Current Trends and Prospective of Digital Occlusion and Implant Prosthodontics: A Review

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Abstract

Contemporary implant rehabilitations are esthetically driven. Consequently, digital planning and guided surgery deliver higher esthetic predictability and precision than do analog procedures. The aim of this article is to show the integration of digital occlusion in the different phases of full arch implant rehabilitation with immediate implant placement and immediate loading procedures. Digital occlusal analysis raises the precision of functional occlusal adjustments, while improving the long-term predictability and stability of both case function and esthetics. This chapter will present a systematic digital workflow detailing every stage of full arch rehabilitation treatment, while showcasing digital occlusal diagnosis with the T-Scan 9 system, to install a precise implant prosthesis occlusal scheme. A full arch rehabilitation case involving immediate implant placement and immediate implant loading will be presented, with it occlusally finished with the T-Scan.

Keywords: Occlusion, Implant, Digital

Introduction

The digital era has created a new dental discipline. Implant rehabilitations that follow a path of immediate placement and loading, which is today a predictable procedure with high success rates (Misch, et al., 2004; Schwarz & Arad, 2012) documented to be 98% success in the mandible, and 97% in the maxilla (Tarnow, et al., 2010).Lately, the esthetic and functional criteria that are being considered parameters of success in multiple implant rehabilitations, are also being researched. (Kinsel & Lamb, 2000; Buser & Belser, 2004; Spiekermann, et al., 2009). Experience shows that in implant rehabilitations, a perfectly adapted occlusion is more important than in the natural dentition, or in dental supported prosthetic constructions. Therefore, an initial, precise diagnosis of the masticatory system components is necessary, as implant rehabilitation in a compromised functional environment that can lead to an irreversible aggravation of the initial dysfunction. This is based on the fact that an implant supported dentition has structures which lack the physical proprieties of resiliency, elasticity, and forgiveness. There is no periodontal space around implants, where implant mobility is 4 microns, which is far less than natural teeth loading motilities of 25 - 200 microns. Additionally, E max abutments, and E max (IPS E Max, Ivoclar Vivadent AG, Schaan, Liechtenstein), or Zirconia prosthetic parts, have different moduli of elasticity and resilience compared to natural teeth, such that without resilience, occlusal wear does not exist or adapt. It has been proven that due to implant overload or incorrect loading, bone loss around implants can compromise the implant reconstruction and lead to peri-implantitis and bone loss (Naert et al., 2012). Often, poor patient occlusal adaptation results from the lack of resilience, which can be followed by the development of muscular disorders and prosthesis structural damage. For sound muscular function and long-term maintenance, a very precise occlusal force profile is necessary. This article will present a systematic Digital Workflow that utilizes occlusally-focused steps to assure a physiologic reproduction of the initial masticatory and muscular system was transferred onto implant rehabilitated tissues, despite changes in the vertical dimension. These steps are:

• Occlusal and functional diagnosis and registration at the first appointment

• Occlusal adjustment of the provisional, immediate restoration
• Reproduction of the digital contacts in the digital planning procedures of the future reconstruction
• Occlusal control of the final restoration at delivery
• Yearly occlusal and functional maintenance of the implant supported reconstruction over the long-term.

A complete full arch rehabilitation involving immediate implant placement and immediate implant loading, that was occlusally finished with the T-Scan 9 (Tekscan Inc., S. Boston, MA, USA), will illustrate each of these steps in great detail.

Complying with functional occlusion criteria is one of the most important steps in maintaining stable results at the end of a treatment. Classical occlusal analysis involves applying articulating papers of different thicknesses and colours between the dental arches in order to detect the location and intensity of the contacts[14–18]. The intensity of the antagonist contact points is evaluated by the intensity of the colour marked on the teeth. Studies have demonstrated that there is no direct link between the area marked with the articulating paper and the force applied, even if there is a tendency of surface increase upon increase of the applied force[19,20]. Intraoral scanning offers the possibility to scan the occlusion and to visualize it after superimposing the scanned virtual models of the 2 arches. Accuracy of scanners is different regarding both fidelity and precision. Beside scanner value, errors may often appear because of the scanning technique and image superposition, which are operator-dependent. Also, errors may occur due to the way the patient performs occlusion when asked (during occlusion scanning on the left side ("Bite 1") and on the right side ("Bite 2")), which may lead to incorrect superpositions. Another limitation of intraoral scanners stems from the impossibility to measure the intensity of the occlusal forces [21]. Computerized T-Scan analysis helps by providing a more thorough occlusal analysis, which offers information regarding occlusion evolution on a digital timeline, contact chronology, intensity, and balance (or lack of) between the left and the right side at every moment of registration[22–24]. Among the disadvantages, there is the operator-dependent factor (to some extent) and the fact that the sensor is not always appropriate for all arch shapes. The sensor may create discomfort when placed intraorally, thus, it may induce an alteration of the mandibular movements. Therefore, it is advisable to have repetitive recordings for safety reasons[25,26].

Recommended Implant Occlusion for Single Implant Prosthesis

- Select a mutually protected occlusal scheme with anterior guidance in exc
- Reduce cantilever prosthesis and cantilever forces on implant crowns
- Create an even force distribution
- Increase the number of implants
- Increase the number of contact points
- Less contact on implant than adjacent natural teeth
- Reduce shear, lateral forces on the tooth
- Monitor parafunctional habits or bruxism
- Maintain adequate crown height space
- Reduce the crown to implant ratio
- Minimize vertical overlap
- Obtain passive fit of prosthesis
- Narrow the size of the occlusal table
- Decrease cuspal inclines
- Center the contact points on the implant crown
- Use progressive loading in patients with poor bone quality (type M)
- Consider implant designs that increase bone to implant contact
- Monitor patient occlusion and provide serial adjustments

Conclusion

T-Scan 10 is an essential component of a modern dental practice's Digital Workflow. It is the most precise, digital occlusal measurement tool available to clinicians, for determining and predictably adjusting the occlusal condition to very high tolerances (20-25 microns). Moreover, the T-Scan is vital for the longterm maintenance of restorations on both teeth and implants, because it protects the supportive bone and soft tissue structures, preventing bone loss, soft tissue recession and inflammation, muscular TMD disorders, ceramic chipping, screw loosening, and implants component material fractures.

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