Chapter 14
Controlling the Implant Supported Occlusion Utilizing the T-Scan System

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ABSTRACT

The relative occlusal force and real-time occlusal contact timing data provided by the T-Scan technology can be used to manage the insertion occlusal force design of implant prostheses, as their long-term survivability is tied directly to their installed occlusal function. This chapter discusses how in daily dental practice, clinicians spend a great deal of time making corrective occlusal adjustments using solely articulating paper as their intended guide. However, current research shows that articulating paper markings do not measure occlusal force, and that dentists poorly Subjectively Interpret the appearance characteristics of the markings, such that implant occlusal force control is highly compromised, leading to peri-implant tissue loss, de-osseointegration, and elevated frequency rates of breakage of implant restorative components. However, by using the T-Scan technology, the clinician eliminates the subjectivity involved in using articulating paper. This ensures the occlusal design of newly-installed implant prostheses are optimal, ensuring prosthesis longevity. Case examples are presented of how occlusal adjustments that employ T-Scan force and timing data with simultaneously-recorded EMG data aid in implant restoration occlusal force control by not only lessening masticatory muscle hyperactivity, but also by improving the muscle tone and length of the face, head, and neck musculature.

INTRODUCTION

Although implant 5-year survival rates are reported to be 90% - 95% (Koldsland, Scheie, & Aass, 2009; Astrand, Ahlqvist, Gunne, Nilson, 2008; Nixon, Chen, & Ivanovski, 2009), it has been shown that prosthesis occlusal material damage, and superstructure breakage, can compromise the longevity of an implant supported prostheses. In one published study involving 76 implant restorations, reported that within 3.25 years of intraoral service, 70% (n = 56) of the delivered implant prostheses sustained documented

dental material damage or breakage (Kaptein, DePutter, Delange, & Blijdorp, 1999). As more time has passed since those earlier studies were published, the evolution of implant dentistry has morphed into implants being virtually placed and virtually restoratively planned, in what presently is referred to as "The Digital Work Flow". However, despite the use of improved tools that enhance restorative design, and precisely locate the proper surgical placement of implant fixtures, high rates of fracture and breakage complications continue to hamper prosthetic success with large implant supported restorations (Wittneben, Buser, & Salvi et al., 2014). This is because computer enhanced design with scanning the external surfaces of teeth, implants, or stone dental casts, captures no true occlusal force or timing data to guide occlusal corrections, still leaving clinicians to utilize highly inaccurate articulating paper to install the final prostheses. The immediate loaded and All-on Four restorations are notably highly susceptible to prosthetic failures (Drago, 2015; Shen et.al, 2018).

These poor material longevity results are due to both the lack of the Periodontal Ligament "cushioning effect" that is absent with dental implants, and from "articulating paper or foil-only", delivery occlusal adjustments, that are made during the insertion of these rigid prostheses, as they sit upon the osseous integrated implant. Because of the lack of shock absorbency within the bone surrounding dental implants, potentially damaging occlusal forces rise very quickly on an implant prosthesis' occlusal surface. Also, the proper locations of any occlusal force excess will not be quantifiably and reliably described to the clinician by the shape and size of articulating paper markings (Gazit, Fitzig, & Lieberman, 1986; Carossa, Lojacono, Schierano, & Pera, 2000; Millstein & Maya, 2001; Carey, Craig, Kerstein, & Radke, 2007; Saad, Weiner, & Ehrenberg, 2008; Qadeer, et. al., 2012). There is no predictable occlusal force control on implant prostheses when insertion occlusal adjustments are performed without measuring occlusal contact time and force. Therefore, the regions of excess occlusal forces are often not removed during the insertion occlusal adjustment procedures, which can lead to the rapid occlusal surface dental material breakdown clinically observed and reported (Kaptein, DePutter, Delange, & Blijdorp, 1999).

Dental implants have been shown to depress vertically within the alveolar bone approximately one fifth of amount that a natural tooth depresses. In addition, horizontally, implants demonstrate less than 50% of the lateral movement that a natural tooth can undergo (Sekine et al., 1986). Moreover, teeth adjacent to an implant when loaded, provide proprioception from the Periodontal Ligament that impacts muscle activity level control over normal chewing function. Implants have none of this proprioceptive feedback, such that the initial contact of the teeth adjacent to an implant, engages the protective proprioception of the adjacent teeth, which is critical for preventing early contact and occlusal force overload from being placed upon the implant.

This implant-tooth movement discrepancy can be compensated for by employing the T-Scan system's (Tekscan Inc. S. Boston, MA, USA) 'Time-delay' principle (Kerstein, 2002), which creates a purposeful late loading of an implant prosthesis that occurs after teeth have begun to sink into their Periodontal Ligaments. In this way, the amount of damaging occlusal forces placed upon the implant prosthesis is lessened. Employing a Time-delay in the occlusion can protect the implant components, the prosthesis superstructure, and the peri-implant soft tissue and supportive bone (Kerstein, 2002).

A full mouth implant prosthesis does not have the same movement discrepancy present when implants and teeth reside in the same arch. Therefore, the occlusal design of a full mouth implant prosthesis differs from the that of combined implant and natural teeth prosthesis. Hobo suggested that when making a fully implant supported prosthesis, one should employ a mutually protected occlusion to obtain posterior disclusion in eccentric movements (Hobo, Ichida, & Garcia, 1989). However, the conventional way to

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