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DIGITAL DENTISTRY MANUFACTURING 101

Creating restorations in-house leads to happier patients, greater profit

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There was a time when everyone followed the same, manual steps when creating dental restorations. The process was sometimes tedious, occasionally laborious, but always requiring skill and craftsmanship. The analog workflow, first, involved the doctor acquiring a physical impression using an impression material like polyvinyl siloxane or alginate and then shipping it off to a lab where the final restoration would be created. The patient, having had his or her tooth prepped, was fitted with a temporary restoration that would hold the tooth over until their final lab-made restoration was completed and delivered, anywhere from six to eight weeks later.

It was a solid, reliable system and it served dentists well for decades. But, there was still room for improvement – enter the era of CAD/CAM and digital dentistry manufacturing.

CAD/CAM (computer-aided design and computer-aided manufacturing) is used to improve the design and creation of dental restorations, especially such prostheses as crowns, veneers, inlays and onlays, fixed bridges and dental implants.

In-house manufacturing basics

CAD/CAM was introduced to the dental world more than three decades ago. Like any cutting-edge technology, it was vastly different from its current manifestation. The machines of the time utilized a large milling wheel, which was somewhat inelegant compared to modern systems, but it afforded those early-adopting clinicians the opportunity to make all-ceramic inlays and onlays, albeit from a not-especially esthetic block of monochromatic ceramic material. However, it was still groundbreaking – patients were able to get their restorations in just one visit.

In the years that followed, the materials, the technology and the processes have evolved. Maybe best of all, what was formerly very expensive – and just too expensive for many doctors – has come down in price and is now quite affordable.

Thanks to digital dentistry and CAD/CAM, dentists are able to do the entire restoration process in-house. By using a digital intraoral scanner, the doctor no longer needs to acquire polyvinyl siloxane or alginate impressions. A scan of the mouth gives them the appropriate physical information, which is then transmitted to a local computer here the case is designed. Finally, the case is sent to a milling machine, also located in the practice, where the computer data is turned into the eventual restoration. Those same patients who would have to wait for two months to get their final restoration can now have it in a couple of hours.

Digital dentistry is becoming more and more prevalent, and for those doctors who haven't already embraced the digital workflow, there's no time like the present.

Benefits abound

Both doctors and patients realize the benefits from chairside manufacturing.

Digital dentistry improves efficiency, both in terms of cost and time. For instance, because doctors no longer have to acquire a physical impression and send it to the lab, they don't have to spend money on impression material. Further, they no longer have to box up the impression and ship it to lab – saving shipping costs. And because the case can be made in-house within an hour or two, gone is the several-week wait for a follow-up appointment to place the restoration.

Dr. Jonathan Abenaim, DMD, is the owner of Smiles by Jonathan at the Jonathan Dental Spa in Hawthorne, N.J. He is also the founder of Smile Syllabus (smilesyllabus.com), an institute where industry leaders can share information about cutting edge dentistry trends with other dental professionals. In his practice, Dr. Abenaim utilizes in-house manufacturing, most often to create full-mouth restorations within a day or two. Further, the ability to do everything in-house makes cases more affordable than if they still had to be made by a lab.

"We have the ability to make all their teeth here," Dr. Abenaim says.

"We have the ability to turn things around in about 24 to 48 hours. We can save the patient a tremendous amount of money because the lab costs are now brought down – and this is for a full mouth restoration. We can also do teeth in the same day. We can do teeth within 24 hours. We have the ability to control a lot of the quality, because we are able to do everything and use CAD/CAM to help us."

The accuracy of a CAD/CAM solution is much better when compared to conventional processes. Intraoral scanners are far more accurate than those taken with physical impression materials.

Impression material expands and contracts, which can lead to inaccurate models and imprecisely fitting restorations. That expansion and contraction does not exist with intraoral scans. This is, obviously, beneficial for a number reasons – a better fitting restoration lessens the need for remakes, potentially requiring the patient to wait and come back for a refitting. At worst, it might even necessitate restarting the whole process with new impressions. This also prevents the doctor from having his or her schedule thrown into chaos with an unexpected appointment added the calendar.

Predictability is an important consideration. Because the restorations are created with computer-precision, doctors can expect a high-level of accuracy and a certain measure of comfort in knowing that the restorations will be accurate, durable and effective.

Options

Digital dentistry does not have to equate to chairside dentistry. Digital is an option for the practice, independent of when it is performed. Same-day dentistry is, of course, an appealing opportunity for patients – no one wants to come back for multiple appointments. But in-house manufacturing provides several options. While restorations can be made in a couple of hours, those patients who are willing to come back the following day can enjoy an even more durable restoration.

"We're switching from a lot of the lithium disilicate or e.Max-type restorations to zirconia," Dr. Abenaim explains. "That is a 24 hour process for us, because we believe that the restoration should look real and it takes that much time between cutting it and sintering it and everything else that needs to be done. We're giving patients a lot of options. We tell them, 'Hey, would you like something that's 400 megapascals strong, or are you looking for something that's

1200 megapascals? The cost is exactly the same. The difference is either I make it here in an hour and a half or you come back tomorrow and get it then. But I can tell you, overwhelmingly, 95 percent of the patients are all choosing the stronger restoration, and 24 hours is not a big deal for them."

Digital dentistry is not an all-or-nothing solution for the doctor, either. Doctors need not buy a scanner, a workstation for design and a milling machine. They can dip their toes in the water, starting small and adding additional components as they grow. Or, they might elect to do just one portion of the workflow.

Further, labs can still be involved in the process, if so desired. Doctors can do as much or as little of the processes they wish. For instance, if they just want to take intraoral impressions and send the case to the lab to handle design and manufacturing, that is an option. Perhaps they would rather do the acquisition and design portions and then send the case to a milling center. That is also an option. And, in some cases, the lab's expertise can be used just for the design of the case – acquiring the intraoral scan in-office, transmitting it to the lab for their design expertise, and then receiving it back for final manufacturing.

"The computer does a lot of it for you, but you just have to understand what you doing," Dr. Abenaim explains. "At our institute, we break it down into: acquisition, design and manufacturing. So, there are three parts to digital dentistry that can help you. For me, I choose to do all three of them. Some doctors will say, 'I only want to acquire the data, and I'll have somebody else do the design and manufacturing.' Or they may say, 'I want to do the acquisition and design, and then I'll send it to a milling center to mill.' For some doctors, they can literally choose different combinations of all three of the processes that they need to do. They can pick one and three, one and two – whatever they want."

While most of his cases are completed in-house, Dr. Abenaim still has a place in his practice for the lab's skilled hand.

"We use a lab for any sort of super-esthetic cases that need porcelain layering and you still need a human touch to it," Dr. Abenaim explains. "It's really about giving patients options. The foundations are always the same. The impressions are always the same. The design is always the same. The question is, 'What do you want the restoration to look like?' Does it have to be a Bimmer, a Ferrari or a Bugatti? They're all cars, it's just a question of what

you want them to look like, and that will require some sort of artistry or some sort of computer generation. The computer will never get rid of the human, it's just a question of the expectation of the patient."

As Dr. Abenaim explains, at its core, in-house manufacturing involves three steps:

- Acquisition
- Design
- Manufacturing

Acquisition

The first stage in digital dentistry is acquisition. This is done most commonly with intraoral scans, but can also be augmented with a cone beam scanning. A conebeam computed tomography (CBCT) scan can give the doctor even more detailed information, which is especially beneficial when planning implant cases.

While the intraoral scanning procedure is seemingly straightforward (the patient sits in the chair and rather than bite down on a tray filled with impression material, the doctor simply moves a wand-shaped intraoral scanner around the teeth), it does require appropriate skill and training. Additionally, the process is dependent on scanner technology.

The benefits of this method are twofold: The patient no longer has to have a mouth full of unpleasant impression material and, if for some reason the impression is not captured properly, the doctor will know immediately.

In some cases, however, intraoral scanners are not appropriate for all restorations that still require the need for traditional impressions. But if the doctor has a 3D dental scanner he or she can use it as part of the workflow. Indeed, it can be a very good idea for a doctor to first implement a digital dental solution with a 3D scanner and take impressions. Many doctors do this and lower initial expenses, decreasing the learning curve. They find it far less disruptive to their practices. Once this is successfully implemented, Introducing an oral scanner is far easier to put into practice from a financial perspective.

In cases where the lab is involved, technicians can inspect the work while the patient is still in the chair. With the analog method, the doctor may not know that there was a problem until the physical

impression was shipped and delivered to the lab. Now, doctors can know within seconds if the impression needs to be retaken.

And while acquisition is a reasonably simple and straightforward process, Dr. Abenaim emphasizes that not just anyone can do it – digital impressions still require the knowledge and skill of a dental professional.

"The technology is there and is very predictable, but they have got to get the education first," he says. "I don't want doctors to think they can just buy the equipment and that it's just going to work straight out-of-the-box."

"Education is tremendous. That's why it's important that any supplier you choose offers comprehensive training and support. I prefer Axsys Dental Solutions because their trainers and support engineers are top-notch. They've been in the CAD/CAM business for almost 40 years, manufacturing everything from plane and car parts to crowns and bridges."

Design

The next phase in the digital dentistry process is the design stage. This is as easy as taking that intraoral scan and manipulating it on a computer so that all of the anatomy is correct.

Like the acquisition process, an understanding of dentistry and anatomy is critical. Even though the computer is doing the heavy lifting, the designer must know what the tooth looks like and what it needs to do.

"It's just a couple of buttons," Dr. Abenaim says. "As long as you understand why you are doing what you're doing, nothing has changed. As long as you understand analog dentistry, there's no problem. You shouldn't have an issue integrating digital. It's not like you can skip the analog understanding of things, like setting a denture. You need to understand where the teeth need to go. You need to understand smile design. You need to understand all that stuff, then you just convert it to a mouse click instead of a wax spatula."

Design can be performed by any number of people on the team. In some offices, the doctor will do the design work, personally. In other offices, this part of the procedure is delegated to a member of staff. "I happen to do it in my practice just because my team is busy with other things, and I can do it much faster than they can, right now,"

Dr. Abenaim says. “But somebody can add a person into their practice to do it. It’s very simple.”

Once the design stage is complete, the case moves to the third and final step.

Manufacturing

Manufacturing is possibly the most impressive part of this process. At this stage, the completed design makes its transition from a virtual model to its physical manifestation. The case is transmitted from the design station to a milling machine where a block of material – like lithium disilicate, e.Max or zirconia – is carved into the final restoration. When that step is completed, the team members simply perform final esthetic touches – like staining and glazing – to get it ready for placement.

Given the material used, this stage can be completed in as little as an hour or so, or it might require up to 24 hours. In Dr. Abenaim’s practice, patients have the option of receiving same-day restorations, or coming back the next day for an even stonger, more durable option. Because zirconia restorations have to be fired in a furnace for 24 hours, it takes longer to deliver a restoration made with that material.

And, like other stages of the process, if a doctor does not want to perform this task – whether it be because of the price of a milling machine or simply lack of interest – this stage can be outsourced to a lab or a milling center.

In the future, doctors might find themselves using 3D printers to create the final restoration. 3D printing is a growing technology and one that is being used more and more by labs.

At this point in time, however, the final restorations cannot be 3D printed. It will require material advancements to make those possible. Many 3D printing manufacturers say that they have the materials ready, however those materials do require FDA approval before they can be used. On the other hand, doctors who are performing dental implant surgeries can 3D print surgical guides. These guides are appliances that fit over the patient’s gums, indicating, precisely, where and at what angle the holes for implants should be drilled. The process starts with a cone beam scan, which gives the doctor an accurate look inside the patient’s head. The scan shows precisely where the implants would best be placed. That data

is then transferred to design station where it is completed before being sent to the 3D printer.

Not all three components of the CAD/CAM solution need to be purchased from the same manufacturer. So-called "open systems" allow different components made by different manufacturers to work together. That is, the process can be started with the intraoral scanner made by one manufacturer. Next, that scan can be sent to a workstation using the design software produced by a second manufacturer. In the end, the final restoration can be produced on the milling machine of a third vendor. Open systems like those offered from Axsys provide a lot of flexibility. The only thing that's required for the equipments' interoperability is that it adheres to a common standard – typically the .STL format.

On the other hand, doctors may elect to just choose a complete system offered by a single vendor. In these cases, there may be features unique to that one vendor. Ultimately, however, it is up to the clinician to decide which equipment option is best for him or her.

Cost

There are any number of reasons why doctors may be disinterested in digital dentistry. Certainly, there are those who, for whatever reason, still prefer the traditional, analog methods. One of the biggest deterrents is price. However, cost aversion should no longer be an issue.

When the equipment for in-house manufacturing first came to market, it was very expensive. Doctors may still be a little gun shy about acquiring one of these systems, because of the expense. That is not necessarily still the case.

"The truth is, they've come down to be extremely affordable, if you know what to look for and how to look for it," Dr. Abenaim says. "Think of a CEREC milling machine. It used to be $80,000 and a scanner was anywhere from $40,000-$60,000. You can now buy a scanner in the range of $15,000 and Axsys offers a quality mill as low as $35,000 and a highly accurate, easy to use scanner for $18,000. The ROI comes really, really fast."

In Dr. Abenaim's practice, the cost savings afforded by in-house manufacturing is a benefit to both him and his patients. Because the previously expensive cases are now more affordable, he can do more of them, while still realizing the same profit margins.

"We created a process that's called the Excel Implant Process," Dr. Abenaim explains. "It's a proprietary process that we are working on and teach other doctors how to implement. All of a sudden, we now have the ability to do full-mouth reconstructions on implants that patients were not able to do before, because they couldn't afford it. We never skimp on quality, but because we're controlling so much, things that used to cost between a $5,000 and $7,000 on a lab bill, we can now do for less than $1,000. All of a sudden, treatments that used to cost $20,000, $30,000, $40,000, can now cost $10,000, $15,000, or $20,000. Doctors have the ability to have the same profit margins, but they're able to do more dentistry. In the past, they didn't always go for the home run of the $50,000 case, and they waited for that. The typical general dentist maybe had one or two of them a year. Now, they have the ability to do 10 or 15 of them a month. It's not that the patients don't need it, it's that they couldn't afford it. So now, integrating this technology and this workflow that we've created, it allows them to do more dentistry."

Avoid pitfalls

Before investing in a digital dentistry CAD/CAM solution, doctors need to be sure that they are making the investment for the right reasons. Dr. Abenaim observes that too often doctors are talked into buying systems for which they may not have a need.

"We created an institute called the Smile Syllabus Institute where all of those questions are answered," he says. "We really educate the doctors as to what they should be choosing, why they should be choosing it, how they should be choosing and how they can implement it into their practice. So really, it's not just about the equipment. It's about so much more including the level of expertise, training and support that can be provided from a supplier. Especially when you are just getting started. I also tell doctors it's about finding a problem in your practice, and then finding a solution. A lot of doctors find a solution first, and then they try to find a problem in their practice. Then they have a piece of equipment that they don't use, because they never had a problem. They're buying solutions, as opposed to buying solutions to their problems. So, if you don't have a problem, then it's not for you. But if it's something you want to do within your practice to increase it and make it better, then we have the Institute to teach you how to do all that."

Also, the doctor must understand whether the new technology will add new excitement and drive new business to the practice. For Dr. Abenaim, it has helped him reach a new, underserved market.

"We have switched from single tooth dentistry," Dr. Abenaim explains. "We were using a CEREC machine for about 10 years of our practice but needed to switch to handle the huge paradigm shift that is happening. By 2020 there are going to be three million people who need full-mouth dentistry. Historically, full-mouth dentistry on implants has been a thing for the rich. It was anywhere between $50,000 to $100,000 to get it done. And, really, people couldn't afford it, so they started getting dentures. That's why the denture game is still alive. We've sort of cracked the code by including CAD/CAM restorations, where we now have the ability to do full-mouth restorations at the same time."

Some doctors may be hesitant to go digital as they are fearful that they are not a lab tech and do not want to hire one. However, doctors are already performing many lab functions since they often need to modify some of low-quality restorations they are currently receiving from their labs.

Finally, the machines do not do it all by themselves. While they do most of the heavy lifting, it is still up to the team members to do the dentistry, but they must also stay current with their equipment. That is, in addition to knowing the dentistry, they must also be willing to dedicate the time and effort to learning the new technology. And, as anyone who owns a computer or a smartphone knows, these solutions are rarely static things. Expect them to be updated from time to time. Those updates will necessitate learning new ways to progress through the workflow.

Ultimately, Dr. Abenaim emphasizes that before adopting a CAD/CAM solution, doctors must make sure that they really need it.

"The biggest pitfall I always find is that they listen to their sales rep to choose the problem," Dr. Abenaim says. "They should definitely look into our institute and come learn about that. There's also a wealth of quality educational–not sales–information in the "Learning Zone" of the Axsys website (axsysdental.com). Most importantly, identify the problem in your practice, and then look for the solution. Don't buy a solution and then look for problem." ■