Review

Digital dentistry: the revolution

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Introduction

Over the past decade there have been many developments in the world of dental technology. Digital dentistry is the use of technology to either carry out dental procedures or produce materials, minimising the dependence upon mechanical tools. One such example is digital scanning, which has revolutionised chairside dentistry through the use of computer-aided design/computer-aided manufacturing, better known as CAD/CAM. Manufactured by Mörmann and Brandestini, the first clinical device of its kind was the CEREC system.[1] It has enabled clinicians to produce chairside restorations, including crowns, bridges, veneers and implant abutments.[2] The benefits of living in a world of technological advancement means that virtual reality (VR) now has its place within the dental profession. VR enables students to learn anatomy and to treat patients using this 3D technology; the possibilities of VR in training is endless, making it likely that it will be introduced to dental schools in years to come.[3] This article will focus on the technology that is used in dentistry to produce chairside restorations, discussing their longevity as well as exploring the benefits of the CAD/CAM system within the profession.

The CEREC system

The original CEREC 1 system has been modified since the 1990s, making it advanced enough to produce accurate restorations on completion of intraoral scanning, without the use of impression materials or compounds. These scans are subsequently used to design and modify restorations with a virtual wax impression that can be 3D-printed. When designing the restoration, the software is able to scan the dentition and determine the anatomy adjacent to the restored tooth. The clinician is then able to make adjustments within the programme before 3D printing and cementing the restoration. These steps minimise the role of the dental technician, whilst also saving a considerable amount of time for the patient and clinician.

Literature search

Ovid was used to search Embase, using free text and subheadings. The date of publication and year of study of included articles were of paramount importance to ensure that the data were current. Furthermore, it was ensured that the studies included were conducted over a period of up to 30 years to allow discussion of the longevity of the restorations produced through the CEREC system. After the initial search, papers were screened based on length of study and sample size.

Longevity of CEREC restorations

One study conducted by Degidi et al[4] followed the success of CEREC restorations over a 2-year period, looking at implant-supported lithium disilicate fixed prosthesis. The study found that all 23 fixed dental prostheses analysed lasted satisfactorily over the study period and there were no damaged prostheses identified.[4] Another study was conducted in 2018 whereby 65 patients with CEREC 1-manufactured feldspathic ceramic inlays and onlays were followed up 27 years after placement, totalling 141 restorations. The success rate of 87.5% at 27 years was deemed to be acceptable for the dentist and patient population. The failures in the devices at follow-up were mostly due to fractures of the ceramic or the tooth, but some also stemmed from carious (18%) and endodontic (4%) origins.[5]

A retrospective study conducted in 2018 by Nejatidanesh et al[6] analysed the long-term success of ceramic laminate veneers created using CAD/CAM. It identified 197 ceramic veneers placed in 21 patients and found that the success rate of ceramic Empress CAD veneers was 97.8%, while for e.max CAD laminate veneers it was 100% following a 5-year period.[6] When comparing this data to the conventional preparation of porcelain veneers in the laboratory (see **Table 1**), it appears the survival rate of the CAD/CAM veneers is higher than those that are laboratory-made, though a robust comparison cannot be made due to varying tooth vitalities.

Table 1. Comparison of CAD/CAM- and laboratory-prepared veneers

Veneer type	Survival rate after 5 years
Porcelain laminate veneers (laboratory preparation)	94.4% (non-vital teeth showed a significantly higher failure risk)
Ceramic Empress CAD veneers	97.8%
e.max CAD laminate veneers	100%

Based on data from Beier[7]

Benefits and limitations of CAD/CAM systems within dentistry

With growing aesthetic concerns and patient expectations, CAD/CAM is beneficial in providing a pre-treatment image of the proposed outcome. In addition, in an age where many dentists are taught to preserve tooth structure, this technology is beneficial as more of the tooth can be preserved during the preparation stages as the material of the restoration is thinner.

Digital scanning also has the potential to replace conventional impressions as it takes less time, requires fewer physical materials and is less uncomfortable for the patient.[8] Furthermore, when taking full-arch impressions with guided scanning, the precision is greater than the current technique used for alginate impressions.[9]

However, this system does have its flaws. When reviewing the literature, the main disadvantage listed is the provision of restorations in subgingival margins due to the difficulty in scanning these areas. Therefore, in these instances, the conventional impression technique would be the obvious choice. With all restorations, the longevity is highly dependent upon the material selected. CAD/CAM is no different and many of the materials used within this system are ceramic based. Ceramic materials are typically brittle and known to fracture and to need replacing, as well as causing abrasive wear of naturally opposing teeth. Hence, despite robust data on restoration longevity, the CEREC approach is not without its detractors.

An article in DentistryIQ highlighted that many within the dental profession are unlikely to switch to CAD/CAM technology based on the learning involved for use of the equipment, preferring to "stick with what they know". However, as a new cohort of dentists continue to enter the profession having learnt CAD/CAM at university, they are unlikely to be able to use such systems in general practice due to the cost of the technology.[10] Thus, the cost of the equipment limits its current use to the private sector.

Conclusions

Despite its perceived shortcomings, digital dentistry is likely to revolutionise the way we practise, ensuring that patient comfort and expectations are met. Furthermore, it opens the path for more patients to be seen because of reduced waiting times from the laboratory and less of a need for making adjustments, which can be made prior to printing. The evidence surrounding the success of digital scanners and CAD/CAM systems in practice is considerable. These systems have the ability to replace the need for a laboratory and a technician with advances in the technology. Therefore, digital dentistry has proven to be an exciting new era for clinicians and patients alike.

References

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