AMERICAN COLLEGE OF PROSTHODONTISTS
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Position Statement

Use of Advanced Digital Technologies in Dentistry

Framing the Scope

The use of advanced digital technologies (ADT) in the fabrication of dental restorations has progressed well past its first introduction as a dental milling system in the early 1980's.[1] Developments of scanning technologies provide the opportunity to scan casts, impressions, and intra-orally.[2-4]

Digital design software technologies accept scanned data, as well as medical and dental digital imaging systems such as Computed Tomography (CT), Cone Beam CT (CBCT), and Magnetic Resonance Imaging (MRI) to develop implant planning, Orthognathic surgical planning, orthodontic planning and design of guides, maxillofacial prosthetic devices, and single and multiple tooth restorations, and dentures.

Digital Manufacturing using milling and additive manufacturing technologies have provided the ability to produce dental prostheses with predictable accuracy and fit.[5] This is truly a technology that will define the practice of dentistry. This position paper will concentrate on the interaction and guidance of the dental profession on the development of ADT to provide patient centered care.[6]

Care delivery efficiency with quality

The ease of using this modality will decrease the time requirement by traditional analog methods. Although the outcomes of using this technology for patient centered improvement is not currently available, the outcomes obtained to enhance patient experience should be comparable to more efficient use of time required by standard methodical treatment.

Digital dental solutions for the restoration of the dentition has both a laboratory and a chairside interface component. The laboratory systems generally do not require modifications of preparation in design and basically fabricate dental restorations from the traditional impression or cast. The next progression in the evolution of digital dental solutions is intra-oral scanning which will bypass the traditional impression and directly provide the dental laboratory with digital casts.[7]

Chairside systems generally require some modification of preparation design to accommodate the milling limitations and are generally restricted to inlay, onlay, single and three unit restorations; designed to provide same day delivery. Digital solutions are also available for the surgical planning and guidance of implant placement; and in some systems there is the availability to pair it with a restorative digital system to plan and fabricate surgical guides and both provisional and final restorations at implant placement.[8] In the past, digital solutions for dentistry were defined by the product produced, the business model for profit and with little interaction between systems and manufacturers.

Although there are examples of integration of Cone beam CT systems, software for implant placement, and restorative design software, these "partnerships" represented a closed proprietary relationship in how files are moved that preclude any other design or manufacturing options.[9] The trend moving forward is for more of an open system in the digital workflow. This involves a common digital file format (e.g. STL) that allows communication and integration of various input devices (3D scanners, intra-oral scanners) with different CAD software and access too many manufacturing processes.

Challenge based on 'Market' or 'Patient' as the focus

The dental profession must consider the overall patient treatment cycle from observation, detection, diagnosis, planning, treatment, maintenance and monitoring. To accomplish this, ADT can address most of these steps as individual systems, but due to the proprietary nature of many of these systems, there is little flexibility to interact with ADT software and hardware to address all aspects of patient care to include the electronic record. Apart from sophistication of interoperability of software, there are issues with file transferability, from the scan, the design and in the manufacturing modality, and a tendency of dental professionals to want to cling to historic recording devices and techniques. This is reflected in how manufactures develop software to address occlusal development, such as the articulator options in many systems that mimic commercially available articulators.

The nature of ADT lends itself to more technical and sophisticated systems such as mandibular tracking and inclusion of masticatory data projects being collected in many databases around the world that are not readily available/transferable in design and diagnostic software for development of virtual surgical and both intraoral and extraoral prosthetic fabrication.

A call for Provider-Industry Partnership with the Patient as the focus

It is in the best interest of dentistry that we insure that the progression of ADT addresses a workflow to accommodate all aspects of care of our patients. As the leader in the care of complex dental, craniofacial, and maxillofacial reconstruction, the College not only promotes the adoption of these technologies, but actively seeks to define optimized workflow, develop ideal requirements, and identify strengths and weaknesses of systems as they emerge such as a taxonomy/nomenclature that will assign tier level efficiency of specific systems.[10]

In addition, we strive to lead the dental profession in the research and development of appropriate materials and methodologies that are more suitable for ADT technologies in manufacturing, as well as develop databases to support sophisticated software in occlusion, surgical intervention, and full mouth restorations.

It is the intention of the College to create this database of patient and practitioner experience so that the ownership is clear on the direction led by this effort. The use of these technologies in dentistry is inevitable, but it is our responsibility to ensure that they are focused with the care, restoration, and maintenance of our patients at their core.

References

1. Duret F, Preston JD. CAD/CAM imaging in dentistry. Curr Opin Dent 1991;1(2): 150–4.

2. Silvia L, Giordano F, Ari K, Michele C, Lapo G, Luciano B. A comparative analysis of intraoral 3D digital scanners for restorative dentistry. Internet Journal of Medical Technology 2008;5:1.

3. Flugge T et al, Precision of intraoral digital dental impressions with iTero and extraoral digitization with the Tero and a model scanner; Am J Orthod Dentofacial Orthop 2013;144:471-8.

4. Stein JM. Stand-alone scanning systems simplify intraoral digital impressioning. Compend Contin Educ Dent 2011;56:58-9.

5. Van Noort, R The future of dental devices is digital; Dent Materials; 2012;28: 3012

6. Berwick. What 'patient-Centered" Should Mean: Confessions of an Extremist, 2009;28(4):w555-w565

7. Patzelt SBM, Lamprinos C, Stampf S, Att W; The time efficiency of intraoral scanners: An invitro Comparative study. JADA 2014;145 (6): 542-551

8. Schnitman PA, Lee SJ, Campard GJ, Dona M: Guided flapless surgery with immediate loading for the high narrow ridge without grafting. J Oral Implantol 2012 June;38(3):279-88.

9. Reiz SD, Neugebauer J, Karapetian VE, Ritter L; Int J comput Dent. 2014;17(2)145-57

10. Ariani N, et al, Current State of Craniofacial Prosthetic Rehabilitation, Int J Prosthodont; 2013;26:57-67.

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