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Perspective

Digital Technology in Implant Dentistry

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Introduction

The last few decades have brought a technological revolution in all areas of knowledge, computer systems are making everything more precise and fast, it would not be different in the clinical practice of dentistry. The technology is gaining more and more space; many modern features have been introducedin the market and have shown incredible results. The purpose of this article is to make a historical contextualization of the contemporary implant dentistry in order to identify which are the most used equipment and digital tools.

Digital Planning and Guided Surgery

The implanted prosthesis planning should start much timebefore the implant placement surgery or even the choice of the implant itself. This is the concept of reverse planning [1]. The emergence of computerized tomography has revolutionized the image exams by the obtaining of much clearer images of the anatomical structures and three-dimensional reconstructions. Associating the concept of stereolithography and CAD/CAM technologyit becomes possible to generate prototyped surgical guides with high precision [2-14]. This technologyis based on real images of the bone anatomy obtained through CT scans and the design of a computerized prototyped surgical guide to implant placement based on mathematical 3-D models.

The CT scan images are manipulated on a specific software, enabling a virtual surgery simulating the implant placement, always looking for the best position, bone anchorage and of course, respecting the future prosthesis that these implants will receive [2-14]. Guided surgeries are suitable for the most varying types of rehabilitation with implants, including edentulous patients, partial or single unit restorations. This technology has been widely used with scientifically proven success [6,9-14], to succeed with this therapy, achieving optimal aesthetic and functional results, we need a proper study on the selection of cases and a detailed planning. Although it seems to be extremely easy and simple, itrequires a lot of expertise and experience of the involved staff, in addition to a detailed planning, avoiding any complications during the procedure. The guided surgery may be considered as a viable alternative for the rehabilitation of edentulous spaces within the correct indications. The highlight of this technique is the detailed planning necessarily performed prior to the surgery, a fact that should be routine and should be performed in all clinical situations, computer-guided or not.

The CAD/CAM Technology in Implant Dentistry

The CAD/CAM technology represents a major revolution within the current context of modern dentistry. It is now possible to generate a virtual model from the direct digital scanning from the mouth, models or even impressions, enabling the design and manufacture of the structure by computer assistance (Figure 1). With this technology, it is possible the manufacture structures for implant bridges, custom abutments, bars, copings, surgical guides and everything thatcan be developed in the software. Many software already comes with data libraries with the settings of many different implants from all over the world, favoring the adaptation of the manufactured components.

This technology has already been described in the 80's [15], but due to technological advances added to the process in recent years, it has gained more and more popularity around the world. The first direct system or also known as "in office" was the CEREC system, by Sirona Dental Systems [15]. The PROCERA concept by Nobel Biocare was the first system to offer indirect CAD/CAM technology. The first scanner owned a sapphire crystal tip with high hardness for contact scanning. Many years has passed and the technology has changed. Recently Nobel Biocare launched a new scanner, the "Nobel Procera optical scanner" with conoscopic holography technology, which is a collinear scanning technology that measures steep angles and deep cavities, making possible a more precise scanning. Nowadays, many other manufacturers are on the market with different optical technologies for digital scanning.

After the obtaining of the virtual model, the structure or restoration can be virtually designed on the software. The data is sent to a milling unit, which performs the process of machining the designed digital project with high precision and a significant reduction of the clinical and laboratorial time. This technique, where the obtaining of the projected is done by milling is classified as a subtraction process. It is possible to obtain prosthetic restorations, abutments or structures in several materials such as wax, acrylic resin, composites, titanium and cobalt chromium alloys, zirconia, alumina, feldspar ceramics, ceramics reinforced with leucite and lithium disilicate. The materials may be present in blocks or pellets, in different sizes and colors [16].

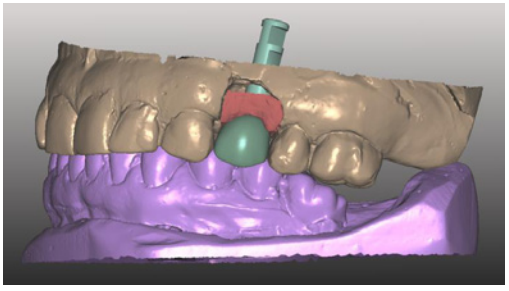

Figure 1: Design of a CAD/CAM restoration.

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There is another situation where the process is by addition. A concept that nowadays is the subject of discussion all around the world, the obtaining of objects by 3D printing. The Direct Metal Laser Sintering (DMLS) technology uses a high temperature laser beam to heat a metal substrate powder selectively, according to the data obtained from the CAD software [17]. Selective laser sintering is a technology that can be used to produce both ceramic and metal restorations. However, instead of cutting, the material is sintered, by continuously adding of the material until the designed piece is completely obtained without any waste of material [17].

Nowadays, it is possible to find many different manufacturers of CAD/CAM systems available on the market. Three different production concepts are available depending on the location of the components of the CAD/CAM system: chairside or in office production; laboratory production or centralized fabrication in a production center [17]. The clinician or technician must know and understand the differences between the systems and the possibilities of each one before making a decision.

The development of CAD/CAM technology in the manufacture of implant structures revolutionized dentistry, providing good clinical outcomes [18,19] and a very good adjustment, with higher accuracy and lower seating mismatch between the components when compared to conventional methods [20-29]. Within the technological advances in implant dentistryit is possible to plan cases virtually, reducing errors and optimizing clinical outcomes. It is even possible to produce computerized surgical guides for faster and less invasive surgeries, accurate prosthetic restorations with high strength and in a great variety of materials. Despite all the advantages and convenience of CAD/CAM systems, the success is not dependent only on of the technology itself, as it involves several steps. All the involved clinical steps should be carried out respecting the right techniques, always seeking the success and the balance between the biological and mechanical factors.

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