Whether a direct or indirect approach is taken when faced with a patient requiring restorative treatment, creating and designing natural occlusal surfaces is not only a challenge, but also important to achieve proper bite registration, occlusion, and masticatory function. The indirect restoration described in this article features a computer-aided design/computer-aided manufacture (CAD/CAM)-generated restoration that is milled, finished, and placed in a single patient visit using the CEREC 3D chairside restoration system with a newly developed biogeneric tooth modeling function that is built into the system’s latest software (Sirona Dental Systems, LLC). The biogeneric tooth modeling function allows dental professionals to generate all-ceramic indirect restorations (onlays, inlays, and full crowns) with anatomically correct occlusal surfaces at the touch of a button.¹

Biogeneric Tooth Modeling

The CEREC 3D system’s biogeneric tooth modeling software was developed by Dr. Albert Mehl of the Department of Restorative Dentistry at Ludwig Maximilians University in Munich and Dr. Volker Blanz of the Max Plank Institute for Computer Science in Saarbruecken, Germany.²⁻⁴ These university professors stored the measurements of several thousand natural teeth in a database. They then identified and categorized common features and structures, such as cusp tips, fissures, marginal ridges, and cusp slopes. These data provided the basis for computing an “average tooth” embodying the median characteristics of all the naturally occurring teeth scanned. Following this, the differences were computed between the individual database teeth and the “average tooth,” and an analysis identified the most frequently occurring deviations. A probability analysis revealed that approximately 20 deviations are sufficient to describe 85% of the natural variability of tooth surfaces. In simpler terms, the combination of the average tooth and the 20 deviations permits a very effective description of occlusal morphology. As this process is based exclusively on data derived from natural teeth, Professors Mehl and Blanz have chosen the designation “biogeneric tooth model.”
Patient Presentation

A 35-year-old man presented to the office as an emergency patient, having suffered a fracture of the distal lingual cusp of tooth No. 19 after biting on hard food (Figure 1). The tooth had an existing distal-occlusal amalgam restoration. Radiographs and pulp testing revealed that the tooth was vital. The patient requested immediate treatment. An all-ceramic, single-visit CAD/CAM onlay was recommended, as it would allow the patient to be fitted with a permanent restoration, with no need for a temporary or a second appointment.

Preparation, Powdering, and Picturing

Before the tooth was prepared, a static bite registration was taken so that the CEREC 3D software program would have an occlusal reference of the case stored in its memory. To take a static registration, a small amount of registration material was placed on the tooth to be restored before it was reduced (Figure 2). The patient was told to bite down and then release. The resultant registration was lightly dusted with imaging powder, and digitally captured using the CAD/CAM system’s built-in infrared camera (Figure 3). This powder makes the teeth visible to the camera. The bite registration image is stored in the CAD/CAM system’s memory, and when it is time to design the restoration, the software will automatically take the occlusal morphology of the antagonist tooth into account when it calculates and proposes the occlusal surface of the restoration. This process ensures functional occlusion between the existing tooth and the new all-ceramic restoration.

Because most CAD/CAM systems rely on a digital scan or “picture” of the prepared tooth as a model from which to construct the actual restoration, the accuracy of the preparation is essential to achieving an ideally fitting restoration. Each CAD/CAM system has its own set of preparation guidelines. In this case, the preparation was achieved as conservatively as possible using an Occlusal Reduction Bur (Meisinger USA, LLC) to create a 2-mm occlusal reduction and a 1.5-mm reduction at the shoulder. The axial walls were smoothed with an approximately 6° taper, leading to a flat cavity floor.

Once all of the decay and remaining filling material was removed, the preparation was cleaned and prepared for powdering (Figure 4). First, a soft-tissue laser was used to facilitate retraction so the margins could be clearly “read” by the CAD/CAM system’s infrared camera. Use of the laser results in exceptionally clean preparation margins without the influence of a retraction cord, blood, or other fluids. Next, an extremely thin coating of contrasting powder was applied to the entire preparation, the remaining mesial and distal teeth (Figure 5). The image captured by the camera is
referred to as a “digital impression.” The system’s intelligent restoration designing software will use this digital impression when it proposes a design for the all-ceramic restoration that will be milled from a single, solid block of ceramic during the milling stage.

**Restoration Design**

With the digital impression displayed on screen, the margins were defined by tracing around the perimeter of the preparation. The software then displayed a green outline, which “snapped” to the edges to conform precisely to the shape of the margin. Once the margin was clearly defined, the software automatically designed and proposed a restoration. As the biogeneric software proposes a restoration, it displays an animated, 3-dimensional, morphing model of the proposal on screen in relation to the preparation (Figures 6 and 7). Within 5 to 10 seconds, the software will finalize the model and present an ideal restoration design—including cusps, contours, and occlusal surfaces—based on its comprehensive database of biogeneric tooth morphology. Then, the interocclusal clearance in relation to the antagonist was inspected to verify proper occlusion before the restoration was milled.

**Fabrication and Cementation**

After checking all aspects of final restoration design, the appropriate block of material was secured into the CAD/CAM milling chamber. In this case, a Vita TriLuxe shade 1M2C multicolored block (Vident) was chosen because of its high strength and esthetic properties. The all-ceramic restoration was milled to specification in approximately 9 minutes. After milling, the restoration was detached from its sprue and lightly finished with a few quick passes of a polishing wheel. The restoration was tried in and found to fit without any adjustments. After a simple application of stain and glaze and approximately 8 minutes in a porcelain oven, the restoration was bonded in place using Simplicity and Anchor bonding agents (Apex Dental Materials, Inc). A photograph taken minutes after bonding shows a distinct border between the restoration and the remaining natural tooth structure (Figures 8 and 9). This is caused by desiccation of the natural tooth because of the need to maintain a clean, dry operating field, and also because the imaging powder tends to wick the moisture out of the tooth, causing a shift in color and shade. However, after the all-ceramic restoration and natural dentition have had a chance to rehydrate, the result is extremely lifelike and it is difficult to visually discern the area where the patient’s actual tooth structure ends and the all-ceramic restoration begins, as seen in the 12-month postoperative photograph (Figure 10).
Conclusion

The design of complex occlusal surfaces is of primary importance because of their critical function in the patient’s stomatognathic system. CAD/CAM systems that use the biogeneric tooth model automatically generate restorations featuring proper occlusal design through the use of a database containing the occlusal anatomy of several thousand human teeth. This simplifies the production of restorations, reduces design time, and improves their quality. The results are all-ceramic restorations that satisfy their individual case parameters regarding contact and separation during excursion with achievement of a balanced, harmonized, and healthy occlusal profile.

Disclosure

Dr. Mirzayan is a CEREC 3D trainer for Sirona Dental Systems, LLC.

References


Product References

Products: CEREC 3D, Biogeneric Tooth Model
Company: Sirona Dental Systems, LLC
Location: Charlotte, North Carolina
Phone: 800.659.5977
Web site: www.sirona.com

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Company: Meisinger USA, LLC
Location: Centennial, Colorado
Phone: 303.268.5400
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Product: Vita TriLuxe
Company: Vident
Location: Brea, California
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Products: Simplicity, Anchor
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