your decision. It's important to take the time to consider your practice's needs – if you purchase a system that doesn't perform all of the tasks that are most important to your practice, the scanner could end up sitting in a corner and collecting dust.

When we chose the 3M True Definition Scanner, we wanted a system that could



Once the field is prepared, an adept user can scan a full diagnostic arch in as little as 60 seconds with the new $3M^{TM}$ True Definition Scanner.

integrate into our existing workflows and would grow with our practice. The scanner's open architecture for STL files allows us to keep using our existing labs and equipment, and with the help of training provided by 3M, only a brief learning period was needed to become proficient in using the system. Because we didn't have to worry about a major learning curve and we didn't have to change our existing practice techniques, using the scanner quickly became second nature to our staff.

For us, one of the most significant benefits of the 3M system was its list of verified Trusted Connection workflows. We know these workflows have been extensively vetted and tested to guarantee the results are accurate and predictable every time we use them. This guarantee gives us confidence in each procedure we complete, and when it comes time to seat a restoration or implant, we know the adjustments will be minimal, if any are needed at all. By using a digital oral scanner that consistently offers results we can trust, our office saves considerable time during delivery appointments, which can lead to an increase in revenue.

Quicker and More Accurate Implants: The Straumann Trusted Connection

With our previous all-digital impression workflow, we used our 3M True Definition Scanner for almost any procedure, from single crowns and bridges to multiunit veneer cases including orthodontic aligner cases. But even with a digital system, our implant cases required that we take an analog impression with polyvinyl siloxane (PVS) material. When the Trusted Connection to Straumann CARES was released, we began using it immediately and saw total production time for implant abutments and crowns decrease on our very first case.

The scanning process for an implant case differs from a traditional scan for a crown or bridge only in that you first place a scanbody onto the head of the implant. Upon completion of the scanning process, we can digitally send all of the scan images to the lab. Virtual design and digital fabrication of the crown and abutment can begin immediately. With the highly accurate scan image that is taken, the lab is able to virtually create custom abutments and crowns for each patient, which translates to a better fitting crown that will last longer, especially when compared with stock abutments.

Stock abutments aren't made for the

specific crown shape or tissue contour, so although the fit is often close, it's not perfect. A custom abutment allows the margin of the abutment and crown to be positioned right at tissue level with ideal contour in mind. This helps immensely when cementing the crown because the excess cement doesn't flow down around the implant and get trapped under the tissue, which can lead to infection and a compromised implant. Cleaning becomes much easier and less invasive when the margins line up with the tissue, and it's easy to verify no cement is left around the implant with a simple radiograph.

With the all-digital process, the lab can 3D print a model of the teeth and place the abutment and crown on it to ensure a proper fit. Upon final placement, the abutments and crowns often need minimal to no adjustments, which further contributes to time-savings for both the patient and clinician.

In contrast, when completing this procedure with PVS materials, we would remove the healing cap and we would place an impression post instead of a scanbody. We then would take an impression and send it off to the lab. In some cases we would actually have the abutment fabricated and placed in the mouth, take another impression of the abutment and then have the lab fabricate a crown, which added a significant amount of time to the process. Transitioning to an all-digital process has allowed us to eliminate extra steps and appointments, while still providing outstanding results.



CASE STUDY

A 60-year-old patient presented with pain when biting on tooth No. 18. Upon radiographic examination, a widened ligament and periapical lesion were noted on the end of the root, and the patient returned to undergo root canal therapy. During treatment, a crack running from mesial to distal was discovered. After determining the tooth was non-restorable, it was removed and a synthetic bone graft with gortex resorbable membrane was placed. The site was allowed to heal for 5 months before a Straumann Bone Level 4.8 mm Regular CrossFitTM implant was placed.

When completing this implant case with the 3M True Definition Scanner, the implant placement procedure and subsequent healing period (4 months in this case) is the same. The difference is in the fabrication process. A true 3D optical impression of the mouth is made with with the scanner instead of using traditional impression material to initiate the process of creating an abutment and crown.



Fig. 1: Once the implant is ready to be restored, the healing cap is removed and a Straumann® Mono Scanbody is placed on top of the implant. The scanbody consists of a small plastic predetermined coping that screws into the implant during the digital impressioning process. This scanbody is only hand tightened. This allows the digital scan to relay the accurate positioning and angulation of the implant. After the scanbody is placed, we scan the area of the implant and the opposing arch. Fig. 2: A bite scan is taken with the patient biting down in centric occlusion. Often the scanbody must be removed to allow for proper occlusion. After placement of the healing cap, the patient leaves until delivery. Upon completion of the scan, we fill out the on screen prescription and select the implant type, abutment and restoration material. The digital scan files and lab RX are then uploaded to the lab. Fig. 3: After receiving the digital files, the lab uses the Straumann® CARES® Virtual Software to design and order the prosthetic components. The SLA model of the area is sent for printing and simultaneously the custom abutment and crown are fabricated at Straumann's central milling facility. The 3D model includes a socket for the corresponding implant analog that allows the lab and dentist to verify the fit of the abutment as well as the esthetics in the mouth. Fig. 4: The Straumann® Repositionable Implant Analog, custom milled abutment and crown all digitally fabricated by the lab.



Fig. 5: The healing cap is removed. Fig. 6: The custom zirconia abutment is placed and torqued to 35 N-cm. The slight blanching that appears when tightening is normal and will disperse in time. Fig. 7: Teflon tape is inserted into the screw housing to ensure no voids occur when the cement is placed.



Figure 8: A radiograph confirms proper placement of the implant and abutment. **Fig. 9:** The final crown is cemented with 3MTM ESPETM RelyXTM Unicem 2 Self-Adhesive Resin Cement. The implant is left slightly out of occlusion to allow for the natural compression that occurs on adjacent teeth under heavy occlusion. **Fig. 10:** A radiograph of the completed implant, abutment, and crown. This view confirms no cement remains around the margins or implant.

A Tool for the Future

The 3M True Definition Scanner has had an immensely positive impact on my practice, and has added efficiency, ease and consistency to many of our workflows. My scans can be completed in a fraction of the time of a traditional impression and are incredibly accurate. With the newest addition of the Trusted Connection to Straumann, the implant procedure process has been streamlined to become less intimidating, more specific, and much faster. This Trusted Connection allows my practice to be completely digital, and also makes us one of the few practices that is able to offer our patients an all-digital workflow for implant procedures. In my opinion, digital oral scanning is the future of dentistry and is here to stay. The proliferation of new, verified Trusted Connections allows me to truly realise the potential of such a powerful machine.



Dr. John Weston is a native Californian who received his doctorate from Oklahoma University in 1989 and graduated with Honors. As a commissioned officer in the US Navy, he received

multiple advanced medical certifications while completing a General Practice Residency at Naval Hospital, San Diego and served independent duty in support of Desert Storm. Dr. Weston has earned the credential of "Accredited Fellow" by the American Academy of Cosmetic Dentistry (AACD), an honor shared by fewer than 51 clinicians worldwide. Dr. Weston is past Chair of the AACD Professional Education Committee and has served two terms as an elected member to the Board of Directors. He is currently an active Accreditation and Fellowship Examiner and is serving a three-year term on the American Board of Cosmetic Dentistry. He lectures nationally and internationally, publishes articles, evaluates new dental products and has been practicing in La Jolla for the past 20 years with an emphasis in reconstructive and esthetic dentistry. He is owner and director of "Scripps Center for Dental Care," a multi-specialty dental center located at Scripps Memorial Hospital, La Jolla, California.

Dr. Weston has received honoraria from 3M ESPE Dental.



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Crossing the Chasm: Digital Scanning and the Economics of CAD/CAM Dentistry

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Digital Impression Taking: The Wait-and-See is Over

In recent years, "going digital" has become a significant movement in many industries, and the dental industry is no exception. Digital photography and radiography have become quite commonplace, and record keeping and practice management are now largely done using a computer. Despite the changing tides, the numbers show that digital impression systems are still the exception instead of the rule in the majority of dental practices. A number of trends are now converging, however, to hasten the tide of adoption of this new technology. In today's digital impression taking marketplace, many dentists who initially took a wait-and-see approach are increasingly realising that the evidence is in. The dentists who have successfully integrated these systems into their practice commonly cite the following benefits that they see firsthand:

Better oral care. Dentists routinely cite tools that are unique to digital impressions that have improved their ability to assess their work. When your prep is magnified 20x the actual size, the technology forces them to take not only a second look, but a closer look at how their prep will impact the final restoration.

Better patient experience. The process of taking a traditional impression is quite often one of the most uncomfortable procedures in a dental practice. With a digital impression, dentists have transformed that procedure into an interactive and educational experience.

Improved productivity. Anytime you move from a traditional process to a digital process, the goal is to eliminate inaccuracies that are inherent in that traditional process. When your final restorations are routinely coming back and are dropping in with little to no adjustments, that predictability can reduce stress and improve the overall practice workflow. For years dentists have heard about reducing their lab bill with a full chairside milling system, but what many don't know is that even without a chairside milling system.

But even with all of these significant benefits, the vast majority of dentists have not adopted this technology.

What's holding dentists back?

"Digital scanners are too expensive. My practice can't afford that kind of initial investment."

" I'm not really having problems with my traditional impression-taking technique, so why should I change something that's working for me?"

Now let's take a closer look at the dental industry and see what is changing and how recent innovations answer many of the objections that have been holding dentists back.

WHAT'S HOLDING DENTISTS BACK FROM DIGITAL SCANNING?

"I've heard that scanning isn't all it's cracked up to be—sometimes the results are unpredictable."

"I don't have the time to spend learning a new system and training my staff to integrate it into our practice."



Traditional Restoration Workflow



Model-Free Digital Restoration Workflow



The Evolution of Digital Impression Taking

The earliest digital scanners introduced to the dental practice in the late 1980s and early 1990s came bundled with in-office CAD/ CAM systems and price tags in excess of \$100,000—high enough that many dentists lost interest after learning the price. Today, many CAD/ CAM systems still carry a similar price tag, but digital scanning technology has evolved considerably. Tools once available only as part of a costly bundle can now be purchased separately.

This freestanding scanning technology opens the door to a number of different workflows for dentists, allowing them to choose their preferred materials, workflow and lab or chairside mill connections.

Traditional Restoration Workflow

- 1. Capture impression
- 2. Place temporary crown
- 3. Ship case to lab
- 4. Modeling
- 5. Waxing
- 6. Casting
- 7. Porcelain
- 8. Receive case from lab
- 9. Seat crown

Model-Free Digital Restoration Workflow

- 1. Scan impression
- 2. Place temporary crown
- 3. Send case to lab electronically and design the restoration
- 4. Milling and finishing
- 5. Receive case from lab
- 6. Seat crown

These new workflow options have many similarities to past technological breakthroughs like digital radiography. While early versions of digital radiography systems came with proprietary components that were only compatible with the manufacturer's preferred practice management system, today sensors can be integrated with the software of the dentist's choice.¹ Dentists have increasingly adopted digital radiography after examining the labour costs associated with processing and developing film x-rays, the cost of film itself,² and the organisational challenges posed by thousands of printed x-rays. Practices with digital radiography in place have already seen that the ability to send digital data instantaneously allows them to serve patients faster and more efficiently.

Chairside CAD/CAM Workflow





Example of Trusted Chairside CAD/CAM Workflow

1. Scan impression

2. Import and design with the various software options available

- 3. Mill with either one of the trusted Chairside Milling options available
- 4. Seat crown

For Many Life-Changing Technologies, a Winding Path to Wide Adoption

The consumer market holds many interesting parallels to technologies that were initially prohibitively expensive or greeted with a tepid public response—only to become indispensable parts of our lives today.

"I hold a considerable measure of doubt as to whether television will for many years to come be a matter of popular appeal in American homes."

- Representative of the National Association of Broadcasters, 1928³

"Not everyone has dye-sublimation color printers or 35-millimeter film recorders attached to the home computer, so to get a high-quality color print of the pictures one must carry a diskette to the local graphics service bureau."

- Technology reporter discussing an early-model digital camera, 19946

The Price of a Breakthrough

HOW MUCH WOULD THESE BLOCKBUSTER TECHNOLOGIES COST IN TODAY'S DOLLARS?			
Technology	Introductory Price (\$US)	Year	Inflation-Adjusted to 2013 Dollars
Personal computer	\$2,000 ⁵	1977	\$7,471
Personal cassette player	\$200 ⁷	1980	\$549
Digital camera	\$799 ⁶	1994	\$1,219

What changed for these technologies? The same things that are changing in the world of digital dentistry—innovation is driving down costs and increasing efficiency, and the technological benefits are becoming impossible to ignore.

The Tipping Point for Digital Scanning

Today, more than 20 years after digital impression-taking technology first started appearing in dental practices, its time has truly come. New, more affordable scanners are removing price barriers, and increasingly flexible workflows are allowing dentists to create the most appropriate restorations for any patient situation.

With approximately 15 percent of general practitioners in the U.S. utilising some kind of digital scanning technology, the trend of "early adopters" is giving way to a new wave—pragmatically minded dentists who recognise the importance of this tool and don't want to wait any longer to experience its benefits.

TECHNOLOGY PUBLIC RESPONSE

"We have perceived an initial ambivalent feeling toward computers. Many [customers] mirror fears, make jokes about the information explosion and the 'big computer' somewhere that knows all."

—Computer retailer, 1978⁵

"No one could say for sure why people might need a computer at home." – Technology reporter, 1977⁴

What are the practical benefits that are winning over these dental professionals?

Accuracy

The instant feedback provided by digital scanners makes it nearly impossible to miss an important detail. While dentists might ship a traditional impression to the lab without realising a void or tear has occurred, the ability to watch the chairside monitor in real time as an impression is being captured lets the dentist instantly recognise and correct errors.

This increased accuracy ultimately produces better-fitting restorations, with data showing crowns produced from digital impressions have a better marginal fit and better internal adaptation than those made with VPS impression material.^{8,9}

Increased Efficiency

While traditional impressions can require 5 to 7 minutes in setting time alone, experienced users of digital scanners report shaving valuable minutes from the procedure.¹⁰ Plus, the risk of a retake is virtually eliminated. The timesavings are dramatic at seating as well—one study has shown 33 percent greater efficiency for digitally scanned restorations.¹¹ Clinicians have also seen dramatic reductions in remakes using digital impression systems. In fact, 3M reports a 99.7% fit rate since the launch of the product.¹² In other words, these statistics irrefutably show that digital impression taking helps both scanning and seating appointments flow predictably.

Improved Lab Communication

With a digital impression, the dentist and the lab are on the same page, and both can refer to the same digital record in the event of questions. If necessary, it is even possible for a lab technician to review the scan while the patient is still in the office, giving the lab the opportunity to provide instant feedback on a complex case.¹³ The back-and-forth caused by poor impressions or ill-fitting restorations is dramatically reduced, thanks to the real-time view that the scanner affords the dentist. When a digital impression is submitted to the lab, there is no longer any doubt that it is complete and accurate.

A Better Patient Experience

The scanning process is preferred over traditional impression taking by the vast majority of patients.¹¹ In addition to increased comfort, digital scanning can also aid in the treatment process and help patients understand the scope of the work being done.¹⁴ With more comfortable, better-informed patients, dentists can enjoy increased retention and referrals.

A Stronger Dental Team

A practice that has adopted digital technologies is often a more attractive place to work for other dental professionals, as dentists aren't the only staff members who benefit from digital scanning.

Same-Day Dentistry

Chairside mill connections available through some digital scanners enable the dentist to efficiently create same-day restorations. While some scanners are marketed as a package with an accompanying CAD/CAM system, a new push toward open architecture is bringing new flexibility to the industry and letting dentists assemble the system that works best for them.

The 3M[™] True Definition Scanner: Accurate, Reliable and Affordable

To gain the most from digital scanning and take advantage of the benefits they've been hearing about, dentists must carefully consider how to enter the market. The 3M True Definition Scanner is specifically engineered to be the best first step into digital dentistry— making digital impression taking simpler, more flexible and more affordable than ever before. Finally, dentists have a practical and affordable path forward.

More accurate and more consistently accurate than leading systems on the market¹⁶

The scanner's powerful "True Definition" video technology provides a true replica of dental anatomy, allowing dentists to capture the scan and simultaneously view it in extraordinary detail.

How important is best-in-class accuracy? If a gap in a restoration is more than 50 microns—the width of a human hair—the dentist can see it, the patient can feel it, and the restoration may fail prematurely. For a 5-millimeter crown, this means the accuracy error cannot exceed more than 1 percent. Compare the performance of the 3M True Definition Scanner to other leading systems.

ACCURACY MEASUREMENT OF INTRA-ORAL SCANNERS



Study methodology described in: van der Meer WJ, et. al. (2012). Application of Intra-Oral Dental Scanners in the Digital Workflow of Implantology. PLoS ONE 7(8):e43312.doi:10.1371/journal. pone.0043312. Additional measurements conducted by ACTA (Academic Center for Dentistry Amsterdam); Wicher J. van der Meer, et. al. (2012). Publication pending.

Trusted Connections

Optics You Can Depend On

The ability to achieve pinpoint accuracy is only an advantage if it can be done time after time. The 3M True Definition Scanner wand requires no user calibration, meaning that accurate results can be consistently achieved without worry or adjustment - and the imaging optics are protected in a compact wand thats completely sealed.

The wands size mimics a handpiece, and its light and balanced feel makes scanning a comfortable and familiar feeling. The 3D- inmotion technology contained within this deceptively small package has no moving parts or peices, so dentists can rest assured their instrument will never drift out of tune.

Predictable Outcomes

With its accuracy and reliability, the 3M True Definition Scanner gives dentists the advantage of the outstanding predictability they hope for with digital imaging. Scans are completed quickly and final restorations fit like a glove.

Easy Integration

Implementing digital scanning doesn't have to mean the practice grinds to a halt while the dentist and staff familiarise themselves

with a new piece of equipment. 3M ESPE provides customised "in practice" training. After startup, 3M ESPE further supports customers ensuring that every dental professional, regardless of their comfort level or experience with digital scanning, can integrate the system smoothly and efficiently.

Trusted and Open Connections

The 3M True Definition Scanner is supported by an open and secure cloud-based platform that lets dentists easily share files and connect with laboratories and other partners. The technology is designed to connect with mills and other systems - now and into the **future**.

The flexibility means that dentists can work with their existing labs to prescribe the materials they prefer, including PFM, full coverage gold, all-ceramics and even custom implant abutements. Dentists and their labs have the freedom to choose the best material solution for the desired outcome.

At Last—Affordability

The outstanding accuracy and utility of the 3M True Definition Scanner are only outshone by its price. The 3M True Definition Scanner is breaking down the high financial barrier of CAD/CAM dentistry. Compare pricing options with other digital scanning systems and it becomes clear that the 3M True Definition Scanner makes digital impression taking more affordable both in the short and long term.

Chairside -	PlanMill 40, TS150
Ortho -	Invisalign, Incognito
Implant-	Straumann, Biomet 3i
Laboratory -	3 Shape, Exocad, Dental Wings



One Owner's Path: Dr. Jeffrey Cecil, in practice for 30 years, explains his recent decision to purchase the 3M True Definition Scanner.

Assessing the Options

"I had looked at several different systems over the years. The early digital scanning systems were all-in-one CAD/CAM systems, which didn't suit my needs—I didn't like the idea of being limited to one certain kind of crown. When other scanners came out that didn't have a milling system attached, I looked at those too, but it seemed that they all had their own inherent weaknesses, like huge wands that I couldn't imagine getting in someone's mouth." "When I heard that 3M was coming out with a new scanner with a wand about the size of a handpiece, it excited me. I went to look at it and was just amazed. It was incredibly compact. It was a video system, versus taking the scan in little pictures. And it allowed me to scan any prep and make whatever kind of restoration I want. That was what I was waiting for."

Choosing the Right Technology Investments

"I'm kind of a gadget guy, but over the years I've been seduced into buying a few new things that are now sitting on shelves. I like technology, but I don't want to take the risk of not using it, especially if it's expensive. I've looked at all the scanners out there, and the 3M True Definition Scanner just seems to incorporate all the things that I'm looking for. The number one reason is it's a much more affordable solution. On top of that, the ease of use is incredible. The learning curve was so small; it just didn't take any time at all to pick up. Now, it takes me a maximum of a minute and a half to scan an entire arch."

Sharing with Colleagues

"At every meeting I've been to, I've shared my successes with this machine with other dentists. A lot of them are my age and they want to know, 'Is this something that really works? Does it make you any faster and help you make better crowns?' And I can very comfortably look them right in the eye and say, 'Everything is great.'"

Wowing Patients

"Patients have a lot of concerns about impressions. The material gags them or makes them feel claustrophobic—those kinds of things. So it's been great to tell them about the scanner and the way we take impressions now. There are so many patients out there who are just relieved; they look at you and say, 'Wow, what a great new invention.' When they look at their scan on the screen, they're just amazed. Then when you go to put the crown in, the fit is incredible."



DR. JEFFREY CECIL

" The 3M True Definition Scanner just seems to incorporate all the things that I'm looking for."

"We've scanned many, many cases now and they're just amazing. Everything is working out great."

Are you ready for digital dentistry?



3M ESPE is ready to help you smoothly transition your practice to the new era of digital dentistry.

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