

CAD/CAM to Make You Smile

Robert W. Hall

Among dentists, the hot topic these days is digital dentistry. Dentists are beginning to design dental implants and make them in their offices. This is done using a CNC milling machine about the size of a kitchen microwave. It shapes a block of porcelain into a custom-designed tooth implant in about 15 minutes. No more than five percent of all dentists have now invested in such a system (about \$100,000), but uptake is going fast.

The advantages of such a system to both dentist and patients are obvious. The dentist can finish an implant in one visit in shorter time, and the patient gets the unpleasantness over with just one or two numb-ups, not multiple ones. Since patient treatment takes less time overall, a dentist using CAD/CAM can see a few more patients. Of course the system takes work away from dental labs that now do this work.

Digital dentistry began in Germany and is spreading to North America. The dentist laser-scans the tooth to be replaced, creates a 3-D CAD image of it, and outlines the margin of the section that is to be cut on the screen. Precision of measurement is within 100 microns, but the dentist still has to exercise craft judgment, altering the shape slightly so that the patient has enough gap between teeth to floss, or so that pressure

points do not cause discomfort. Once the CAD spec is complete, the dentist mounts a block of porcelain or other material in the milling machine, and in 10-20 minutes, the replacement crown is ready to fit into the patient's mouth.

Dr. Jim Phelan, a dentist in South Attleboro, MA is one of the first dentists to use this system. He graciously demonstrated it during a visit to his practice, which he named "Exquisite Smiles." Cosmetic dentistry is a specialty, but Phelan notes that almost all patients are concerned about how their smile will look after dental alteration.

Phelan's system is a Sirona CEREC 3, consisting of a CAD station with a laser scanner which converts scans directly to dimensions, plus the milling machine. He had to learn how to integrate it into his practice, but now he has now built considerable confidence using it, and is an enthusiastic promoter of digital dentistry. It increases his skill fitting prosthetics into patients' mouths and changing tooth configuration. For instance, when correcting misaligned teeth, the system helps visualize not only how the patient will look afterward, but whether the changes will be comfortable and functional. He notes that a human body does not maintain fixed geometry; for example, when a change is made, gums may recede. Digitization is a marvelous tool, but it does not tell the dentist how oral biology works.

That is, CAD/CAM improves the quality of work that Dr. Phelan gives a patient. The system, plus the versatility of dental materials that can be used, allow him to better fit implants to last a long time. He

In Brief

CAD/CAM for digital dentistry shows how it could become a more versatile tool for manufacturing.



Figure 1. Dr. Phelan scanning a cast into the CAD system, which simulates scanning a tooth for which a cap is to be made and fitted.

can even stain materials to match teeth, so they not only fit more tightly, they cannot be distinguished from a patient's aged teeth. For an overview of how this works, see Figures 1 through 4.

While digital dentistry is a hot topic in that field, CAD/CAM uptake among American dentists lags behind Europe. The first CEREC CAD/CAM system was marketed in Europe in 1987 by a division of Siemens, which a group of institutional investors bought in 1997 to form Sirona Dental Systems GmbH, in Bensheim, Germany. Until recently Sirona had this field to itself (see www.sirona.com), but now D4D Technologies of Richardson, TX is fielding a competing entry which can be seen in demo form at www.d4dtech.com.

From the view of manufacturers, the significance of digital dentistry is that dentists have enough to consider without mastering details of how scanning, digitization, and machining of various dental materials technically occur. Development of digital dentistry required a system that allows dentists to think about what concerns them, not the technology of the system. If this can be done for an environment that takes lot-size-one customization like dentistry, where else can CAD/CAM be applied?



Figure 2. Dr. Phelan removing the finished implant from the milling machine spindle.



Figure 3. Inserting the porcelain implant into the cavity, just as it would be done in a patient's mouth.



Figure 4. Dr. Phelan enthusing about the system with the author in his examination chair, getting a patient's perspective of the procedure.

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