achieved by means of the photoinitiator Ivocerin® for example, which is employed by Ivoclar Vivadent. Good mechanical properties such as high flexural strength are also important in order to make a composite resin suitable for use in occlusion bearing areas [8].

Tetric® N-Ceram Bulk Fill from Ivoclar Vivadent combines all of these qualities. This light-curing posterior composite has been specifically developed for the bulk-filling technique. Increments of up to 4 mm thickness can be cured in only 10 seconds at a light intensity of >1,000mW/cm².

Tetric N-Ceram Bulk Fill contains four different types of fillers: a barium aluminium silicate filler, yttrium trioxide and mixed oxide. Additionally, a prepolymer filler (a shrinkage stress reliever) has been incorporated which makes the composite resin less sensitive to ambient light and thus gives the clinician more time to apply and contour the restoration. Another useful quality of this material is its good polishability, which supports the achievement of a glossy surface, excellent resistance to wear in the contact area and a high flexural strength of 120 MPa. Moreover, Tetric N-Ceram Bulk Fill is highly radiopaque; therefore, the restorative result is easy to examine on dental radiographs.

A clinical case
The shade of the composite to be used should always be selected at the start of the appointment, i.e. before the rubber dam is placed. This prevents incorrect colour matching due to dehydration. After the carious tissue has been removed (Figs 5 and 6) and the adhesive has been applied (Fig. 5), the entire restorative procedure is performed with Tetric N-Ceram Bulk Fill. As a consequence, a uniform and anatomic restorative result is achieved. The size and location of the cavities can be restored with several increments. Insensitivity to light is a considerable advantage of Tetric N-Ceram Bulk Fill, as it ensures a reliable depth of cure within the cavity after a relatively short irradiation time. A special light booster ensures a reliable depth of cure in the deeper portions of the cavity after a relatively short irradiation time. A special light sensitivity inhibitor has also been incorporated which makes the composite resin less sensitive to ambient light and thus gives the clinician more time to apply and contour the restoration. Another useful quality of this material is its good polishability, which supports the achievement of a glossy surface, excellent resistance to wear in the contact area and a high flexural strength of 120 MPa. Moreover, Tetric N-Ceram Bulk Fill is highly radiopaque; therefore, the restorative result is easy to examine on dental radiographs.

The photoinitiator system in Tetric N-Ceram Bulk Fill includes an Italian electrical engineer, Marco Brandestini, that developed the concept for what was to be introduced in 1987 as CEREC® by Sirona Dental Systems LLC (Charlotte, NC), the first commercially CAD-CAM system for dental restorations. It allows esthetic treatment to be performed in an efficient way. Proper attention to technological advances in the field of restorative therapy allows esthetic treatment to be provided that will satisfy not only the patient but also the dentist performing the restorative procedure.

Full list of references is available from the publisher.

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Fig. 10. Carbide bars are recommended for the removal of marginal overhangs.

Fig. 11. Final polishing is performed with Astradent.

Fig. 12 and 13. The result is an esthetic posterior restoration without postoperative sensitivity.

CARD CAM TECHNOLOGY: A REVIEW

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CARD/CAM technology and materials are currently used in a number of clinical applications, including the fabrication of indirect restorations. CARD/CAM gives both the dentist and the laboratory an opportunity to automate fixed restoration fabrication. Both chairside and laboratory- fabricated procedures are available. The properties of these restorative materials—sils and their indications and appropriate use must be understood in order to enable the achievement of predictable and esthetic results for patients.

KEYWORDS: CARD/CAM systems Intracor scanner Digital impression

Introduction
In the past decade, the demand for all ceramic restorations has increased in both anterior and posterior teeth as the search for materials with improved properties has expanded. The need for a uniform material quality, reduction in production cost, and standardization of manufacturing process has encouraged researchers to seek to automate the manual process via the use of CAD/CAM technology since 1980.

Computer-aided design (CAD) and computer-aided manufac- turing (CAM) technology sy- stems use computers to collect information and design, and to manufacture a wide range of products. The introduction of the first digital intraoral scanner for restorative dentistry was in the 1980s by a Swiss dentist, Dr. Werner Mörmann, and an Italian electrical engi- neer, Marco Brandestini, that developed the concept for what was to be introduced in 1987 as CEREC® by Sirona Dental Systems LLC (Charlotte, NC), the first commercially CAD/CAM system for dental restorations. Ever since research and development sectors at a lot of companies have improved the technologies and created in-office intraoral scanners. All the existing intraoral scanners try to face with problems and disadvantages of tradition- al impression fabrication pro- cesses and are driven by several non-contact optical technolo- gies and principles.

The purpose of this present publication is to provide an extensive review on the CAD/CAM technology and to emphasise on the application of this technology in restorative dentistry.

CAD –CAM techniques
The major goals of the impres- sion – taking process in restor- ative dentistry are obtaining a copy of one or several prepared teeth, healthy adjacent and an- tagonist teeth, establishing a proper interocclusal relation- ship and then converting this information into accurate rep- licates of the dentition on which indirect restorations can be performed.

Traditional restorative tech- niques for fixed restorations require the use of impression materials to record the contours and dimensions of the preparation. This is followed by the pouring of stone models and dies prior to laboratory fab- rication of the final restorative fixed restoration. Taking an accurate impression is one of the most difficult procedures in dentis- tery, requiring careful retraction or removal of soft tissue around preparation margins, hemostas- is, and selection of an appro- priate impression material and tray for the technique used.

By using a CAD/CAM restor- ative technique, a number of steps can be simplified or elimi- nated.

Digital systems now offer the opportunity to avoid tradi- tional, analog impressions, in- cluding the usual impression materials, time, and handling limitations associated with them. Intraoral scanners have the potential to offer excellent accuracy with a more comfort- able experience for the patient and more efficient workflow for the office. But care must be taken to ensure that the whole preparation is scanned, to avoid introducing errors.

Two techniques can be used for CAD/CAM: Each case is either a chairside technique or the in- tegrated chairside-laboratory procedure.
In summary, with these systems, tooth preparation is delineated by the dentist. It eliminates several cumbersome steps, such as selecting trays, preparing and using materials, disinfecting and sending impressions to the laboratory. It also removes a source of discomfort and anxiety for the patient. Moreover, it enables the clinician to take a digital impression as well as design and mill the final prosthesis in the office, and to fabricate cosmetic crowns, onlays and veneers, with a potential to improve contours and tooth shade and finally it enhances the accuracy of the restoration to the preparation.

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The “die” is virtually cut on the screen before the outer ceramic substructure is created. During scanning, the clinician must ensure that all margins of the preparation are highlighted to allow the computer to record the details of the die scan and visualize the image. The accuracy of CAD/CAM restorations depends on the ability to visualize the margin.

A true laser scanner/digitizer consists of a cart containing a single image camera. They capture a “stitched” image of the object. The overlapping images are “stitched” together using the computer software program to process a single 3-D virtual model.

Digital systems

The Cerec Bluecam, E4D intraoral digital laser scanner, and iTero scanner are considered single-image cameras. They capture a “stitched” image of the object. The overlapping images are “stitched” together using the computer software program to process a single 3-D virtual model.

CEREC AC® system powered by BlueCam: A LED camera projects a changing pattern of blue light (approximately 470 nm) on the object and generates a composite point cloud that is used by the computer scientist to create the virtual model.

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that the average Chipping Factor (CF) of the CEREC copings was 2.8% for the 0° level angle, 3.5% for the 30° level angle and 10% for the 60° level angle. For the EVEREST copings the average CF was 0.6% for the 0° level angle, 5.2% for the 30° level angle and 20% for the 60° level angle. Univariate Analysis of Variance and multiple comparisons showed that there was a statistically significant difference in the quality of margins between the two systems for the 0° and 60° level finishing line.10

Mjör and Al have evaluated CAD/CAM restorations and found that they have a marginal fit as good as or superior to that of traditional impressions. A further benefit found with CAD/CAM restorations has been the reduced incidence of secondary caries (the leading cause of direct restoration failure with both amalgam and composite materials), attributed to the high accuracy of the proximal fit and the ability to ascertain that this is accurate prior to completion of the restoration and cementation.11

Another study evaluated the accuracy of marginal and internal fit between the all-ceramic crowns manufactured by a conventional double-layer computer-aided design/computer-aided manufacturing (CAD/CAM) system and a single-layer system. Ten standardized crowns were fabricated from each of these two systems: conventional double-layer CAD/CAM system (Procera) and a single-layer system (Cerec 3D). Marginal discrepancies of Procera copings and Cerec 3D crowns (p < 0.05). On internal gaps, Cerec 3D crowns showed significantly larger internal gaps than Procera copings and crowns (p < 0.05). Within the limitations of this study, the single-layer system demonstrated acceptable marginal and internal fit.12

On the other hand, depending on the preparation design, either an adhesive or a non-adhesive luting cement can be used with these materials. CAD/CAM restorative materials can be cemented with either traditional luting cements such as zinc phosphate, poly-carboxylate cement, glass ionomers, or resin-modified glass ionomers. Materials that can be sealed with these include zirconia, lithium disilicate, alumina, and resin nano-ceramics.13,14

Concerning the resin adhesive cements, they offer superior aesthetics and low viscosity. They chemically bond to the restoration surface and the tooth surface, either providing all of the retention or, for retentive preparations, improved retentive strength. They also have greater compressive strength.15 Meanwhile zirconia fixed partial dentures showed good to sufficient marginal integrity in combination with Panavia/ED, Compolute/EBS and RelyX Unicem.16

When evaluating the initial and the artificially aged push-out bond strength (PBS) between ceramic and dentin produced by one of five resin cements, there was a significant effect of resin cement (p<0.0001); RelyX Unicem showed significantly higher PBS than the other cements. Syntac/Vario-link II showed significantly higher PBS than SmartCem2 (p<0.001). No significant differences were found between SpeedCEM, SmartCem2, and IceCEM. The predominant failure mode was adhesive failure of cements at the dentin interface except for RelyX Unicem which in most cases showed cohesive failure in ceramic.17

Conclusion

Digital impressions tend to reduce repeat visits and retreatment while increasing treatment effectiveness. Patients will benefit from more comfort and a much more pleasant experience in the dentist’s chair.18

The quality of adaptation of CAD/CAM-generated restorations is an area of current interest. Studies demonstrate the clinically acceptable durability of CAD/CAM restorations for color matching, interfacing staining, secondary caries, anatomic contour, marginal adaptation, surface texture, and postoperative sensitivity.19-24

Adhesive cementation seems to be the key for the long-term clinical success of CAD/CAM inlays and onlays.14

References


Full list of references is available from the publisher.

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