

Practice Management/ Integration to Digital Dentistry

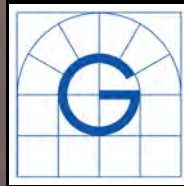


A close-up photograph of a row of human teeth, likely the upper front teeth (incisors). The teeth are white and have a glossy, reflective surface. The background is dark, making the teeth stand out. The text "Presentation PDF" is overlaid in white at the top.

Presentation PDF

<https://www.gdental.com/events/>









Objectives

- ✓ Become familiar with digital dentistry concepts.
- ✓ Selection of suitable technology and equipment.
- ✓ Integration and training of the staff.
- ✓ Implementation of digital dentistry into a prosthodontic practice.

Roadmap



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graph LR; A[Why Digital?] --> B[Technology Assessment]; B --> C[Technology Selection]; C --> D[Integration & Training]; D --> E[Implementation]
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Why Digital?

Technology Selection

Technology Assessment

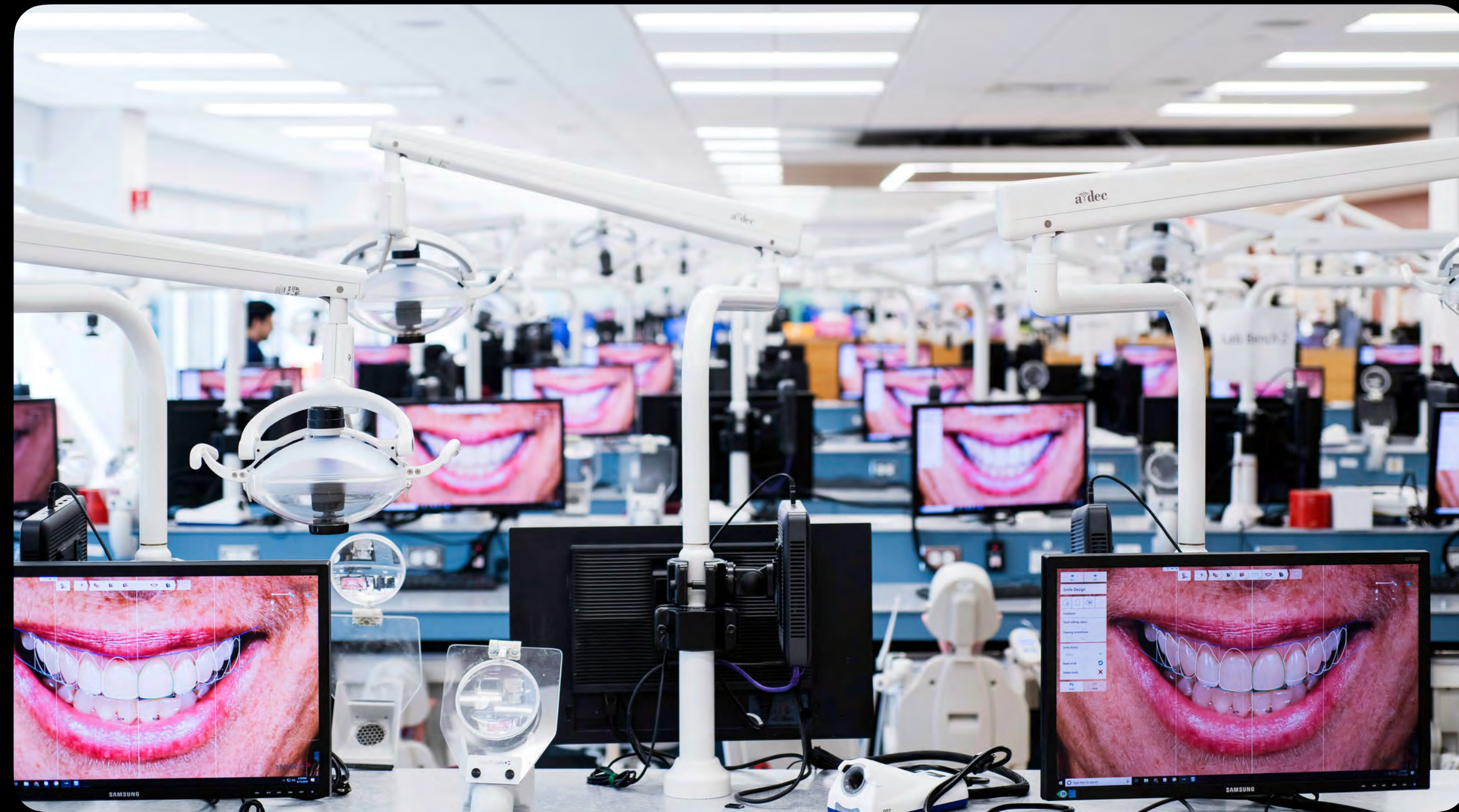
Integration & Training

Implementation



2019

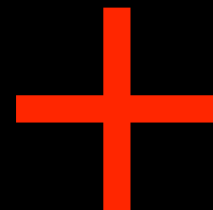
- ✓ 66% of Dentists use Digital X-Rays
- ✓ 16-26% of Dentists use Digital Impressions



Digitization



Scan



Digitalization



Digital Transformation



Quintessence Int. 2019;50(10):830-838. doi: 10.3290/j.qi.a43151.

Digitalization in dentistry: ethical challenges and implications.

Gross D, Gross K, Wilhelmy S.

Considerations

Existing Digital
Technology
(Digital Records)

Providers &
Staff Ages
(<40 Yrs Old)

Retirement
Plan
(< 5 Yrs)

Steep Digital
Learning Curve
(6-12 Months)



2003

r



2006-2015

Chairside

Digital Workflow

Laboratory

I Scanning (IOS)



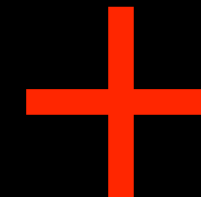
Chairside



Scan/Design (CAD)



Manufacture (CAM)



Crystallize

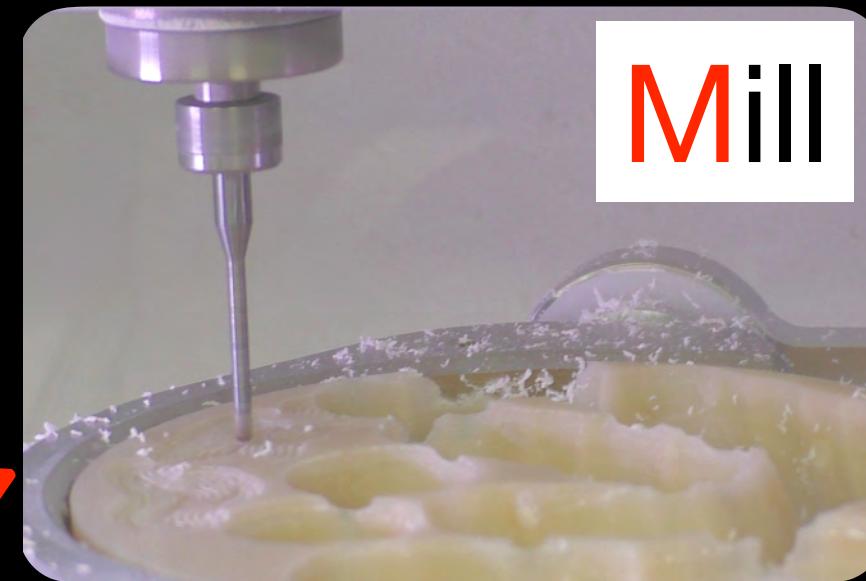
Laboratory

Scan

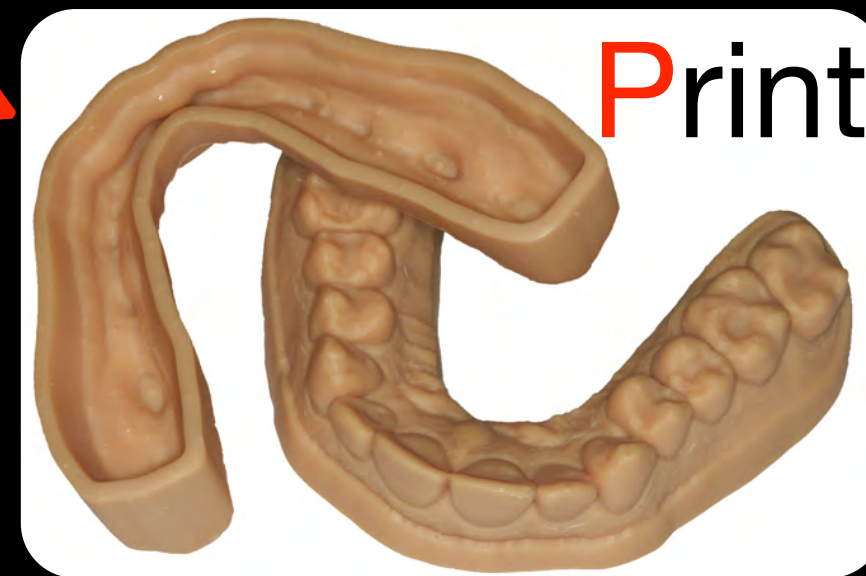


CAD Design

CAM Manufacturing



Mill



Print



Advantages of Digital Dentistry

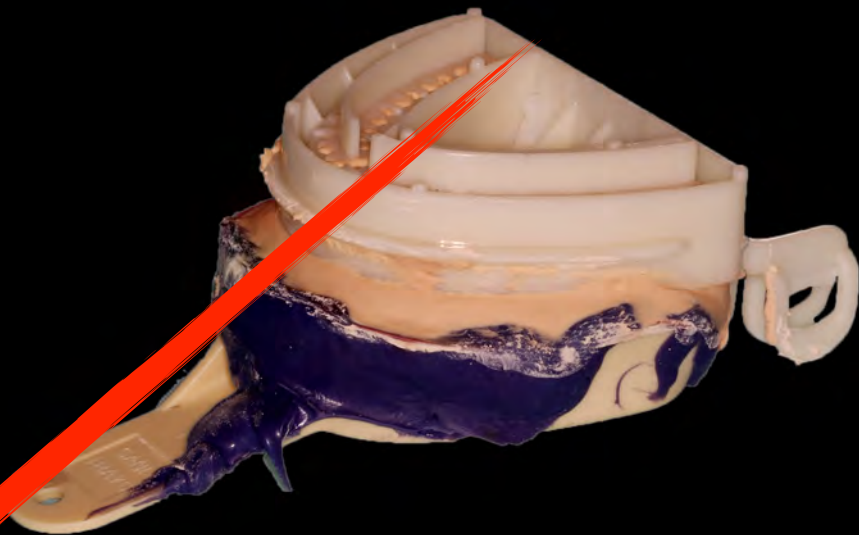
- ✓ Improve Patient Experience, Comfort, and Perception
- ✓ Accurate and Efficient
- ✓ No Messy Impressions and/or Model Work
- ✓ Better Patient, Laboratory, and Referral Communication
- ✓ Reduce Supply Costs

Disadvantages of Digital Dentistry

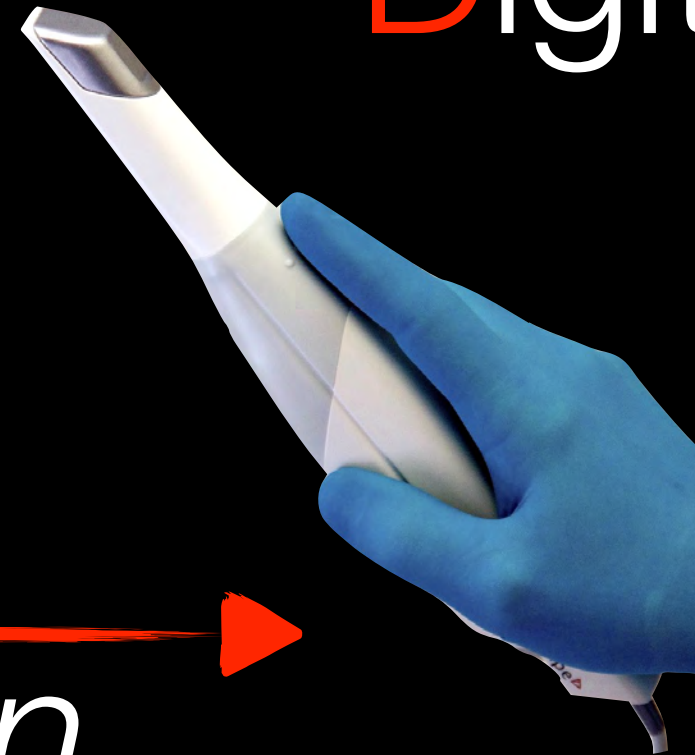
- ✓ Difficulty Detecting Deep Subgingival Margins
- ✓ Inaccurate for Long Span Restorations
- ✓ Steep Learning Curve
- ✓ Initial Investment and Software Licensing Costs

Conventional

Digital



Digitization



Common Pitfalls

- ✓ Incomplete Technology Assessment
- ✓ Lack of IT Support
- ✓ Insufficient Staff Training & Delegation



Roadmap



Why Digital?

Technology Assessment

Technology Assessment

Hardware

CBCT

Optic Scanners

Milling Machines

3D Printers

Software

Acquisition

Planning

CAD

CAM

Materials

Lithium Disilicate

Zirconia

Titanium

PMMA

Technology Assessment

Hardware

CBCT

Optic Scanners

Milling Machines

3D Printers

Software

Acquisition

Planning

CAD

CAM

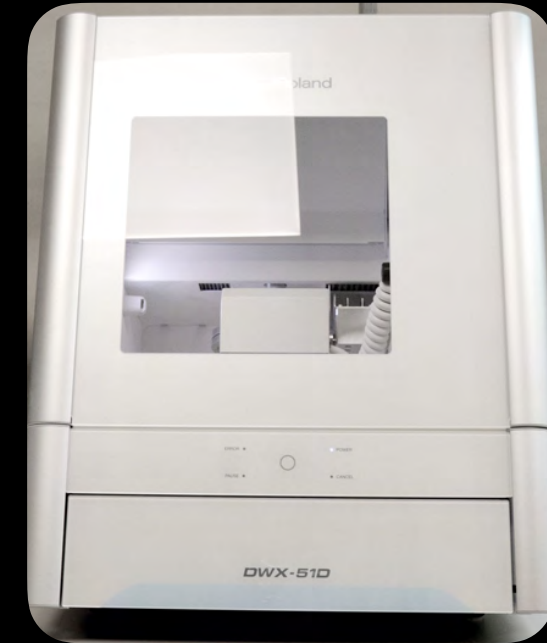
Materials

Lithium Disilicate

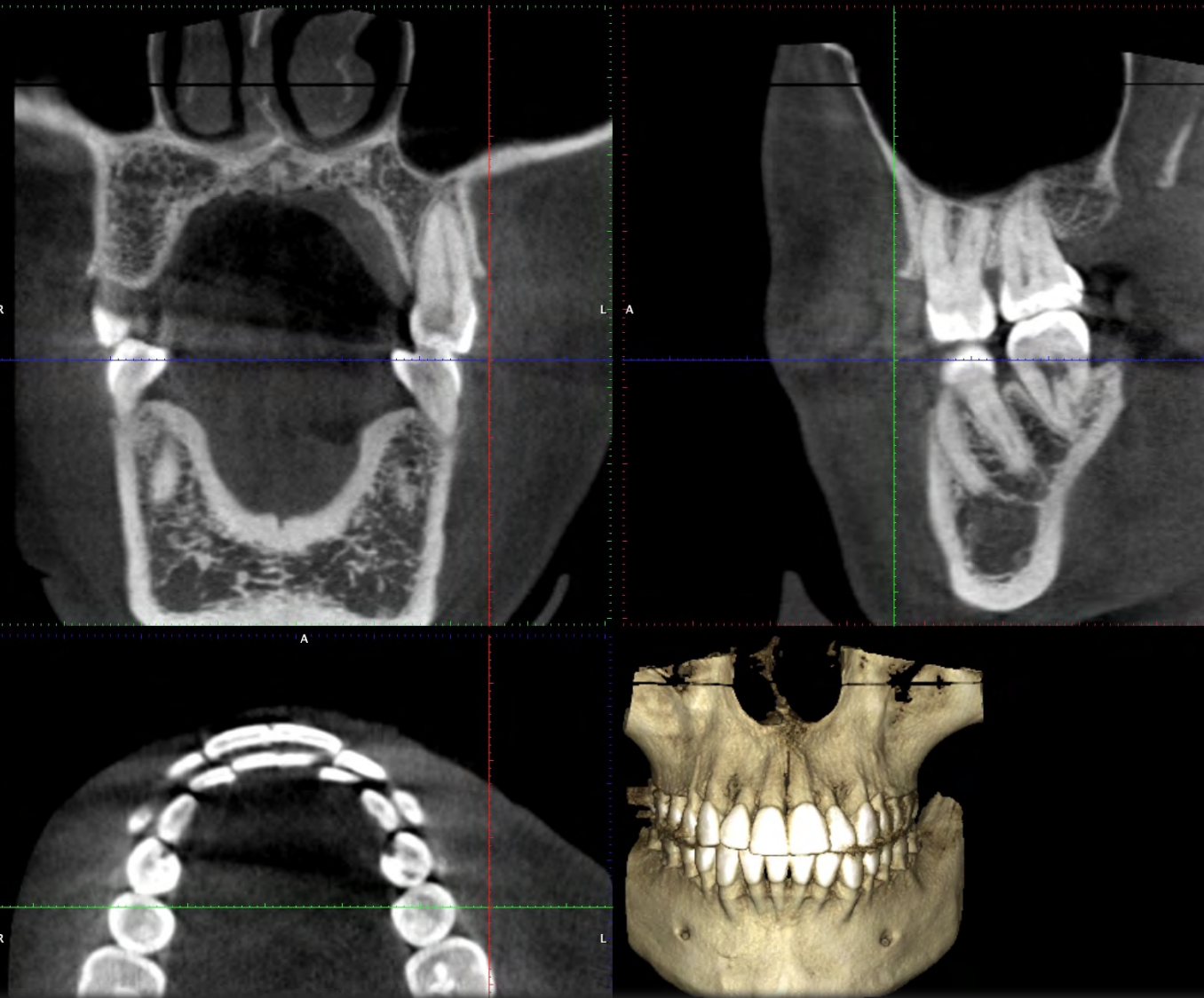
Zirconia

Titanium

PMMA



Technology is a *tool*, not a
substitute for *critical thinking*.



Brullmann, D, et al. Spatial resolution in CBCT machines for dental/maxillofacial applications. *Dentalmaxillofac Radiol.*, 2015; Jan; 44(1): 20140204.

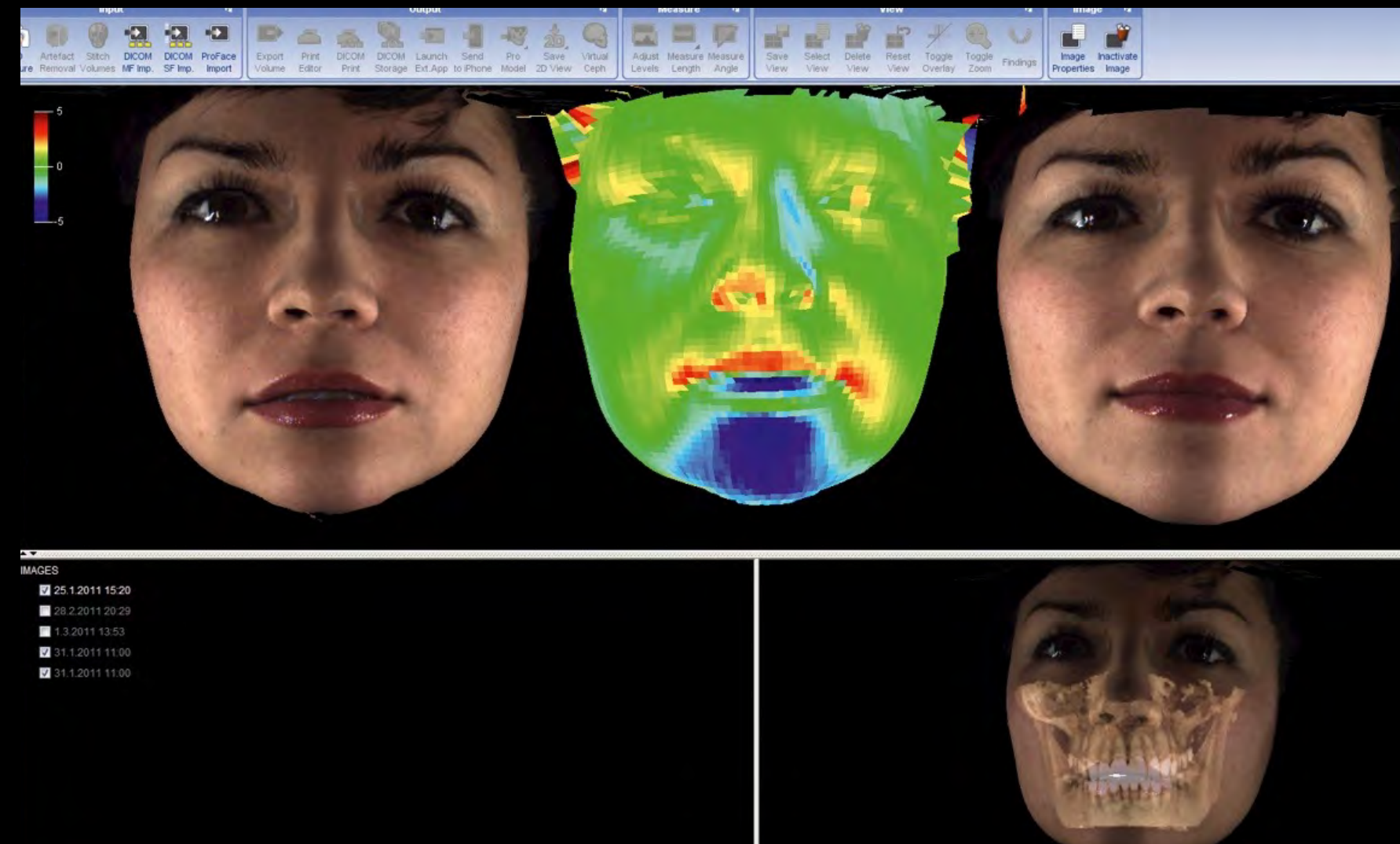
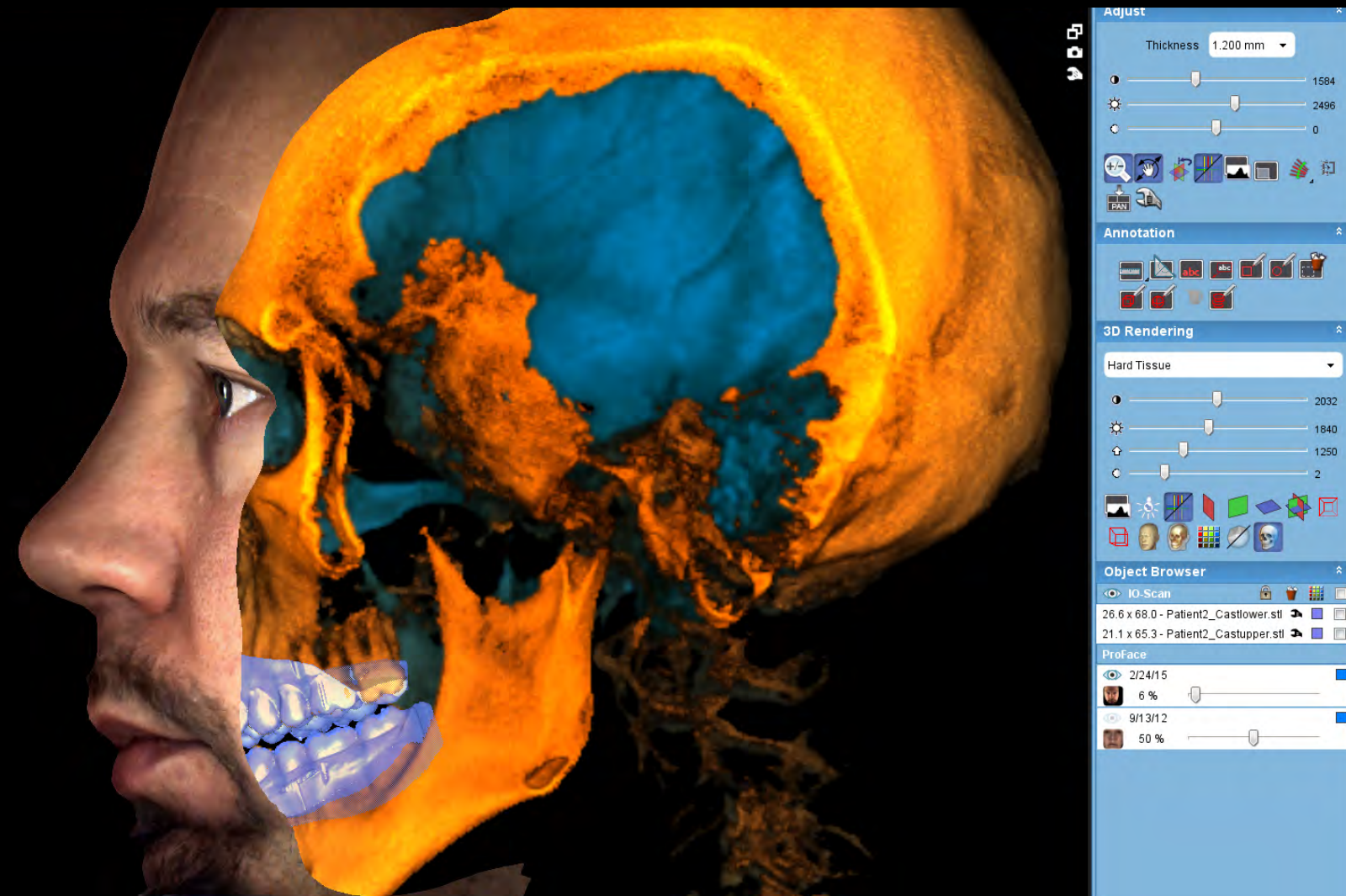
C

BCT

Extraoral Bitewings 4D Jaw Motion

- ✓ User Friendly
- ✓ Integrates w/ Management & Planning Software
- ✓ Monitor Resolution
- ✓ Spatial Resolution (1mm)
- ✓ Low Dose Setting
- ✓ Volume Size
- ✓ On-site Repair

Samuel, DS, et al. Cone-beam computer tomography and its applications in dentistry. *Drug Invention Today*, 2019; 12(1):1-4.



Joda, T, et al. The virtual patient in dental medicine. Clin Oral Impl Res., 2015; 26:725–726.



Wand/Pen



Intraoral Scanner (IOS)

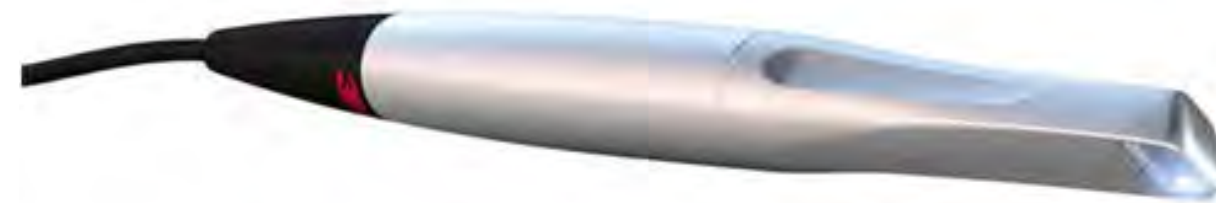
- ✓ Open System
- ✓ STL, OBJ, PLY Files
- ✓ Small Wand
- ✓ Speed and Accuracy
- ✓ Powder Free & Color
- ✓ PC Requirements



TRIOS 3®, 3 SHAPE



CS 3600®, CARESTREAM



TRUE DEFINITION®, 3M ESPE

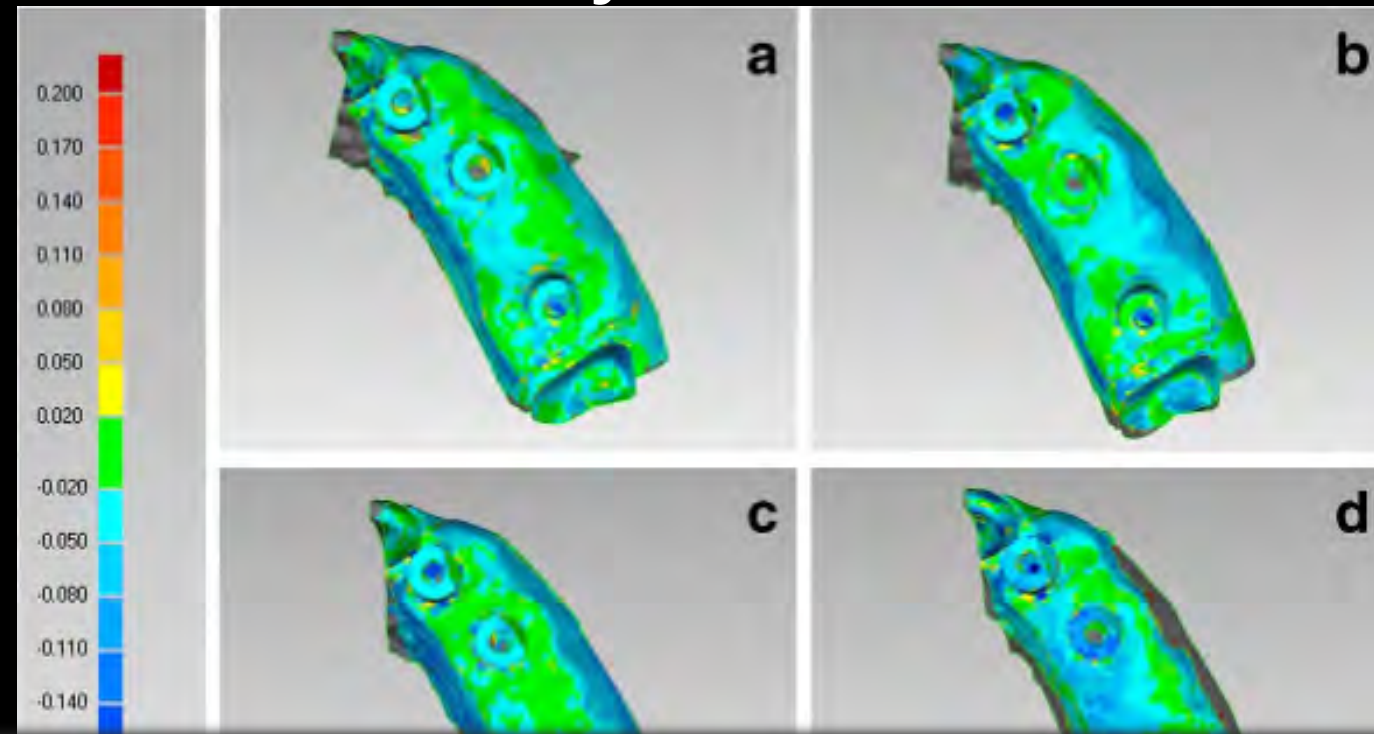


OMNICAM®, SIRONA

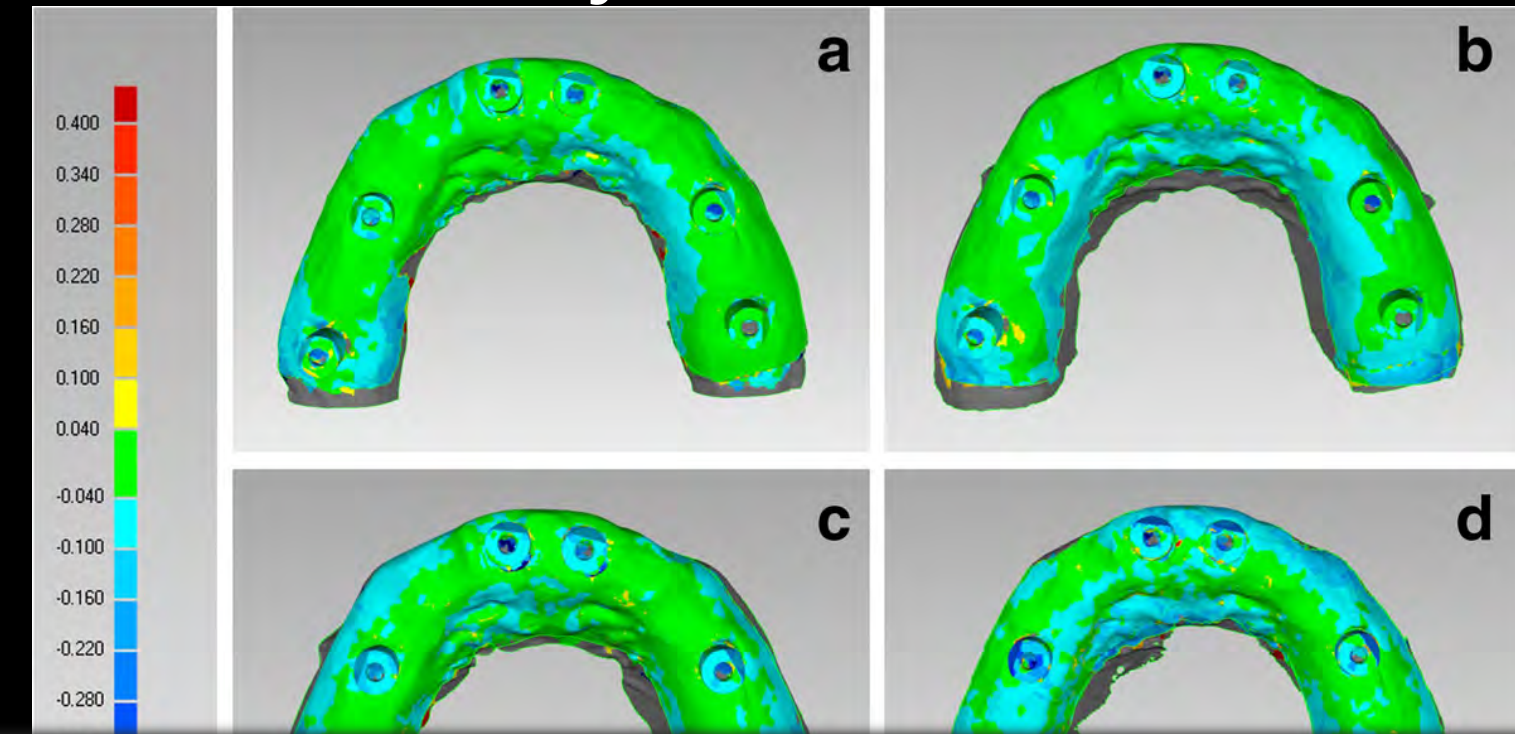
Imburgia, M, et al. Accuracy of four intraoral scanners in oral implantology: a comparative in vitro study. BMC Oral Health 2017; 17:92.

Excellent results were achieved with all four IOS.

Partially Edentulous



Fully Edentulous



Chochlidakis, K, et al. Digital versus conventional impressions for fixed prosthodontics: A systematic review and meta-analysis of ceramic partial crown in vitro. JPD 2016; 116(2):184–190.

Partially Edentulous scans *more accurate* than **F**ully Edentulous scans.

Lithium Disilicate
Composite
Ceramic Hybrid
PMMA

Wet

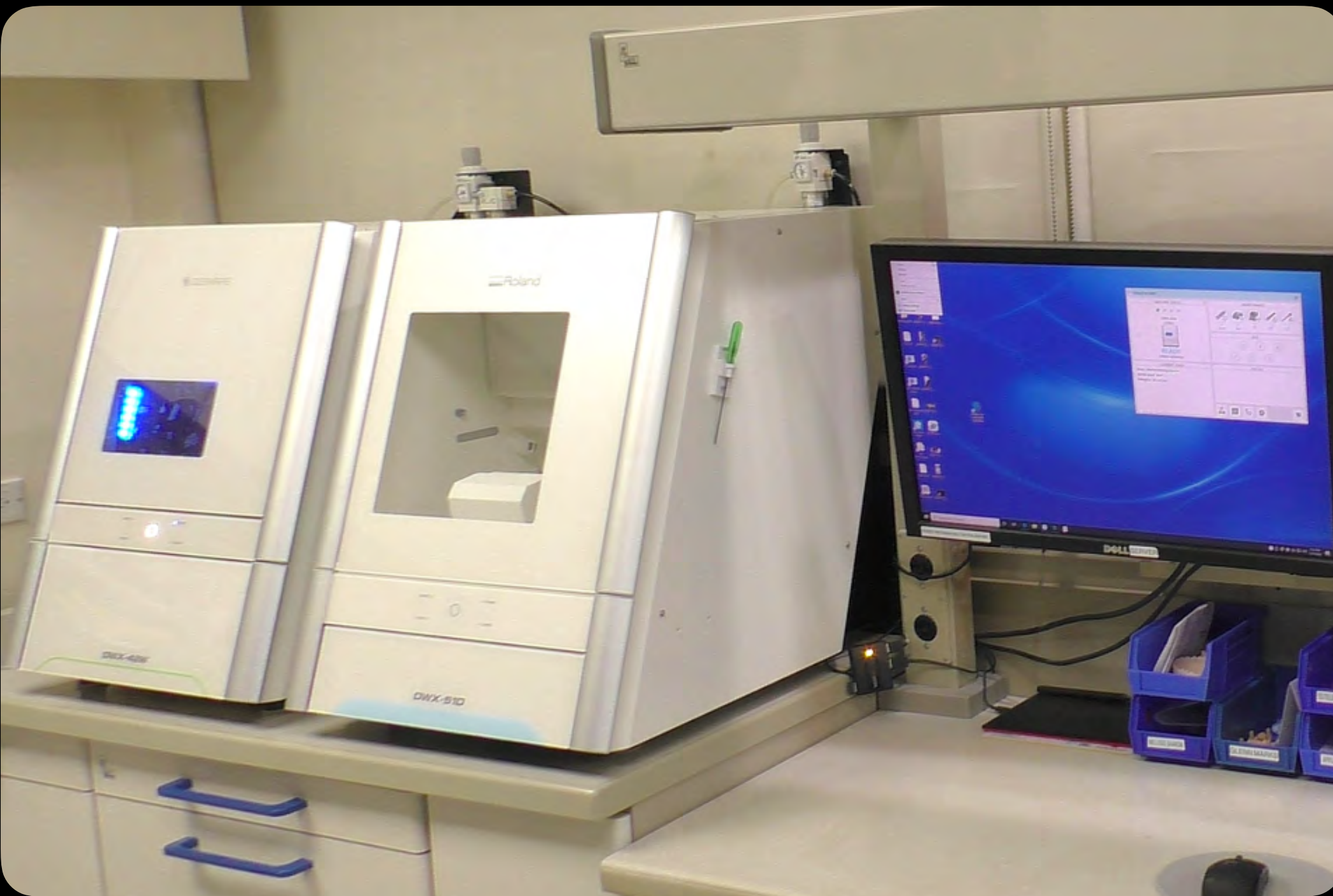


Dry



Zirconia
PMMA
Wax

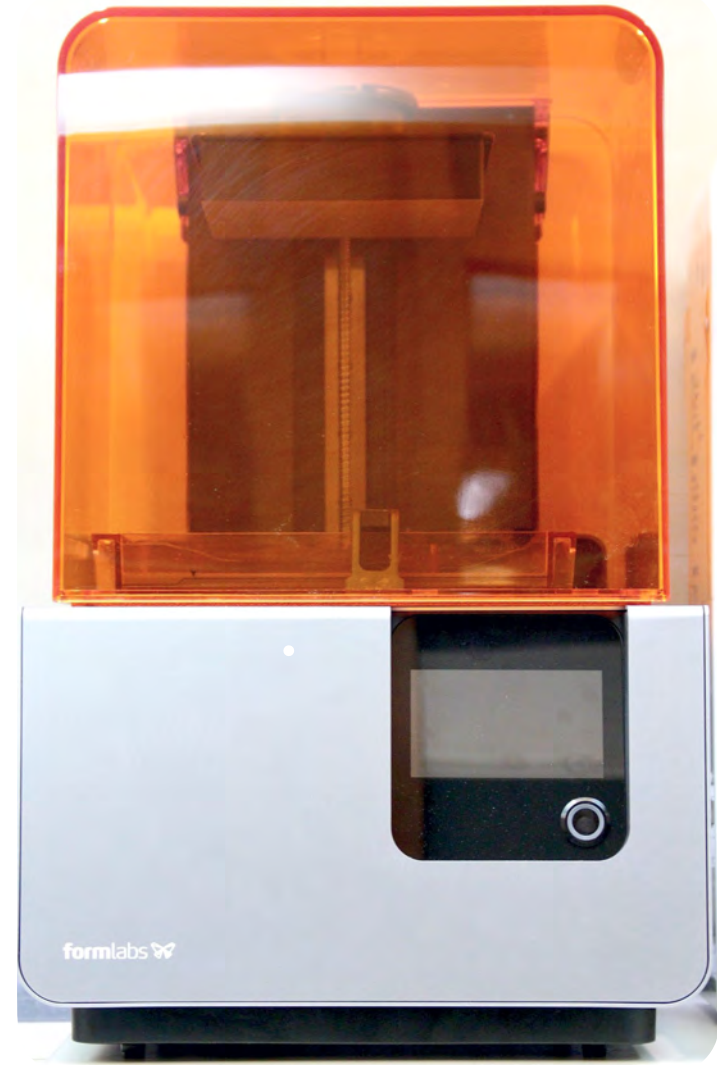




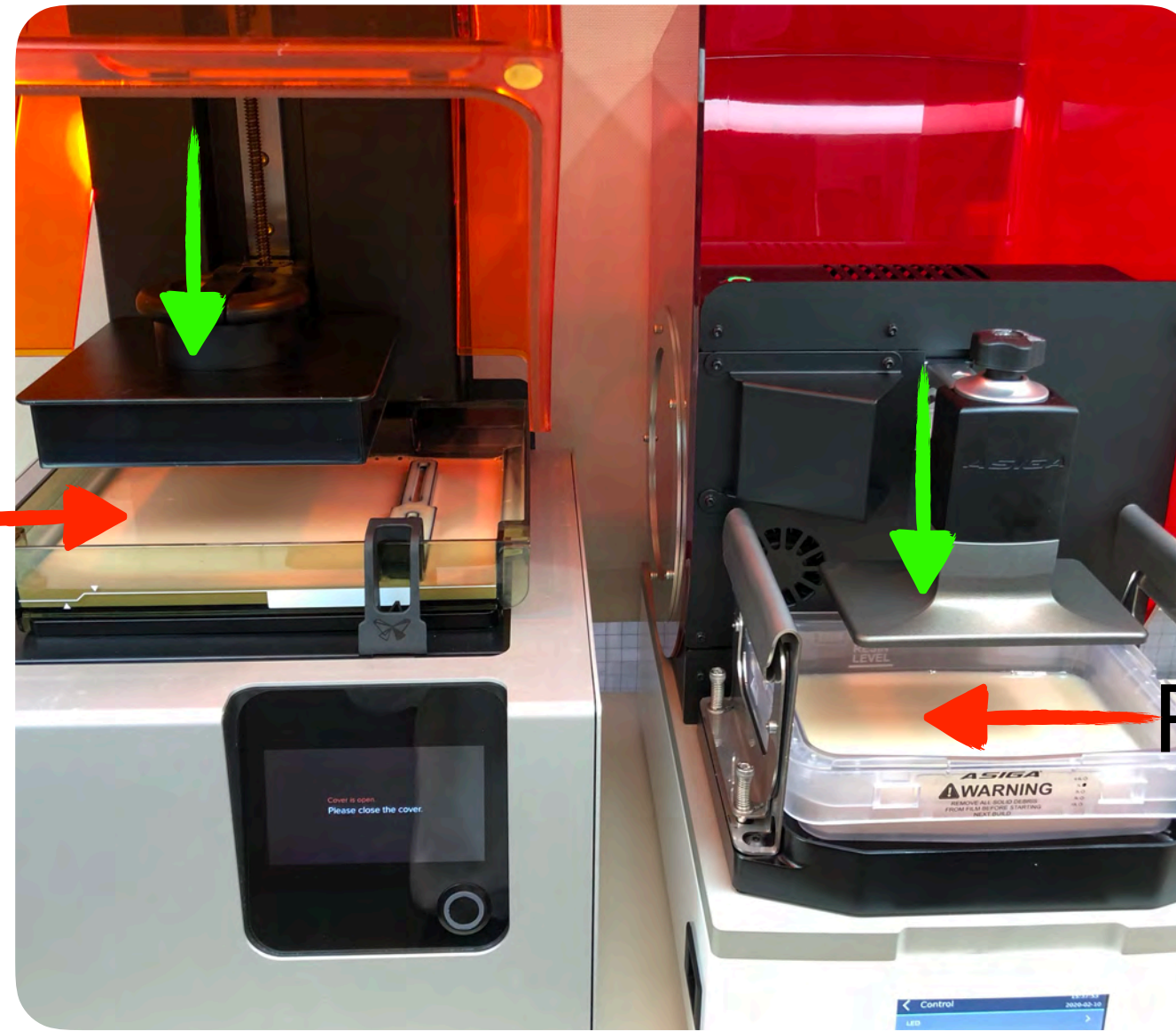
Milling Machines

- ✓ Speed (Time/Unit)
- ✓ Marginal Accuracy
- ✓ Units/Run
- ✓ Maintenance
- ✓ Utilities Requirements
- ✓ Repair Policy

Stereolithography (SLA)



ResinTray



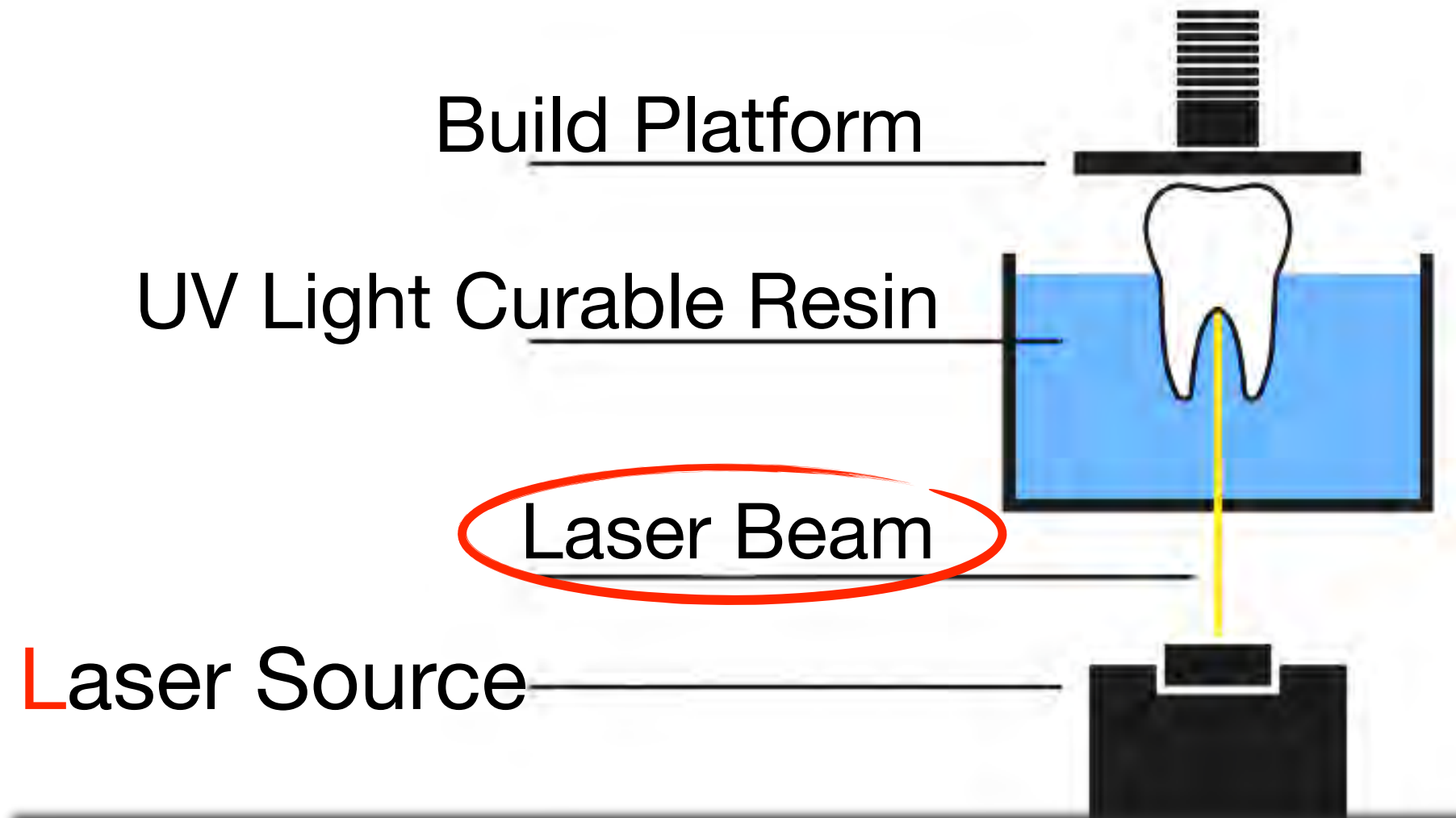
Digital Light Processing (DLP)

ResinTray

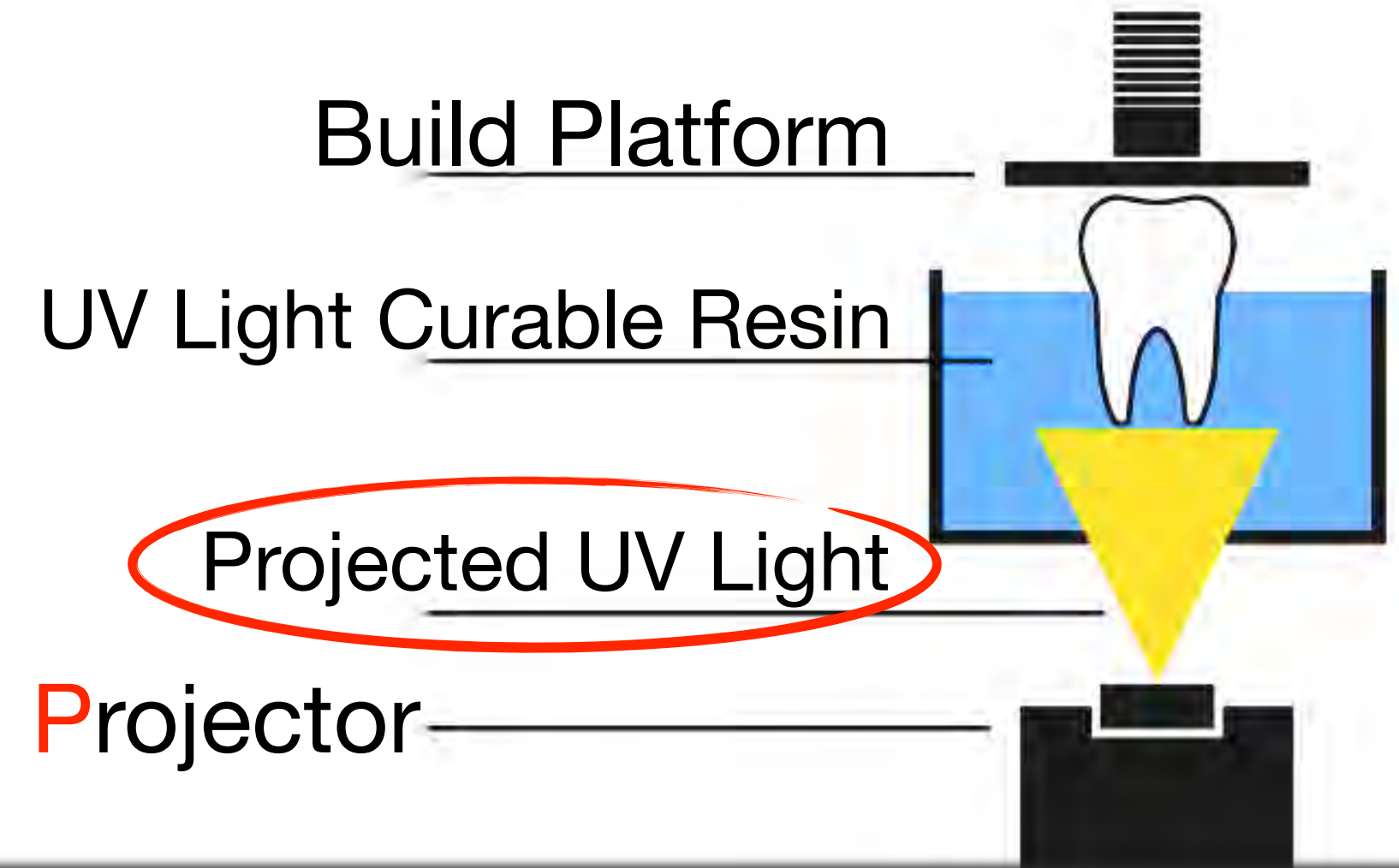


Cherdo, L. The 13 Best Resin 3D Printers (SLA/DLP/LCD) in 2020.
<https://www.aniwaa.com/the-best-resin-3d-printer-sla-and-dlp/>

SLA



DLP



SLA

Laser Beam
Slow
Smooth Surface
Large Platform

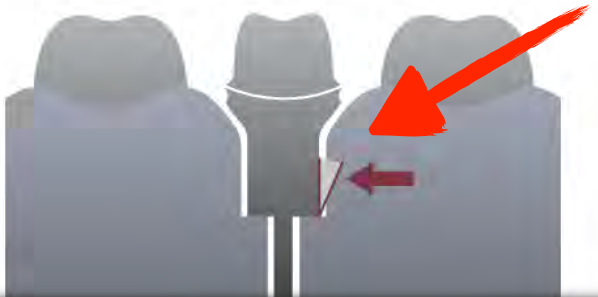
Vs.

DLP

Projected Light
Fast
Textured Surface
Small Platform

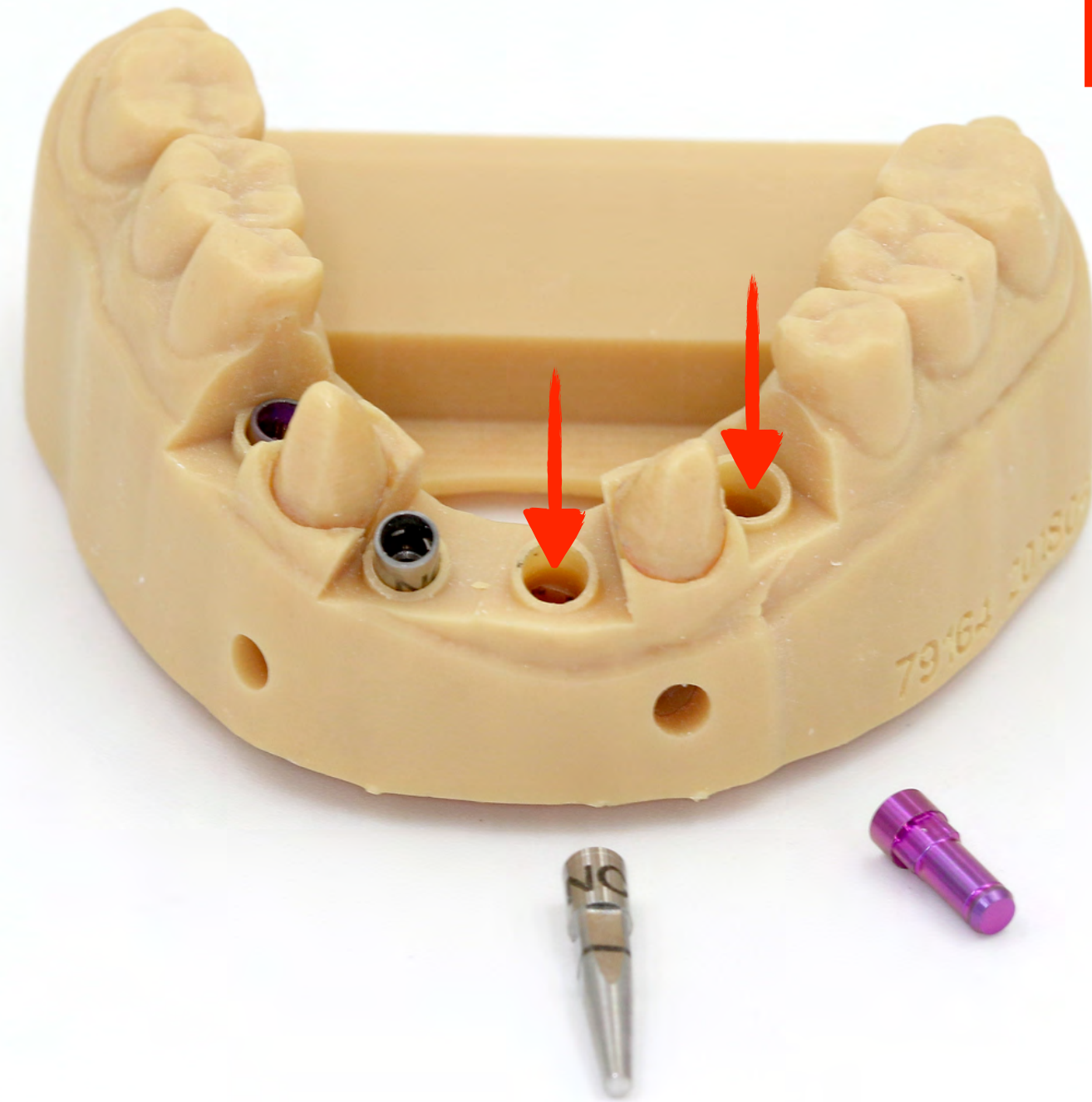


Name	Base Wall Angle (deg)	Base Stop Surface Width (mm)	Base Stop Surface Angle (deg)	Die to Model Spacing (mm)	Post to Model Spacing (mm)	Friction bar Width (mm)	Friction bar Angle (deg)
Digital Model	2.000	0.001	0.000	0.100	0.100	0.700	0.000
Dreve FotoDent	2.000	0.650	0.000	0.100	0.100	0.700	0.000
Quad. 3DS ProJet 3000	2.000	0.001	0.000	0.040	0.100	0.700	0.000
Full. 3DS ProJet 3000	2.000	0.001	0.000	0.040	0.100	0.700	0.000
Formlabs Dental Model (Lo...	2.000	0.001	15.000	0.065	0.100	0.800	0.000
Formlabs Dental Model (C...	2.000	0.200	15.000	0.230	0.000	0.800	0.000
Formlabs Dental Model (M...	2.000	0.001	15.000	0.065	0.100	0.800	0.000
Formlabs Dental Model (Ti...	2.000	0.001	15.000	0.050	0.100	0.800	0.000
MedentikaPrint	2.000	0.001	0.000	0.100	0.100	0.700	0.000
MedentikaPrint	2.000	0.001	0.000	0.100	0.100	0.700	0.000
Formlabs_Model	2.000	0.001	15.000	0.080	0.100	0.800	0.000
ntiDent_Milling	5.000	0.650	0.000	0.100	0.100	0.000	0.000
SnowRock Full Auto Pins	5.000	0.650	0.000	0.100	0.100	0.000	0.000
SnowRock Full All Pins	5.000	0.650	0.000	0.100	0.100	0.000	0.000
Rapidshape P30 Digital M...	2.000	0.001	25.000	0.060	0.100	0.800	0.000
Argen Model C Full Arch w ...	2.000	0.000	45.000	0.075	0.030	0.600	0.000
Argen Model C Quad w DIM	2.000	0.000	45.000	0.075	0.030	0.600	0.000
Argen Model T Full Arch w ...	5.000	0.650	0.000	0.100	0.100	0.000	0.000
Argen Model T Quad w DIM	5.000	0.650	0.000	0.100	0.100	0.000	0.000
Argen Model T Full Arch	2.000	0.001	0.000	0.040	0.100	0.700	0.000
Argen Model T Quad	2.000	0.001	0.000	0.040	0.100	0.700	0.000
Argen Model T Single Die	2.000	0.001	0.000	0.040	0.100	0.700	0.000
Argen Model C Full Arch	2.000	0.000	45.000	0.075	0.030	0.600	0.000
Argen Model C Quad	2.000	0.000	45.000	0.075	0.030	0.600	0.000
Argen Model C Single Die	2.000	0.000	45.000	0.075	0.030	0.600	0.000
Implant Direct Model_Loose	2.000	0.001	0.000	0.300	0.125	0.700	0.000
Implant Direct Model_Medi...	1.000	0.001	0.000	0.225	0.100	0.700	0.000
Implant Direct Model_Tight	0.000	0.001	0.000	0.150	0.750	0.700	0.000

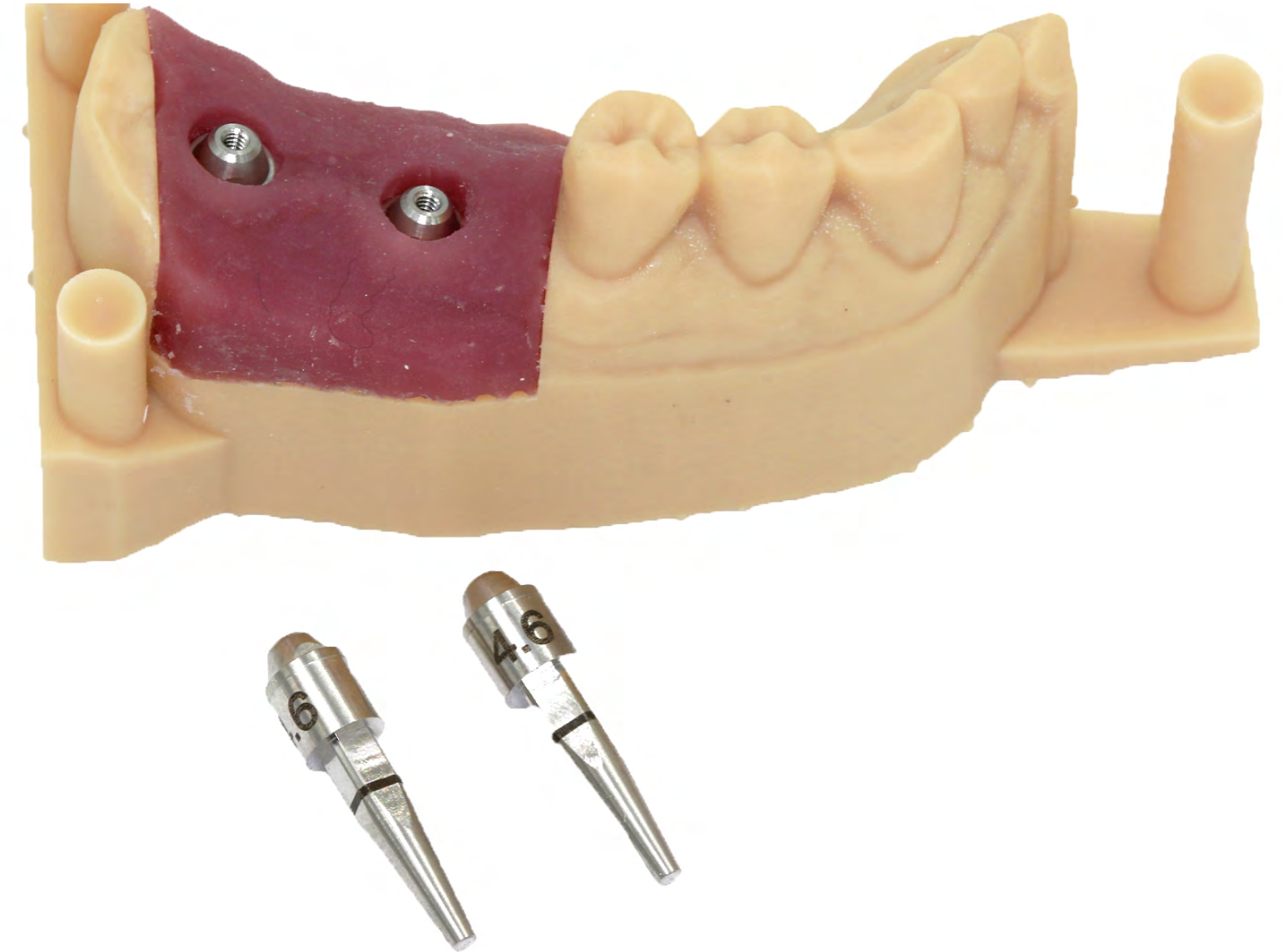


Getting better prints. 2020. <https://support.3dverkstan.se/article/30-getting-better-prints/>

Resin Models

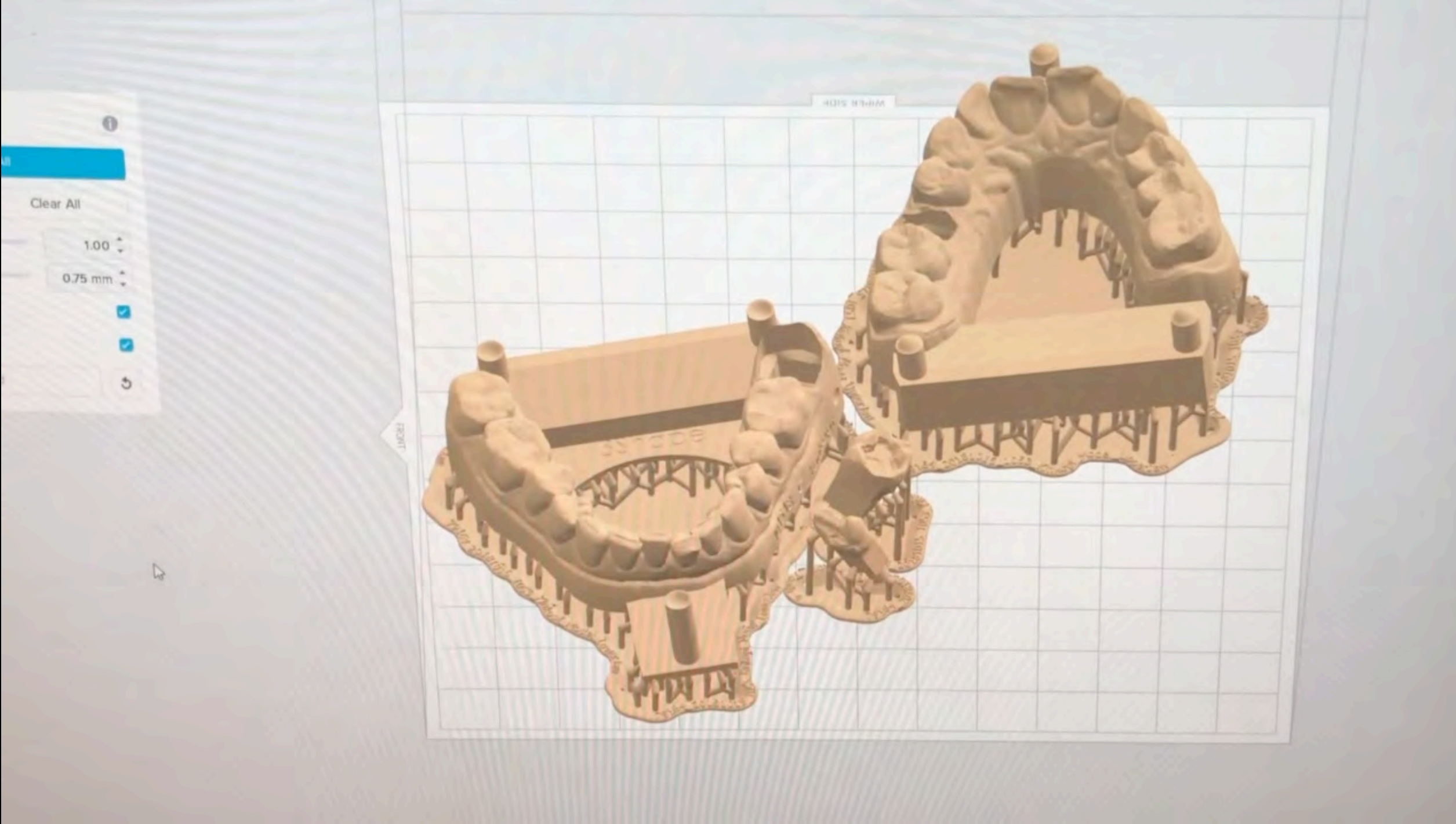


Digital Implant Replicas



3D Printers

- ✓ Speed & Accuracy
- ✓ Print Resolution
- ✓ Post Processing
- ✓ Open Material System
- ✓ Maintenance
- ✓ Repair Policy



Technology Assessment

Hardware

Software

Materials

CBCT

Acquisition

Lithium Disilicate

Optic Scanners

Planning

Zirconia

Milling Machines

CAD

Titanium

3D Printers

CAM

PMMA

Software



*Intraoral
Scanner*



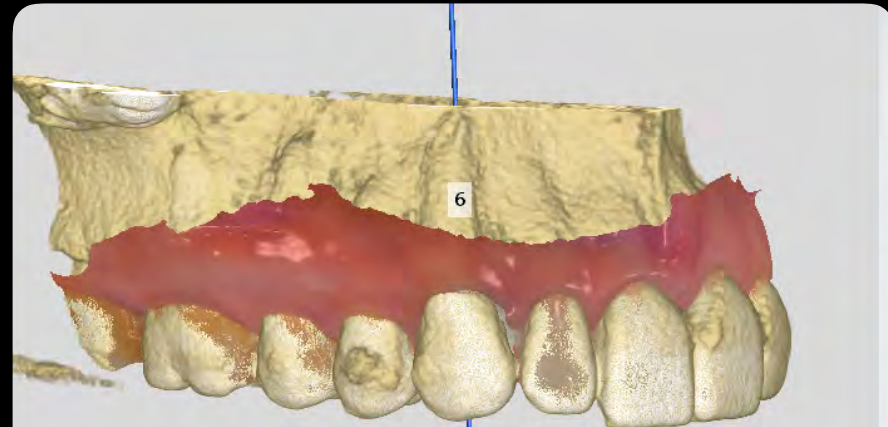
Acquisition



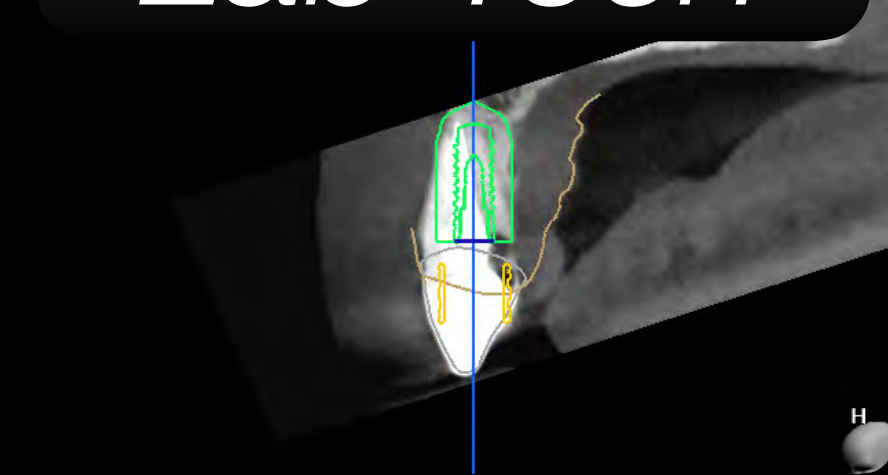
*Intraoral
Scanner*



Acquisition



*Surgeon &
Lab Tech*



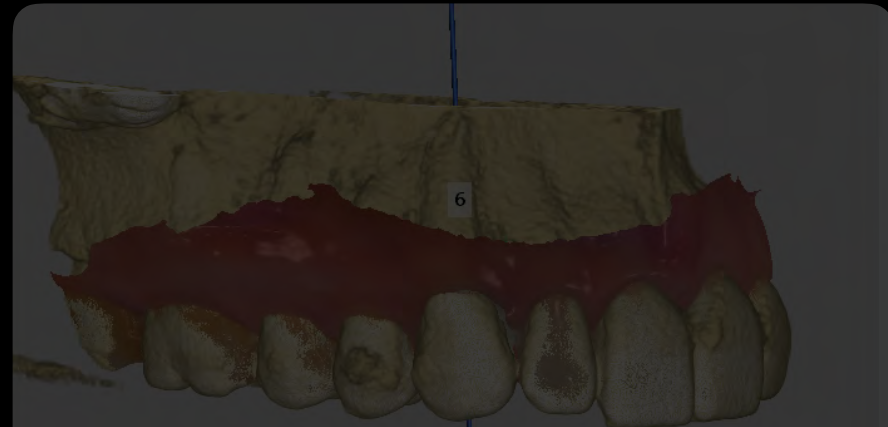
Planning



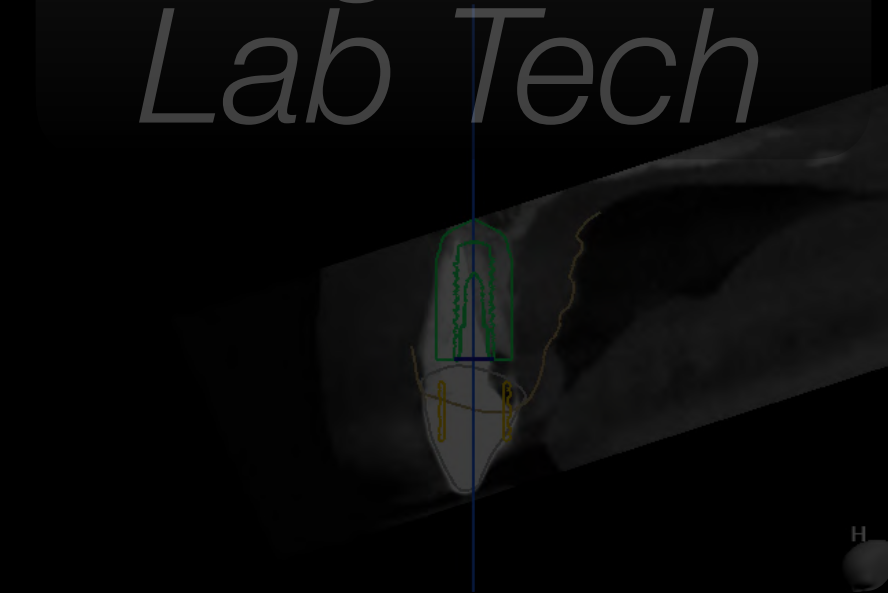
*Intraoral
Scanner*



Acquisition



*Surgeon &
Lab Tech*



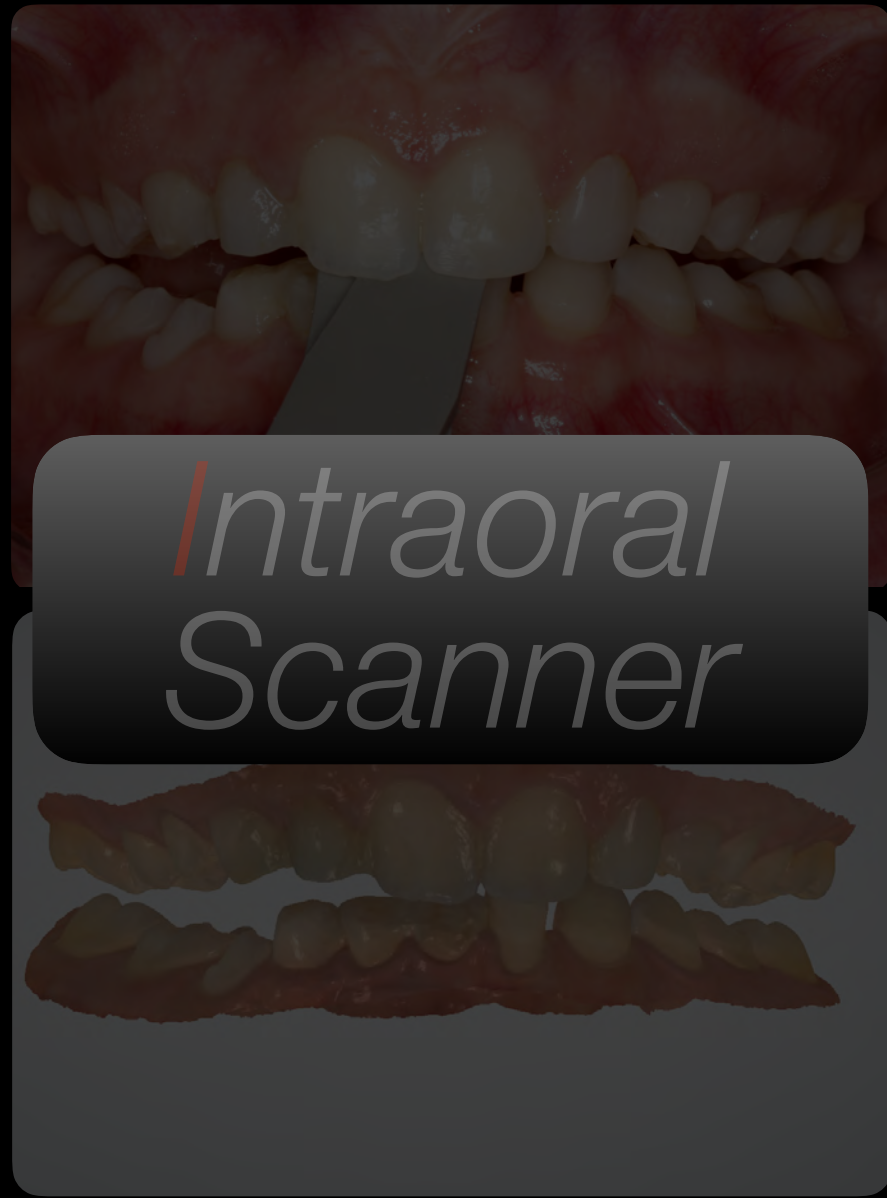
Planning



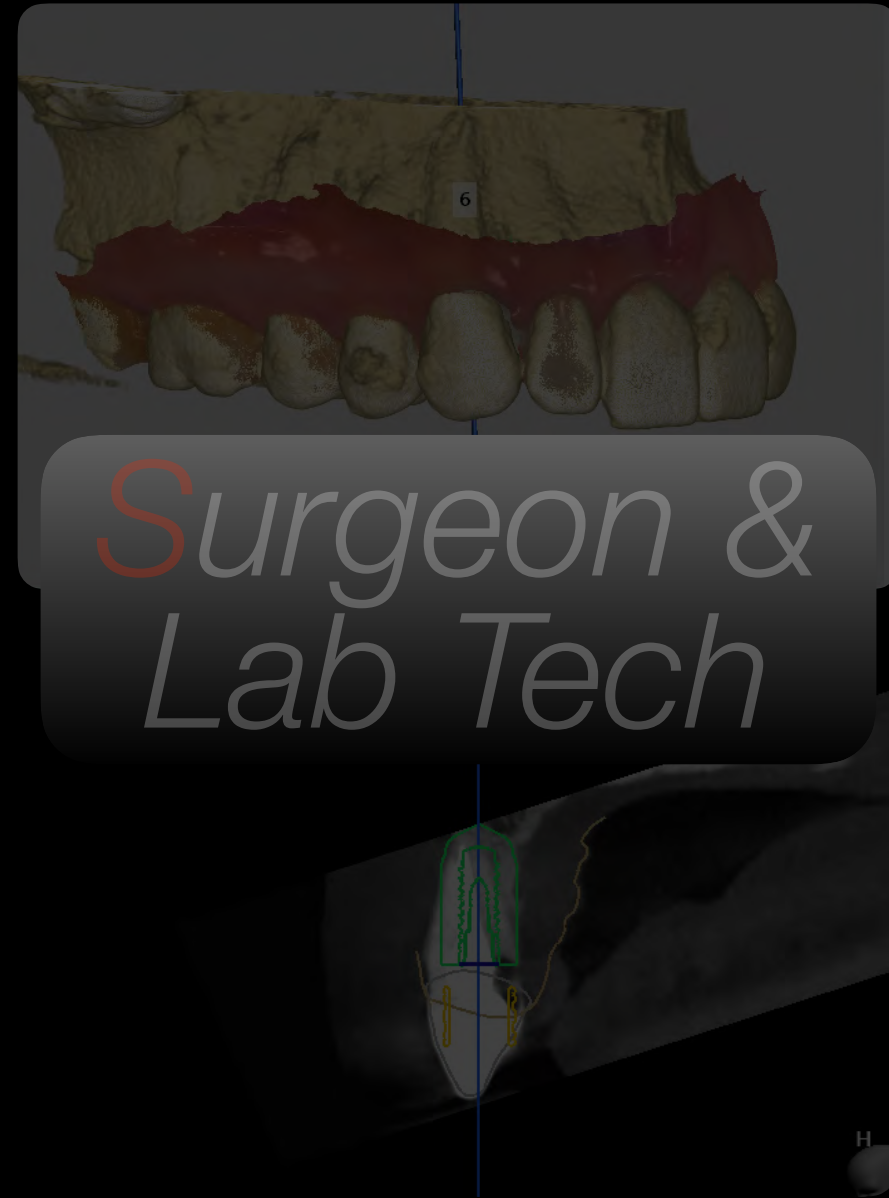
Lab Tech



CAD



*Intraoral
Scanner*



*Surgeon &
Lab Tech*



Lab Tech



Lab Tech

Acquisition

Planning

CAD

CAM

Technology Assessment

Hardware

CBCT

Optic Scanners

Milling Machines

3D Printers

Software

Acquisition

Planning

CAD

CAM

Materials

Lithium Disilicate

Zirconia

Titanium

PMMA

Pressed Lithium Disilicate

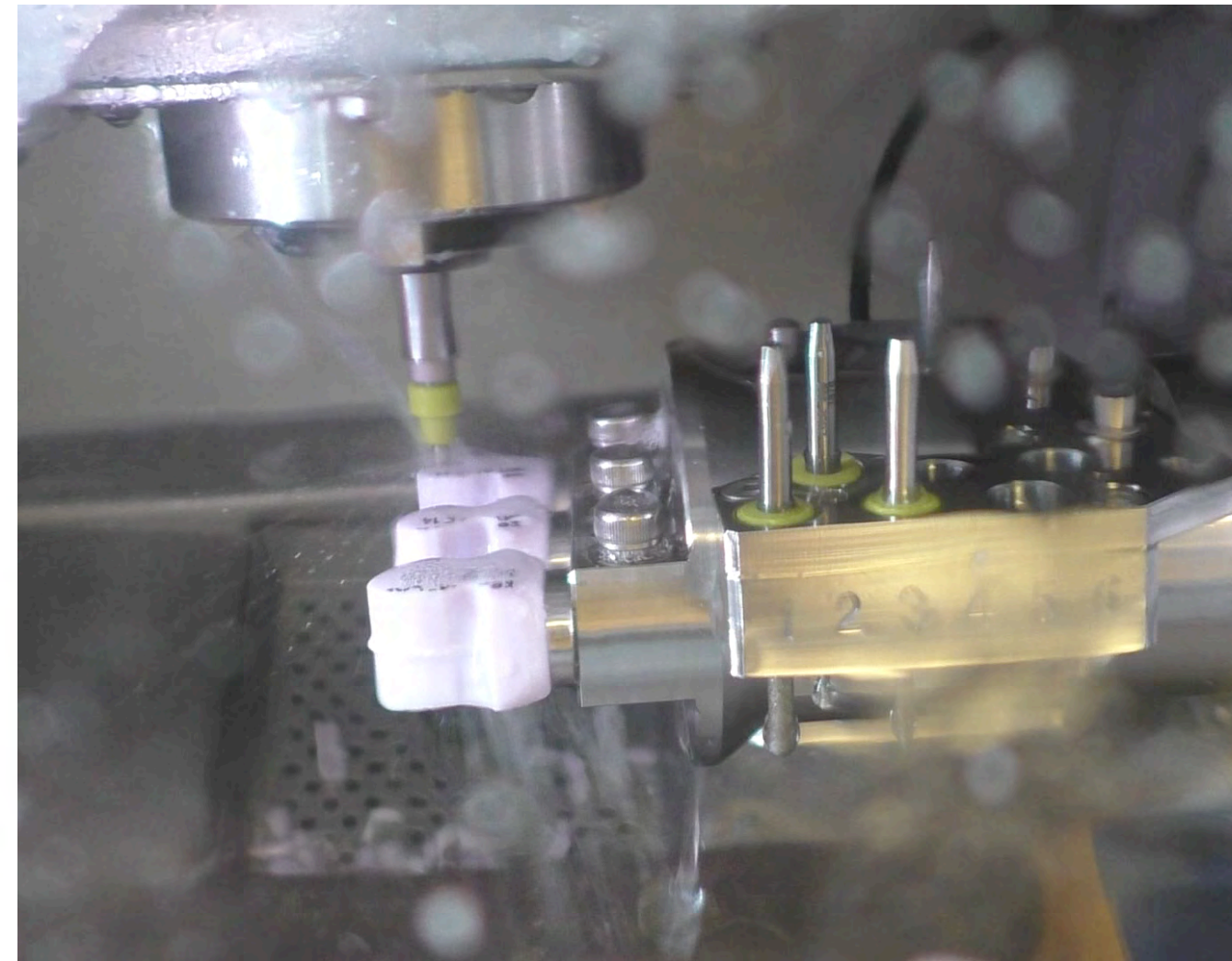






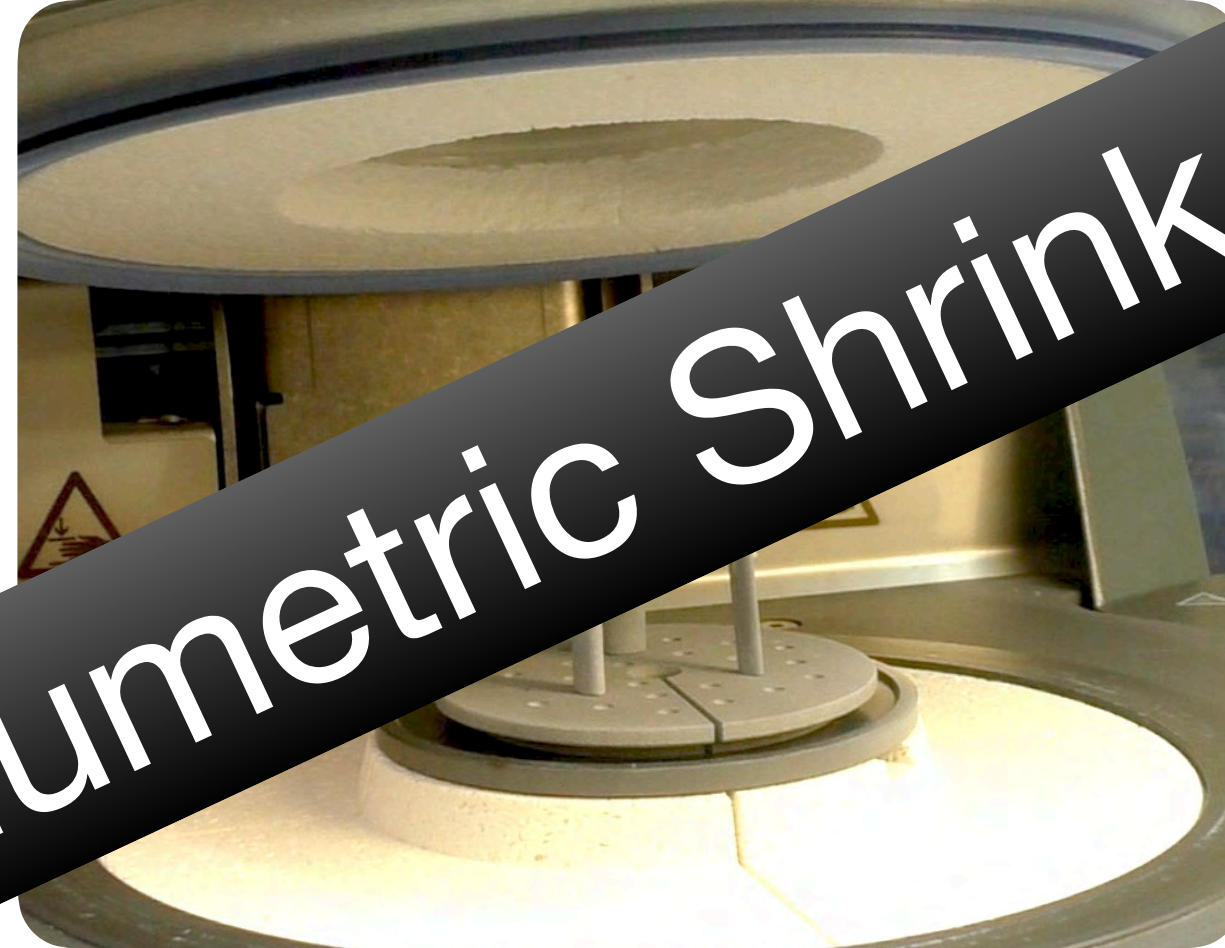


Milled Lithium Disilicate

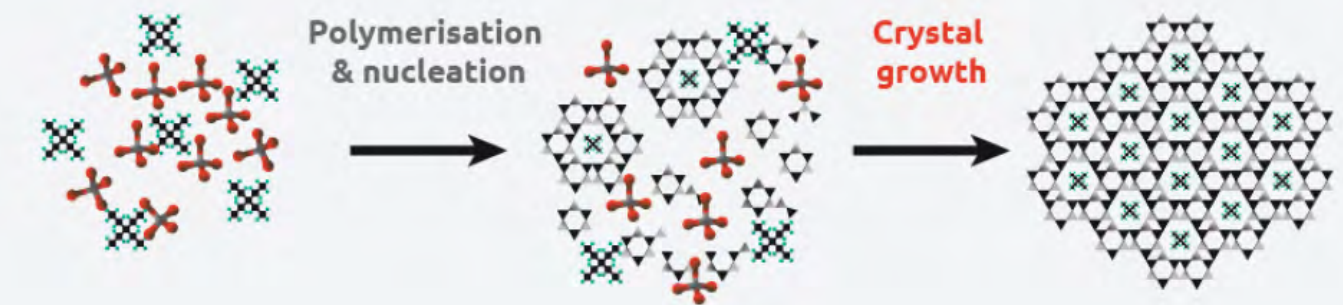
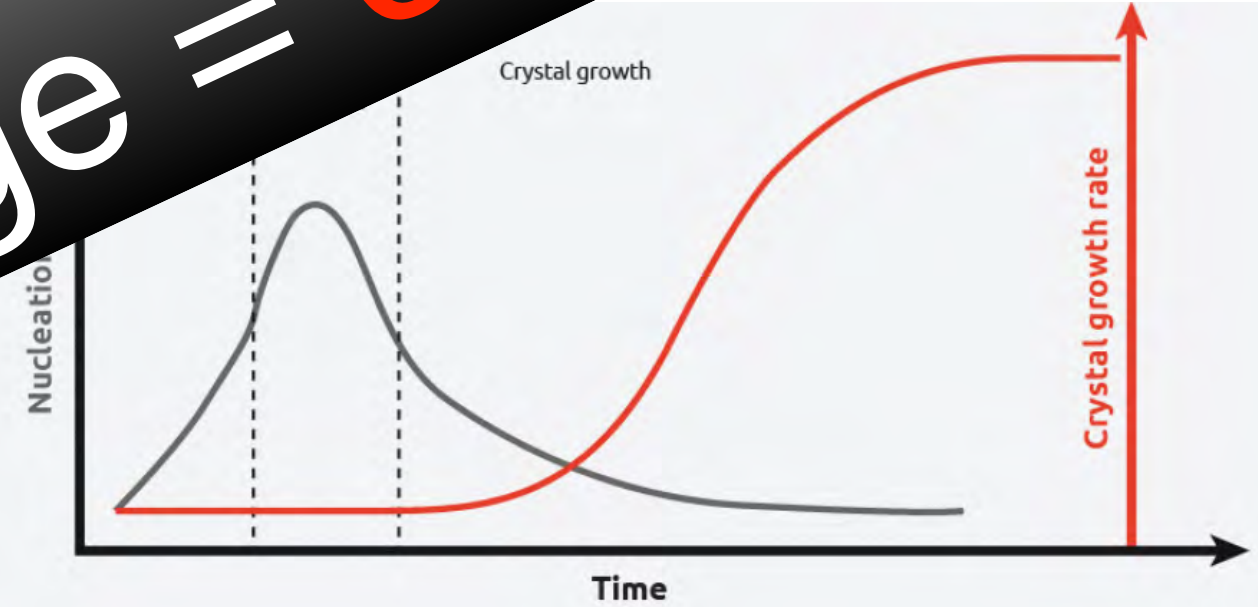


Crystallization

Dislicate



Volumetric Shrinkage = 0%







Zirconia



Nakamura, K, et al. Zirconia as a Dental Implant Material: A Systematic Review. Int J Pros 2010; 23:299-307

Biocompatible

Promotes Cell Adhesion and Proliferation

Minimum Thickness = **0.5** mm

Soon, G, et al. Review of zirconia-based bioceramics: Surface modification and cellular response. Ceramics International 2016; 42:12543-12555.

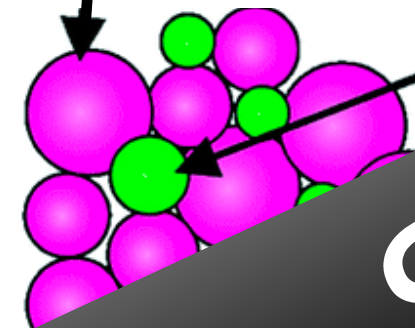
Sintering

Temperature

KNN-SSN particle

ZnO

Volumetric Shrinkage = 25%



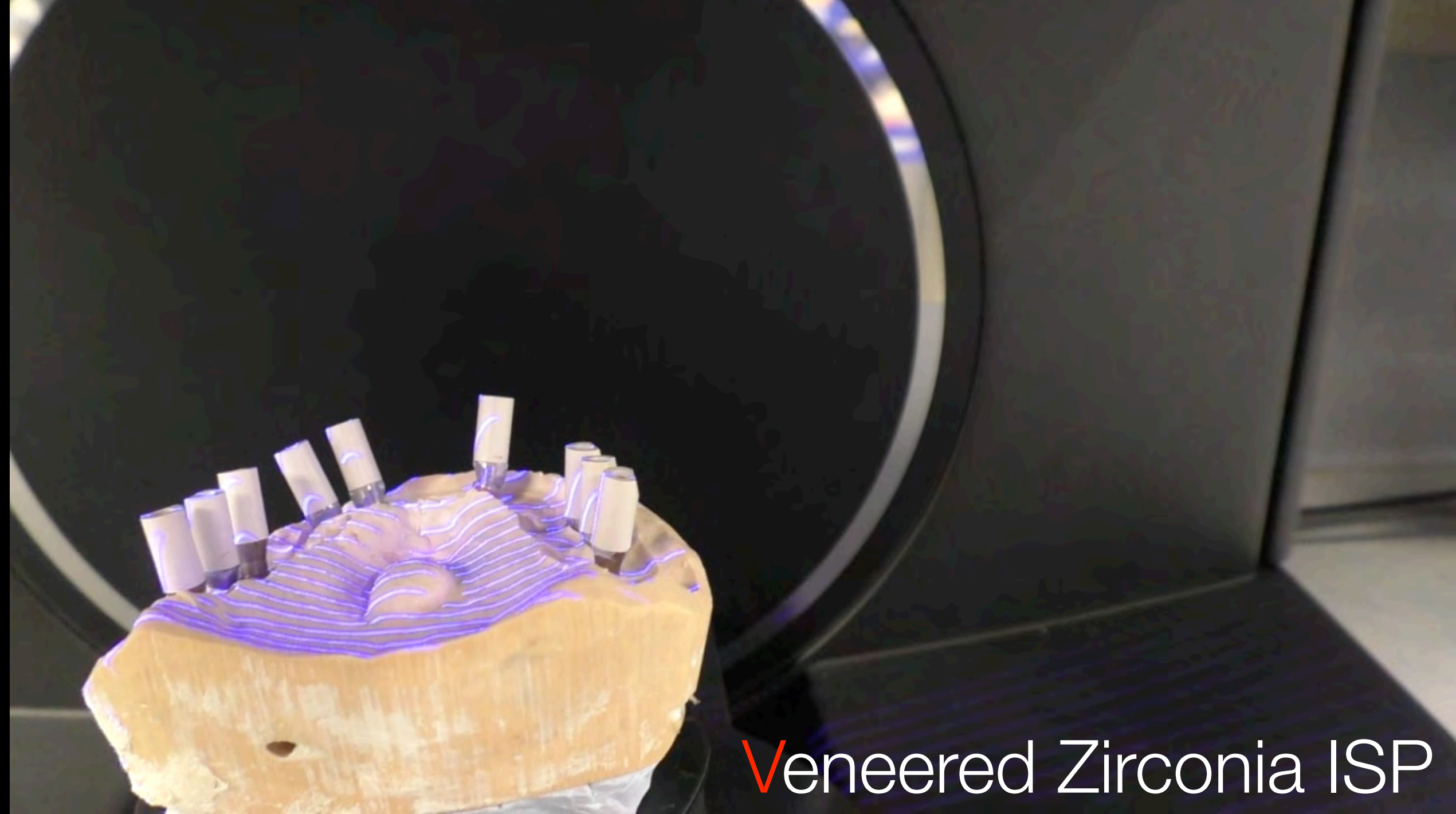
Liquid formation

Grains growing

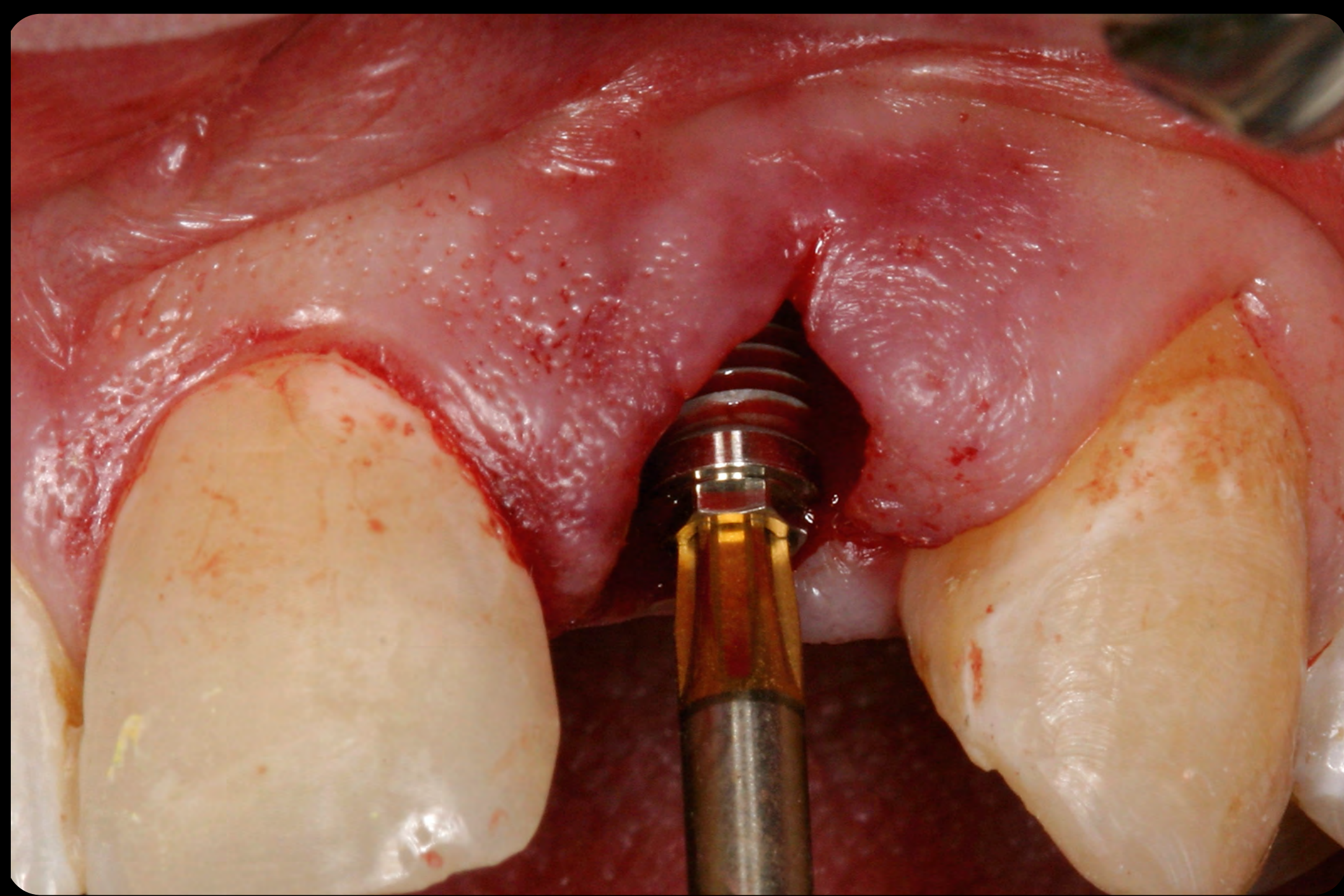
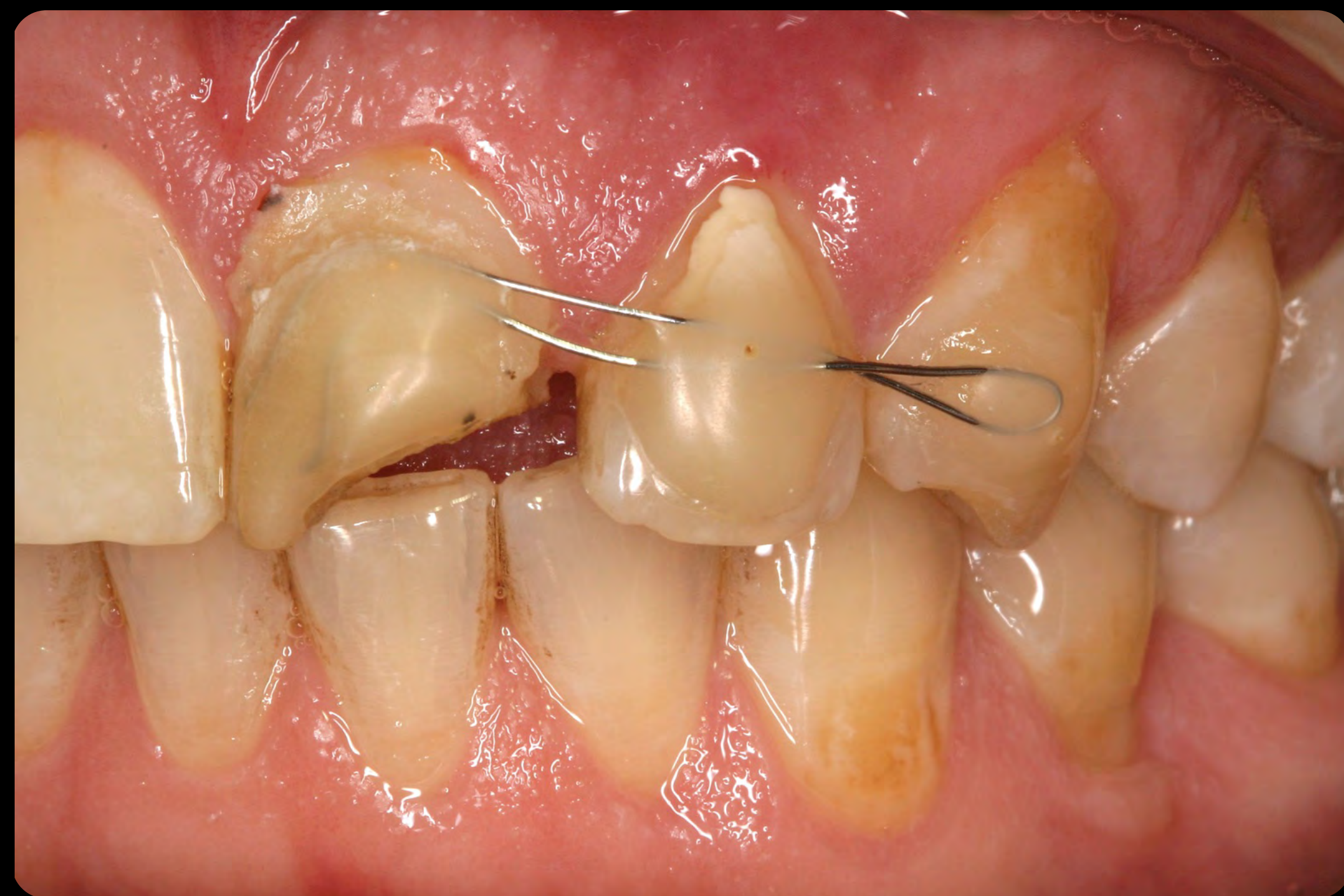
Dense Ceramics

Zirconia





Veneered Zirconia ISP



One Abutment/One Time

Canullo, L, et al. Clinical Considerations on Strategies That Avoid Multiple Connections and Disconnections of Implant Abutments. Int J Periodontics Restorative Dent 2020; 40:9-17.

Tallarico, M, et al. Definitive abutments placed at implant insertion and never removed: Is it an effective approach? A systematic review and meta-analysis of randomized controlled trials. J Oral Maxillofac Surg 2018; 76:316-324.

Abrahamsson, et. al. The mucosal barrier following abutment dis/reconnection. J Clin Periodontol 1997; 24:568-72.



Veneered Lithium Disilicate



Poly (methyl methacrylate) (PMMA)





Roadmap

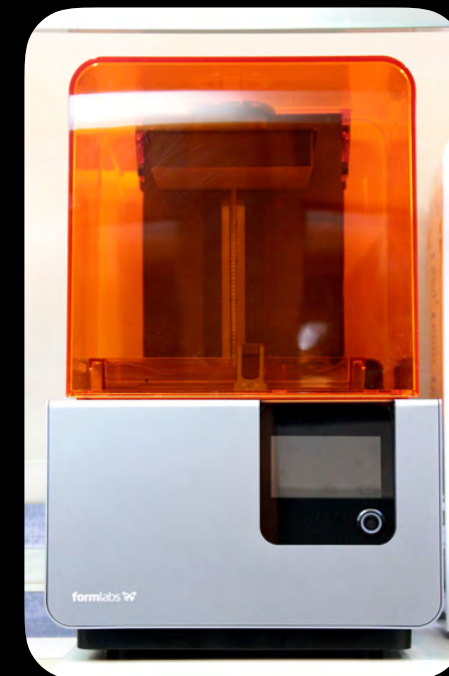
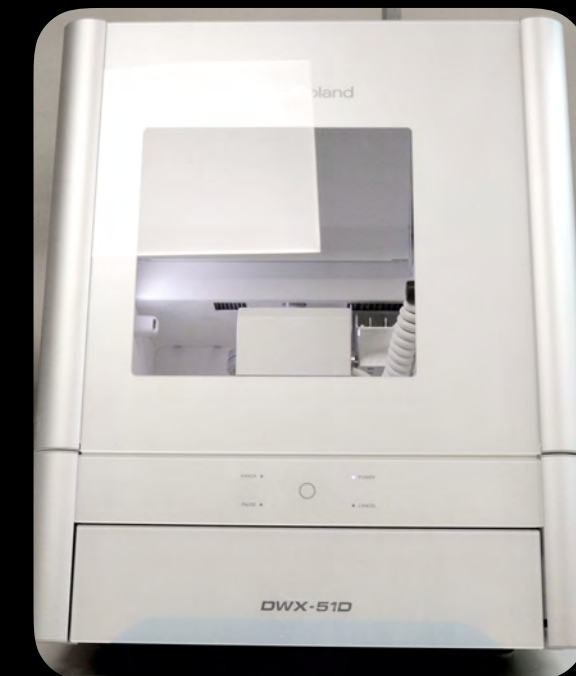


The diagram illustrates a strategic roadmap. It begins with a red dot at the bottom left, followed by a horizontal line segment. From there, the path curves upwards and to the right, passing through two more red dots. The text 'Why Digital?' is positioned to the left of the first dot. The text 'Technology Assessment' is positioned below the second dot. The text 'Technology Selection' is positioned to the left of the third dot. The path continues to curve upwards and to the right, ending in a long, horizontal, slightly wavy line at the top right of the image.

Why Digital?

Technology Selection

Technology Assessment



Technology	Company	Positives	Negatives	Cost	Yearly Fees
CBCT					
IOS Hardware & Software					
Facial Scanner/Digital Camera					
CAD/Planning/CAM Hardware & Software					
Model Scanner					
Milling Machine					
3D Printer					
Sintering Oven					
Ceramic Furnace					

Considerations

- ✓ 3-5 Year Lifecycle & Payoff
- ✓ Open System for Future Expansion & Flexibility
- ✓ Speed, Accuracy, Reliability, & Support
- ✓ Reduction in Supply, Laboratory, & Delivery Costs
- ✓ Develop a More Efficient Workflow & Archival System
- ✓ Faster Laboratory Turnaround Time

Technology	Cost	Monthly Payment	Total Payment
IOS	\$40,000		
Mill	\$40,000		
Oven	\$10,000		
3D Printer	\$10,000		

Payments Based on 3 Yr Lease at 4.5% Annual Interest

Technology	Cost	Monthly Payment	Total Payment
10S	\$40,000	\$1190	\$42,836
Mill	\$40,000	\$1190	\$42,836
oven	\$10,000	\$297	\$10,708
3D Printer	\$10,000	\$297	\$10,708

Total Cost = \$107,088

Monthly Payment = \$2,974

Payments Based on 3 Yr Lease at 4.5% Annual Interest

Return On Investment (ROI)

Chairside & Laboratory Efficiency = ?

Patient Education & Marketing Tool = ?

Income (2 Additional Crowns @ \$1800 ea. /mo x 36 mos) = \$129,600

Supply Costs Savings (\$500/mo x 36 mos) = \$ 18,000

Total Cost of Technology = **-\$107,088**

Software Licensing Fees (\$1900/Yr x 3 Yrs) = **-\$ 5,700**

Net Income (3 Yrs) = **\$ 34,812**

ROI Calculation

$$\text{ROI} = \frac{\text{Net Profit}}{\text{Total Investment}} \times 100\% = \frac{\$ 34,812}{\$112,788} \times 100\%$$

(\$107,088 + \$5700)

$$\text{ROI} = 30.86\%$$

Roadmap



The diagram illustrates a four-stage roadmap. It begins with a horizontal line at the bottom left, marked by a red dot and the label 'Why Digital?'. This line transitions into a curved path that moves upwards and to the right. A second red dot marks the start of the curve, labeled 'Technology Assessment'. The curve continues to rise, marked by a third red dot labeled 'Technology Selection'. Finally, the path levels out towards the top right, marked by a fourth red dot labeled 'Integration & Training'. The word 'Roadmap' is written in a large, stylized font at the top left, with the 'R' in red and the rest in black, underlined with a red brushstroke.

Integration & Training

Technology Selection

Why Digital?

Technology Assessment



Practice Management
CBCT
Optic Scanners
Digital Radiography
Digital Photography/Video

Clinic



Practice Management
CBCT
Model Scanner
CAD/CAM
Digital Photography/Video
Planning

Laboratory

Referrals



Mobile
Devices

Laboratories
Milling Centers



Practice Management
CBCT
Optic Scanners
Digital Radiography
Digital Photography/Video

Clinic

Practice Management
CBCT
Model Scanner
CAD/CAM
Digital Photography/Video
Planning

Lab

Vendor

Install, Train, & Support

Integration & Staff
Training

IT Company

Integration & Network

Internal IT

Onsite Troubleshooting

Digital Lab &/or Milling Center

Technical Design & Milling

IT Company

Technology
Consultant

Cyber Security
&
Back Up
Systems

Hardware
&
Software
Maintenance

HIPAA
Compliance

IT/**N**etwork

Milling **C**enter

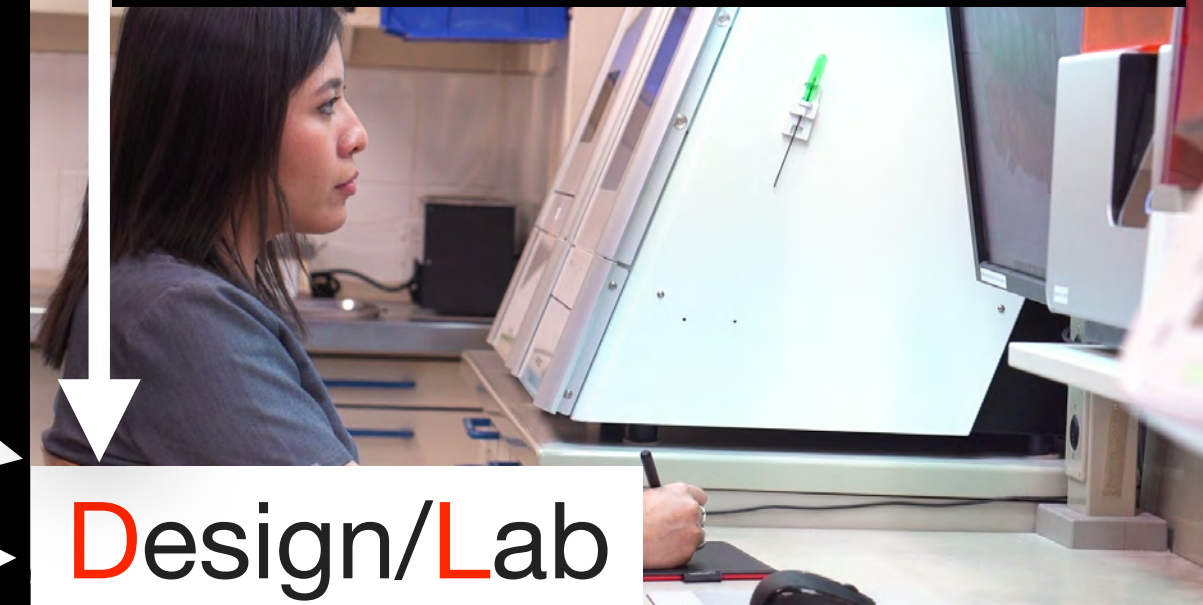
Service

CAM

Internal **I**T

Vendor/**S**upport

Design/**L**ab



Support & Training



Roadmap



The diagram illustrates a five-stage roadmap for digital transformation. A dark gray, textured line represents the path, which starts horizontally at the bottom left, curves upwards and to the right, then curves downwards and to the right, and finally levels out horizontally at the top right. Five red circular markers are placed along this path at each stage. The stages are labeled with text: 'Why Digital?' (red 'W', gray 'hy Digital?'), 'Technology Assessment' (red 'T', gray 'echnology Assessment'), 'Technology Selection' (red 'T', gray 'echnology Selection'), 'Integration & Training' (red 'I', gray 'ntegration & Training'), and 'Implementation' (red 'I', gray 'mplementation'). The word 'Roadmap' is written in large black font at the top left, with the 'R' in red and the rest in black, and a red underline.

Why Digital?

Technology Assessment

Technology Selection

Integration & Training

Implementation



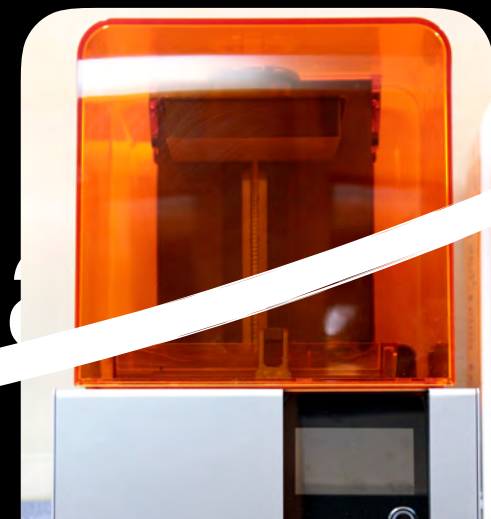
~~Conver Workflow~~

~~Model Scanner~~



~~Digital Workflow~~

~~3D Printer~~



Lithium
Disilicate

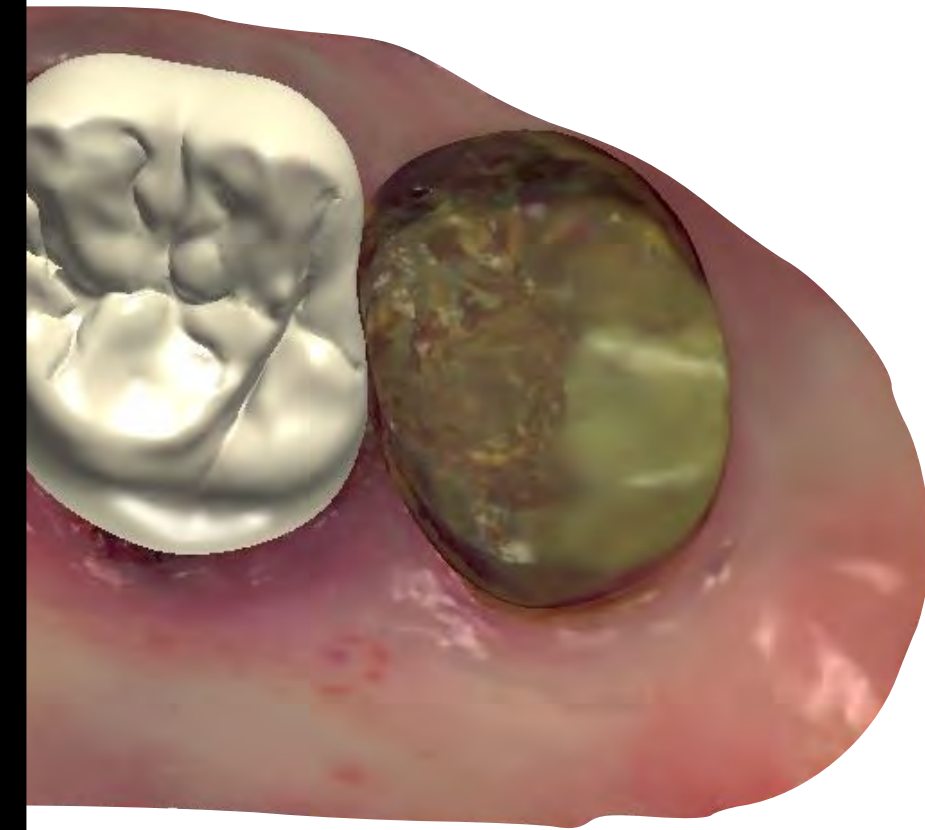
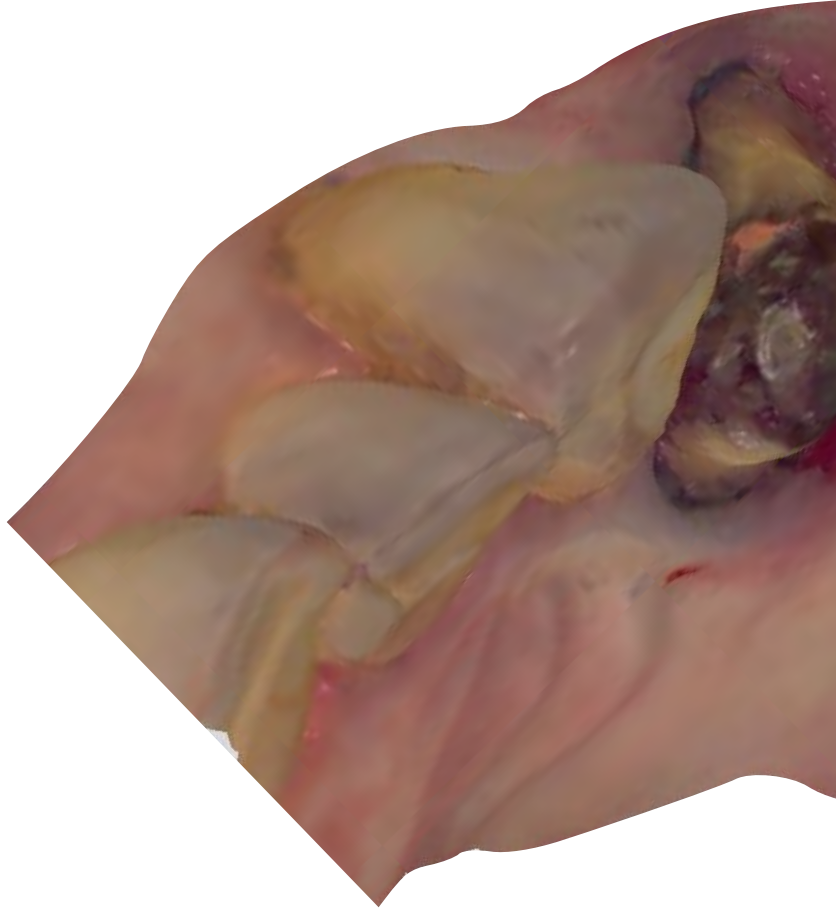


Mon



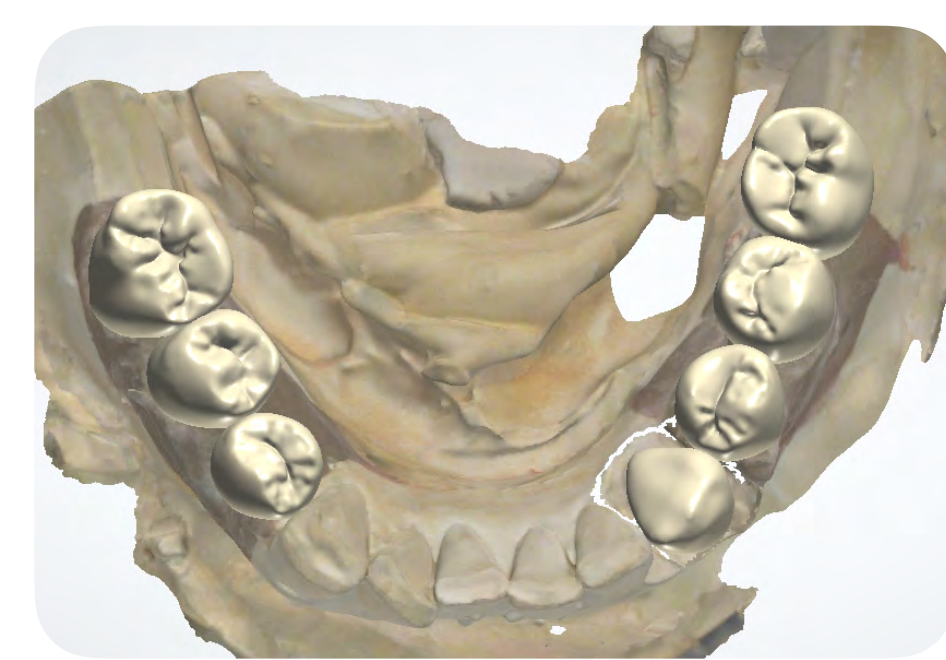
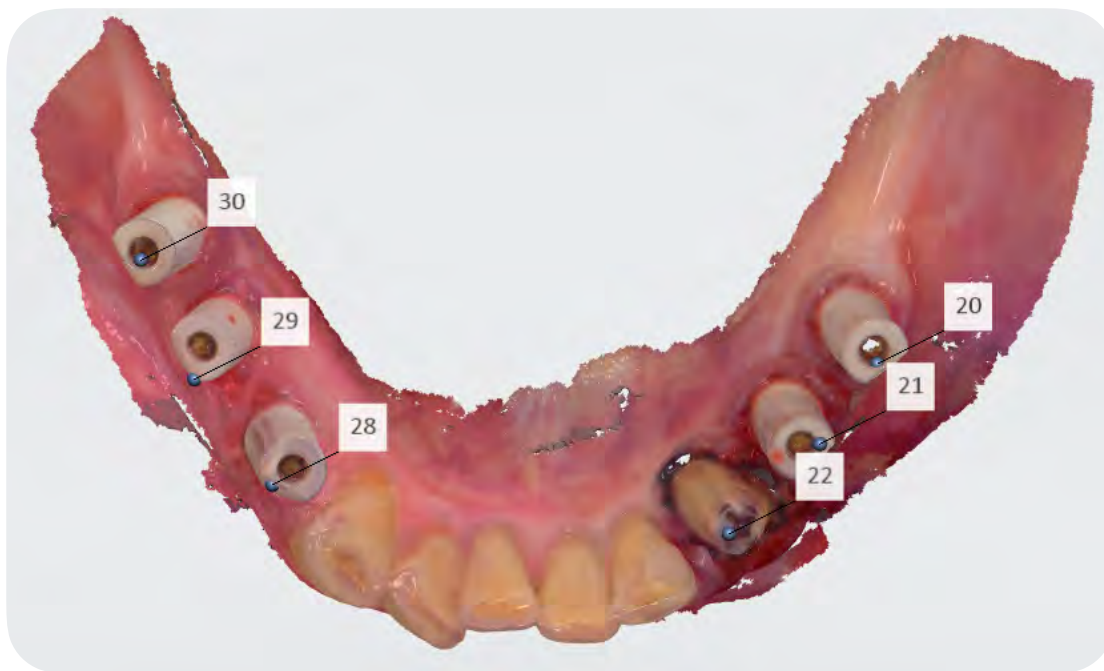
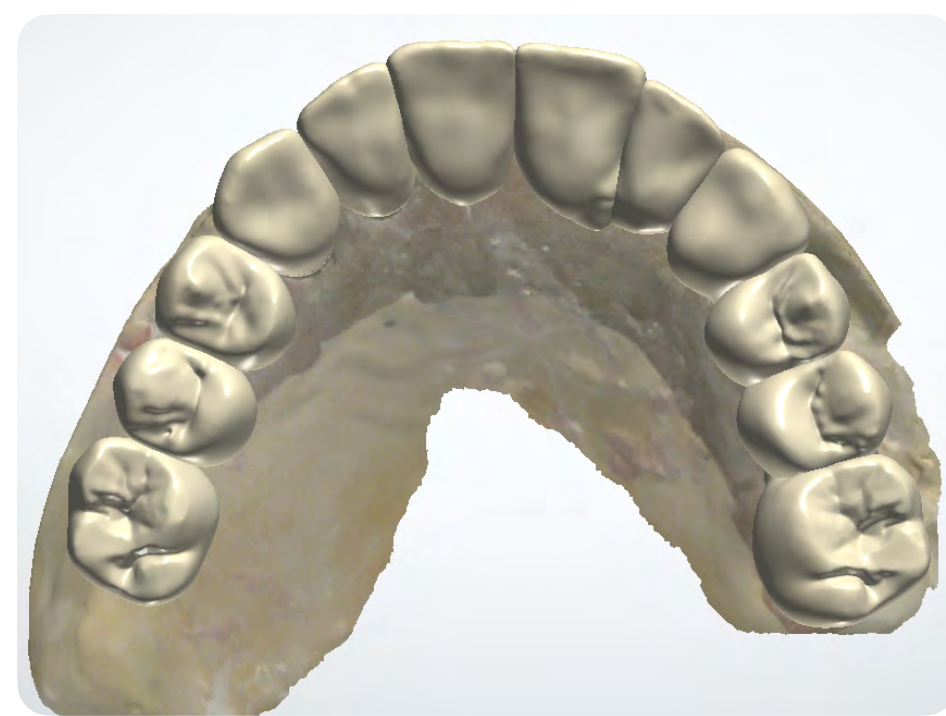
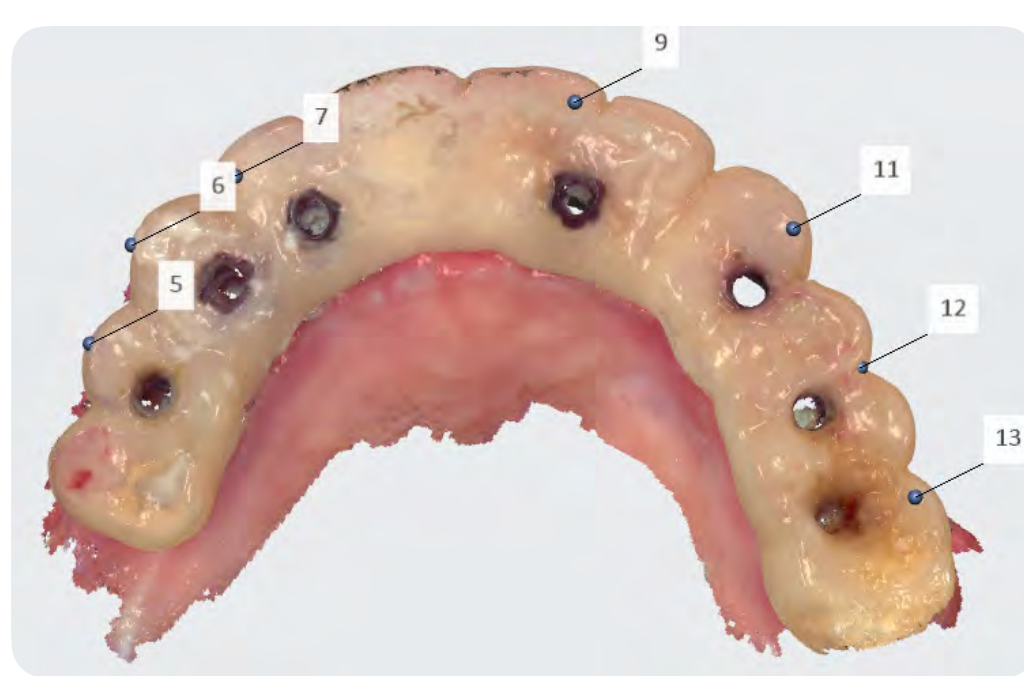
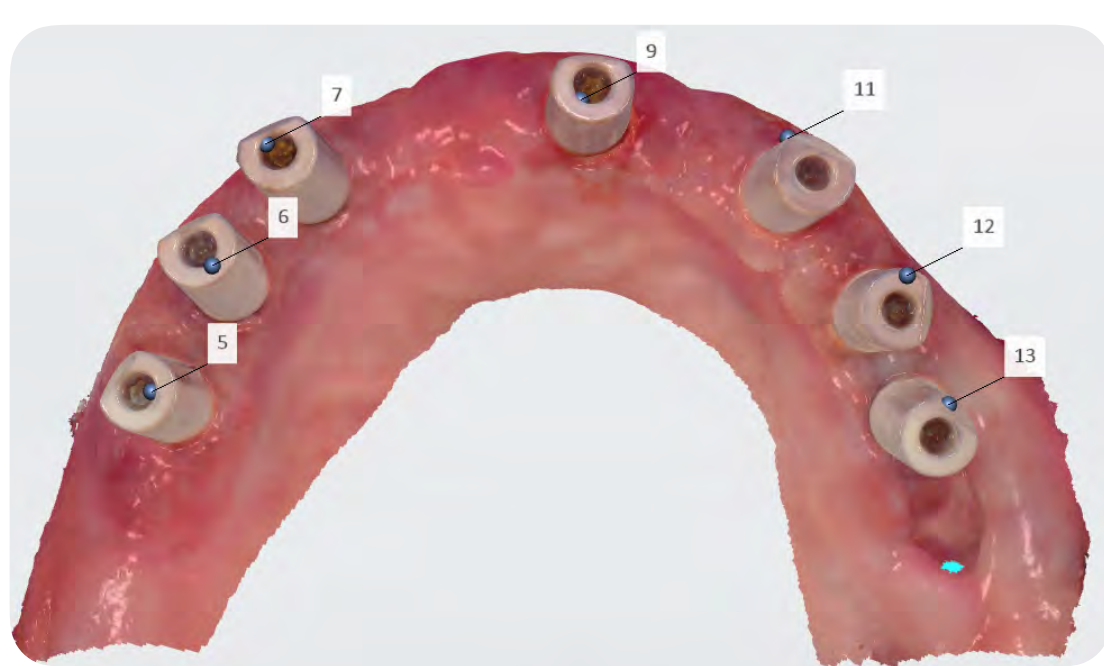


Modelless









Monolithic Zirconia



Kim, KR, et al. Conventional open-tray impression versus intraoral digital scan for implant-level complete arch impression. J Prosthet Dent 2019; 122(6):543-549.





Virtual Wax-up

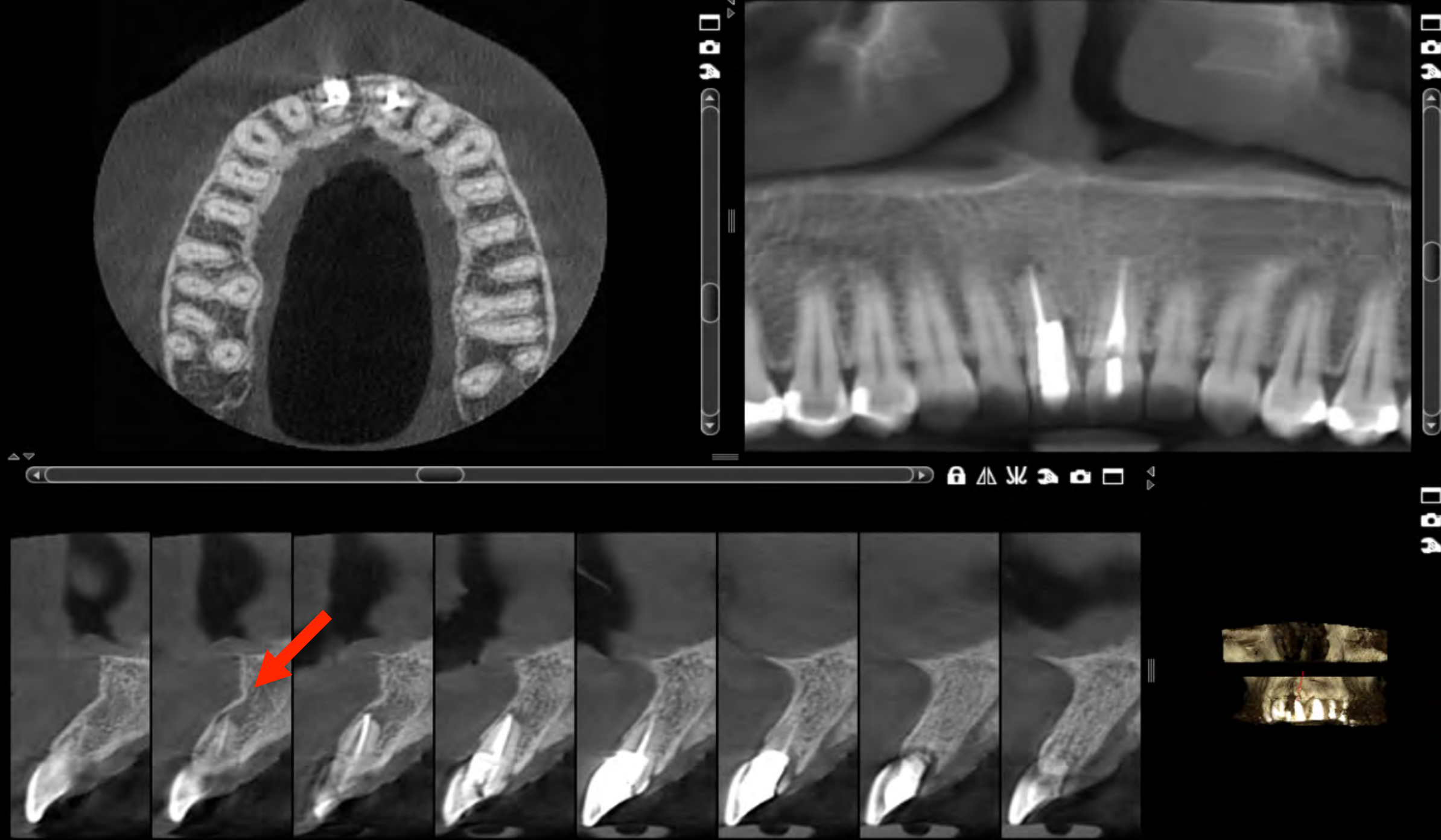


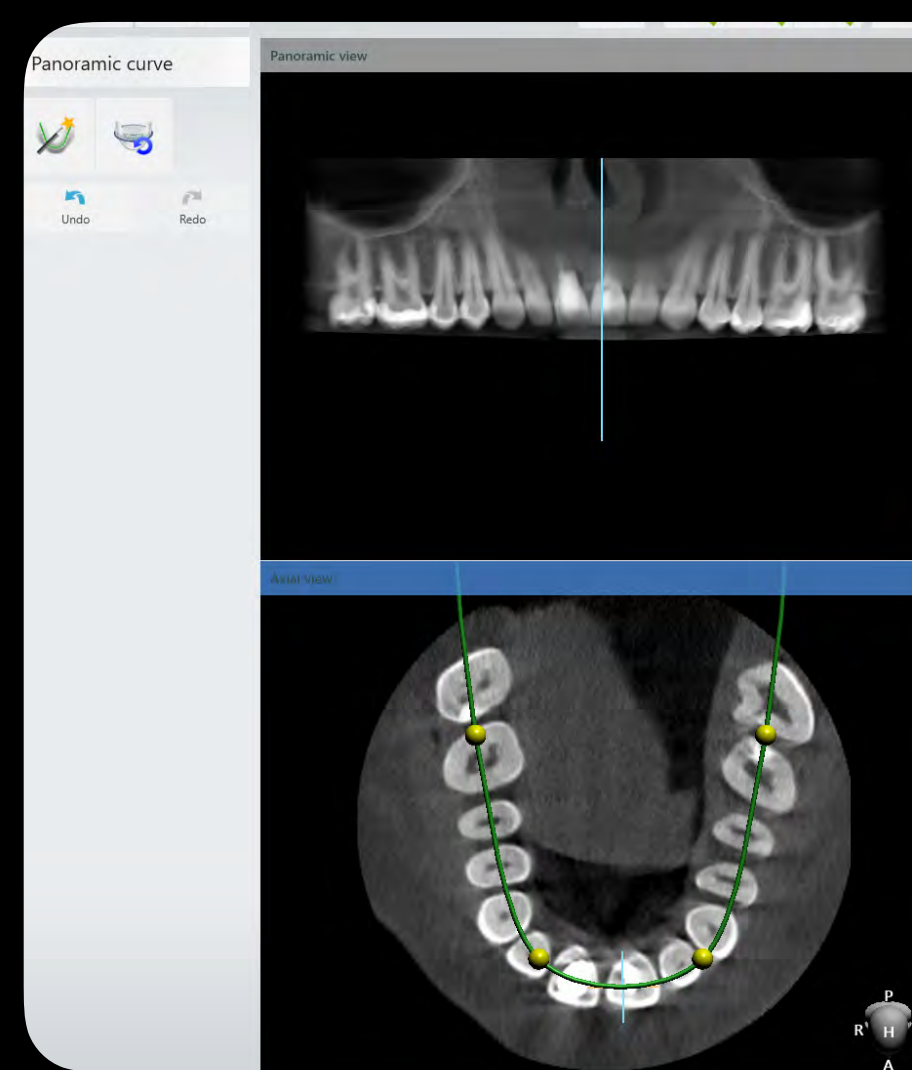


Virtual Design

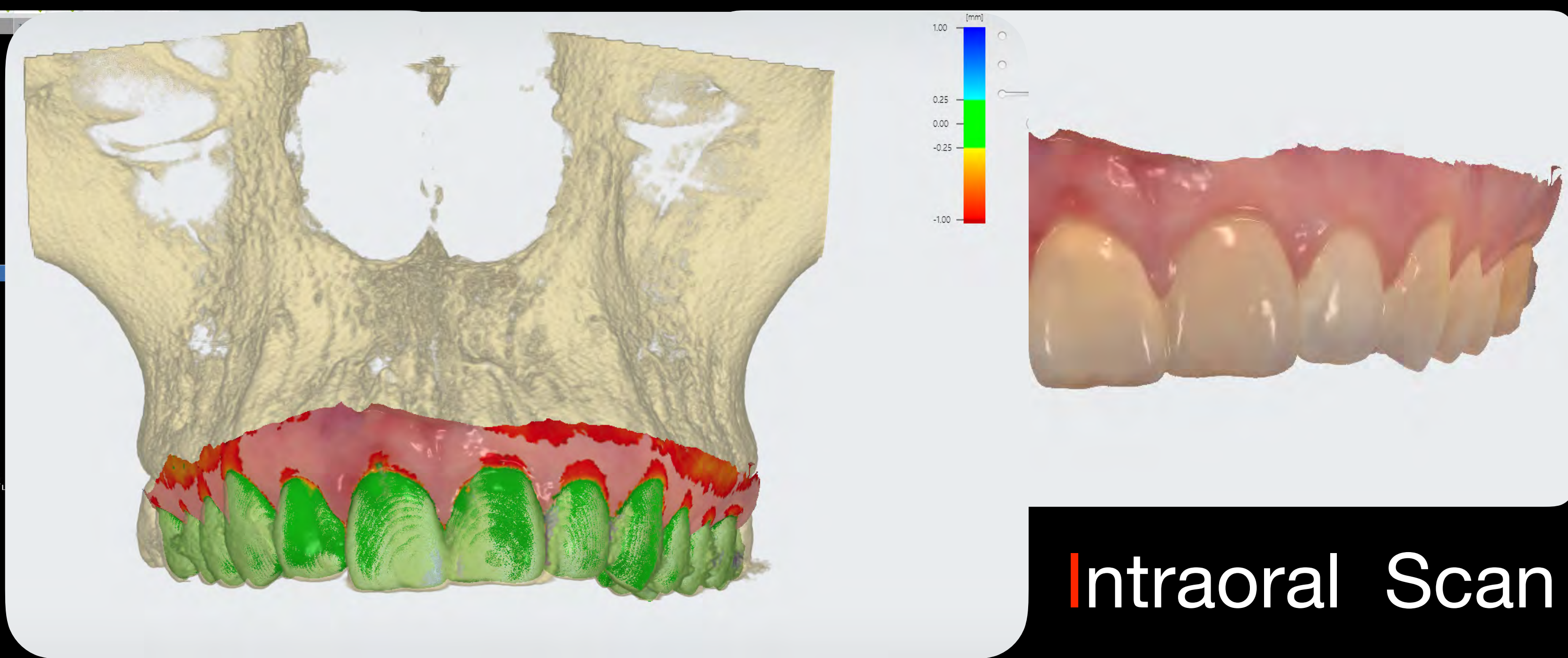




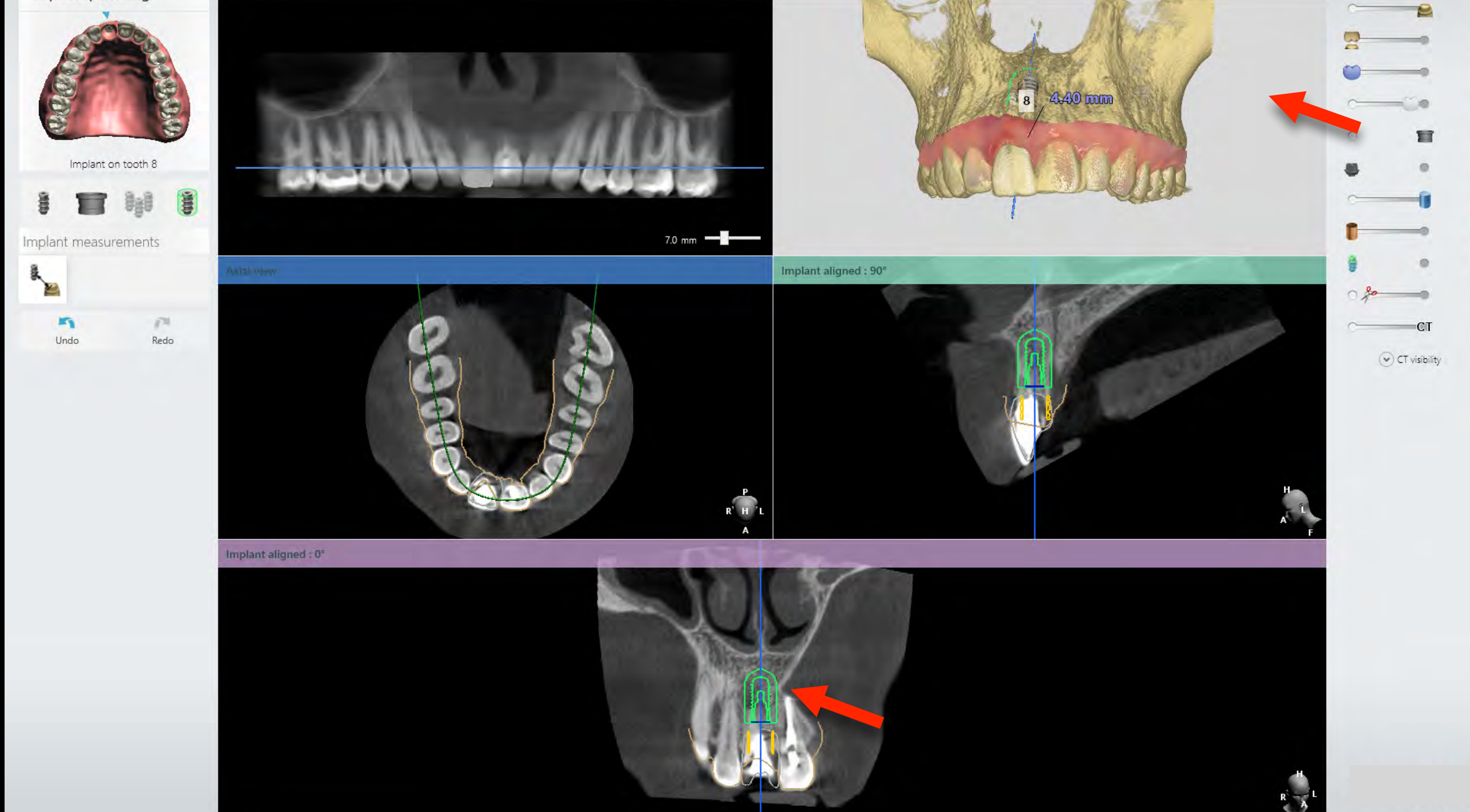




CBCT



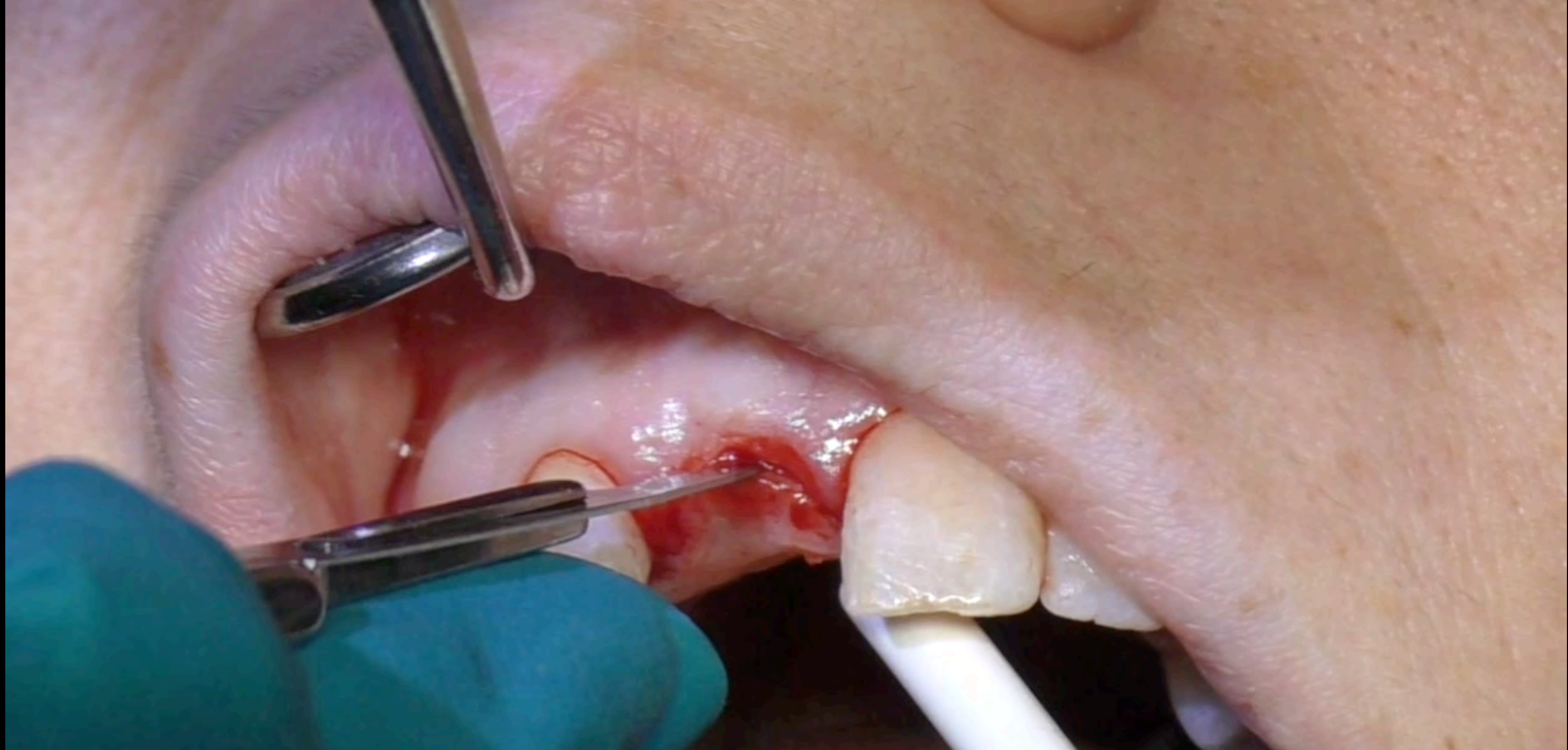
Intraoral Scan



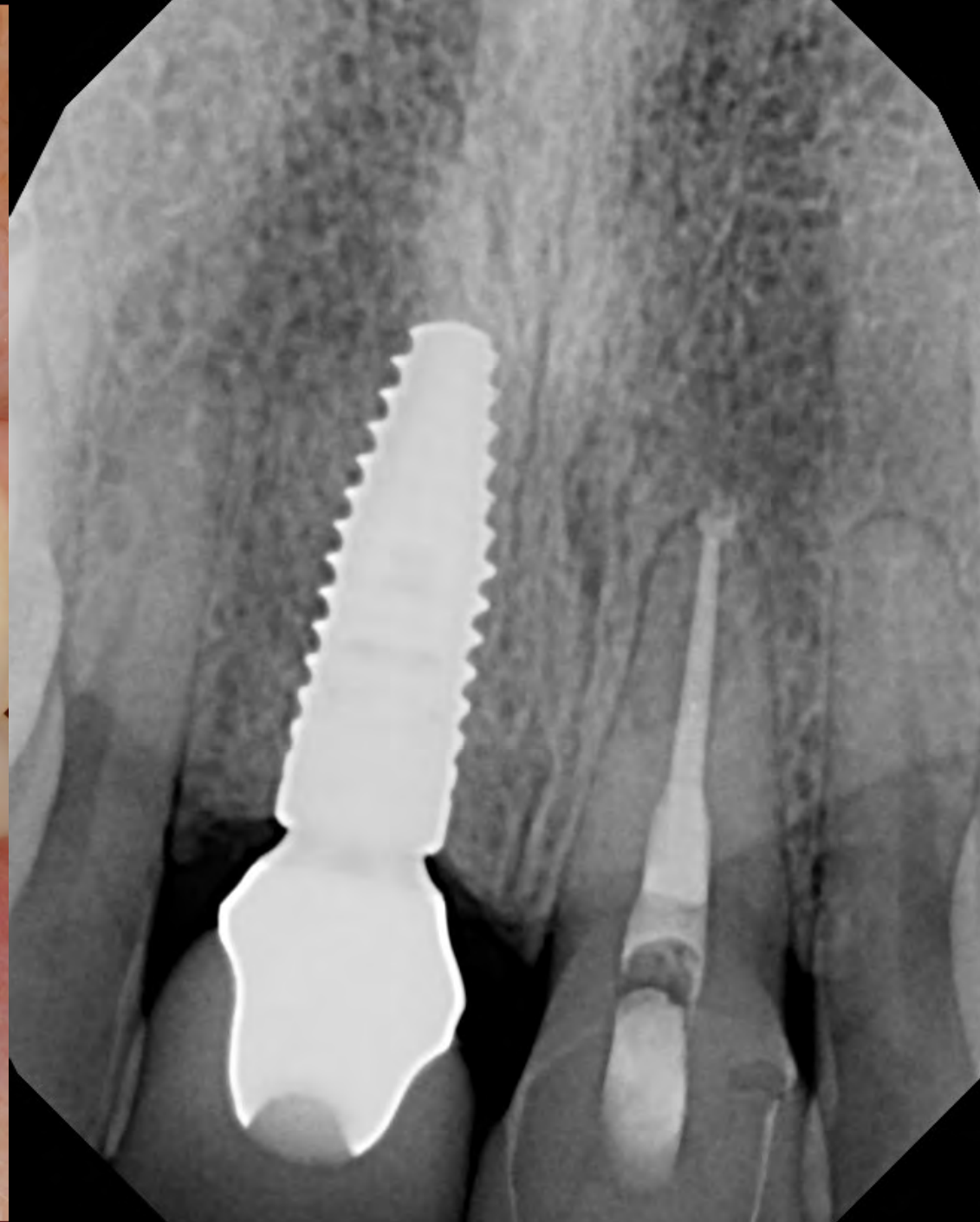
Advantages

- ✓ Treatment Planning
- ✓ Surgical Guide
- ✓ Abutment Fabrication
- ✓ Provisional Fabrication









Take Home Messages

- ✓ Do not feel pressured to convert to digital.
- ✓ Thoroughly research & evaluate the technology before any commitment.
- ✓ Steep digital learning curve...precede slowly and steadily.
- ✓ Learn to delegate and develop a team concept.



*Digital dentistry **will not replace** dentists.*

*Dentists who embrace digital dentistry **will**
replace those who don't.*



<https://www.gdental.com/events/>

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