



CAD/CAM Technology in Orthodontics- A Magical Box: A Detailed Review

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ABSTRACT

Based on pertinent studies from the previous 30 years, this article will demonstrate Dental CAD/CAM in a number of areas, including its development, history, applications in dentistry, and more. The CAD/CAM systems that are now in use around the globe will be covered, although the primary focus of this study will be the orthodontic application. This study will finish up by discussing the potential uses for this gear in the future. Even though the current selection of dental CAD/CAM applications is limited, this technology will undoubtedly improve the health and appearance of patients. Its use is not just restricted to crowns and Fixed Partial Dentures but also in other dental specialties like orthodontics.

Keywords: CAD/CAM, Dentistry, Orthodontics, Prosthesis.

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INTRODUCTION

Dentists have a very long history of providing patients with various treatment modalities in the field of dentistry, including orthodontic, prosthetic, and restorative devices like crowns, FPDs, inlays, onlays, and so forth. At first, all of these devices were created traditionally, or by having them tailored, but as time went on and during the 20th century, notable improvements were observed in dental technologies and dental materials used to create these dental devices [1]. Due to the increased demand for materials that are both safe and visually pleasing, new ceramic materials with high strength properties have recently been proposed as materials for dental equipment [2]. These materials, which seem more appealing than conventional ones, required new, sophisticated processes. Therefore, CAD/CAM was established to meet this difficulty. The term "CAD-CAM technology" refers to a group of linked processes used to create three-dimensional physical models [3-4]. The method enables the layer-by-layer construction of a medical model that replicates nearly every form of the external and internal anatomical structure in accordance with the 3D input. To construct the end object, subtractive manufacturing and additive manufacturing are both used. Finally, we will discuss prospective CAD/CAM uses in the field of dentistry in the future.

A BRIEF BACKGROUND OF CAD/CAM IN DENTAL WORLD:

CAD/CAM was found by an engineer named Pierre Bezier (Arts et Metiers Paris Tech, Renault) between the year 1966 and 1968 and it was first used in dentistry by Duret *et al.* [5] in the 1970s when they developed an intraoral grid surface mapping method in 1977 utilising optical instrumentation

An overlook of dental CAD/CAM

There are series of CAD/CAM procedures to fabricate a proper model including Digitising (Optical impression), Restoration or Prosthesis Designing, Milling, Sintering and Polishing. Digitizing is to build a 3D unique image, an optical scanner will digitally capture the teeth and the surrounding anatomy (Fig 1). Then, the dental practitioner will design the final device or restoration using CAD software and those 3D photos. After that, a milling machine uses the design to cut a single ceramic block into the shape of the appliance. Before being polished, the restoration or item is stained or coated to make it appear more natural. Veneers, crowns, and bridges are examples of restorations that are permanently affixed to the mouth with the help of cements to complete the smile [6].

APPLICATIONS OF CAD/CAM IN ORTHODONTICS

This technology can be used in orthodontic diagnosis in a variety of ways. The diagnosis procedure has been transformed by the creation of 3Dimensional digital study models using Ortho CAD software. It is

possible to assess the precise location of an impacted canine and to see how it relates to nearby structures. Customized brackets, arch wires, and removable, useful appliances can all be made using CAD-CAM processes (Fig 2). The use of 3D models of the jaw in orthognathic surgery aids the surgeon in the planning and execution of surgical procedures as well. as the creation of splints for use during surgery. By using prediction tools to create 3D models, patients may see the anticipated surgery outcomes [6]. The installation of TADs and corticotomy-assisted orthodontic treatment can both be done utilising surgical guidance created using CAD-CAM technology [7]. It also helps in indirect bonding which is a type of bonding in fixed mechanotherapy [8]. This technology benefits the retention phase of orthodontics in addition to aiding in diagnosis and treatment planning. After braces are taken off, it is now able to design and create CAD-CAM retainers using a scan of the dentition.

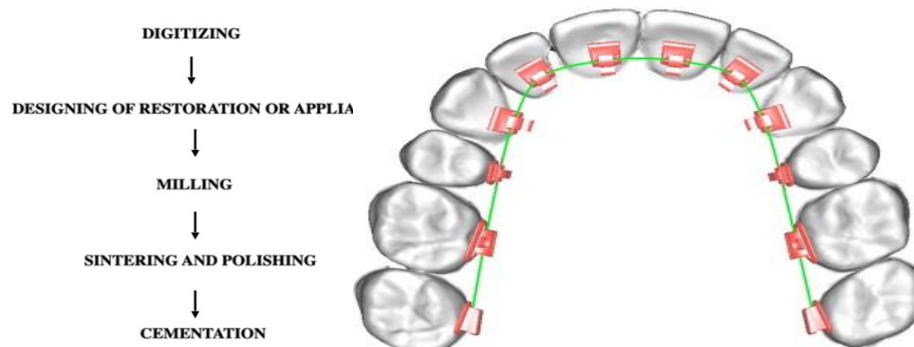


Figure 1. Flowchart of CAD/CAM process Fig2. Straight wire lingual technique using CAD/CAM

ADVANTAGES OF CAD/CAM

Use of advancing materials

The use of traditional technologies is initially examined when new materials are proposed as potential possibilities for dental device materials. When processing new materials there are always some challenges, but, we occasionally succeed in consistently introducing new materials. Overall, the dimensions changes brought on by processing chalky material were effectively and helpfully compensated for by CAD/CAM technology [9].

Reduced labor

Traditional dental laboratory technologies require a lot of labour. However, employing CAD/CAM technology ought to reduce the overall amount of labour needed, even within the processing system. Further reducing labour time is made possible by systems that use network connections to outsource some specialised tasks to a processing facility [10]

Quality control

In addition to using milling to shape restorations, CAD/CAM technology helps quality check of dental appliances by creating optimum forms according to material properties. This stops processing impacts from degrading residual strain and eventually provides reproducible processing [11]. Throughout the device's useful life, processing data can be kept and tracked. Despite the fact that proof is required to determine the likelihood of restorations occurring during the functioning period, the aspects discussed here have not been accessible with standard production procedures now in use. Future use of this technology will increase due to ageing population and the requirement for quality assurance of dental restorative and prosthetic products [12].

Future perspective for CAD/CAM in orthodontics:

Undoubtedly, dental treatment methods and materials have improved over the last few years, particularly in the fields of Orthodontics and Restorative dentistry. According to several dental experts, these services have achieved their pinnacle and will not require further technological advancement in the future. However, this is a matter of conflict. In an ageing culture, maintaining a good quality life of patient through dental care is crucial to promoting overall health. To maintain oral health and improve QOL (Quality of Life), dentists must provide all patients with dental care that is more comfortable and of higher quality. Therefore, it will be crucial for dental services in the future to effectively apply innovative materials and cutting-edge technologies on Analog to digital conversion (Fig 3). According to this study, CAD/CAM technology will significantly aid in patients' healthy ageing [13]



Fig3. Analog to digital conversion

CONCLUSION:

From a perspective based on the thoughts of some great leaders in this sector, this study analysed many scopes in the coming future, namely in the speciality of the Orthodontics, crowns fabrication and FPD restorations. Even though their contribution is now modest, dental CAD/CAM systems hold promise for use in other areas of dentistry too. Dentists have been employing various dental modalities to restore and preserve patients' oral health and function. Undoubtedly, CAD/CAM technology in dentistry offers cutting-edge, modern dental services and improves the health status and Quality Of Life of society in ageing populations. As a result, dental professionals must move quickly to adopt new advancements for the advantage of the patients.

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