**CERAMIC MATERIALS USED IN CAD/CAM SYSTEMS**

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| **Abstract**  Today, with the increase in esthetic expectations of patients and the development of digital technologies, it has become possible to produce new generation materials that are superior to the previous ones and function better. CAD/CAM technology has advanced to a point where it provides dentist with a wide range of restorative options both chair-side and at a traditional dental laboratory. These systems which enable prosthesis making to be possible in a single chair-side time are getting increasingly common since they eliminate laboratory process and traditional measurement methods, save time, diminish the risk of cross contamination to minimum and help us make more aesthetical, biocompatible restorations. With the increasing prevalence of restorations produced using CAD/CAM systems, new materials have started to be introduced rapidly. Ceramics are the most commonly used materials in CAD/CAM systems because of the fact that they are the best materials that can imitate the natural tooth. The purpose of this article is to introduce the current materials used in CAD-CAM systems. |
| Keywords: CAD/CAM, dental materials, dental ceramics, prosthetic dentistry |

1. **Introduction**

The most important aim of prosthetic dental treatment is to replace lost teeth and tissues and to restore esthetics, function and phonation. For this purpose, precious and non-precious metal alloys, acrylic and composite based resins and ceramics with different physical and structural properties were used. Ceramics, which have many advantages such as color, optical properties, light transmittance (translucency) and tissue compatibility compared to other materials, are still the most preferred materials[[1-3](#_ENREF_1)]. In recent years, the use of CAD-CAM systems in dentistry, especially in prosthetic dental treatment, has become quite widespread[[4](#_ENREF_4)]. The evolution of computerized systems for the production of dental restorations associated to the development of novel microstructures for ceramic materials has caused an important change in the clinical workflow for dentists and technicians, as well as in the treatment options offered to patients [5].

1. **CAD/CAM İN DENTİSTRY**

CAD-CAM refers to a computer system that is used to both design and manufacture a dental restoration. CAD technology uses a software to define the shape and dimensions of the restoration, while CAM technology takes the designed model to a computer numeric control (CNC) machine to manufacture the restoration, usually from a block made of a dental material [5]. This technology, which has been used in the industry for many years, started with the first applications of CAD / CAM technology in dentistry in the 1970s with Bruce Altschuler in the USA, Francois Duret in France, Werner Mormann and Marco Brandestini in Switzerland [6, 7]. In 1984, Duret introduced the “Duret system”[8]. The first commercially produced CAD/CAM system was CEREC (Sirona, Bensheim, Germany) developed by Mormann and Brandestini in 1980 [9, 10].

Today, CAD/CAM systems have a wide range of indications such as inlays, onlays, laminate veneers, partial crowns, all-ceramic crown and bridge systems, skeletal structures of removable partial dentures, and production of stents used in implant surgery [11].

Dental CAD/CAM systems consist of three functional elements [12, 13].

1- Optical or mechanical scanner that digitizes the three-dimensional geometry of the preparation

2- The software program in which the data of the product to be obtained is created and the design of the dental restoration is made.

3- Milling unit that transforms the designed data into the desired restoration [2].

**2.1. CERAMIC BLOCK MATERIALS USED IN CAD CAM SYSTEMS**

In the traditional method, fragile dental ceramics were used by being supported by a strong metal infrastructure. However, today, with the developments in CAD/CAM technology, the production of monolithic restorations has become possible in dentistry [14, 15].

Monolithic CAD/CAM materials used for this purpose can be listed as follows: [2].

1-Feldspathic ceramics

2-Leucite reinforced ceramics

3-Glass ceramics reinforced with lithium disilicate

4-Ceramics reinforced with zirconia

5-Yttrium-tetragonal zirconia polycrystalline ceramics

6-Oxide ceramics

7-Nanoceramics

8-Hybrid ceramics

***1-Feldspathic ceramics***

Feldspar-based glasses are highly biocompatible. Feldspathic ceramic blocks can be used in inlay, onlay, laminate veneer, anterior partial or full crown construction [16, 17].

*Blocks used*

VITABLOCKS Mark II (*VITA, BadSäckingen, Germany*) blocks can be used both in the clinic and in the laboratory [18].

VITABLOCS RealLife (*VITA, BadSäckingen, Germany*) blocks are produced especially for anterior restorations where aesthetic expectations increase [18].

CerecBlocs C In (Sirona, NY, USA) blocks are silicate ceramic blocks that can be processed in the CEREC unit [19].

***2- Leucite reinforced ceramics***

The properties of these materials such as color, translucency, fluorescence, opalescence, abrasion and abrasion resistance are similar to natural teeth. It can be used in anterior crown prostheses, inlays, onlays and laminate veneers [20].

*Blocks used*

IPS Empress CAD (*Ivoclar Vivadent, Schaan, Lihtenstayn*) and Paradigm™ C (*3M/ESPE, Saint Paul*, *MN, USA*) blocks from 3M ESPE are examples of leucite-reinforced glass ceramic blocks [21].

***3-Glass ceramics reinforced with Lithium Disilicate***

These ceramics have improved resilience, good optical properties, and many levels of translucency and tints. These ceramic blocks can be used in restorations such as veneers, inlays, onlays, endocurons, anterior and posterior crowns [22].

*Blocks used*

IPS e.max CAD block. These blocks with high translucency can be used in the construction of inlays, onlays and full crown restorations due to their chameleon effect and aesthetic properties[23, 24].

***4-Zirconia Reinforced Lithium Disilicate Ceramics***

Lithium disilicate reinforced glass ceramics was one of the first blocks used in CAD/CAM systems. These blocks are now mechanically developed to produce zirconia reinforced lithium disilicate ceramic blocks. These monolithic CAD/CAM materials are indicated for the manufacture of inlays, onlays, laminate veneers, anteroposterior and implant supported crown prostheses [25, 26].

*Blocks used*

Vita Suprinity (*VITA Zahnfabrik, Bad Säckingen, Germany*) and Celtra DeguDent (*DeguDent, Hanau, Germany*) are examples of zirconia reinforced ceramic blocks.

***5-Yttrium-tetragonal zirconia polycrystalline ceramics (Y-Tzp)***

It is zirconium stabilized with 3 mol% yttrium oxide and alumina crystal. Its partially stabilized structure facilitates its processing. Monolithic zirconia restorations can also be used in the manufacture of posterior crown prostheses in individuals with parafunctional habits such as insufficient occlusal distance and bruxism. However, due to the fact that zirconia is a white opaque material and insufficient aesthetic properties, its use is limited to posterior region crown prostheses[26].

*Blocks used*

Lava all-Zirconia (*3M ESPE, Seefeld, Germany*), Zircon Zahn (*Zırconzahn GMBH, Bruneck, Italy*) and BruxZir Solid Zirconia (*Gildewell laboratories, California, USA*) are blocks introduced for use in the manufacture of monolithic zirconia restorations [27].

***6- Oxide ceramics***

This ceramic system is called the In-Ceram ceramic system. It is called InCeram because molten glass particles are infiltrated into the sintered oxide substrate.

*Blocks used*

Representatives of the In-Ceram system are In-Ceram Alumina, In-Ceram Spinell and In-Ceram Zirconia (*Vita, D-Bad Sackingen*).

***7- Nanoceramics***

Nanoceramics and resin composites have the same microstructure but different proportions. Nanoceramic blocks are blocks with high durability. These blocks are indicated for veneers, inlay/onlay, anterior and posterior single crowns, anterior and posterior bridges [28].

*Blocks used*

LAVA Ultimate (*3M ESPE, Neuss, Minn, USA*); It is a new material produced with nanoceramic technology and is called resin nanoceramic (*RNC*).

Cerasmart (*GC Dental Poducts, USA*); flexible nanoceramic is available in the literature[29].

***8- Hybrid ceramics***

Hybrid blocks have lower durability than glass ceramic and nanoceramic blocks [30].

*Blocks used*

Vita Enamic (*Vita Zahnfabrik, Bad Sackingen, Germany*). Fracture strength is higher than full ceramics and the preparation procedure is easier with CAD/CAM systems [31].

Vita enamic is indicated in implant prostheses as well as veneers, inlay/onlay, anterior/posterior single crowns.

**3-SUMMARY**

New technological products and materials are entering dentistry clinics every day. The popularity of CAD/CAM technology in dentistry is increasing day by day. Today, dental materials used for CAD/CAM systems are rapidly increasing and developing. For this reason, it is an issue that should be constantly followed by dentists.

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