BUILT ON THE BASICS

Denture fundamentals remain the cornerstone of digital workflows

WITH THE DRAMATIC INCREASE IN adoption of digital technology in dentistry, digital and integrated treatment workflows have emerged to join the conventional processes of fabricating complete dentures for edentulous patients. As time progresses, the conventional workflow processes, as well as the equipment and materials, that have been used in removable prosthetics for the last century are slowly being replaced by processes that employ digital technology.[1]

As more dental professionals implement digital technology into their workflows for removable prosthetics, it is essential to remember that certain fundamental principles of denture fabrication still apply—and must be taught. "You can apply the fundamentals with digital dentures just as easily as you can with analog ones," says Kimberley Daxon, DDS, a senior faculty member at The Dawson Academy. "But doctors still need to have a clinical understanding of these fundamentals because digital dentures are not the be-all and end-all to problem-solving."

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Although the required steps can be accomplished more efficiently with a digital process than a conventional one—in as few as two visits instead of five—the essential elements remain. "What we're able to do now is not to eliminate key steps but to combine them and become more efficient," says Brian Goodacre, DDS, MSD, an associate professor at the Loma Linda University School of Dentistry. "We can combine acquiring a diagnostic impression and fabricating a custom tray into one chairside appointment with the patient. It definitely provides an advantage to the clinician and patient."

A FOCUS ON FUNDAMENTALS

Regardless of the advances in technology and digital workflows, it is imperative that dentists uphold the clinical fundamentals during the process. "You still have to do your conventional analysis when evaluating the patient," says Goodacre. "Some people assume that because the workflow is digital, it can make up for bad records or missed information, but it can't. We need to make sure that we don't forget the principles on which dentistry was built."

Whatever workflow is chosen, Daxon recognizes that it's important to begin with these fundamentals. "When you think about restorative protocols like those for crowns and veneers—all of those come from removable principles," says Daxon. "How do we know where the teeth need to be from an esthetic, functional, and phonetic standpoint? When we talk about determining tooth position, we must start with the upper anterior teeth. Figuring out where those teeth need to be is one of the most challenging things that we are tasked with in the edentulous patient. The horizontal and vertical position of the maxillary incisal edge and midline—that's our starting point."

Despite the advantages of the modern age of smile design, which enable the use of digital technologies to create and design ideal smiles, clinicians and laboratory professionals involved with the fabrication process still rely on the sound concepts and principles of facial and dentofacial esthetics.[2] Providers still need to focus on each aspect of dentofacial analysis, including how to look at the face and smile, where the teeth are positioned within the face, and how to factor in the incisal edge position, lip mobility, lip display, and lip length. "Capturing borders and landmarks when making final impressions, positioning the teeth in the face, and determining occlusal schemes—these concepts are all critical to the success of a removable prosthesis and carry through whether analog or digital techniques are being utilized," says Dean E. Kois, DMD, MSD, an instructor at the Kois Center and a prosthodontist with a private practice limited to restorative, esthetic, and implant dentistry in Seattle, Washington.

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Goodacre believes that it's essential to start the process by focusing on what the patient wants. "On top of that, determine the correct vertical dimension of occlusion to start so that what you fabricate is functional and esthetic," he says. "Take advantage of a try-in to evaluate the planned tooth positions and make changes chairside as needed. This gives the patient a preview of the denture and allows for his or her approval. These things don't change just because you're doing something digitally."

Focusing on the proper landmarks and dentofacial relationships is an effective way to ensure the fabrication of a well-supported denture. Although dentists have some leeway regarding the use of bilateral balanced, lingualized, or monoplane designs to achieve proper occlusion, their preference in each case must come from a foundational knowledge. As with other aspects of the profession, it's up to the provider to apply clinical decision-making and reasoning in order to help each patient develop proper function. "Regardless of how dentures are made, you still need to have an understanding of whether or not the teeth are in the right position," says Daxon. "If a patient's teeth touch during phonetics or if a patient complains of a lisp, how do you fix that? This is why an understanding of the principles is key to problem-solving."

STREAMLINING THE PROCESS

One of the benchmarks of success for the transition to any new process is a gain in efficiency through the elimination of steps. In a digital denture workflow, several of the conventional steps can be condensed or eliminated in order to require fewer visits. For example, with digital dentures, all of the records are taken during the first visit. In theory, the need for fewer steps translates into fewer opportunities for mistakes and shorter treatment times.[3]

"We have proven that we can cut steps," says Alexander Bendayan, DDS, an associate dean and clinical professor at Boston University's School of Dental Medicine. "That's a benefit to both the dentist and the patient. Digital dentistry allows us to communicate with the laboratory faster. Overall, we're minimizing the number of appointments and maximizing the delivery of care."

The essential elements of the traditional denture workflow, which include the initial impression, tray fabrication, prototype denture, and final delivery, have not changed much over time. In the digital denture workflow, the first visit for record taking typically requires approximately 45 to 90 minutes. The second visit is short because the accuracy of the try-in regarding fit, esthetics, function, and speech can be easily verified and any necessary changes can be easily made. In addition, the delivery appointment is typically briefer when compared with traditional dentures due to the accuracy of digital fabrication methods.[3]

Bendayan also emphasizes that beyond eliminating steps, digital dentistry provides an advantage in its reproducibility. "With conventional dentistry, if a patient needed a replacement set of dentures, I would have to start from scratch," says Bendayan. "With digital dentistry, I have all of the reference points that I need, and I'm able to output the same data in a heartbeat. To me, that is really the added value."

Robert Kreyer, CDT, director of advanced dentures and implants at MicroDental Laboratories, echoes the value of data-driven

denture workflows. "The clinical data is collected and then retained for future use," he says. "With traditional or analog denture workflows, the clinical and technical data is destroyed. However, with digital denture workflows, we don't lose this data. I believe that acquisition and retention of data is the main differentiator."

It's important to note that although a digital denture workflow allows some steps to be eliminated, combined, or performed using more efficient methods, the essential elements of the traditional process, such as capturing an accurate bite record, cannot simply be skipped. "Almost all of our digital techniques are adopted from our analog techniques," says Kois. "Digital dentistry is making us more efficient by consolidating office visits and permitting the electronic transfer of information, but it is not a substitute for our knowledge of dentistry. Moving to a digital workflow will not make you immune to errors. Knowledge, experience, and understanding give you the immunity."

From a laboratory perspective, Kreyer sees an emerging interest in and adoption of digital workflows for complete and partial dentures. "Our dental laboratory role is to provide prosthetic solutions and clinical options for dentists," he says. Kreyer also sees consistency in design as a major advantage of CAD for removable prosthetics. "The biggest change is the clinical integration of intraoral scanners for complete and partial digital denture workflows. We now have digital tools that truly help us to make removable prosthetics with precision and predictability," he says. "Some technicians say that dentures are better when made by hand, but that's like comparing apples to oranges. One workflow is data-driven and the other is not. They are two different processes used to get to the same prosthetic end result." Despite the excellent work that technicians provide in the traditional analog workflow, "everyone sees things differently," says Kreyer. "Sometimes, with traditional setups, the plane of occlusion might not be even, which contributes to an occlusal scheme that is unbalanced and does not provide the best functional result for edentulous patients." However, now trained technicians can work with the software, removing some of the subjectivity, and improve the results in a more streamlined fashion.

Like the others, Kois recognizes that one of the biggest advantages of the digital workflow is that the denture is preserved as a digital file. "The fabrication of removable prostheses is traditionally a craft procedure that requires numerous visits," he says. "Each restoration is a one-off. This requires time and skill. With a digital file, changes are more easily adapted on the computer. If the restoration is lost or broken or if a backup denture is requested, fabrication is just a few clicks of the computer away. This advantage reduces chair time for the clinician as well as time at the bench for the laboratory technician."

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CAPTURING THE EDENTULOUS ARCH

When discussing the transition to a digital workflow for complete dentures, one area that gives many clinicians pause is scanning the edentulous arch. This has proven to be one of the most challenging steps to digitize, causing much debate about whether or not it is viable to use an intraoral scanner for this part of the workflow.

Because poor impressions will lead to poor-fitting dentures, getting the necessary data is very important during record taking. "You still have to understand the anatomy and supporting landmarks when you make preliminary impressions," says Daxon. "It's fundamental that you know how to take excellent border-molded final impressions. That can't be skipped over. You have to know the anatomy and ensure that you're capturing those soft-tissue landmarks. Most of the laboratories are scanning conventional impressions and then beginning the digital workflow from that step."

To build a foundation for success for removable dentures, it's absolutely critical for dental professionals to possess a strong understanding of soft-tissue anatomy. When an impression is created, if the necessary anatomy of the denture space is not completely captured in the negative aspect, then another must be created until it is correct, and the necessary soft-tissue anatomy can be visualized. It is important to capture all of the critical anatomical landmarks, including the retromolar pads, external oblique, mentalis muscle, frenum attachments, mylohyoid ridge, tuberosities, hamular notches, incisive papilla, labial sulcus, and buccal vestibule when making an edentulous impression.[4]

Although it is challenging to use a digital scanner on a patient with no teeth, Goodacre believes that it can be viable. "You'll find that the maxilla is a lot easier to capture than the mandible," he says. "This is due to the increased amount of attached tissue in the maxilla. In the mandible, you have the tongue and cheeks, which are constantly moving. The scanner cannot capture moving tissue, and you can struggle to capture the entire mandibular denture extension." Clinically, using an intraoral scanner to capture the arches of edentulous patients can be tricky. It can be difficult to accurately scan the posterior palatal seal area in the maxilla, and the complicated floor-of-the-mouth anatomy and interference from the tongue and saliva can make capturing the mandible even more problematic. In patients who have a limited amount of keratinized mucosa, the soft tissue demonstrates more movement and needs to be recorded in one pass because returning later to scan a missed area can result in an error in the digital impression if it is in a different position.[5]

If a computer is not capturing due to movement or insufficient overextended tissue, Bendayan encourages marking the patient's ridges. "In this manner, we can create a visual landmark for the intraoral scanner," he says. "That's a way for us to bypass something that the computer is unable to do. There is a big market push to get to the point where the digital workflow offers a solution for this."

"According to Bendayan, the digital workflow has also dramatically improved the collaborative relationship between dentists and laboratories."

Goodacre notes that the operator's skill can be a critical factor in the success of scanning edentulous arches. "With conventional border molding, we have patients do functional movements to determine the proper extension," he says. "When you're scanning, you have to approximate and hold the tissue in the desired extension while you scan in one pass. This emphasizes the need for proper patient selection, and although it may seem impossible, with practice, it becomes easier."

THE FUTURE OF DENTURES IS DIGITAL

The time of analog workflows dominating denture fabrication is coming to an end. Thanks to vastly improved software, greater flexibility, and faster processes, as well as better manufacturing equipment, clinicians will soon be using CAD/CAM to fabricate removable prostheses as often as they do for crown and bridge.[6] With the benefits of digital dentures far outweighing the negatives, it's becoming broadly accepted that this workflow will continue to advance and evolve as long as the fundamentals of removable prosthetics are maintained.

In addition to the numerous advantages that the digital workflow offers the dentist and the laboratory regarding efficiency and repeatability, initial studies on digital dentures have shown promising short-term clinical performance, positive patient-related results, and reasonable cost-effectiveness. Moreover, the integration of 3D printing has the potential to further modernize and streamline digital denture fabrication techniques, materials, and workflows.[7]

According to Bendayan, the digital workflow has also dramatically improved the collaborative relationship between dentists and laboratories. "The speed with which I can provide a set of impressions digitally and communicate with my laboratory is impressive," he says. "The laboratory can then directly communicate with me on proposals. It's all becoming so much faster and more efficient, and digital is facilitating it."

Kreyer is seeing the same benefit from the laboratory's perspective. "We can now discuss acquired clinical and technical data in real time," he says. "Dentists can open an email for online access to the proposed digital denture case plan previewer then analyze the design in different virtual perspectives while discussing prosthetic variables with the digital denture technician."

As for the future, there is a general excitement in the field about the next generation of dentists and technicians. Goodacre also sees potential growth for the laboratory market. "There are laboratories that are very well known for making fixed restorations and are exceptional at designing beautiful teeth," he says. "They would have never considered looking at fabricating removable prostheses in their laboratories previously, but they know the software for crowns, and now that allows them to make beautiful esthetic dentures."

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