Hard Science Articles
The following articles are the articles with the hardest science in the T-Scan bibliography.


This 7 subject pilot study isolated and described a new occlusal parameter resultant from using the timing capability of the T Scan I System to measure excursive movements. *Posterior Disclusion Time* is a measure of the elapsed time required for a patient to exit MIP and reach solely anterior teeth during an excursive movement. This study showed that when Disclusion Time >1.39 sec per excursion, massetter and working temporalis activity is elevated until the anterior teeth are reached solely. By shortening the Disclusion Time to <.4 seconds per excursion using a new, time-based, measurement driven, excursive coronoplasty procedure known as ICAGD; Immediate Complete Anterior Guidance Development (not *Occlusal Equilibration*), the elevated muscle activity in those same muscles dropped to resting state levels during the excursion. Statistical analyses showed that 5-10x less excursive muscle activity was observed across the subject pool when the Disclusion Time was <.4 seconds duration. Along with the drop in muscle activity, numerous MPDS symptoms were resolved in less than 1 months’ time without the use of any deprogrammers, appliances, nightguards etc. This study showed that excursive muscle hyperactivity was resultant from Posterior long Disclusion Time, and that Short Disclusion Time was an effective treatment for MPDS symptomotology.


This study showed that once changed from long Disclusion Time to Short Disclusion Time, the occlusal change was stable for 1 yr (at least) beyond treatment day 1. Also, The MPDS symptoms that were resolved at treatment time, were still absent from the patient pool 1 year later.


This study revealed that Disclusion Time length is longer on Open Occlusion and Class II malocclusions, than in Class III and Class I Occlusions. Most importantly, the Class I mean Disclusion Time was 1.2 seconds long, which is 3x greater than physiologic short Disclusion Time (.4 sec. per excursion). This study revealed that being Class I does not insure that an occlusal scheme will function with physiologic measurable immediate posterior disclusion (<.4 sec per excursion)


This study is the only measured, controlled, occlusal adjustment study performed to date in the dental literature. No other occlusal adjustment study was ever performed with numerical timed occlusal parameter end points to define the precision of occlusal adjustment treatment completeness. 2 groups of MPDS Class I dental students were separated into Treatment (17) and Control groups (13). The treated group received ICAGD at Day 1; the control group received high speed occlusal surface polishing with rubber points with rear delivery so the students could not see the bur being used on their occlusal surfaces. Each subject in both groups were recalled at Day 7, 1 month, 6 months, and 1 yr (all from day 1), for observation of their Disclusion Time and
their MPDS symptoms changes. The treated group maintained a mean Disclusion Time of < .4 seconds per excursion; the control group maintained their untreated Disclusion times of 1.2 - 1.5 seconds per excursion. The treated group showed marked and lasting MPDS symptom resolution without the need for appliance therapy or chronic medication ingestion that began at day 1 and was consistent thru the 1 yr period of observation. The control group maintained their MPDS symptoms and still needed appliances and medications to attempt to minimize their non-resolving MPDS symptoms that persisted thru the 1 yr period of observation.


This study shows the T scan III High Definition 4th generation sensor is able to reproduce force 20-24 times. This study answered questions about the reliability of the T Scan III Sensors’ ability to consistently reproduce occlusal force, recording after recording. Researchers today must realize, and definitely include that the current research was done with the 4th generation High Definition (HD) sensor, and that the HD sensor is a completely different sensor from sensor Generation 1, 2, and 3. If the researcher desires to list other T-Scan sensor references as part of the literature review, professionally and for clarification they need to state what sensor generation was used with T Scan I hardware and sensors from generation 1, 2, and 3. Modern research has proven the reliability of the very different HD sensor and T Scan III Hardware. If authors need clarification as to what T-Scan system and sensor generation was used in a study Tekscan will help provide clarification on this upon request.


This study tested strength increases from Disclusion Time Reduction occlusal therapy performed with the ICAGD enameloplasty. This study showed that, improvements made to the occlusion of 62 MPDS subjects by shortening their posterior disclusion times resulted in statistically significant maximal clench muscle strength improvements in the 4 muscles of mastication. Pages 156-165 will explain how to statistically analyze data for this type of study. Most likely you well need an ANOVA test to be run on the tabled data, or at least a Student’s t-test.

#91 - Carey JP, Craig M, Kerstein RB, Radke J. Determining a relationship between applied occlusal load and articulating paper mark area. The Open Dentistry Journal, July 2007: (1); 1-7.

This is the most comprehensive articulating paper marking study performed to date. 600 articulating paper marks were made on epoxy interdigitated casts, at varying human occlusal forces from 0-500N, to determine if mark size and load are related. The results showed that a single mark size could represent numerous differing loads, and that equal mark sizes did not represent equal loads. This study refutes the longstanding occlusal concepts that large dark marks indicate high force and that small light marks indicate low force. The conclusions determined that using paper mark size as a force indicator is highly error prone and would lead to poor occlusal adjustment force control. Paper mark size cannot be reliably used as a way to force-map occlusal contacts, and similar sized markings do not indicate evenness or equal intensity.


This study followed 102 MPDS patients who were treated with Disclusion Time Reduction after they were out of active treatment for a minimum of 2 years up to 9 years out of treatment. The retrospective follow-up results showed that MPDS symptom resolution was lasting from the time treatment was initiated, that medication use, splint use, and adjunctive therapies (PT, Chiropractic
care etc.) were minimized, pain was minimized and its absence was lasting, headache was minimized and its absence was lasting, and that the most therapeutic effect of ICAGD was to treat muscle problems. No statistically significant findings showed ICAGD can be predictably successful at treating internal derangements.


An interesting clinical report that shows that implant prostheses wear non-uniformly resulting in changing occlusal force patterns thru (at least) the 1st 18 months of intraoral use. This paper relates to #92 Stevens, Chris: Computerized Occlusal Implant Management, *Implant Dentistry Today*, May 2007, Vol. 1, No. 2. The Stevens article would also relate to an article by Leung et al. The Leung report indicates bone loss from occlusal overload is not only possible, but may even be reversible.

Kerstein R. has also written clinical papers on applications of the T-Scan with implants. See T-Scan reference articles #48, #61, #88, #90 on bibliography.


This clinical report describes the rationale behind why the ICAGD enameloplasty is so effective for treating MPDS when compared to other occlusal adjustment procedures that are unmeasured and subjective. The article contains a detailed explanation of the etiology of MPDS resultant from prolonged Disclusion Time. Long Disclusion Time causes the involved posterior teeth to compress the periodontal ligament for an equally long compression time, which thru the CNS, causes excursive hyperactivity in the masseter and working temporalis muscles that leads to ischemia and pain as time evolves thru the life of the occlusion. This mechanism, which was first described in 1993, (Kerstein, R.B., A comparison of traditional occlusal equilibration and immediate complete anterior guidance development. *Cranio*. 1993; 11(2):126 - 140) theorizes that the periodontal ligament mechanoreceptors are excitatory to the muscles of mastication both in closure and in excursive function such that their prolonged and repeated compressions cause the MPDS to appear clinically once the ischemia has set in chronically. All other publications describe the mechanoreceptors as providing neurologic feedback to the muscles, but do not describe the PDL fibers as being the cause of MPDS. *Note: This is a case study with great introduction summarizing much of Dr. Kerstein’s research.*


This study showed that when the recording sensor was changed in a single patient, and the patient was re-recorded with the new sensor, the differing sensors yielded very similar force results trial after trial. The authors found a 95% force reproduction independent of sensors across six trials per patient. They deemed the T scan III as “very precise”. Occlusal analysis with the method tested here can be regarded as precise and reliable. The authors reported that weaknesses quoted by various authors in the past (insufficient accuracy, reproducibility) appear to have been resolved by the manufacturer with the existing version T-Scan® III. The method presented here is a possible enhancement to everyday clinical practice and, in combination with color-marking
foils, offers orthodontics as well as restorative dentistry a means of reliably identifying objectively overloading contacts in which excessive relative masticatory force arises in maximum habitual intercuspsation.

The objective of this study was to describe precisely and analyze force relations in the dental arch over the course of time and in correlation with their antagonistic dental contact points via instrumental occlusal analysis using the T-Scan III system
This detailed analysis of occlusion over time demonstrates that it is the central incisors that usually to come into initial contact, whereas over time, the force distribution shifts to the posterior teeth.
Analysis of the occlusion cycles revealed a progressive course with respect to the number of teeth coming into antagonistic contact. While the first contact occurred at an average of 1.9 antagonistic tooth contacts, this number had quadrupled after 0.04 sec (average of 8.2 teeth). At .08 sec, there was already an average of 10.7 tooth contacts. As time proceeded, the curve leveled off significantly up to a maximum average contact number of 12.5 teeth.
The first antagonistic contacts occurred most frequently in the posterior region (44%) with initial contact in the anterior region (including the canines) in 40% of all recorded occlusal events. Only 16% of all cases involved circular, uniformly distributed initial contact.
At the beginning of occlusal buildup, the central incisors dominated (mean 41%) compared to the canines (mean 20%) or molars (mean 32%). This distribution reversed over time, when the major center of force distribution was over the molars and premolars (mean 86%). Nevertheless, significant involvement of the central incisors (mean = 70%) and canines (mean = 72%) at the end of occlusal buildup was also noted.
The timing of the distributions of antagonistic contacts and relative masticatory force was the same. Both demonstrated a shift to the posterior with increasing relative overall masticatory force.
The findings contradict in part the assertions of many studies, namely that the strongest forces occur between the first molars and the lowest forces between the incisors. According to the study measurements, the lowest forces exist at the lateral incisors, followed by canines, premolars and then central incisors. It is general knowledge that the molars are the center of the greatest masticatory force.
Overall, the data included in this analysis contradicts the widespread assumption that occlusion normally develops in a simultaneous and uniform manner.

Additional written material is available in various dental texts. To see a reference to these texts visit Tekscan’s website at http://www.tekscan.com/t-scan-featured-dental-text-book-chapters

Bibliography:


Kerstein, RB. Analise oclusal computadoriza o sistema T-Scan. Chapter 11 in "Bruxismo" Maciel, Roberto N. Editora Artes Medicas Ltda 2010. San Paulo, Brazil. (Translated)