Chapter 1
The Evolution of the T-Scan I System From 1984 to the Present Day T-Scan 10 System

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ABSTRACT

Since its inception in 1984, Computerized Occlusal Analysis technology has revolutionized both dental Occlusal Science and daily clinical practice, by bringing objective precision measurement to the largely subjectively analyzed Dental Medicine discipline of Occlusion. The development of this technology has required much iteration over the past 30 years beginning with T-Scan I, then T-Scan II for Windows®, then T-Scan III with Turbo recording, to a simplified desktop version introduced in T-Scan 8, to the present-day, state-of-the-art occlusal analysis version known as T-Scan 10. Numerous authors since the mid-1980s have studied the various T-Scan versions, which inspired the manufacturer to improve the hardware and its recording sensors to be more accurate, repeatable, and precise. The present day Novus recording handle represents a major ergonomic and functional upgrade over the Evolution handle that was used up to T-Scan 8, while the T-Scan 9 software has evolved into T-Scan software Version 10, which includes many new high-tech measurement tools like the Digital Impression Overlay (DIO), the Sensitivity Wizard, the Implant Warning feature, and the Force Eraser tool. All of these new system modifications improve the clinician's ability to diagnose and treat a wide range of occlusal abnormalities. Chapter One's Specific Aims are to detail the evolution of the differing T-Scan system versions, while describing the many scientific studies that inspired important system improvements to the T-Scan's accuracy and repeatability, from version to version.

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INTRODUCTION

Since its' inception in 1984, Computerized Occlusal Analysis technology has revolutionized both dental Occlusal Science and daily clinical practice, by bringing objective precision measurement to the largely subjectively analyzed Dental Medicine discipline of *Occlusion*. Present day Computerized Occlusal Analysis technology records and quickly displays for clinical interpretation, tooth contact timing sequences and tooth contact fluctuating relative occlusal force levels, which occur during functional mandibular movements. These occlusal data measurements are recorded intraorally with an ultra-thin, Mylar-encased sensor that is connected to a computer workstation via a USB interface. This sensor is placed between a patient's teeth to record changing tooth-tooth contact interactions. This combination of dynamic tooth contact relative force and time data, affords a clinician detailed, precise, and unparalleled diagnostic and treatment occlusal measurement data, with which to address many differing clinical occlusal pathologies. The displayed relative occlusal force and timing data aids in the examination and treatment of occlusal abnormalities on natural teeth, dental prostheses, and dental implant prostheses (Kerstein, 2010).

The evolution of this technology has required much iteration over the past 30 years beginning with T-Scan I in 1984, then T-Scan II for Windows® in 1995, to T-Scan III (software versions 5, 6, and 7) in 2004, with development of Turbo recording in 2008, to T-Scan 8 with its simplified graphic display for easier T-Scan user acclimation, to the present day 2018 version known as T-Scan 10 (Tekscan Inc., South Boston, MA, USA). Numerous authors since the mid-1980s, have studied the various T-Scan versions, which inspired the manufacturer to improve the hardware components and the system's recording sensors, to be more accurate, repeatable, and precise. These needed improvements combined with the addition of many relative occlusal force and timing analysis software tools, ultimately negated existing system problems that evoked criticism of the T-Scan system from the Dental Medicine scientific community.

The T-Scan system was developed as a *relative occlusal force measuring system*. All of the T-Scan system iterations (T-Scan I, II, III, T-Scan 8, T-Scan 9, and T-Scan 10) have never recorded or measured, absolute occlusal force in engineering units (calibrated force numbers such as in Newtons per square centimeter, n/cm.^{2} or pounds per square inch, lb./in.^{2}), although some authors have tried to study the T-Scan's capabilities to measure absolute force (Throckmorton, Rasmussen & Calos, 2009; Cerna, 2015). Therefore, throughout the remainder of this book going forward, all references made to *occlusal force*, will be describing *relative occlusal force*, unless otherwise denoted as *absolute occlusal force*.

By measuring relative occlusal force, the T-Scan system(s) detect whether an occlusal force on one set of contacting opposing teeth is greater, equal to, or less than the occlusal forces occurring on other contacting teeth all throughout the dental arches (Kerstein, 2010). Determining relative force is important to the clinician, as relative force illustrates measured differences of varying applied loads upon all contacting tooth locations at any instant within a recorded functional mandibular movement. Relative occlusal force is reported as a percentage of the maximum occlusal force obtained within the recording. Detected relative occlusal force variances can be employed clinically to precisely balance an unbalanced occlusion, by using *targeted time-based and force-based* occlusal adjustments, and can diagnose areas of excessively high occlusal force concentration present in one area of the occlusion while simultaneously diagnosing where there is little, moderate, or no occlusal force in other areas of the same occlusion (Kerstein, 2010).

This chapter will detail the evolution of the differing T-Scan system versions from inception until present day (Figure 1), while describing the many scientific studies that gave rise to important sensor and system improvements that generationally from version to version, optimized the T-Scan's accuracy and repeatability.

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