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The power of digital dentistry.

Diana Cerghizan[1], Janosi Kinga Maria[1]

[1] George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Târgu-Mureș, Romania.

Digital technology is present in all fields of our life, including in healthcare. This is because computers work with higher speed and accuracy and lower costs than humans. Nowadays, most of the aspects of clinical practice are computer-assisted. Digital dentistry is used in many dental areas, such as medical record management, photography, digital radiology, intraoral imaging, computer-aided treatment planning, diagnosis, shade matching, and occlusal analysis. Digital technologies help the practician to deliver a treatment plan based on an accurate diagnosis and help the patient to understand the proposed treatment and give informed consent [1-3].

A significant step in dental digitalization occurred in 1980 when the first Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) system was used in dentistry [4, 5]. The primary purpose of this technology was to deliver well-fitting restorations, reduce the cost and processing time, and improve patient satisfaction and aesthetics [1].

This technology provides many advantages, such as the accuracy of a computer-based treatment design/planning, the speed of the digital intraoral impression, the high quality of the digital manufacturing restorations, and any-time reproducibility [1,6]. Another major advantage offered by this technology is the tridimensional simulation which allows the display on the screen of each step of the treatment plan allowing the practician to evaluate from each point of view, enhancing the diagnosis and accuracy capabilities of the treatment. Also, this technology allows rapid and easy communication between the practician, dental technician, and patient, shortening the time in restoration manufacturing [1].

CAD/CAM systems consist of these components: a scanner with software that aids in processing the scanned data and a fabrication system that is comprised of a digital design software and a digital milling machine. The digital workflow, which records both dental arches, allows dental clinicians to evaluate the tooth preparation in real-time. The digital file can be quickly sent via the cloud server to the dental technician, and if any adjustments are necessary, those can be performed before proceeding to the next step [1].

The most considerable innovations in digital dentistry are digital impressions, optically detected by intraoral scanners (IOS), the introduction of the Cone-Beam Computerized Tomography (CBCT), and their combination, thanks to which a faster, more predictable, and safer diagnosis and planning are possible [7]. Intraoral optic impressions of the IOS allow tridimensional captures of the patient's dentitions. Digital impressions provide information about dentition spatial arrangements, occlusal relationships, teeth texture, and shade details [8-10].

The digital models allow progressive treatment planning for surgical and restorative interventions. Intraoral scanners represent the perfect complement for the CAD/CAM technology; the main benefit is the possibility of checking immediately with the patient in the dental chair for impression accuracy. Another significant advantage is the possibility of analyzing interocclusal relationships in such a way as to determine if the occlusal clearance is appropriate for the specific materials used for manufacturing the restorations through CAD/CAM technologies [1, 11].

Numerous studies have been carried out with the aim of comparing the data obtained by scanning and the reference material. The results show minor differences between intraoral, extraoral scans, and conventional impression data within acceptable limits for clinical use. Many factors, such as sharps margins, powder coating, presence/absence of the buccal fluids, and long cross-arch spans, can influence the accuracy of the digital impressions [12-14].

The primary concern in clinical practice is if the restorations fabricated with the help of the data obtained through digital impressions are equal to those obtained through conventional impressions. Regarding the marginal fit, most of the studies showed no statistical difference between these two approaches to data acquisition [13, 15, 16]. It was proven that the internal fit of the restorations obtained through digital impressions is slightly worse than those obtained from conventional impressions but without clinical significance [17]. A ceramic 3-unit framework digitally performed will fit better than a metallic 3-unit framework fabricated by conventional technology [18].

Digital dentistry gained more significance in implantology, starting with the diagnosis and finishing with well-adapted implant-supported prosthetic reconstructions. A digital impression of the scan bodies allows the implant to reposition in this precise position with the help of CAD software that matches the specific shape of the scan body with its dedicated library, creating the possibility of performing abutments, frameworks, and crowns. This system is more accurate because there are no distortions that can occur in the case of conventional impressions. The combination between the digital impression and data obtained from CBCT allows for a more precise diagnostic and virtual planning of the implant positioning, including the designing/manufacturing surgical guides. In the end, the virtual implant planning can be performed according to a precise prosthetic design, and the surgical template can be realized through the help of 3D printing [1, 19].

Orthodontics has benefited from the introduction of facial and intraoral scanning, 3d printers, and digital radiographs, including CBCT, allowing to facilitate and improve diagnosis as well as the execution of the treatment. Digital models provide advantages over cast stone models, such as easier and quicker data transfer, immediate analysis, and limited storage space. Digital impressions/models can be analyzed with the help of specific software that can provide information about teeth, arch shape, degree of crowding or spacing, etc. All of this can allow simulation and per-visualization of the orthodontic treatment results. The 3D printing technology is also an essential component in orthodontics. Besides assisting in obtaining the model, 3D printing technology is often used in manufacturing aligners. With the help of this technology guides can be performed for the indirect bandaging of brackets, retainers, and appliances for sleep apneas [1].

Intraoral scanning and digital workflow also have applications in dental aesthetics. Digital impressions, photos of the patient's face and smile, and digital smile design software allow the shaping of the aesthetic area of dental arches providing a virtual simulation of the results. This approach is extremely valuable in complex, multidisciplinary oral rehabilitations. In this case, the patient must be involved in choices that affect aesthetics and setting realistic expectations the patient has for treatment outcomes [1, 20, 21].

Dental occlusion is a critical factor in restoration design, longevity, and patient satisfaction [21]. Dynamic and static occlusion captured through CBCT or facial and intraoral scanners allow the creation of a virtual articulator. It can be beneficial in cases involving smile aesthetics, changes in the vertical dimension, computer-assisted implant planning, or digital maxillofacial surgery planning [22, 23].

The development of digital dentistry is now focused on creating 3D virtual patients [24]. Over the course of time different approaches were proposed in order to obtain o reliable method to superimpose the 3D data obtained by intraoral and facial scanning and CBCT [25]. While intraoral scanners are widely studied in literature, and their accuracy and limitations are recognized, the management of facial scans still needs to be investigated [24].

In conclusion, digital dentistry has evolved, facilitating treatment planning and the treatment itself in almost all dental medicine areas. The most important but underestimated tool of digital dentistry and digital workflow is the involvement of the patient, who can view the 3D image of the teeth and the proposed treatments, even contributing to planning.

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Corresponding author:
Janosi Kinga Maria
George Emil Palade University of Medicine, Pharmacy, Science and Technology of Târgu Mureș, 38 Gheorghe Marinescu street, Târgu Mureș, 540139, Romania.
Email: kinga.janosi@umfst.ro

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