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CHAIRSIDE CEREC SYSTEM AND CAD/CAM MATERIALS

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ABSTRACT

Background
As chairside Computer Aided Design and Computed Aided Manufacturing (CAD/CAM) have gained popularity in dentistry in the last decade, the variety of novel CAD/CAM blocks have been introduced for CAD/CAM applications.

Mainly glass ceramics/ceramics and resin composites were used in the production of CAD/CAM restorations. Recently new formulations for chairside CAD/CAM materials have been developed to combine the advantageous properties of ceramics and composite resins.

Conclusion
In this review, computer aided dentistry and the materials used for chairside CEREC System for designing CAD/CAM restorations from past to present are summarized.

Keywords: *CAD/CAM, CAD/CAM Materials, CEREC, chairside, glass-ceramic, metal-free, optical impression, resin nanoceramic*

ÖZET

Giriş
Son on yılda hasta başında, Bilgisayar Destekli Tasarım ve Bilgisayar Destekli Üretim'in (CAD/CAM) diş hekimliğinde popülerlik kazanması ile CAD/CAM uygulamaları için yeni CAD/CAM blokları geliştirilmiştir. CAD/CAM restorasyonların yapımında ağırlıklı olarak cam seramik, seramik ve kompozit rezinler kullanılmıştır.

En son olarak seramik ve kompozit rezinlerin avantajlı özellikleri birleştirilerek hasta başında kullanılmak üzere yeni formülasyonlara sahip CAD/CAM malzemeleri geliştirilmiştir.

Sonuç
Bu derlemede geçmişten günümüze bilgisayar destekli diş hekimliği ve hastabaşında CEREC Sistem kullanılarak dizayn edilen CAD/CAM restorasyonlar için kullanılan materyaller özetlenmektedir.

Anahtar Kelimeler: *CAD/CAM, CAD/CAM materyalleri, cam seramik, CEREC, hasta başında, metal desteksiz, optik ölçü, rezin nanoseramik*

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INTRODUCTION

The new developments in digital computer technology led to research into related applications in the world of dentistry. The goal was to allow clinicians to design, produce and apply individual restorations directly at the point of treatment (chairside) in a single appointment.[1] Based on this goal, various systems were introduced.

The Cerec System was introduced by Drs Mörmann and Brandestini to make one visit restorations in dental clinics in 1988.[2] In this system, an optical impression of a cavity preparation is taken with a small optoelectronic videocamera and subsequently saved. The digital 3-dimensional (3D) data is transmitted to a computer and the clinician interactively designs the restoration on the screen which is called computer-aided design (CAD). These datas are used for the milling of an industrially prefabricated block with a special diamond-coated disk incorporated into a 3-axis milling unit which is called computer-aided machining (CAM).[3]

CEREC 1 had enabled the scanned images of 2 dimensional view and with this system only inlay resrorations could be milled. The developments of software and hardware programs of computer systems have led to 3 dimensional (3D) design.[4] CEREC 3D System has increased the various types of restoration production. Inlays, onlays, crowns, laminates and three unit bridges also implant abutments can be milled from CAD/CAM blocks.[5]

CAD/CAM Systems based on the production method can be divided into three different groups:[6]

1. Chairside System: The clinican scans the prepared tooth intraorally, creates restorations

chairside and then seats it within a single appointment (Figure 1).

2. Laboratory System: Laboratories scan models made from physical impressions and use CAD/CAM to produce restorations (Figure 2).

3. Centralized Production: The clinician takes the digital impressions and then sent datas via the internet to the laboratory.[4]

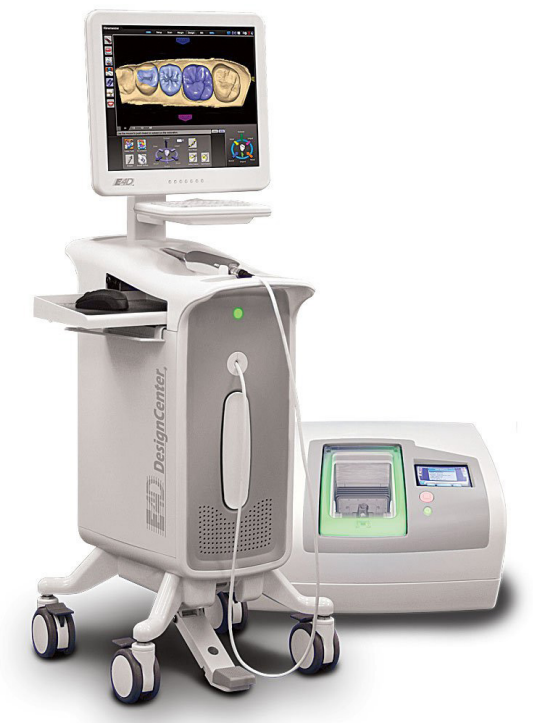

Figure 1. Chairside System: Planmeca E4D Technologies

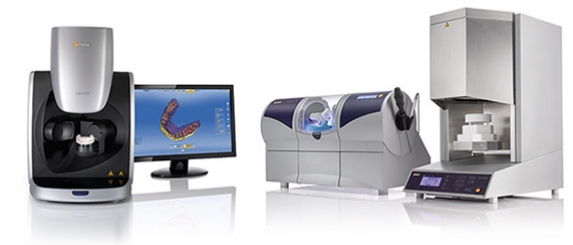

Figure 2. Laboratory System: Sirona Cerec inLab

Chairside CEREC CAD/CAM Materials

CEREC or Cerec means; Chairside Economical Restoration of Esthetic Ceramics or CEramic REConstruction.[7] According to this description, this system is mainly based on chairside treatment which is very comfortable to the clinican and the patient completing the process in a single appointment.

Vita™ Mark I

In 1985 CAD/CAM ceramic blocks were firstly introduced to dental markets as Cad/Cam restorative materials (Vita™ Mark I, Vita Zahnfabrik, Bad Sackingen, Germany). These blocks were comprised of fine grain feldspathic ceramic with a flexural strength ~120 MPa that were used for inlay, onlay and veneer restorations.[8]

Vita™ Mark II

In 1991, Vita™ Mark II (Vita Zahnfabrik, Bad Sackingen, Germany) improved ceramic blocks were developed (Figure 3).[8] They exhibited better mechanical properties than Vita ™ Mark I with a reported flexural strength from 100 MPa to 160 MPa when glazed.[9] Vita™ Mark II was considered suitable for the fabrication of inlays, onlays, monolithic anterior crowns and veneers.[10]

Vitablocs Mark II was approved of the oldest-marketed chairside CAD/CAM material by the clinical studies.[11] A review of 29 clinical studies have stated that the fracture of the ceramic restoration was found to be the primary mode of failure while the tooth fracture, wear of the cement, and postoperative sensitivity were indicated as less common failures after CAD/CAM restorations.[12] In 2012 Beier et all. have evaluated the clinical performance of 547 glass ceramic inlay/onlay restorations on the posterior teeth of 120 patients and reported 12-year survival rate as 89.6% for the inlay restorations.[13]

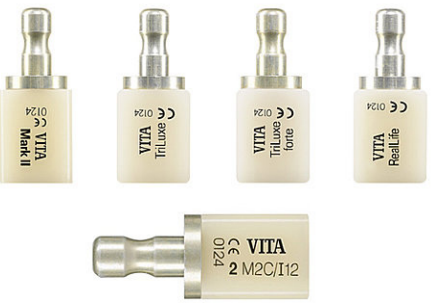

Figure 3. Cad/Cam Blocks VitaBlocs

ProCAD

In 1998, ProCAD (Ivoclar-Vivadent, Schaan, Liectenstein), the first leucite-reinforced glass-ceramic CAD/CAM blocks were introduced to be used with Cerec System. Nine popular shades with either a high translucency (HT) or low translucency (LT) version were avalible for ProcCAD blocks. When the structure of this material examined, it was found to be smilar to the heat pressed ceramic Empress™ (Ivoclar Vivadent).[14]

EmpressCAD

In 2006, EmpressCAD material which was superior to Empress Procad was introduced

to the dentists. EmpressCAD has 45% leucite with particle size about 1-5µm that helps resistance to the machining damages. EmpressCAD was recomended for single tooth restoration due to the flexural strength of ~ 160 MPa. It had three forms: polychromatic, high and low translucency.[15]

VITABLOCS

VITABLOCS are fine-structure feldspatic ceramic blocks used for producing inlays, onlays, veneers and crowns with CEREC. VITABLOCS had improved Mark II ceramic blocks and then produced VITABLOCS TriLuxe in 2003. In 2007 VITABLOCS TriLuxe forte had been available on the market. And finally VITABLOCS RealLife was introduced in 2010 (Figure 3).[16]

CEREC Blocks

CEREC blocks are fine-structured feldspathic ceramics manufactured by Sirona (Figure 4). CEREC Blocs are indicated for the CEREC/ inLab CAD/CAM production of inlays, onlays, overlays, partial crowns, full crowns and endocrowns.

There are two types of CEREC Blocks. One is CEREC Bloc C in monocolor that is highly translucent and especially used in the production of inlays and partial crowns. The other one is CEREC Bloc C PC (polychromatic) which is particularly suitable for producing crowns for the posterior teeth.[17]

In 2013 Vichi et. all tested eight types of cerec cad cam materials which were on the market and they compared the mean flexural strength of these materials: Paradigm C, IPS Empress CAD LT, IPS Empress CAD Multi, Cerec Blocs, Cerec Blocs PC, Triluxe, Triluxe Forte, Mark II. As a result of the study, they stated that IPS Empress CAD had higher mean flexural strength than Cerec Blocs and Cerec Blocs PC. All the materials tested in this study had a flexural strength more than 100 MPa. which is an ISO standard for the clinical indications of these materials.[18]

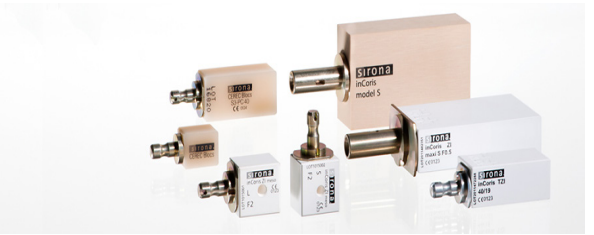

Figure 4. Cad/Cam Blocks Sirona Cerec Blocks

IPS e.max

IPS e.max CAD (Ivoclar Vivadent) is a lithium disilicate glass-ceramic for CAD/ CAM applications (Figure 5). Lithium disilicate has flexural strength between 350-450 MPa which is higher than lecuite-reinforced dental ceramics.[19]

In 2015 Albero et. all investigated the mechanical properties of Polymer-Infiltrated-Ceramic-Network (Vita Enamic) and compared its performance with other materials used for Cerec chairside system. Polymer-infiltrated ceramic (Vita Enamic), Nano-ceramic resin (Lava Ultimate), Feldspathic ceramic (Mark II), Lithium disilicate ceramic (IPS-e max CAD) and Leucite based ceramic (Empress - CAD) test blocks were investigated according to the flexural strength, fracture stress and hardness of each material. IPS-e max CAD's strain at failure, flexural strength and hardness exhibited significantly higher values compared to others materials. [20]

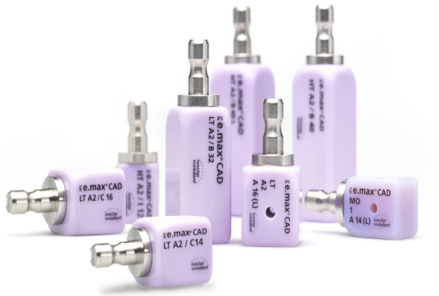

Figure 5. Cad/Cam Blocks IPS e.max CAD

Paradigm MZ100

In 2000, 3M ESPE introduced a resin based composite (85% zirconia-silica ceramic by weight) called Paradigm MZ100 which was an aesthetic material with improved physical properties and clinical performance. The indications of this material were veneers, crowns, inlays and onlays.[21,22]

Paradigm C

In 2006 a new material, Paradigm C, introduced by 3M ESPE that was a glass ceramic block made out of a two phase leucite-reinforced ceramic. The indications of this material were the same like Paradigm MZ100. Pradigm C has six different shades.[21]

Vita™ Enamic

ENAMIC (VITA Zahnfabrik, Bad Sackingen, Germany) is a newly developed hybrid material that combines ceramic with composite materials properties. The hybrid material is defined as, the dominant fine-structure ceramic network strenthened by a polymer network, according to the manufacturer.[23] PICN (Polymer-Infiltrated-Ceramic-Network) consist of, 75% of its volume feldspathic ceramic (86% ceramic by weight) and 25% polymer.[24] The pores in the structure-sintered ceramic matrix are filled with a polymer material. This hybrid combination increases the fracture strength, flexural strength and elastic properties of the material compared to traditional ceramics.[8,21,24]

He and Swain stated that the hardness and elastic modulus of enamic were very similar to human tooth structure values (natural dentin and enamel) which makes this material a good choice for inlay restorations in the posterior region.[25,26,27]

Lava Ultimate

Lava Ultimate is called as a resin nanoceramic (Figure 6). The composition of this material is composite resin (BisGMA, UDMA, BisEMA, TEGDMA) with 80 wt % silica and zirconia nanoparticles and zirconia/ silica nanoclusters.[28] The indications of Lava Ultimate are; veneers, crowns, inlays and onlays. This novel material can be repaired both intraorally and extraorally.[21]

In 2015, El-Damanhoury HM et. all, tested three endocrowns produced from different types of materials; feldspatic porcelain (CEREC Blocks, Sirona Dental Systems GmbH, Bensheim, Germany), lithium disilicate (e-max, Ivoclor Vivadent, Schaan, Liechtenstein) and resin nanoceramic (Lava Ultimate, 3M ESPE, St Paul, MN, USA); according to the marginal leakage and fracture resistance. As a result, although resin nanoceramic endocrowns showed better fracture resistance than the other investigated ceramic blocks, more microleakage had been observed with this material.[29]

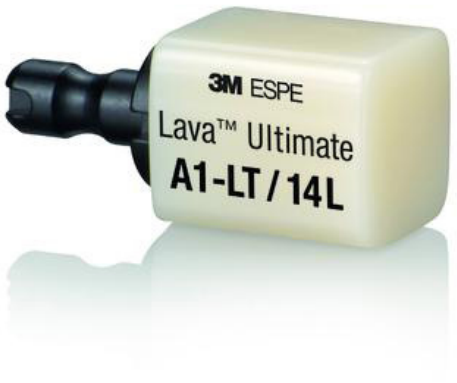

Figure 6. Cad/Cam Blocks 3M Lava Ultimate

Cerasmart

Cerasmart is a force absorbing, flexible nano ceramic CAD/CAM Block (Figure 7). It has natural opalescence and florescence. Koizumi et. all evaluated surface roughness and gloss of current CAD/CAM resin composites before and after toothbrush and stated that the Ra and Rz **of** Cerasmart **and** Shofu Block were significantly higher than the ceramic block.[30]

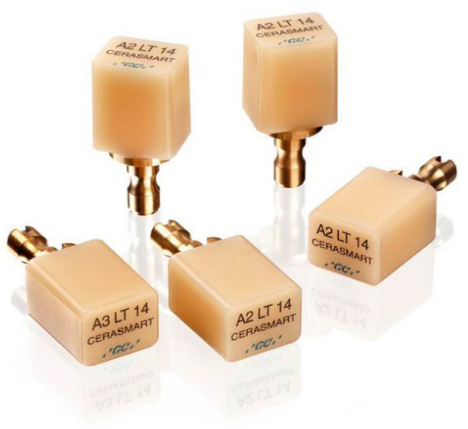

Figure 7. Cad/Cam Blocks GC Cerasmart

Suprinity

Suprinity (VITA Zahnfabrik, Bad Sackingen Germany) is a CAD/CAM glass-ceramic material which is reinforced with zirconia. Suprinity has a fine-grained and homogeneous structure with 10% weight of zirconia. It has a flexural strength 420MPa Vita Suprinity has superior aesthetic properties with excellent translucency.[21]

CONCLUSIONS

Improvements in CAD/CAM technology have facilitate the developments of all restorations with superior mechanical properties and aesthehtics. This technology is effective, time saving and can be applied successfully in clinical practice. The digital impression, the design software and the milling procedure in the same clinic allow to produce restorations in a single visit. Although the material selection is still related to the type of the restoration, the way of designing the restorations made with chairside CAD/CAM device is preferred by most of the clinicians in recent years.

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