Chapter 1
History of the T-Scan System Development from 1984 to the Present Day

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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 evolution of this technology has required much iteration over the past 30 years beginning with T-Scan I, then T-Scan II for Windows®, to T-Scan III with Turbo recording, to the present day version known as T-Scan 8. 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 software has also evolved such that the present day T-Scan 8 includes many high-tech measurement tools that aid the clinician in diagnosing and treating a wide range of occlusal abnormalities. This chapter'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.

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

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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 the present day 2014 version known as T-Scan 8 (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 and T-Scan 8) 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}). 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.

SECTION I: THE T-SCAN I SYSTEM

Computerized Occlusal Analysis technology was first introduced to Dental Medicine in 1984, when the T-Scan I System (T-Scan 2000, Tekscan, Inc., Boston, MA, USA) was commercially manufactured from a prototype version (T-Scan 1100,Tekscan, Inc., Boston, MA, USA) (Figures 2a and 2b). Since its inception, the T-Scan technology has been able to record and display for clinical interpretation, tooth contact timing sequences while simultaneously mapping each tooth contacts' fluctuating relative occlusal force levels which occurred during functional jaw movements . The earliest publication about the T-Scan I system appeared in the dental literature in1987 (Maness, Benjamin, Podoloff, Bobick, & Golden, 1987).