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A 2017 GUIDE TO

CAD/CAM & CHAIRSIDE MILLING

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Written for dentists, hygienists, and assistants
CAD/CAM technology has helped to transform the manner in which restorative treatment can be provided. In particular, the ability to provide patients with single-visit indirect restorations is appreciated by clinicians and patients. Chairside milling produces restorations that are at least as accurate as traditionally fabricated indirect restorations. Chairside milling also allows clinicians to optimize the process flow, reducing chairside time, increasing efficiency, and saving patients additional visits. As with other procedures, each step must be accurately performed. Once the learning curve has been mastered, chairside milling represents an accurate method to provide patients with efficient and esthetic restorative care.

Fabrication of a CAD/CAM restoration may occur in a laboratory after sending the digital files through a secure internet portal, either in a central location designated by the CAD/CAM system’s manufacturer or in laboratories that are authorized by the manufacturer. Such systems are “closed” systems. Increasingly, systems are “open,” meaning that any laboratory with the capability to use the software can fabricate the restoration using virtual models and CAD/CAM dentistry, or by milling a model and sending it to a laboratory. The overall goal of this course is to provide information on CAD/CAM dentistry and the chairside milling of indirect restorations. After completing this course, participants will be able to:

1. Describe the key attributes of single-visit indirect restorative dentistry;
2. Review the process workflow options with CAD/CAM and chairside milling of restorations;
3. List potential advantages and disadvantages of chairside milling;
4. Describe the impact of CAD/CAM and chairside milling on office efficiency and patient satisfaction.

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Dr. Tarun Agarwal represents the next generation of leadership for the dental profession. As a respected speaker, author, and opinion leader, he is changing the way general dentists practice. His common sense approach to business, dedication to clinical excellence, integration of technology and down-to-earth demeanor has made him a recognized educator. Dr. Agarwal received his dental degree from the University of Missouri at Kansas City and practices in Raleigh, North Carolina.
then using a traditional technique to fabricate the restoration.

With digital impressions, a scan is taken of the clinical site, adjacent teeth, and opposing arch, after which the scans are transformed into images for immediate viewing on the screen. This allows the clinician to check the preparation for any deficiencies on a large screen and to immediately correct any deficient areas. From there, the restoration can be designed and fabricated. In contrast, with traditional impressions and a traditional technique, it may be more difficult to spot marginal defects in the impression, and models must be poured from these. Inherently, there are more opportunities for errors with a traditional technique, from defects in impressions or models to manual fabrication of the final restoration. Scanning of traditional impressions is a third option—this does digitize the information, allowing for CAD/CAM fabrication of the restoration; however, it will also scan any impression errors. A CAD/CAM milling unit may also be incorporated into the dental office, making it possible to mill restorations chairside while the patient is in the office.

**Chairside Milling**

In addition to the obvious advantage of being able to provide single-visit indirect restorations that are esthetic and accurate, chairside milling reduces the time required for restorative care, does not require delivery of a provisional restoration, and gives the dentist complete control over the procedure and the process workflow. A further advantage is the ease with which digital scanning and chairside milling can be performed in challenging situations, such as treating elderly patients with reduced cognition, or patients with limited mobility or ability to tolerate long treatments. Conversely, the cost of chairside-milling technology is a capital investment not required if laboratory milling is performed, and there is a learning curve associated with its adoption by the dental team and optimization of process workflow, including delegation of tasks.

**Block Options**

Regardless of the type of restoration, CAD/CAM milling begins with a CAD/CAM block and should end with an esthetic result even for challenging cases. Options include zirconia-based, leucite-based, and feldspar-based ceramics; lithium disilicate; and composite blocks. All-ceramic CAD/CAM blocks offer strength and esthetics, including a chameleon effect. The preparation design must take into account the type of block being used, and provide the correct preparation form and clearance for that material. CAD/CAM materials blend well, allowing margins to be placed supragingivally or perigingivally.

**Accuracy and Longevity of CAD/CAM Restorations**

Several studies have determined that CAD/CAM restorations in general have a marginal fit at least equivalent to those fabricated using traditional impressions and laboratory techniques. In vivo and in vitro studies have also assessed overall accuracy and fit of single-unit crowns milled using all-ceramic, zirconia, or lithium disilicate blocks, and found these to be acceptable and comparable to the use of a traditional technique. Similarly, single-unit implant crowns and abutments were clinically accurate in other studies. In one recent review, the long-term survival rate for single-tooth indirect restorations was similar following digital or traditional fabrication.

A significant number of studies have been conducted on chairside-milled restorations using ceramic and composite block materials. The marginal and overall fit of chairside-milled restorations was found to be at least as accurate as those fabricated using traditional methods; the materials were also found to offer sufficient strength and fracture resistance and clinically acceptable outcomes. In addition, the 5- and 10-year survival rates for chairside milled restorations were found to be 97% and 90%, respectively, in one review.

**Process Flow**

The process flow when providing patients with single-visit CAD/CAM restorations can be simple. After scanning and verifying the margins, interocclusal clearance, and proposed restoration design, it’s simply a matter of waiting for the restoration to be milled, any necessary staining and glazing or sintering, and trying in the restoration and seating it. In cases where the shape of the teeth must be duplicated, scans of the pre-existing teeth shapes can be made.

**Table 1. Chairside milling**

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<th>POTENTIAL ADVANTAGES</th>
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<td>Single-visit indirect restorations</td>
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<th>POTENTIAL DISADVANTAGES</th>
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<td>Cost of acquisition</td>
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and used as a virtual template for the restorations, provided the intent is to have restorations with the same shape. This reduces the likelihood of adjustments being needed or patient dissatisfaction.

Chairside milling also allows you to use a process flow that optimizes the treatment schedule by performing other procedures in the same visit as well as delivering the final restoration without an intermediate provisional phase (Figure 1). During the time of onset of local anesthesia, scans of the opposing dentition can be made as well as of the existing teeth at the site(s) if the same shape is desired, and the shade can be selected. Later in the appointment, while waiting for the restoration(s) to be chairside milled, and finished, other treatment needs can be addressed in the same visit. Treatment such as a direct composite restoration or endodontic therapy can be completed, if appropriate, while the restoration is being milled. This saves chairside time, maximizes efficiency, and saves the patient another visit.

**Efficiency (Speed)**

CAD/CAM imaging and chairside milling together save valuable time by streamlining treatment and permitting delegation of significant portions of the process. In one study, digital scanning alone saved dentists 55% of the time previously required to take a traditional impression. Digital images are immediately available for examination, such that any imperfect areas of a preparation can be adjusted and rescanned if necessary, without the patient having to return. Studies have shown that significant time savings can be achieved using CAD/CAM software and milling machines. In addition, CAD/CAM software now has automated marking and evaluation of margins, and uses digital articulating paper to rapidly determine the occlusion and interdigitation of teeth in opposing arches. Full-color images have also made it easier for us to view margins and other aspects of the preparation. The case below shows use of CAD/CAM and chairside milling for a single-unit esthetic anterior restoration.

**Case 1**

The patient in this case was a 35-year-old female who arrived with a fractured upper left canine. The patient was not experiencing any pain. After a clinical evaluation including a periapical radiograph and discussion with the patient, it was determined that the tooth was nonvital and would require root canal treatment if it were to be saved and crowned. Although the crown on the adjacent bicuspid was white, and the anterior composites were discolored with areas of microleakage, the patient declined to have these treated at this time. Together with the patient, we therefore decided that the best option was to perform same-day root canal therapy and fabricate a chairside-milled crown for same-day placement (Figures 2, 3). Our patient had experienced moderate levels of caries and had recurrent caries in the tooth being treated. Of relevance, one of the benefits
shown for CAD/CAM restorations has been a potential decrease in recurrent caries believed to be a result of the excellent marginal fit of these restorations.19

We first performed the root canal therapy and removed dental caries before placing a fiber post cemented with a self-adhesive resin composite luting agent and creating a resin composite buildup around this (Figure 4). The preparation and margins were then finalized. Given the patient’s low lip line and smile line, together with the availability of esthetic restorative materials, a perigingival margin was created. This would provide the best biocompatibility with the gingival architecture (Figure 5).

My assistant then placed gingival retraction cord and took a scan of the preparation and surrounding dentition, as well as the opposing arch. After this, the digital images were reviewed to check the margins and the scans overall. Subsequently, the full-color software provided an image of the proposed restoration for us to check on the screen (Figure 6). The shade had been determined using natural northern light. With current CAD/CAM systems, shade selection for each tooth can be automated or determined by the software, providing a reliable comparison point with assessing the shade(s) you have selected. This has two advantages—it saves time, and it removes subjectivity in shade selection, thereby reducing the likelihood of errors in shade selection. After the proposed restoration was accepted, it was milled while the patient waited in the office.

We verified the fit of the milled crown, then stained it where required for customization and glazed the crown. Historically, one of the drawbacks of CAD/CAM restorations milled chairside was the time required to stain and glaze a chairside-milled restoration. Compact technology has been introduced that significantly speeds up the stain and glaze process. The crown was cemented using a self-etch resin composite luting agent. After seating the crown, we waited until the cement had reached the gel phase,
making it possible to easily peel away the excess cement using an explorer before final curing (Figures 7–8).

Case 2. Implant Placement and Restoration

In the case shown here, the patient had fractured the root of an endodontically treated upper right molar. It was determined that the tooth was hopeless and would need to be extracted. The patient opted for immediate implant placement. After scans were taken, the surgical guide was created for optimal positioning of the immediate implant, and the implant was provisionalized. After osseointegration, the patient returned for the final indirect restorations. A scan body was placed over the implant-abutment complex, and the area was scanned using CAD/CAM software (Figure 9). Subsequently, we were able to view the proposed restoration design, which was then milled chairside before being placed and screw-retained (Figures 10–12). This procedure was streamlined with chairside milling.

Patient Benefits

For patients, chairside CAD/CAM restorations offer significant benefits. One-visit restorations are possible, with same-day preparation and placement of indirect restorations. The convenience and experience of digitally scanned, chairside-milled restorations result in high levels of patient satisfaction. Overall, patients have been found to prefer digital scans, which are less unpleasant and less likely to induce gagging than traditional impressions. Patients have also indicated a preference for single-visit indirect restorations. In addition, the chairside-milled restoration looks lifelike and natural.
Conclusions

Digital impressions can be taken and restorations created that rival traditional techniques for form and esthetics. Of course, care must be taken to ensure that the digital scans are accurate and that preparation and milling procedures are properly executed. Once the learning curve has been mastered, chairside milling provides an easy and efficient method to provide restorative care. The process workflow with chairside milling can be streamlined and efficient dentistry provided. Chairside time is optimized, accurate and esthetic restorations can be provided, and patient satisfaction is excellent.

References

**CAD/CAM Chairside Milling**

**CE Quiz**

1. __________________ are the most frequently provided indirect restorations.
   a. Three-unit bridges  
   b. Single-unit crowns  
   c. Veneers  
   d. Inlays

2. Digital impressions are transformed into images for immediate viewing on the screen, allowing the clinician to check the preparation on a large screen and to immediately ____________.
   a. adjust the software image  
   b. ask the laboratory to adjust any deficient areas  
   c. correct any deficient areas  
   d. make an extra appointment for the patient

3. Scanning of traditional impression allows adjustment of any impression errors.
   a. True  
   b. False

4. Chairside milling ____________ .
   a. can be advantageous when treating elderly patients  
   b. reduces the time required for restorative care  
   c. gives the dentist complete control over the process  
   d. all of the above

5. Studies have found the accuracy and fit of single-unit crowns milled using ____________ blocks to be acceptable.
   a. zirconia  
   b. all-ceramic  
   c. lithium disilicate  
   d. all of the above

6. In one review, the 10-year survival rate for chairside-milled restorations was ____________.
   a. 80%  
   b. 85%  
   c. 90%  
   d. 95%

7. As one of the steps for chairside milling and provision of single-visit restorations, scans of the pre-existing teeth shapes can be made and used to create a ____________.
   a. provisional restoration  
   b. virtual tray for the scan  
   c. digital template to duplicate the shape of the teeth  
   d. mouth guard

8. Chairside milling makes it possible to perform other procedures while the restoration is being milled.
   a. True  
   b. False

9. In one study, digital scanning saved dentists ____________ of the time previously required to take a traditional impression.
   a. 25%  
   b. 35%  
   c. 45%  
   d. 55%

10. Digital articulating paper ____________.
    a. does not yet exist  
    b. must be blue for accuracy  
    c. allows rapid determination of the occlusion  
    d. b and c

11. One of the potential disadvantages of CAD/CAM and chairside milling is the ____________.
    a. learning curve required after adopting this technology  
    b. resistance from patients  
    c. need for remakes  
    d. none of the above

12. When performing CAD/CAM restorations, the preparation design must take into account the ____________.
    a. form and clearance required for the block material being used  
    b. shade required  
    c. patient’s age  
    d. time required

13. The marginal fit of CAD/CAM restorations in general, compared to traditional restorations, is ____________.
    a. usually almost equivalent  
    b. at least equivalent  
    c. always inferior  
    d. always superior

14. CAD/CAM software now offers automated marking and evaluation of margins.
    a. True  
    b. False

15. A potential decrease in recurrent caries with CAD/CAM restorations is believed to be due to ____________.
    a. patients’ resulting motivation to floss  
    b. their excellent marginal fit  
    c. their internal fit  
    d. the materials used

16. Having software that can assess the shades of teeth adjacent to the preparation can ____________.
    a. save time  
    b. help provide verification of the shade you have selected  
    c. remove all possibility of needing to do any staining or glazing  
    d. a and b

17. Compact technology has been introduced that significantly speeds up the in-office stain and glaze process.
    a. True  
    b. False

18. The ability to remove excess cement during a gel phase makes it ____________.
    a. impossible to leave any behind  
    b. easy to peel away before the final cure  
    c. more radiopaque  
    d. easier to dissolve any residual cement afterward

19. Patient preference and satisfaction with single-visit milled restorations is good due to the ____________.
    a. needle-free experience  
    b. the overall convenience, experience, and reduced likelihood of gagging  
    c. lack of taste associated with scanning  
    d. ease of adjusting the occlusion after seating

20. The process workflow with chairside milling allows for ____________.
    a. optimized chairside time  
    b. accurate restorations, provided steps in the process are properly followed  
    c. esthetic restorations  
    d. all of the above

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EDUCATIONAL OBJECTIVES
1. Describe the key attributes of single-visit indirect restorative dentistry;
2. Review the process workflow options with CAD/CAM and chairside milling of restorations;
3. List potential advantages and disadvantages of chairside milling;
4. Describe the impact of CAD/CAM and chairside milling on office efficiency and patient satisfaction.

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5. Quality of written presentation 6. Quality of illustrations 7. Clarity of quiz questions 8. Relevance of quiz questions

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