In vitro study on the performance of the new T-Scan®III HD system

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INTRODUCTION

Maness *et al. (1987)* described for the 1st time the prototype of a computerized occlusal analysis system
→ **T-Scan®I** *(T-Scan® Tekscan Inc., South Boston, USA)*

The 1st generations *(T-Scan®I & II)* created some **controversy** in literature.

Some of the described limitations:

- *the thickness & low flexibility of the sensor* *[Kasuyoshi et al. (2000); …]*
- *its low reproducibility* *[Moini et al. (1992); Harvey et al.(1992); …]*
- *its little accuracy* *[Yamamura et al. (1990); Kasuyoshi et al. (2000); …]*
- *the existence of non-sensible spots* *[Patyk et al.(1989); Hsu et al.(1992); …]*

Tekscan® ***Inovation*** **T-Scan®III HD**

(density of the electronic grid ↗, thickness ↘, flexibility ↗, etc…)

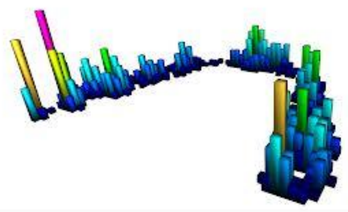
Quality of the new film↗ *[Kerstein et al. (2006); Koos et al. (2010); …]*

N° of studies proving the systems validity↗

OBJECTIVES

Analysis of the T-Scan®III HD' s **PERFORMANCE**

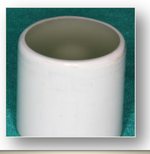
- **Sensibility**
- **Reproducibility**
- **Accuracy**



How? → *in vitro*
Conditions? → 4 simulated occlusal tables
3 load magnitudes

MATERIALS & METHODS

❑ 4 simulated occlusal tables:



180°
Plane surface:
control

100°
Simulates the sensor's bending in the anterior occlusion

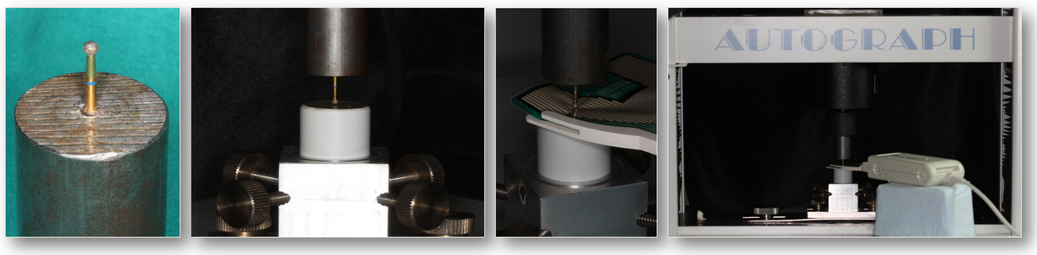
120° without PDL
Rigid model simulating an implant

120° with PDL
Resiliant model simulating a natural tooth

Self-curing acrilic resin *(Orthocryl® Dentaurum, Ispringen, Deutschland)*
Inferior 1st molar *(Ivoclar® Vivadent, Liechtenstein)*
Periodontal ligament simulator *(Affinis® Putty soft, Coltène/Whaledent, Aldstätten, Schweiz)*

❑ Procedure

Universal testing machine *(Autograph®, AG-I; Shimadzu Co., Kyoto, Japan)*
Contact point: *Spherical bur (Ø=2.2mm) included into na iron cylinder with cyanoacrilic glue*



Number of compressions: *40*

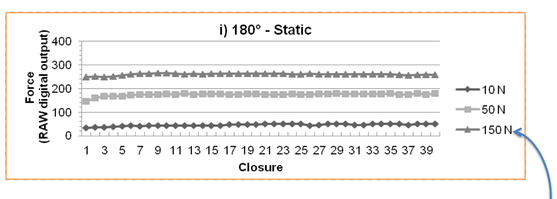
Load magnitudes: *10N, 50N e 150N*

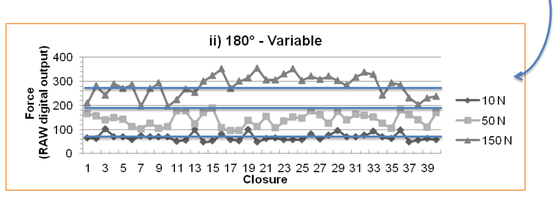
Table	180°		100°	120°	
	Static positions	Variable positions		Without PDL	With PDL
Load	10N	10N	10N	10N	10N
	50N	50N	50N	50N	50N
	150N	150N	150N	150N	150N

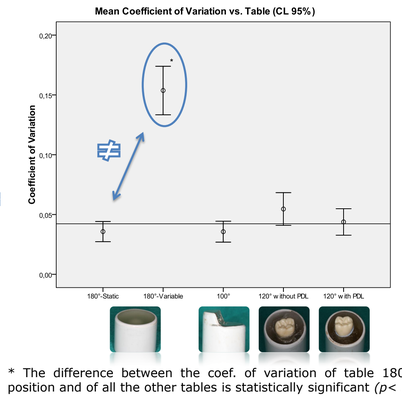
Statistical anaysis:
SPSS® v17.0 *(SPSS® Co., Chicago, Illinois)*
One-way ANOVA with post-hoc tests using *Bonferroni* corrections for multiple comparisons.

RESULTS & DISCUSSION

T-Scan®III HD: **Sensibility** ◇ *Reproducibility* ◇ *Accuracy*







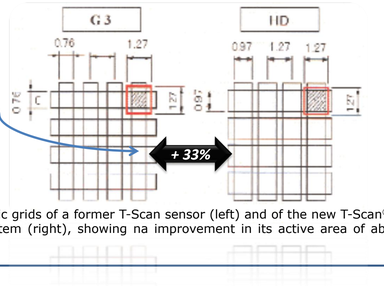
* The difference between the coef. of variation of table 180° in static position and of all the other tables is statistically significant *(p< .05)*

How can this variability be explained?

1ª - density of the electronic grid ≠ 100%
(however, a considerable effort has been done to improve this density as compared to former generations)

2ª - some tension might have occured ? ⟹ *Bias?*

3ª - no *conditioning* of the sensor was performed

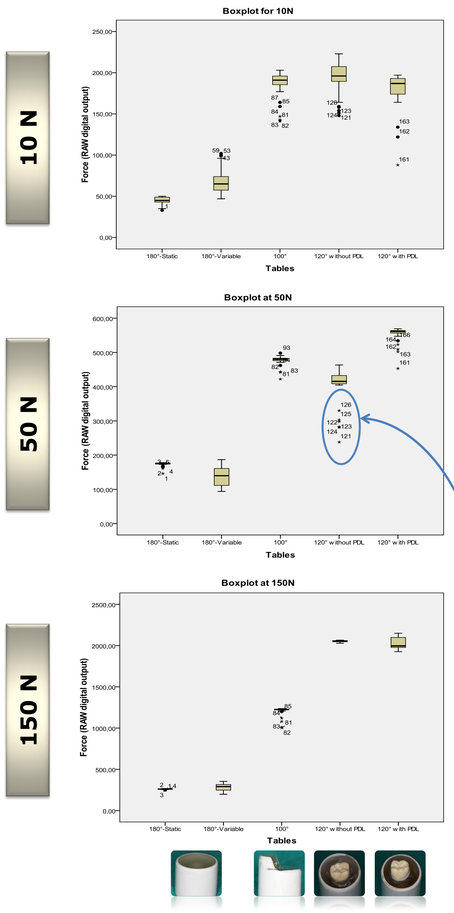


Electonic grids of a former T-Scan sensor (left) and of the new T-Scan®III HD system (right), showing na improvement in its active area of about 33%.

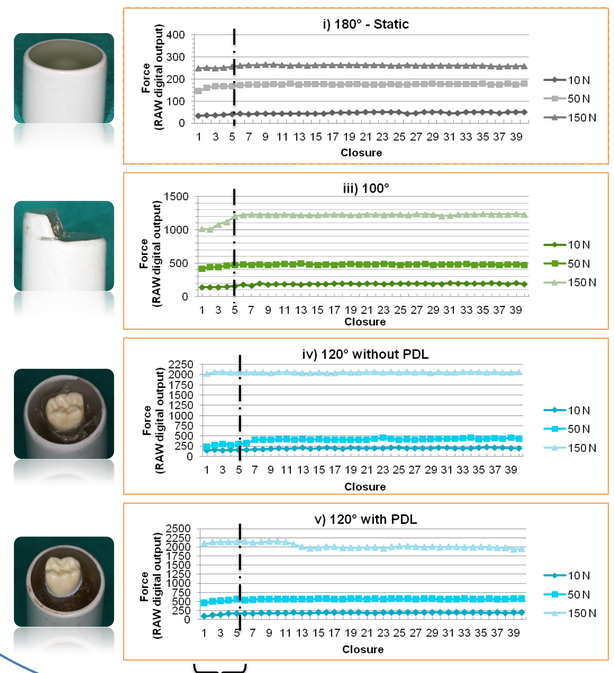
RESULTS & DISCUSSION

T-Scan®III HD: **Reproducibility** ◇ *Sensibility* ◇ *Accuracy*

Dispersion of the values: **BOXPLOTS**



Evoltion of the digital output (RAW-sum)



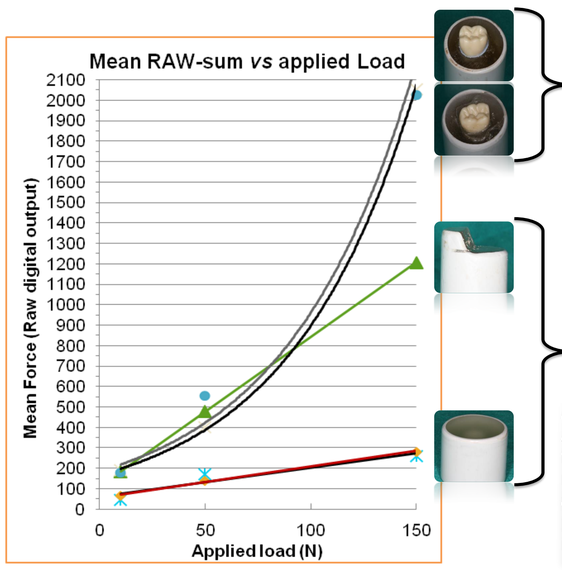
Outliers

85% of them are within the ***5 first*** values

They represent the sensor's ***conditioning phase*** BEFORE obtaining comparable na diagnostically relevant data .

The representation of the data's dispertion indicates a better reproducibility in reduced occlusal anatomy (plane surface), in a static position and after conditioning the sensor.

T-Scan®III HD: *Sensibility* ◇ *Reproducibility* ◇ **Accuracy**



EXPONENCIAL regression

The digital output (RAW-sum) does not directly reflect the applied load!!

Why?
The digital output (RAW-sum) does not only depend on the applied load, but also on the contact area and the sensor's bending.

LINEAR regression

Note:
A statistically significant difference could be shown for the biting force of 50N between the rigid model (implant) and the resiliant model (natural tooth). Due to its close to zero resilance, less contact area is created when na implant occludes. This diminishes the probability of an over-interpretation by the software and therefore impoves its accuracy as compared to natural teeth.

For loads close to zero, there seems to be an over-interpretation of the load by the sensor. However, the graphs show that the system's accuracy poved to be excelent for small contact areas, and therefore we must lower the sensor's sensibility when too large contact areas are created to avoid an over-interpretation of the load.

CONCLUSIONS

Sensibility ↗ *vs.* T-Scan®I & II

However: Still some statistically significant variability exists

More studies are required on this issue!

Reproducibility ↗ *vs.* T-Scan®I & II

However: Respect the sensor's *conditioning phase (5 first closures)*

Accuracy

The digital output *(RAW-sum)* does not only reflect the applied load, but also the created contact area and the sensor's bending.
This influences the sensor's interpretation of the load and therefore its sensibility must be adjusted in order to visualize small contact points only.

Clinical Implications

Handling/ Interpretation of the T-Scan®III HD:

→ Always perform a *conditioning* of the sensor BEFORE taking useful data;

→ Always assure the sensor's stability intraorally in order to have the same spots being compressed to maximize its reprodutibility;

→ Take caution in the interpretation of the depicted force, especially in mixed oclususions (tooth-implant).

The T-Scan system has undergone notorious improvements as compared to its former generations (T-Scan®I & II). T-Scan®III HD presents a very acceptable sensibilty and an outstanding reproducibility. It seems to be partcularly useful in occlusal adjustments when implants are involved. In order to obtain accurate data, the sensor's sensibility has to be adjusted to the occlusal load and anatomy of each case.

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