30 Years of
Leadership and Credibility

Implant Treatment Planning Software

An Essential Tool or Gadgetry?

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Amsterdam, The Netherlands

Are we in dentistry going to be working in a matrix or are we in for a second life?

Implant Treatment Planning Software
An Essential Tool or Gadgetry?

Are we aware of the impact that digital/virtual dentistry will have on our everyday practice?

Implant Treatment Planning Software

Biomodelling (D'Urso and Thompson 1998)
The process of using radiant energy to capture morphological data of a biological structure and the processing of such data by a computer to generate the code required to manufacture the structure by a rapid prototyping apparatus.

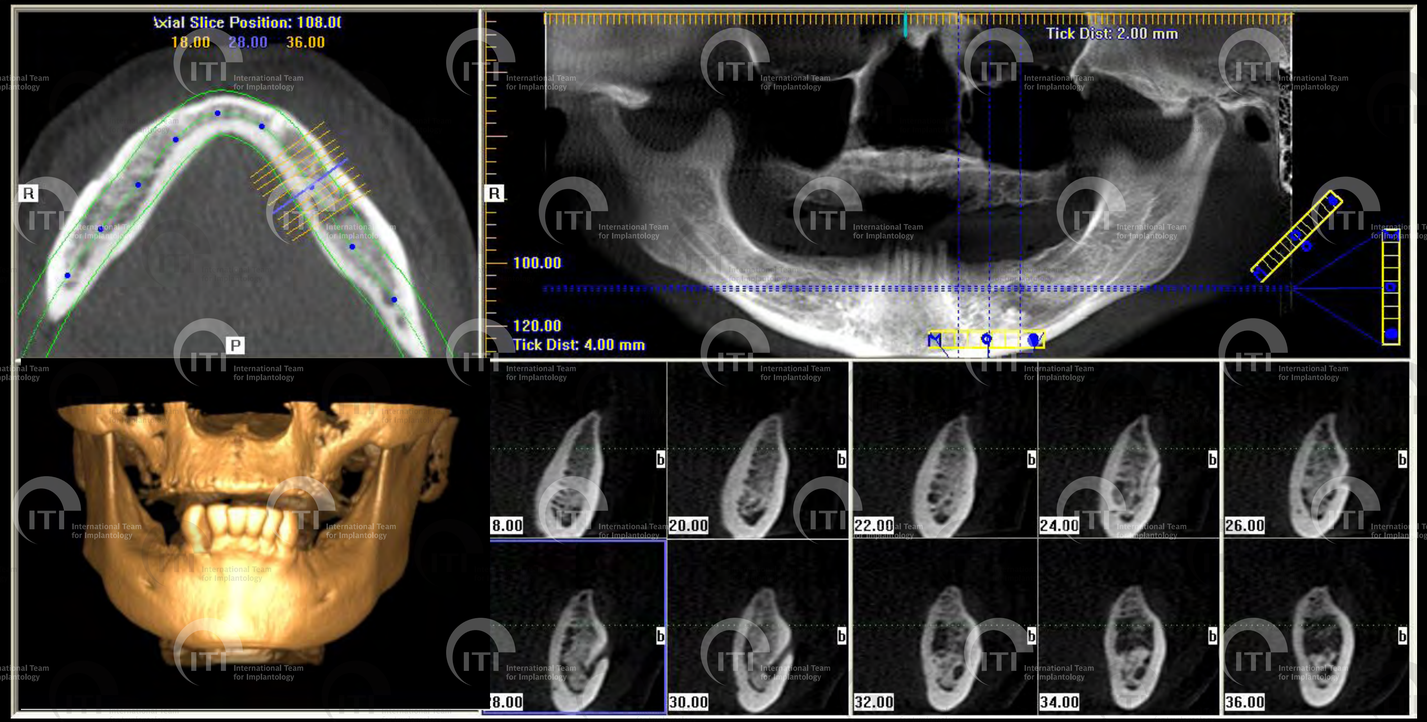
Patient specific biomodelling:
The ability to replicate the morphology of a biological structure in a solid substance

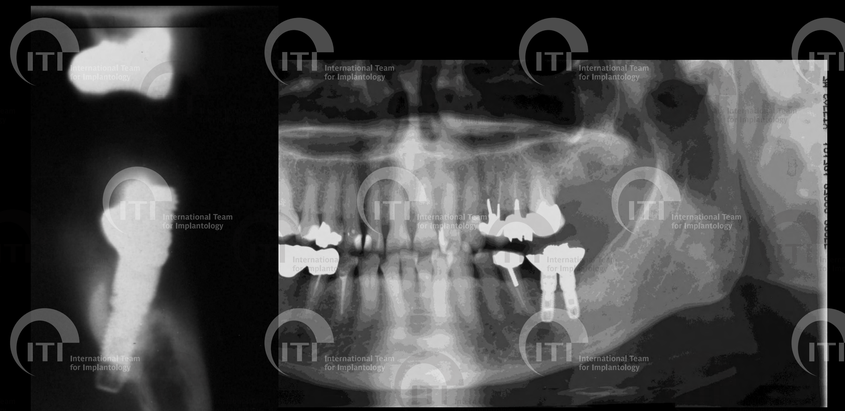
A computer synthesized Biomodel making guided stereotatic surgery possible

*(CB)CT scanning: Biomodel manufacturing
*Definable points on the patient and the model
*Drilling guide is designed to realize the planned treatment
*Intervention is carried out in the patient

Drilling templates are produced using Rapid Prototyping (SLA model) or milling

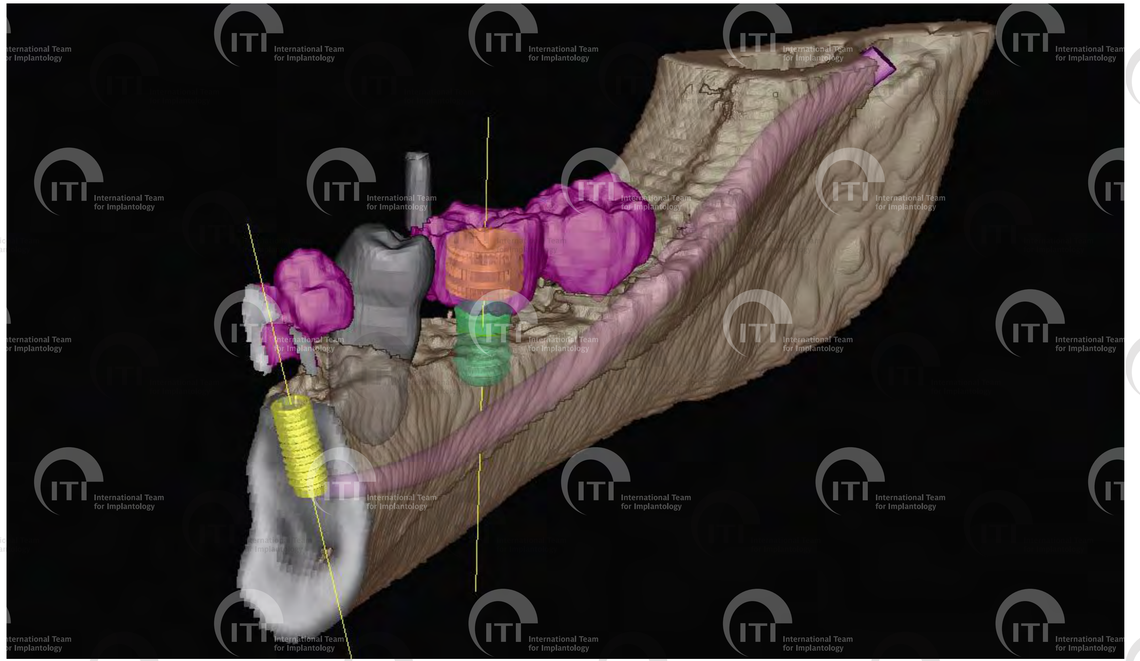
CBCT scanning



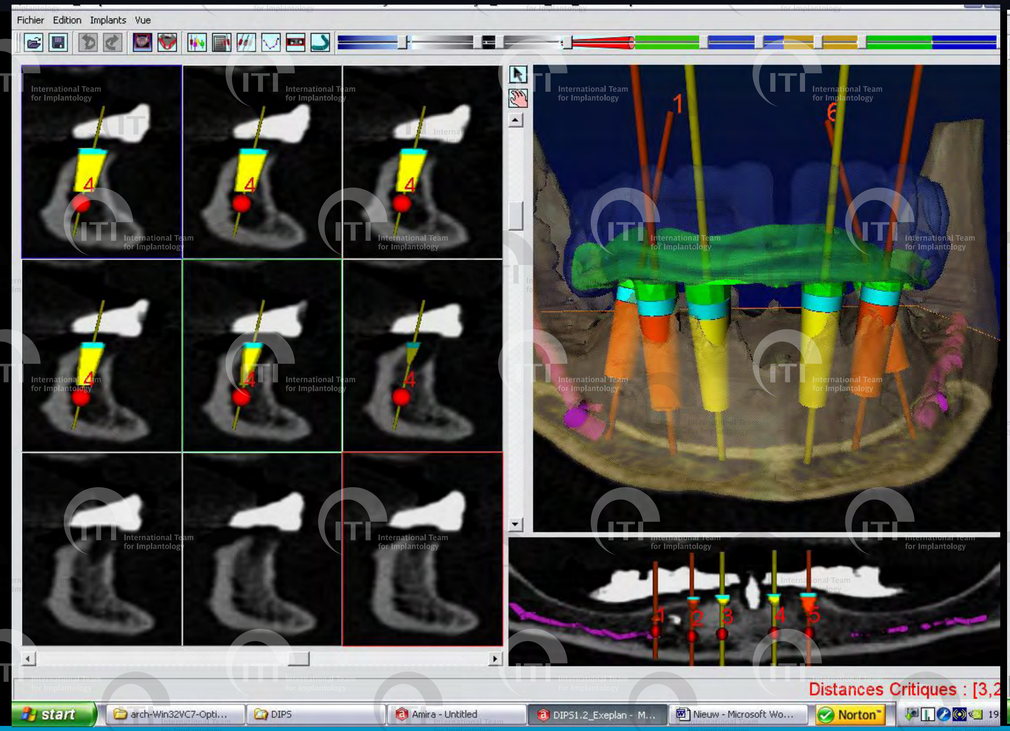


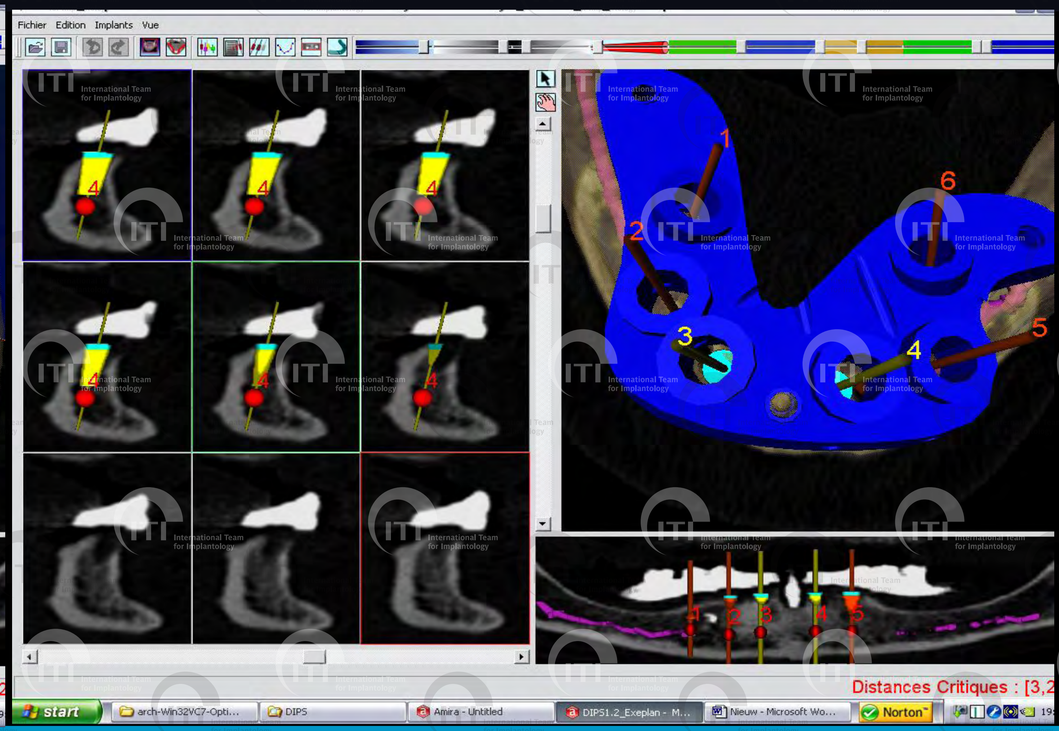
2D and 3D visualization and segmentation

Segmentation: Removing artifacts or separating objects from the created dataset in 2D and 3D.



Virtual reality





The use of treatment planning software as we know it

Rapid prototyping

A range of technologies that can fabricate 3D objects in a single stage, directly from their CAD descriptions

Rapid protoyping

Stereo lithography (SLA)

* Resin based system
* Resin cures when exposed to ultraviolet radiation (laser)
* Layer thickness defined by depth of laser penetration
* Layer thickness defines precision

Fusion deposition modeling (FDM)

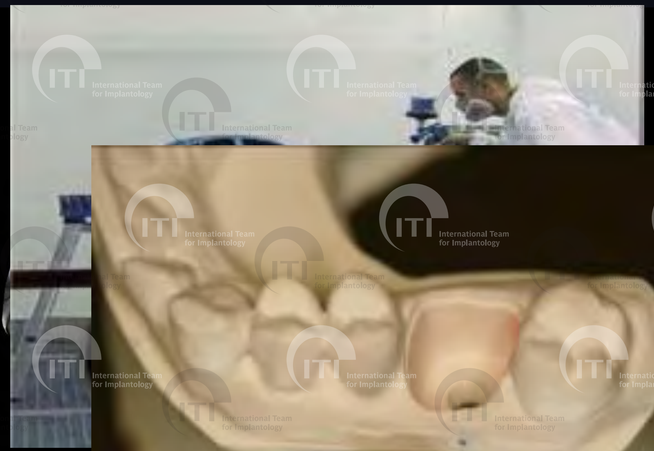
Heat melts the metal inside an extrusion chamber thus creating the model

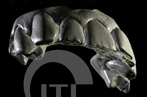
Selective Laser Sintering (SLS)

Material (powder) is melted by a laser forming a layer

Droplet/Binder system (3D printing) Compare to inject printing.
Drop-on-powder (binder glues powder)
Drop-on-drop (curing the droplets with heat or light)

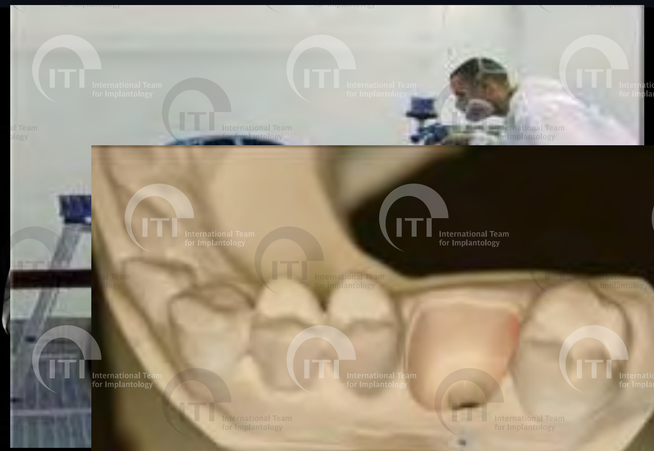
Rapid prototyping

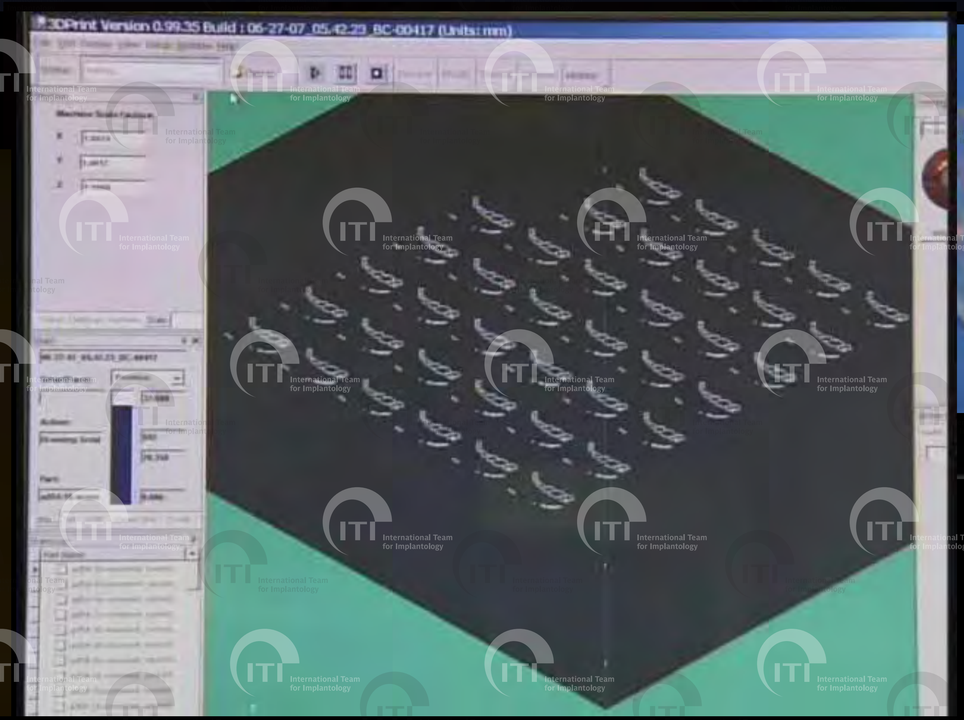


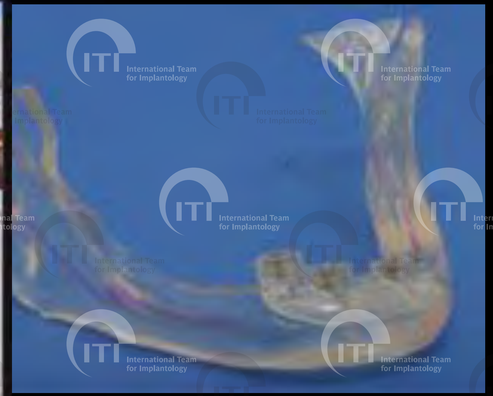


Rapid prototyping

Rapid prototyping







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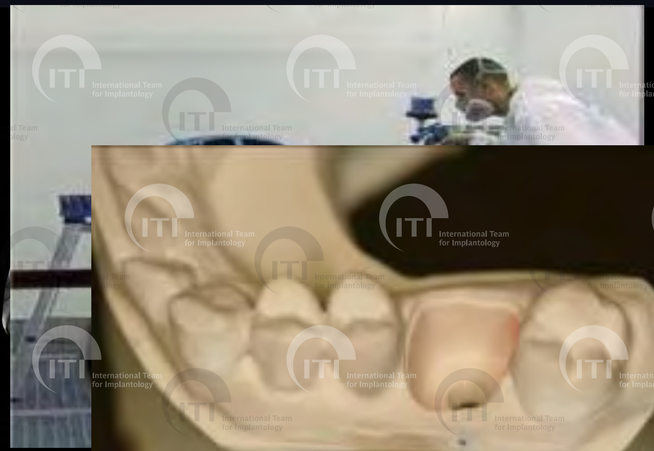

Rapid prototyping

Virtual reality

1) Computer guided (static) surgery based on the Bio Model

A static surgical guide which is a reproduction of the virtual position of the implant in the jaw according to the digital planning procedure. The guide dictates the implant position.

2) Computer Navigated (dynamic) stereotactic surgery

A surgical navigation system based on the correlation of preoperative scanning data with real time surgery. It reproduces the position of the implant on the tomograms during implant surgery allowing the surgeon to adapt the implant position during the procedure.

Virtual reality

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2) Computer Navigated (

A surgical navigation syste
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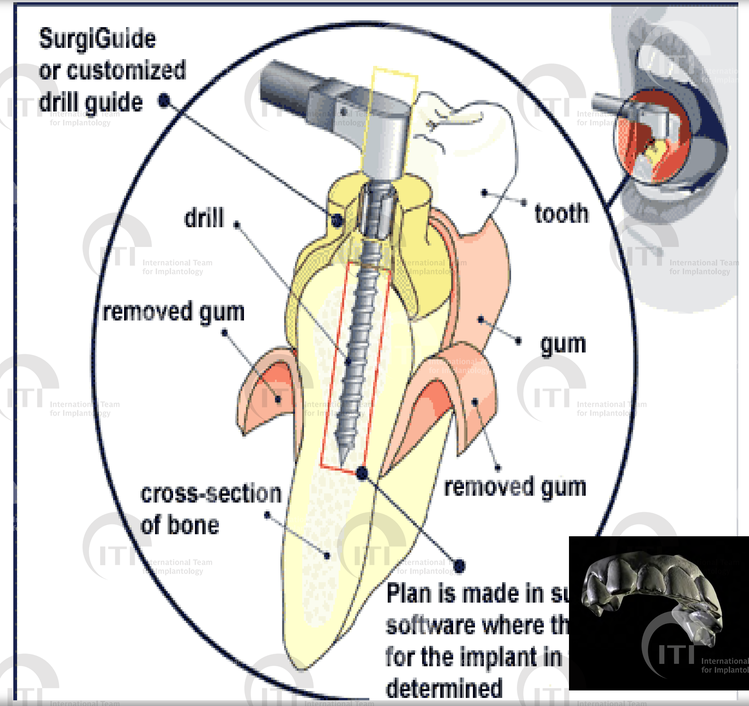
Biomodel guided stereotactic surgery

Creating a planning environment from CT scanning to 3D imaging

The drilling templates are placed on either
*The teeth (tooth supported)
*The mucosa (soft tissue supported)
*The bone (bone supported)
*On previously placed mini implants (implant supported)

Drilling templates are produced using RP (SLA model) or milling



Biomodel guided stereotactic surgery

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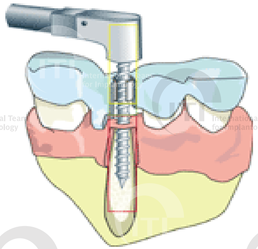
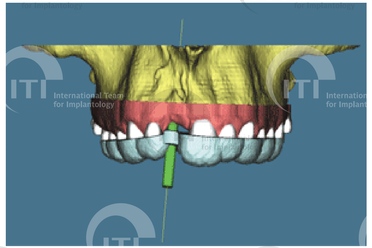
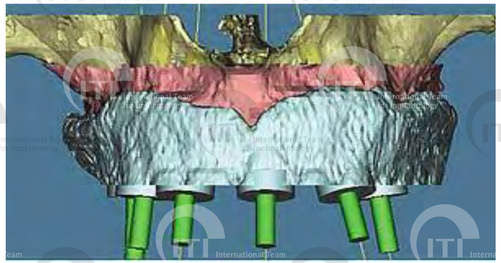
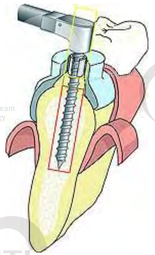


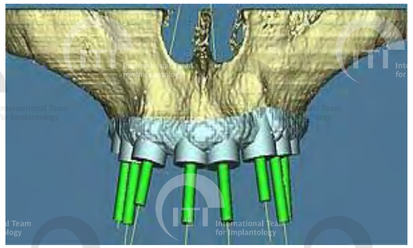


The mucosa (soft tissue supported)



The bone (bone supported)





Precision?

Computer technology applications in surgical implant dentisrty.
A systematic review.
Jung RE, Schneider D, Ganeles J, Wismeijer D, Hammerle CHF, Tahmaseb A.
Int J Oral Maxillofac Imp 2009 (ITI consensus Conference 2008)

A systematic review on the accuracy and the clinical outcome of Computerguided template based implant dentistry.
Schneider D, Marquardt P, Zwahlen R, Jung RE
Clin Oral Implants Res 2009 (EAO Consensus Conference 2009)

The aim of these systematic reviews was to systematically assess the literature regarding the accuracy and the clinical performance of computer technology applications in surgical implant dentistry.

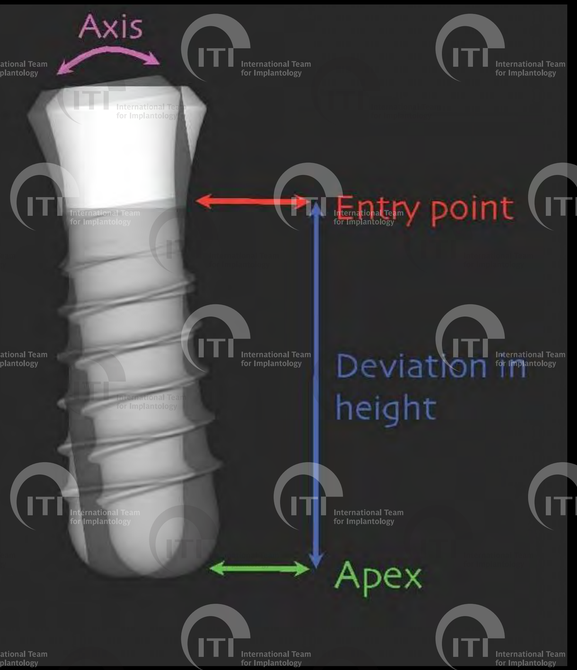
Precision?

mean: 0.74 mm
95% CI: 0.58-0.90 mm
maximum: 4.5 mm

mean: 0.85 mm
95% CI: 0.72-0.99 mm
maximum: 7.1 mm

mean: 0.32 mm
median: 0.23 mm
maximum: 1.43 mm

mean: 4.1°
median: 4°
maximum: 20.43°



Results: inaccuracies (n=1302 Impl.)

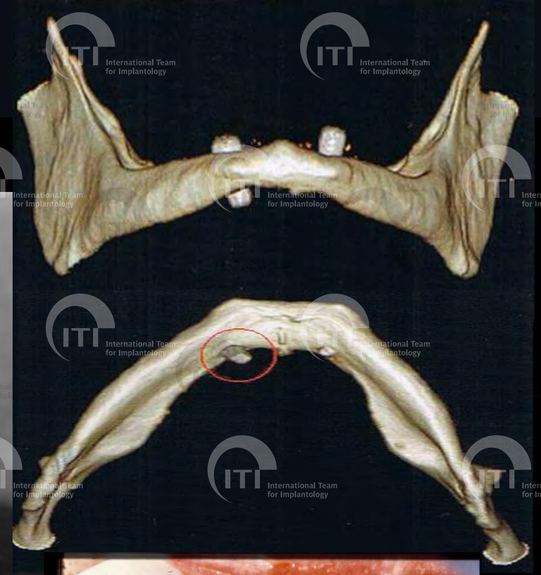
Why do things go wrong and how do we explain this?

Precision?

Frenken JWFH et al. Ned Tijdschr Tandheelkd 2010;117:17-21

Lononi s et al: Implant Dent 2007;16:131-138

Bruggenkate CM et al. IJOMI 1993;8:329-334



Precision?

Why do things go wrong??

Impression taking and cast production

+

Resolution of the CB CT

Scanning artifacts

Metal artifacts

Repositioning of the stent in the mouth

+

Super-positioning the prosthesis

Calibration of the grey values

+

Rigidity of the stent

Positioning the drill sleeves in the stent

+

Repositioning the stent in the mouth.

Precision of the drill sleeves

=

Sum of the Faults gives the total inaccuracy

Precision?

A mix of analogue and digital work flow
Calibrating the CB CT scan
Problems when repositioning the stent
Precision of the drill sleeves

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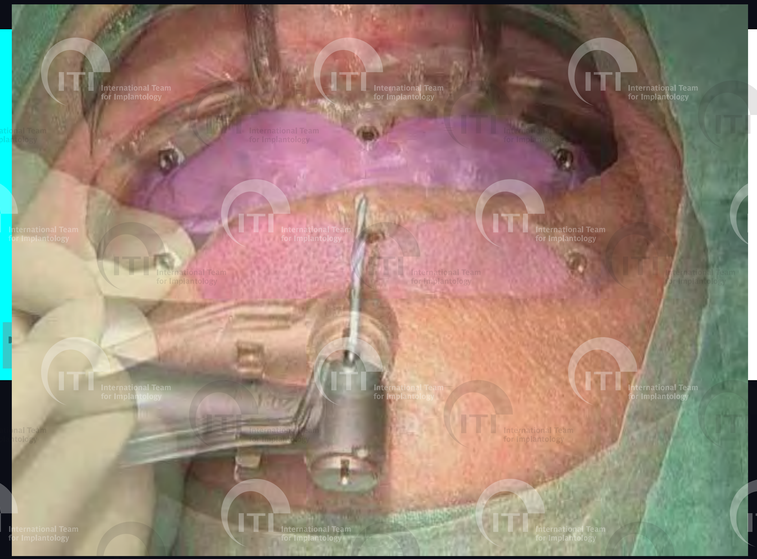
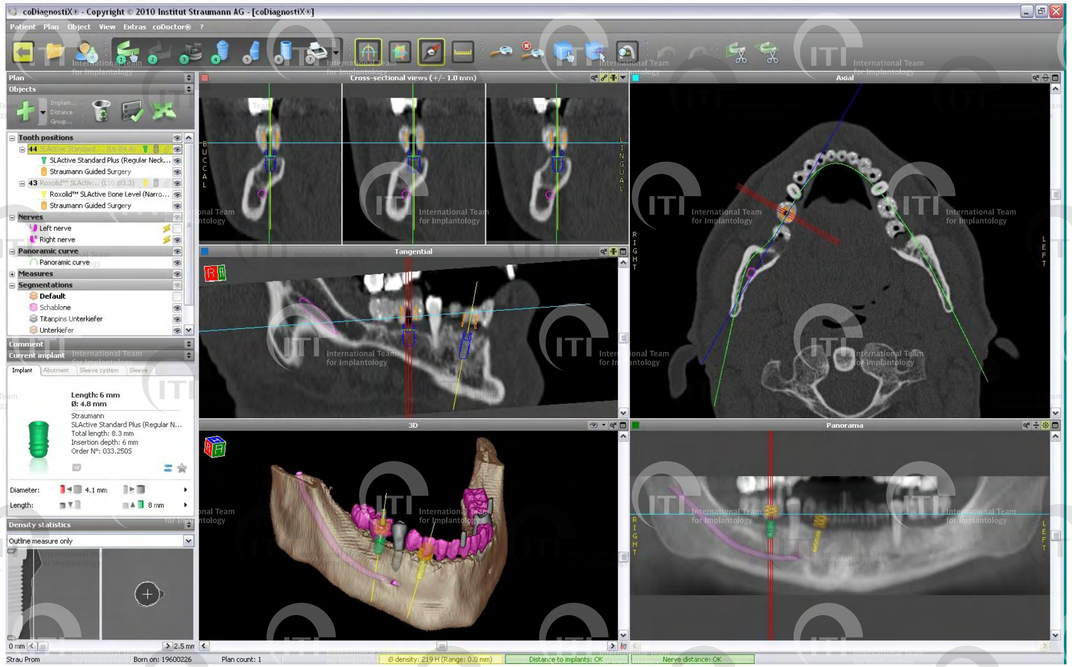
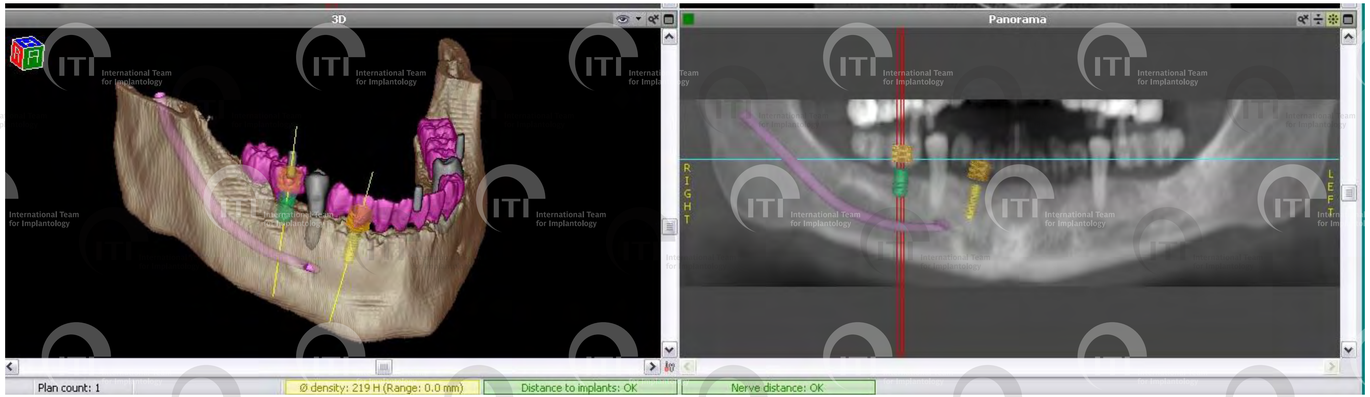


Sum of the Faults gives the total inaccuracy

Virtual reality.

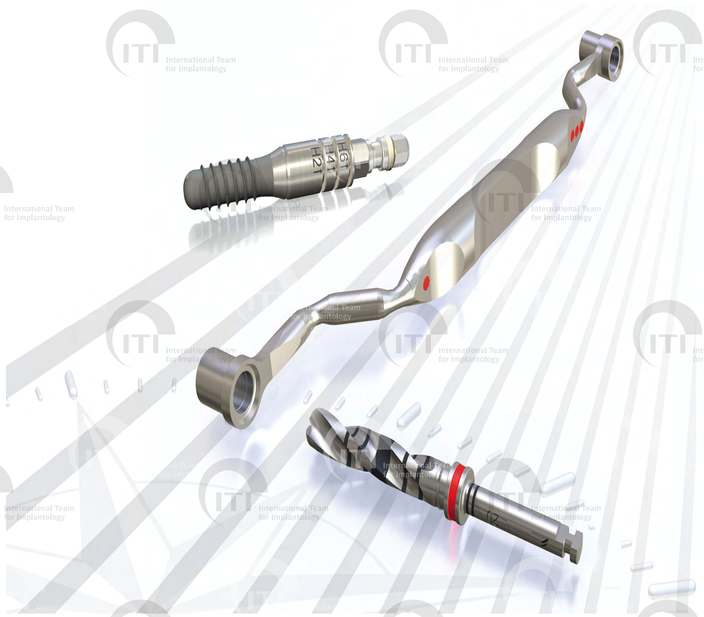




Precision?

IVS
Gonyx

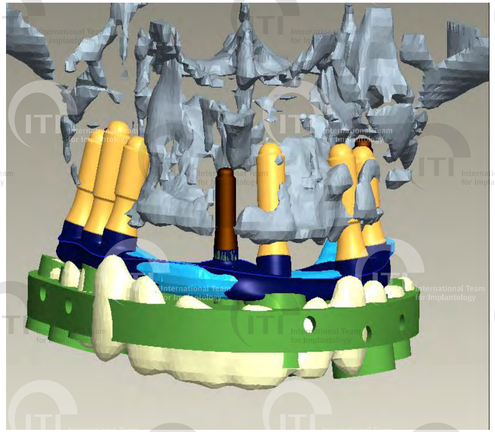
Precision?

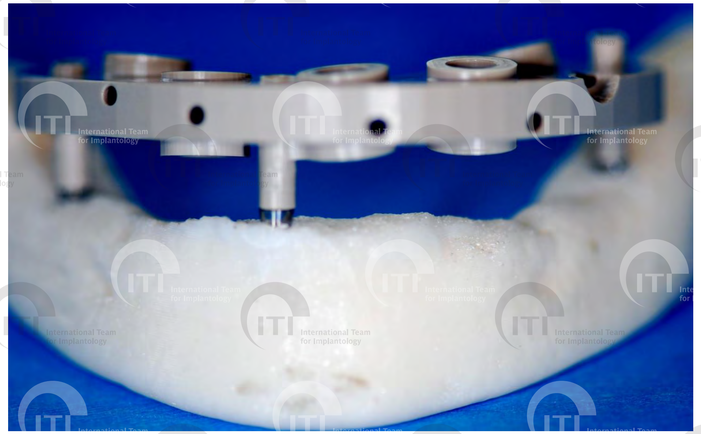


Grooves for stop key according sleeve height (H2, H4, H6)

Biomodel guided stereotactic surgery

Working on a virtual biomodel on previously placed mini implants (implant supported drilling guide)





Biomodel guided stereotactic surgery

Working on a virtual biomodel on prev … pported drilling guide)

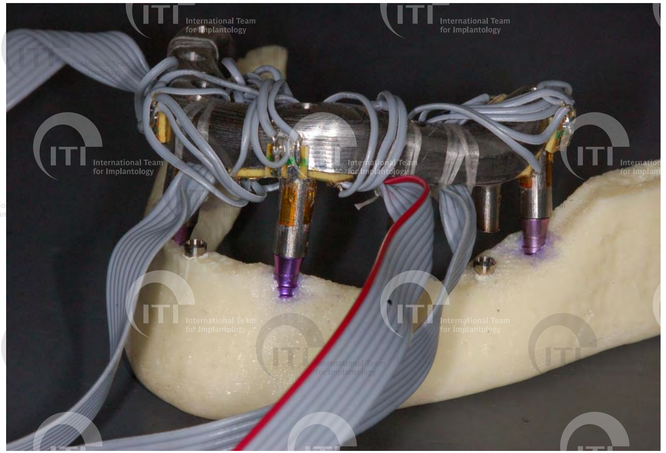
Biomodel guided stereotactic surgery

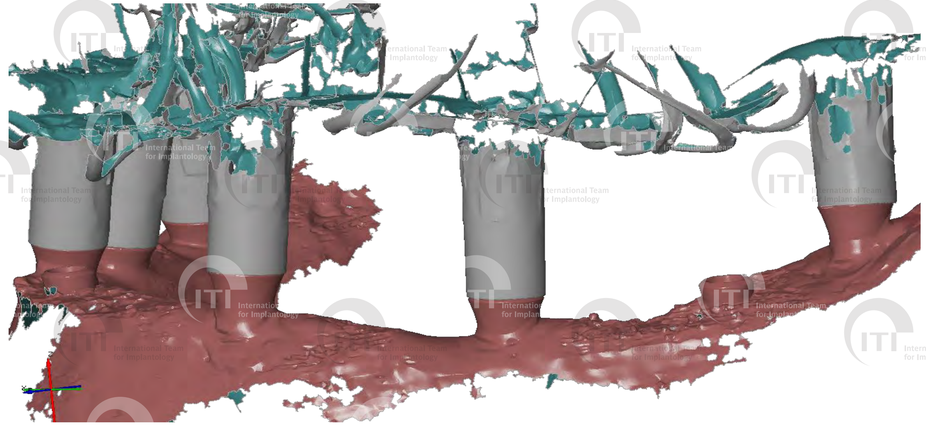
Working on a virtual biomodel on previously placed mini implants (implant supported drilling guide)

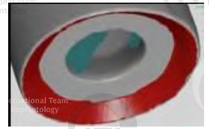
34 patients treated in the trial

Largest misfit measured = 40 µ

Tahmaseb, J v/d Weiden, P Mercelis, R de Clerck, D.Wismeijer. IJOMI 2010







Virtual biomodel guided stereotactic surgery

Planning en designing the total treatment work flow in a virtual environment decreases the chance of inaccuracies and provides the option to repeat and repair without even seeing the patient.

Impression
Model wax-up

CBCT scan
Segmentation and planning software
Implant planning
Import into superstructure planning software
Milling drilling template and superstructure

Coloring / finishing
Inserting prosthesis

Precision?

Why do things go wrong??

Impression taking and cast production

+

Resolution of the CB CT

Scanning artifacts

Metal artifacts

Repositioning of the stent in the mouth

+

Super-positioning the prosthesis

Calibration of the grey values

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Rigidity of the stent

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Repositioning the stent in the mouth.

Precision of the drill sleeves

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Sum of the Faults gives the total inaccuracy

Digital workflow

Implant treatment planning

virtual

CB CT scan → import into planning software → segmentation implant planning →

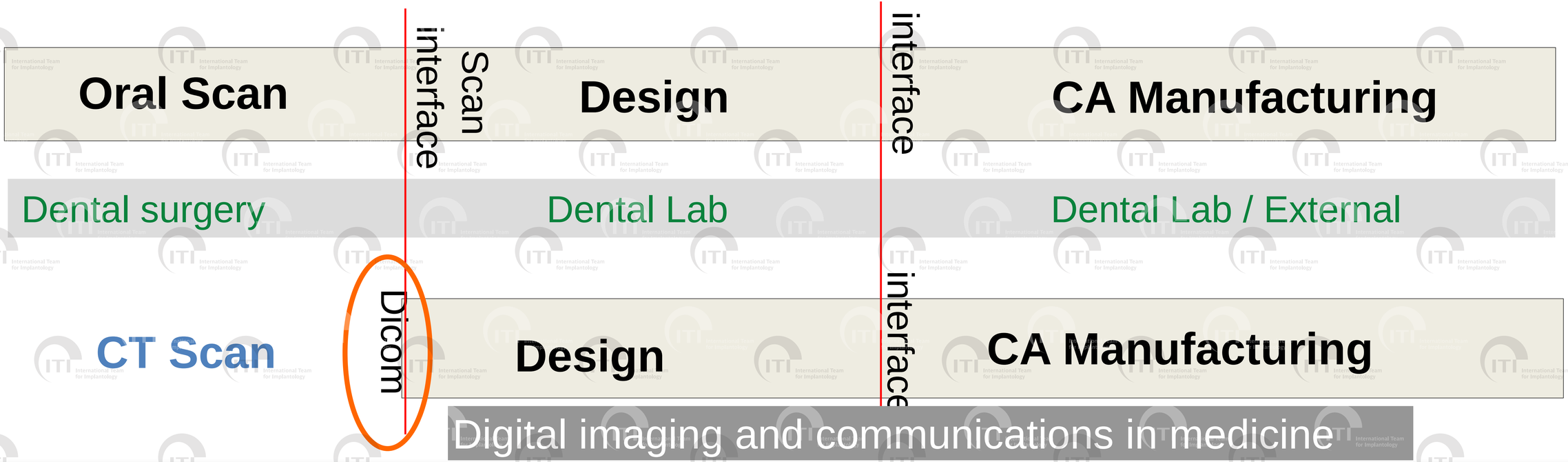
planning the superstructures → milling drilling template and superstructures

analogue

Impression ⇄ **Model / wax-up** → **Coloring / finishing** → Inserting prosthesis

Dental office — Dental lab — Dental lab — Dental office

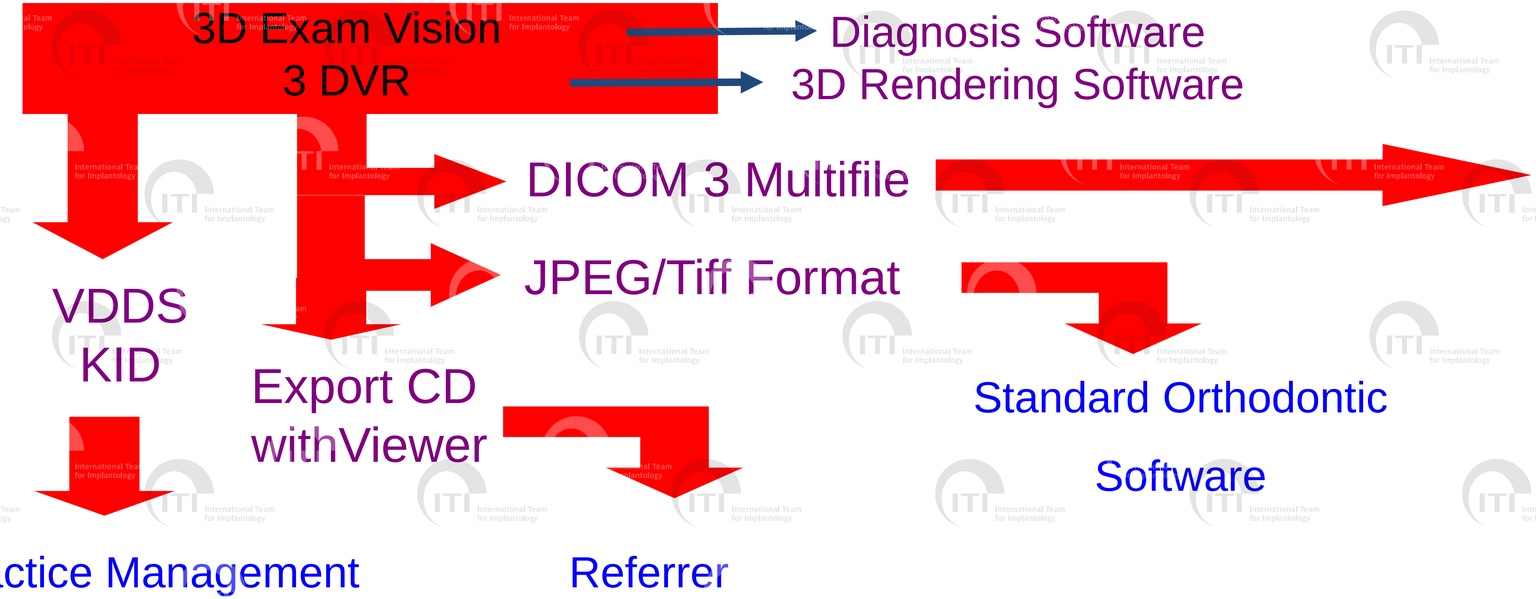
Digital environment



Digital environment

We lack an internationally recognized communication standard.

Software concept (CB)CT



SimPlant

Materialise

Nobel Biocare

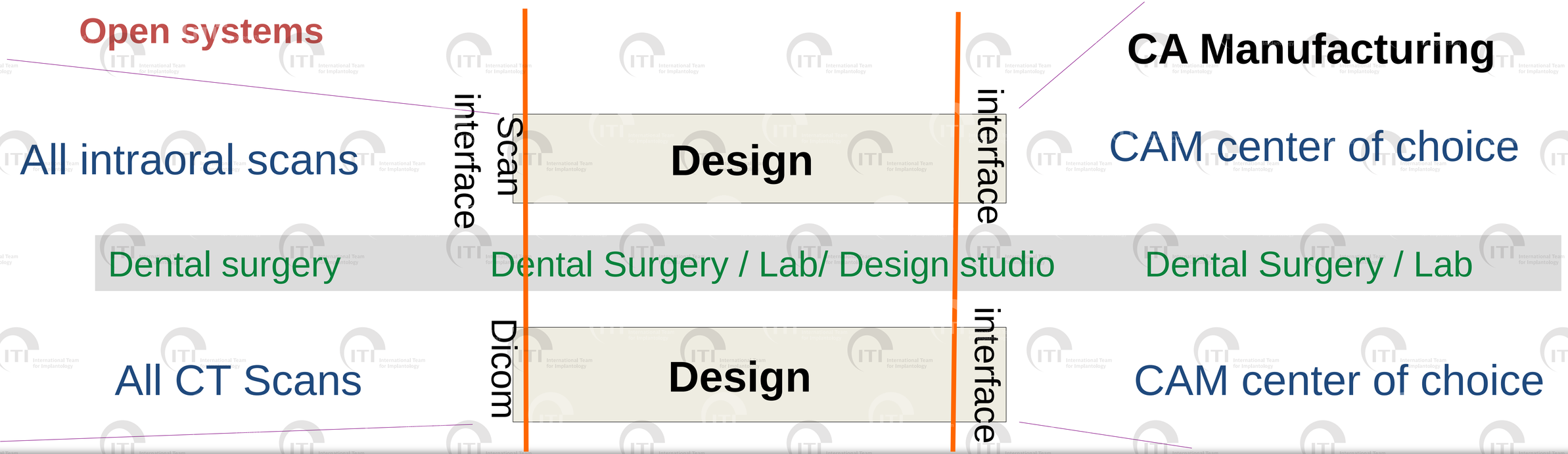
DENTSPLY FRIADENT

fr-win

Dolphin

coDiagnostiX /
coDoctor

Digital environment

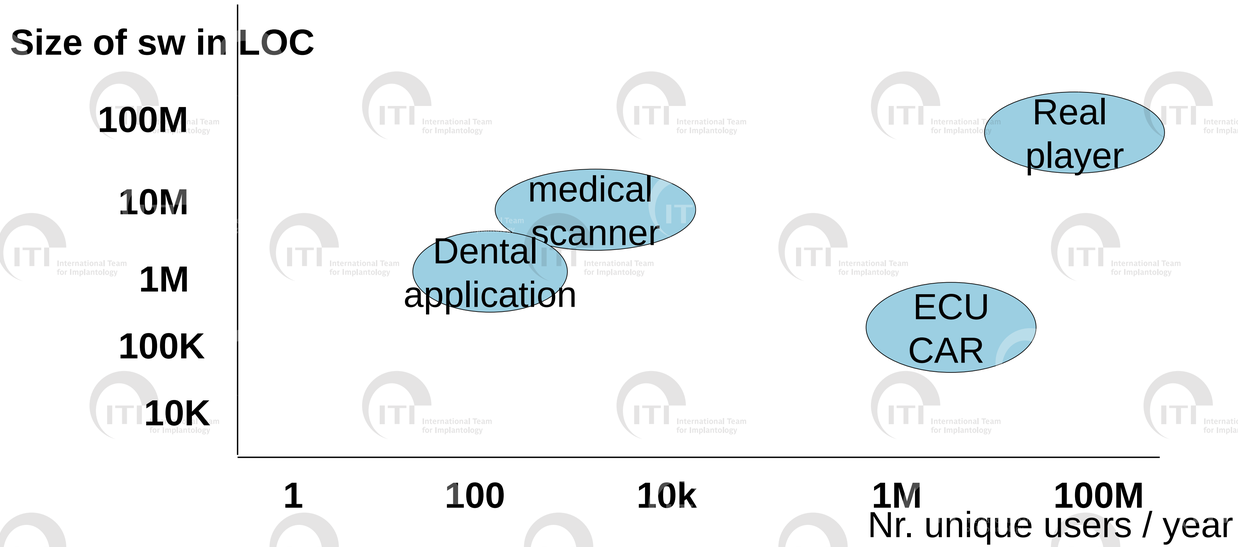


Why go for open systems?

Software keeps growing measured in millions of lines of code

Mobile phone:	10
Microsoft Windows:	50
Software in cars:	100
Software in medical scanner:	10
Pre-operative planning sw:	1.5
Dental design software:	1

Software across industries



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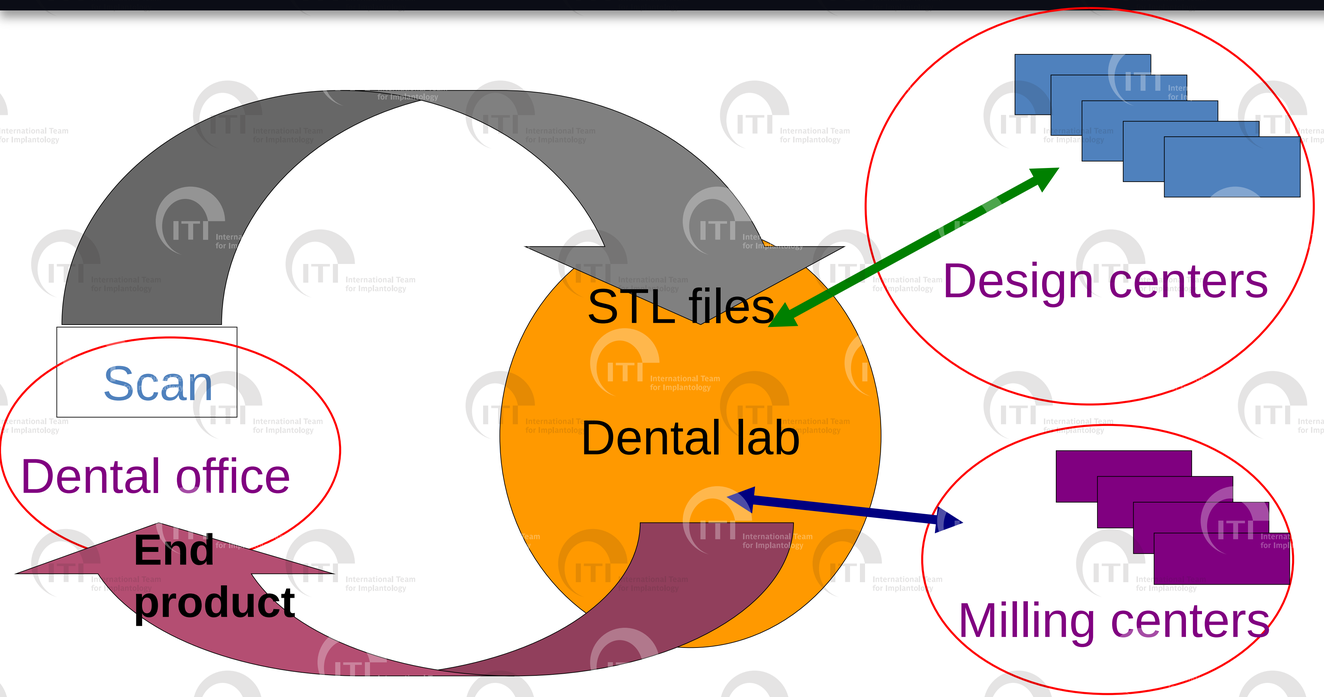

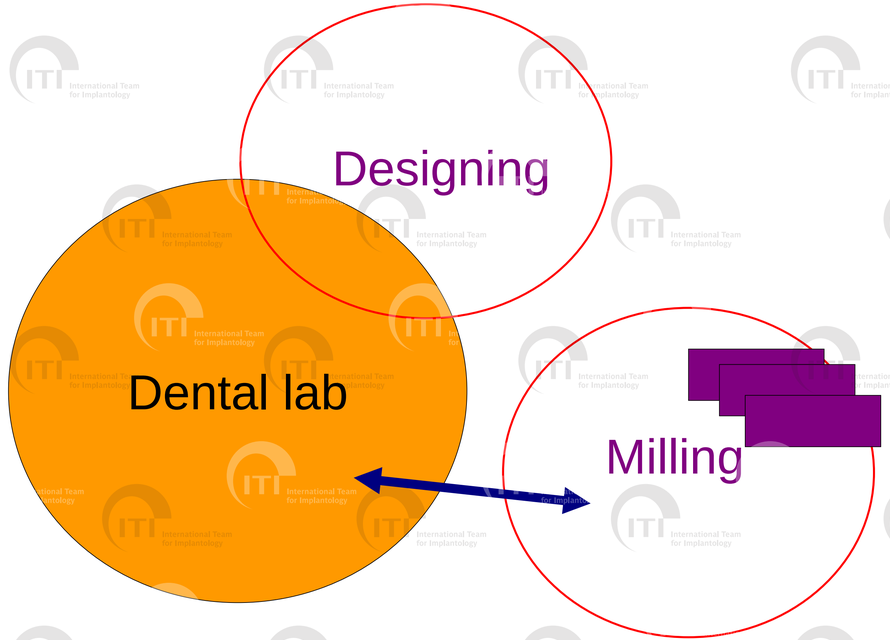

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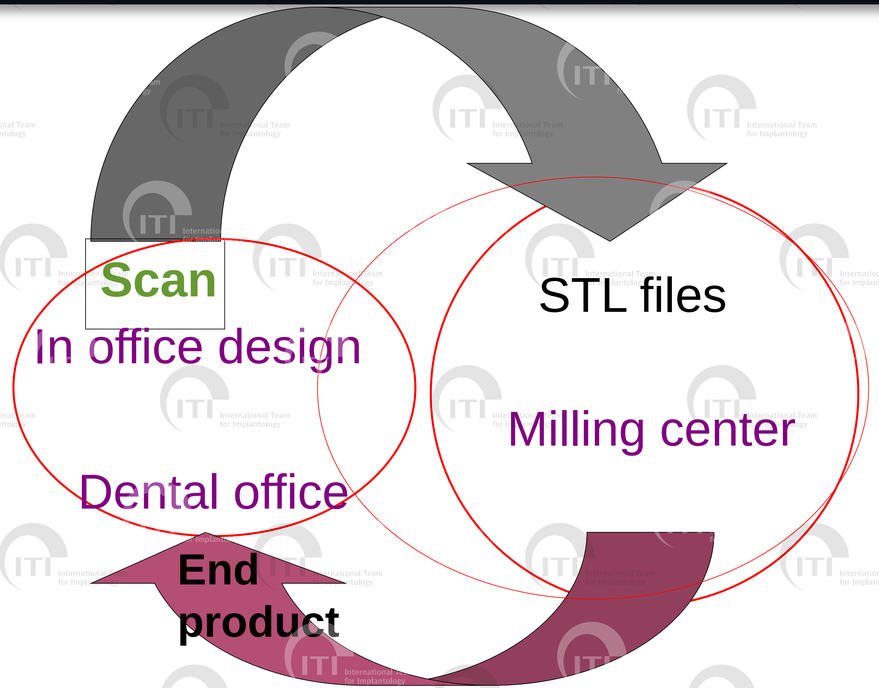
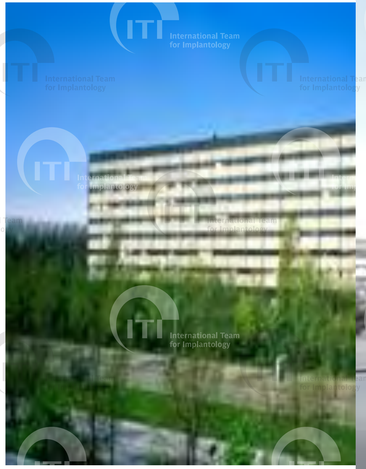


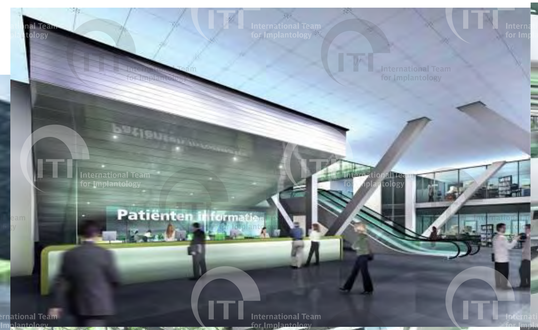
Kodak

AGFA

Are we in dentistry going to be working in a matrix or are we in for a second life?

ACTA





- Generation Z
- Digital natives
- Millenials
- Hyves generation
- Creative generation
- Generation Einstein

Are we in dentistry going to be working in a matrix or are we in for a second life?

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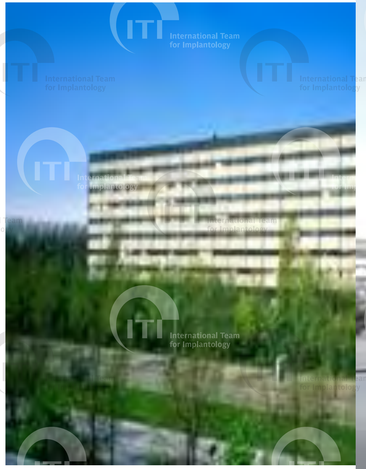

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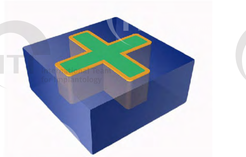
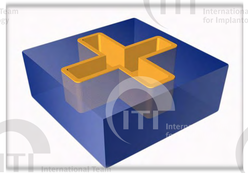
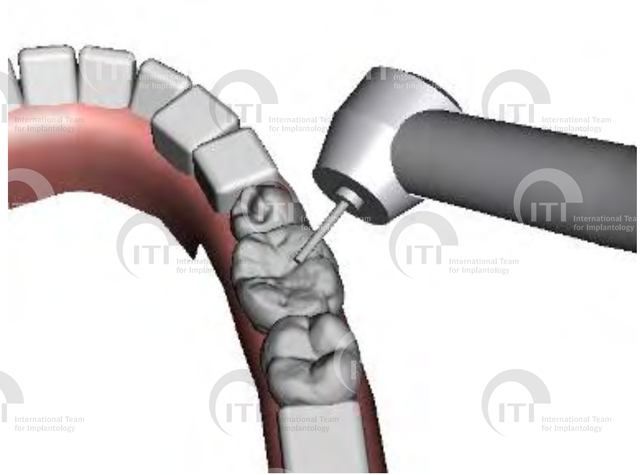
Virtual biomodel guided stereotactic surgery







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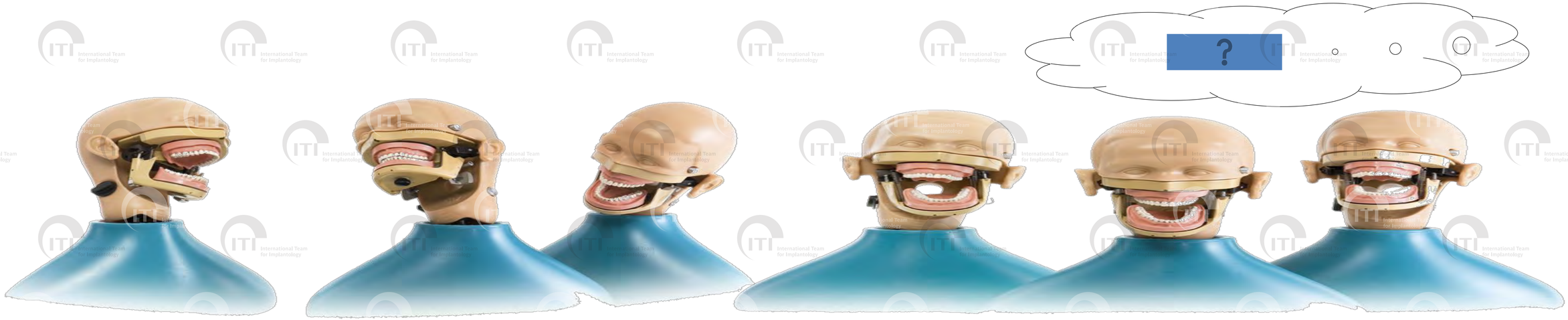
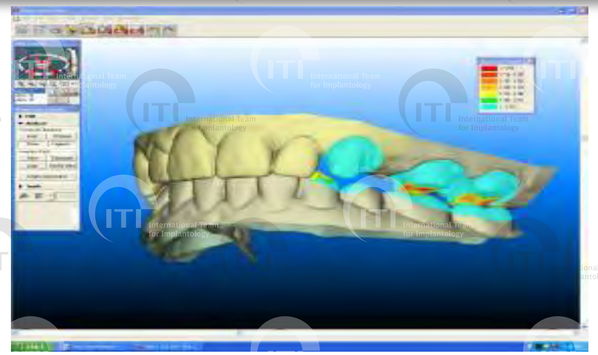
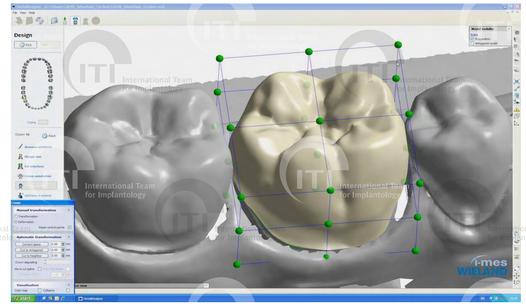
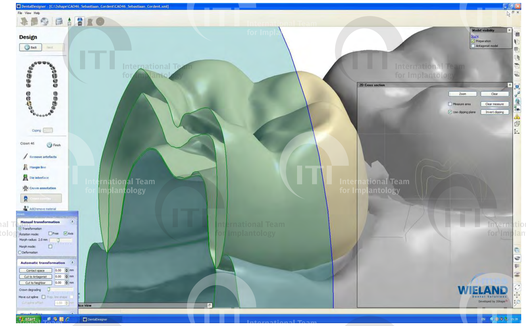


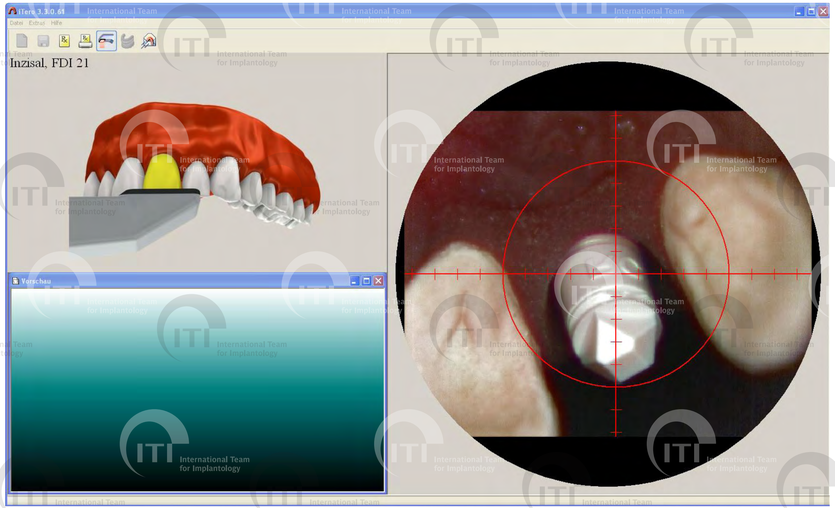
Digital dentistry

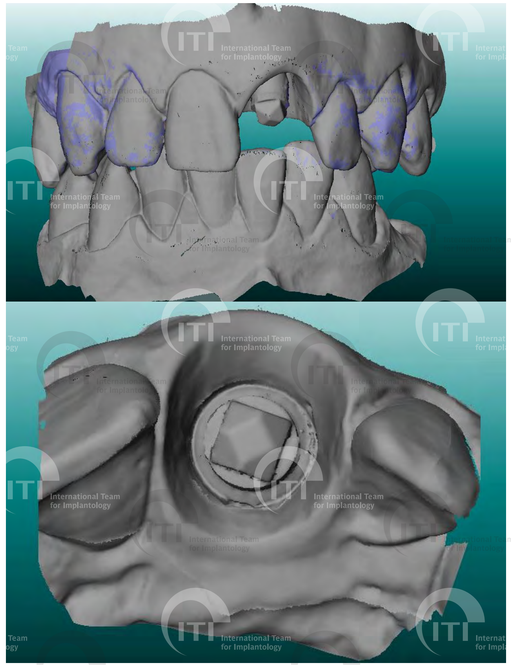


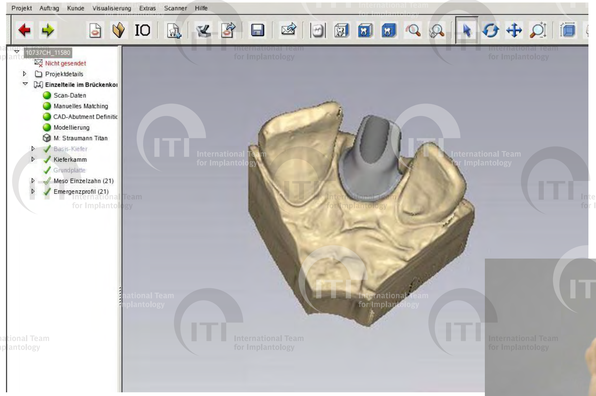




Are we in dentistry going to be working in a matrix or are we in for a second life?







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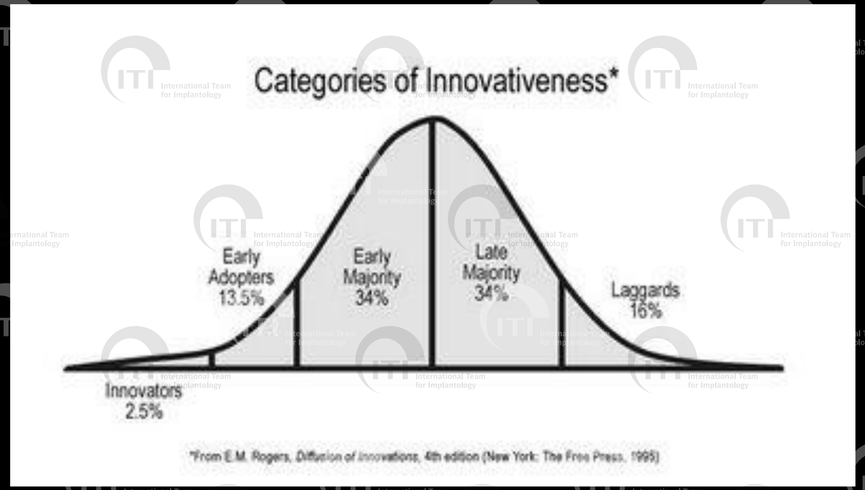

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Thanks for Your attention!

Daniel Wismeijer