

Application of the Dental Avatar



Isaac D Tawil
DDS MS

**Everything changes and
somewhere along the line we
need to change with it or fall
behind**

—George Bernard Shaw

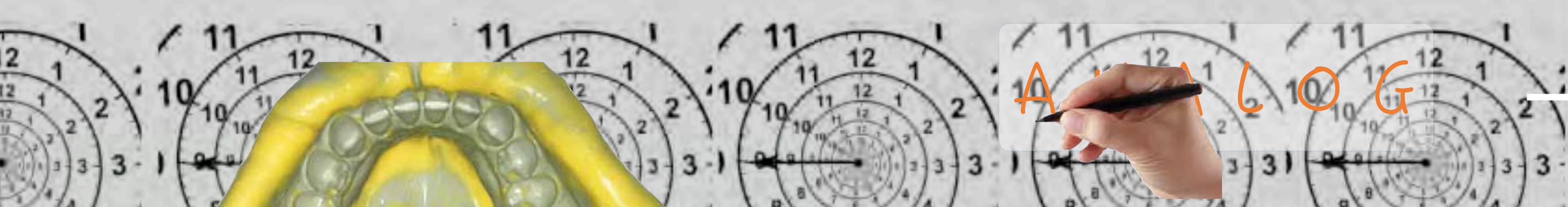


**“We should strive to welcome change and challenges,
because they are what help us
grow.....**

**We need to constantly be challenging ourselves in
order to strengthen our character and increase our
intelligence.”**

— H.G. Wells, The Time Machine





ANALOG

DIGITAL

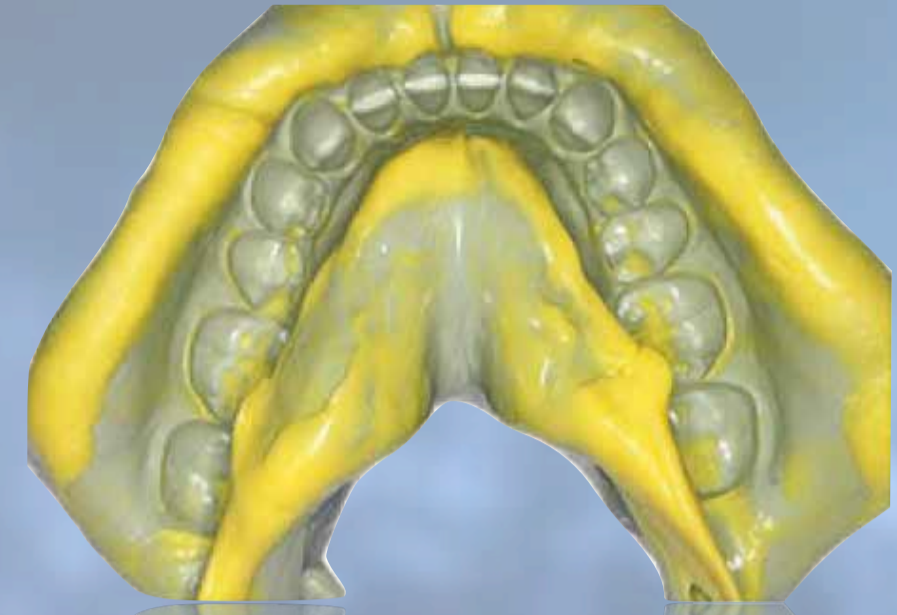




ANALOG



DIGITAL



ANALOG → DIGITAL



AI

01010101 0101 010101 0101

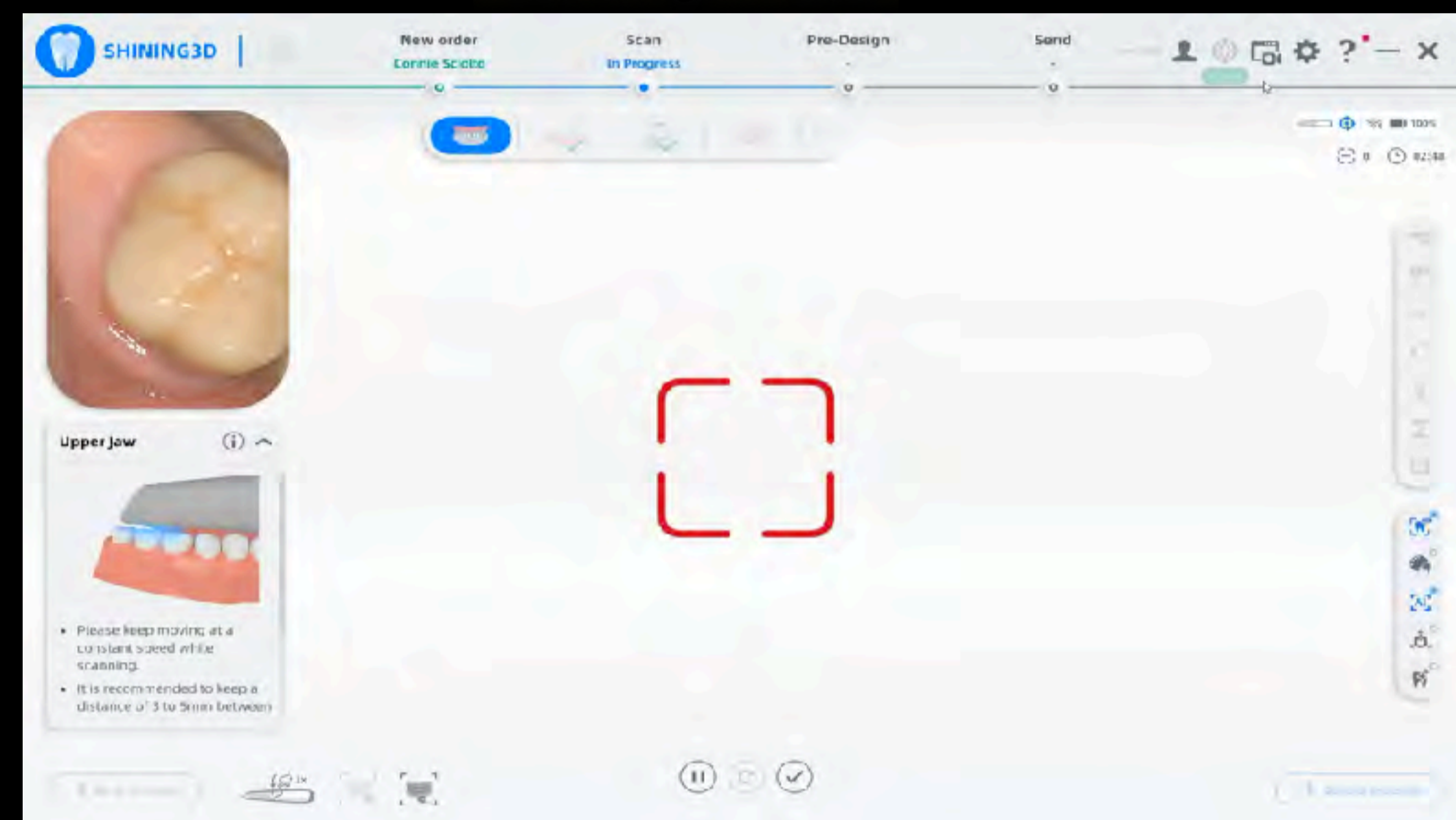
01010101 0101 010101 0101

01010101 0101 010101 0101

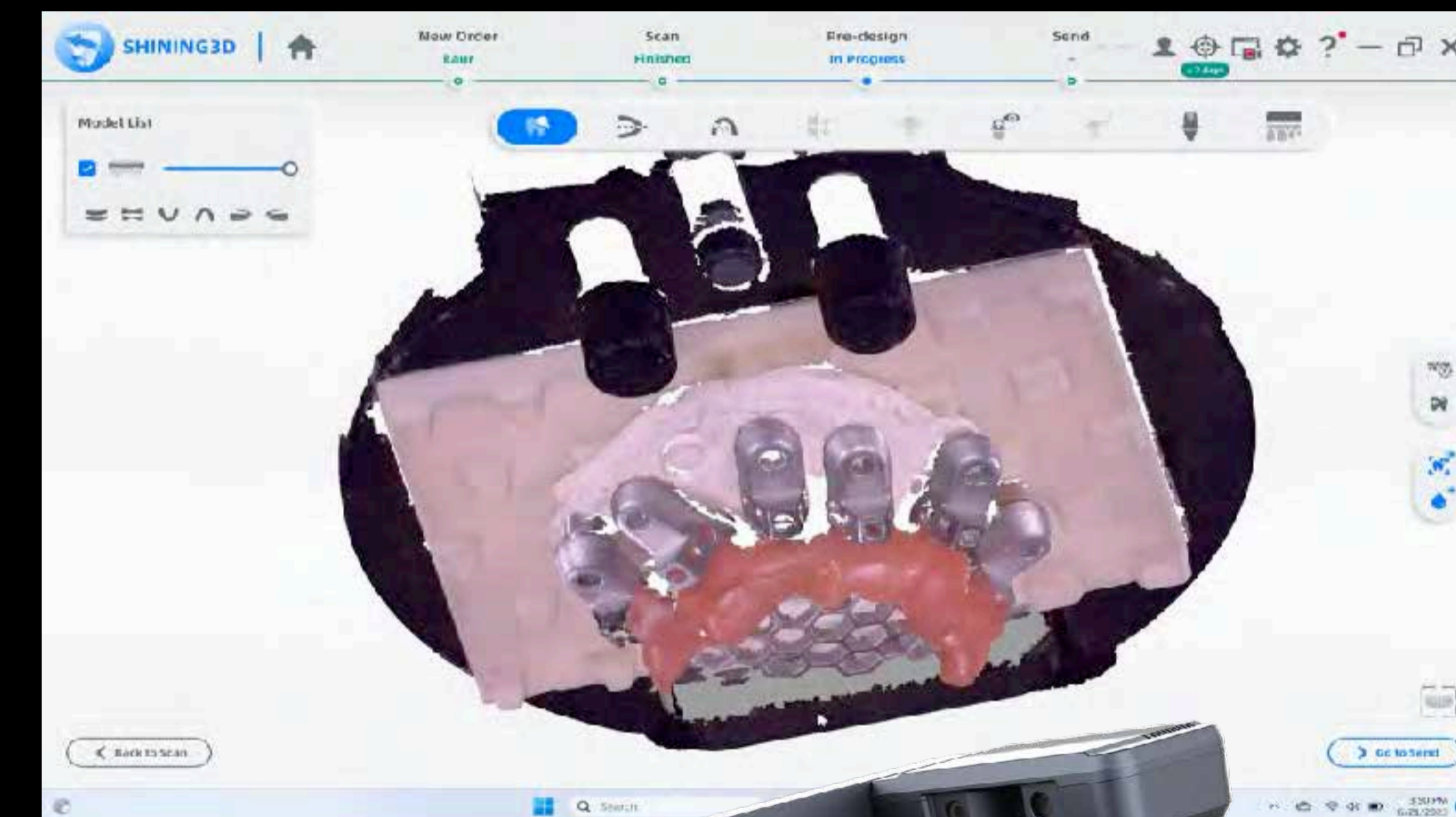




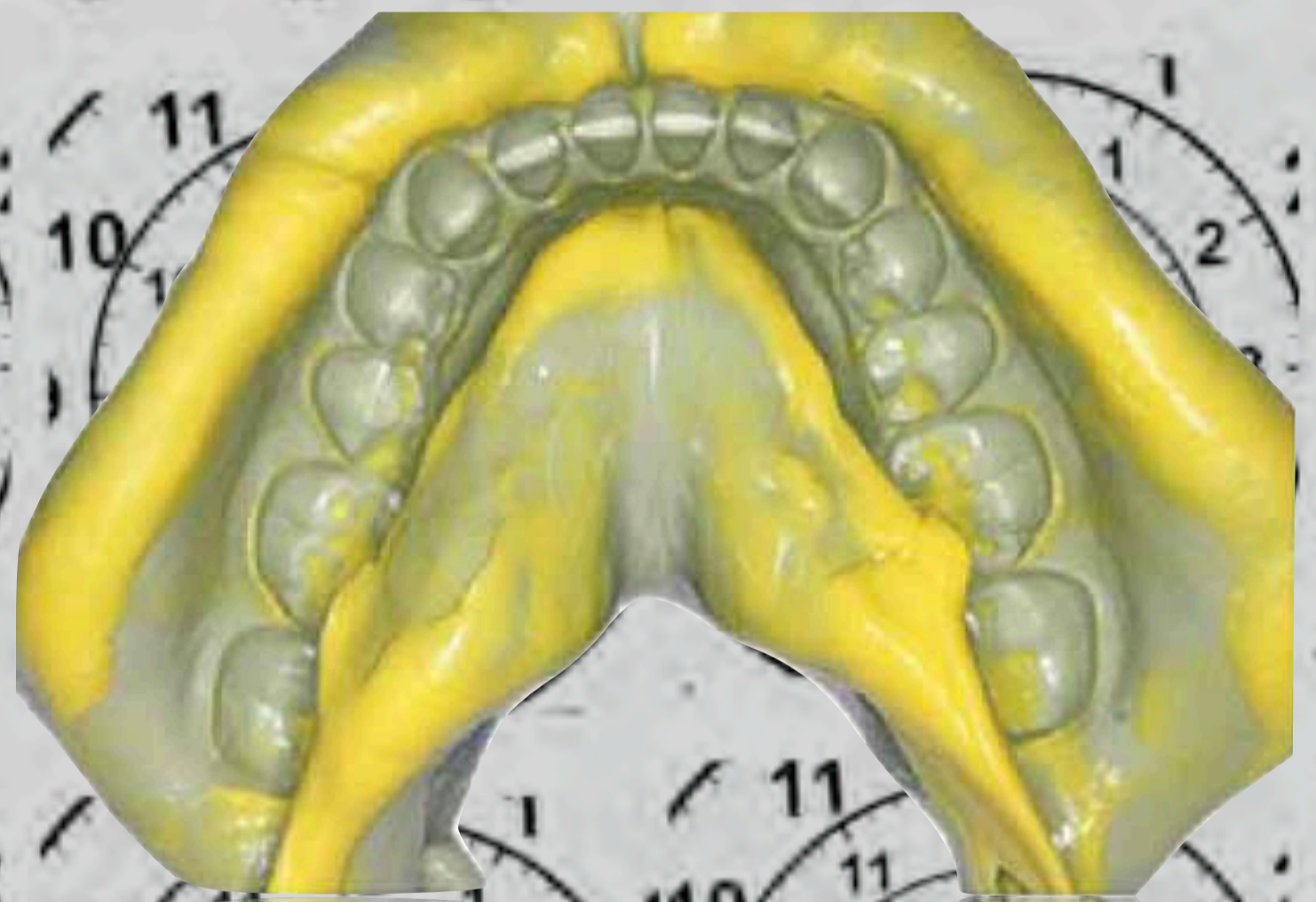
ANALOG → DIGITAL



The digital Handshake

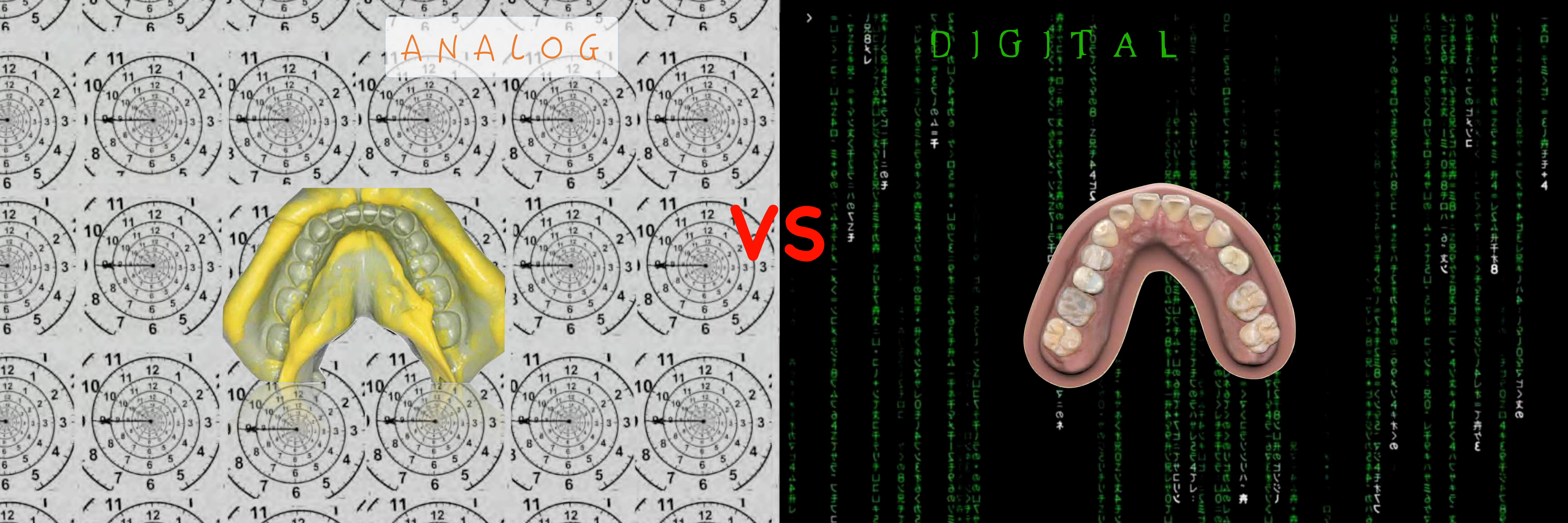


ANALOG



VS

DIGITAL



PRE-OP DATA COLLECTION - IOS

ACCURACY

Trueness and Precision of Three-Dimensional Digitizing Intraoral Devices



Hussam Mutwali¹, Michael Braian¹, Deyar Mahmood¹ and Christel Larsson²

¹Department of Prosthodontics, Faculty of Odontology, Malmö University, Smedjegatan 16, 214 21 Malmö, Sweden
²Department of Materials Science and Technology, Faculty of Odontology, Malmö University, Smedjegatan 16, 214 21 Malmö, Sweden

Published in final edited form as:
Clin Oral Implants Res. 2015 June ; 26(6): 715–719. doi:10.1111/clr.12375.

Accuracy of Digital vs. Conventional Implant Impressions

Sang J. Lee, DMD, MMSc¹, Rebecca A. Betensky, Ph.D.², Grace E. Gianneschi, DMD Candidate.¹, and German O. Gallucci, DMD, Dr. Med. Dent. Ph.D.¹

Eur J Oral Implantol. 2017;10 Suppl 1:101-120.

Accuracy of digital implant impressions with intraoral scanners. A systematic review.

Rutkūnas V, Gečiauskaitė A, Jęgelevičius D, Vaitiekūnas M.

Abstract
AIM: The use of intraoral scanners (IOS) for making digital implant impressions is increasing. However, there is a lack of evidence on the accuracy of IOS compared with conventional techniques. Therefore, the aim of this systematic review was to collect evidence on the accuracy of digital implant impression techniques, as well as to identify the main factors influencing the accuracy outcomes.
MATERIALS AND METHODS: Two reviewers searched electronic databases in November, 2016. Controlled vocabulary, free-text terms, and defined inclusion and exclusion criteria were used. Publications in English language evaluating the accuracy outcomes of digital implant impressions were identified. Pooled data were analysed qualitatively and pertinent data extracted.

Imburgia et al. *BMC Oral Health* (2017) 17:92
DOI 10.1186/s12903-017-0383-4

BMC Oral Health

RESEARCH ARTICLE Open Access

Accuracy of four intraoral scanners in oral implantology: a comparative in vitro study

Mario Imburgia¹, Silvia Logozzo^{2,3}, Uli Hauschild⁴, Giovanni Veronesi⁵, Carlo Mangano⁶ and Francesco Guido Mangano^{5*}

Original Article | Published: 17 November 2013

Accuracy of full-arch scans using intraoral scanners

Sebastian B. M. Patzelt, Archontia Emmanouilidi, Susanne Stampf, Joerg R. Strub & Wael Att

Clinical Oral Investigations 18, 1687–1694(2014) | Cite this article

4456 Accesses | 162 Citations | 1 Altmetric | Metrics

Contents lists available at ScienceDirect

ELSEVIER Journal of Dentistry

journal homepage: www.elsevier.com/locate/jdent

Accuracy and precision of 3 intraoral scanners and accuracy of conventional impressions: A novel in vivo analysis method

R. Nedelcu^a, P. Olsson^b, I. Nyström^b, J. Rydén^c, A. Thor^a

^aDepartment of Surgical Sciences, Plastic & Oral and Maxillofacial Surgery, Uppsala University, 751 85, Uppsala, Sweden
^bDepartment of Information Technology, Centre for Image Analysis, Uppsala University, Box 337, 751 05, Uppsala, Sweden
^cDepartment of Mathematics, Uppsala University, Box 480, 751 06, Uppsala, Sweden

PROSTHETIC OPTIONS



Cemented Retained
TEETH



Screw Retained
TEETH

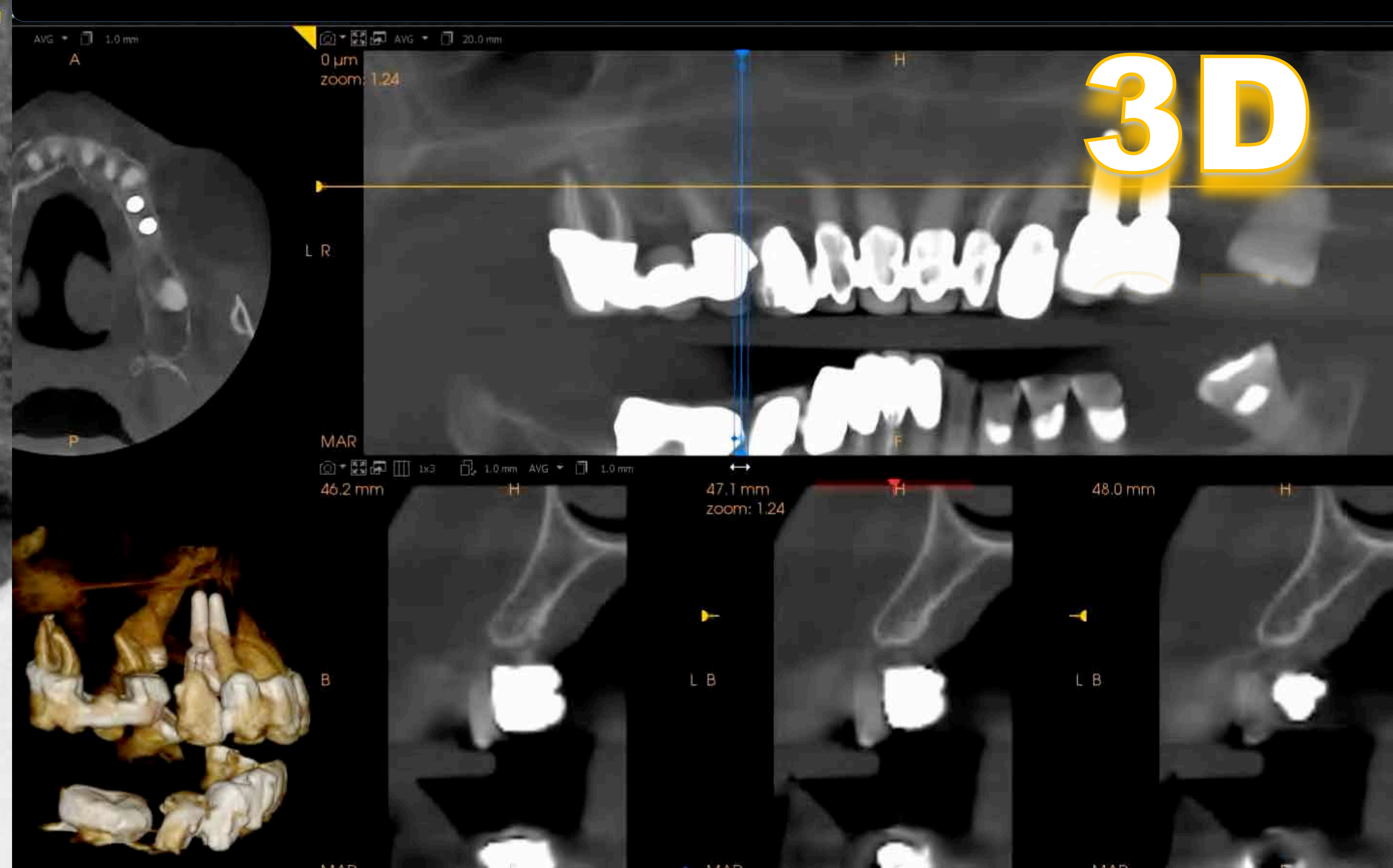


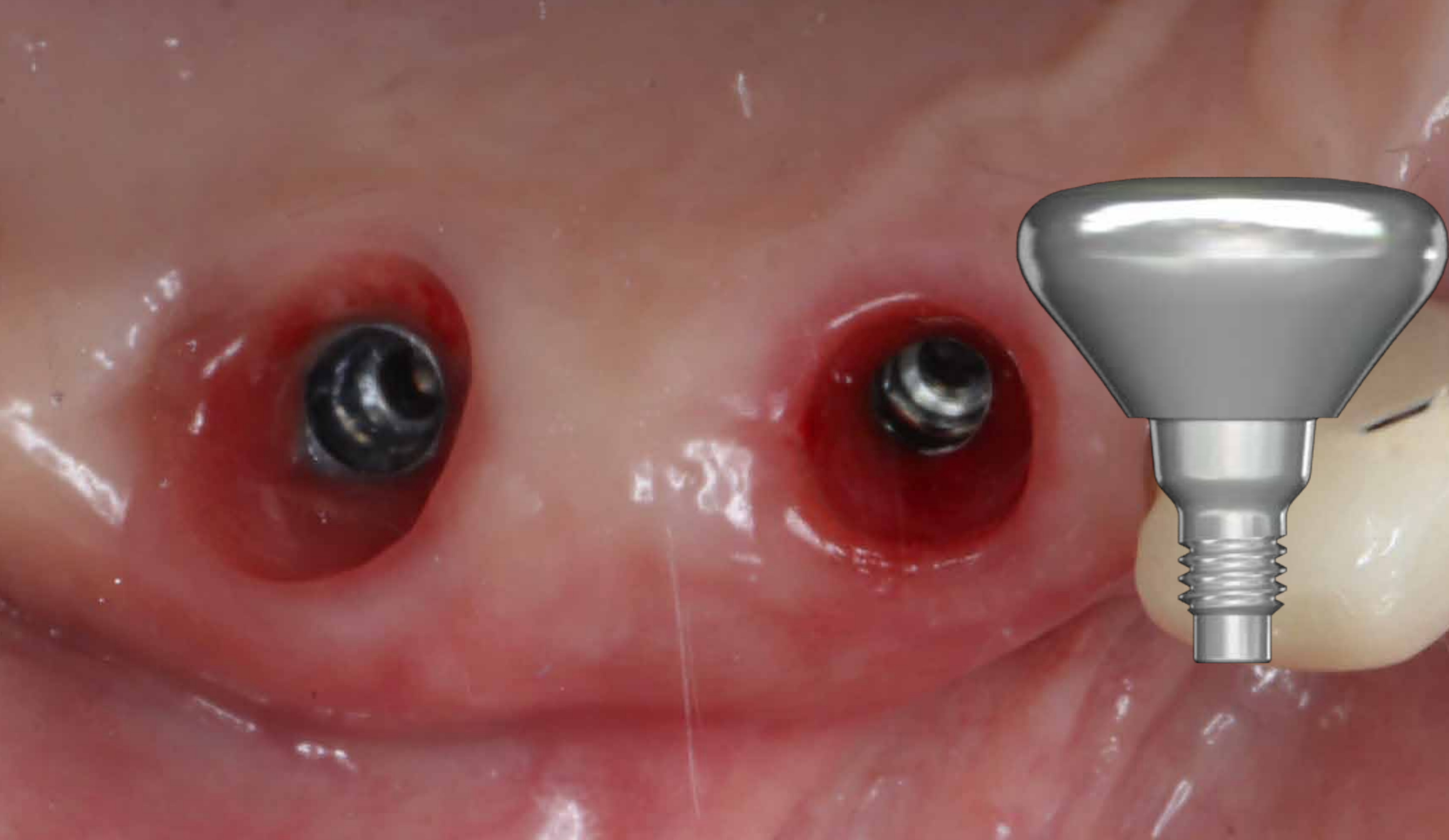
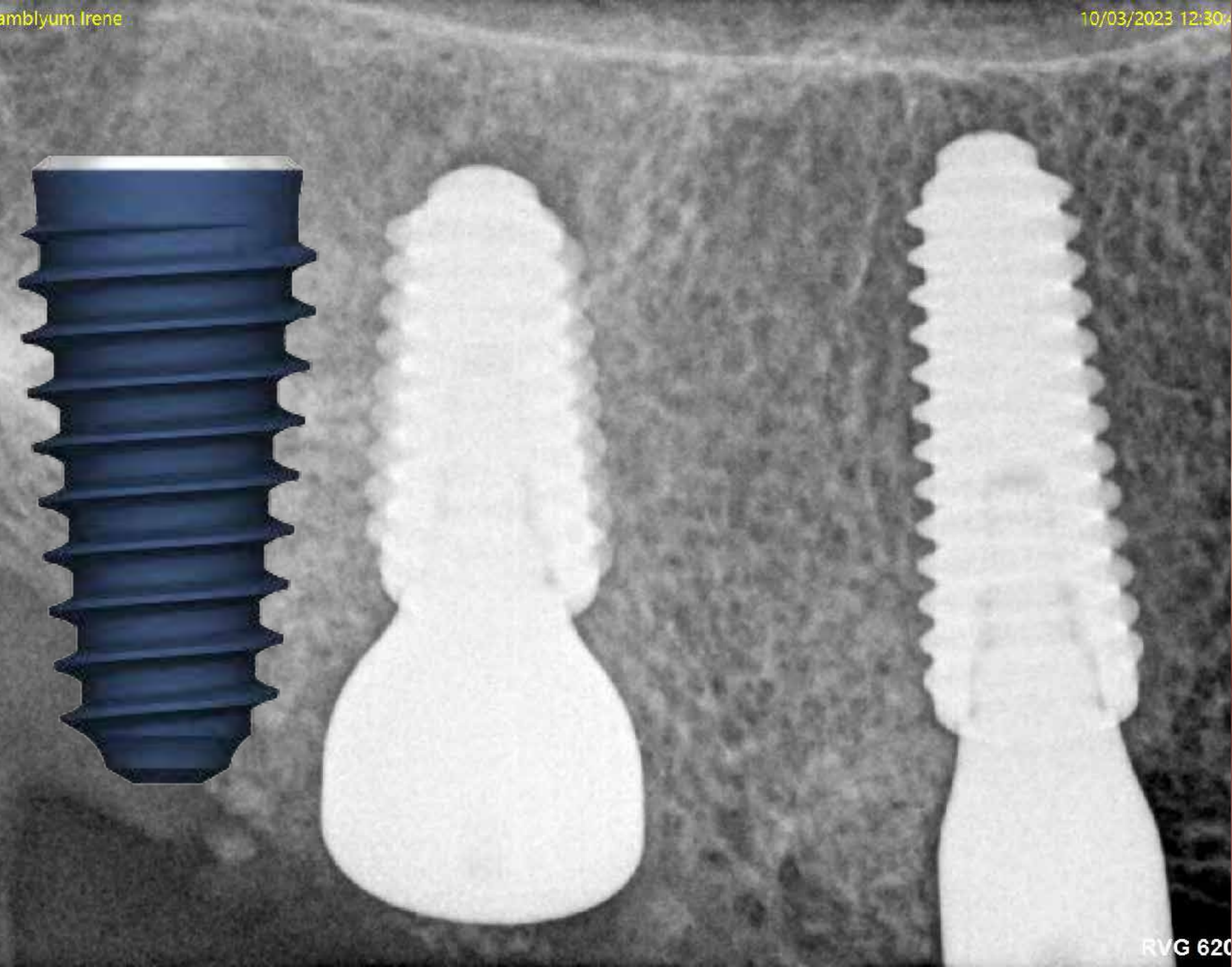
Lab Communication

2D

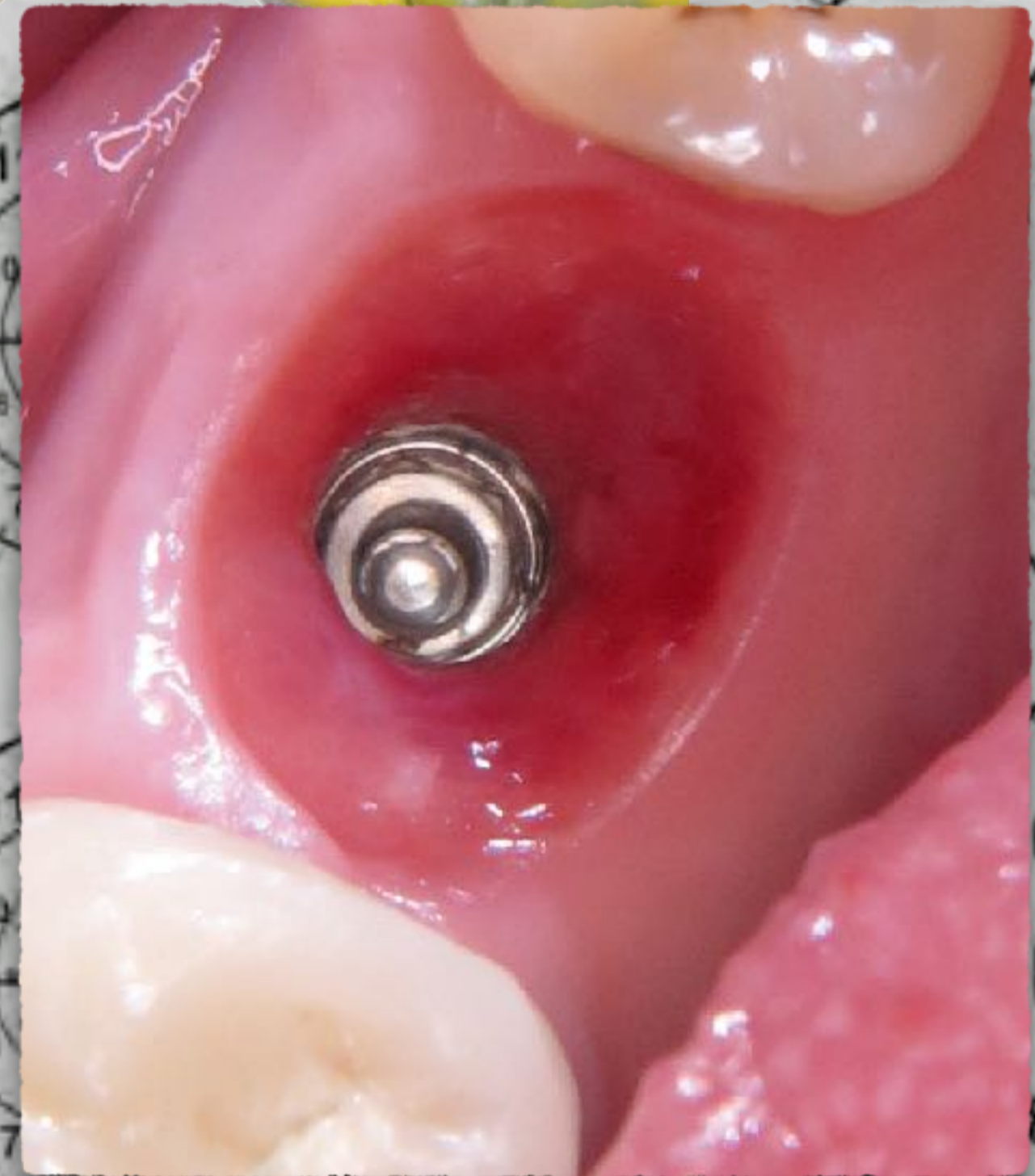
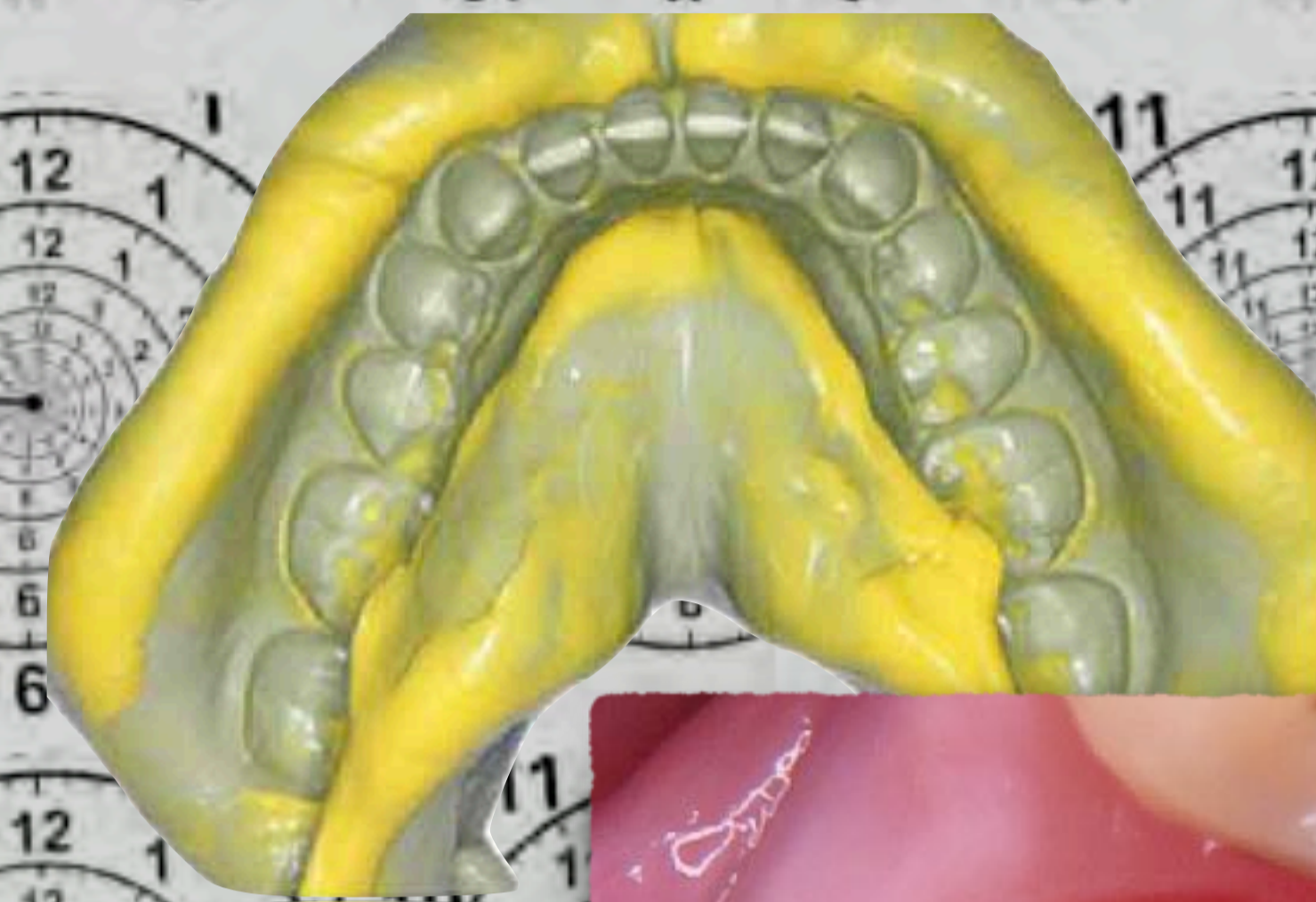


3D



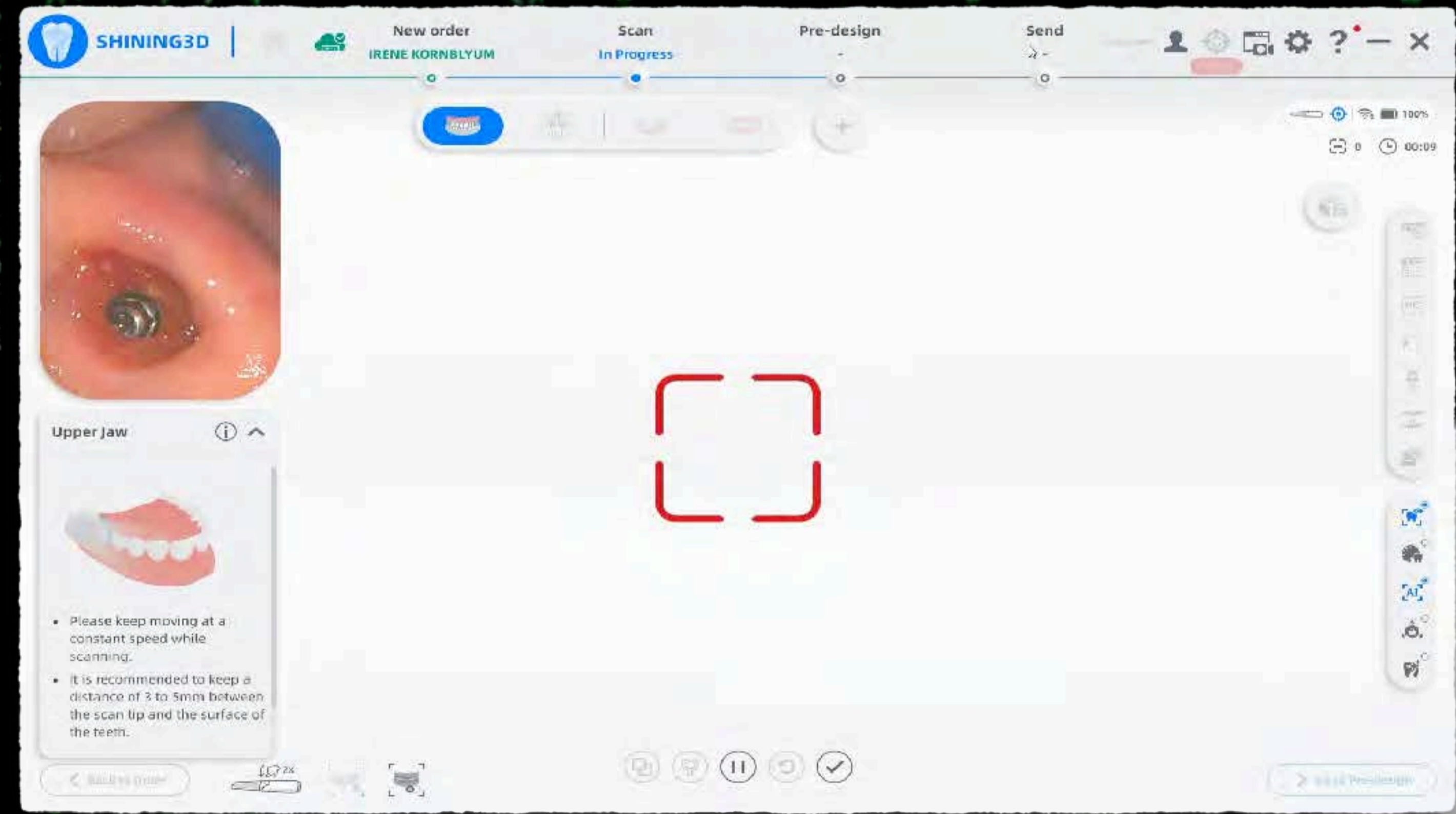


A N A L O G

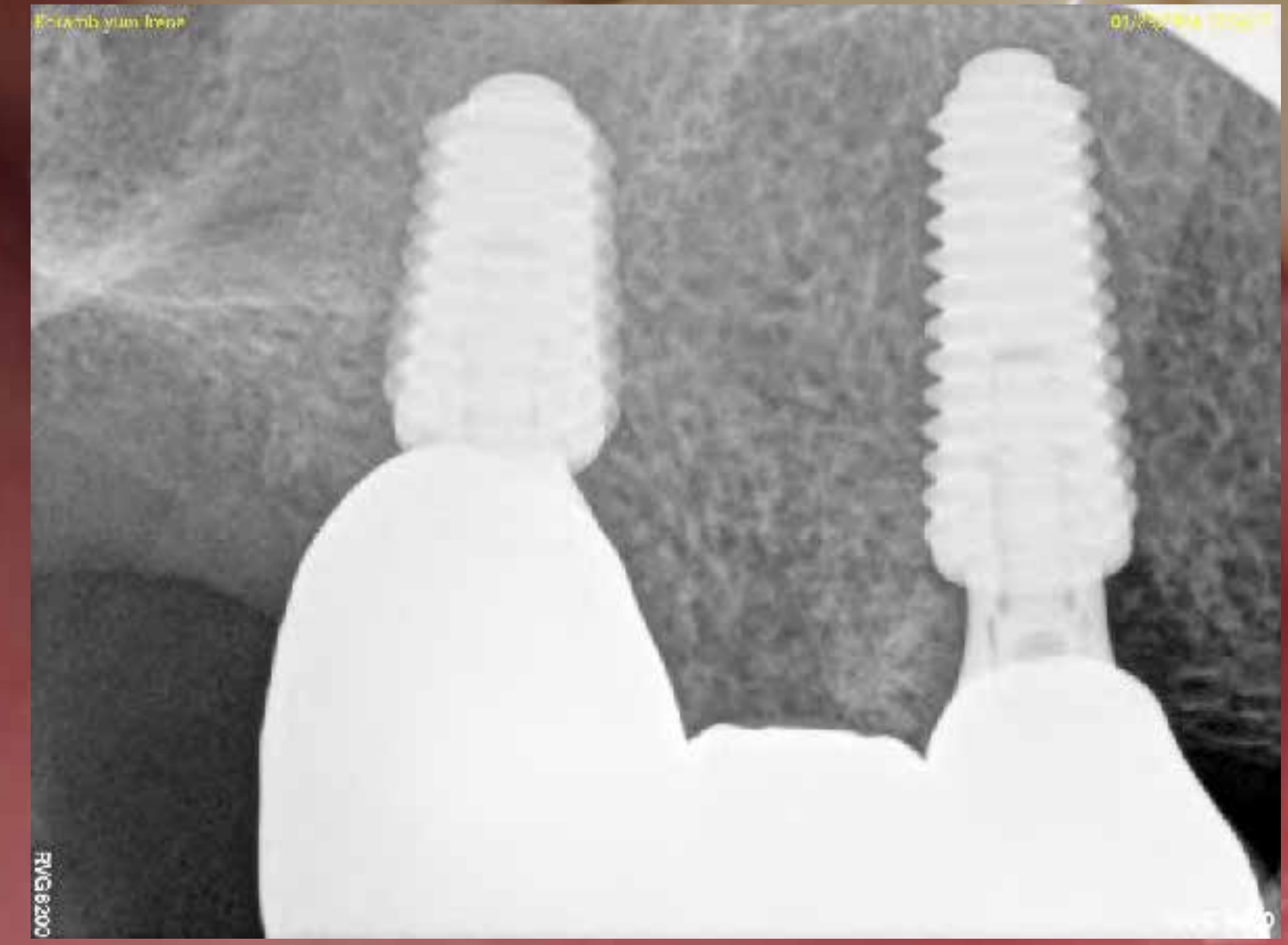
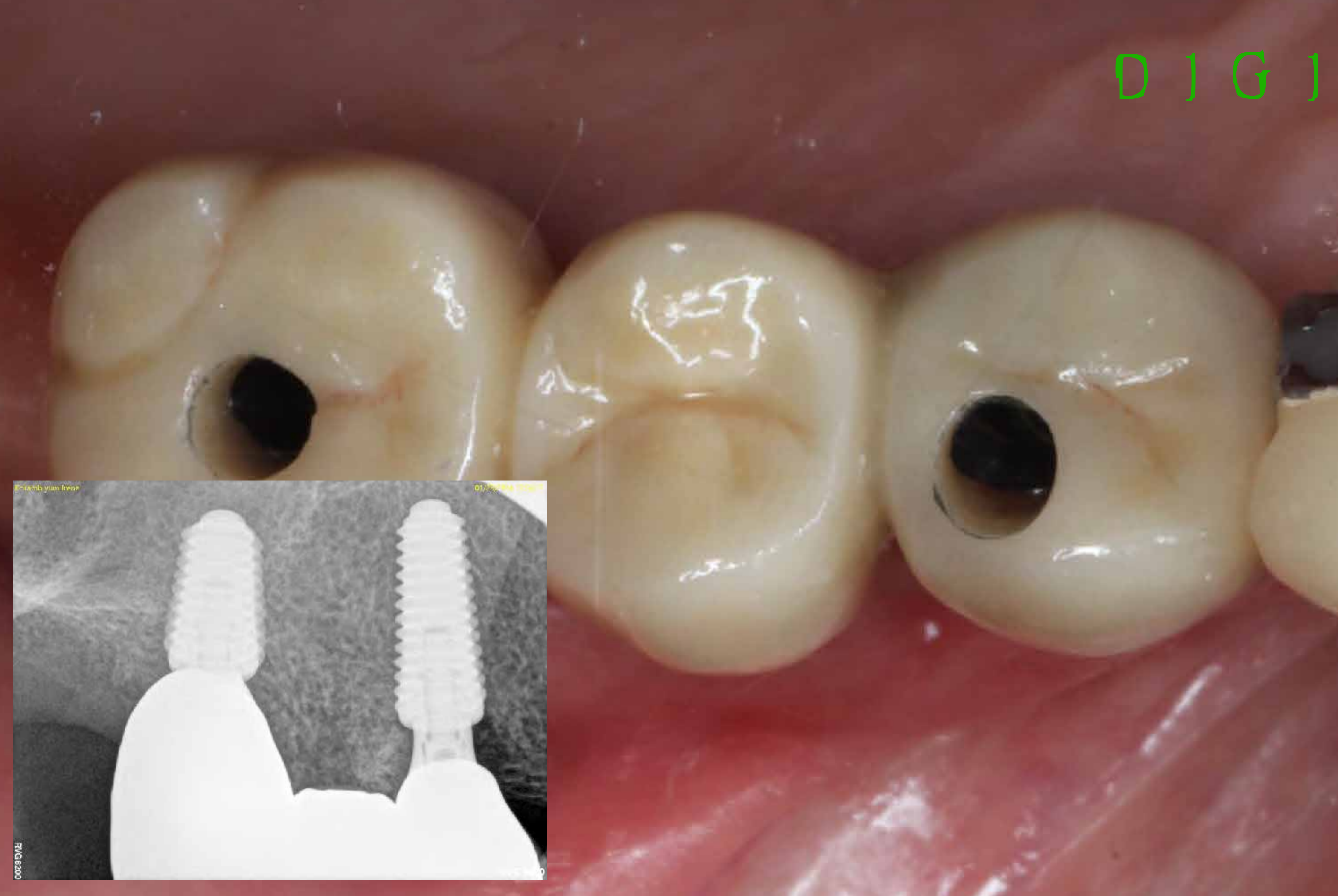


V S

D I G I T A L



D I G I T A L



FULL ARCH PROSTHETIC OPTIONS



▶ **FP 1 (No PINK)**

▶ **FP 2 (LONG TEETH)**

▶ **FP 3 (Artificial PINK)**



Lower Jaw

- Please keep moving at a constant speed while scanning.
- It is recommended to keep a distance of 3 to 5mm between

Keys to Success 

Scan Path - Landmarks are crucial to the Accuracy of Unit

Teeth available?

Maxilla > Mandible Palatal Rugae

File Types (STL,PLY,OBJ)



Fully Digital Full Arch

Edentulous

Maxilla > Mandible

Keratinized tissue -

Palatal Rugae

Scan Path - Landmarks are crucial to the Accuracy of Unit



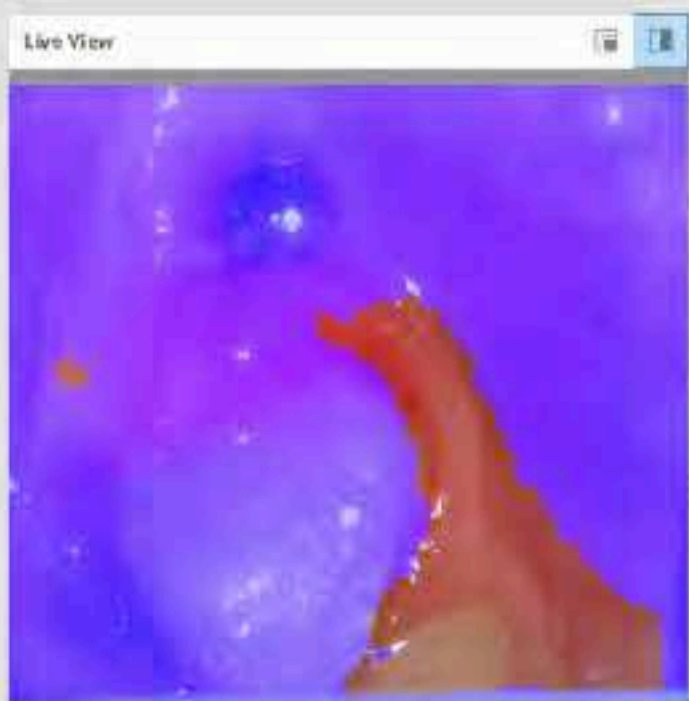
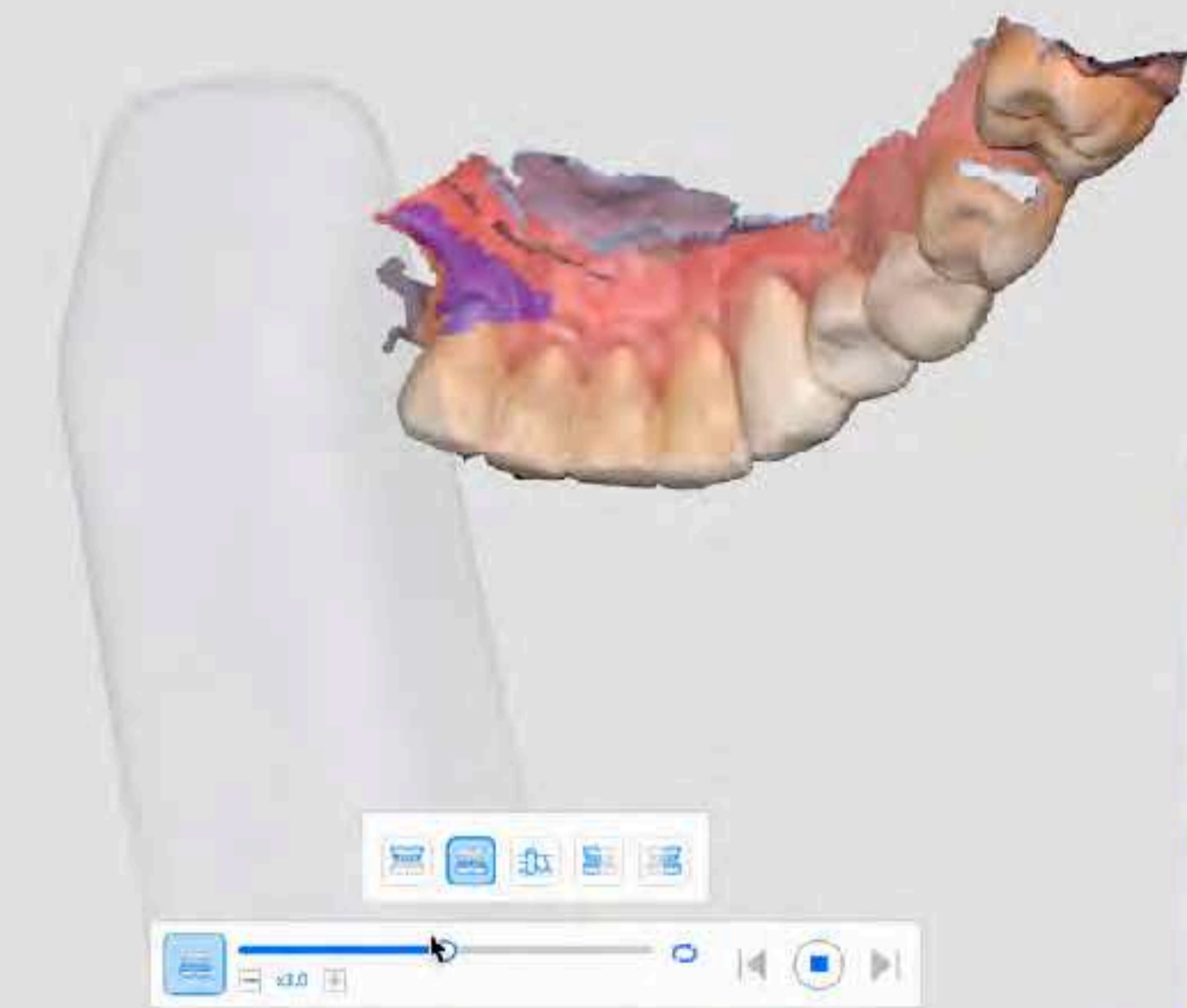
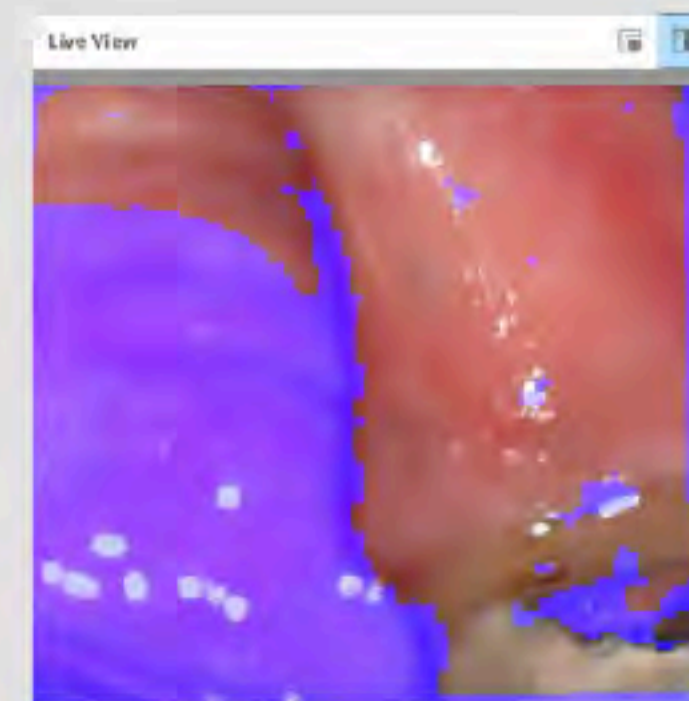
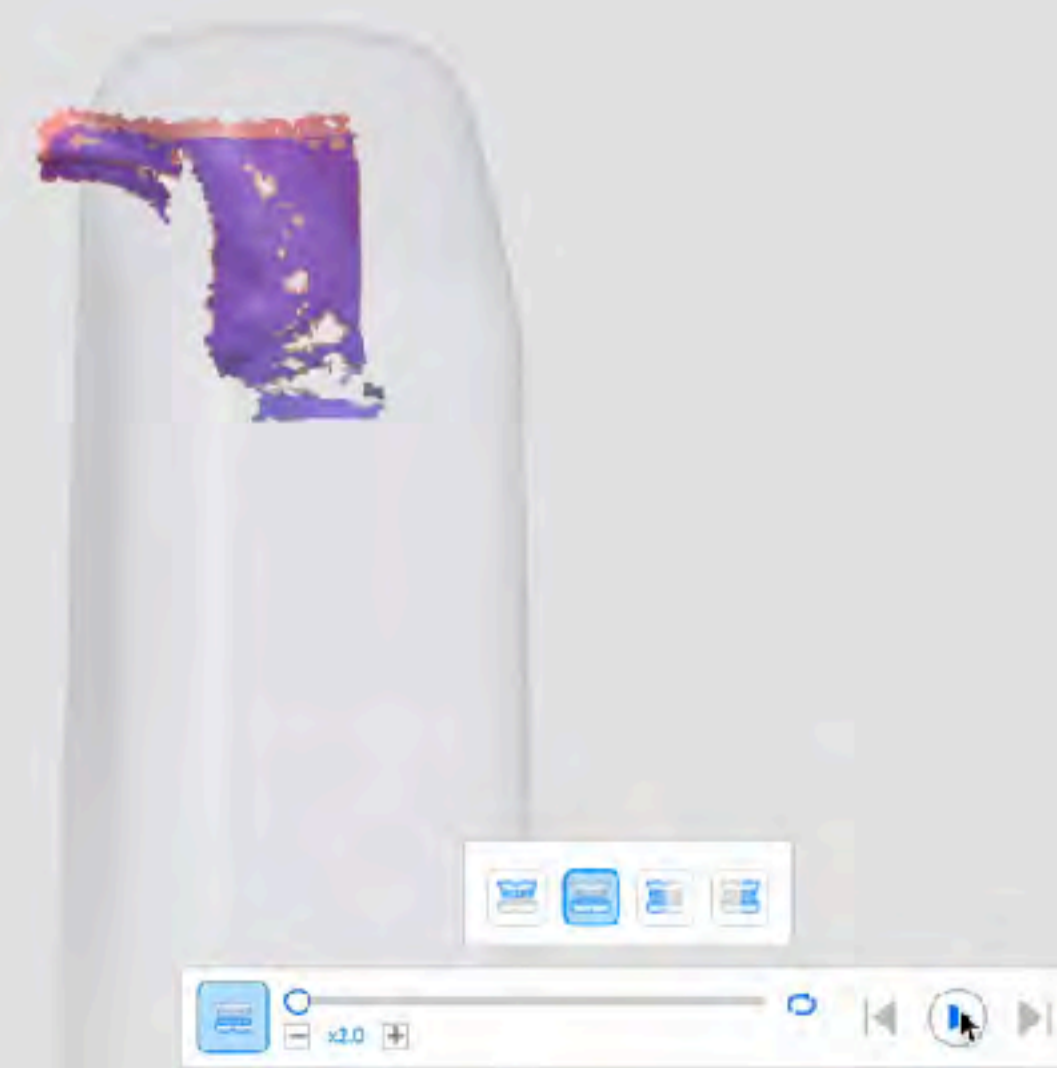
Fully Digital Full Arch

Edentulous spans

Lack of keratinized tissue

Mucosal tissue movement

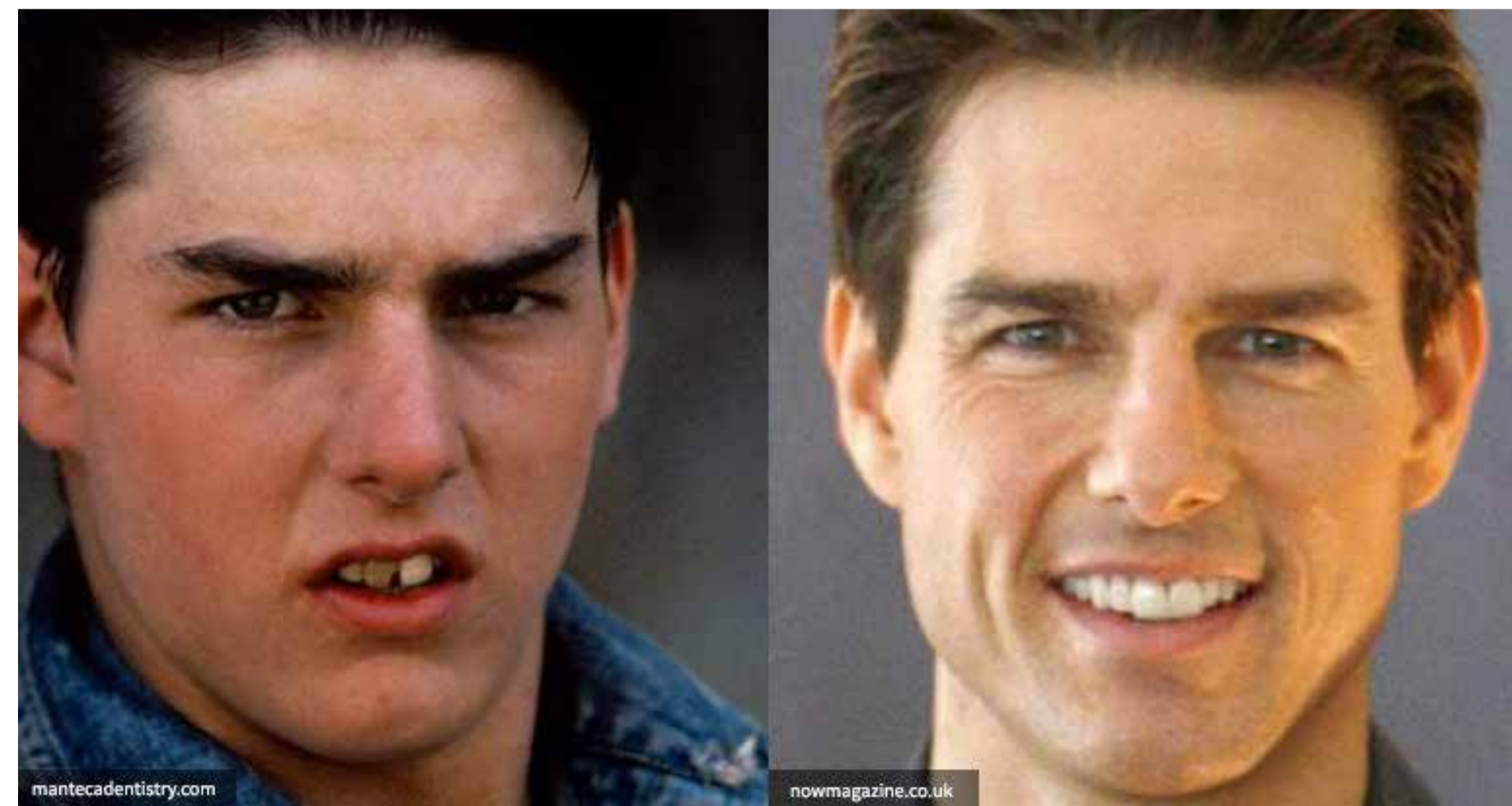
Saliva - Reflection





Who's that Hollywood smile?



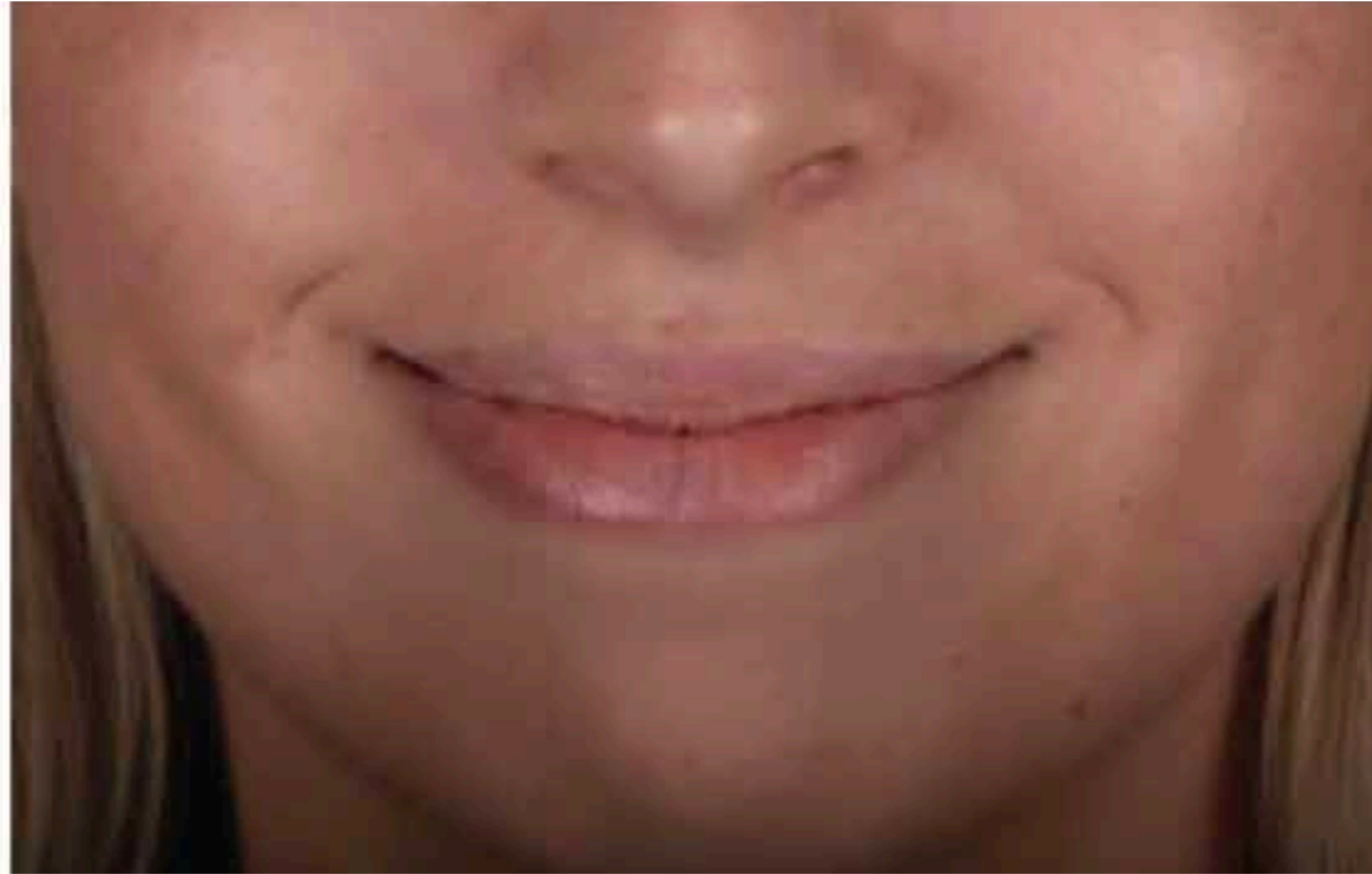


THE SMILE IS OUR

SIGNATURE



Three smile types have been shown in the literature



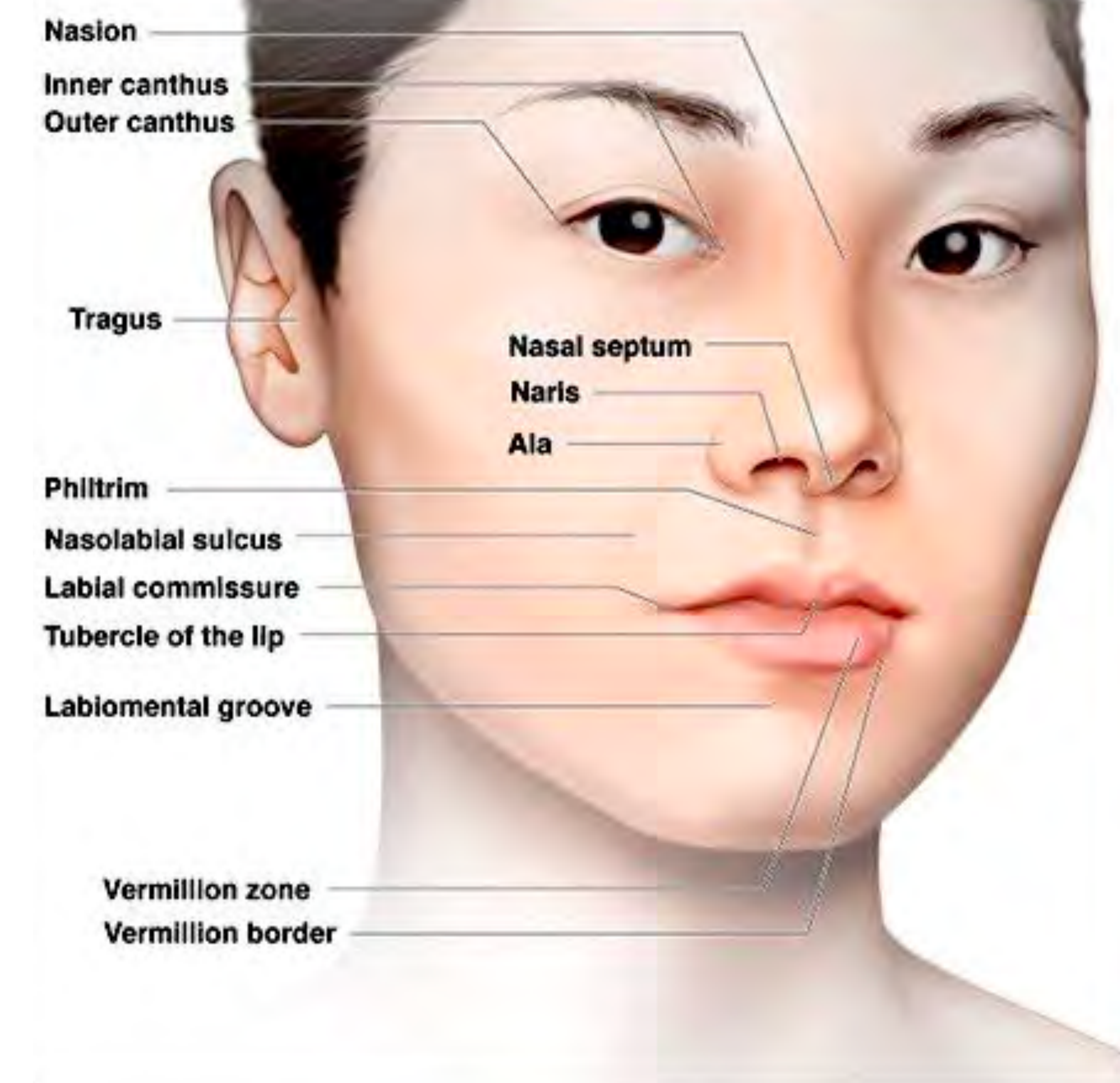
**Commissure smile
(Mona Lisa smile)**



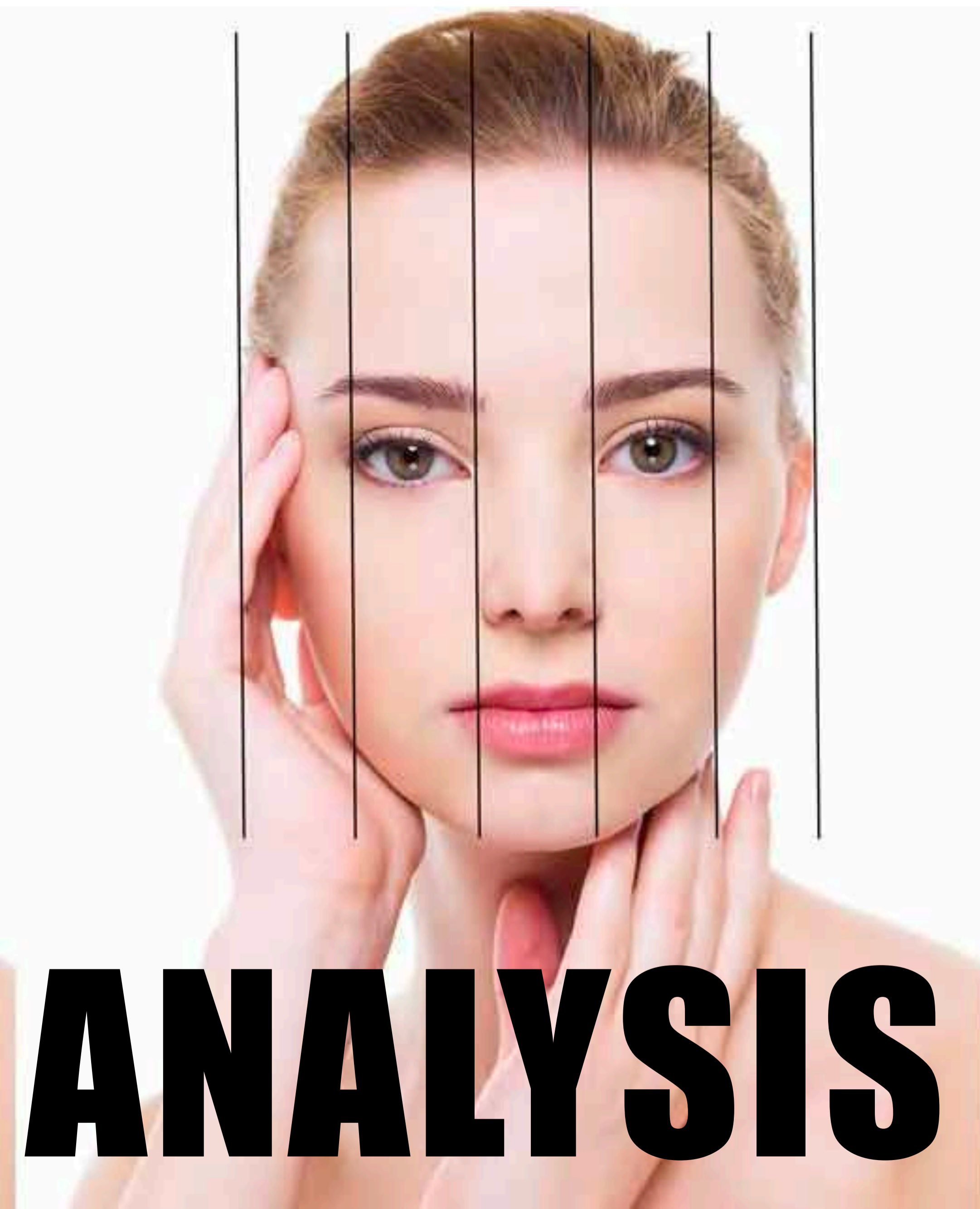
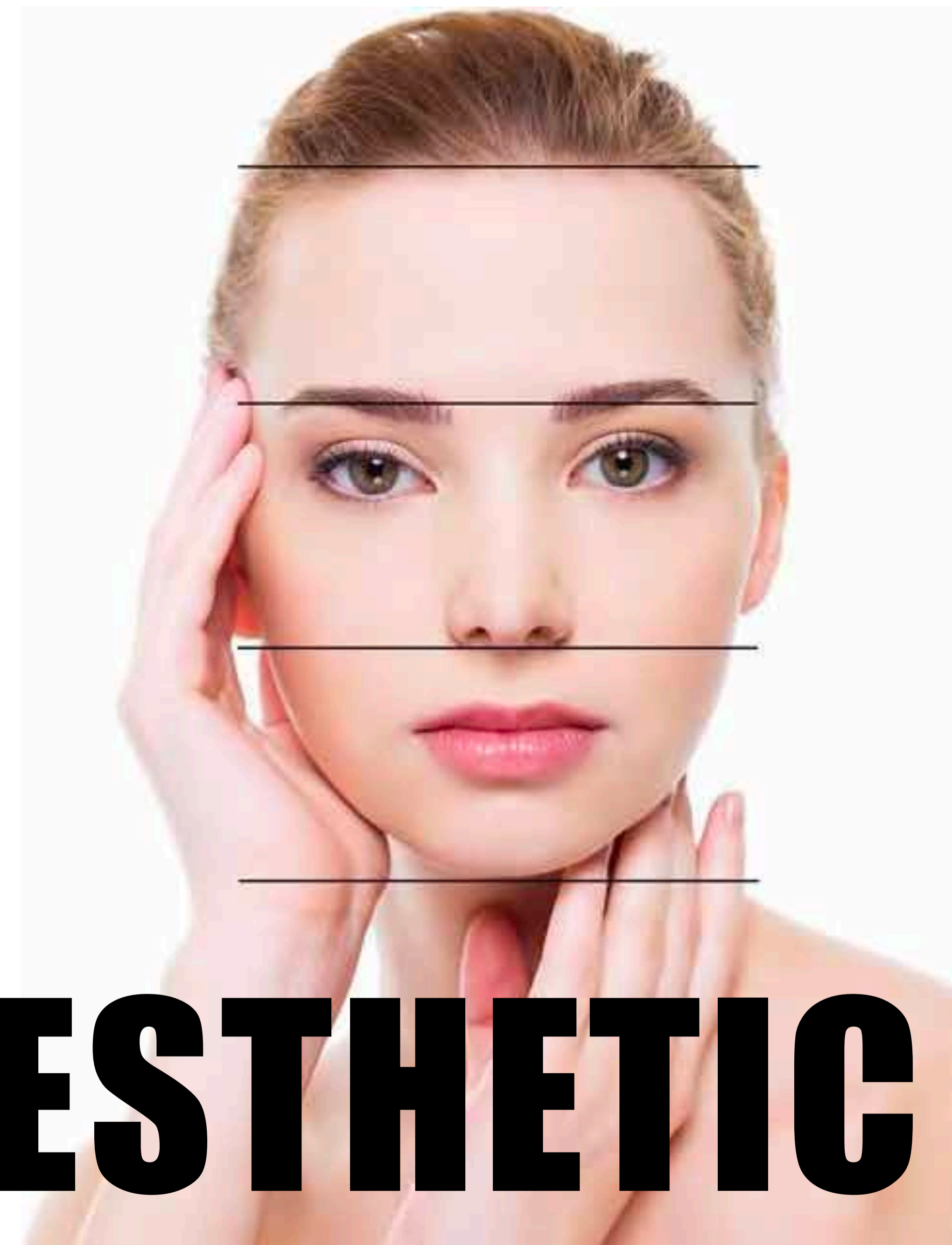
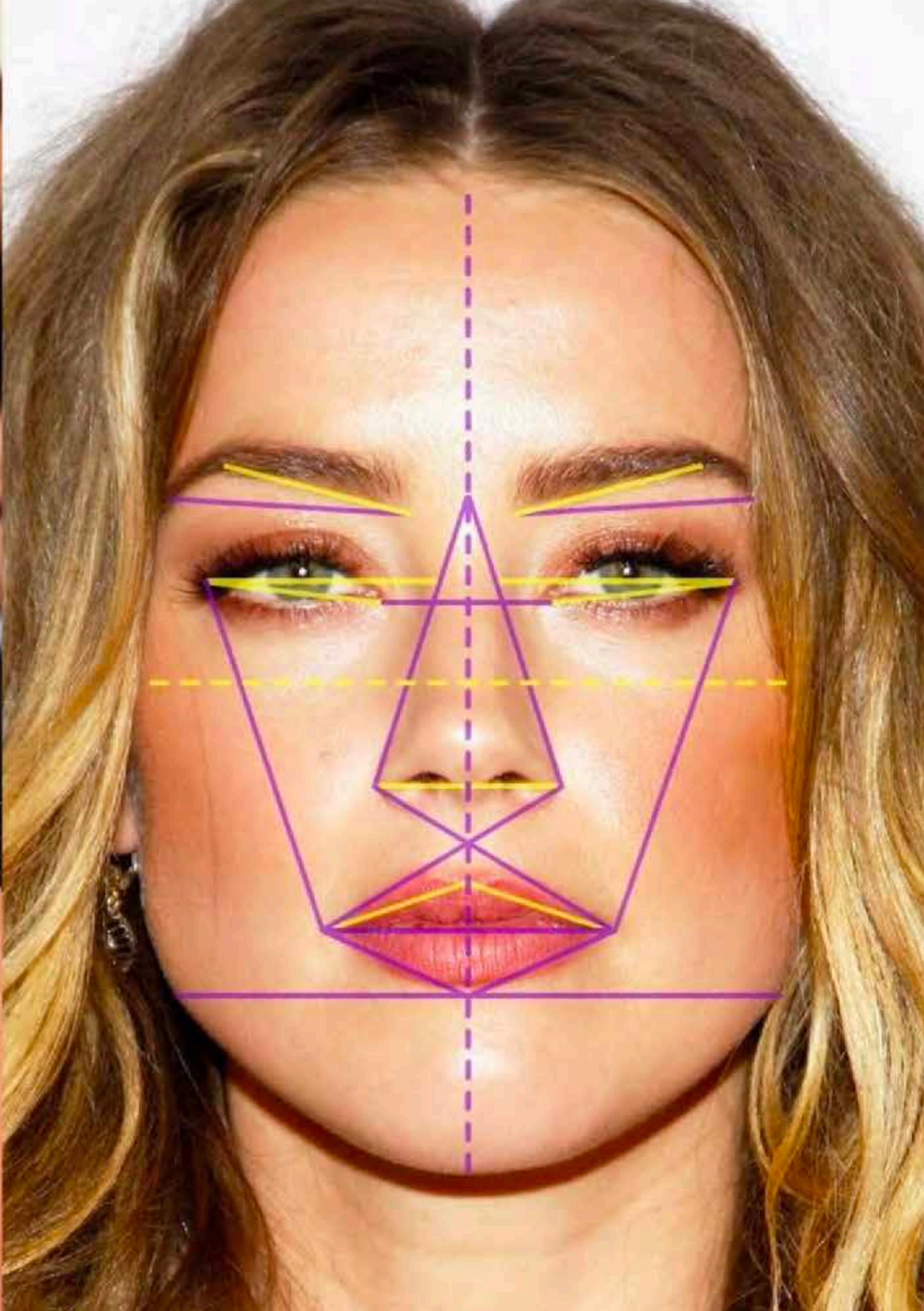
**Social smile
(cupid smile)**



**Spontaneous smile
(complex smile)**



**What about
the FACE?**



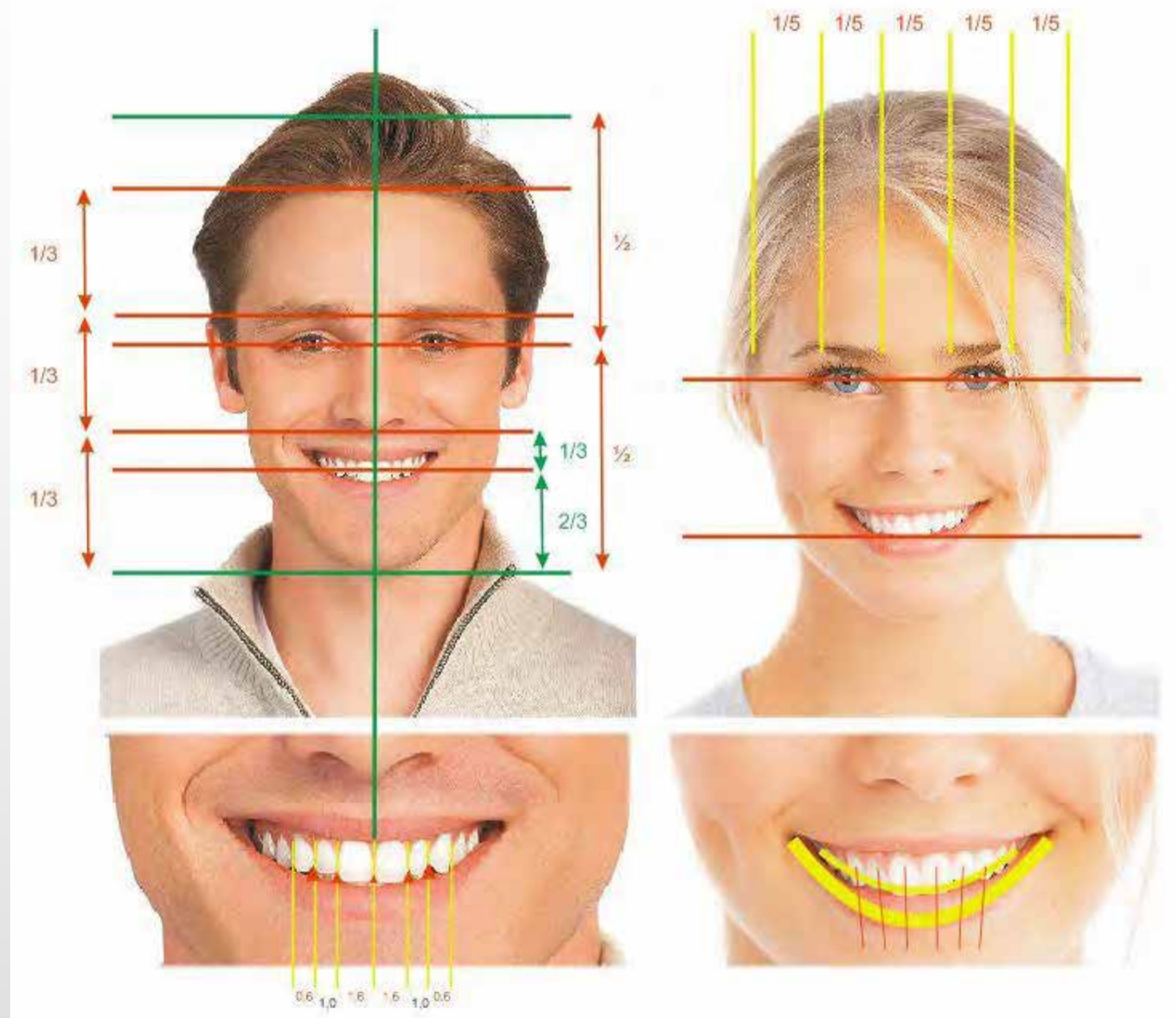
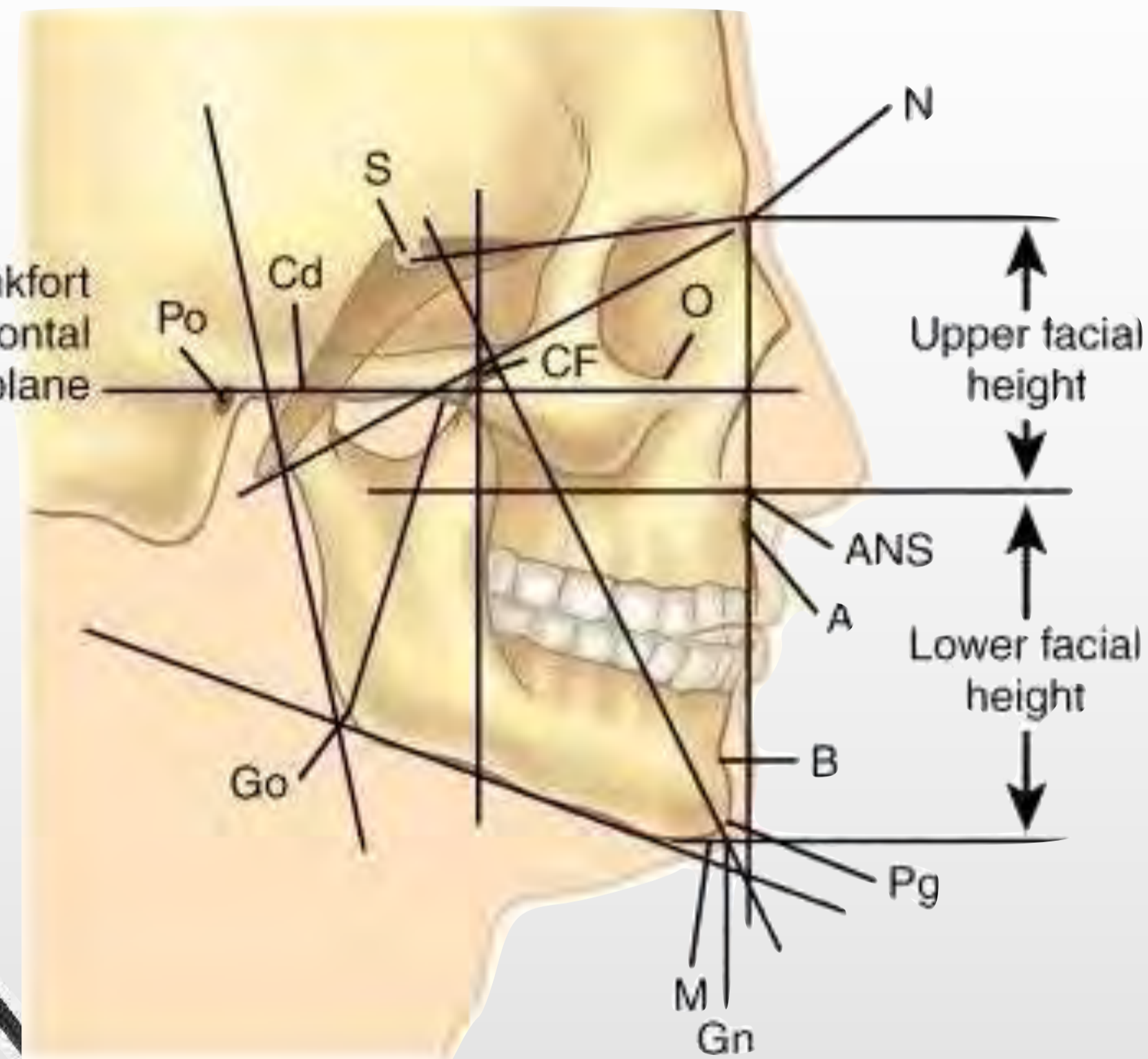
ESTHETIC ANALYSIS

2D PHOTOGRAPHY



Dental Photography

Facial measurements



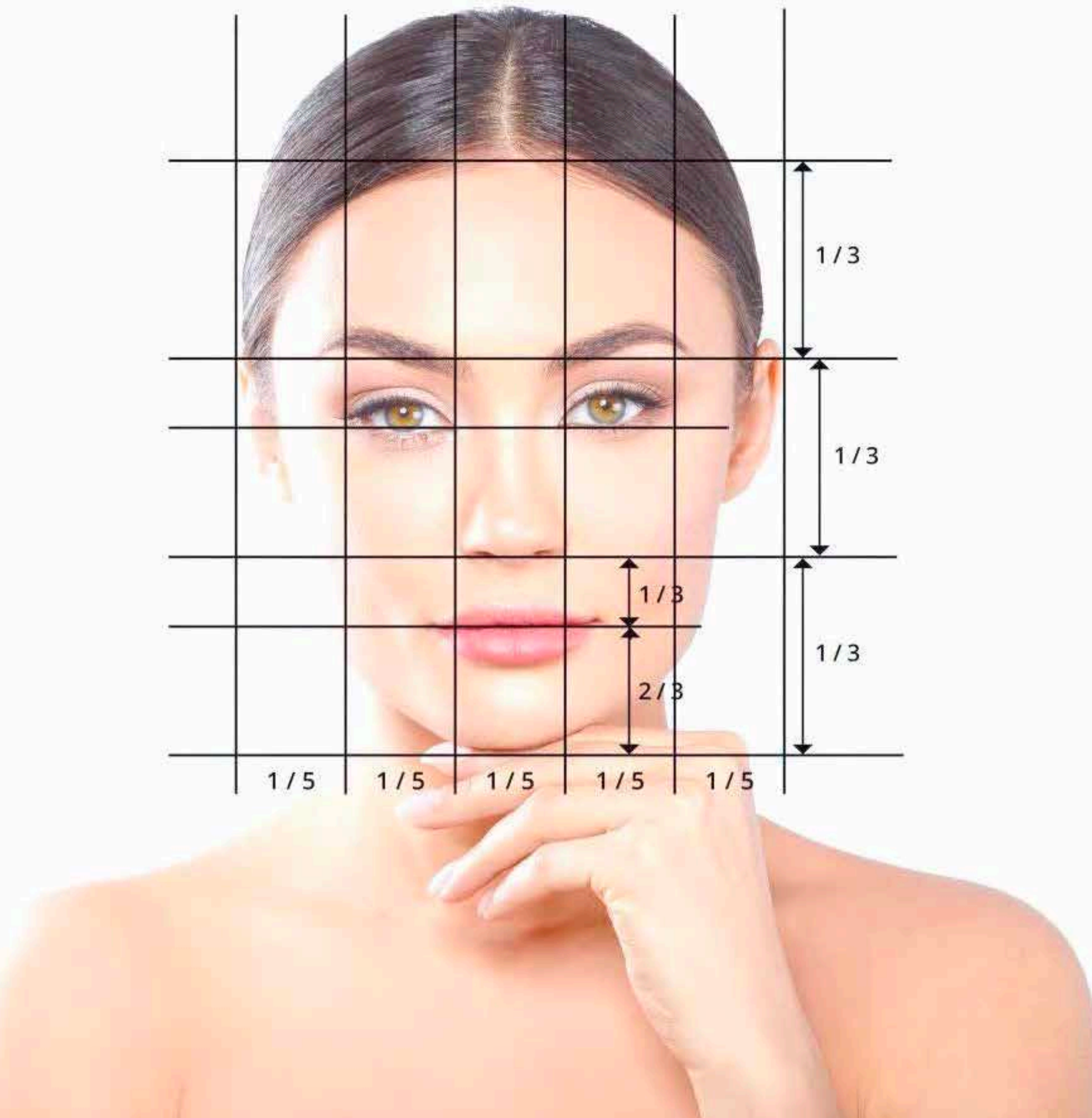
Importance of facial height in Orthodontic treatment

Kian Fazail Naki DMD, MClin, Pros, PGC, Orth.
Academic Director at the LSFO
Published Jan 6, 2015

GOALS

Tooth measurements





FACIAL ANALYSIS

Horizontal Lines (Ophriac Line/Bipupillary Line/Commissural Line)
Vertical Lines/Facial Midline/Facial Proportions/Reference Planes
E-Line/Naso-Labial Angle

DENTO-LABIAL ANALYSIS

Dental exposure at rest/Incisal edges Vs lower lip /Smile line /
Amplitude of the smile /Lateral spaces/Interincisal line Vs midline/
Occlusal plane
commissural line/Occlusal plane Vs horizon

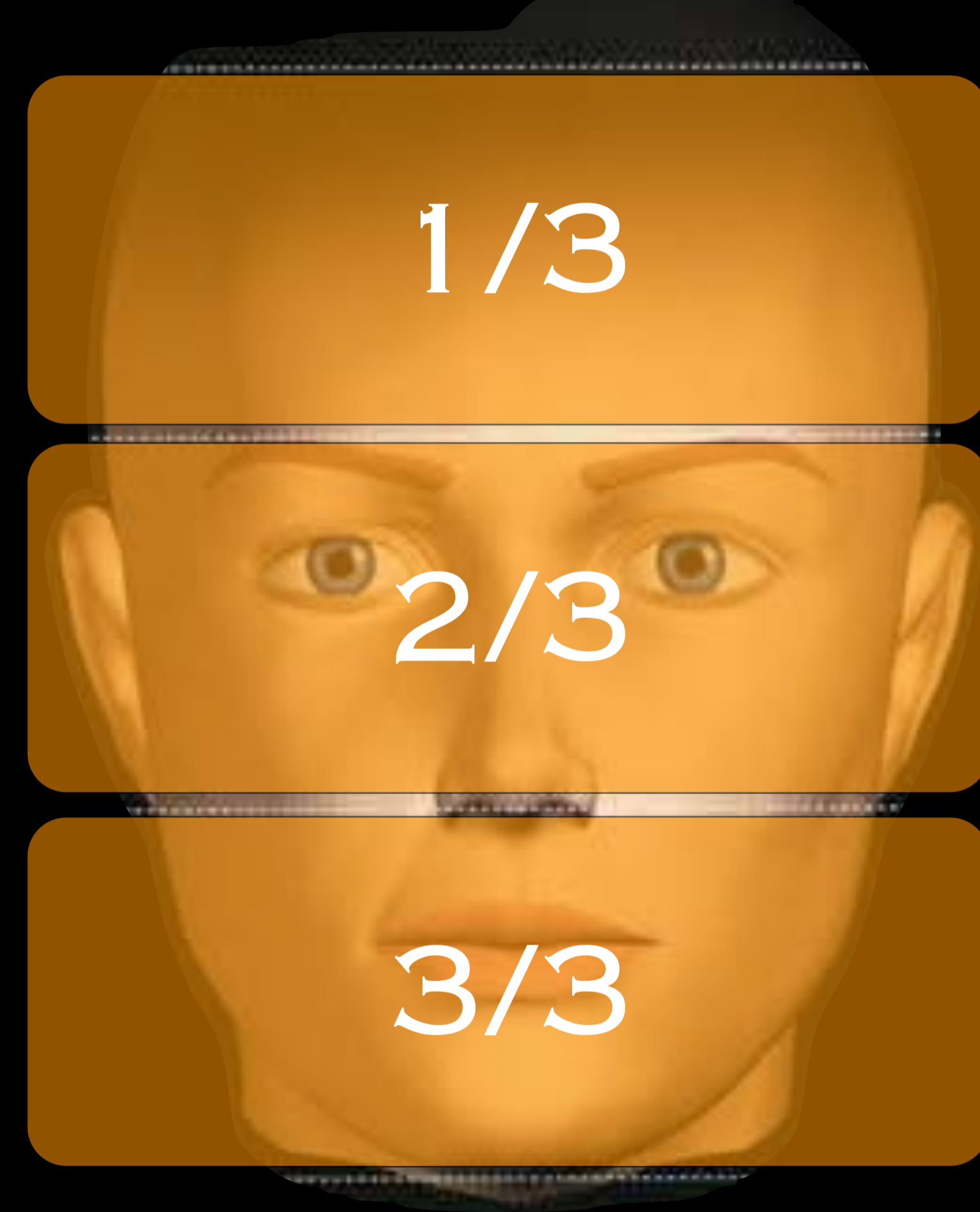
PHONETIC ANALYSIS

Phoneme "M"/Phoneme "E"/Phoneme "F/V"/Phoneme "S"

Dental Analysis

Typology/Color/Texture/Size/Proportions/Incisal edge/Dental
composition

FACIAL 3rds



HAIR LINE

1/3

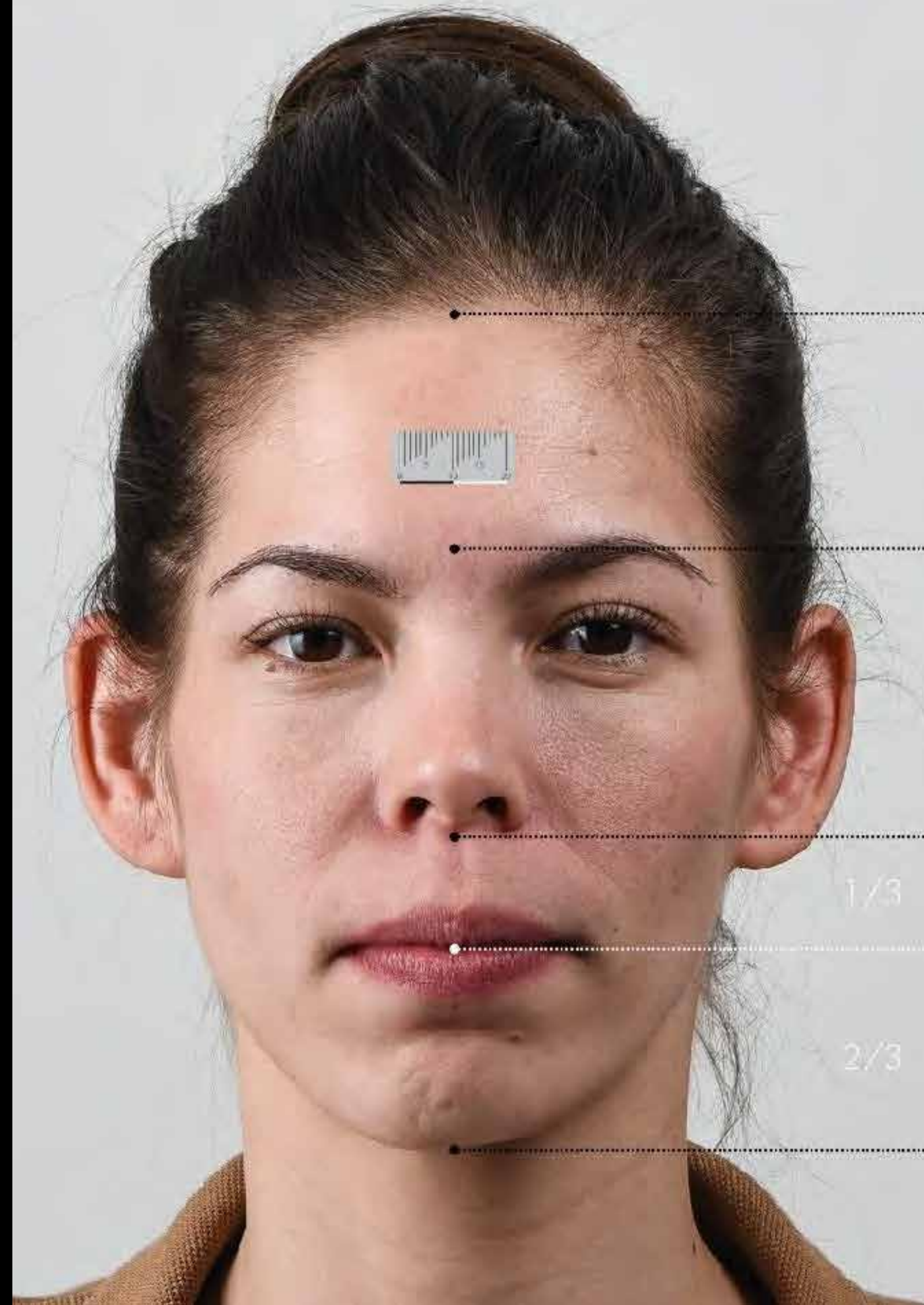
OPHRIAC LINE

2/3

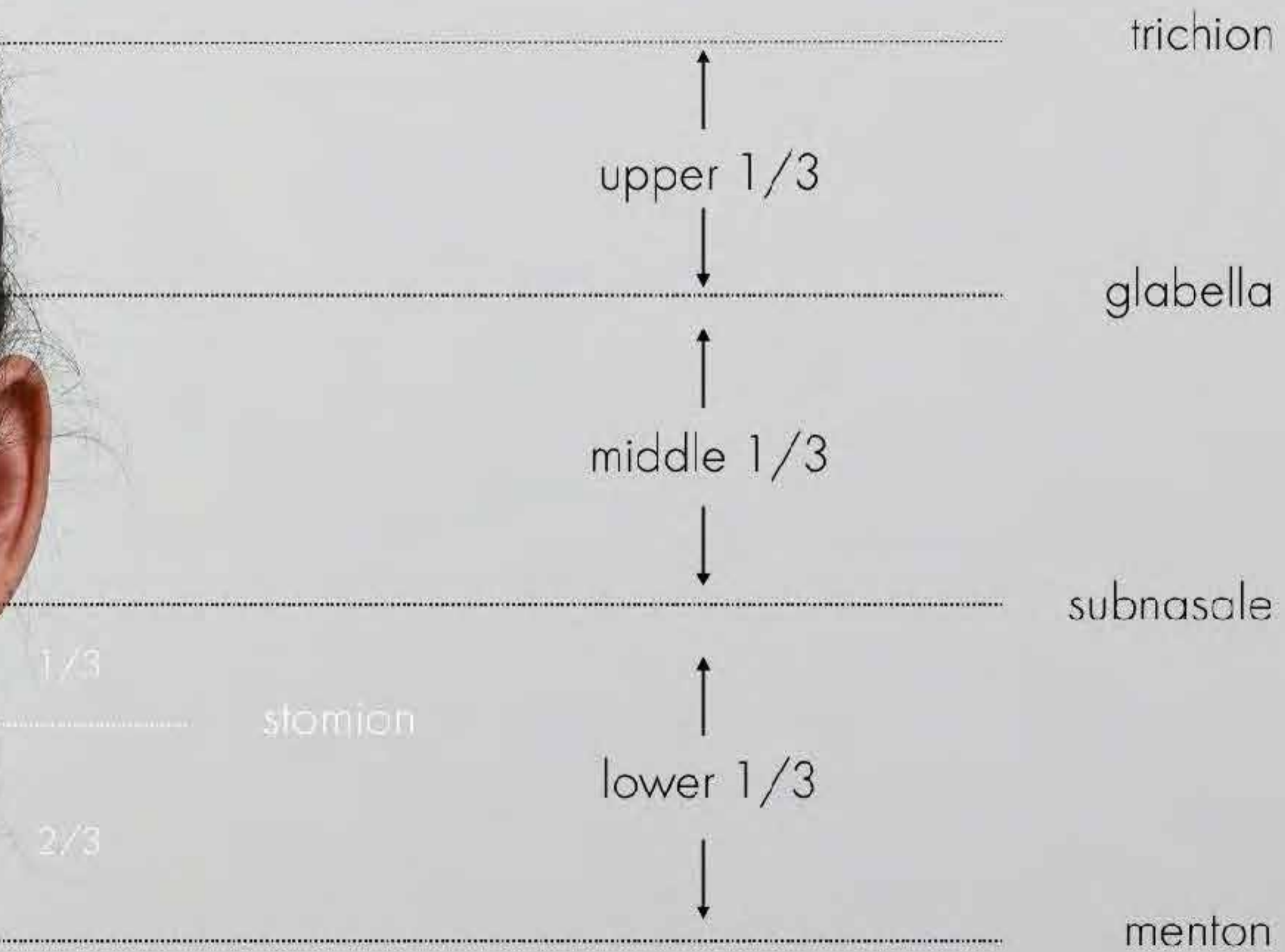
NASAL LINE

3/3

CHIN



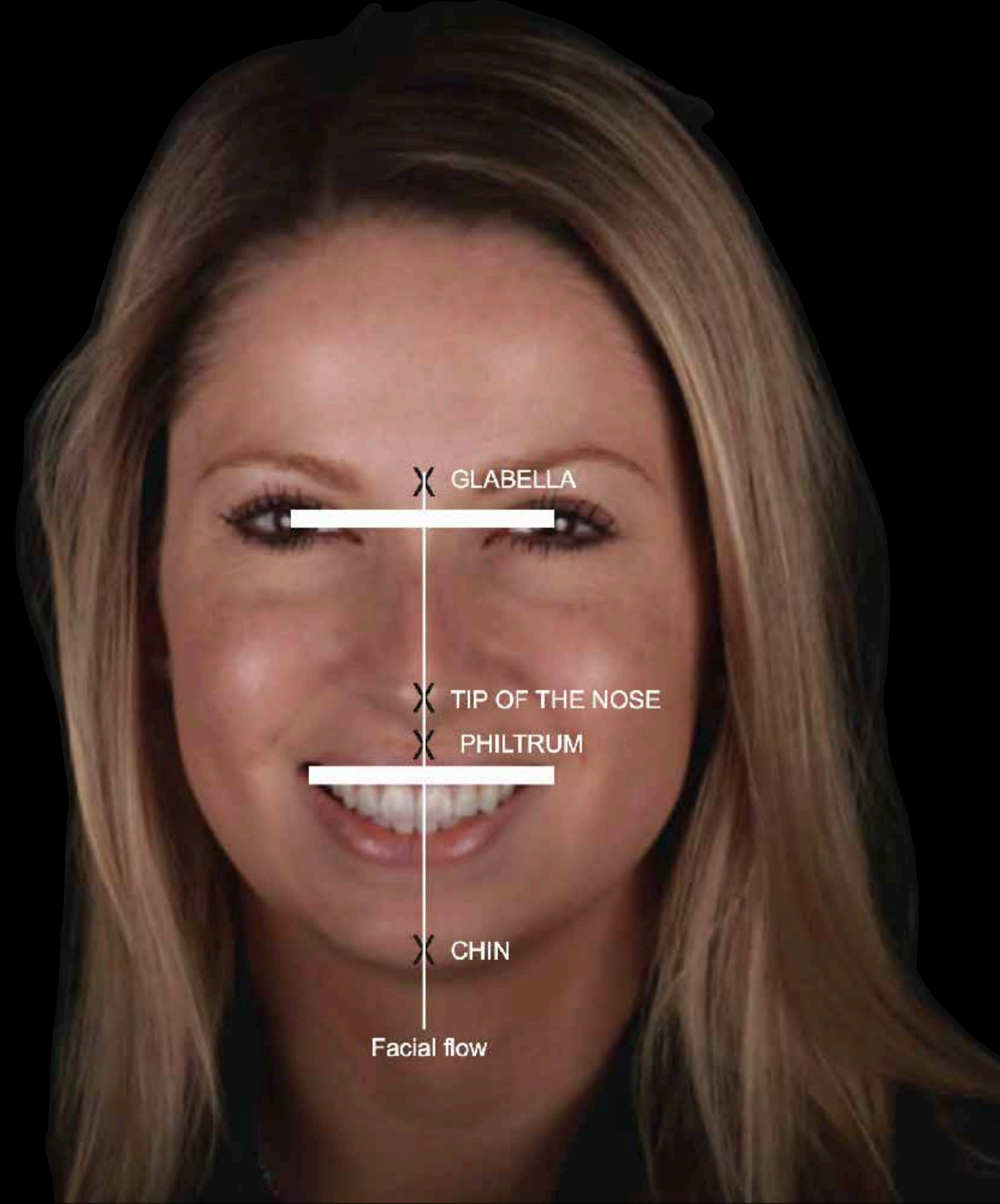
FACIAL ANALYSIS



MIDLINE

FACIAL ANALYSIS

Facial midline is a straight line drawn through the glabella, the tip of the nose, philtrum, and the tip of the chin



Reference Lines

FRONTAL VIEW

A longer lower third is diagnosed as VME

This patient's middle third measures at 64 mm and lower third is 74 mm.

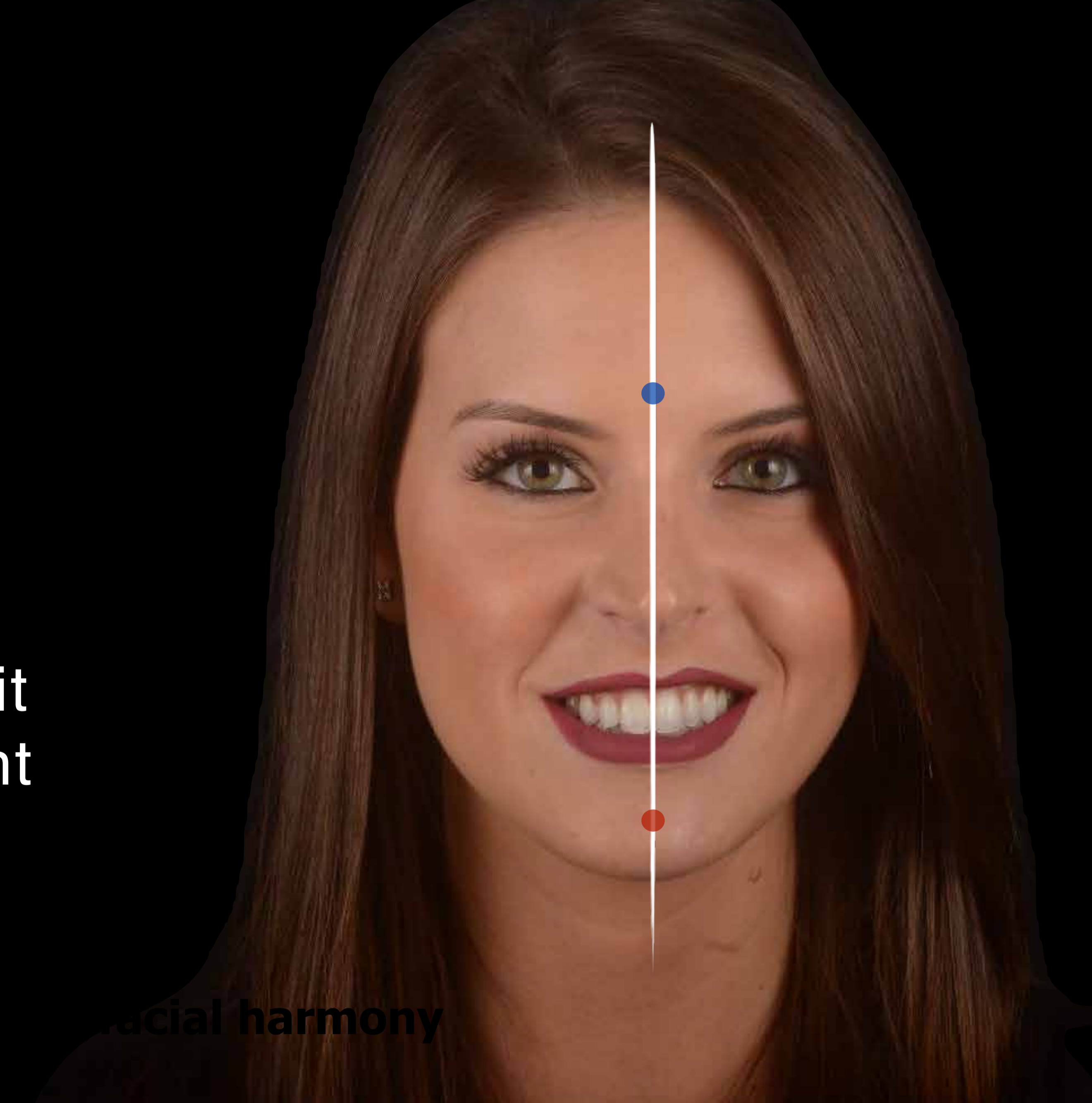
SYMMETRY

FACIAL ANALYSIS

FACIAL FLOW

Facial FLOW: concept that states that due to the **natural asymmetry** of the human face, it is impossible to define a straight line as the midline. Rather, a **curved line** connecting facial landmarks is more acceptable.

facial harmony



Reference Lines

FRONTAL VIEW

F-D 70% match

75% max-mand discrepancy

Bodden, Miller, Jamison A study of the relationship of the dental midline to the facial median line

J Prosthet Dent 1979 Jun;41(6):657-60. doi:

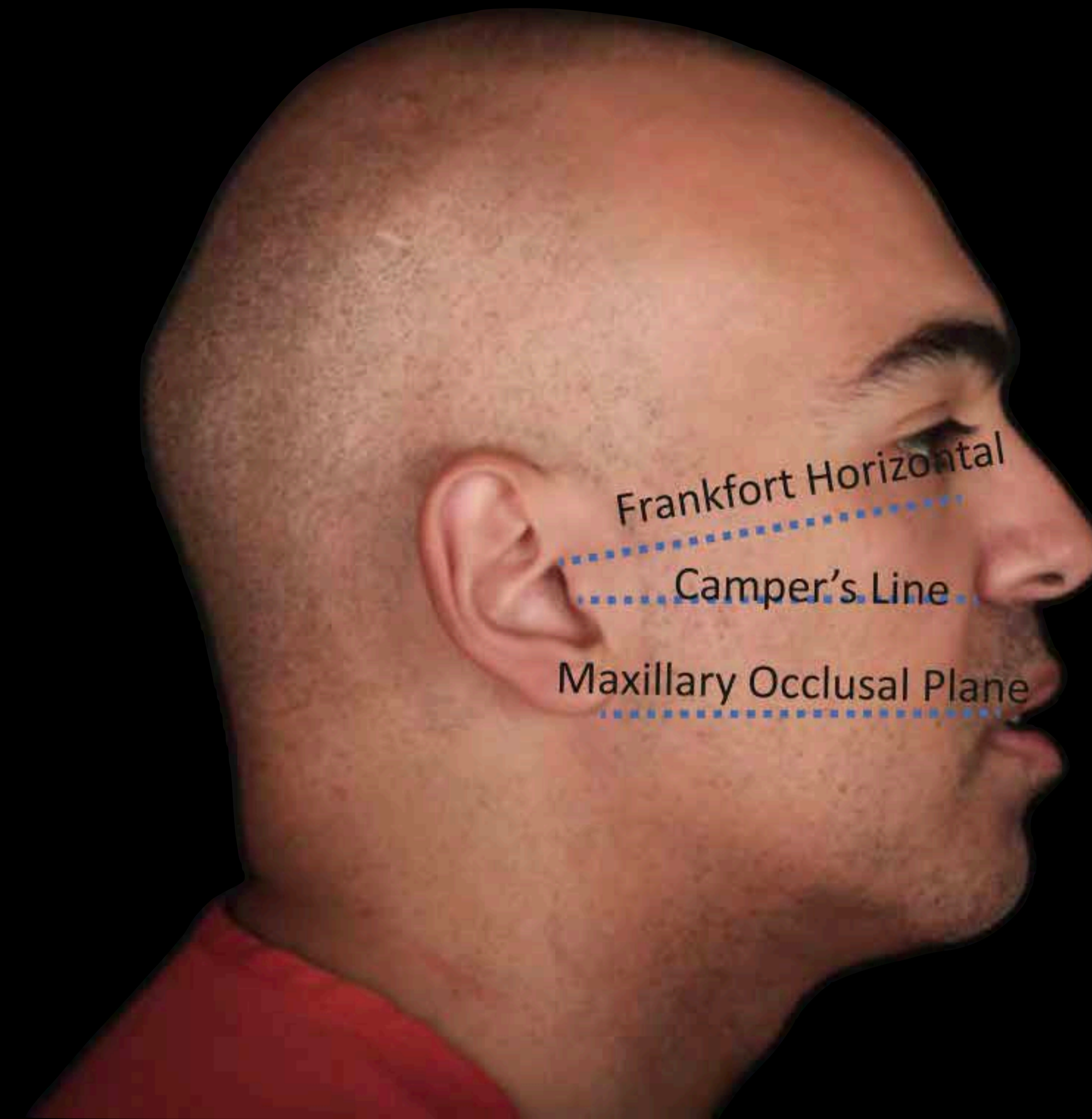
10.1016/0022-3913(79)90065-9.e

PLANES

FACIAL ANALYSIS

Frankfort horizontal:

Straight line from the highest point on the margin of the **auditory meatus** to the lowest point of the **orbit**, Should be parallel to the horizon when the patient is in NHP



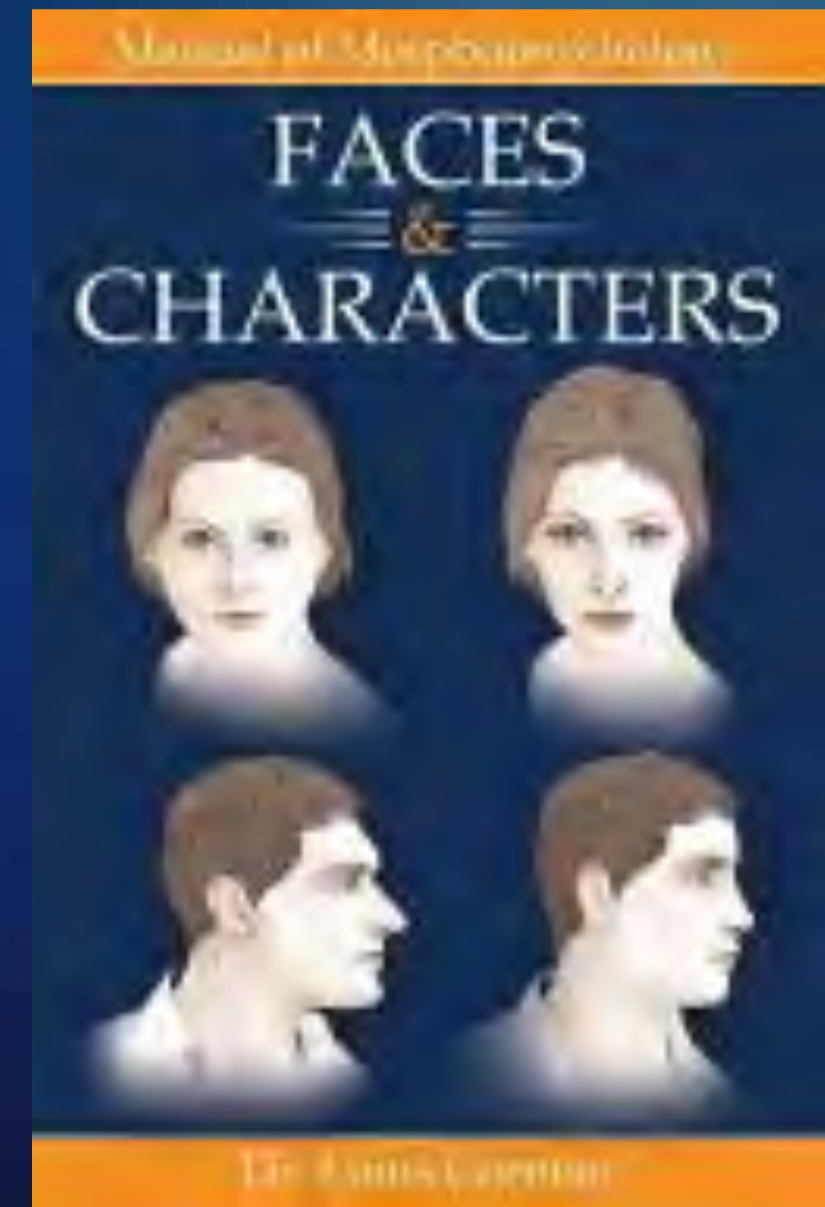
Reference Lines

PROFILE VIEW

Camper's plane or Ala-

Tragus line: A line running from the **inferior border of the ala** to the **superior border of the tragus** of the ear, determines the maxillary occlusal plane.

2D



Louis

Corman PhD



Fig 2-3 The lymphatic, heavy person, with a voluminous abdomen, thick members, and a full face. This individual is slow-moving, with a calm and placid character.

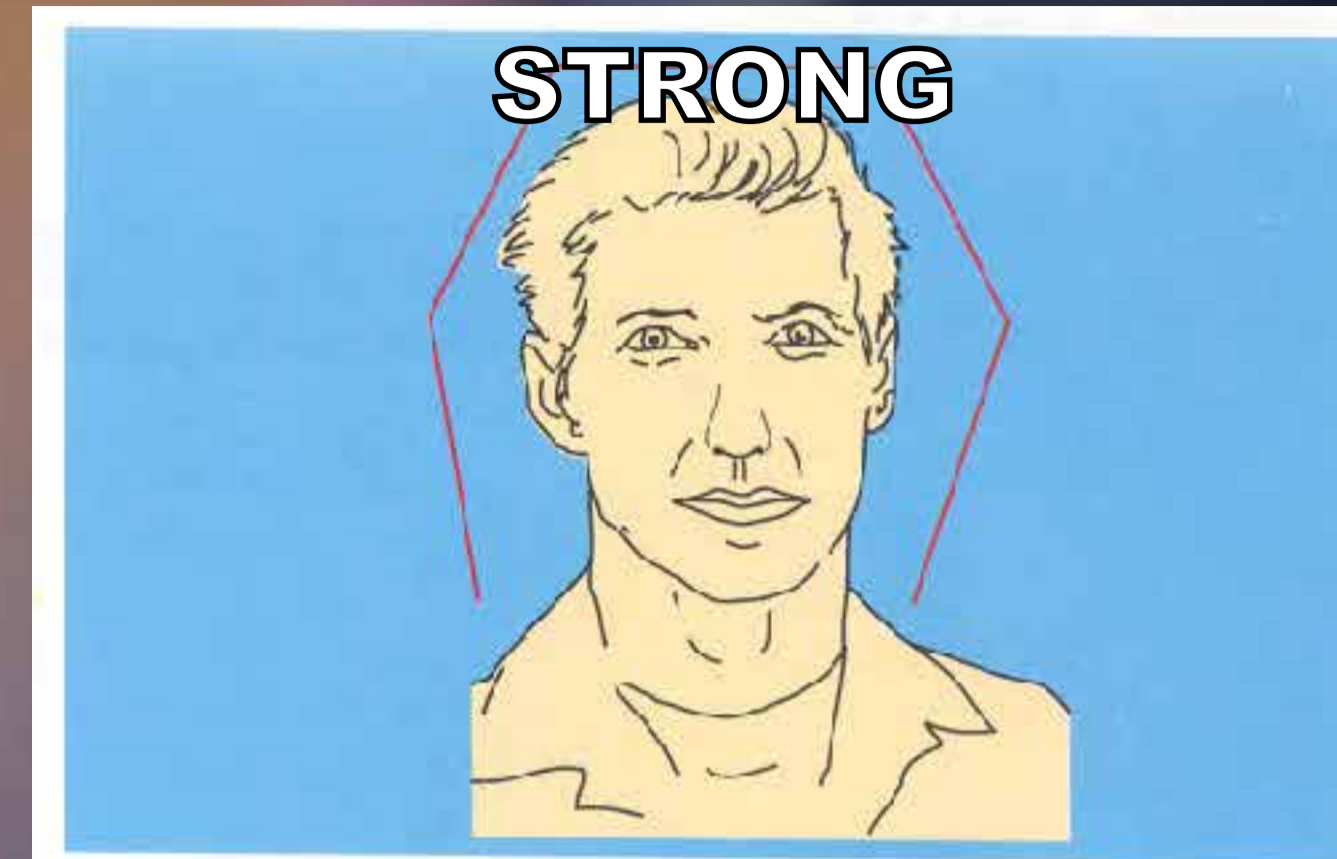


Fig 2-4 The sanguine, strong, and thick-set person has a well-developed thorax, a wide, ruddy complexion, spontaneous gestures, and an ebullient spirit.

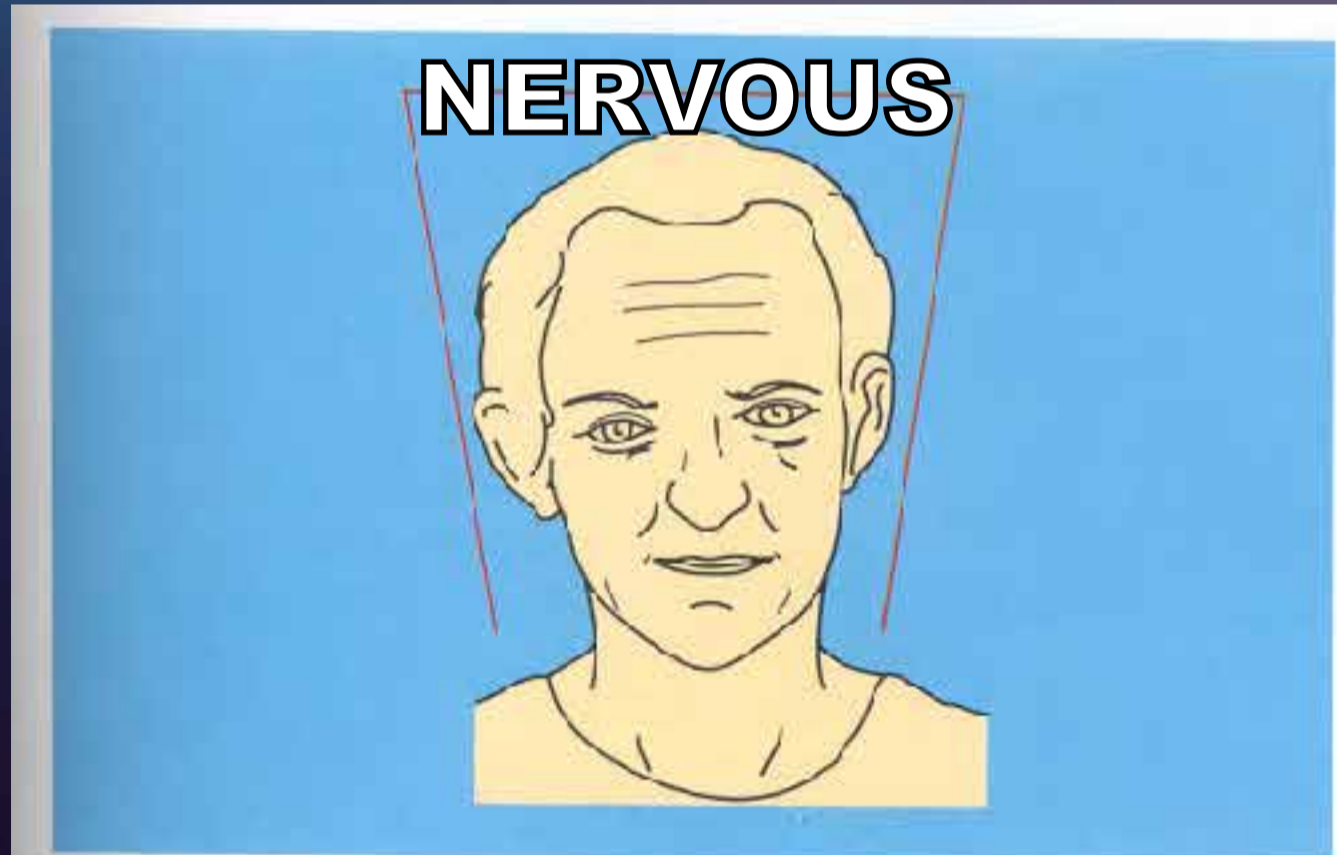


Fig 2-5 The nervous individual presents an elongated, pear-like head, with a wide superior extremity and an ample cerebral volume that contrasts with the others. The body is thin, with tegument of a grayish pallor and a thoughtful, anxious look.

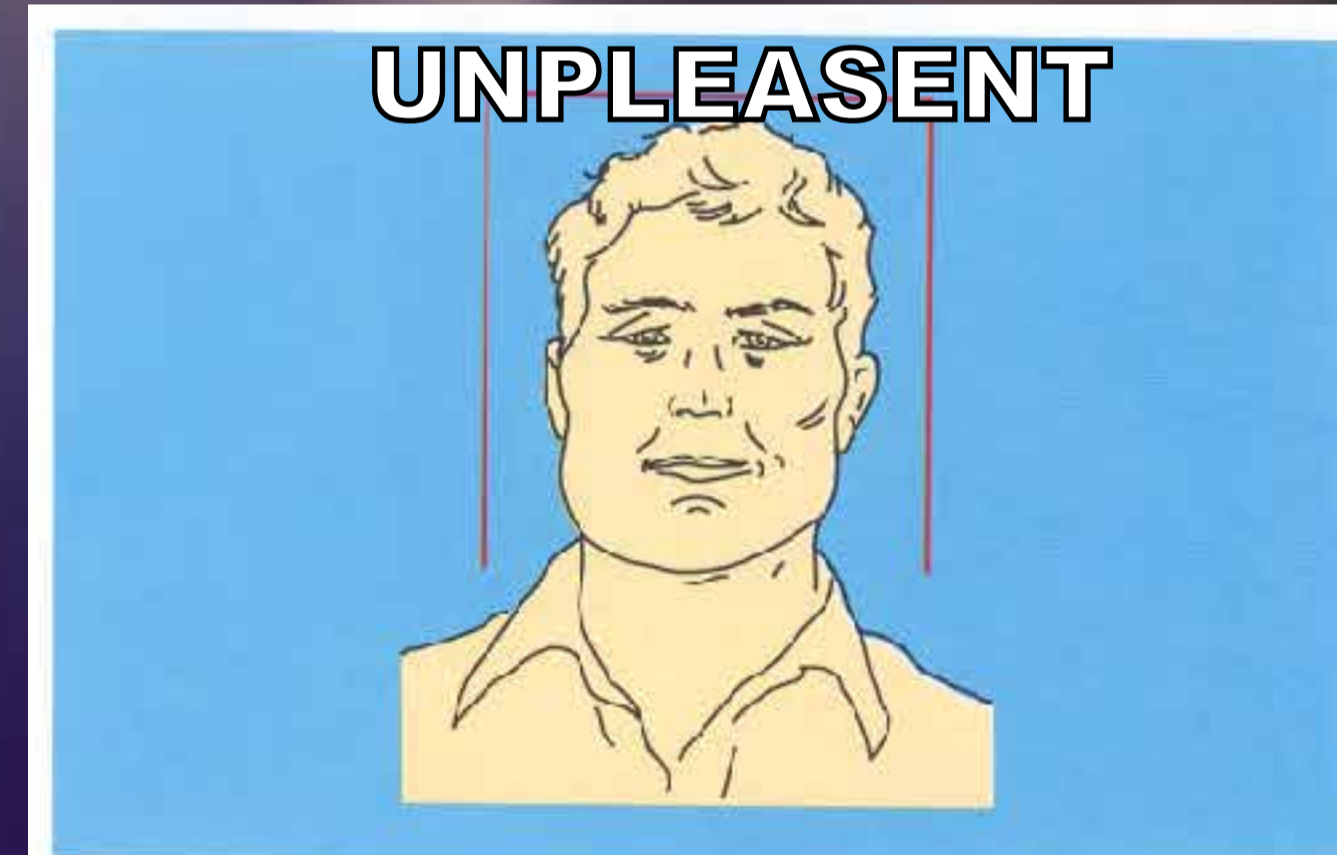


Fig 2-6 The bilious person has a rectangular face, straight eyebrows, an ardent and dominating look, and a firm, prominent musculature.

“Facial Shapes = reflection of the individual”

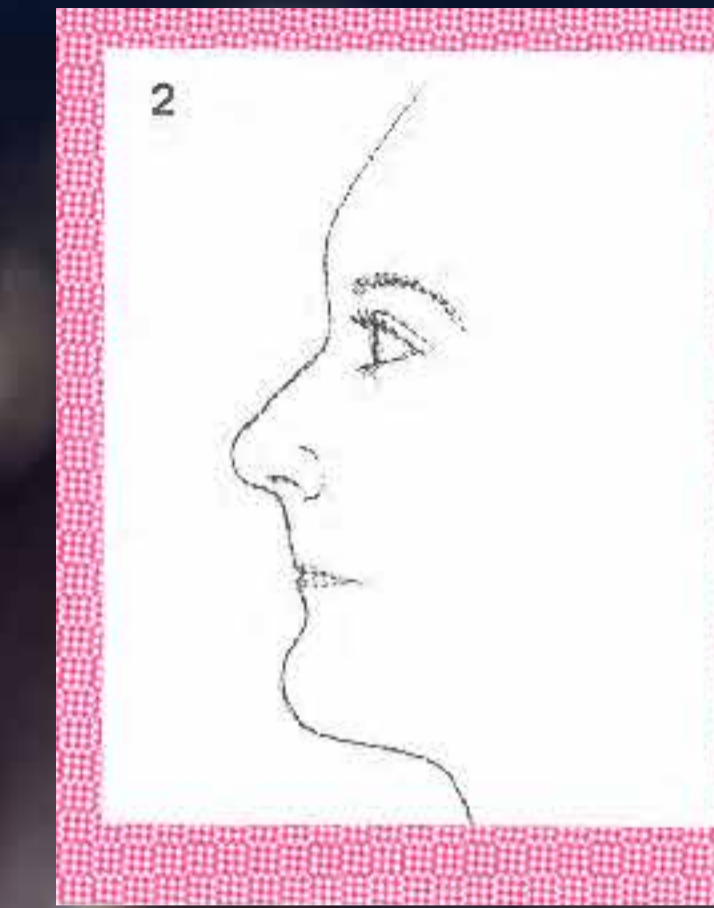
Perception

2D Perception

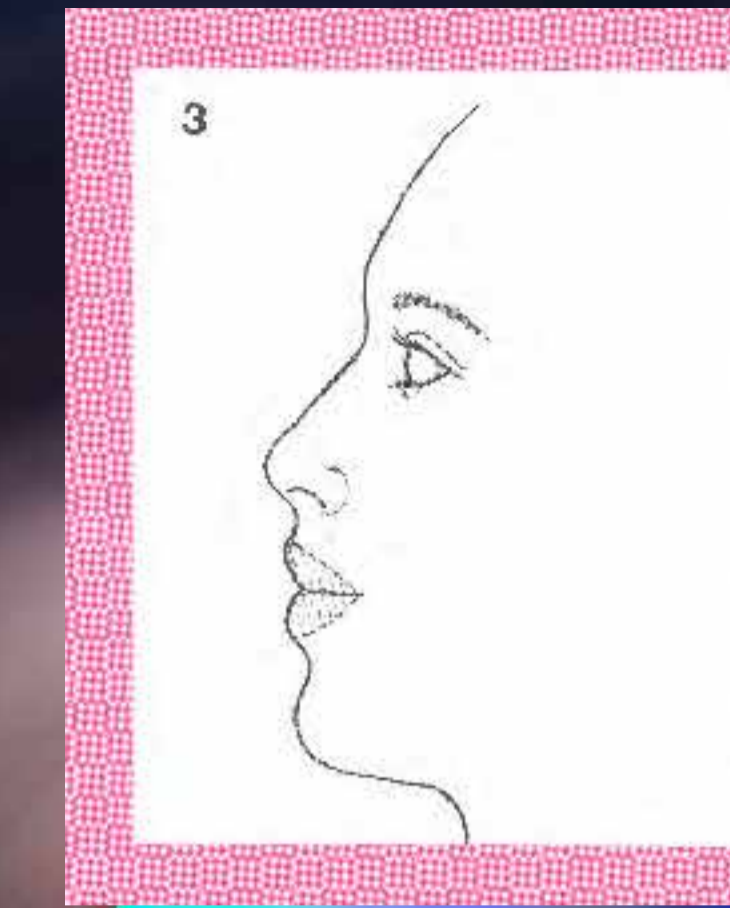
Subjective



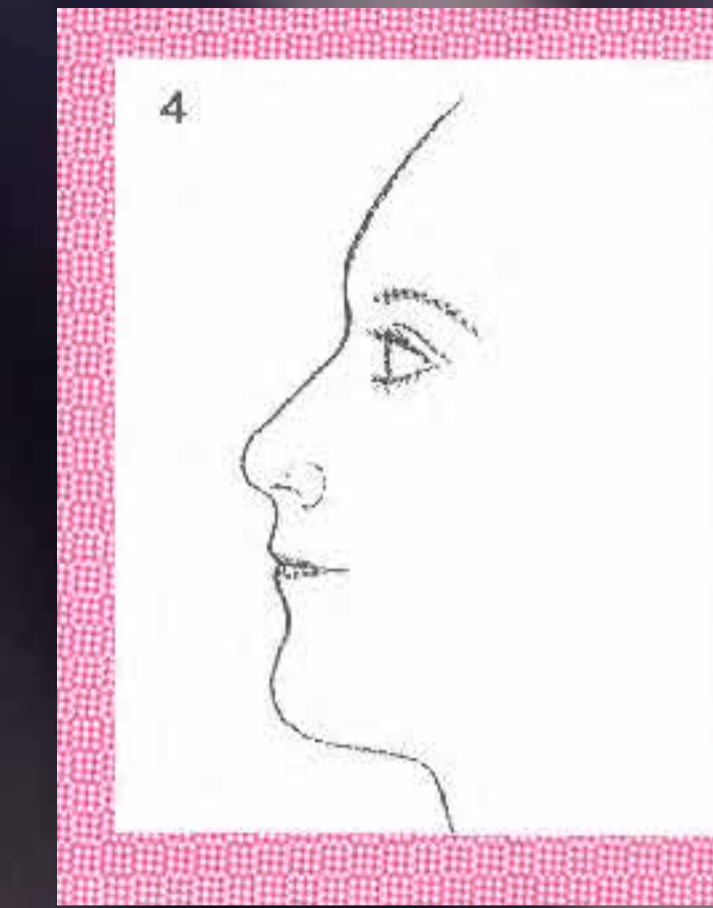
**Ambitious
Dominant**



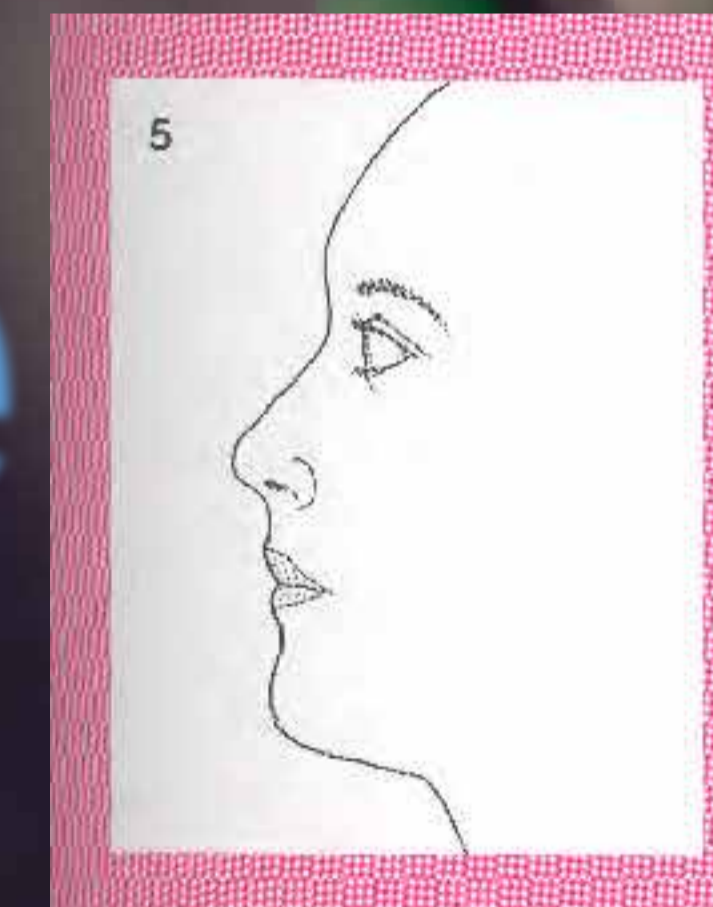
**Follower
Ambitionless**



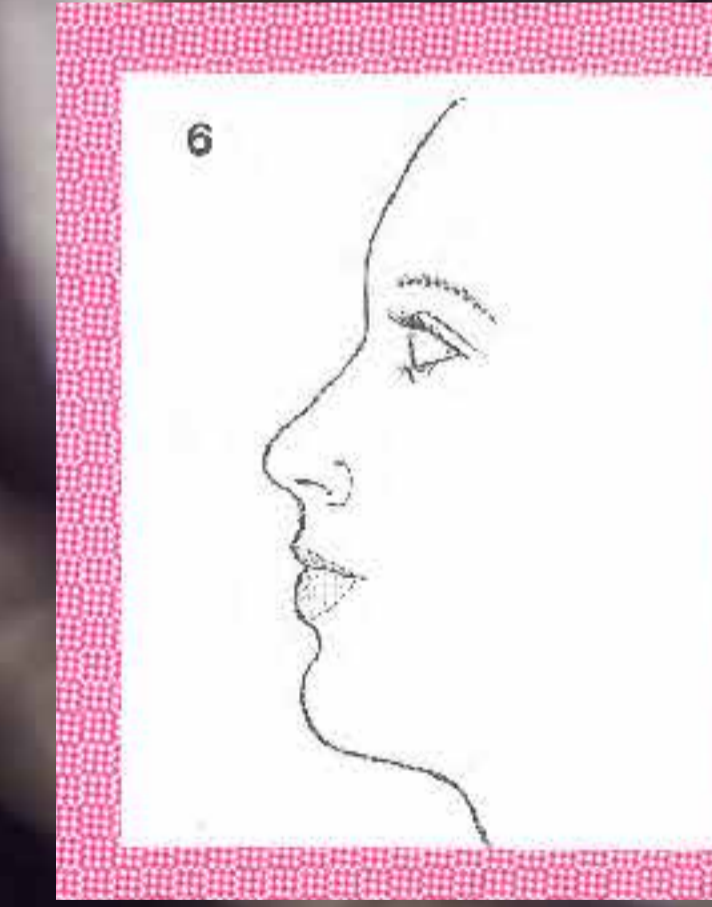
**Subjective
Materialist**



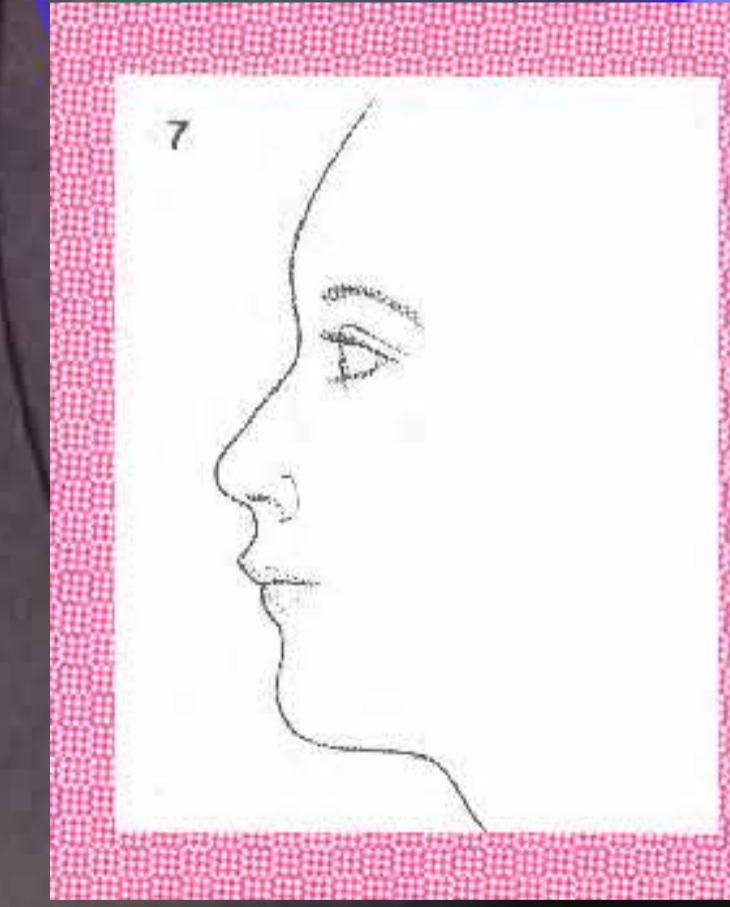
**Self Control
Interiorization**



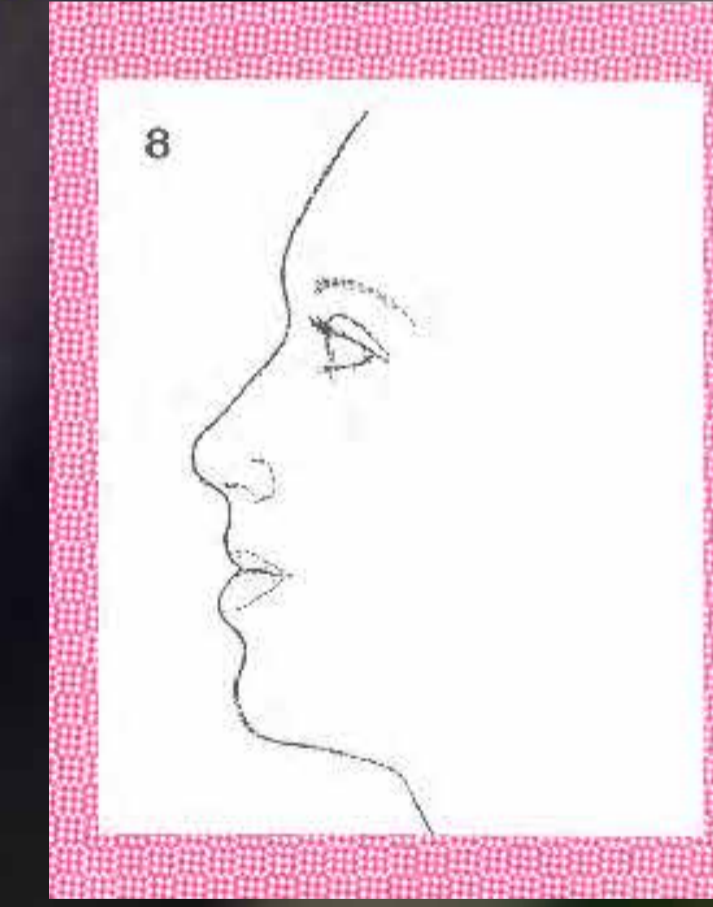
**Goodness
Courage**



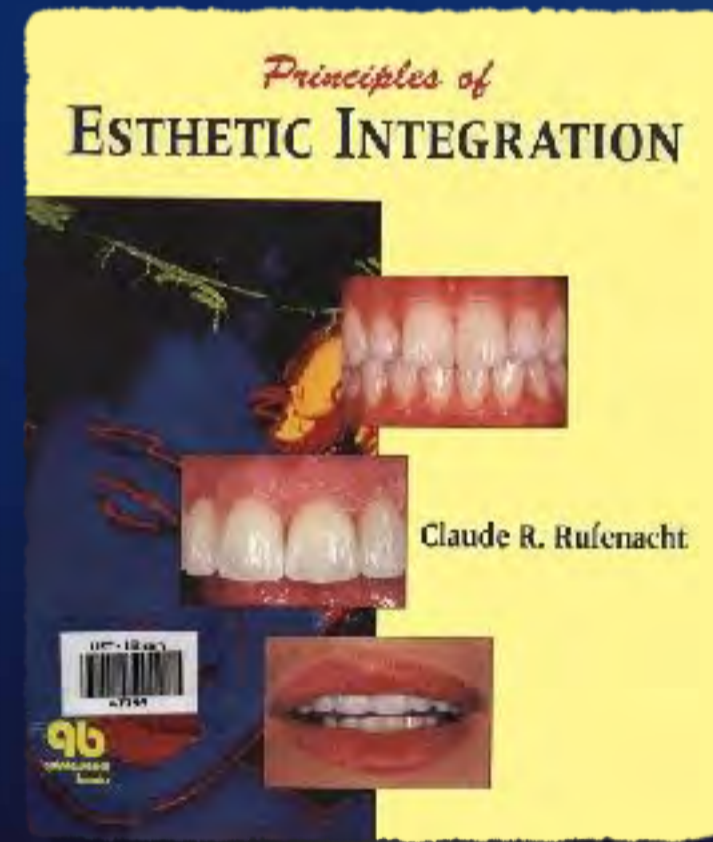
**Ingenious
Sensuality**



**Dominant
Scruples**



**Cannot Hide
Pride**

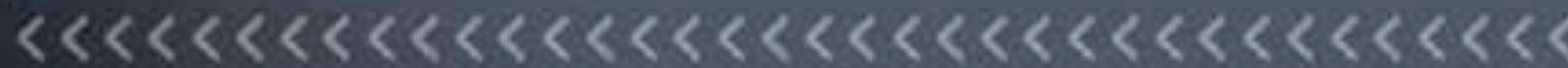
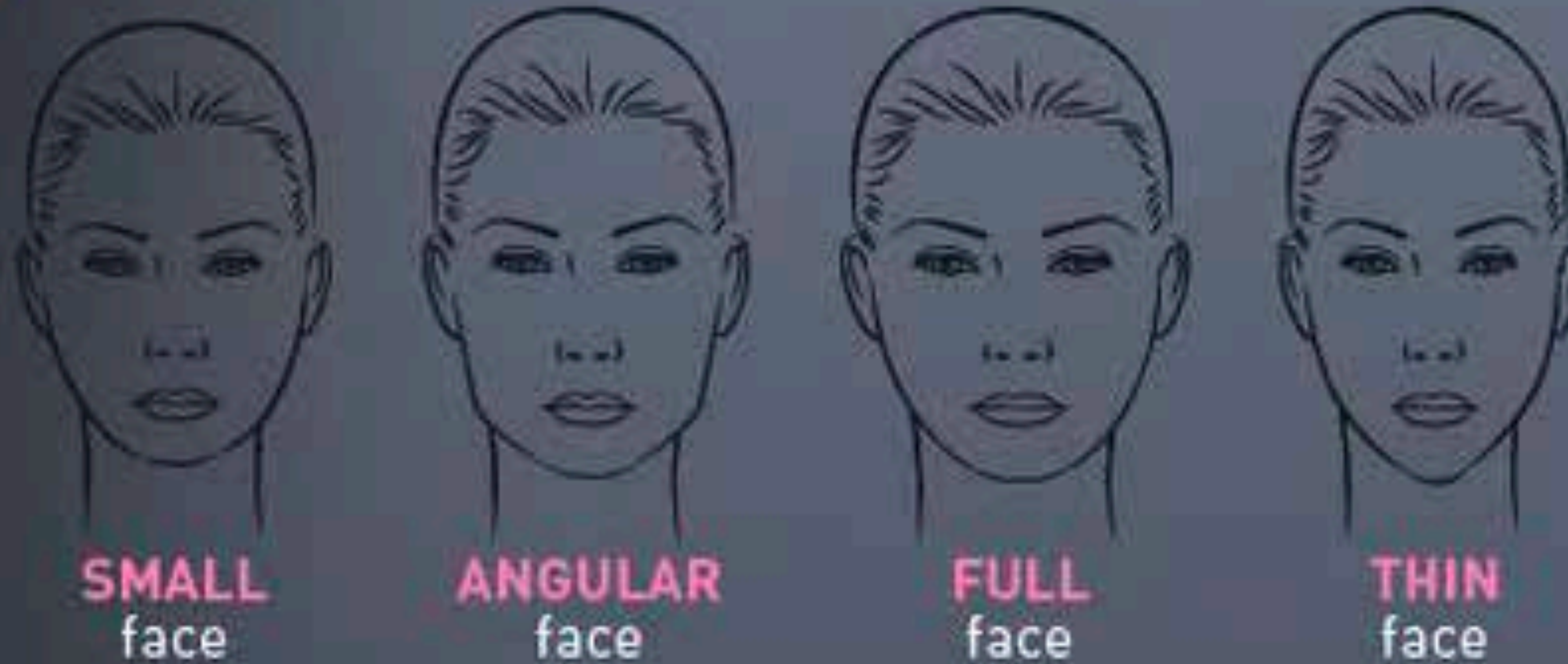


**Claude R.
Rufenacht**



Facial shapes

“The law of harmony” suggested a correlation between facial shape and contours of upper permanent incisors.



The facial shapes described are oval, triangle, and square

Dental shapes



Dental shapes



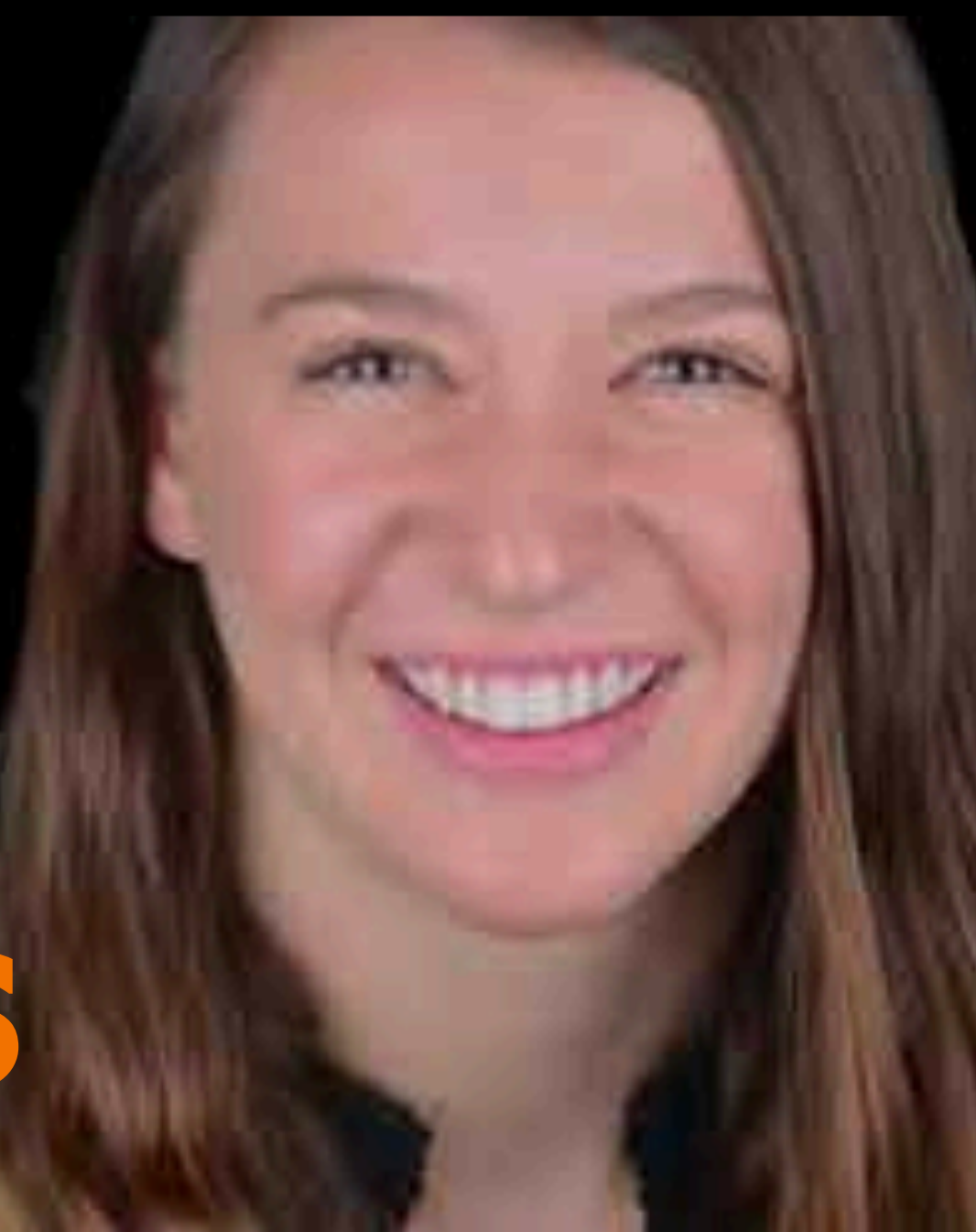
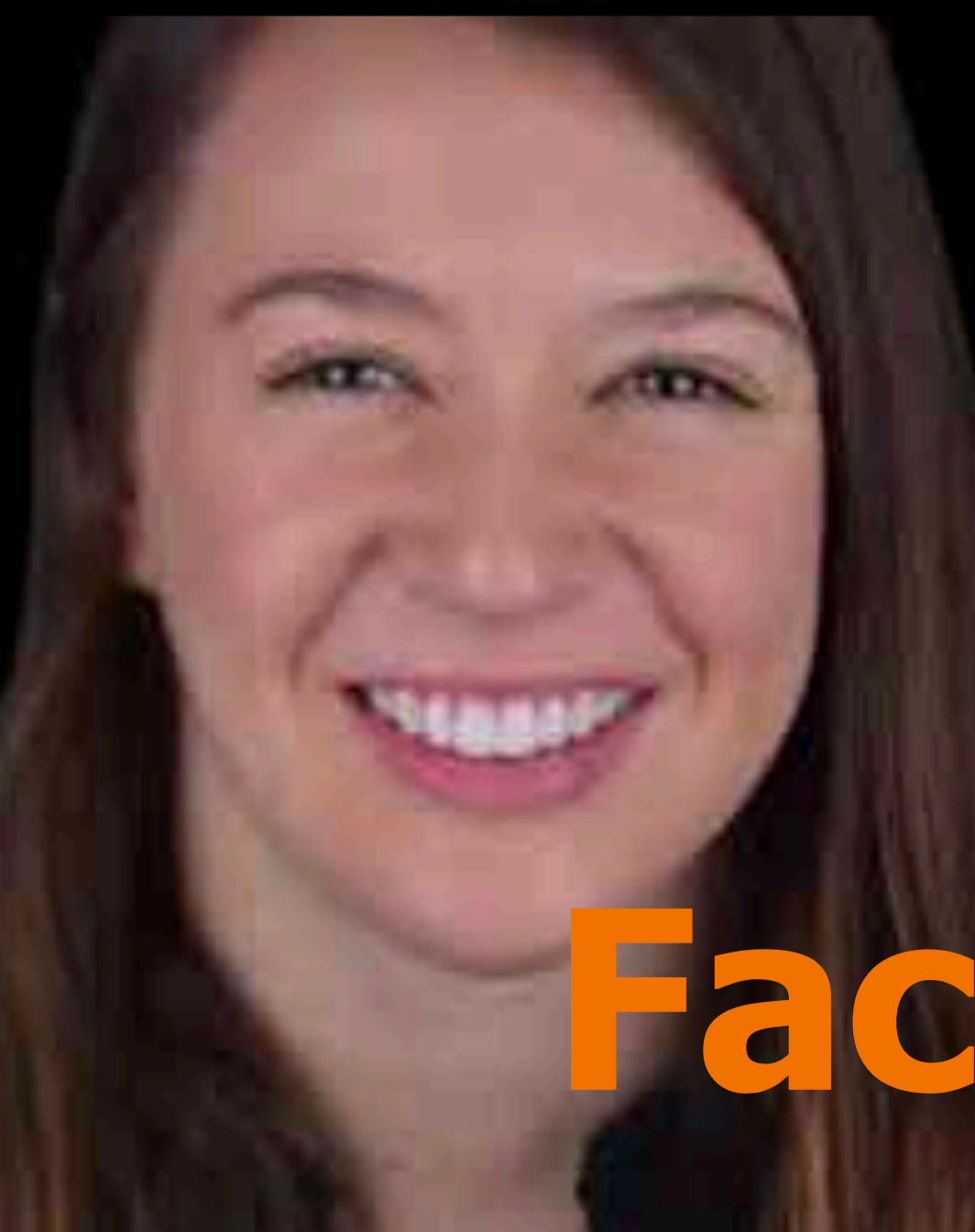
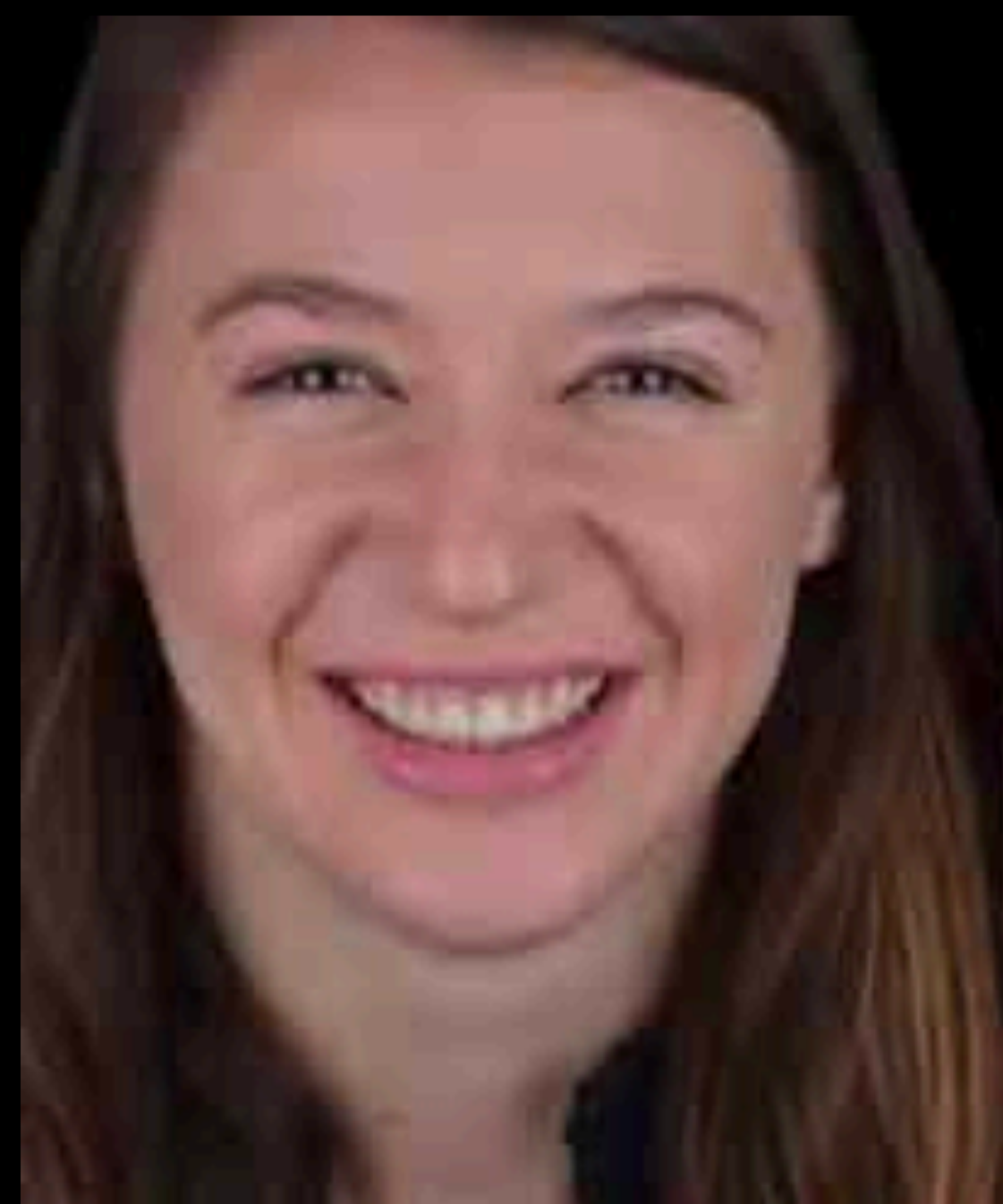
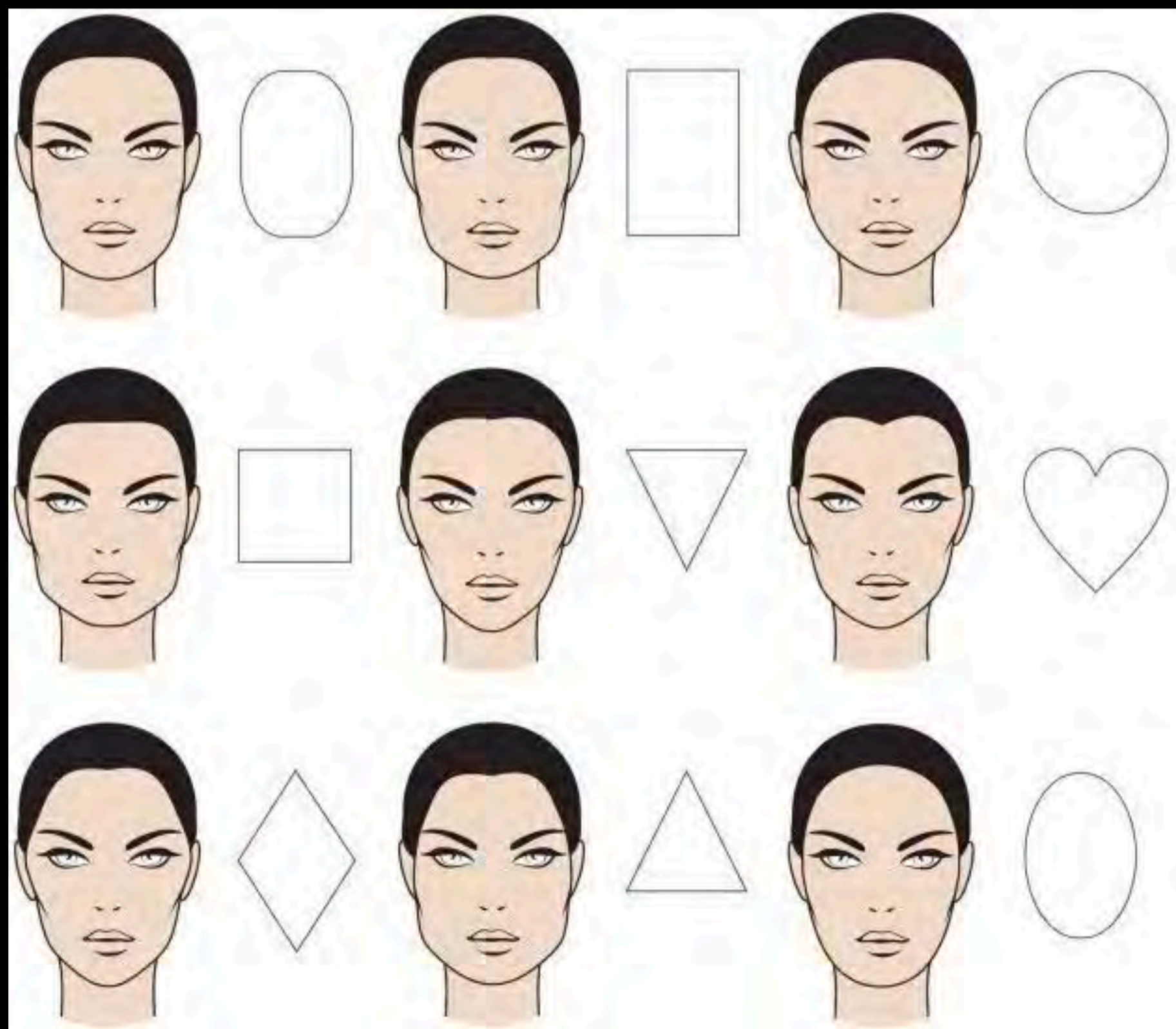
INITIAL

OVAL

SQUARE

RECTANGULAR

TRIANGULAR



Facial shapes

Visagism: The Art of Dental Composition



Braulio Paolucci, DDS¹
Marcelo Calamita, DDS, MS, PhD²
Christian Coachman, DDS, CDT³
Galip Gürel, DDS, MS⁴
Adriano Shayder, CDT⁵
Philip Hallawell⁶

**MAKES IT POSSIBLE FOR
THE PATIENTS TO
EXPRESS THE DESIRABLE
EMOTIONS AND
PERSONALITY TRAITS,
THROUGH THEIR SMILE**

MORPHO PSYCHOLOGY - VISAGISM

EXPRESSING THE DESIRABLE EMOTIONS AND PERSONALITY TRAITS, THROUGH THEIR SMILE

Sensible



Oval

Organized
Perfectionist
Artistic
Abstractive
Timid
Reserved

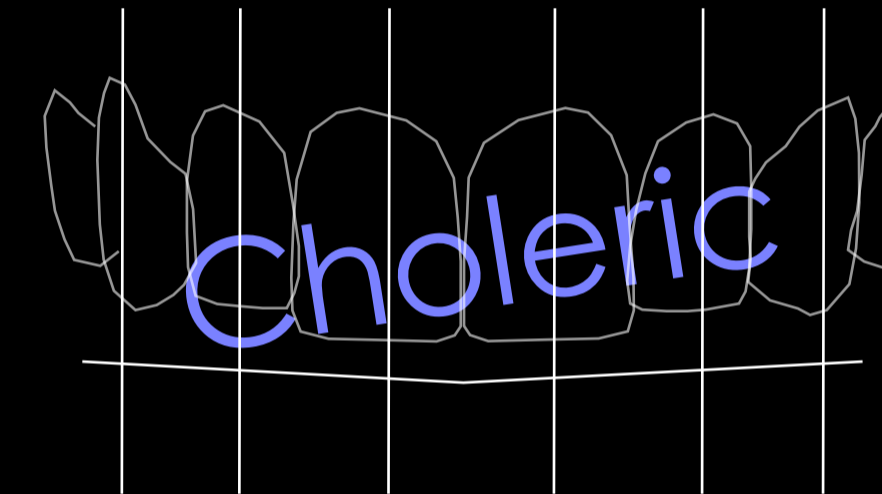
Dynamic



Triangular

Extroverted
Communicative
enthusiastic
Dynamic
Impulsive

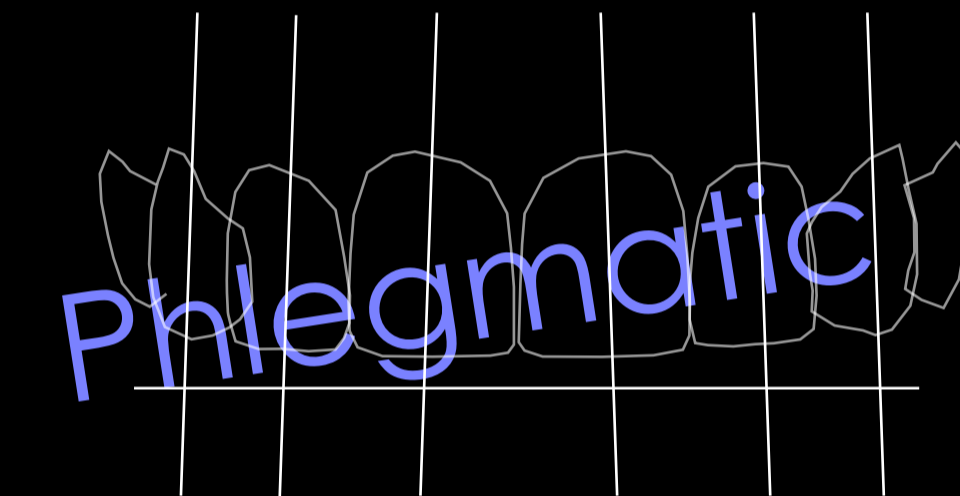
Strong



Rectangular

Determined
Objective
Explosive
Intense
entrepreneur
Passionate

Calm



Square

Diplomatic
Pacific
Mystic
spiritualized
Conformist
Discreet

Dental shapes

Dental shapes

MORPHO PSYCHOLOGY - VISAGISM

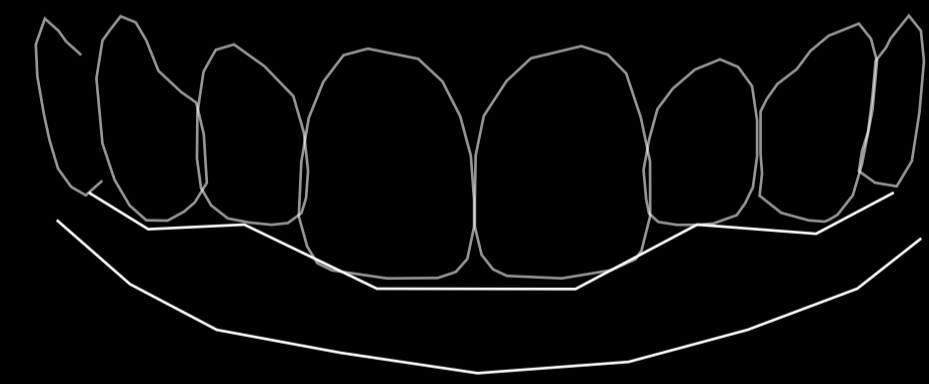
EXPRESSING THE DESIRABLE EMOTIONS AND PERSONALITY TRAITS, THROUGH THEIR SMILE

Dental shapes

Dental shapes



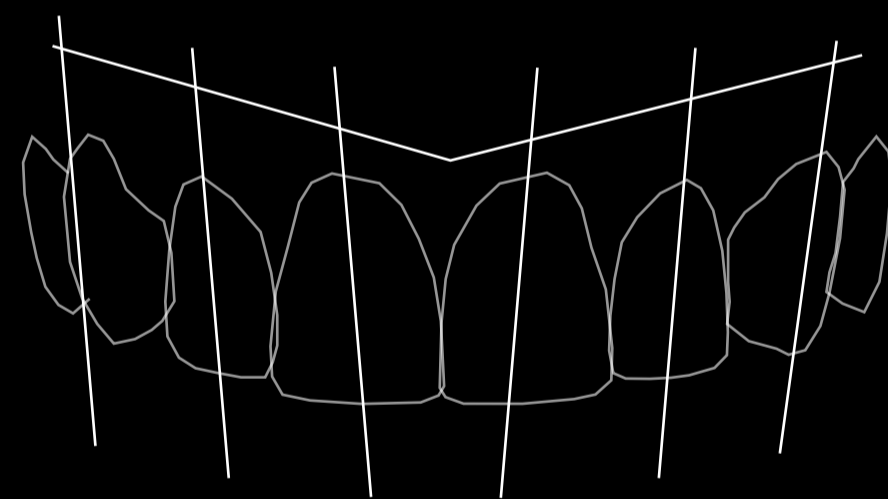
Oval



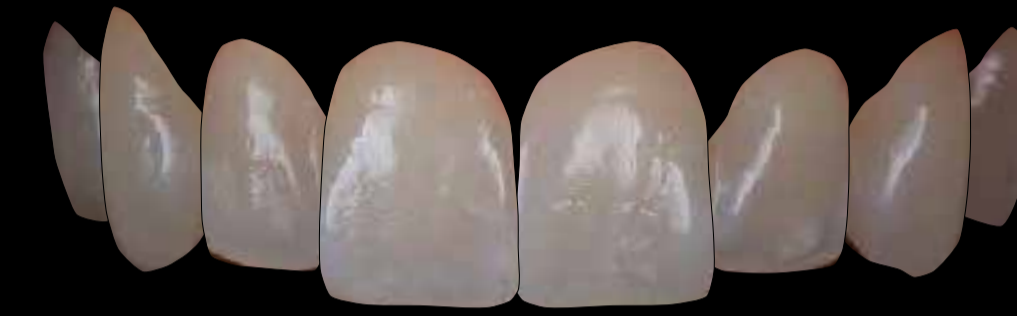
Dominant Centrals
Rounded cusps
Delicate laterals
Round Arch



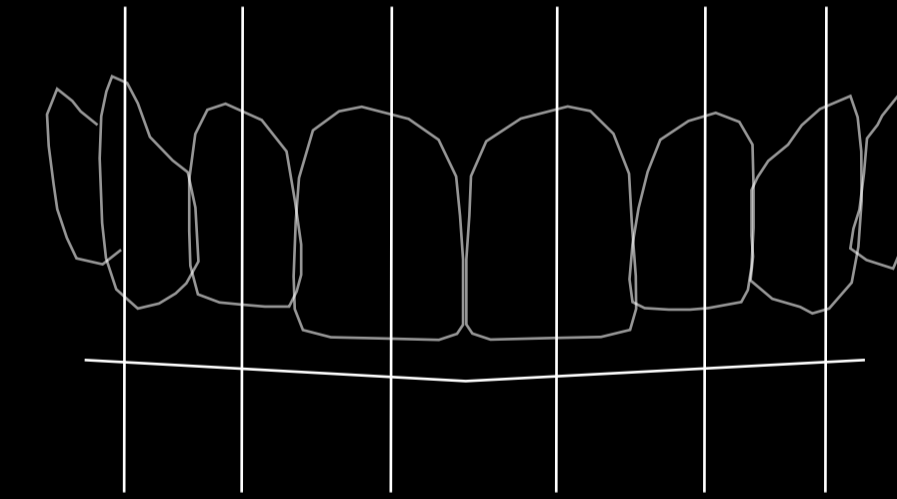
Triangular



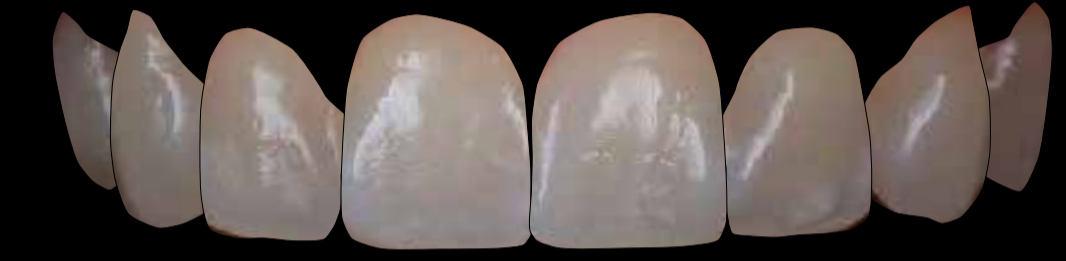
Ascendant Smile Line
Converging Axis
Incline cusps



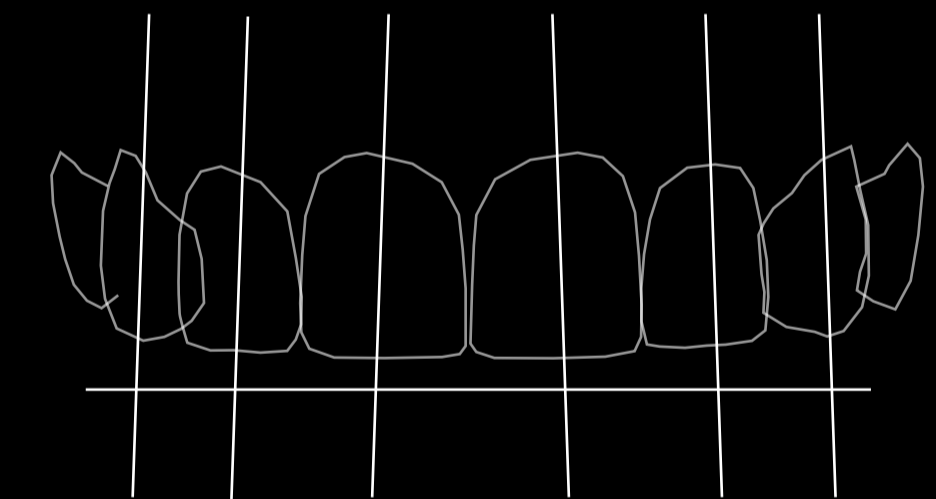
Rectangular



Dominant Centrals
Flat incisal edge
Aggressive Cusps **Vertical** Axis



Square



Lack of Dominance
Diverging Axis
Horizontal arrangement

2D PHOTOGRAPHY



Can we capture all these details?

Can we capture all these details?

Dental Photography

GOALS

Documentation

Case Acceptance

Communication

Diagnosis/Planning

Monitoring Progress



Common errors in extraoral photographs

- **The absence of a plain, non-distractive backdrop**
- **An incongruous, asymmetrical frame with too much background, or over-trimmed areas of interest, including cropped head or smile**
- **An incorrect distance between the patient and operator**
- **Capturing images that are too bright or too dark**
- **Portraying patients wearing excessive jewelry and accessories; hair disguising the patient's face; ears with no visible landmarks**
- **Allowing patients to tilt the head, or to look away, up, or to the side of the camera causing unreliable measurements**

The American Board of Orthodontics (ABO)

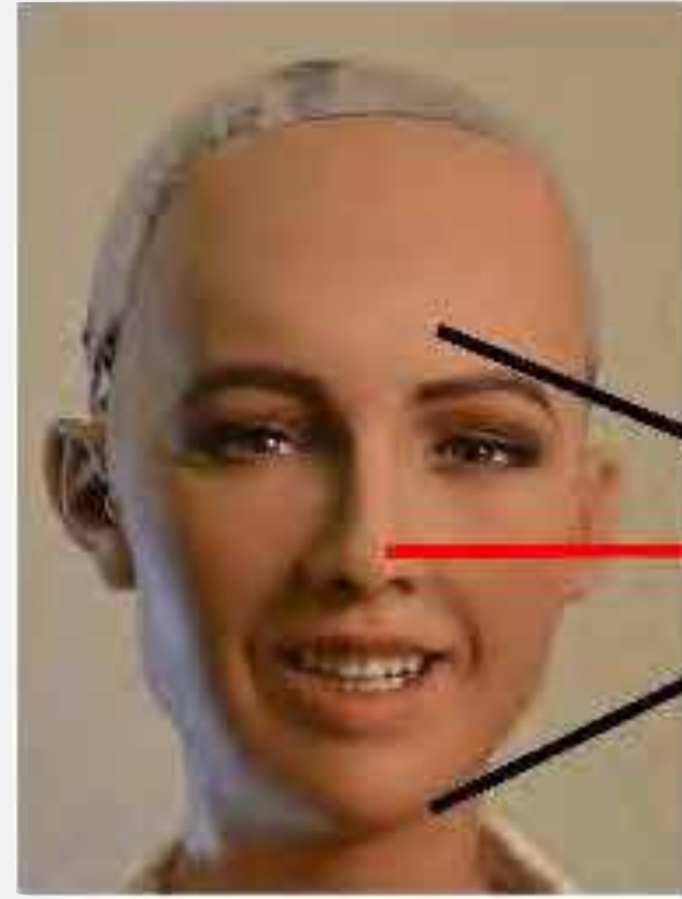
[https:// www.americanboardortho.com/orthodontic-professionals/about-board-certification/ clinical-examination/case-record-preparation/photograph-requirements/](https://www.americanboardortho.com/orthodontic-professionals/about-board-certification/clinical-examination/case-record-preparation/photograph-requirements/)
Accessed March 10, 2017



Can We

capture?

2D



Place camera lens directly in front of the nose to capture the plane of occlusion. If possible, use an f-stop of 22 or higher so that the back teeth are in focus.



Full face full smile for the SmileSIM and prosthetic work up

Full Face Patient photographs



Maxillary prognathism



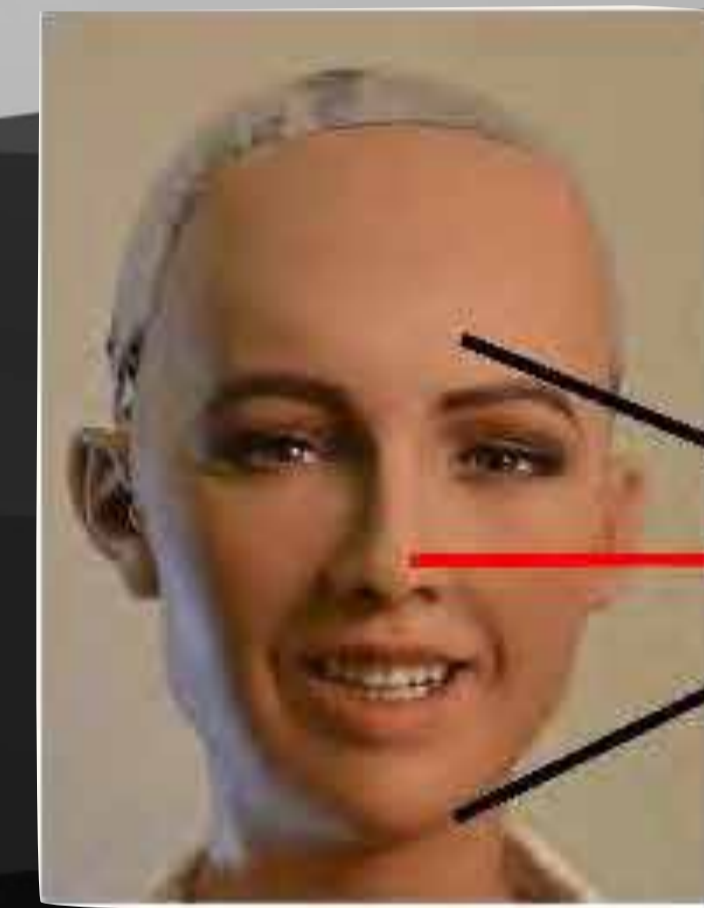
Mandibular prognathism

2D

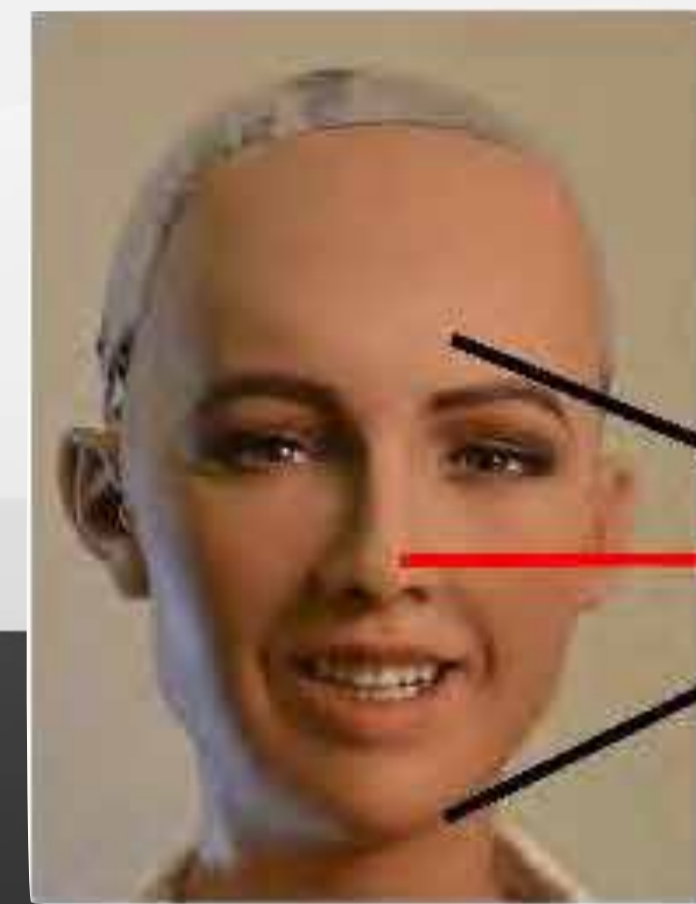
Shoulder shrug



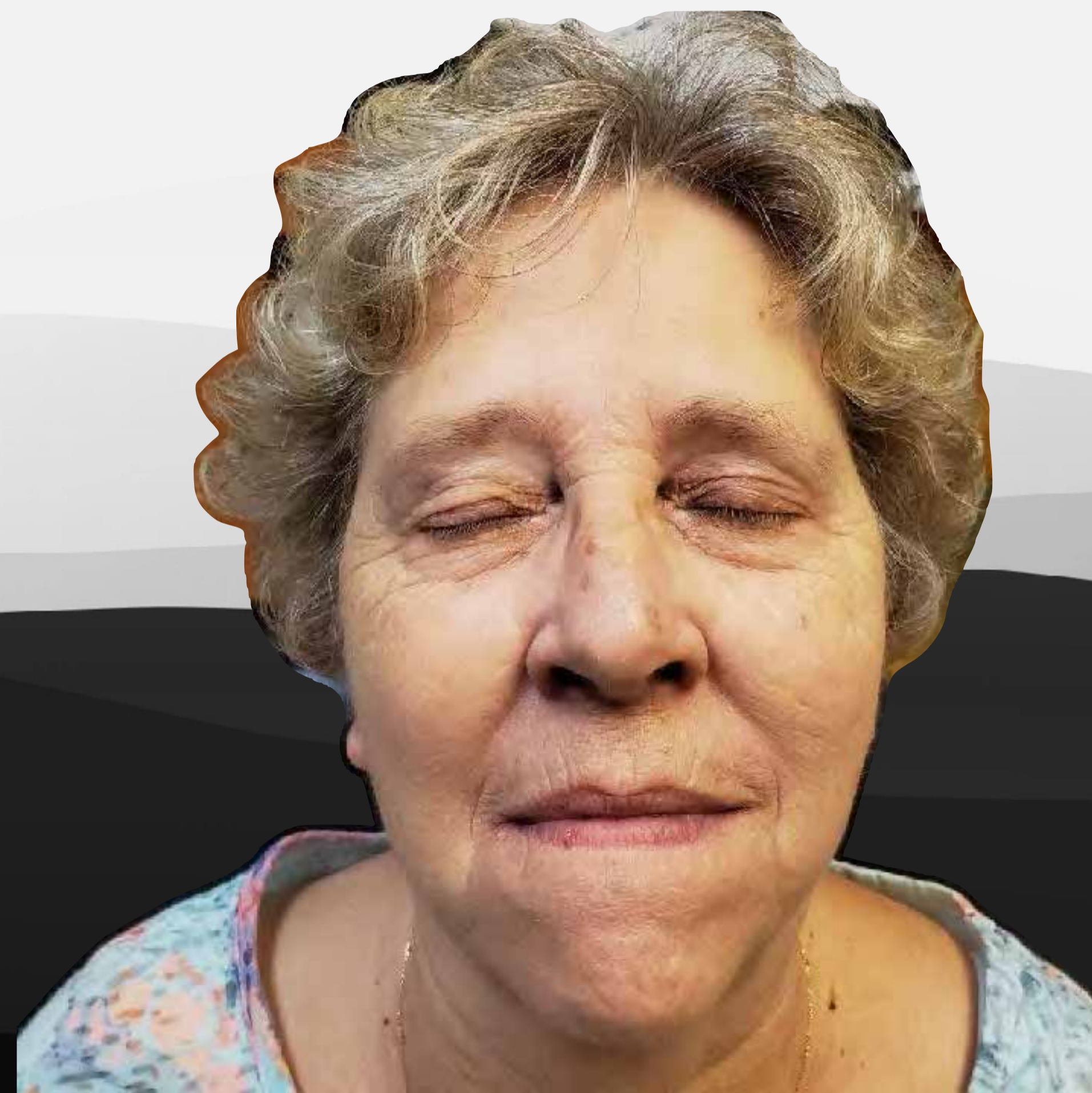
Wash out (Flash)



2D



Eyes closed

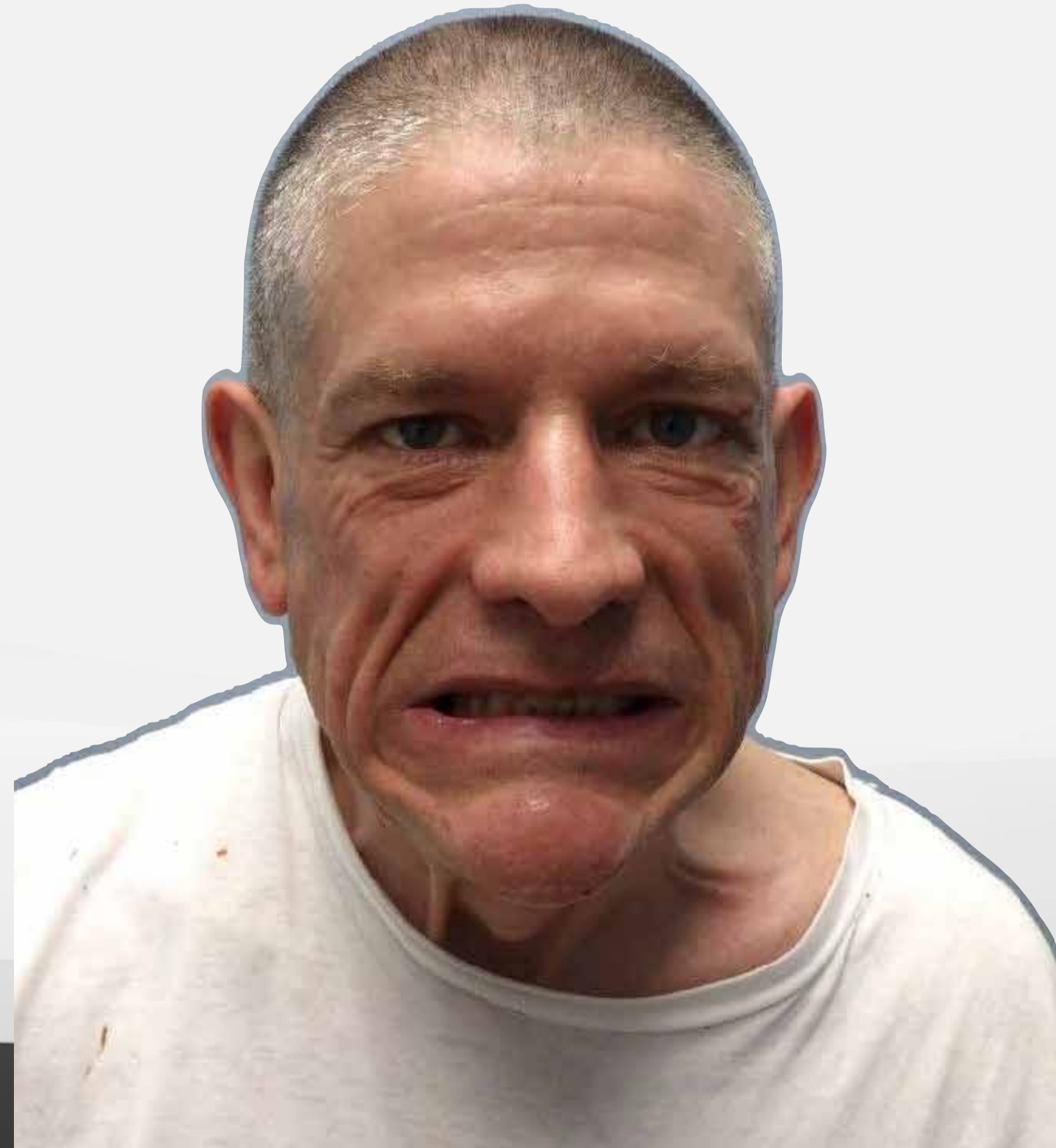


Too far away

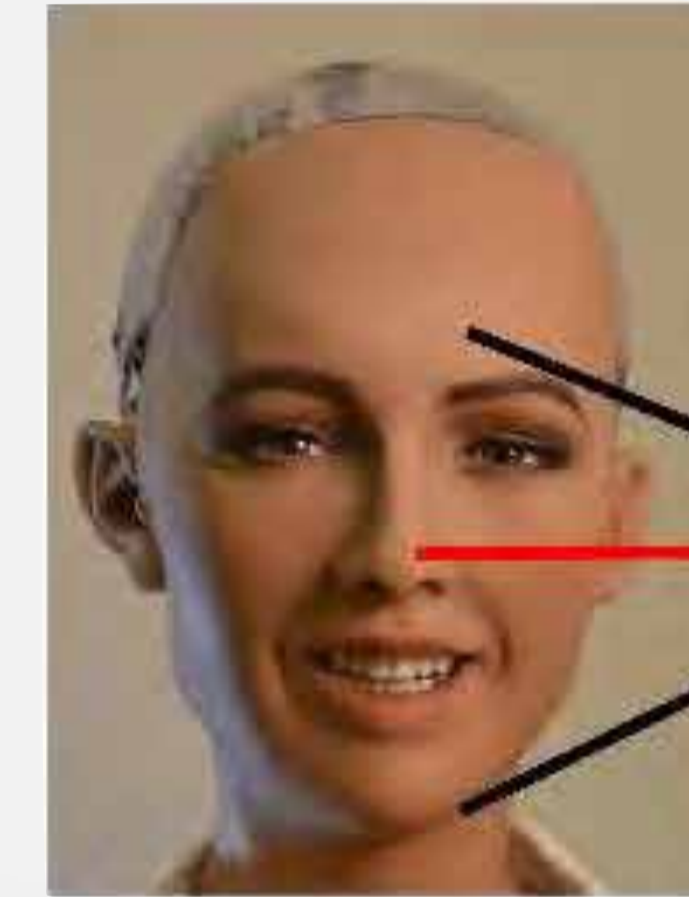


2D

Can I get a smile?

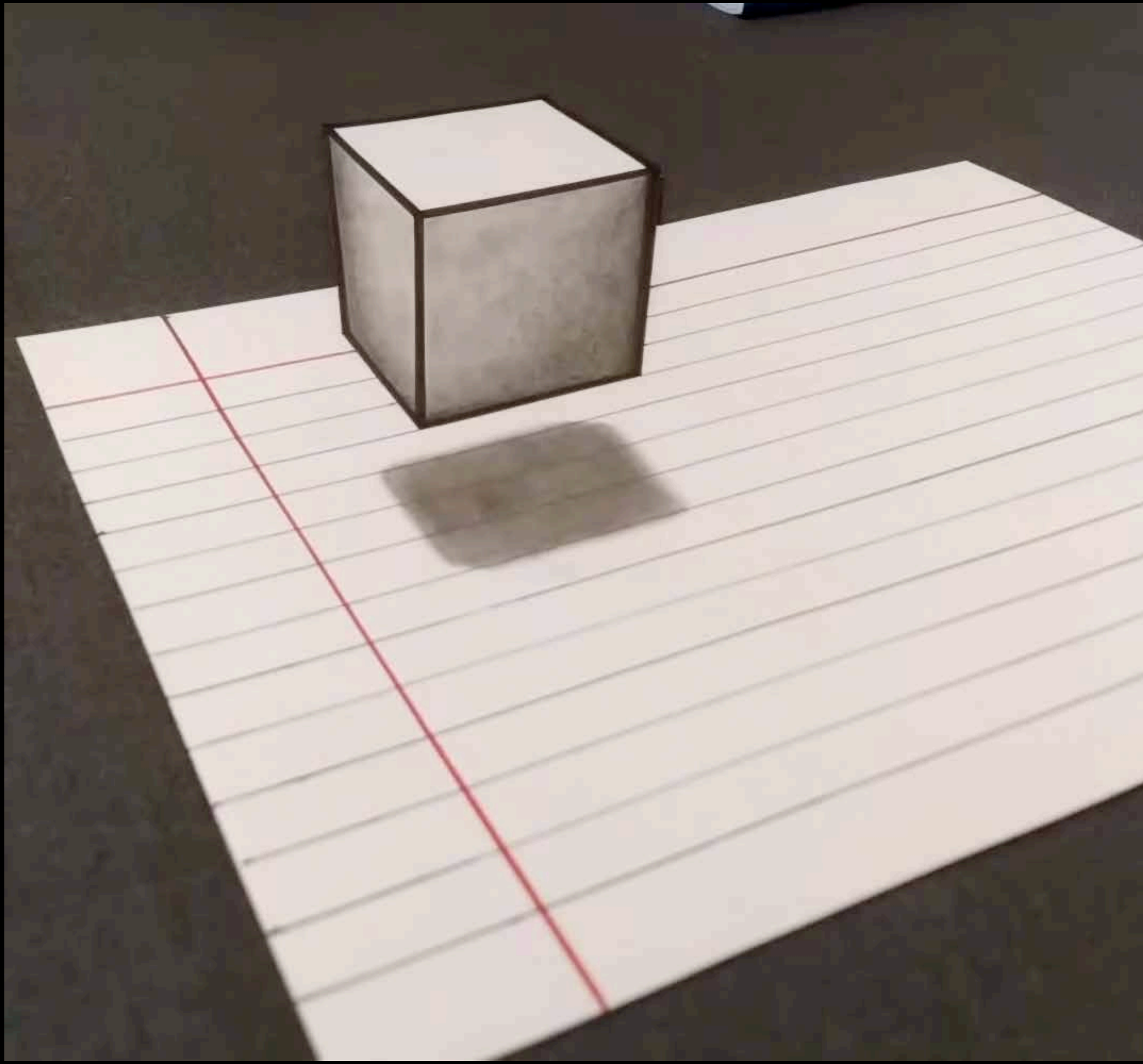


FLAT

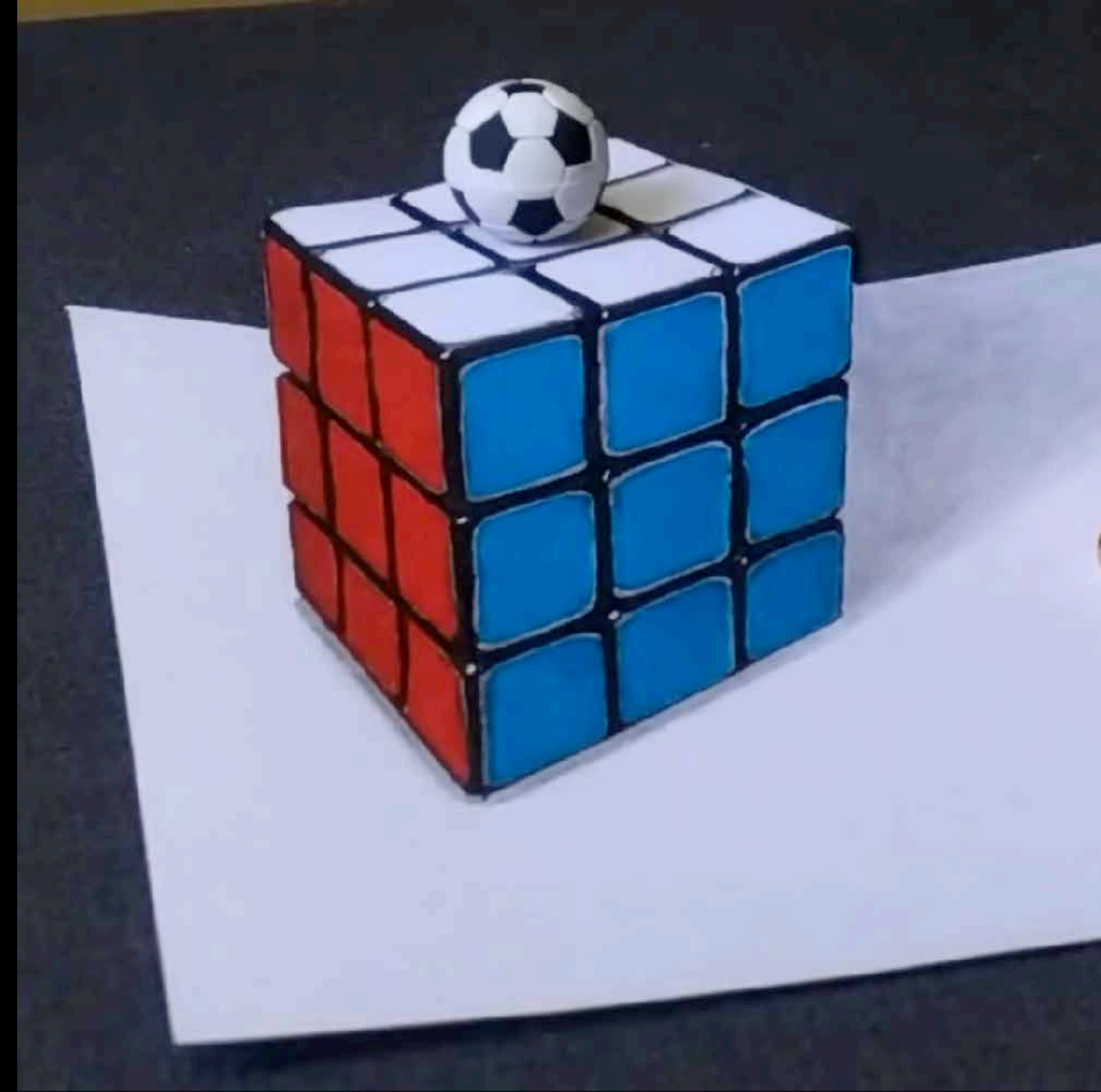




2D



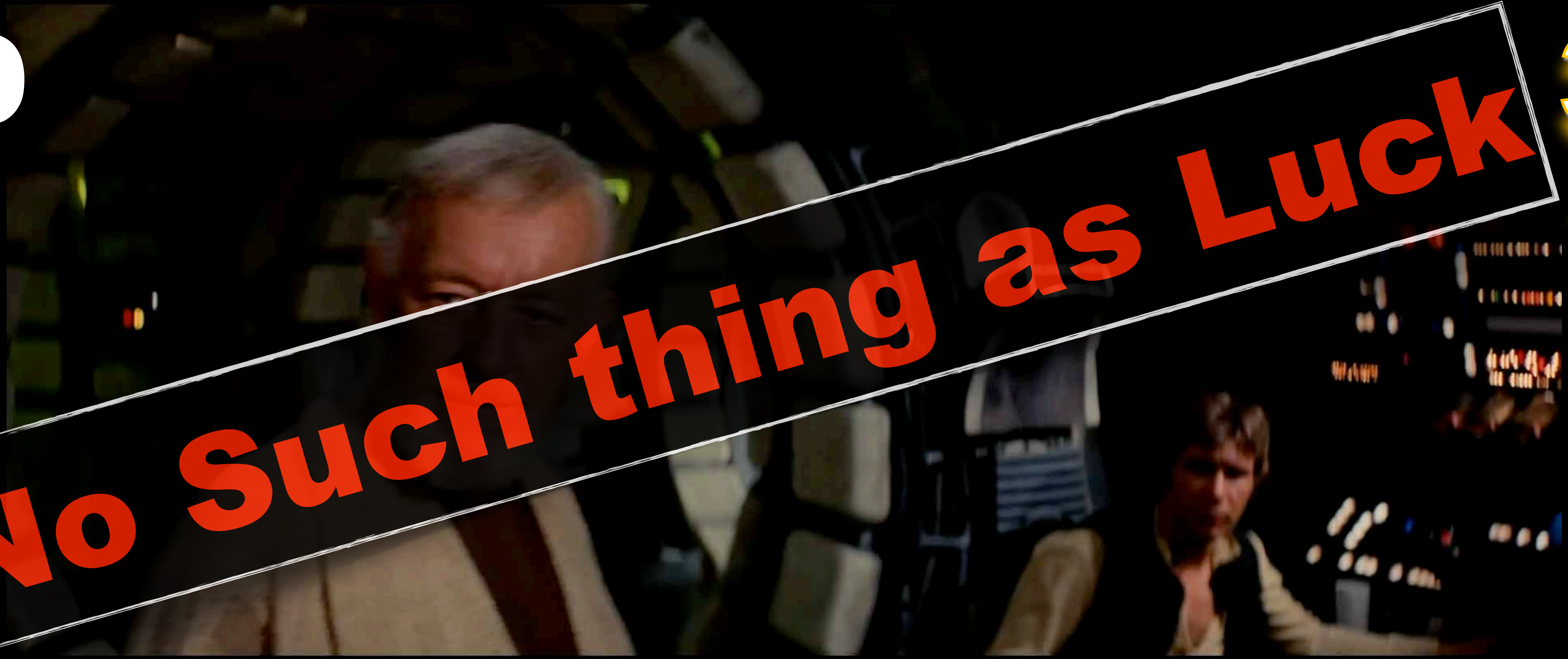
3D

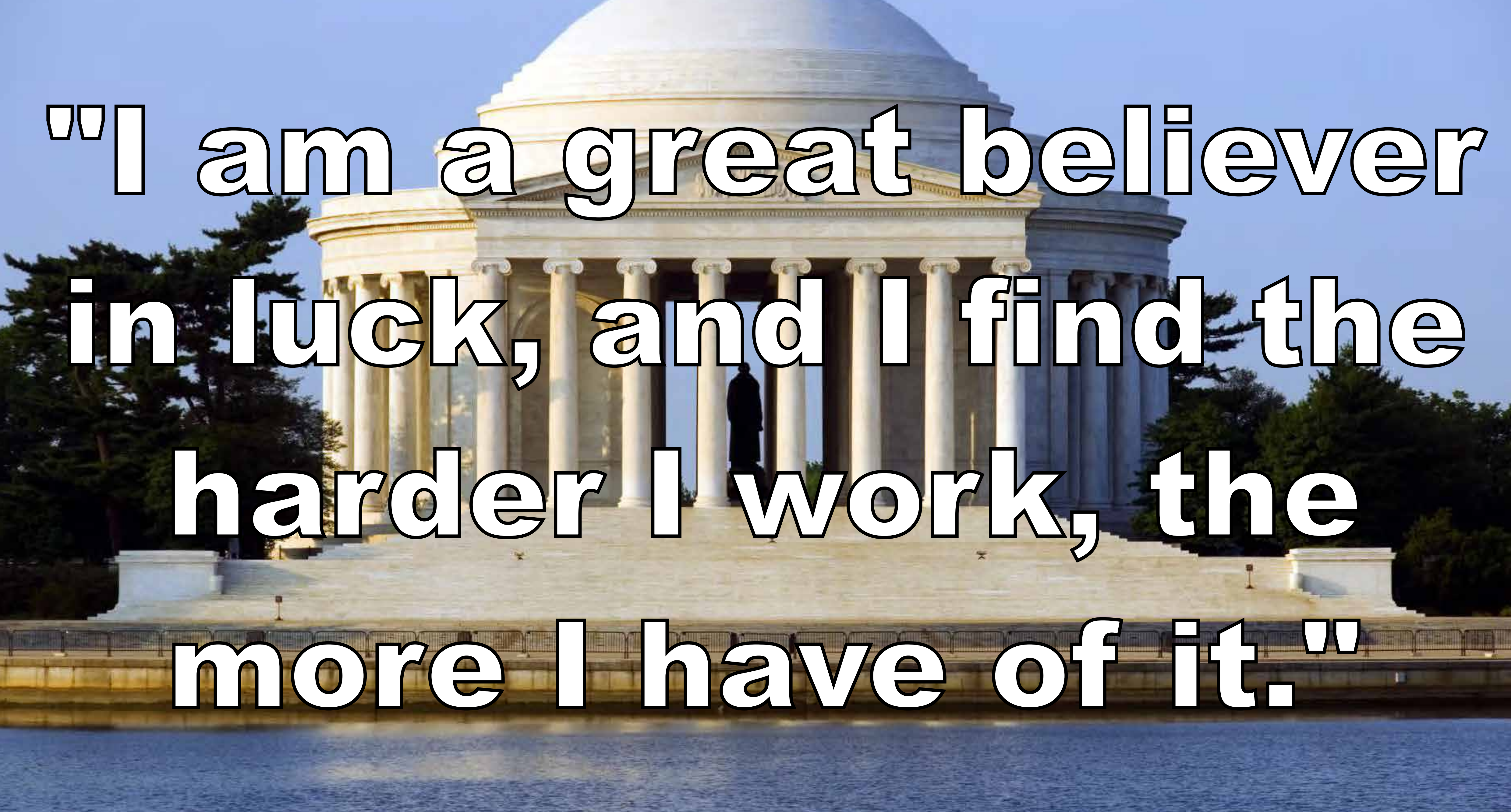


2D

3D

No Such thing as Luck



The Jefferson Memorial in Washington, D.C., featuring a large white dome and classical columns, with a person standing on the steps and a body of water in the foreground.

**"I am a great believer
in luck, and I find the
harder I work, the
more I have of it."**

A close-up of a bronze bust of Thomas Jefferson, showing his face and upper torso, set against a blurred background of green and yellow foliage.

Thomas Jefferson

Computer Aided Design

3D



FACE RECOGNITION



scanning 58%

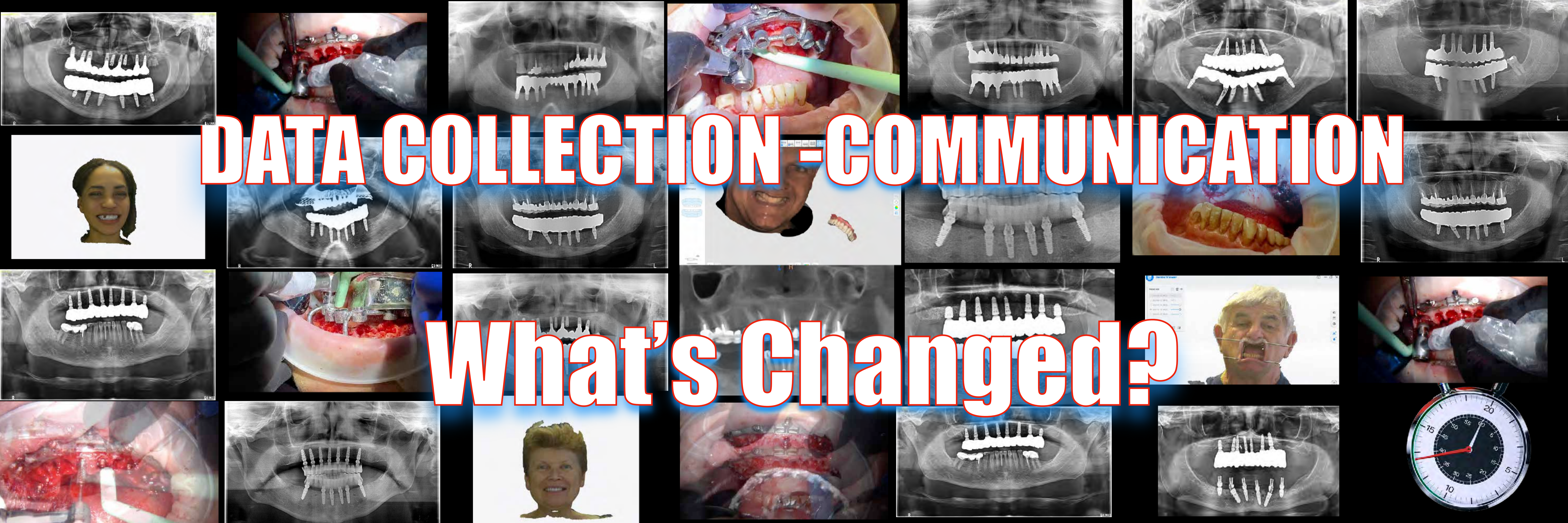


3D



DATA COLLECTION-COMMUNICATION

What's Changed?



FACIAL SCANNING

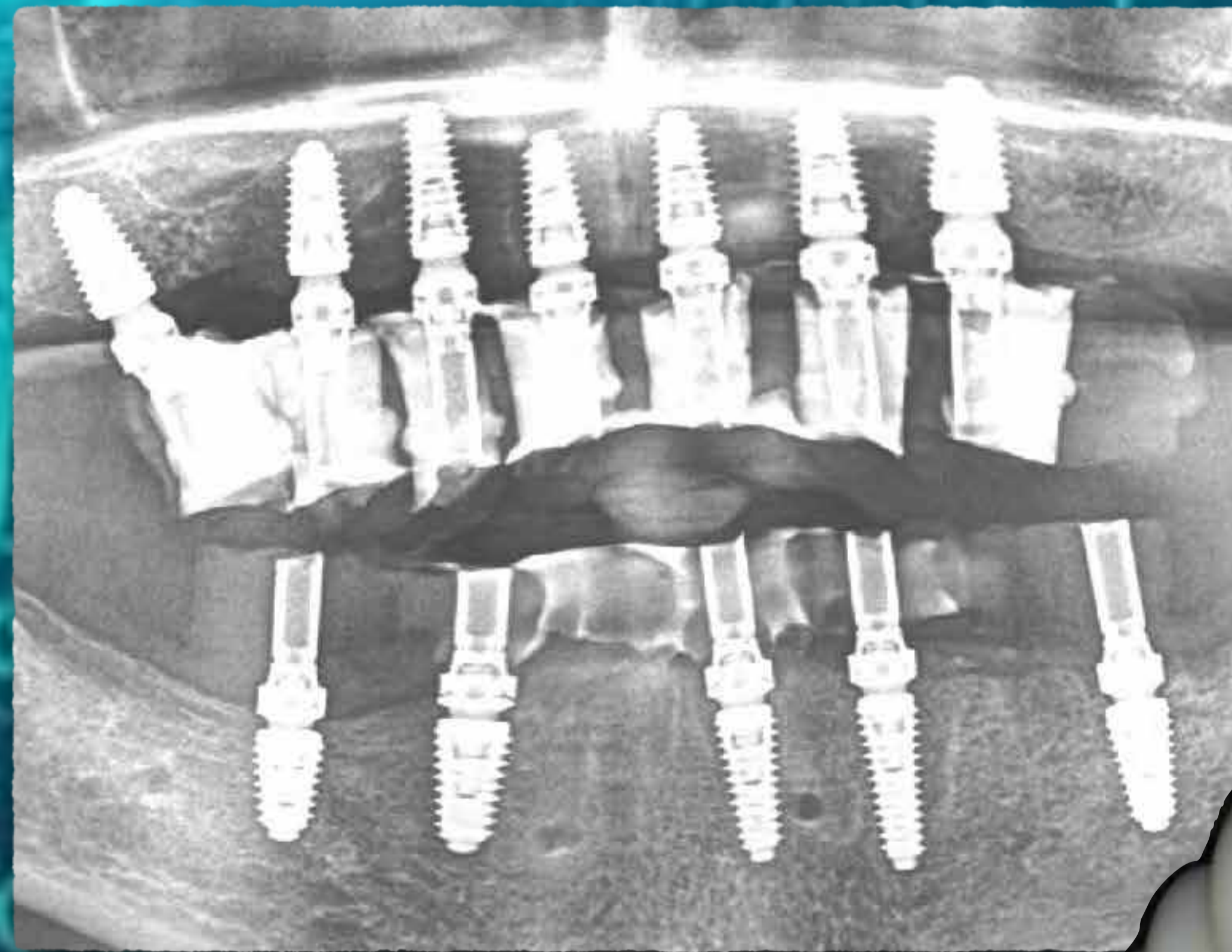
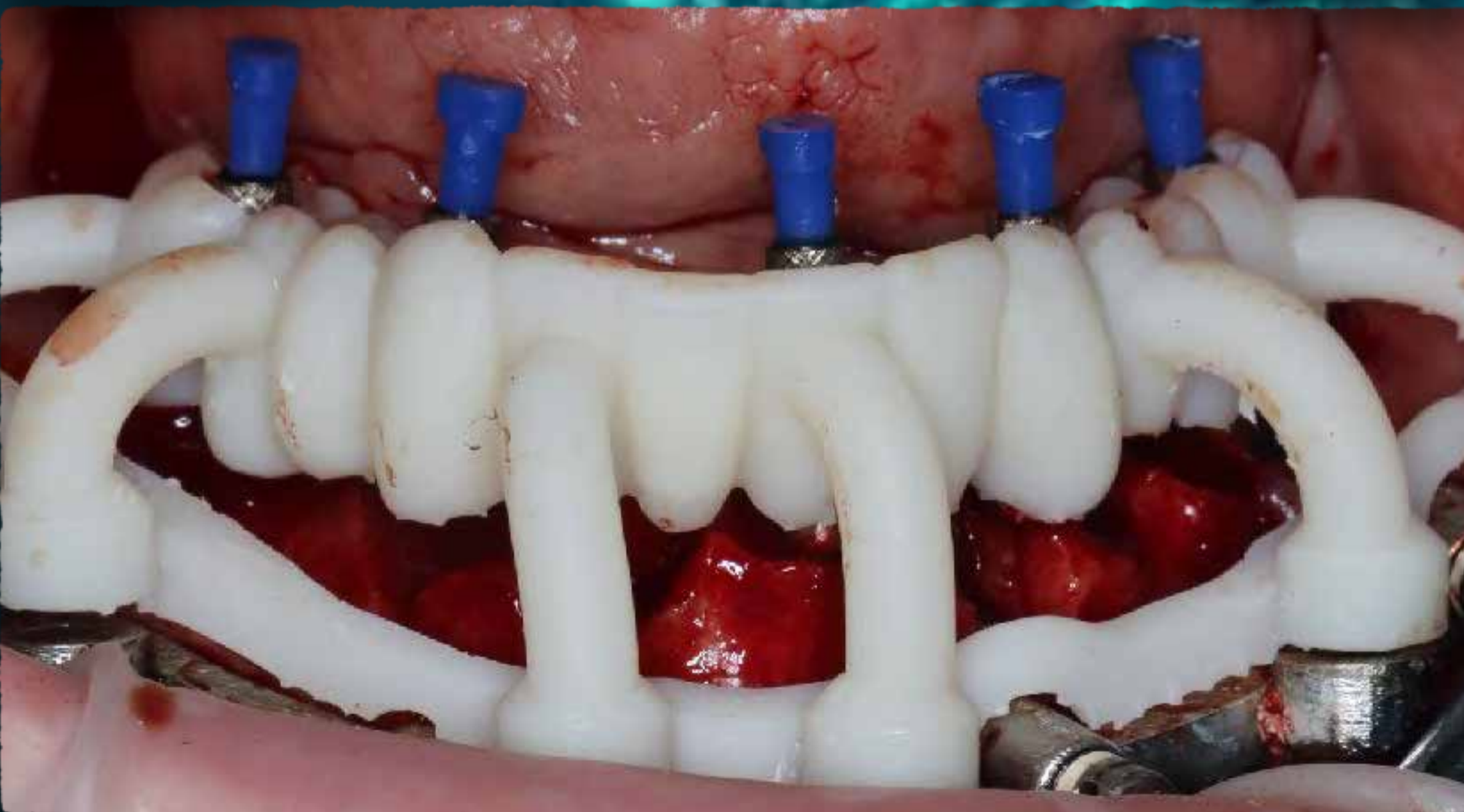


DATA

UNSTABLE RECORDS

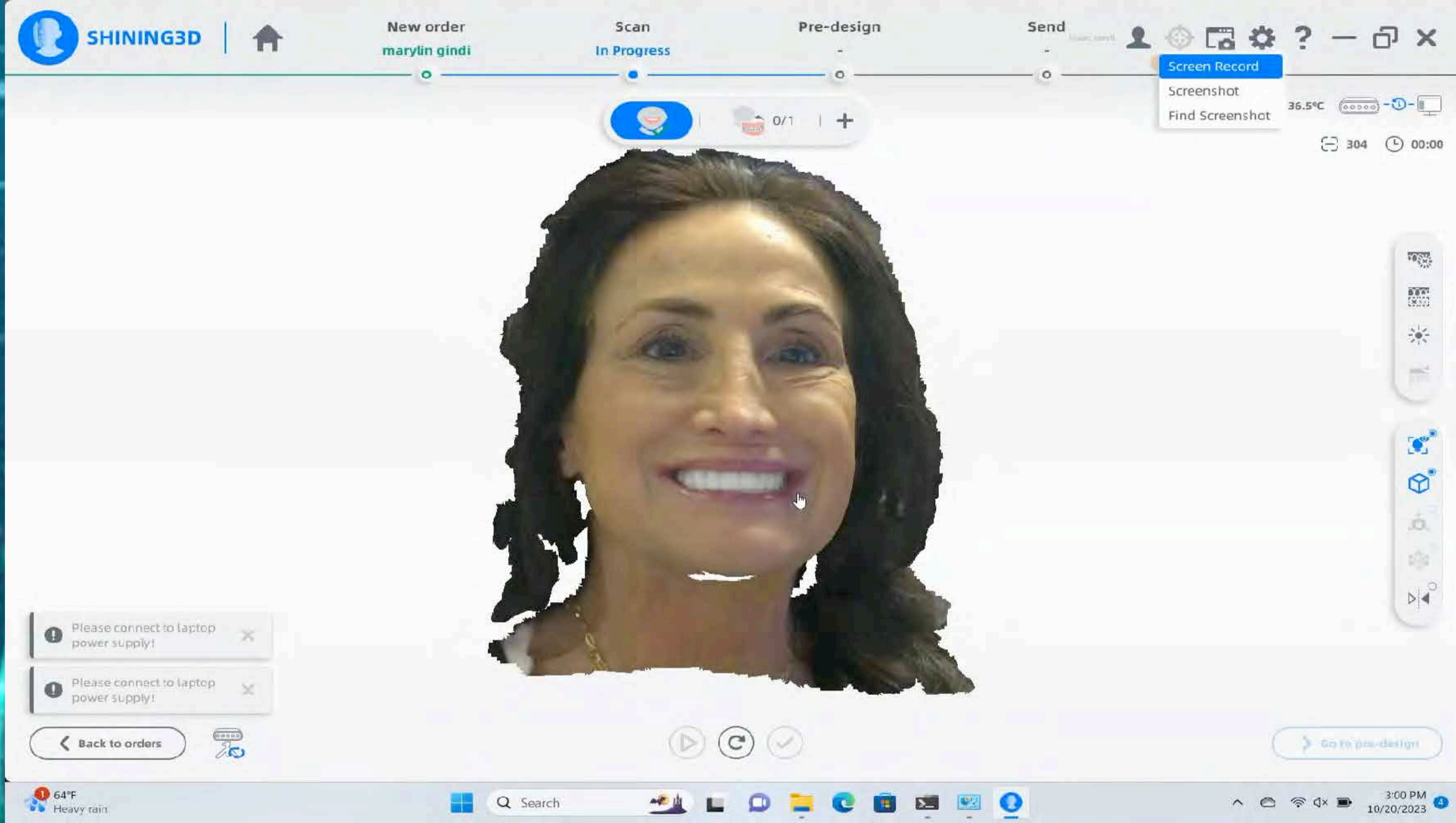
COLLECTION

Provisional





STABLE DATA COLLECTION



Facial Values



CAD



DESIGN



PRINTED TEMPORARIES



Changing lives one smile at a time



SHINING3D

New order Mark Hoffman

Scan In Progress

Pre-design

Send

36.2°C

00:00

3 seconds later automatically start scanning

Suitable

Back to orders

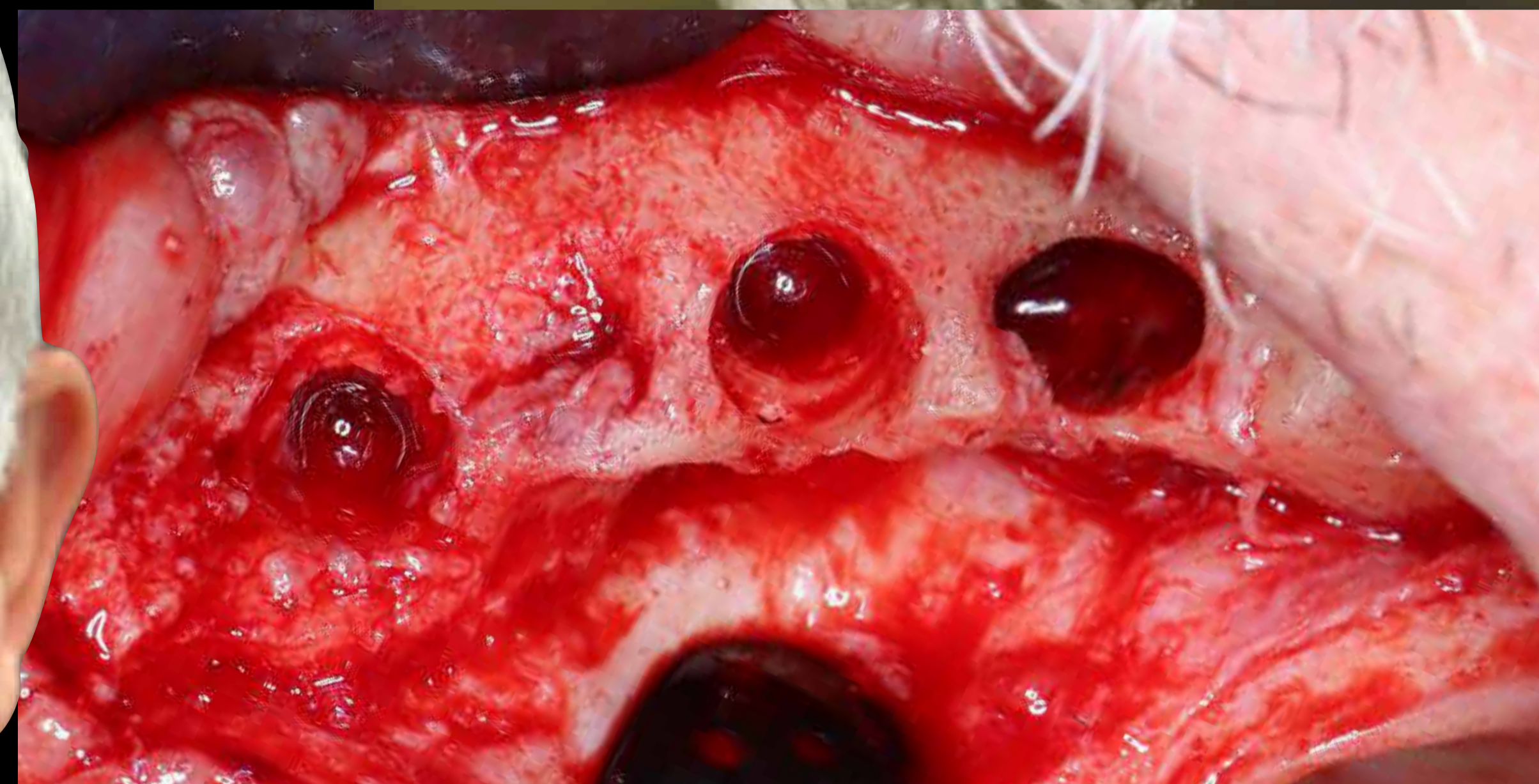
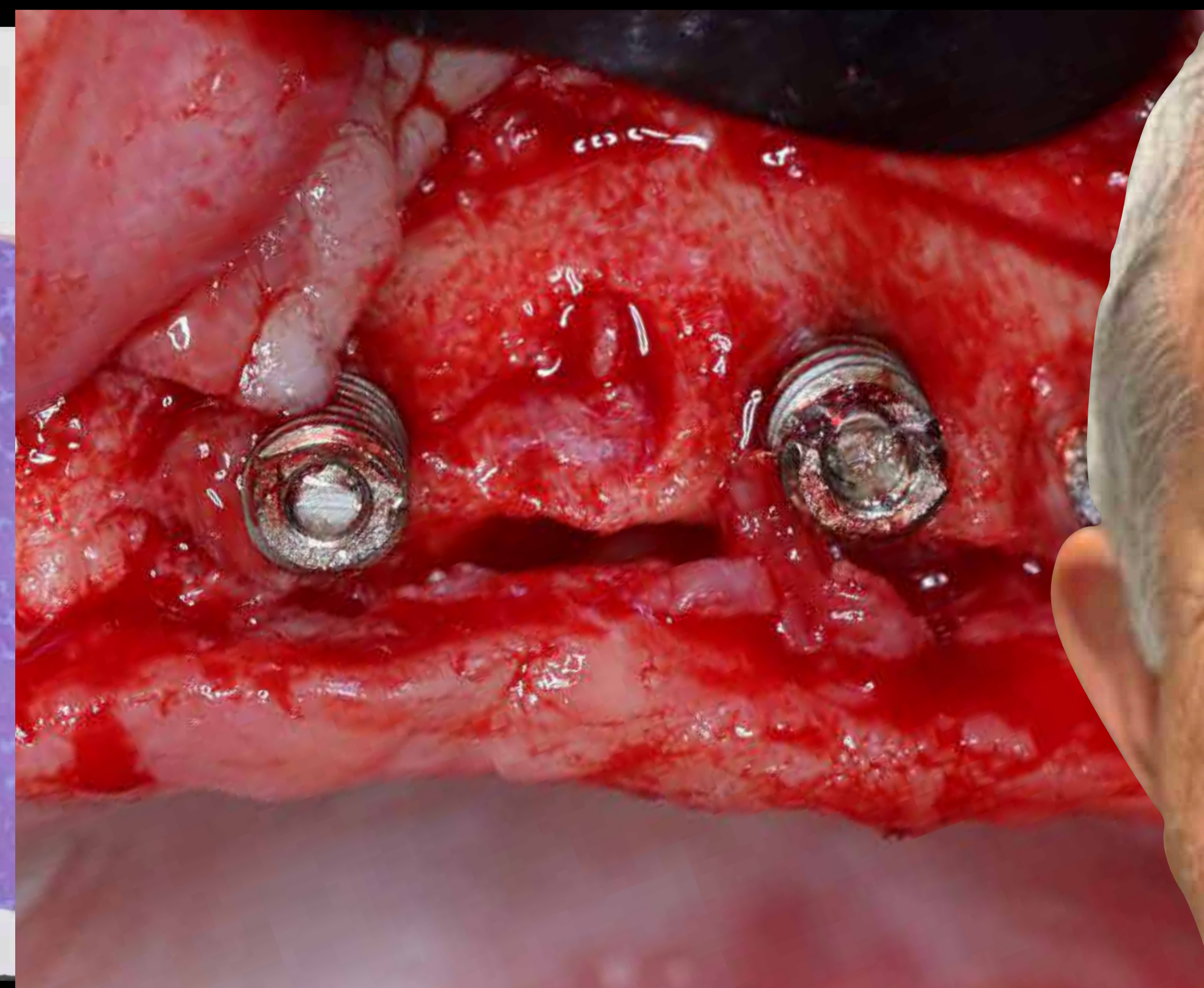
76° Partly sunny

10:29 AM 7/10/2023

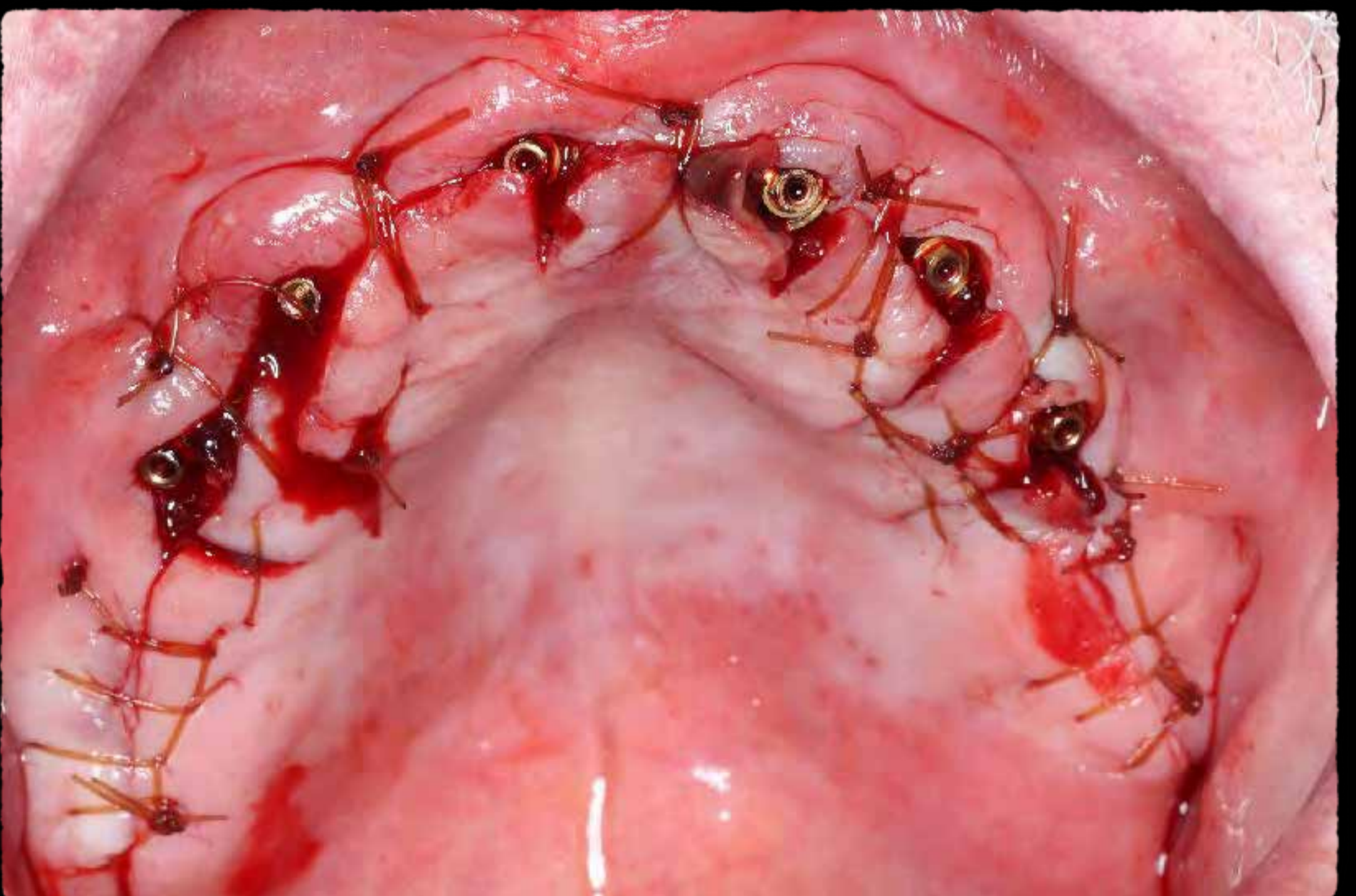
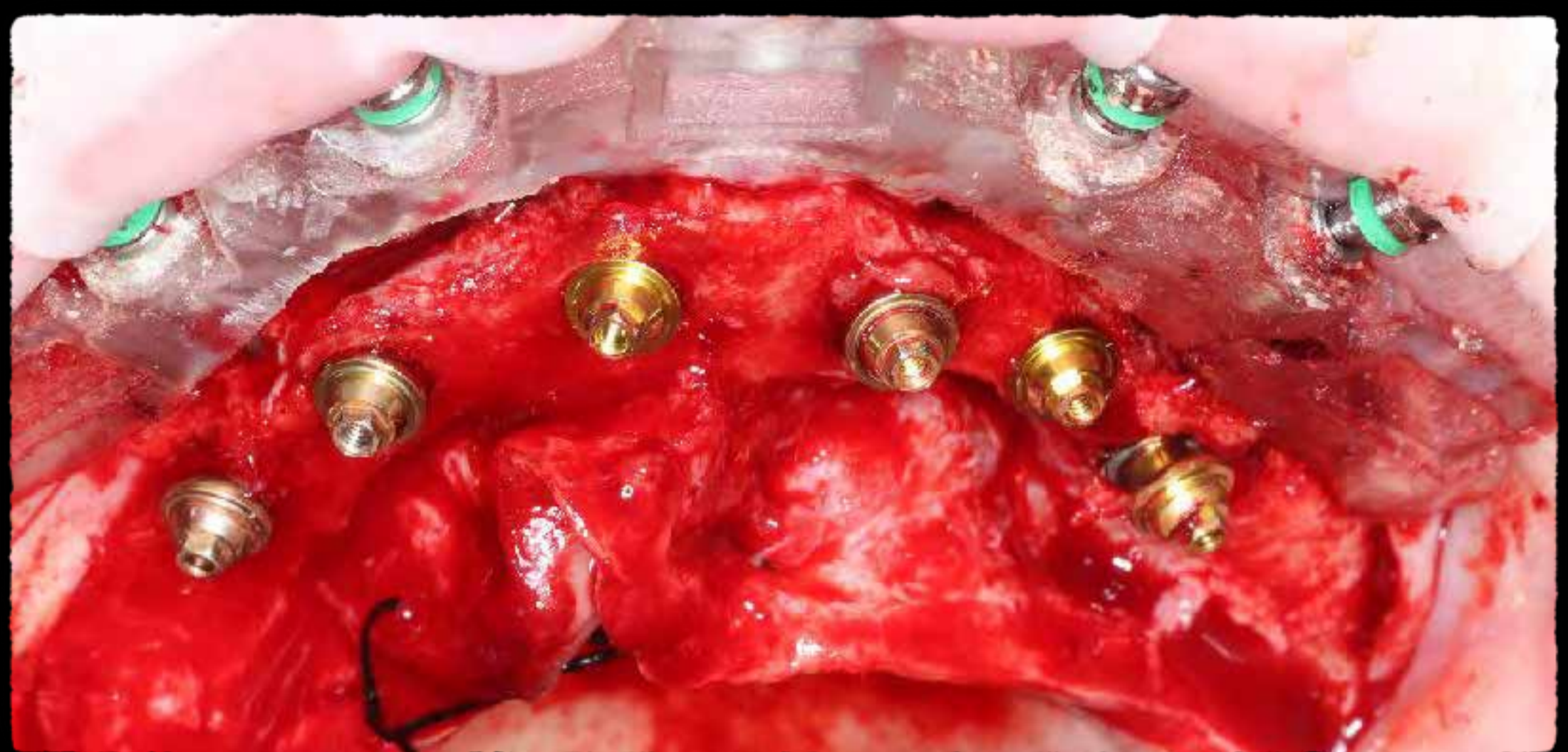
UNSTABLE RECORDS

LOST DENTURE

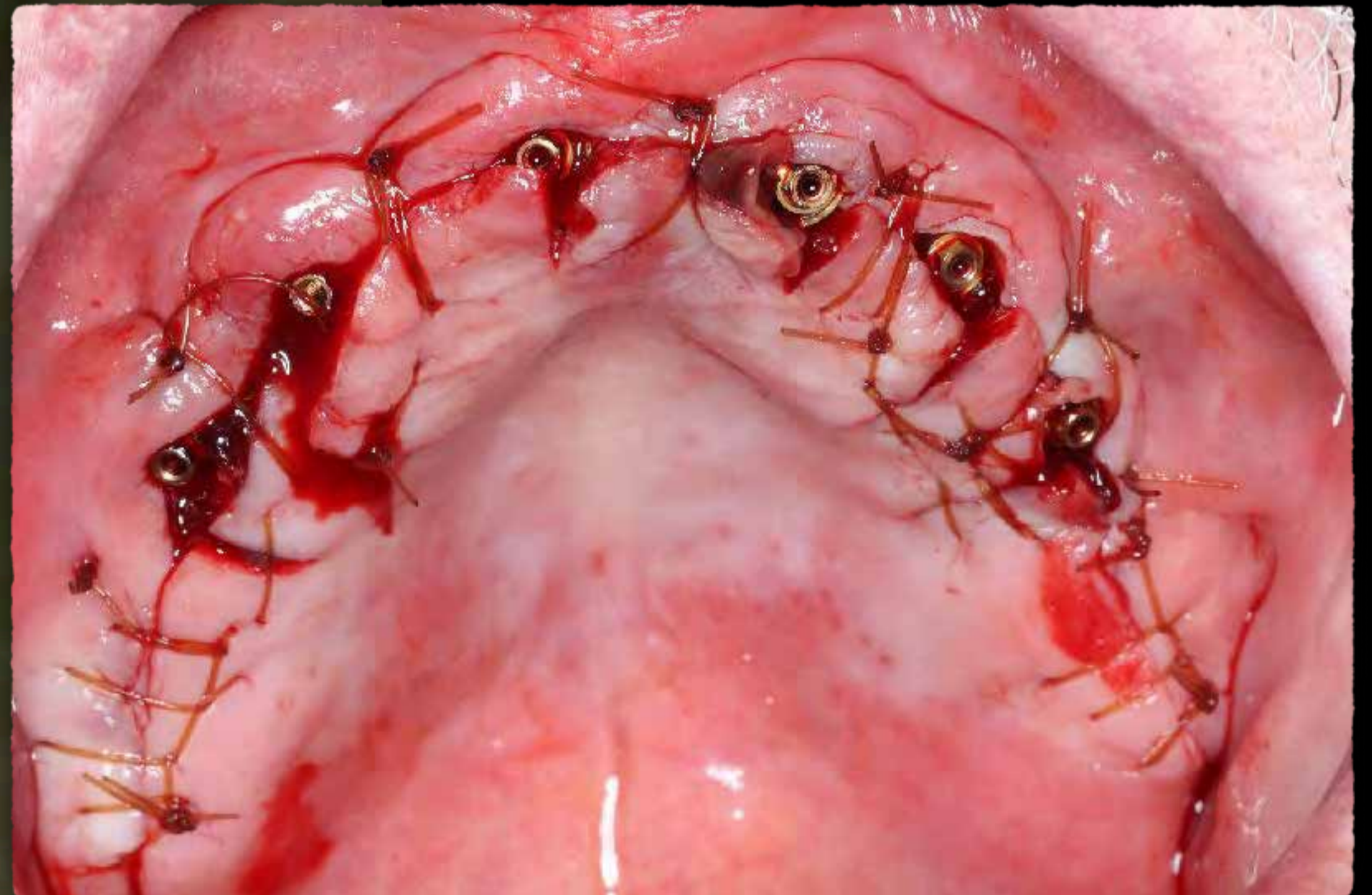
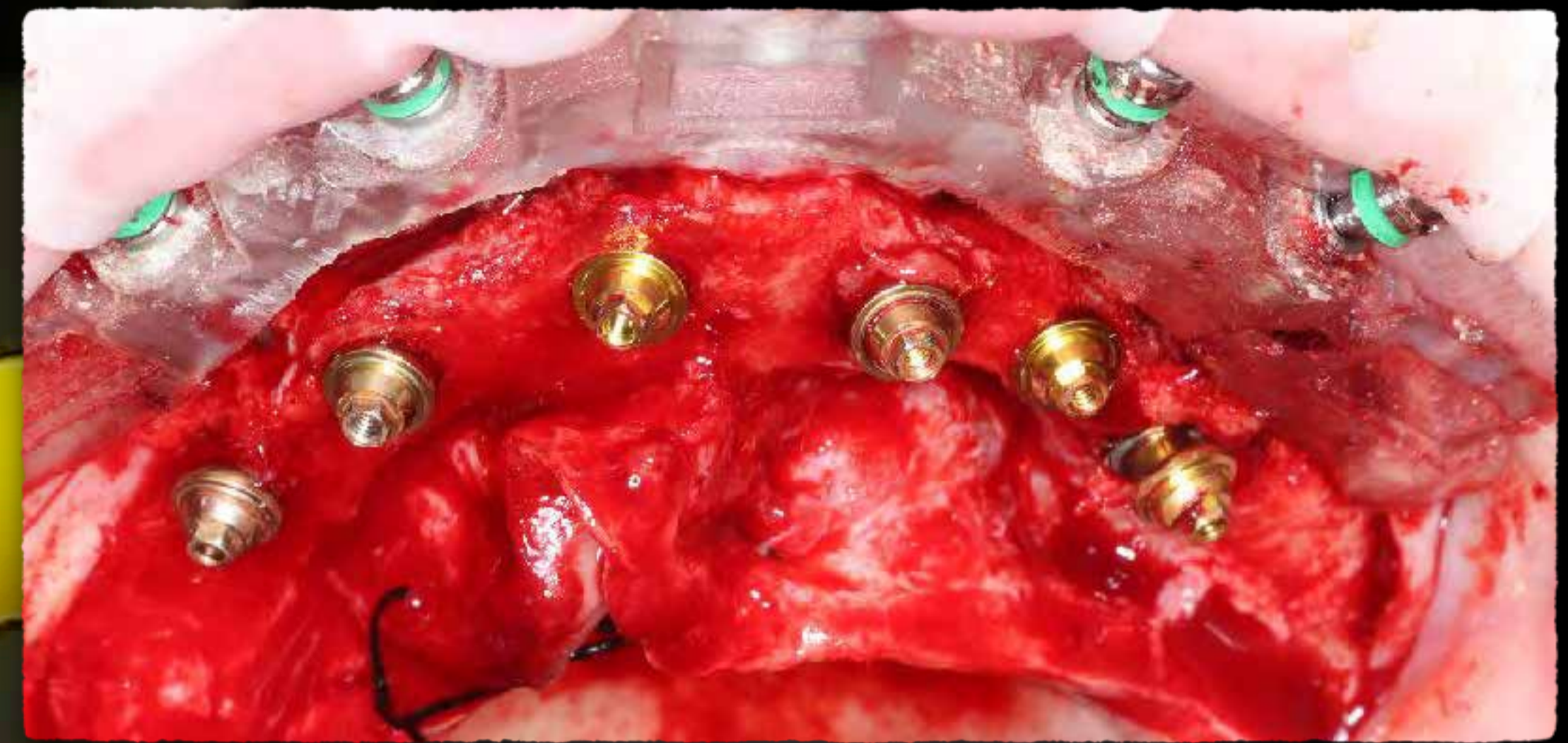
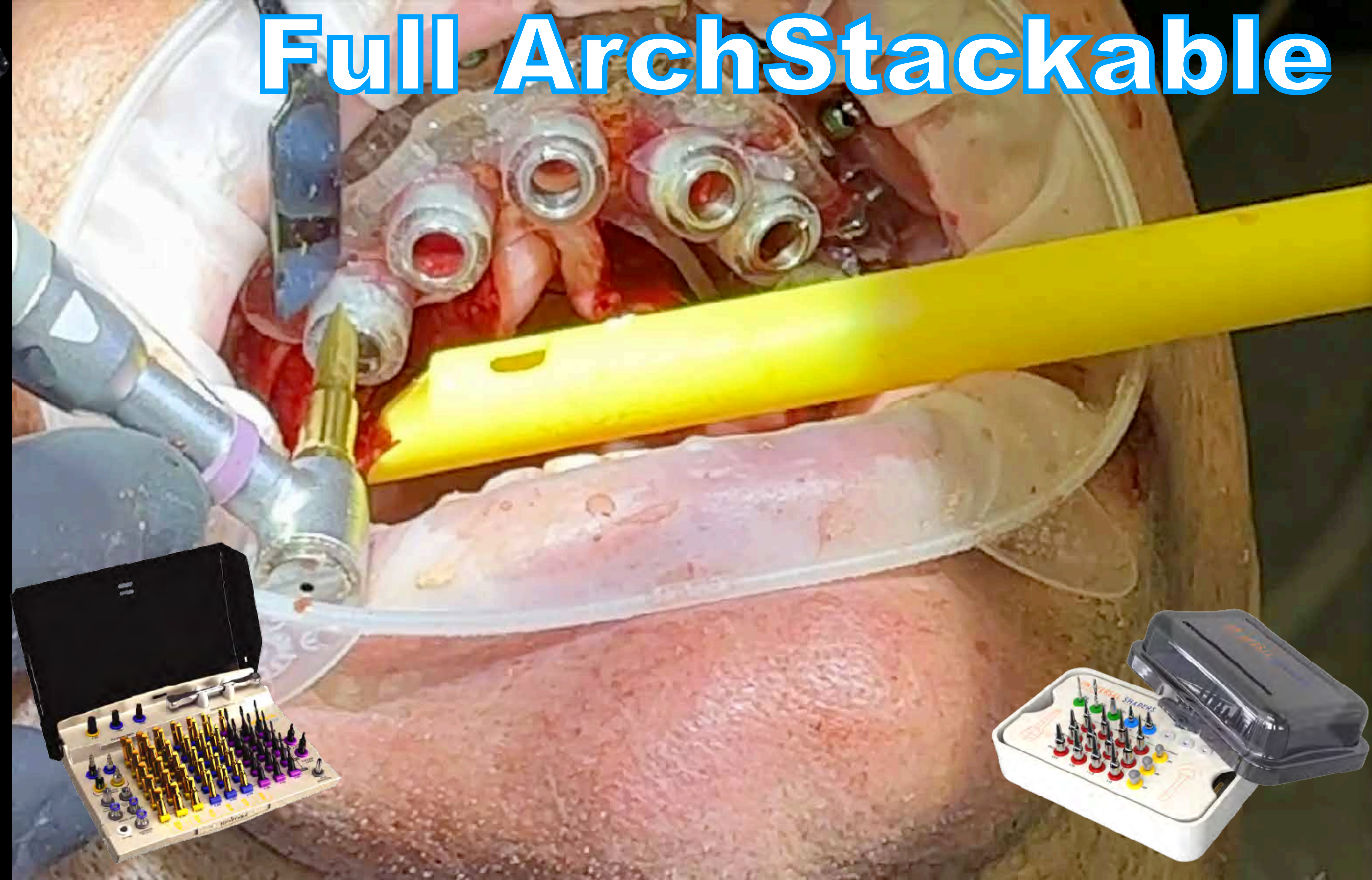




Full Arch Stackable



Full Arch Stackable





Scott D. Garth, DMD



Scott Tarril, DDS

Full-Arch Implant Surgical and Restorative Considerations

Utilizing a Full Template Guidance Technique

INTRODUCTION

Full-arch dental implant reconstruction requires proper diagnosis and treatment planning to assess the existing patient anatomy, any pathologies, occlusion, soft tissue volume, lip support, and aesthetics, and gain understanding of the desired outcome.¹ A decision tree can be established based upon some paradigms and surgical protocols to maximize success when a full-arch, implant-supported reconstruction is contemplated. Technological innovations can only enhance the diagnostic, treatment planning, communication, surgical, and restorative aspects for each patient. Three-dimensional imaging modalities afforded by current cone beam computed tomography (CBCT) provides the foundation for all that follows.^{2,3} The native DICOM (Digital Imaging and Communications in Medicine) data, once imported into an interactive treatment planning software application, allows for careful inspection of the existing anatomical presentation to identify potential implant receptor sites that will aid in realistic implant placement simulations and avoid potential complications (RzGate Software, MegaGeo.)⁴ (Figure 2). Regardless of the eventual surgical protocol, the authors believe that the diagnostic phase must be based on a complete and thorough review of the CBCT scan data.⁵

CASE REPORT

A failing maxillary and mandibular dentition exhibited mobile teeth, a poor bite, mal-aligned teeth, and bone loss (Figure 3). The CBCT data were analyzed to determine the most appropriate treatment alternatives based upon bone quality, bone density, and an appreciation of the patient's desires. Utilizing advanced software applications (Blue Sky Plan [Blue Sky Bio]),⁶ the diagnostic information for implant planning can be fully appreciated in all of the necessary views, including cross-sectional, coronal, sagittal and axial, and in 3D reconstructed surface models. Implant receptor sites can be identified, and virtual implants can be positioned with each of the previously mentioned views, as no single view can provide all of the necessary information to achieve success (Figure 4). Placing an implant into a cross-sectional slice is only the beginning of the process of helping to visualize the thickness and opacity of the buccal and palatal cortical plates and the quality of the intermediate bone to determine whether an implant can be placed that has an appropriate length and diameter to fit the remaining alveolus based upon the "Triangle of Bone" protocol.⁷ (Figures 3b and 4c). Additionally, virtual implant simulation plays a significant role in managing the desired restorative outcomes based upon tooth position and the choice of screw or cement retention (Blue Sky Bio). In the authors' opinion, the most efficient manner to facilitate the pro-

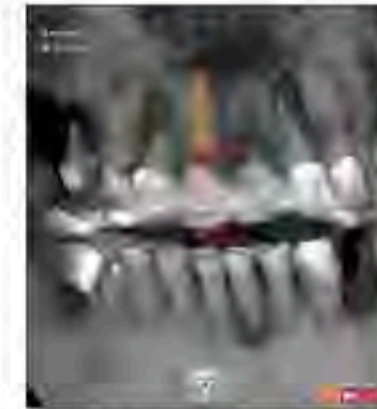


Figure 1. Three-dimensional imaging modalities afforded by a cone beam computed tomography (CBCT) are essential for proper diagnosis and treatment planning.



Figure 2. Interactive treatment planning software, such as the DICOM (Digital Imaging and Communications in Medicine) software (MegaGeo), helps clinicians identify potential implant receptor sites to aid in realistic implant placement simulations.

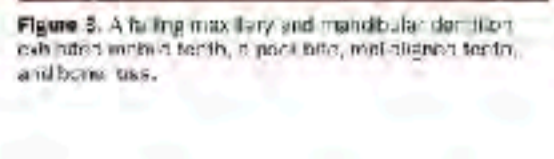


Figure 3. A failing maxillary and mandibular dentition exhibits mobile teeth, a poor bite, mal-aligned teeth, and bone loss.

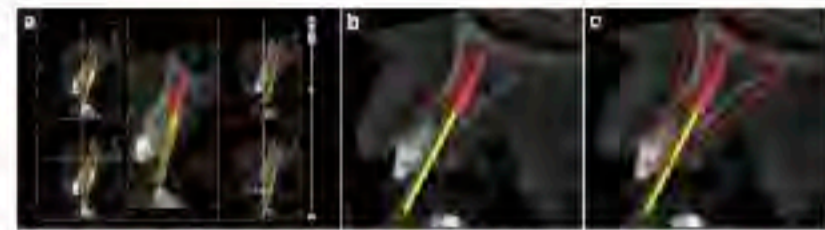


Figure 4. (a) Virtual implants are positioned on the buccal and palatal cortical plates and the quality of the intermediate bone. (b) An appropriate length and diameter of the implant was positioned in the remaining alveolus based upon the "Triangle of Bone" protocol.

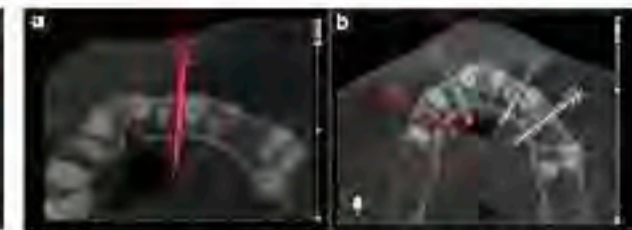


Figure 5. Surface models were carefully constructed to avoid adjacent vital structures and engage dense cortical bone, helping to gain bone tissue stabilization when possible. They will allow placement of both buccal and lingual plates at a specific angle depending on the remaining alveolus.

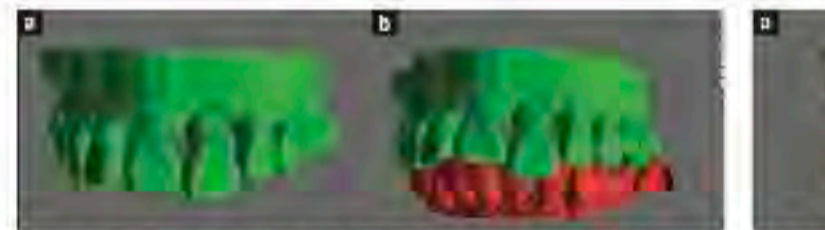


Figure 6. To complete the planning process, the diagnostic waxup or virtual tooth sets of the desired restorative outcome was applied to the CBCT surface DICOM data in order to determine the potential implant placement.



Figure 7. (a) Through the process of digitization, a surface model was reconstructed from the DICOM data back on bone density. (b) These software applications avoid any unnecessary overlap of the data files of the planning software, models, and the DICOM data.

Full-Arch Implant Surgical and Restorative Considerations

cess is to extend an "abutment projection" from the coronal aspect of the implant through the occlusal table, as visualized in yellow in Figures 4a and 6. When a guided surgical approach is contemplated, the template can be designed to be tooth bone, bone-bone, or mucosa bone. When appropriate, it is important that the drill guide best aimed to prevent any unnecessary damage to the soft tissue when not demonstrated in the planning of fixation or anchor pins to help achieve the highest degree of surgical accuracy. Each potential anchor pin must be positioned to avoid adjacent vital structures and engage dense cortical bone helping to gain bionatural stabilization when possible. This will often penetrate both buccal and lingual plates and avoid close proximity to implant receptor sites (Figure 5).

The diagnostic phase is greatly enhanced when the existing occlusal condition can be captured with either an analog or a digital method. In a traditional analog method, a physical impression records the teeth and soft tissue. A stone model can then be fabricated from the impression. To facilitate 3D planning, the stone cast can then be digitized using a desktop scanner. Alternatively, the impression itself can be scanned, resulting in an STL (stereolithography) file that can be aligned at the opposing occlusion



Figure 8. To complete the planning process, the diagnostic waxup or virtual tooth sets of the desired restorative outcome was applied to the CBCT surface DICOM data in order to determine the potential implant placement.

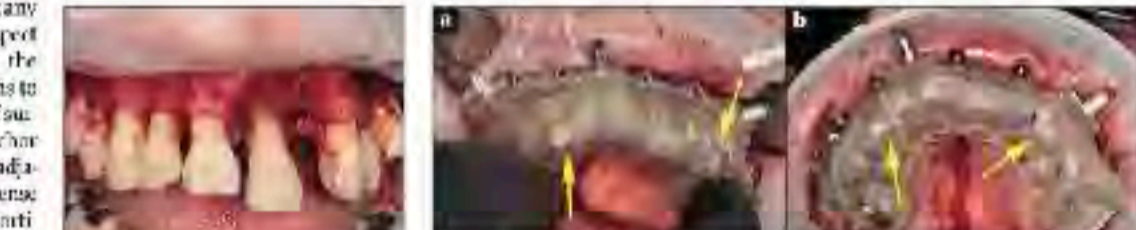


Figure 9. A full-thickness, unresorbable metal frame with a diagnostic waxup or virtual tooth sets was secured to the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.

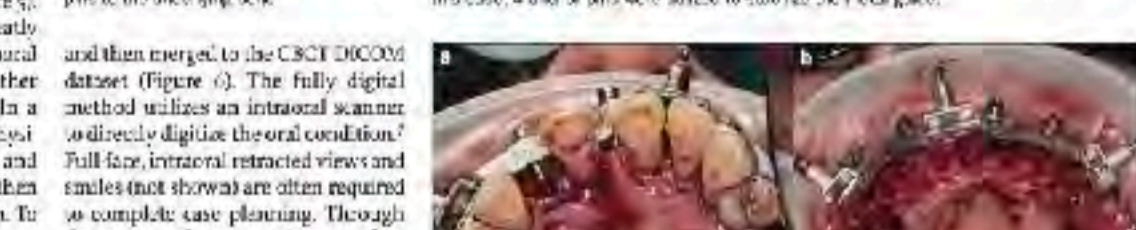


Figure 10. (a) After the frames were in place, the metal guide was secured leaving the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.

and then merged to the CBCT DICOM dataset (Figure 6). The fully digital method utilizes an introral scanner to capture the dental condition.⁸ Full-size, introral, restricted views and files that do not show are often required to complete case planning. Through the process of segmentation, a surface model can be reconstructed from the DICOM data based on bone density (Figure 7). Often, this process is hindered by metal scatter artifact from porcelain or age-

ing ceramic metal restorations, making it difficult to adequately define the anatomy. Therefore, it is recommended that there be a space between the upper and lower jaw when the CBCT scan is acquired. As good segmentation is often very time-consuming, third-party companies, such as 3D Diagnostic, are available to manage this often essential aspect of implant planning. Present software applications allow for extremely accurate mapping of STL files and DICOM data (Figure 8). To complete the planning process, a diagnostic waxup or virtual tooth sets of the desired restorative outcome can be designed to achieve true, restorative driven implant placement when applied to

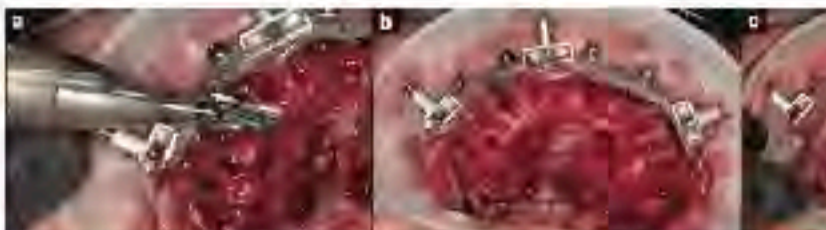


Figure 11. (a) The metal frame was secured to the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.

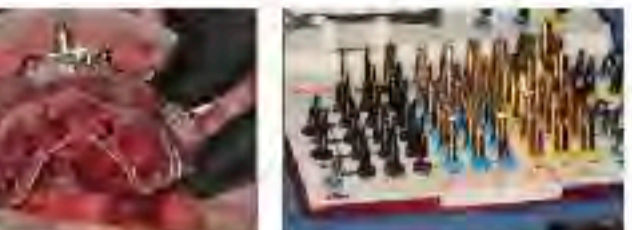


Figure 12. (a) After the frames were in place, the metal guide was secured leaving the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.



Figure 13. (a) After the frames were in place, the metal guide was secured leaving the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.

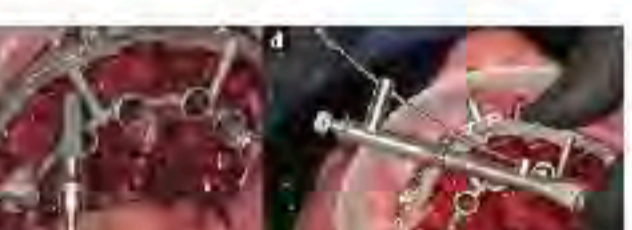


Figure 14. (a) After the frames were in place, the metal guide was secured leaving the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.



Figure 15. (a) After the frames were in place, the metal guide was secured leaving the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.

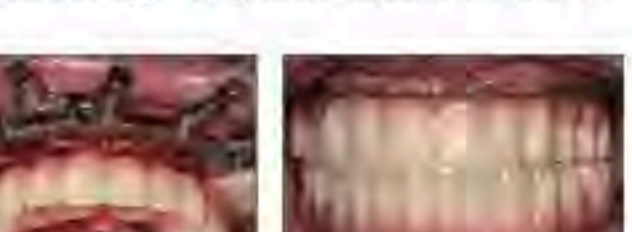


Figure 16. The low-alveolus upper and lower segments (positioned at the same height) were delivered to the site of the appropriate maxillary and lower (Figure 14a). To maximize implant stability within the maxillary bone, it was important to use an appropriate implant design. The AnyLogic implants (Integrated Dental Systems) were placed first using the maxillary and then mandibular until final depth was achieved. (b) Once all final depth was achieved, the implant was tested for stability using resonance frequency analysis (Mora SR) (Integrated Dental Systems) and found to be sufficient to receive an immediate restoration.

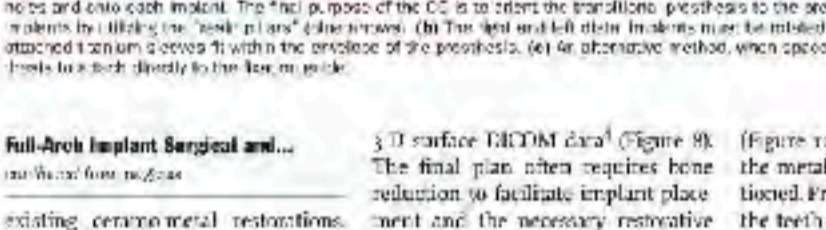


Figure 17. (a) After the frames were in place, the metal guide was secured leaving the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.

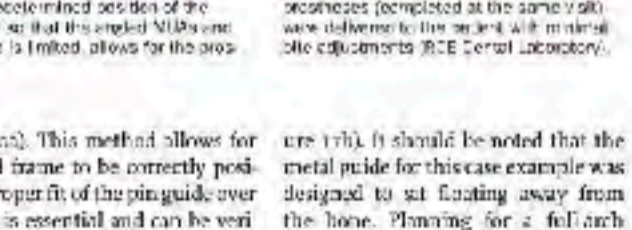


Figure 18. (a) After the frames were in place, the metal guide was secured leaving the maxillary teeth outside for fixation. (b) The sets were all carefully removed, leaving the remaining alveolus exposed.

3D surface DICOM data (Figure 9). The final plan when restorative bone reduction is to facilitate implant placement and the necessary restorative space for the prosthesis.⁹

An innovative approach to full template guidance utilizes the existing dentition to position a metal "fixation base" (FB) to which everything else will be related (Guided Esthetic CHROME ROOF Dental Laboratory). Positioning the FB was to manage this often essential aspect of implant planning. Present software applications allow for extremely accurate mapping of STL files and DICOM data (Figure 10). To complete the planning process, a diagnostic waxup or virtual tooth sets of the desired restorative outcome can be designed to achieve true, restorative driven implant placement when applied to

3D surface DICOM data (Figure 9). The final plan when restorative bone reduction is to facilitate implant placement and the necessary restorative space for the prosthesis.⁹

An innovative approach to full template guidance utilizes the existing dentition to position a metal "fixation base" (FB) to which everything else will be related (Guided Esthetic CHROME ROOF Dental Laboratory). Positioning the FB was to manage this often essential aspect of implant planning. Present software applications allow for extremely accurate mapping of STL files and DICOM data (Figure 10). To complete the planning process, a diagnostic waxup or virtual tooth sets of the desired restorative outcome can be designed to achieve true, restorative driven implant placement when applied to

3D surface DICOM data (Figure 9). The final plan when restorative bone reduction is to facilitate implant placement and the necessary restorative space for the prosthesis.⁹

An innovative approach to full template guidance utilizes the existing dentition to position a metal "fixation base" (FB) to which everything else will be related (Guided Esthetic CHROME ROOF Dental Laboratory). Positioning the FB was to manage this often essential aspect of implant planning. Present software applications allow for extremely accurate mapping of STL files and DICOM data (Figure 10). To complete the planning process, a diagnostic waxup or virtual tooth sets of the desired restorative outcome can be designed to achieve true, restorative driven implant placement when applied to

3D surface DICOM data (Figure 9). The final plan when restorative bone reduction is to facilitate implant placement and the necessary restorative space for the prosthesis.⁹

An innovative approach to full template guidance utilizes the existing dentition to position a metal "fixation base" (FB) to which everything else will be related (Guided Esthetic CHROME ROOF Dental Laboratory). Positioning the FB was to manage this often essential aspect of implant planning. Present software applications allow for extremely accurate mapping of STL files and DICOM data (Figure 10). To complete the planning process, a diagnostic waxup or virtual tooth sets of the desired restorative outcome can be designed to achieve true, restorative driven implant placement when applied to

3D surface DICOM data (Figure 9). The final plan when restorative bone reduction is to facilitate implant placement and the necessary restorative space for the prosthesis.⁹

An innovative approach to full template guidance utilizes the existing dentition to position a metal "fixation base" (FB) to which everything else will be related (Guided Esthetic CHROME ROOF Dental Laboratory). Positioning the FB was to manage this often essential aspect of implant planning. Present software applications allow for extremely accurate mapping of STL files and DICOM data (Figure 10). To complete the planning process, a diagnostic waxup or virtual tooth sets of the desired restorative outcome can be designed to achieve true, restorative driven implant placement when applied to

3D surface DICOM data (Figure 9). The final plan when restorative bone reduction is to facilitate implant placement and the necessary restorative space for the prosthesis.⁹

An innovative approach to full template guidance utilizes the existing dentition to position a metal "fixation base" (FB) to which everything else will be related (Guided Esthetic CHROME ROOF Dental Laboratory). Positioning the FB was to manage this often essential aspect of implant planning. Present software applications allow for extremely accurate mapping of STL files and DICOM data (Figure 10). To complete the planning process, a diagnostic waxup or virtual tooth sets of the desired restorative outcome can be designed to achieve true, restorative driven implant placement when applied to

CLOSING COMMENTS

The ability to incorporate 3D imaging modalities when combined with restorative treatment planning software has greatly enhanced the clinician's ability to diagnose and treatment plan for single and multiple implants.¹⁰⁻¹² As technology has advanced, guided surgery options have increased, allowing restorative clinicians to fully and fully acknowledge patients while 3D-directed surgical complex have been available for almost a decade. The focus has been on the surgical aspect of implant placement. Interactive treatment planning software has provided clinicians with an appreciation of the early anatomy to assess complex restorations and even assess the evolution of guided applications has increased the development of the bone reduction guide, the sinus lift guide, and the harvest guide for guided bone grafting procedures. Software applications, such as RzGate (RzGate Software), allow for the planning of implants in relation to the desired restorative outcomes. However, the underlying technology and the position of the prosthesis at the time of surgery. The ray-tracing CAD/CAM design with 3D DICOM data enables restorative driven implant planning at a very high level. Implants can be predictably placed with the restorative

The case example illustrates the use of the software that provides results to the bone as well as the mounts for wax and a carrier guide on transitional prostheses facilitates the process placement, and final form. Further search to validate the restorative outcomes of this full arch foundation for reconstruction.

The authors would like to thank the staff of the CHROME ROOF Dental Laboratory for their assistance in the preparation of this manuscript.

References

1. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
2. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
3. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
4. MegaGeo. RzGate Software. MegaGeo. 2010.
5. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
6. Blue Sky Bio. Blue Sky Plan. Blue Sky Bio. 2010.
7. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
8. 3D Diagnostic. 3D Diagnostic. 3D Diagnostic. 2010.
9. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
10. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
11. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.
12. Garth SD, Garth TD. Implant-retained full-arch dental reconstruction: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(12):2800-2808.

Disclosures

Dr. Garth is a consultant for MegaGeo, Blue Sky Bio, and RzGate. Dr. Tarril is a consultant for MegaGeo, Blue Sky Bio, and RzGate. Dr. Garth is a consultant for MegaGeo, Blue Sky Bio, and RzGate. Dr. Tarril is a consultant for MegaGeo, Blue Sky Bio, and RzGate.

Correspondence

Scott D. Garth, DMD, CHROME ROOF Dental Laboratory, 10000 West 10th Avenue, Suite 100, Golden, CO 80401. Email: scott@chrome.roof.com

Reprints

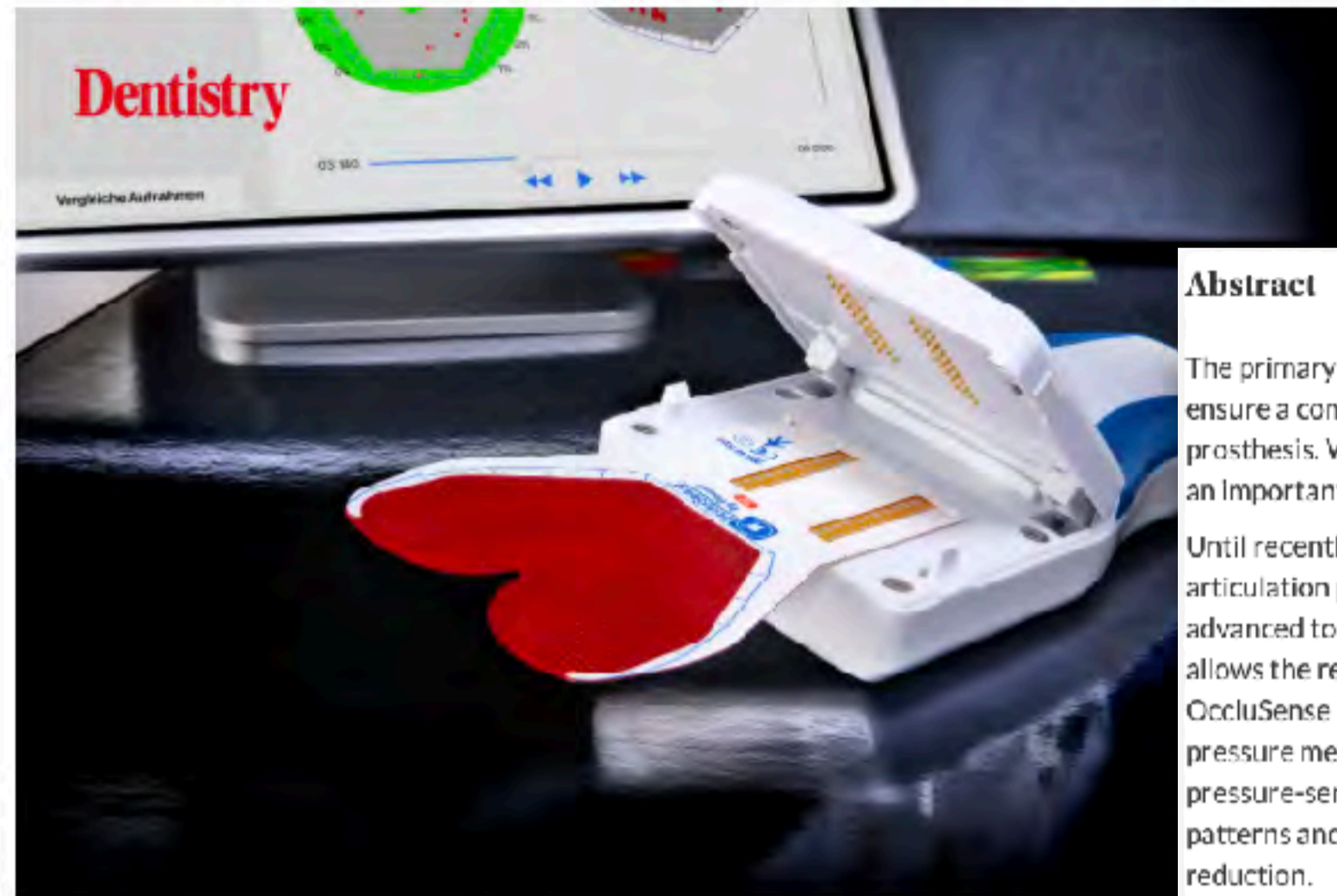
Reprints of this article are available from the publisher, Elsevier, at a special discount rate. For more information, contact Elsevier at 1600 Broadway, New York, NY 10019. Tel: 212 633 3830. Fax: 212 633 3830. Email: journals@elsevier.com

Copyright

© 2010 Elsevier Inc. All rights reserved. This article is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.



Digital management of functional occlusion



Isaac Tawil, Scott Ganz and Michael Erdos investigate the digital management of functional occlusion utilising digital pressure-sensing registration.

Abstract

The primary goal in the treatment of patients with full-arch restorations is to ensure a comfortable, functional occlusion with a structurally sound restorative prosthesis. While prosthetic failure is a multifactorial issue, occlusal overload is an important potential contributing factor.

Until recently, intraoral occlusal measurement has been confined to the use of articulation paper. However, occlusal measurement technologies have now advanced to include the use of digital occlusal-pressure articulation, which allows the recording of masticatory forces over a designated time period. OccluSense (Bausch – Köln, Germany), a wireless digital device for occlusal pressure measurement, combines traditional carbon articulation with digital pressure-sensing registration to enable clinicians to view occlusal pressure patterns and evaluate premature or hyperocclusal contacts for potential reduction.

This article provides a case study comparing traditional articulation versus digital occlusal-pressure articulation using the OccluSense digital device, both of which were used in a patient who required full-mouth rehabilitation.

Introduction

The use of full-arch implant-supported fixed restorations in clinical practice has increased dramatically over the past several decades.

At the same time, patients today have a greater awareness of the various full-arch implant options that are available, as well as the potential financing and payment plans for treatment, and thus are better empowered to enhance their quality of life through the improved function and aesthetics of restored dentition.

As a result, dental occlusion has once again become a highly relevant and important topic in dentistry, as ensuring a functional occlusion is central to successful full-arch rehabilitations with a structurally sound prosthesis.

Digital Occlusion

Advancements in occlusal measurement technologies

Dental occlusion has been studied for decades, resulting in various schools of thought regarding optimal treatment. While the 3D relationship of the jaws is clearly defined by the VDO, horizontal centric relation, and envelope of function, theories regarding occlusion may conflict as to whether occlusal function is tooth-borne, neuromuscular, skeletal, static, dynamic, based on centric relation, or based on centric occlusion.

Regardless of differing opinions, the common goal in the treatment of patients with full-arch restorations is to ensure a comfortable, functional occlusion with a structurally sound restorative prosthesis, which will ultimately result in improved patient satisfaction.

While dental technology has progressed dramatically over the past several years, until recently traditional measurements of occlusal contacts and balance have undergone very little change.

Although extraoral articulation is extremely valuable and has been enhanced through the use of digital technology, conventional measurements of intraoral occlusion have remained limited to the use of articulation paper (Figure 2), the clinician's observations of carbon paper markings, and the patient's awareness of pressure.



Role of occlusion in prosthetic failure

For decades, conventional crown and bridge dentistry for both natural teeth and dental implants has been achieved with ceramic-metal restorations. While metal has always served as a reliable substructure that is highly resistant to fracture, the secondary ceramic layers have been prone to chipping or fracturing as a result of misdirected or excessive occlusal forces.

Improvements in ceramic materials (eg, zirconia) and production capabilities (eg, 3D printing, milling units) have been helpful in enabling laboratories and dental technicians to fabricate stronger, longer-lasting solutions.

In addition, improved synergies between ancillary technologies such as intraoral scanning, photogrammetry, and virtual articulation have reduced the production time and increased the accuracy of ceramic-metal restorations.

However, even with stronger and more precise ceramic materials, prosthetic fracture and implant failure due to occlusal overload remain a valid concern.

Prosthetic failure is a multifactorial problem that goes beyond issues of ceramic strength. One factor that contributes to potential restorative failure is increased stress due to lack of appreciation of the proper vertical dimension of occlusion (VDO). Another is reduced height and thickness of material, or poor reduction of substructures. Also, increased cantilever or pontic lengths due to poor anterior-posterior spread (A-P spread), or an unbalanced occlusion.

An occlusal high spot on a screw-retained prosthetic in the location of a titanium base (I-base) often results in fracture propagation, as it is a point of weakness (Figure 2).



Benefits of occlusal measurement technologies

Unfortunately, patient perception becomes increasingly difficult to utilize when proprioception is absent or diminished, as is the case with patients who have dental implants. In patients with full-arch and full-mouth implant rehabilitation, a broader awareness of the patient is required, with muscular and skeletal sensations utilized to convey potential occlusal imbalances that are otherwise often unnoticed.

Initially, intraoral occlusal measurement technologies could be used only to measure static pressure points through the use of gauges. Over the past few years, however, these technologies have advanced to include digital devices that can capture pressure and movement over time, thus greatly enhancing diagnostic competencies.

By incorporating these innovative technologies with traditional methods, clinicians can achieve an ideal measurable outcome, which in turn will improve the functionality and resiliency of both temporary and final restorative materials.

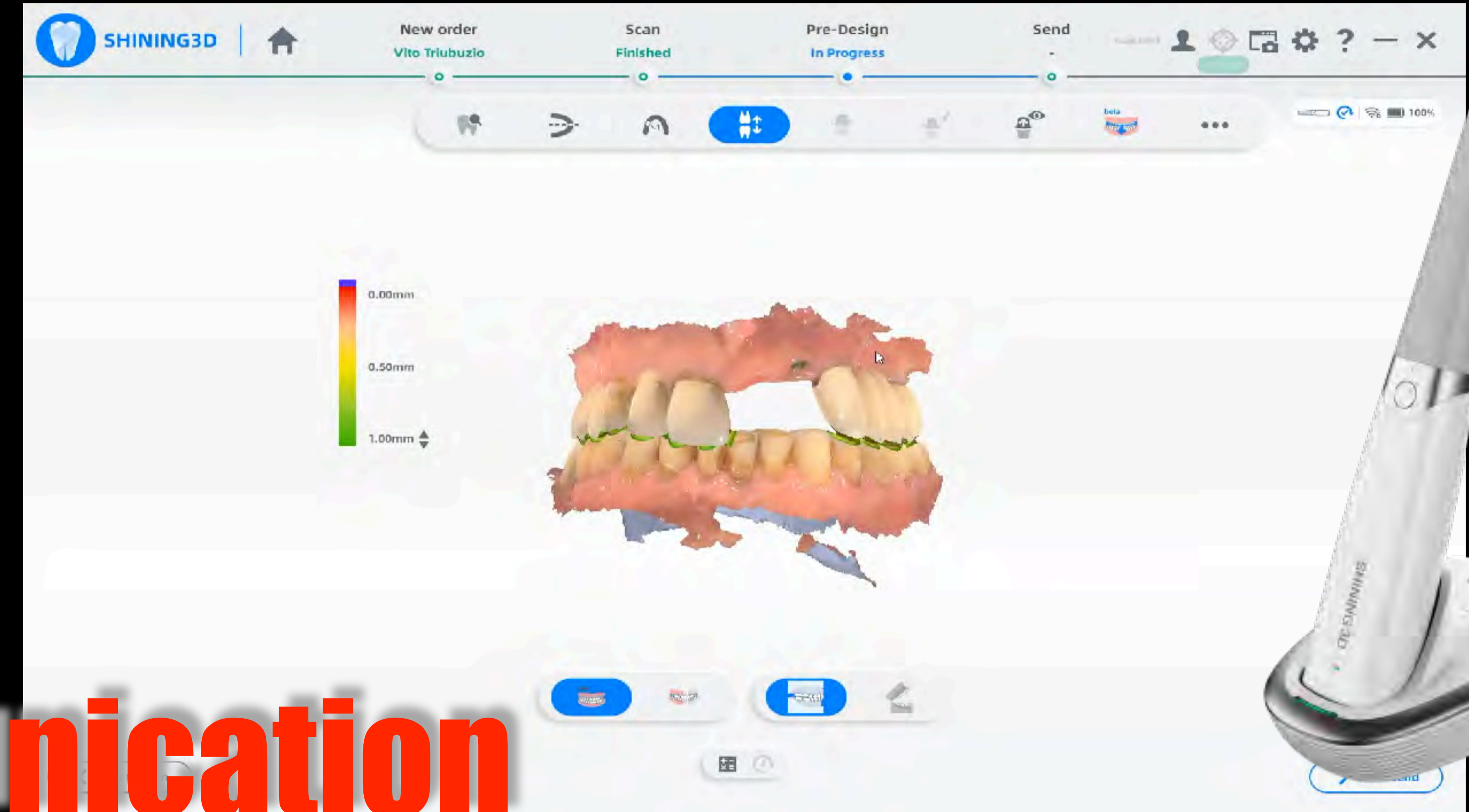
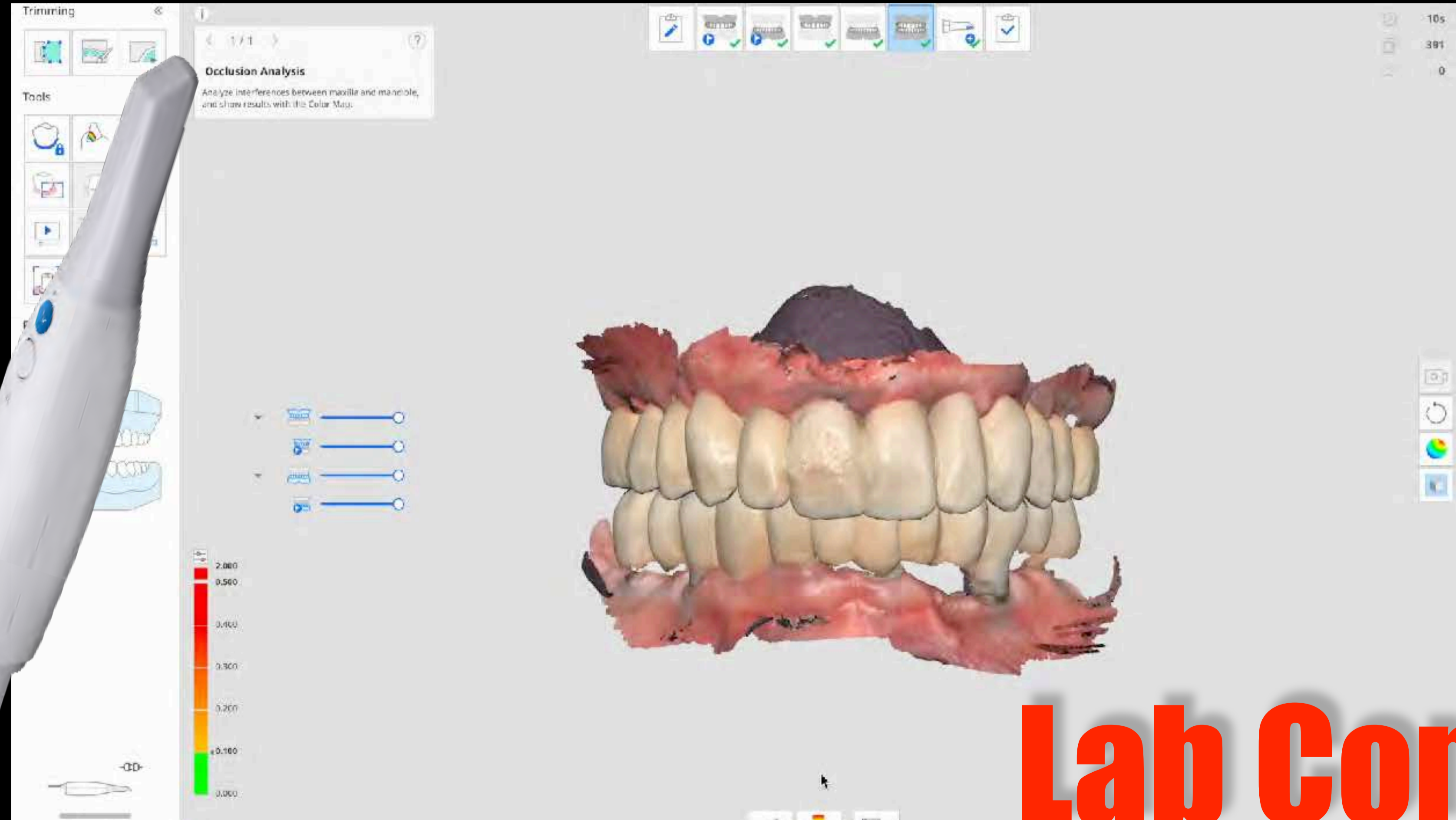
An innovative wireless device called OccluSense (Bausch – Köln, Germany) combines traditional carbon articulation with digital pressure-sensing registration, allowing the recording of masticatory forces over a designated time period (Figure 3).



Occlusal

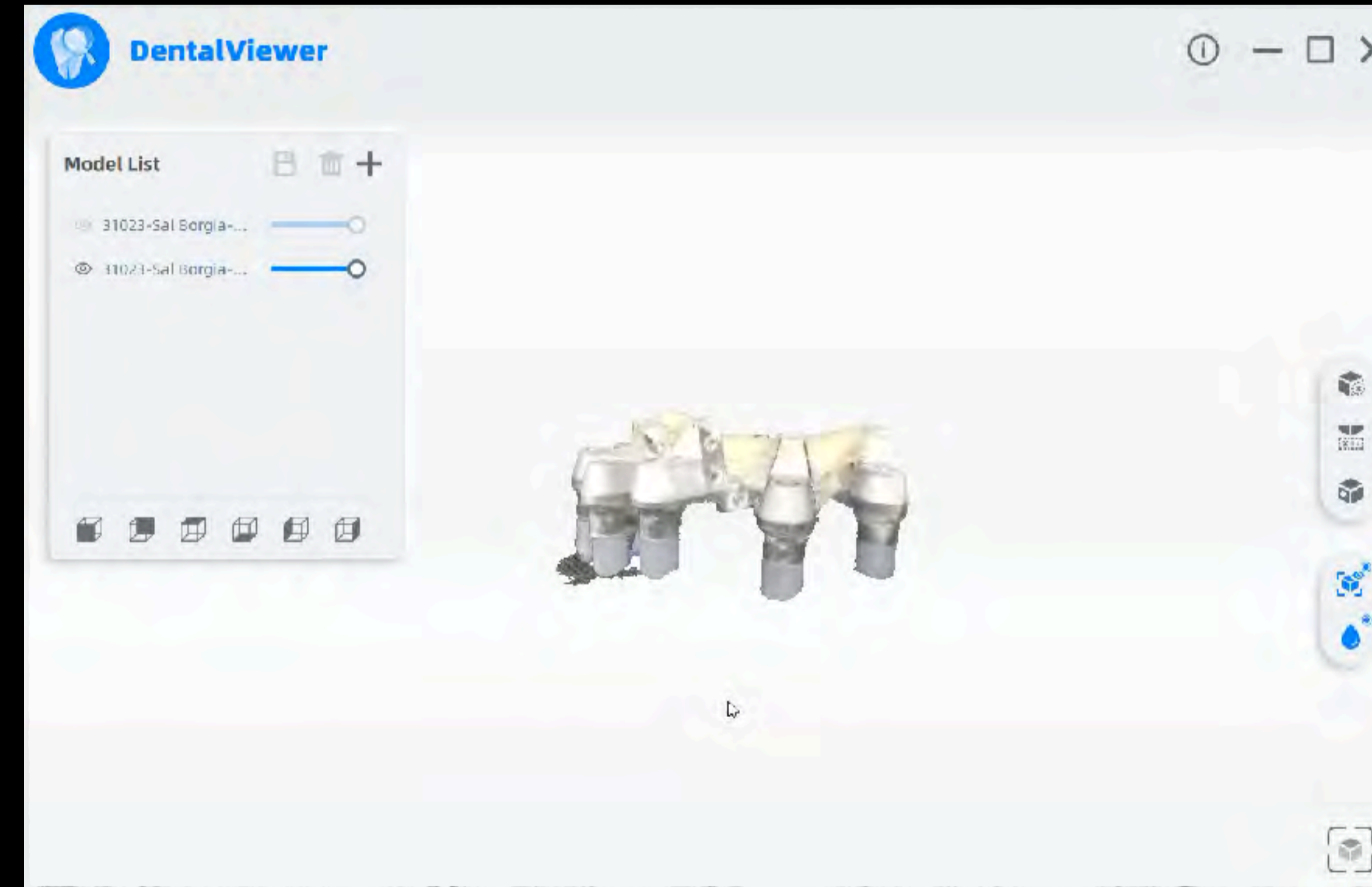
Digital Occlusion

Analysis

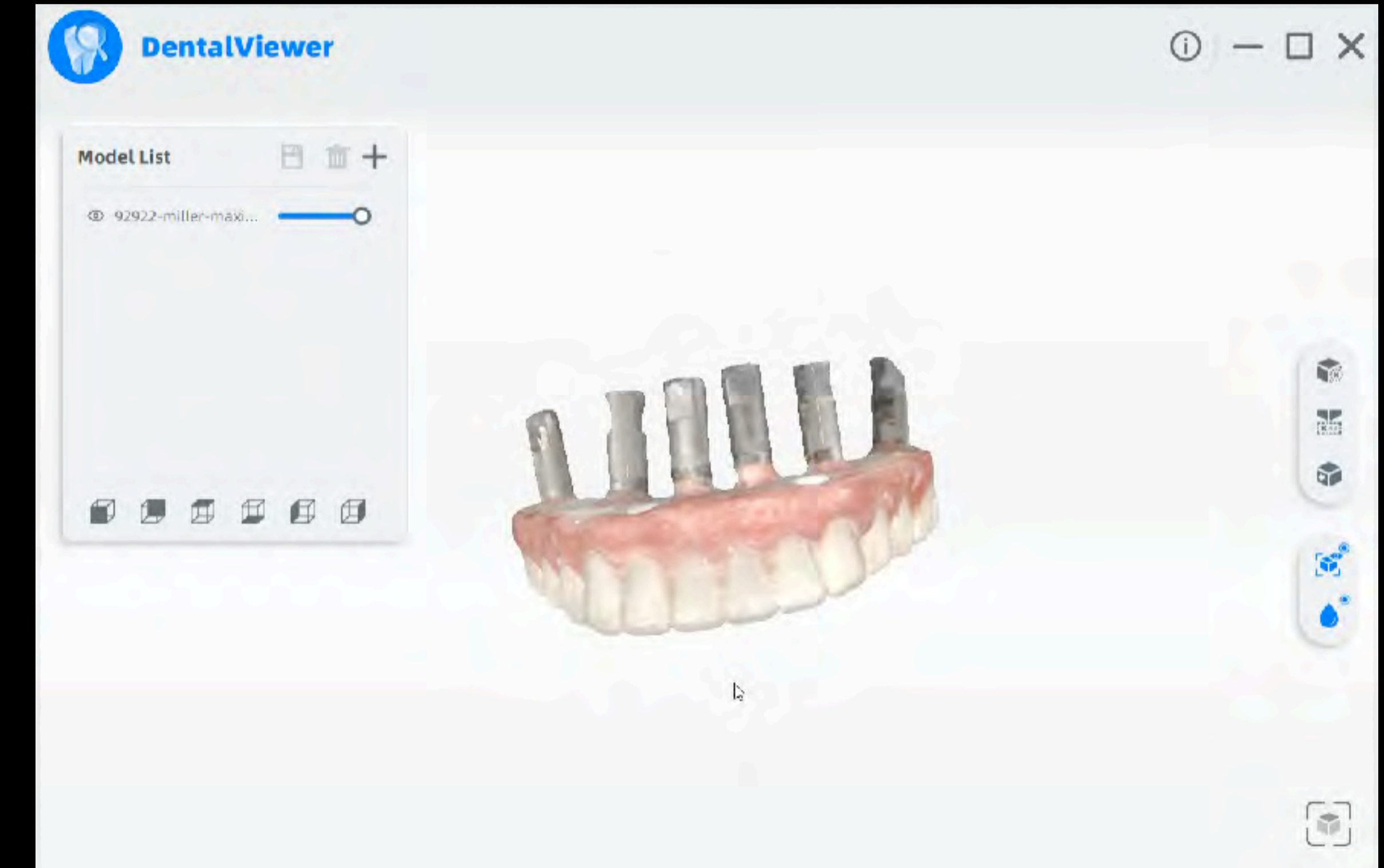


Lab Communication

Finalization



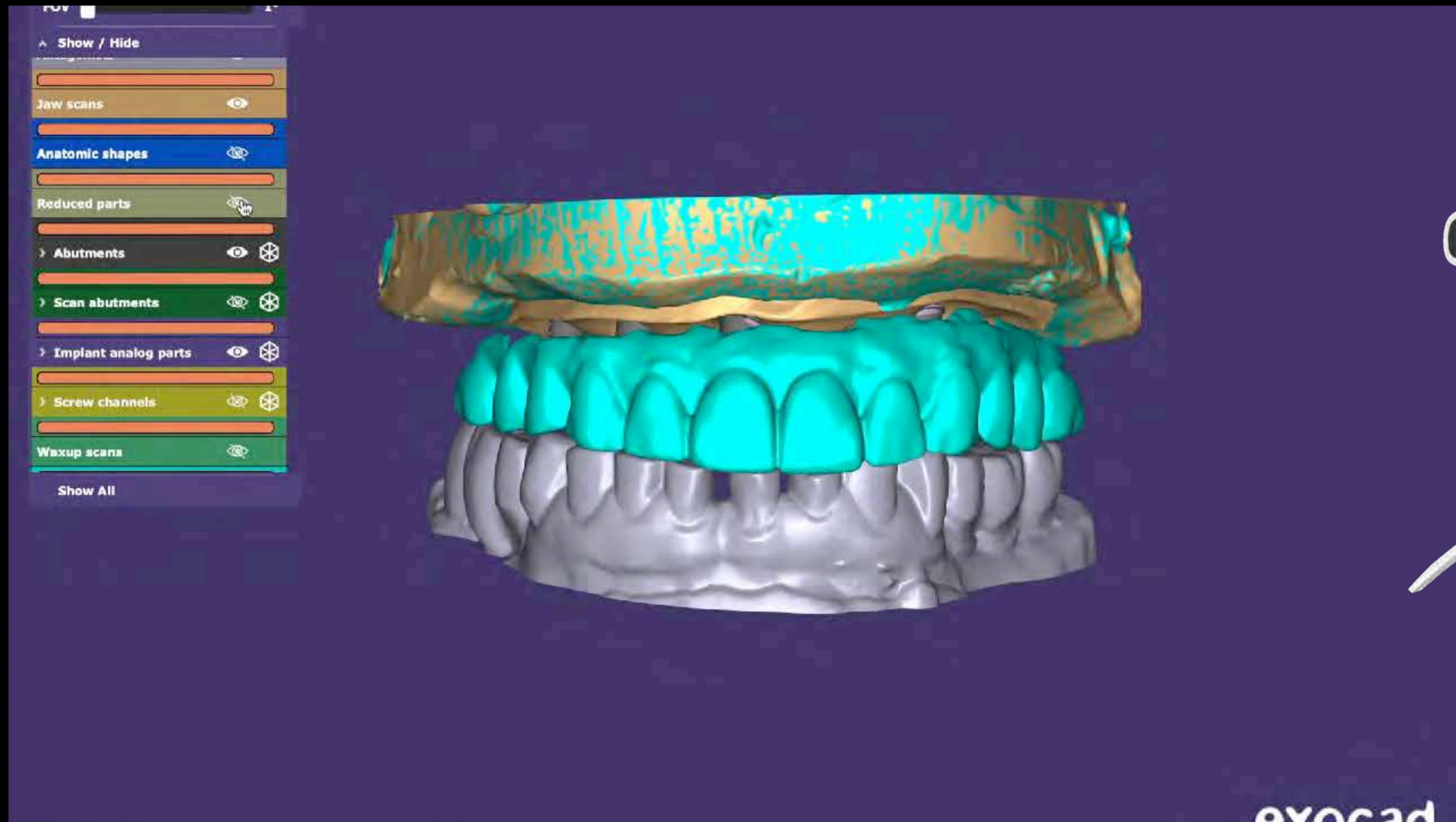
Grammetry



iJig

Design

Cad-Cam



MILL



Changing lives one smile at a time



Metal-Free



WHY? Metal-Free



▶ FP1 (NO PINK)



▶ FP2 (LONG TEETH)

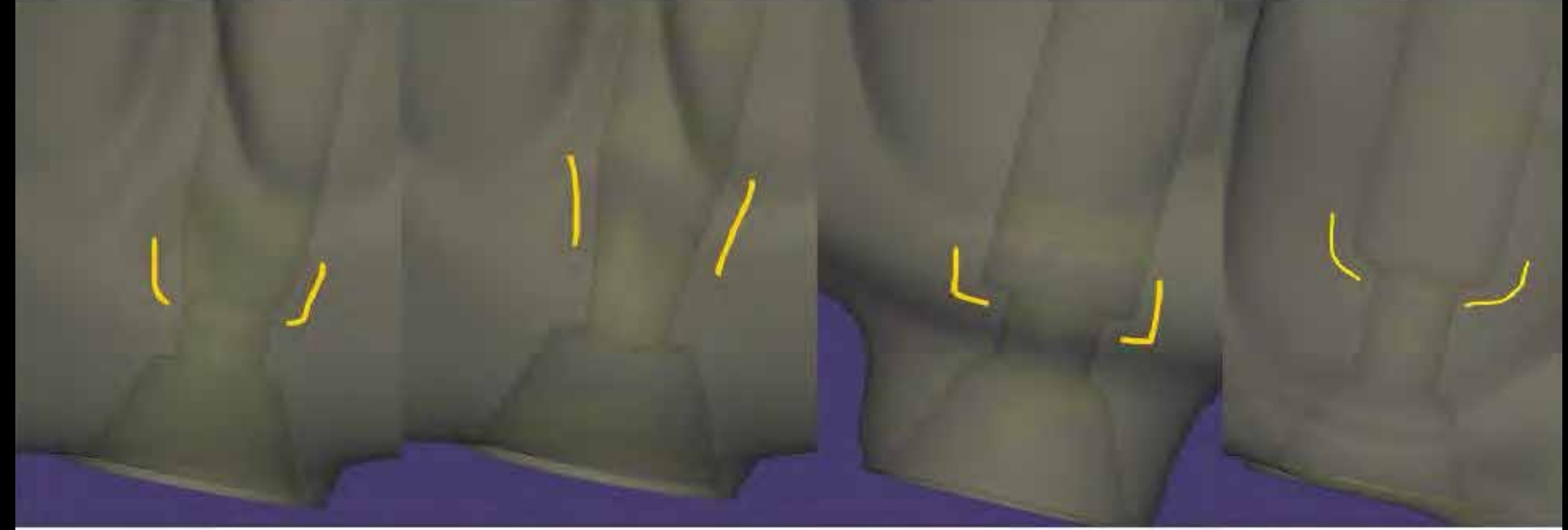


▶ FP3 (ARTIFICIAL PINK)

Metal-Free



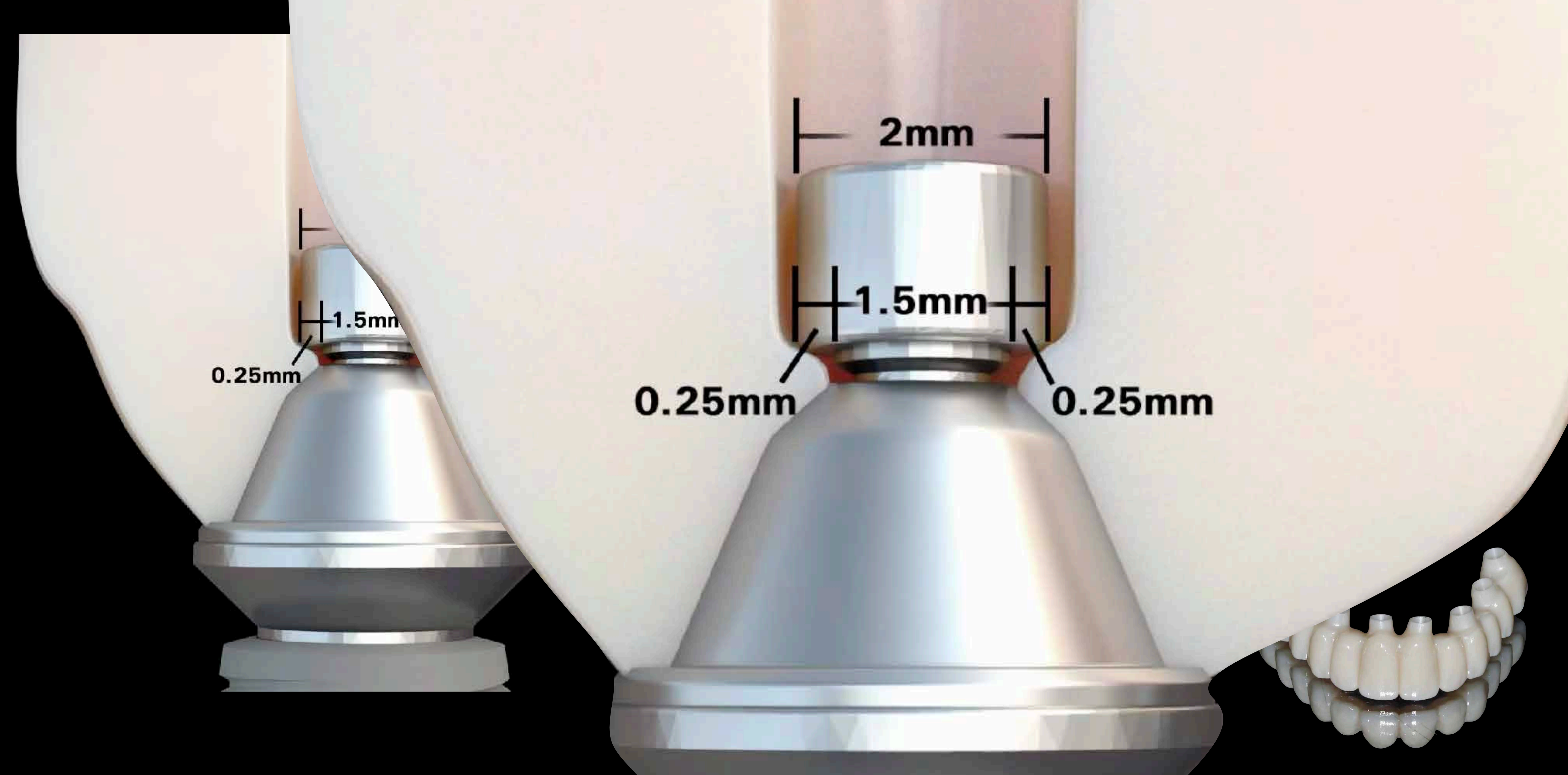
<p>La Vis Grammetry Direct to MUA, ti-base or ti-bar Angled screw channel Downward and outward pressure Variable height setting for materials Wide channel milling T5 torx Driver 15ncm (Breakaway safety feature)</p>	<p>Rosen screw Direct to MUA Angled screw channel Outward pressure Wedge channel milling Hand torque .050 hex driver</p>	<p>Dess screw 19.018-P10 Direct to MUA or ti-base Downward pressure Right angle seating 15ncm .050 hex driver</p>	<p>Powerball Direct to MUA Angled screw channel Downward and outward pressure Biaxial driver 15ncm</p>
---	--	--	---



Model

Finals

Metal-Free




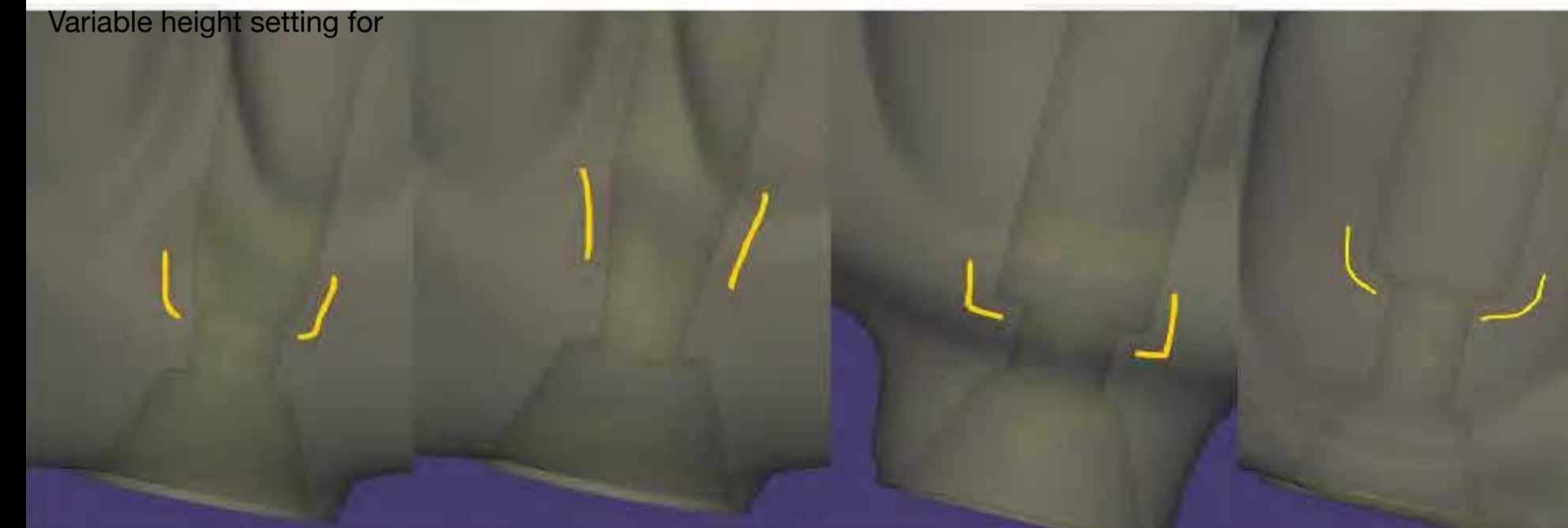


PROSTHETIC FAILURE

Metal-Free

Only screw that can be milled with **ALL THREE**

La Vis Grammetry	Rosen screw	Dess screw	Powerball
Direct to MUA, ti-base or ti-bar	Direct to MUA	Direct to MUA or ti-base	Direct to MUA
Angled screw channel	Angled screw channel		Angled screw channel
Downward and outward pressure	Outward pressure		Downward and outward pressure
Variable height setting for	Wedge channel milling		



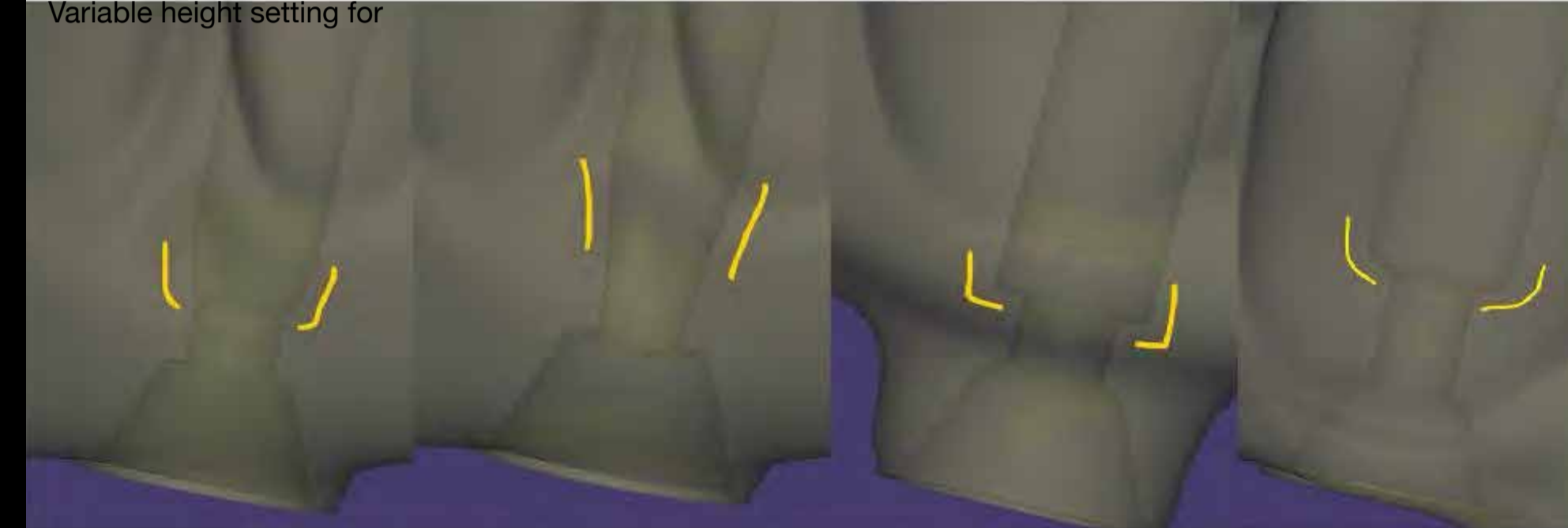

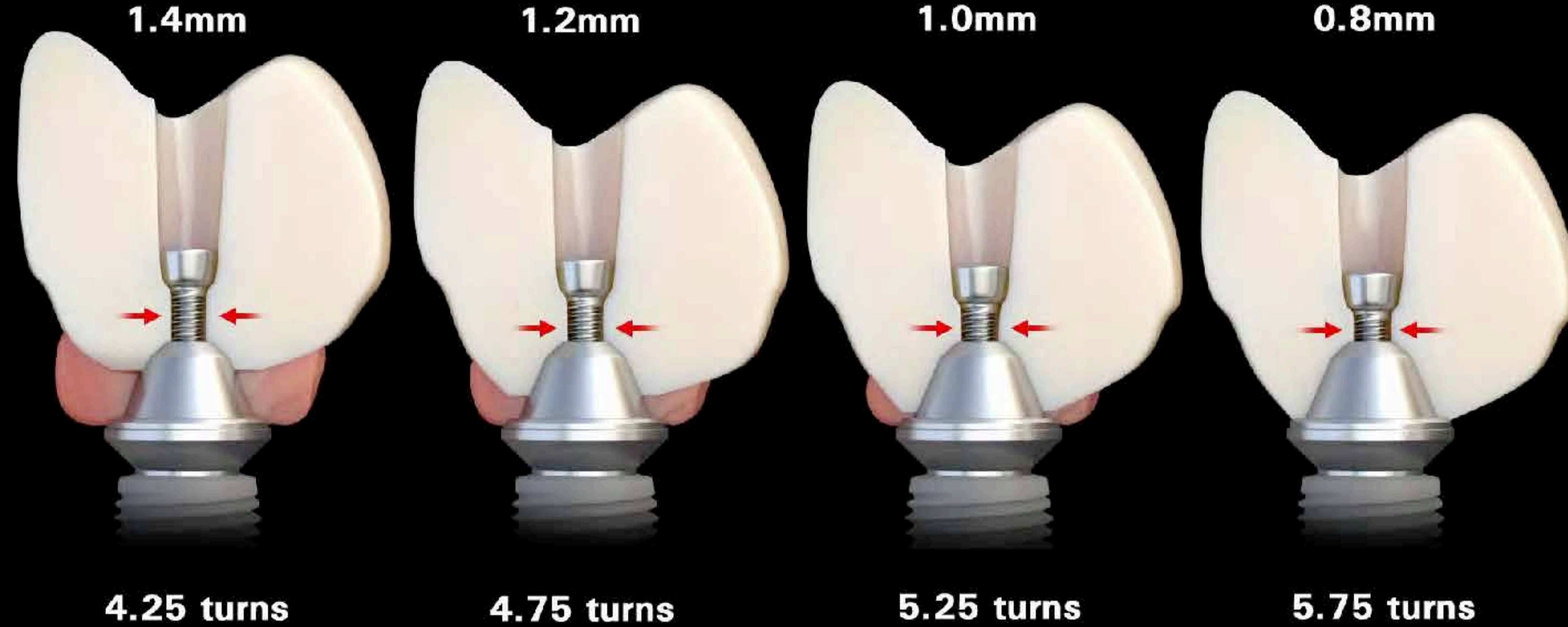
Finals



Metal-Free

Different Prosthesis Types

La Vis Grammetry	Rosen screw	Dess screw	Powerball
Direct to MUA, ti-base or ti-bar	Direct to MUA	Direct to MUA or ti-base	Direct to MUA
Angled screw channel	Angled screw channel		Angled screw channel
Downward and outward pressure	Outward pressure		Downward and outward pressure
Variable height setting for	Wedge channel milling		

Holds down by lateral walls and apical direction with zirconia under the screw head

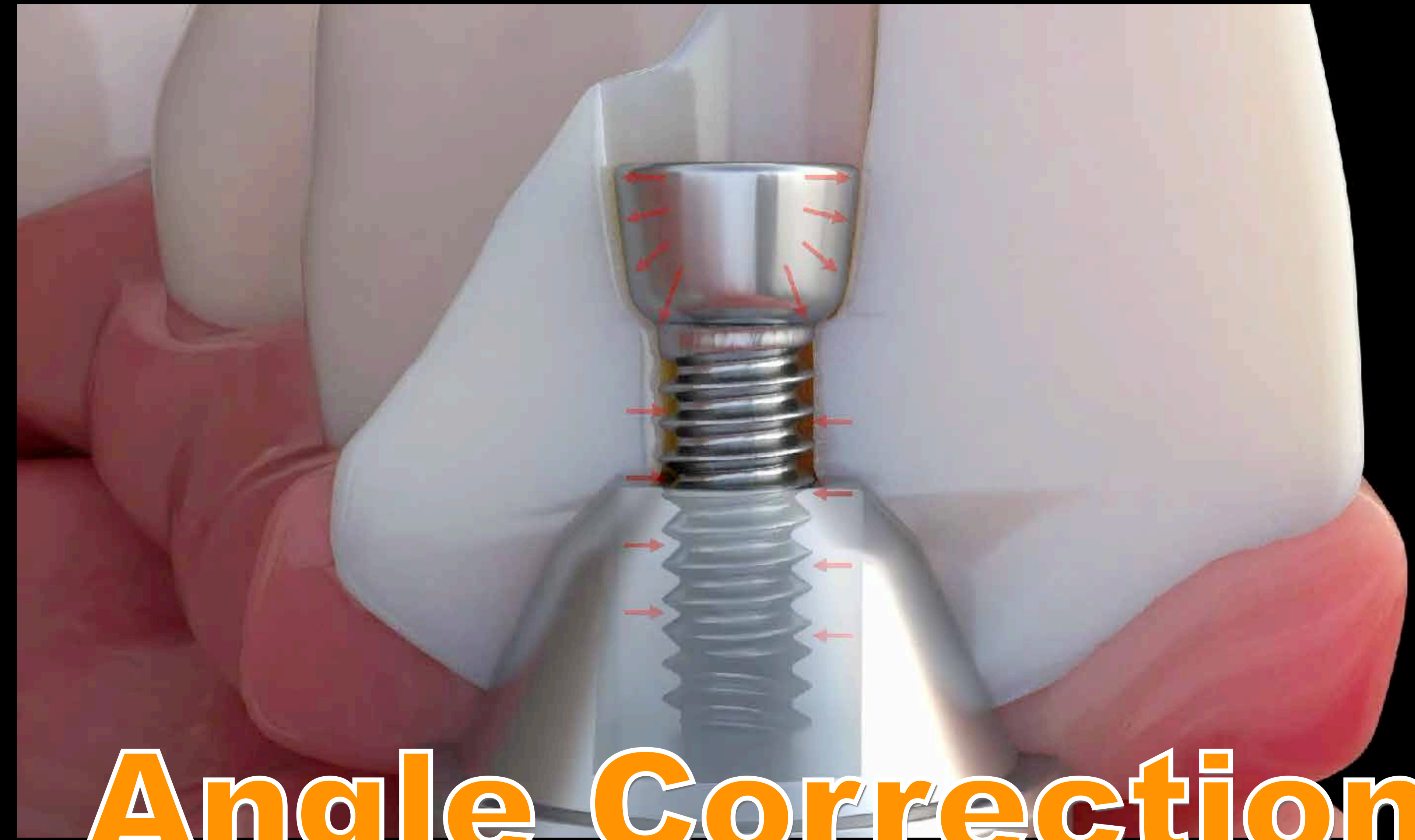
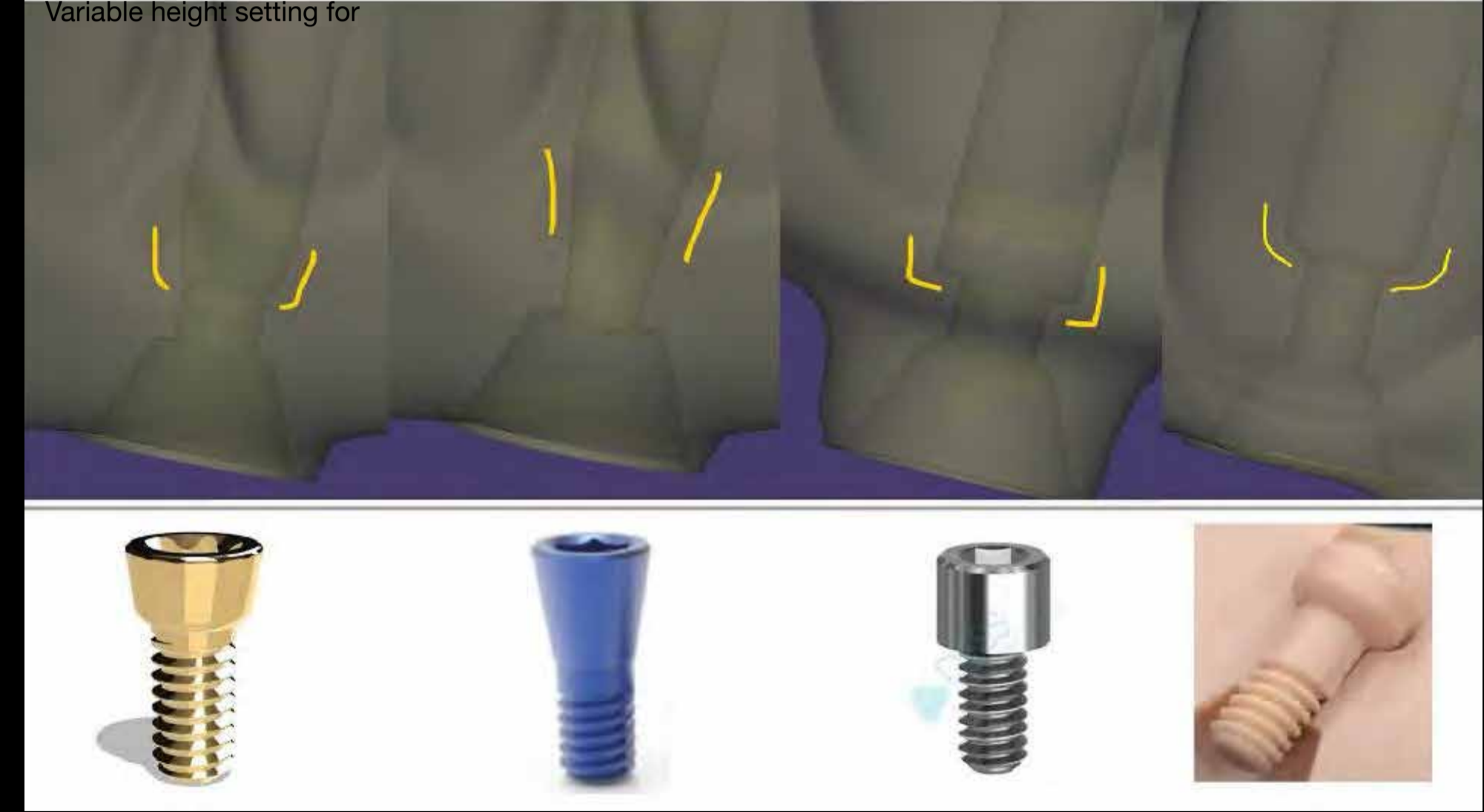


Finals



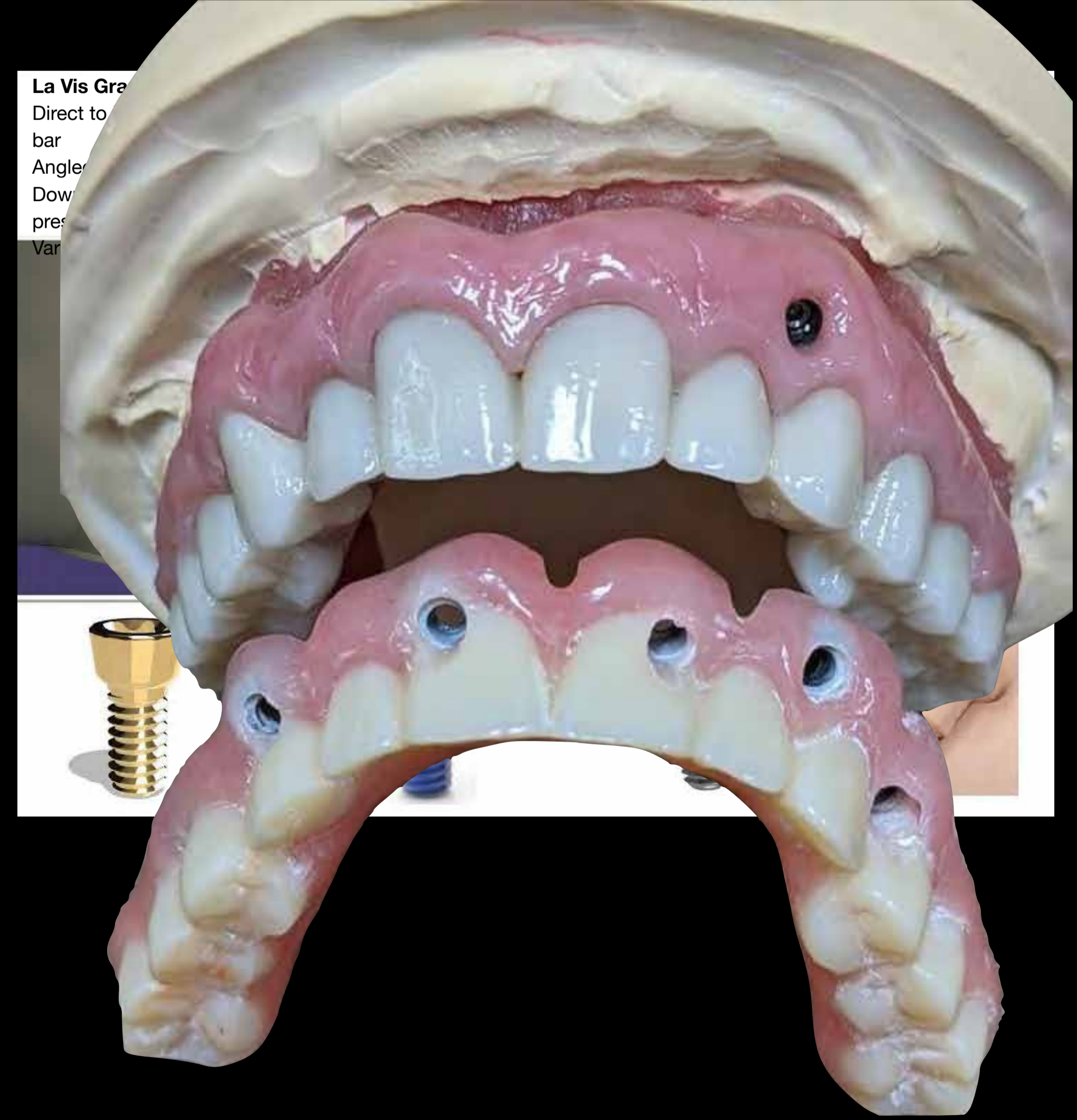
Metal-Free

La Vis Grammetry	Rosen screw	Dess screw 19.018-P10	Powerball
Direct to MUA, ti-base or ti-bar	Direct to MUA	Direct to MUA or ti-base	Direct to MUA
Angled screw channel	Angled screw channel		Angled screw channel
Downward and outward pressure	Outward pressure		Downward and outward pressure
Variable height setting for	Wedge channel milling		

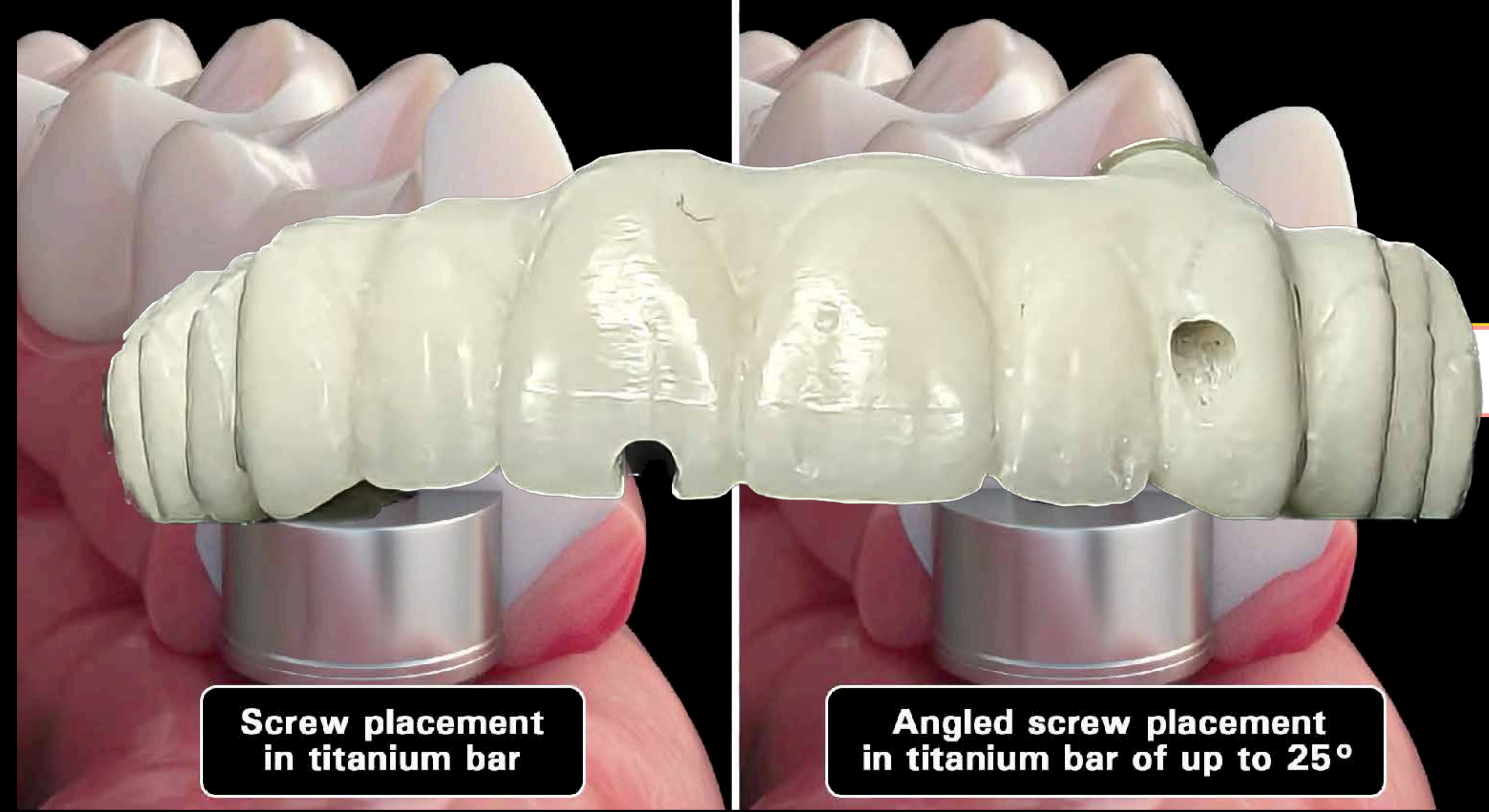


Angle Correction

Metal-Free



Angled Screw Channel



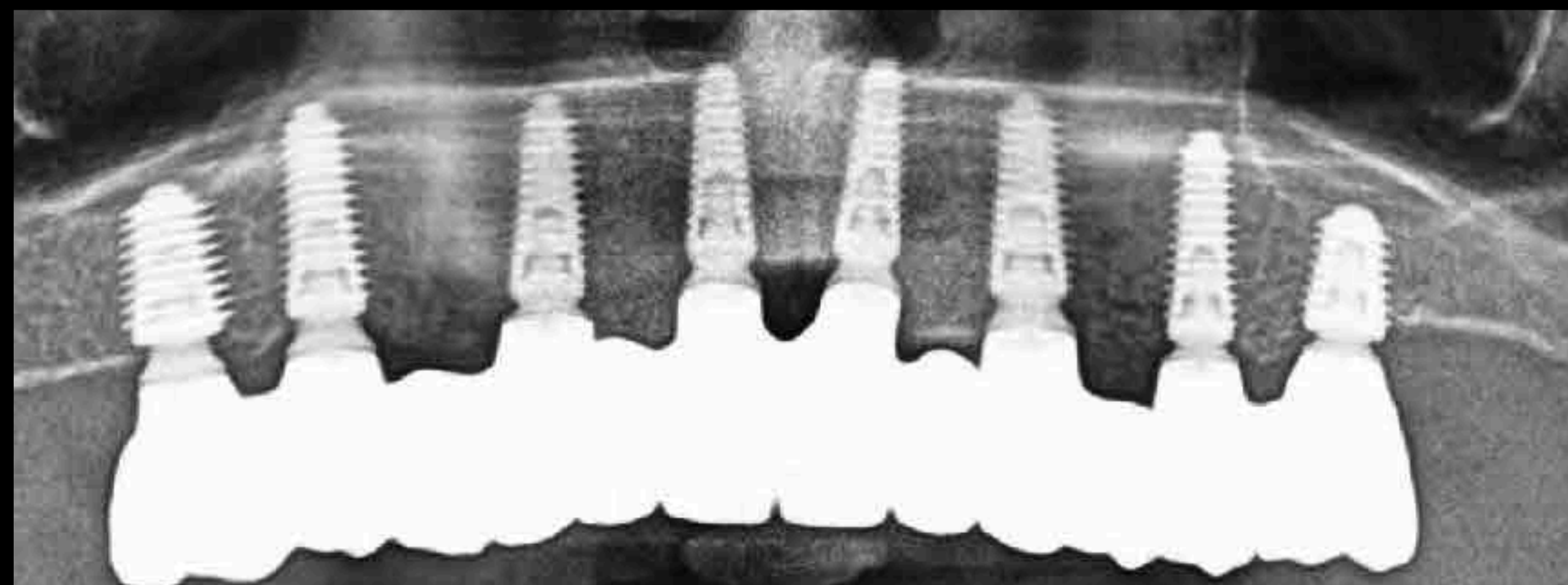
Screw placement in titanium bar

Angled screw placement in titanium bar of up to 25°

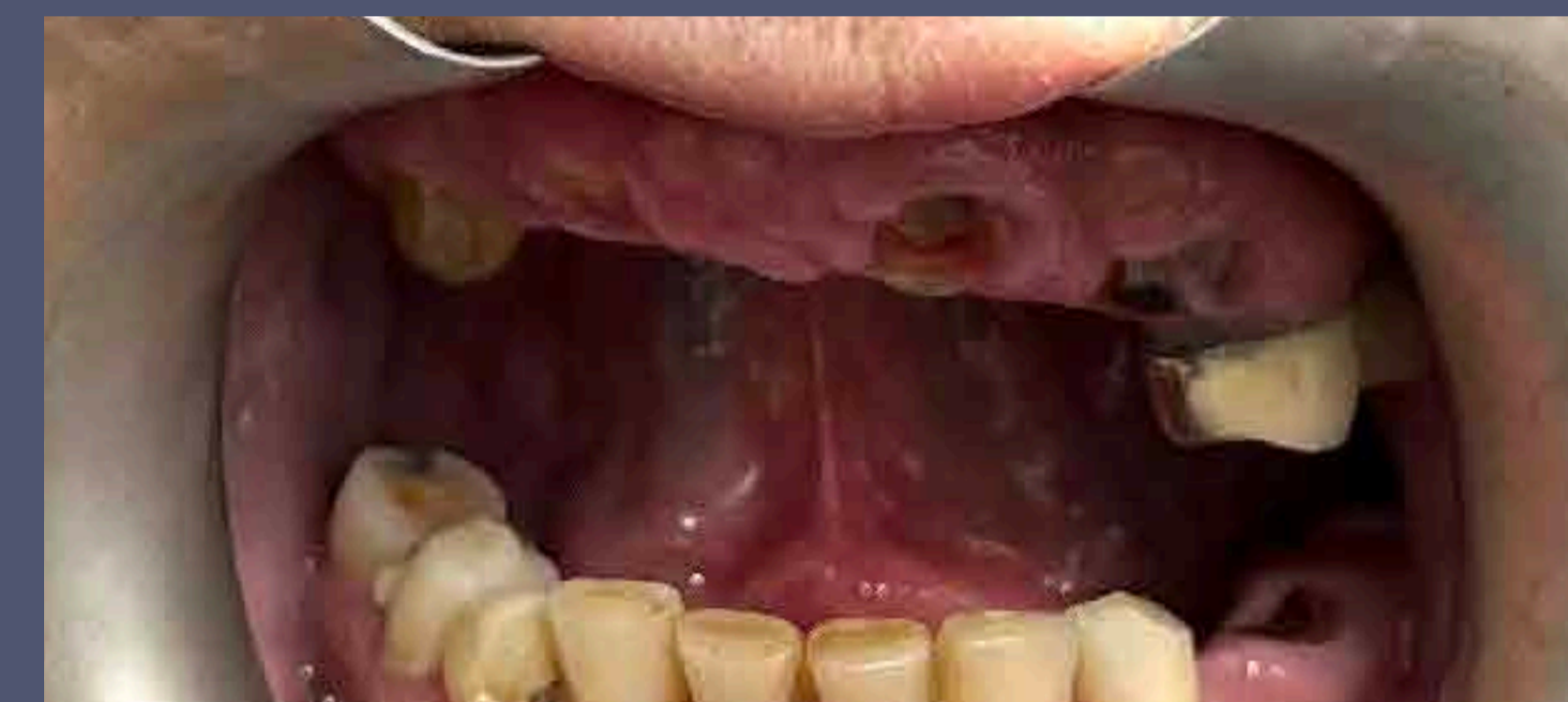


Finals



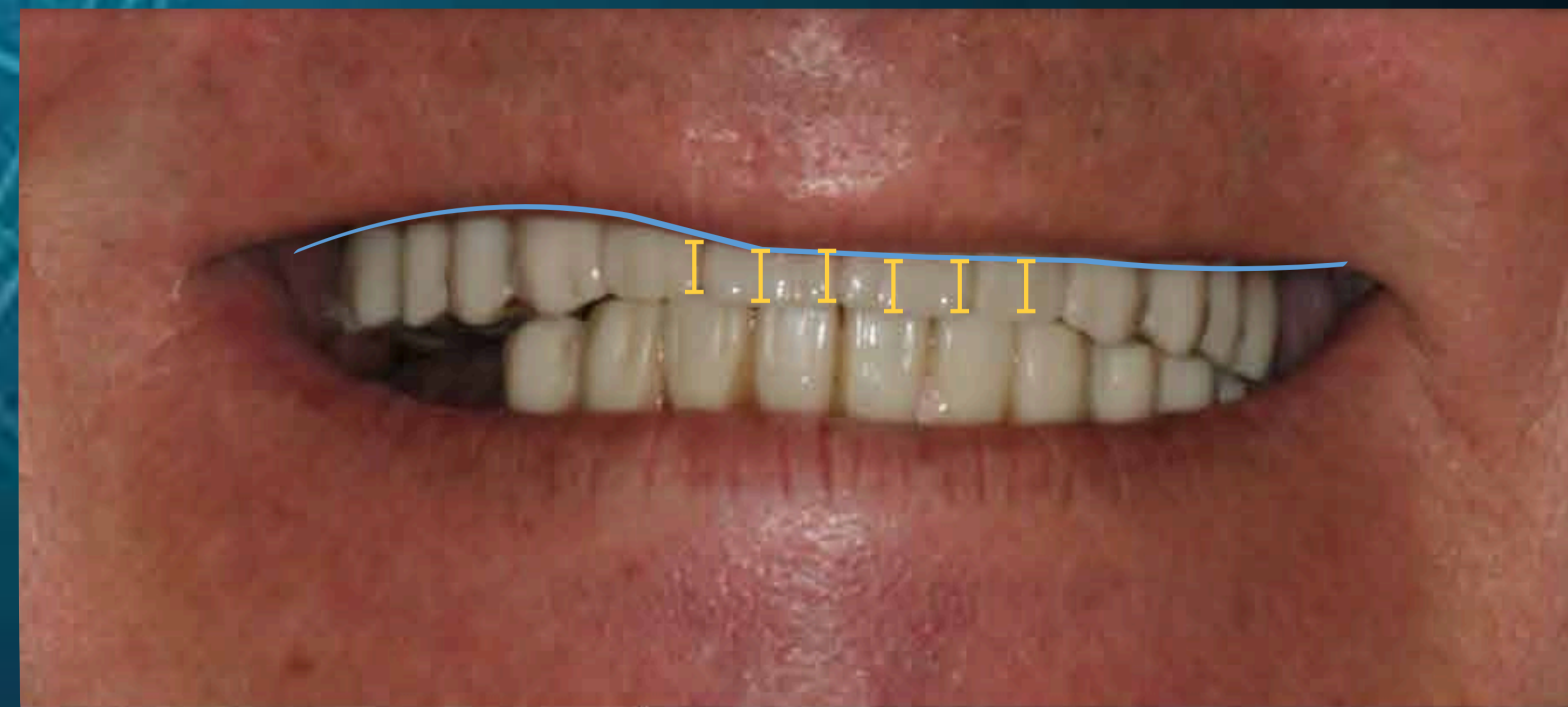
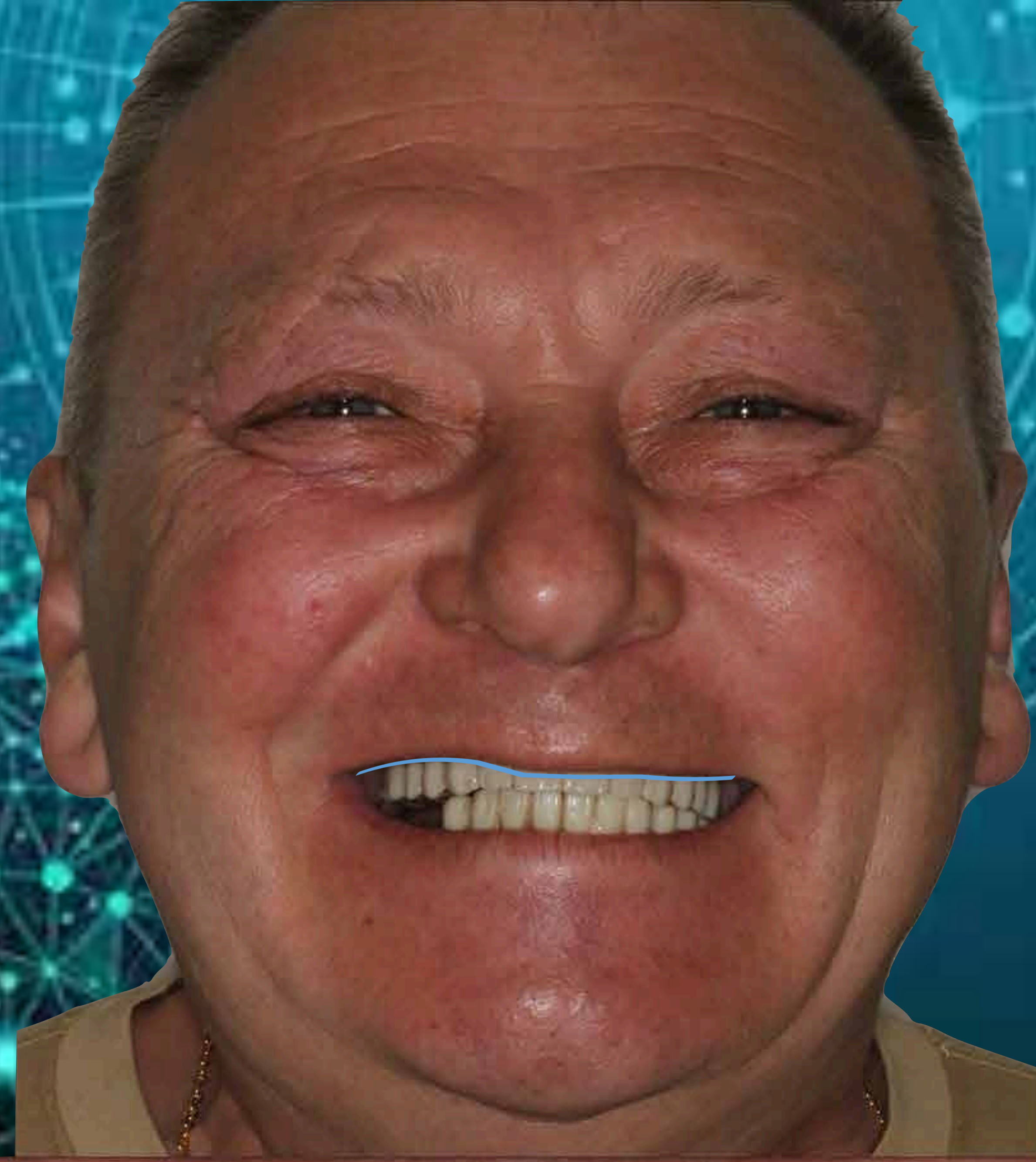


Finals



Changing lives one smile at a time







The screenshot shows the Microsoft Kinect v2 software interface. In the center, a 3D model of a man's face is displayed, showing detailed facial features like wrinkles and teeth. The interface includes a "Model List" on the left with four rows of icons and sliders, where the last two are checked. At the top, there are navigation icons for different views. On the right, there are icons for "Reset", "Zoom", "Rotate", and "Fit". At the bottom, there are buttons for "Back to scan" and "Go to send".

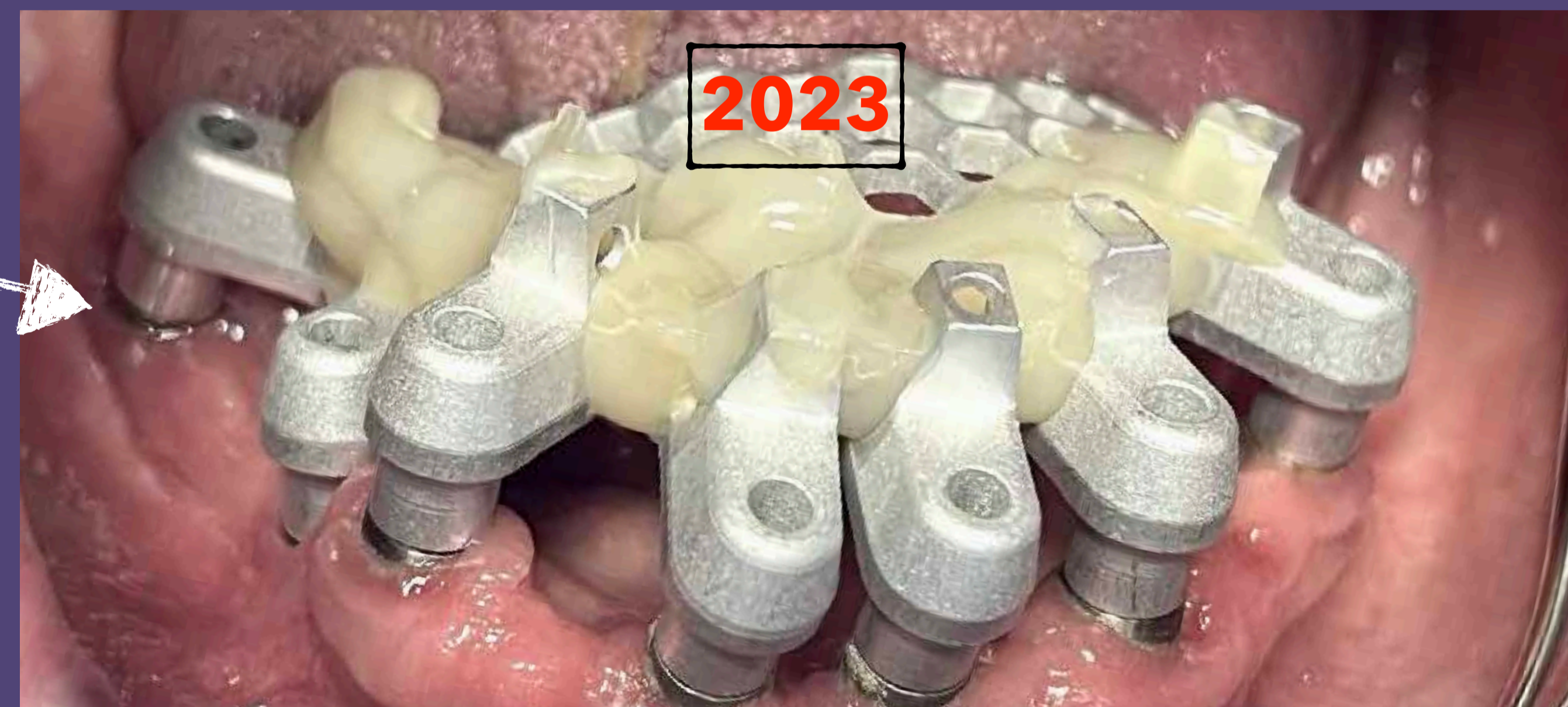
Model List

Model	Icon	Slider
1		<input type="checkbox"/>
2		<input type="checkbox"/>
3		<input checked="" type="checkbox"/>
4		<input checked="" type="checkbox"/>

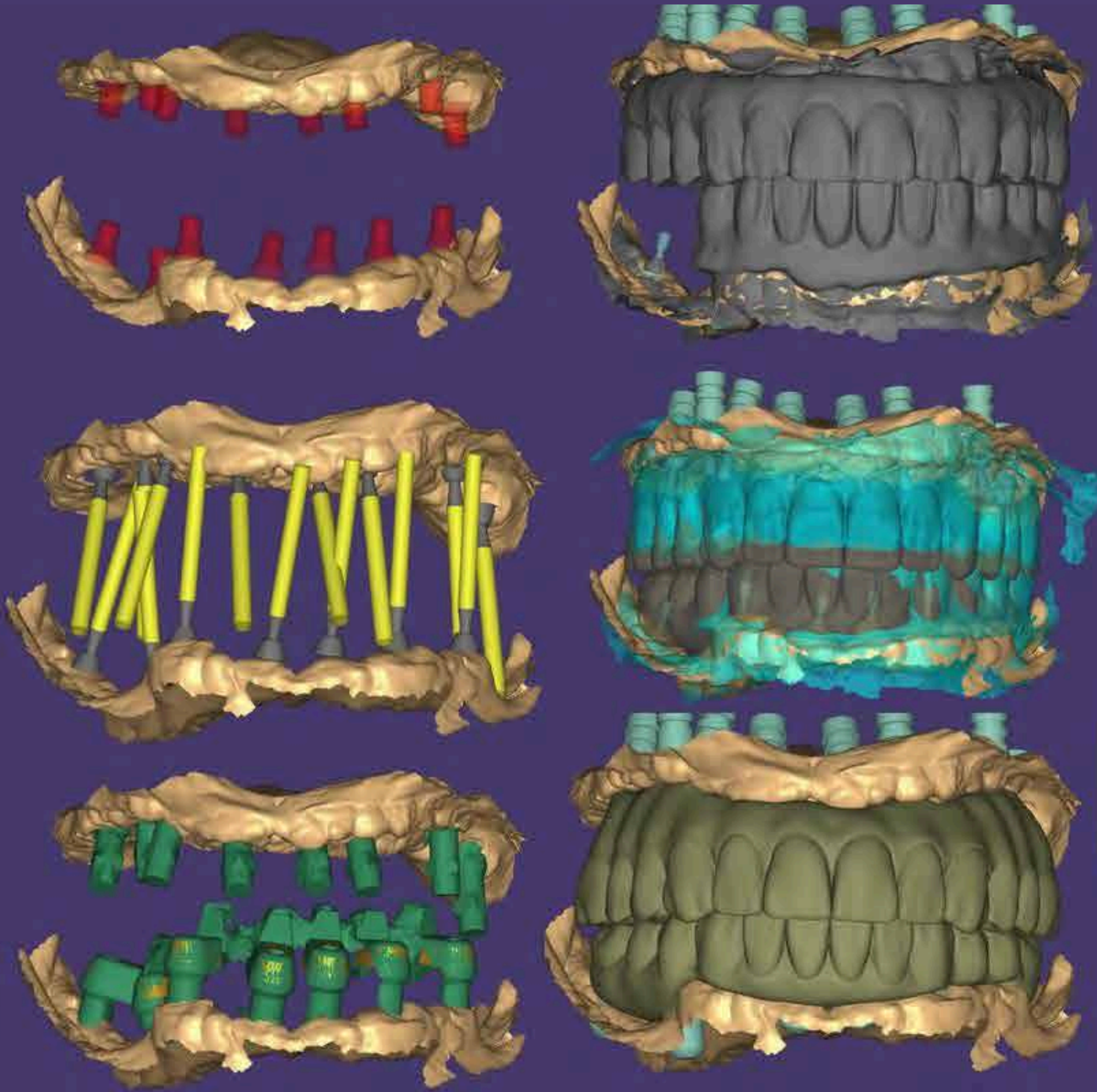
Power of facial scanning



Capture & Design



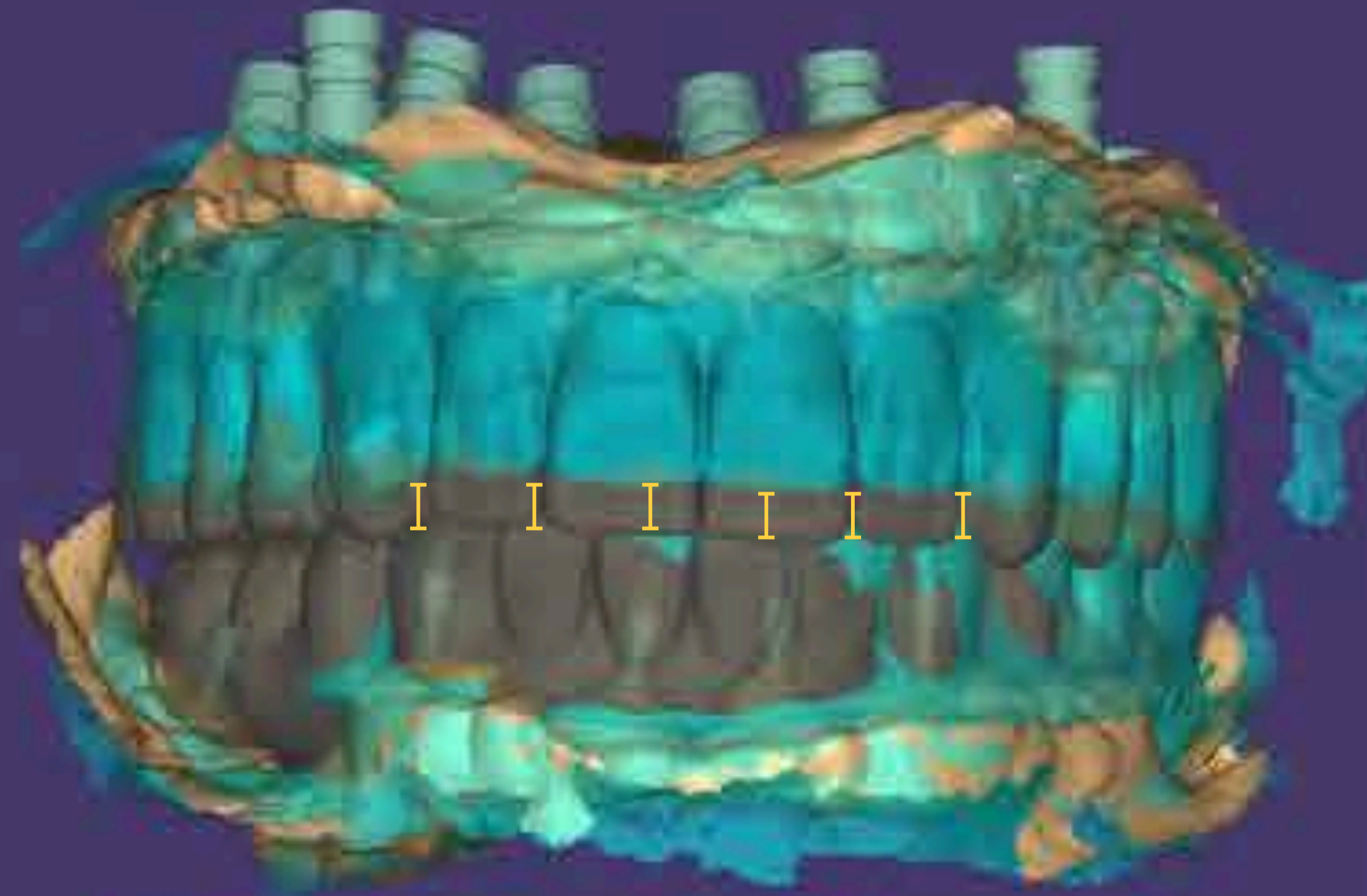
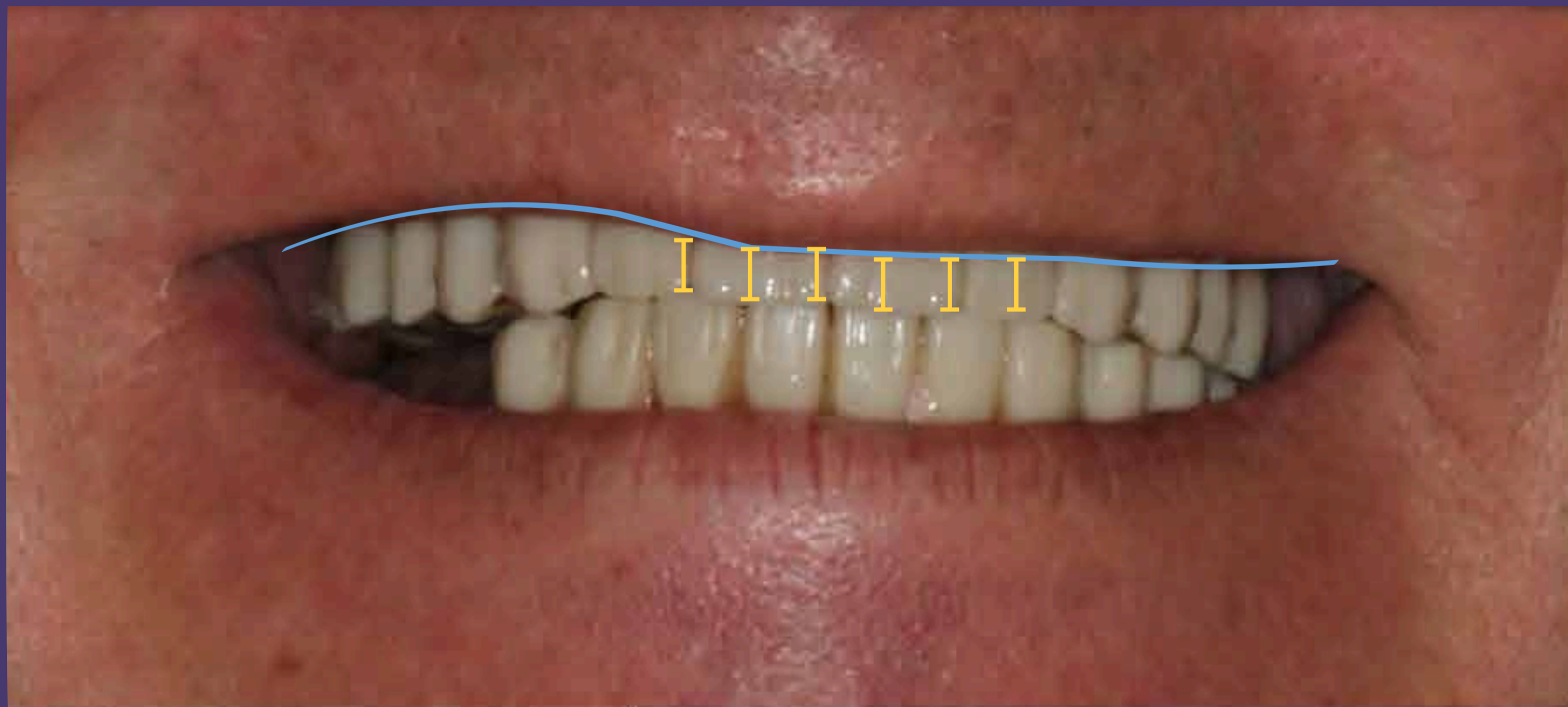
Redesign



Redesign

Fully Digital Reallocation

Redesign



Redesign

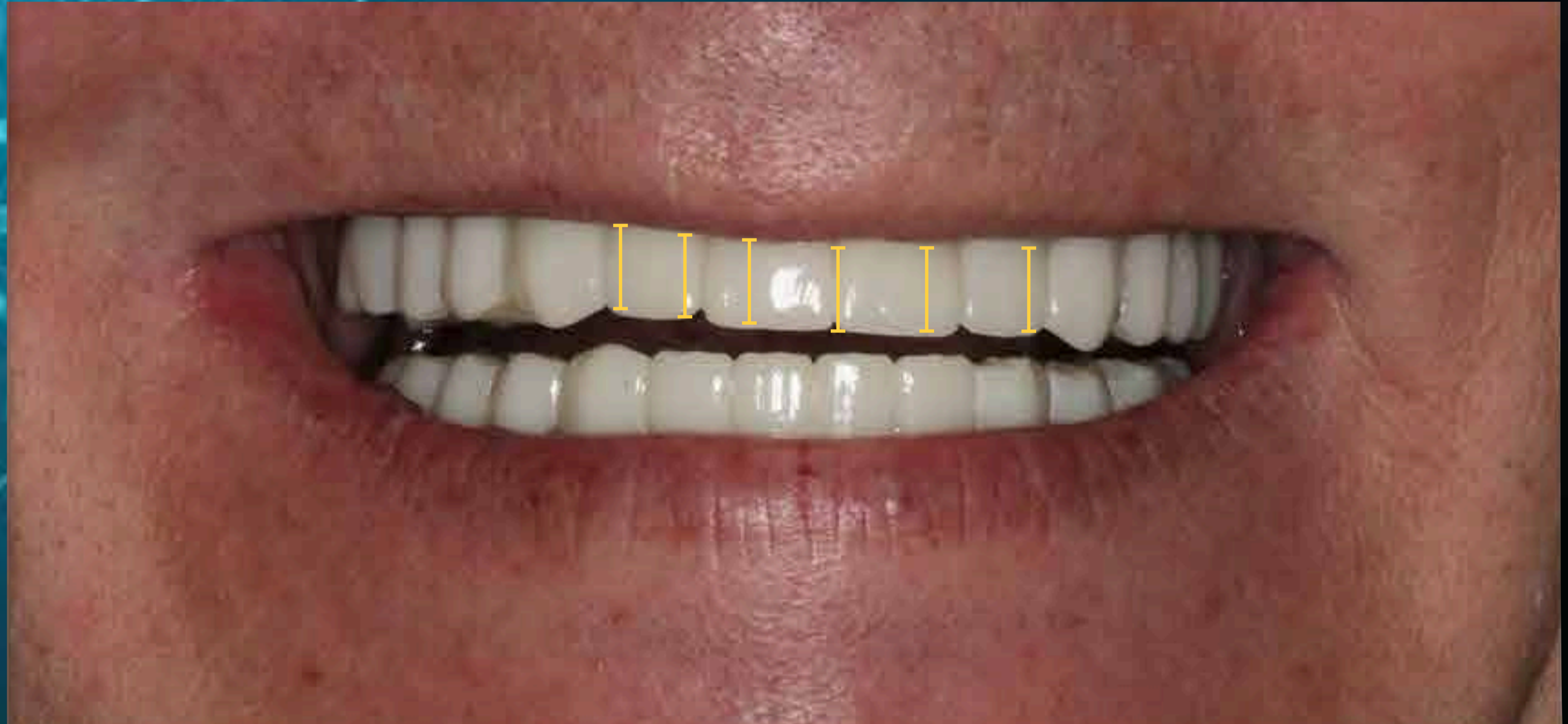
PRE



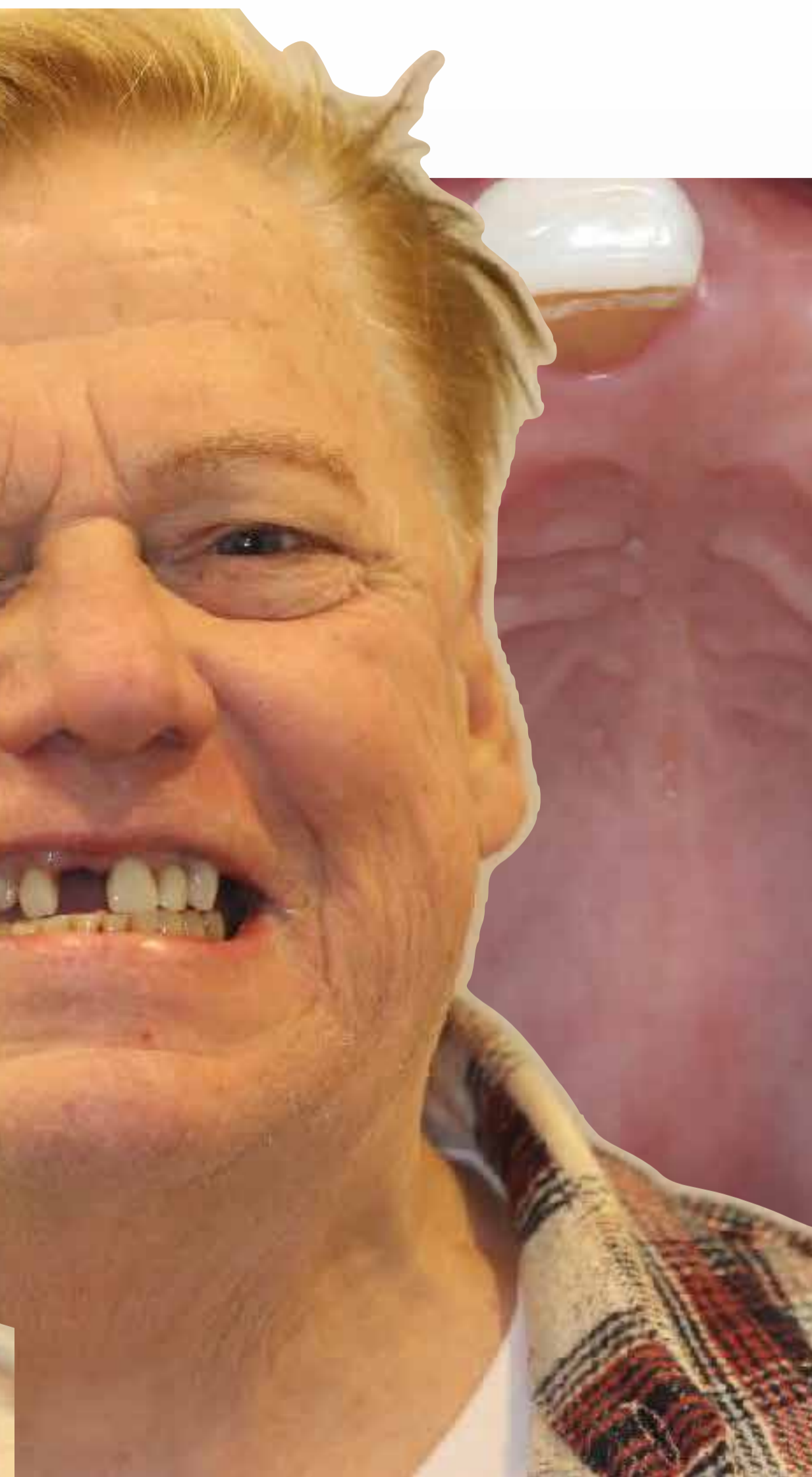
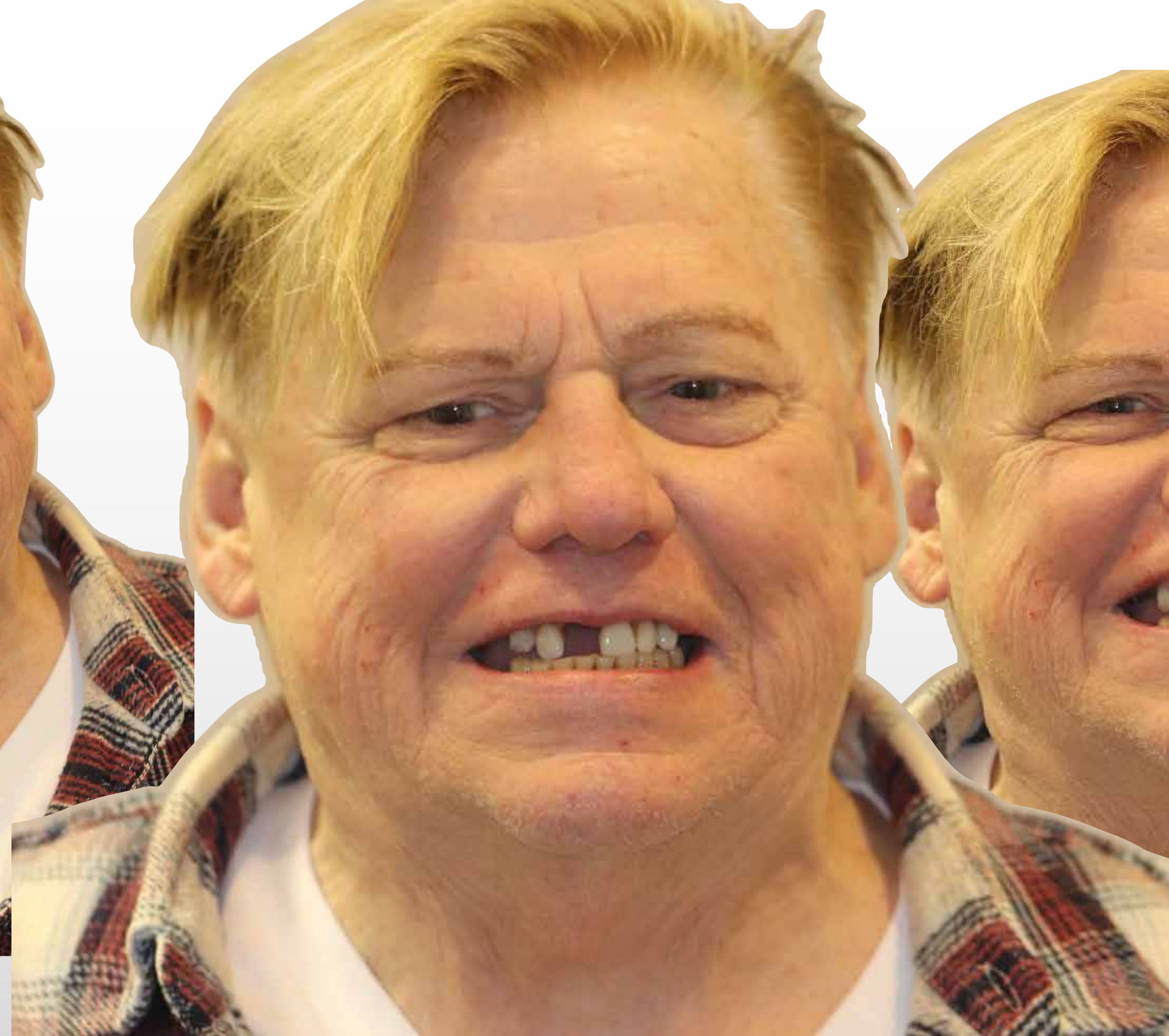
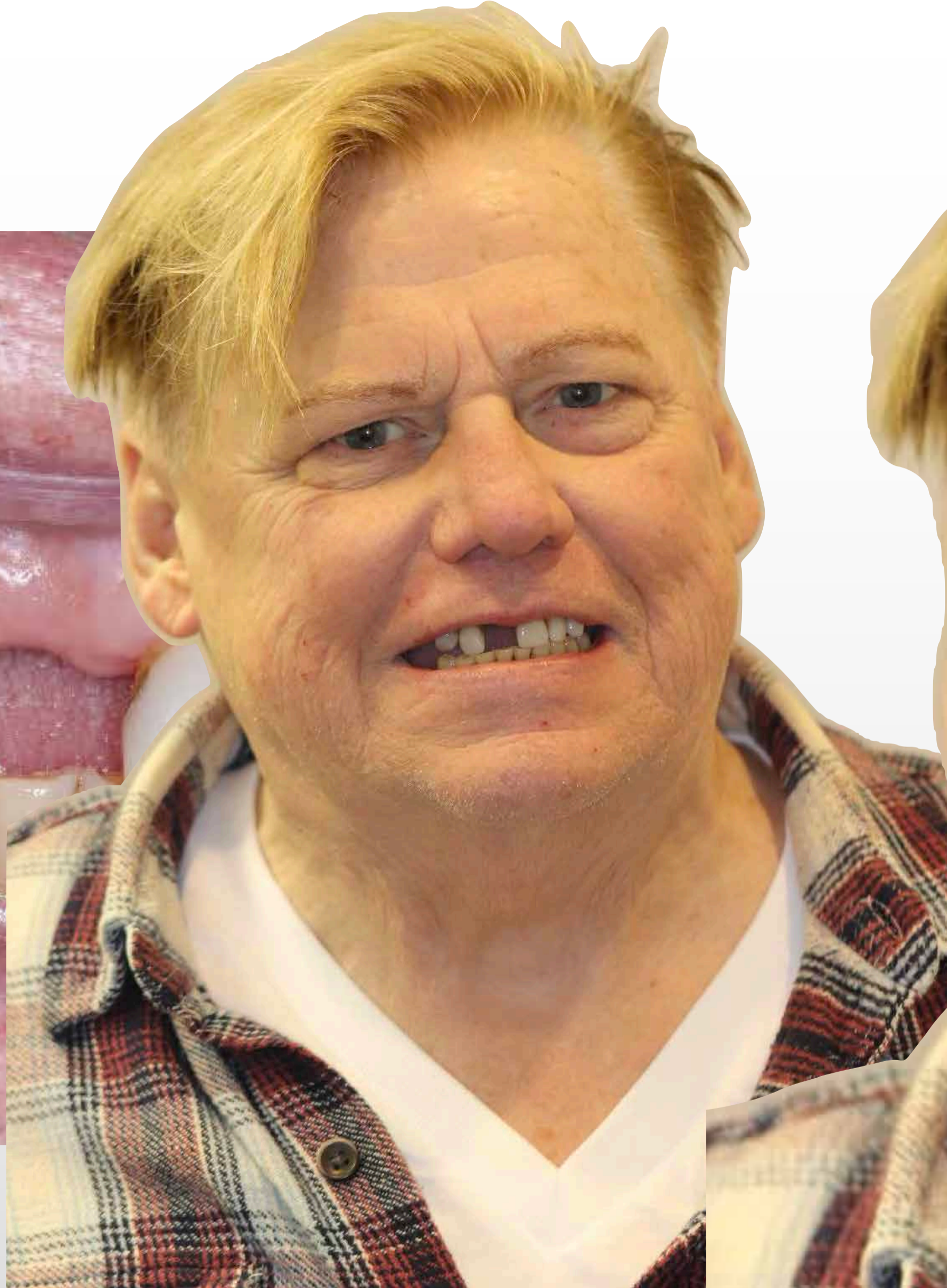
POST



Transformation

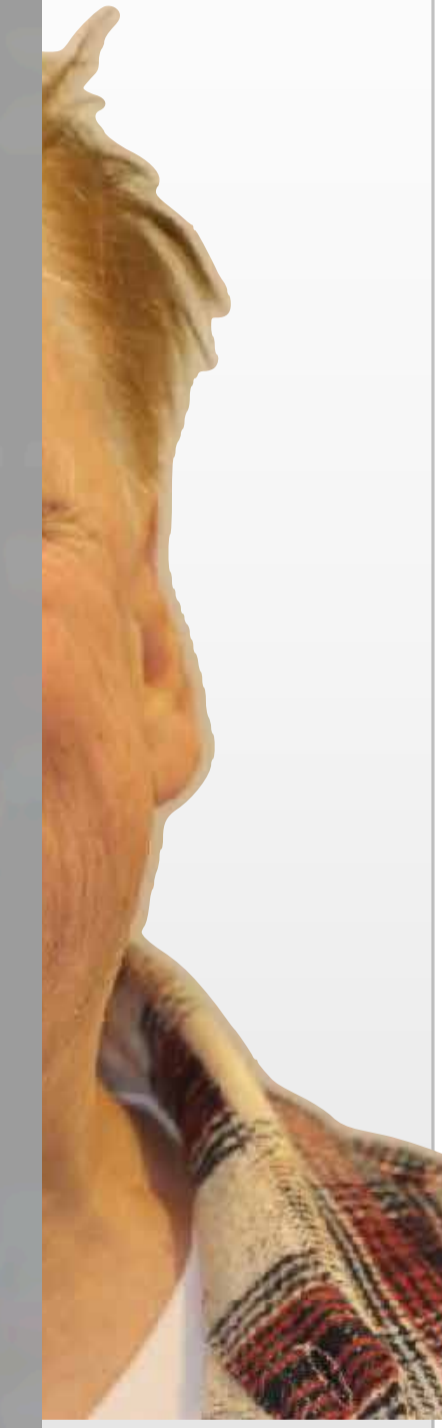
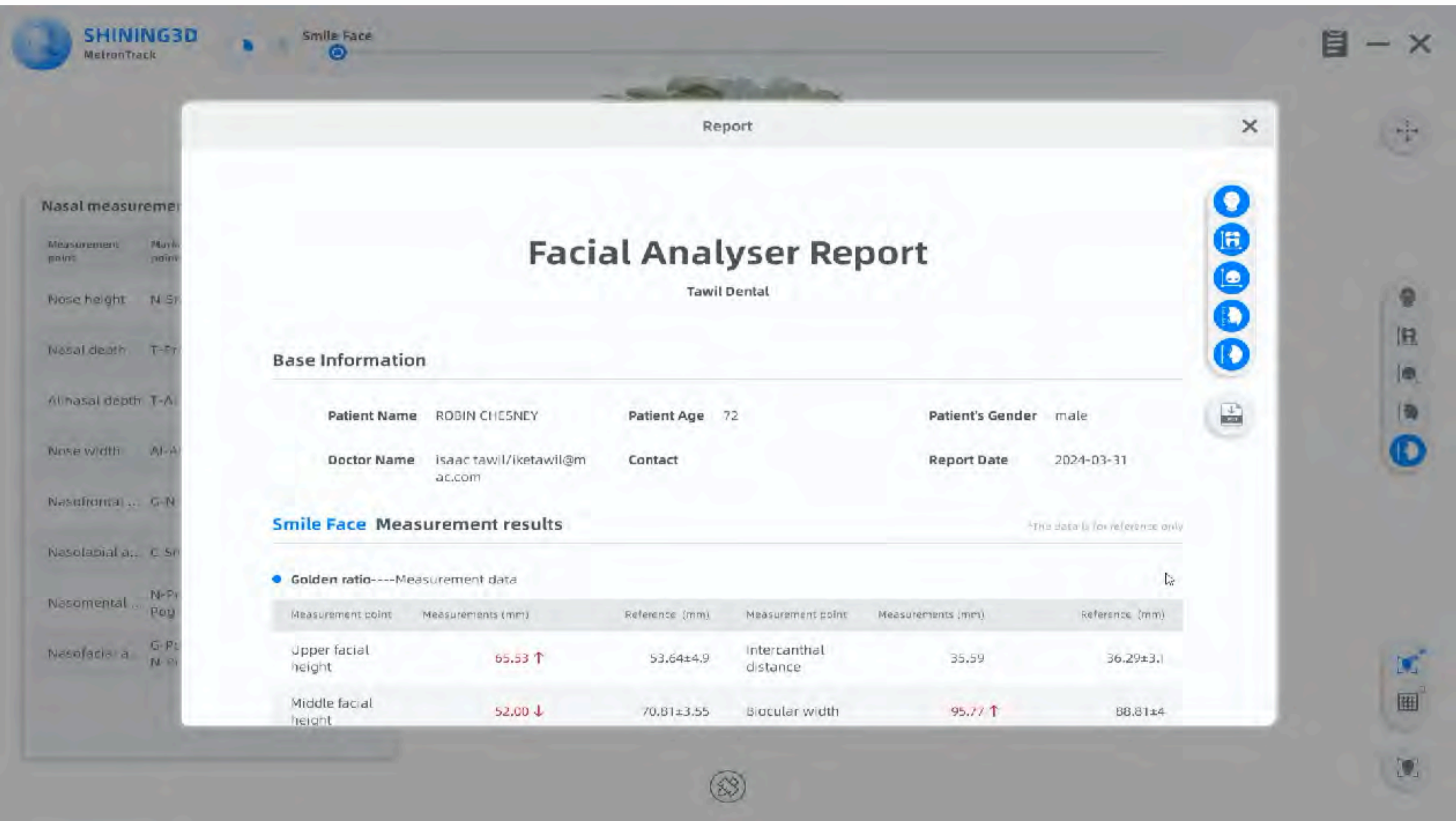
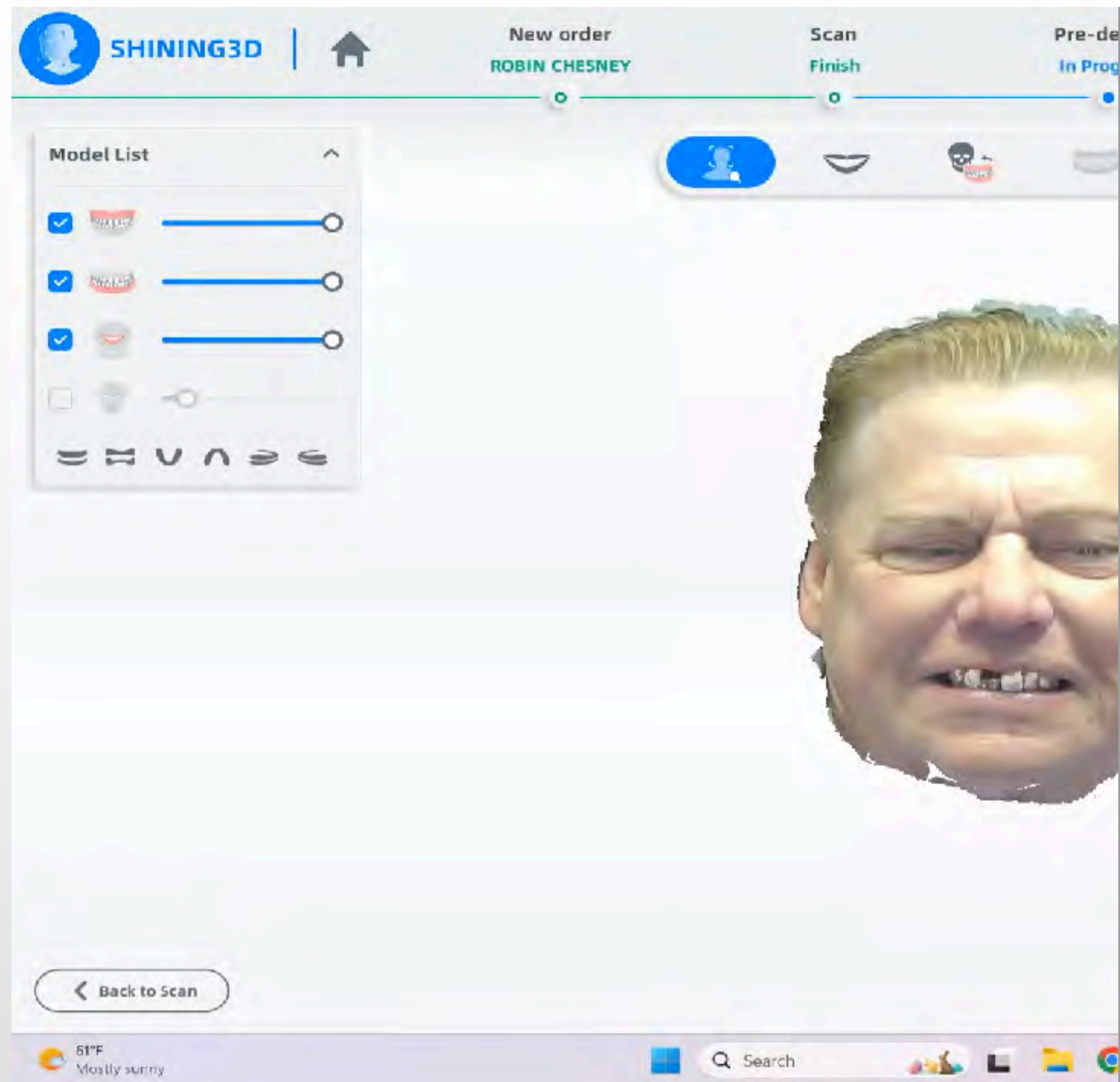






DATA MERGE

CBCT



PLANNING

FEATURES

SMILE LINE

SYMMETRY

GUIDANCE



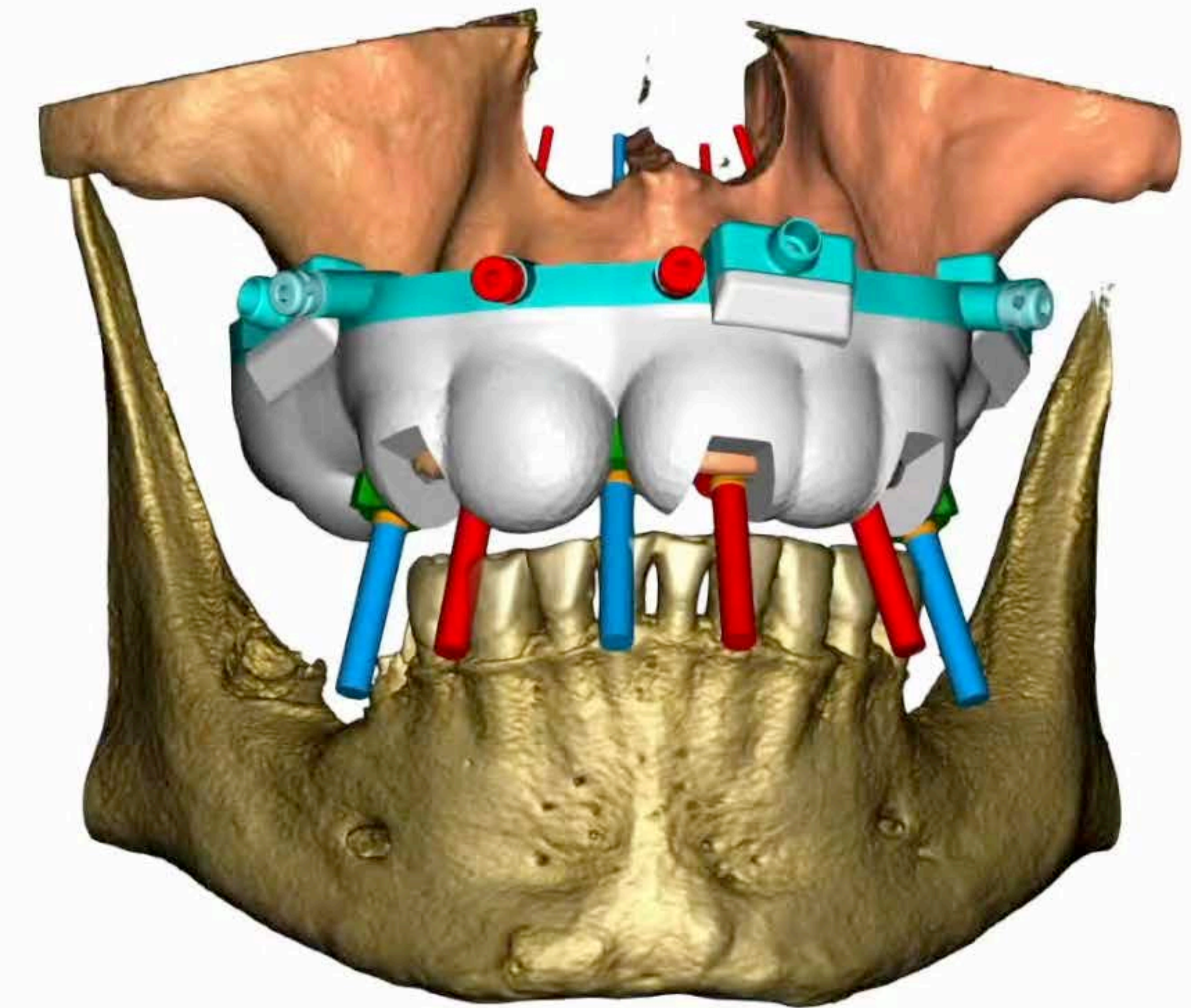
SCALLOP

PRECISION

SURGICAL GUIDANCE

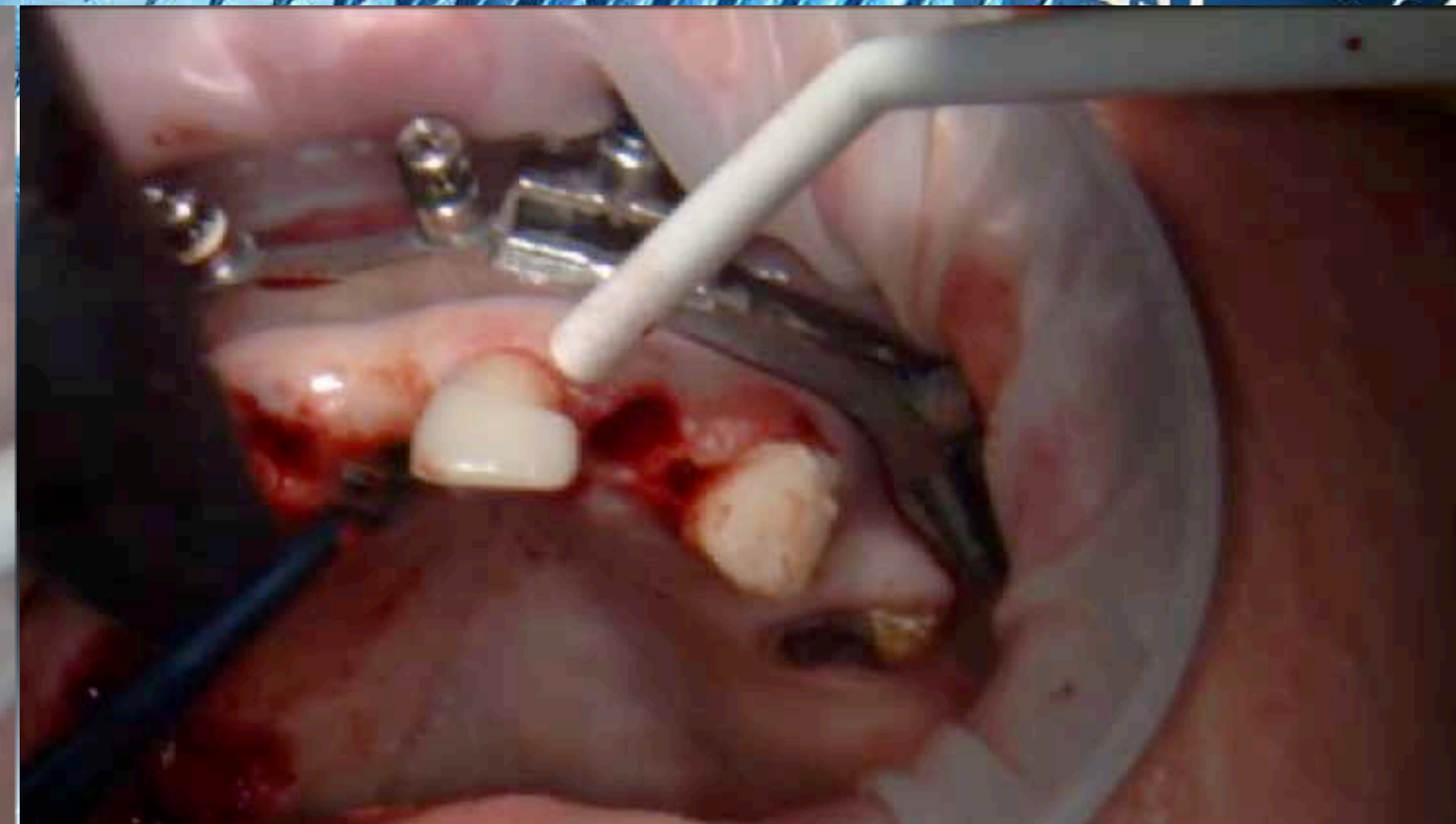
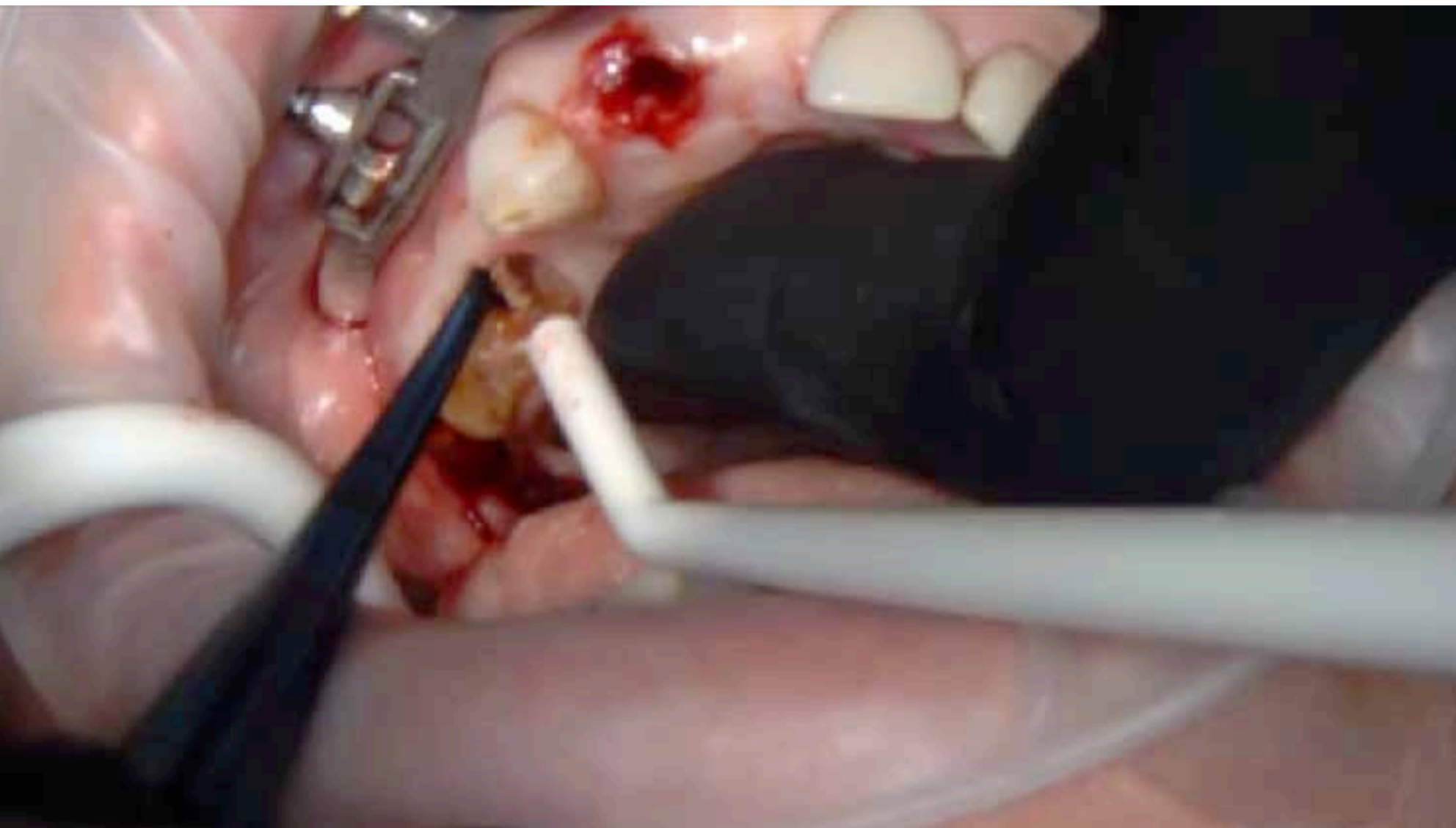


SURGICAL GUIDANCE





MINIMALLY-TRAUMATIC



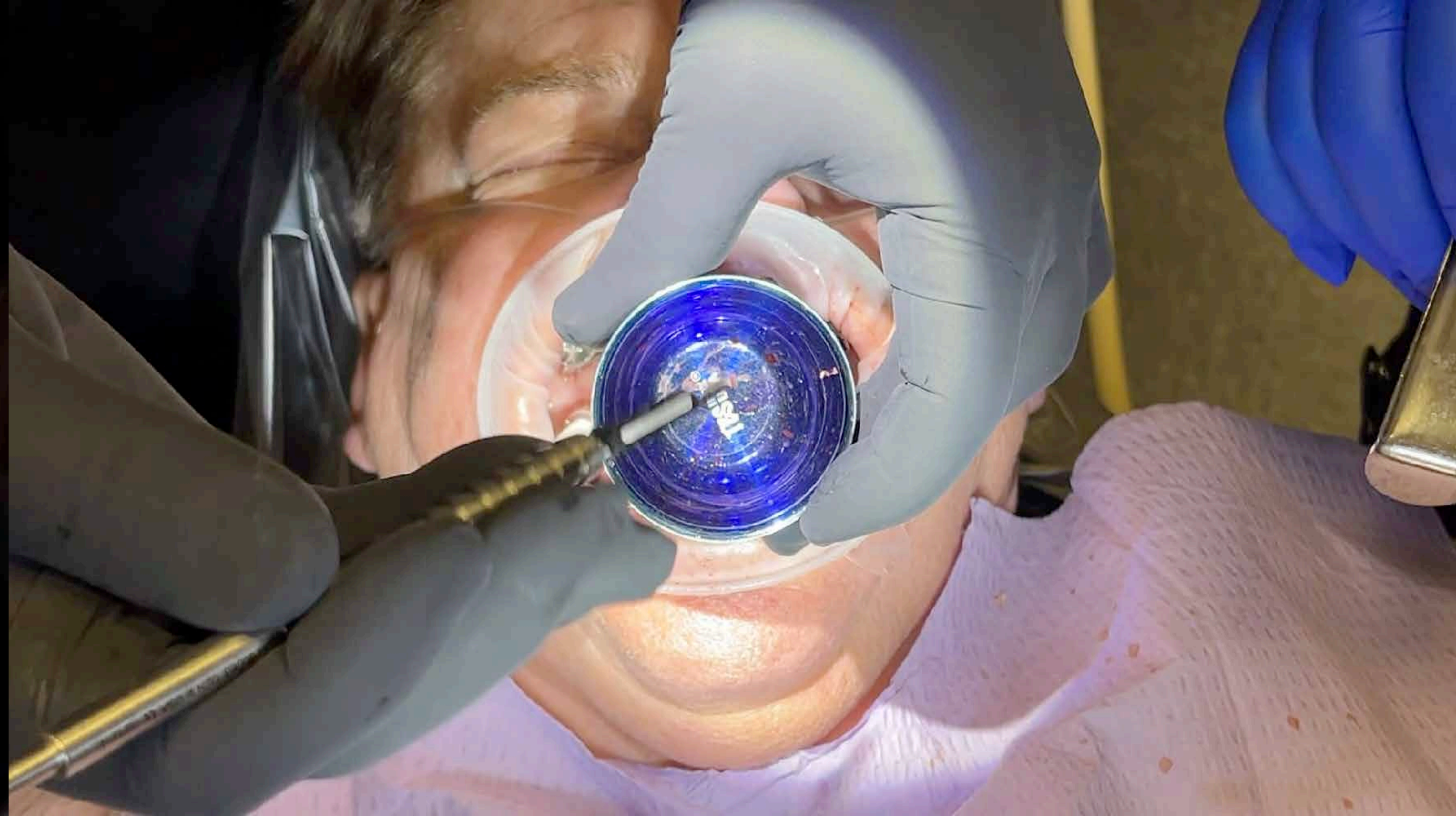


PET

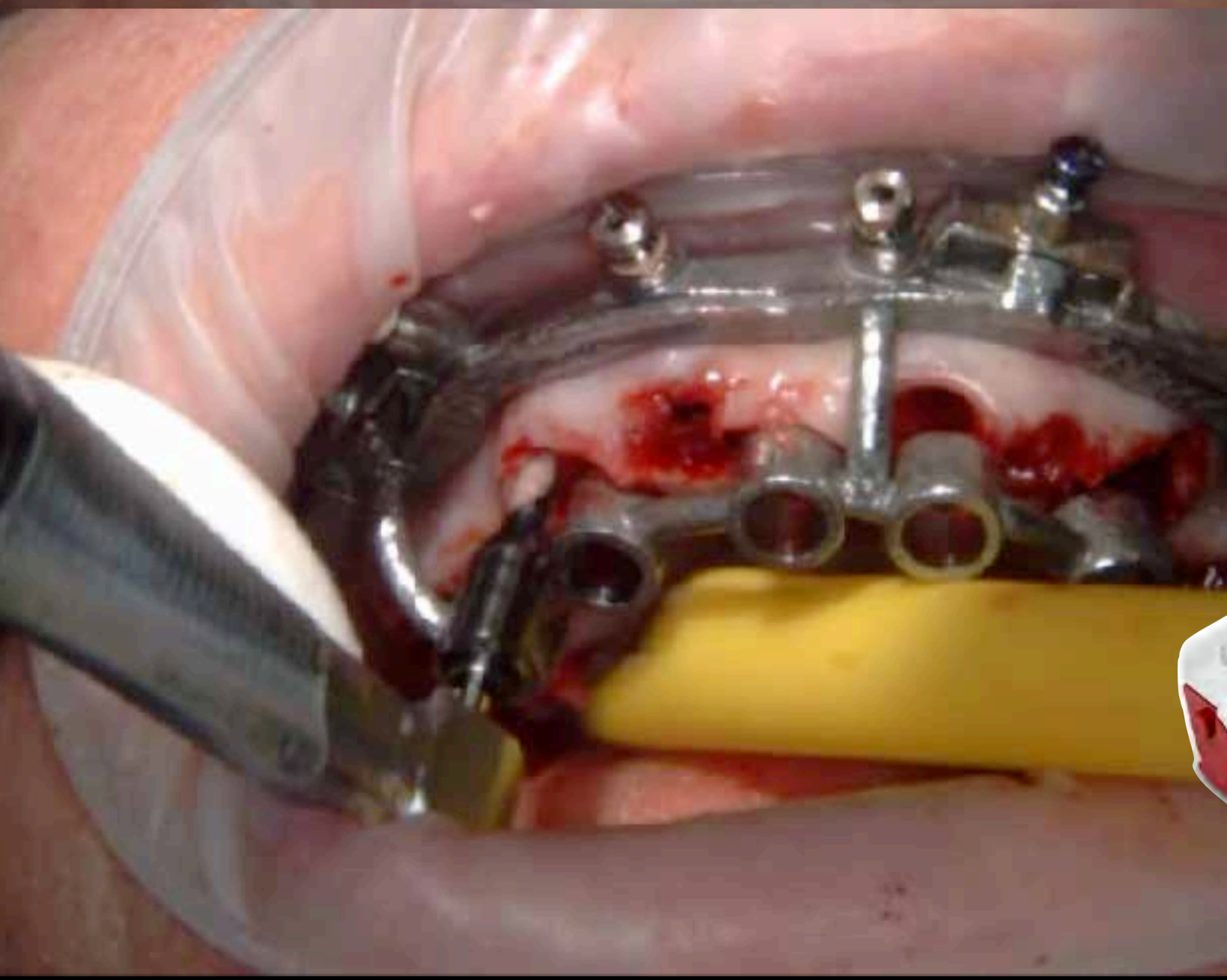
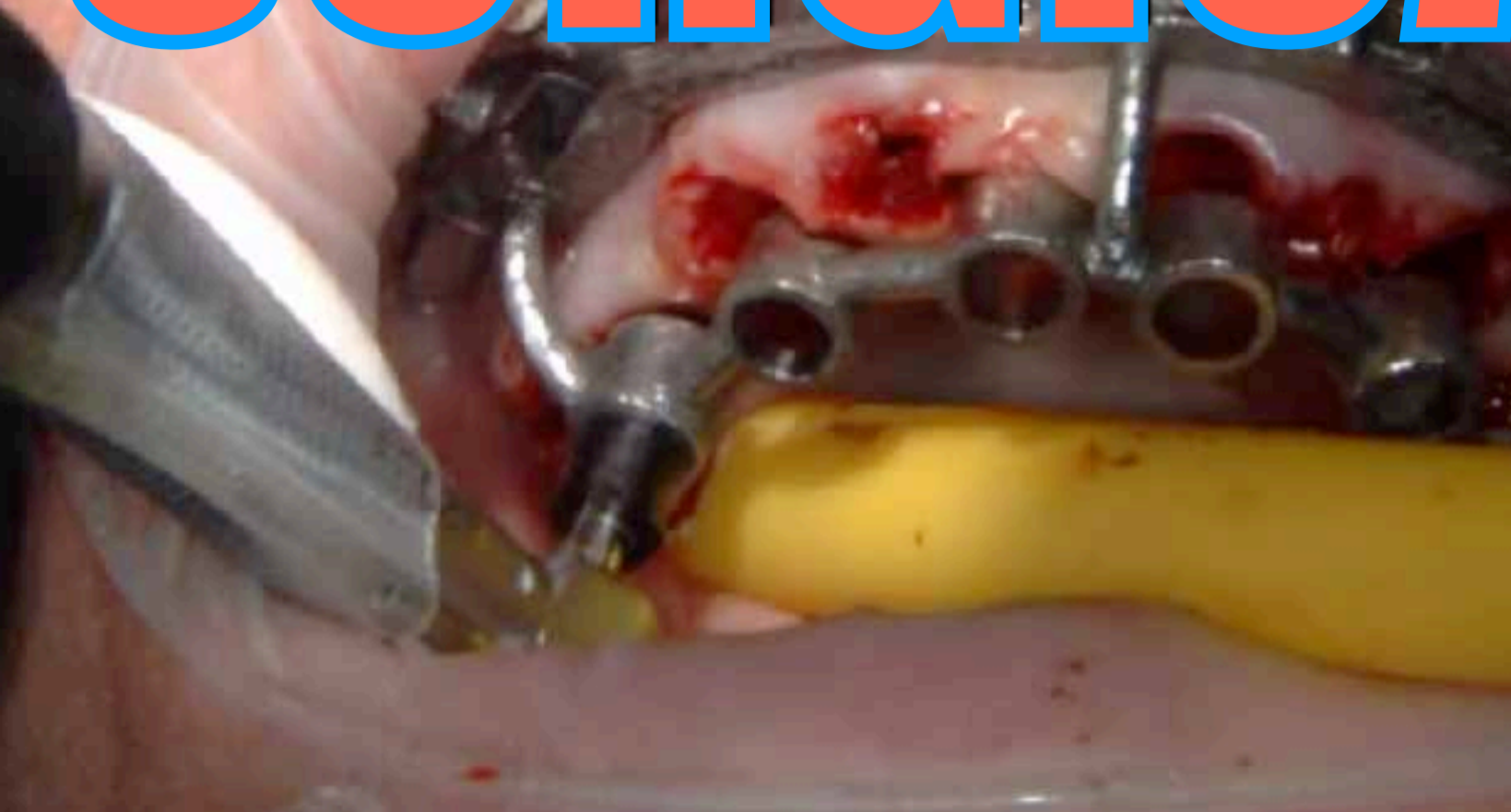
PET



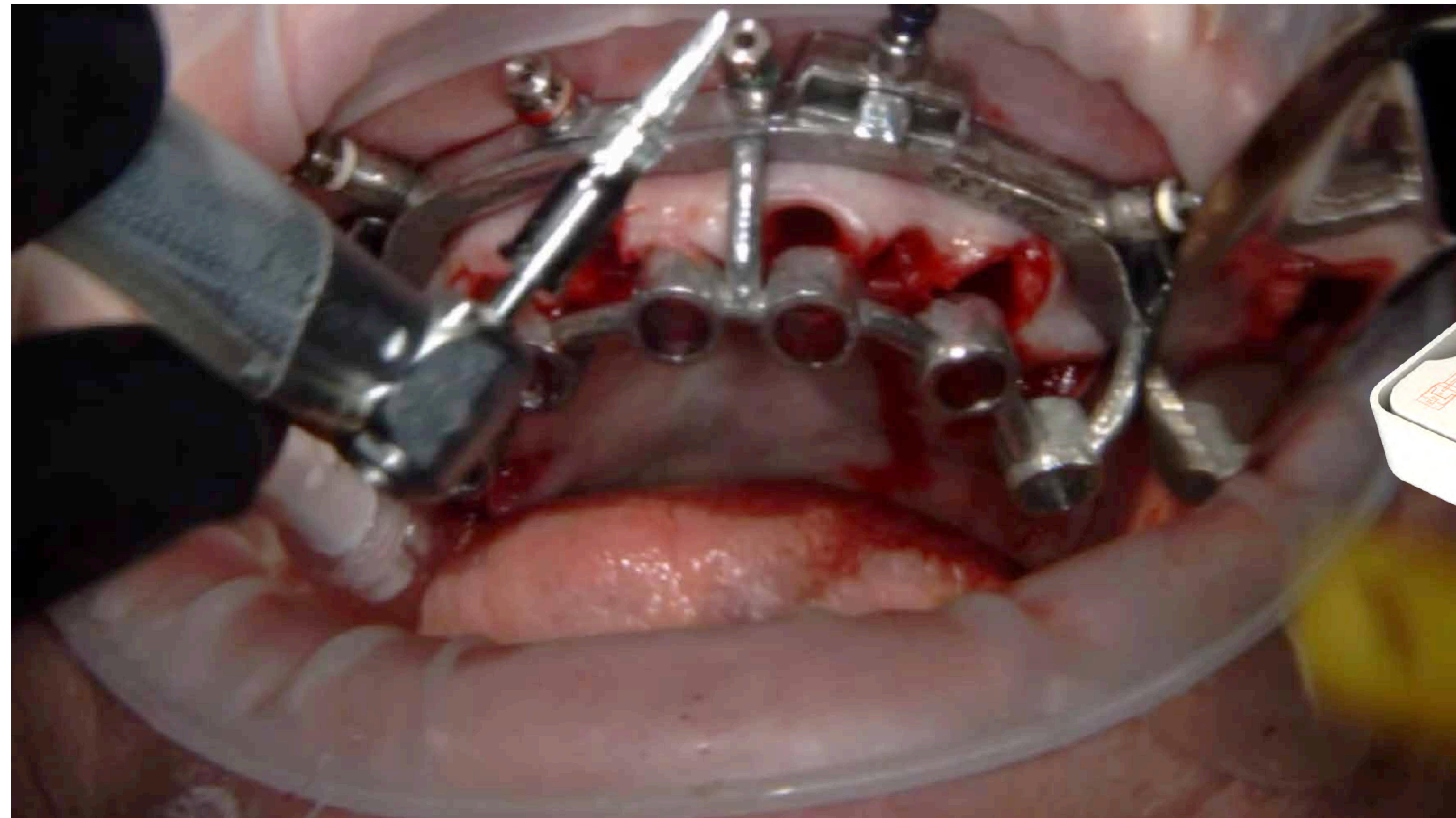
TAWIL



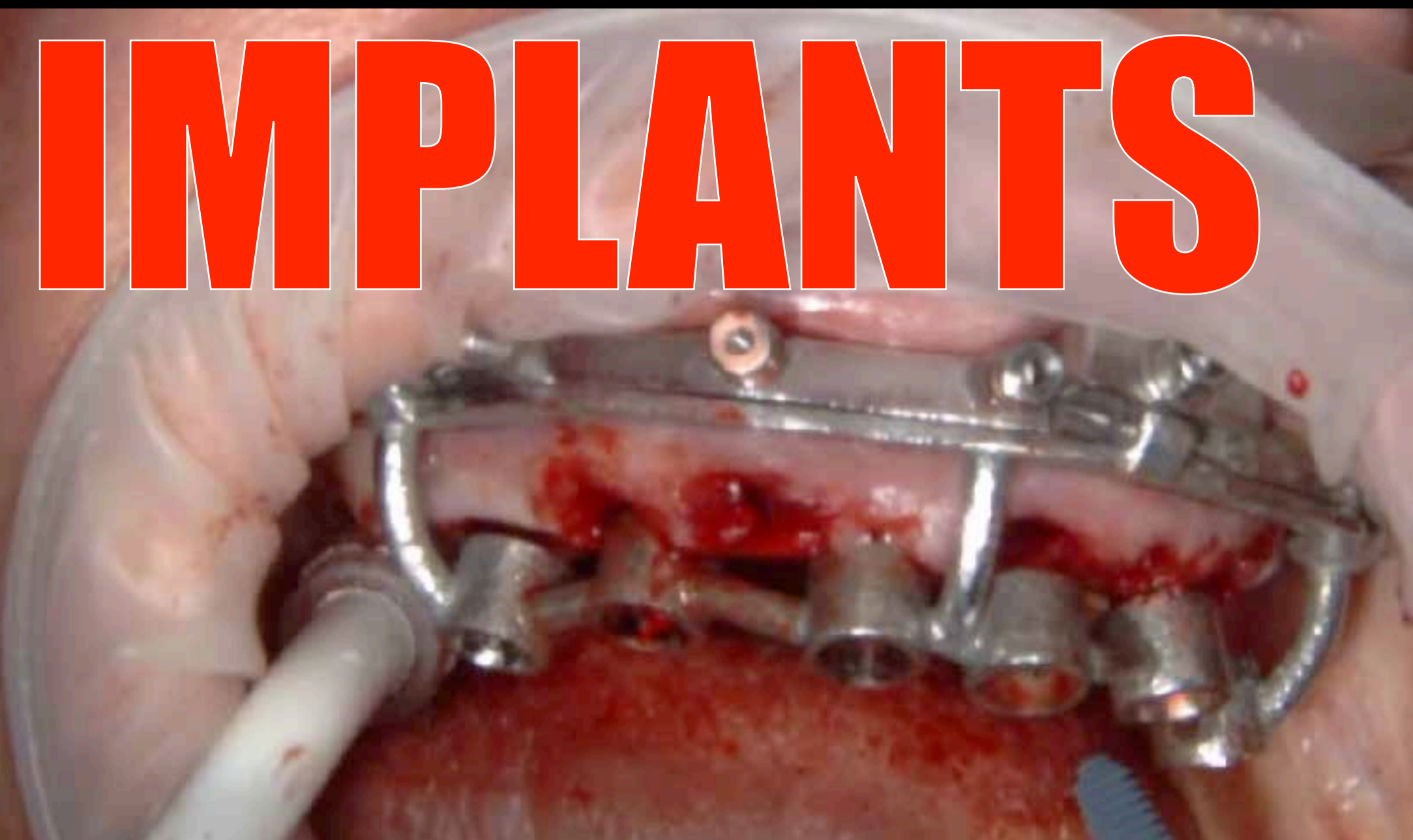
SURGICAL GUIDANCE



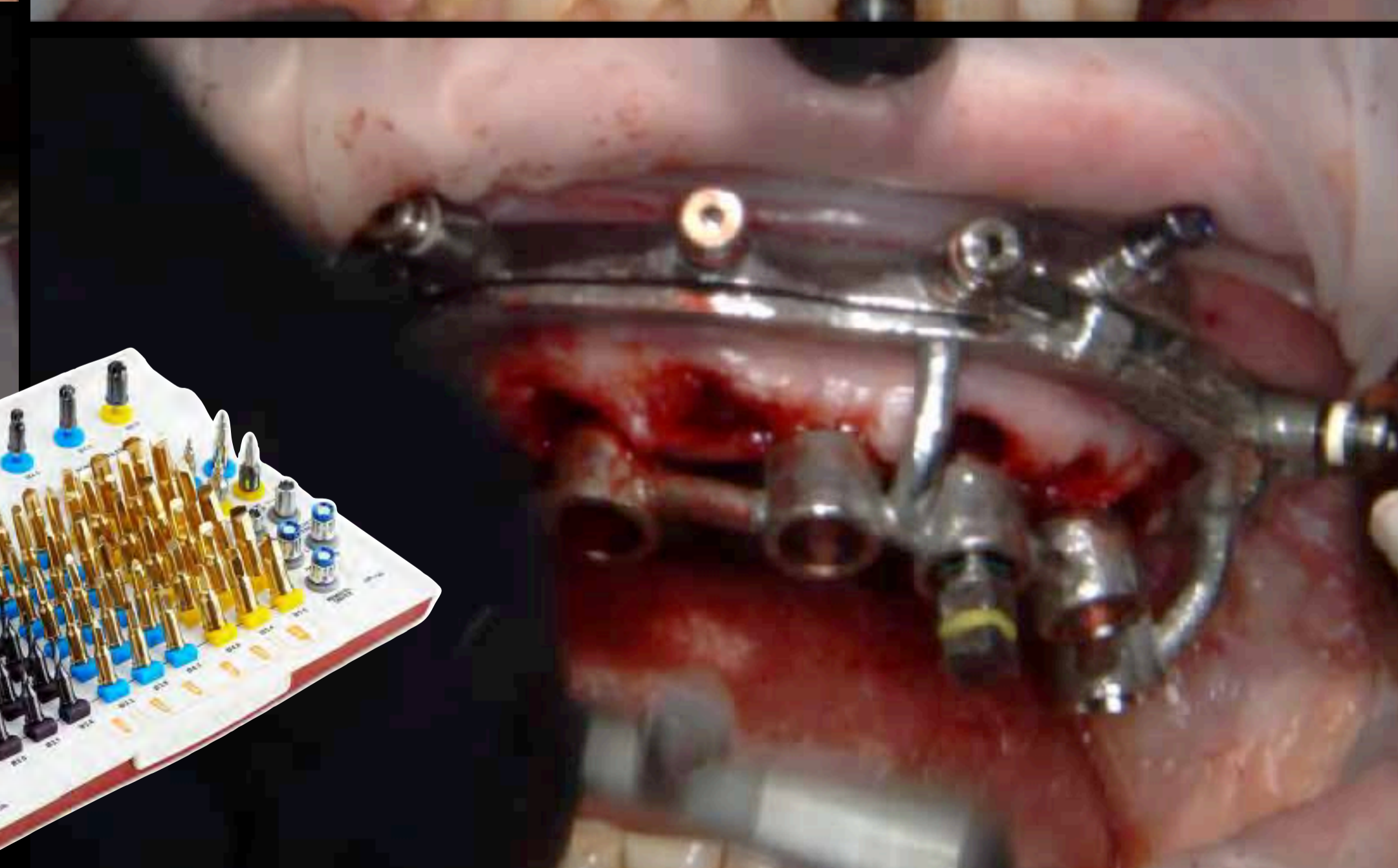
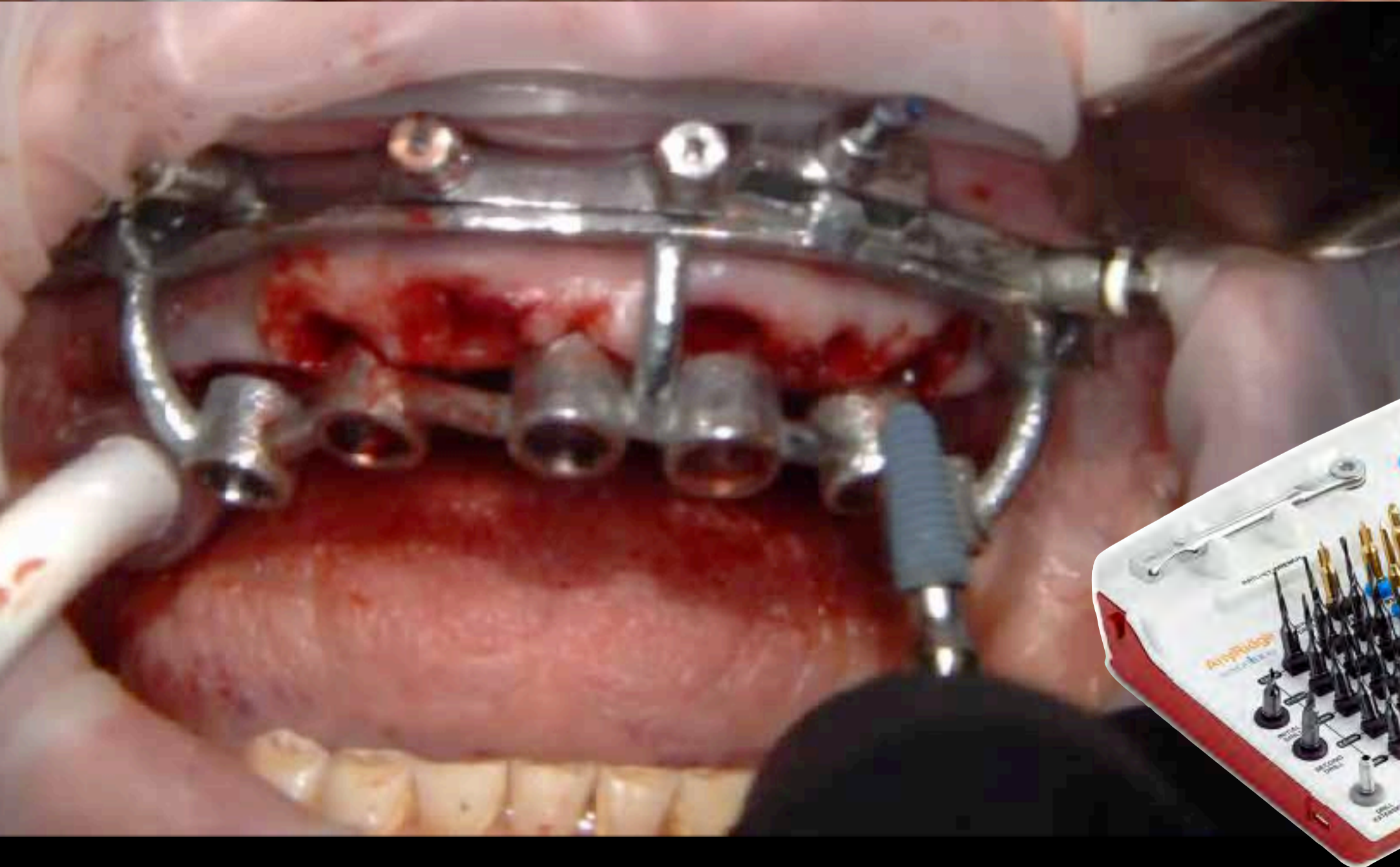
ANYRIDGE[®]
by MEGA'GEN



IMPLANTS

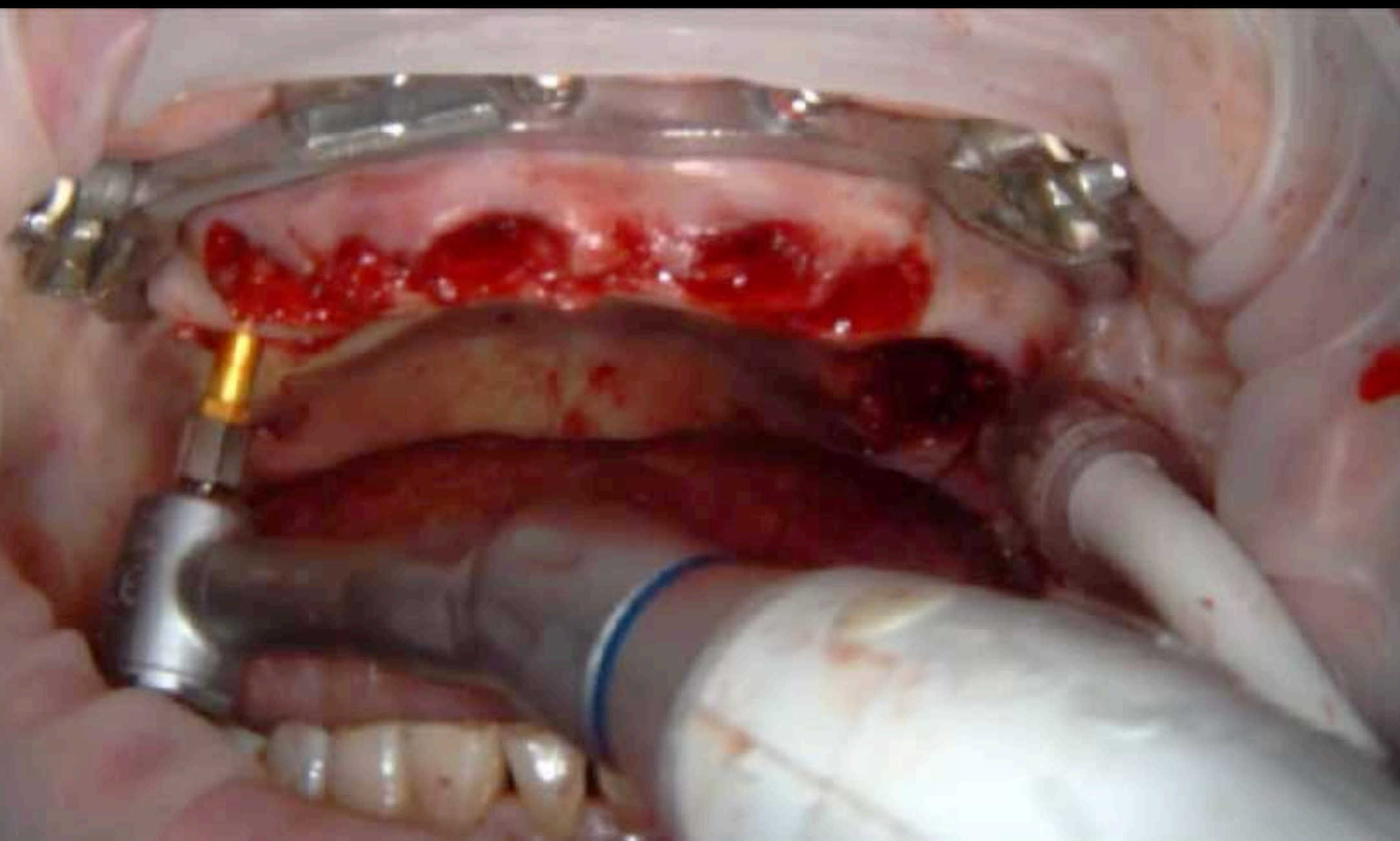


PLASMA-X

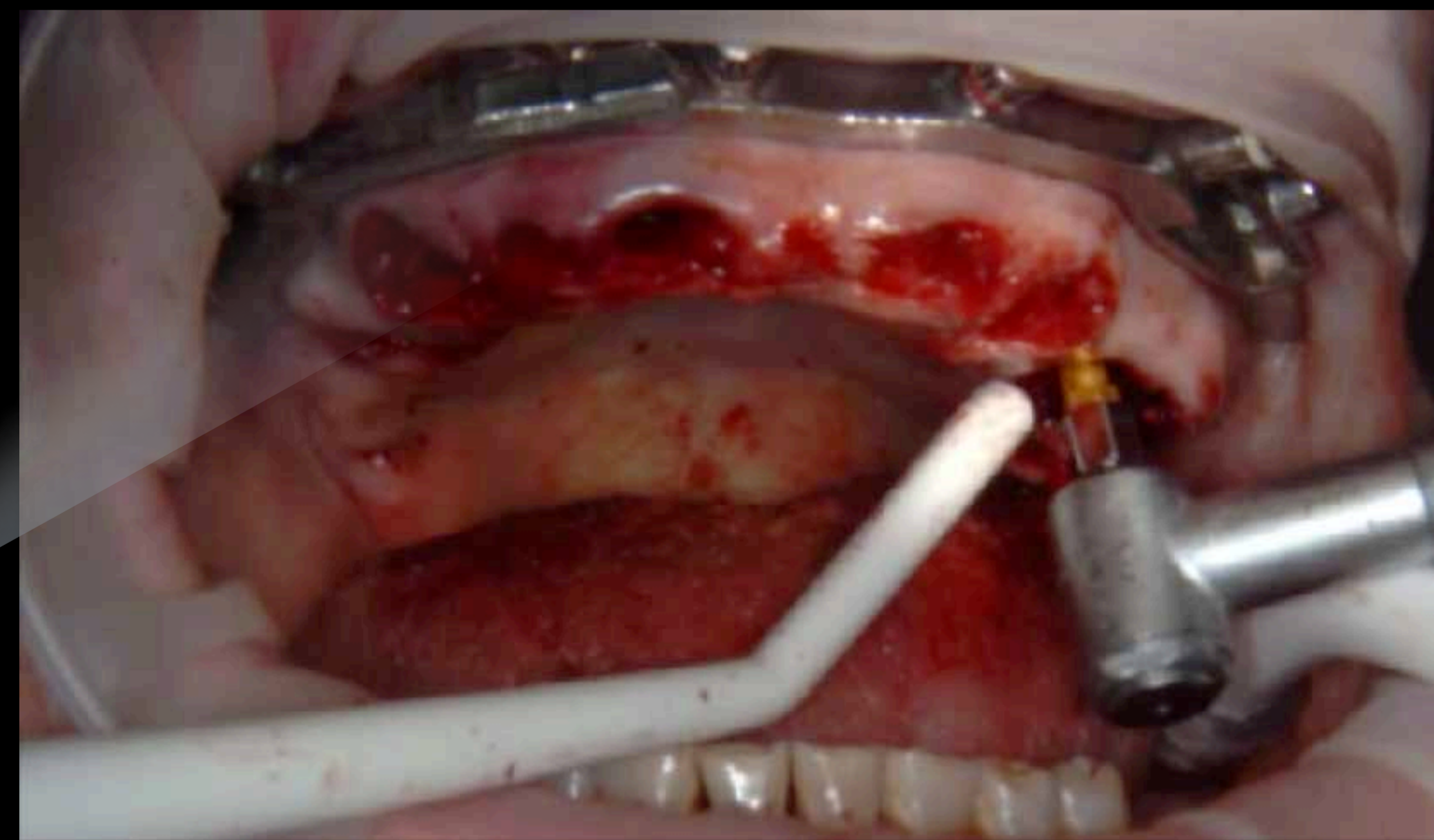
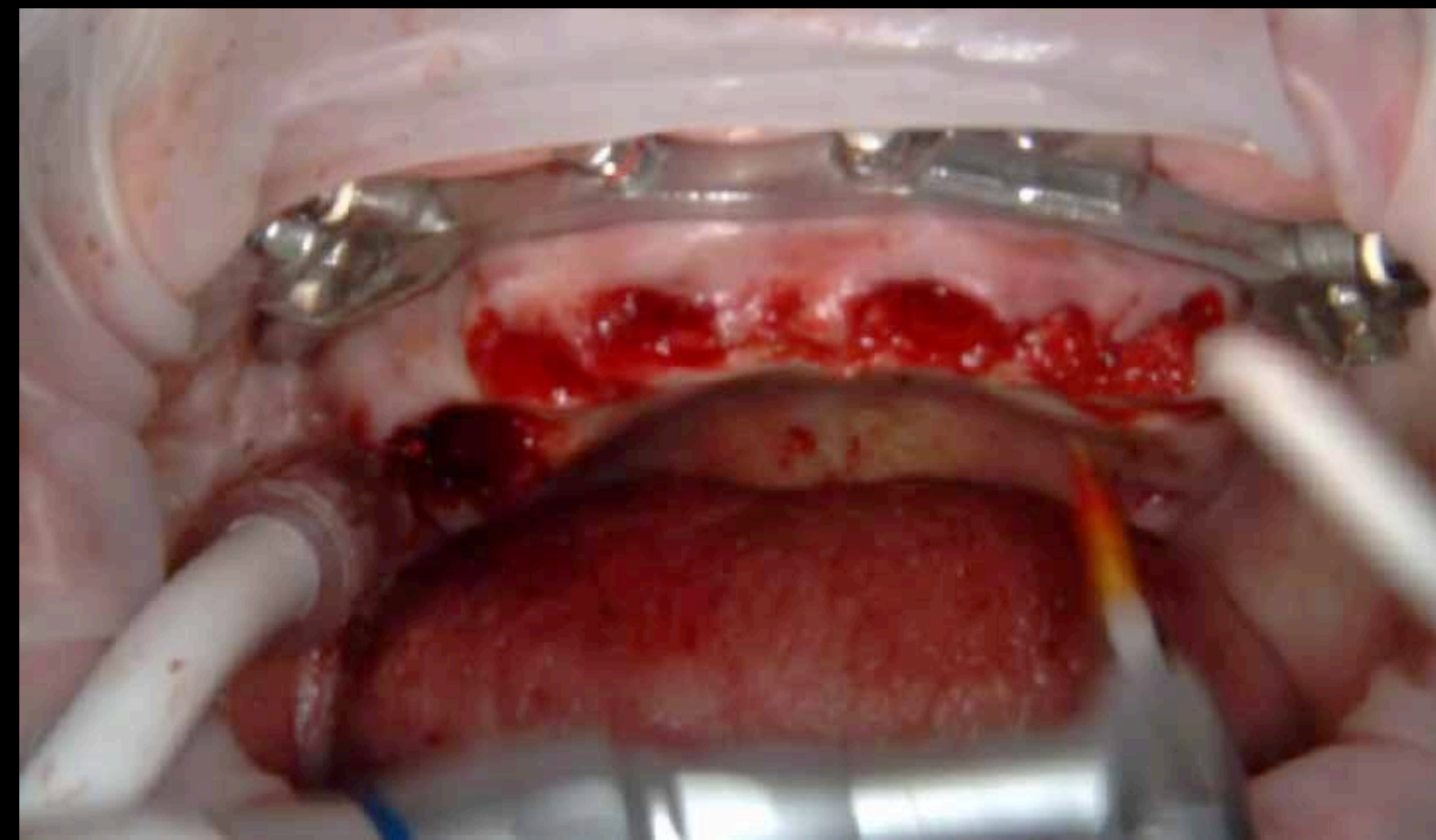
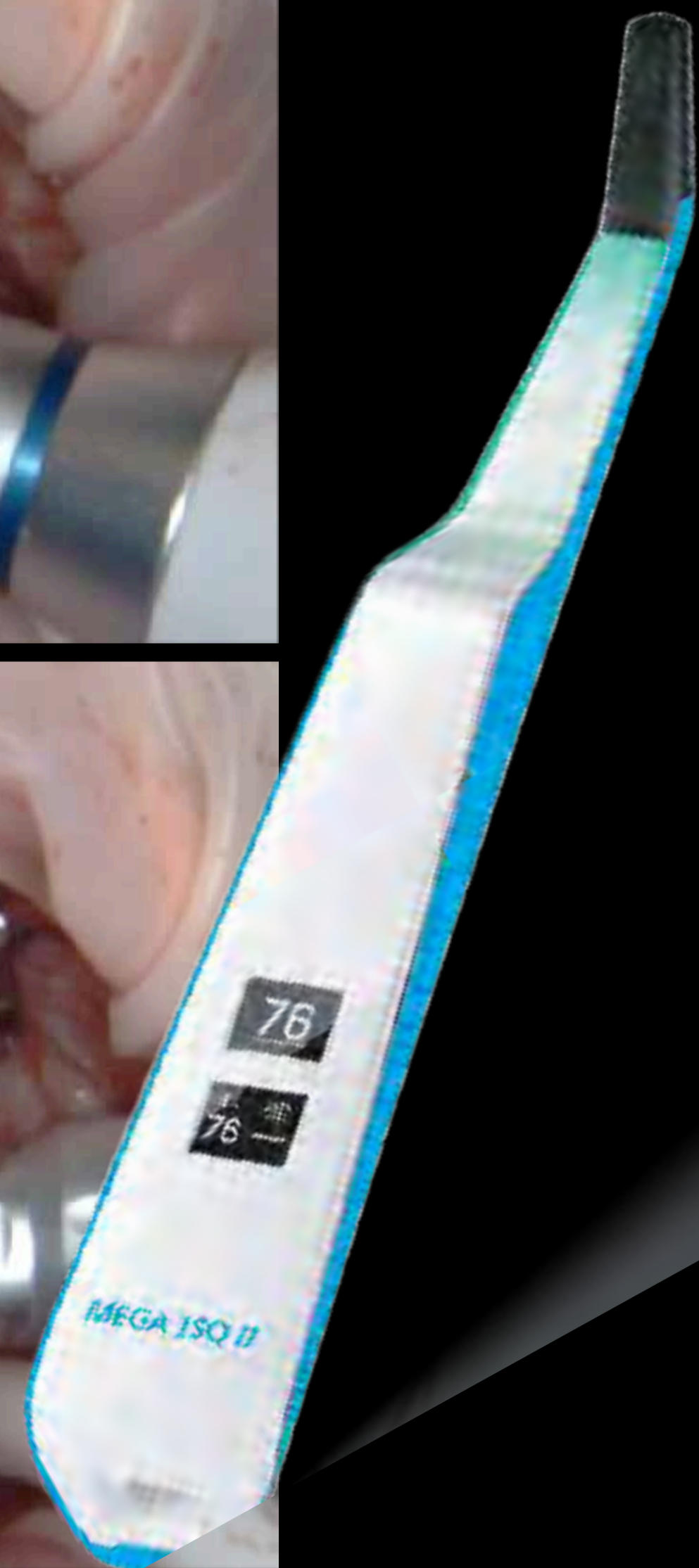
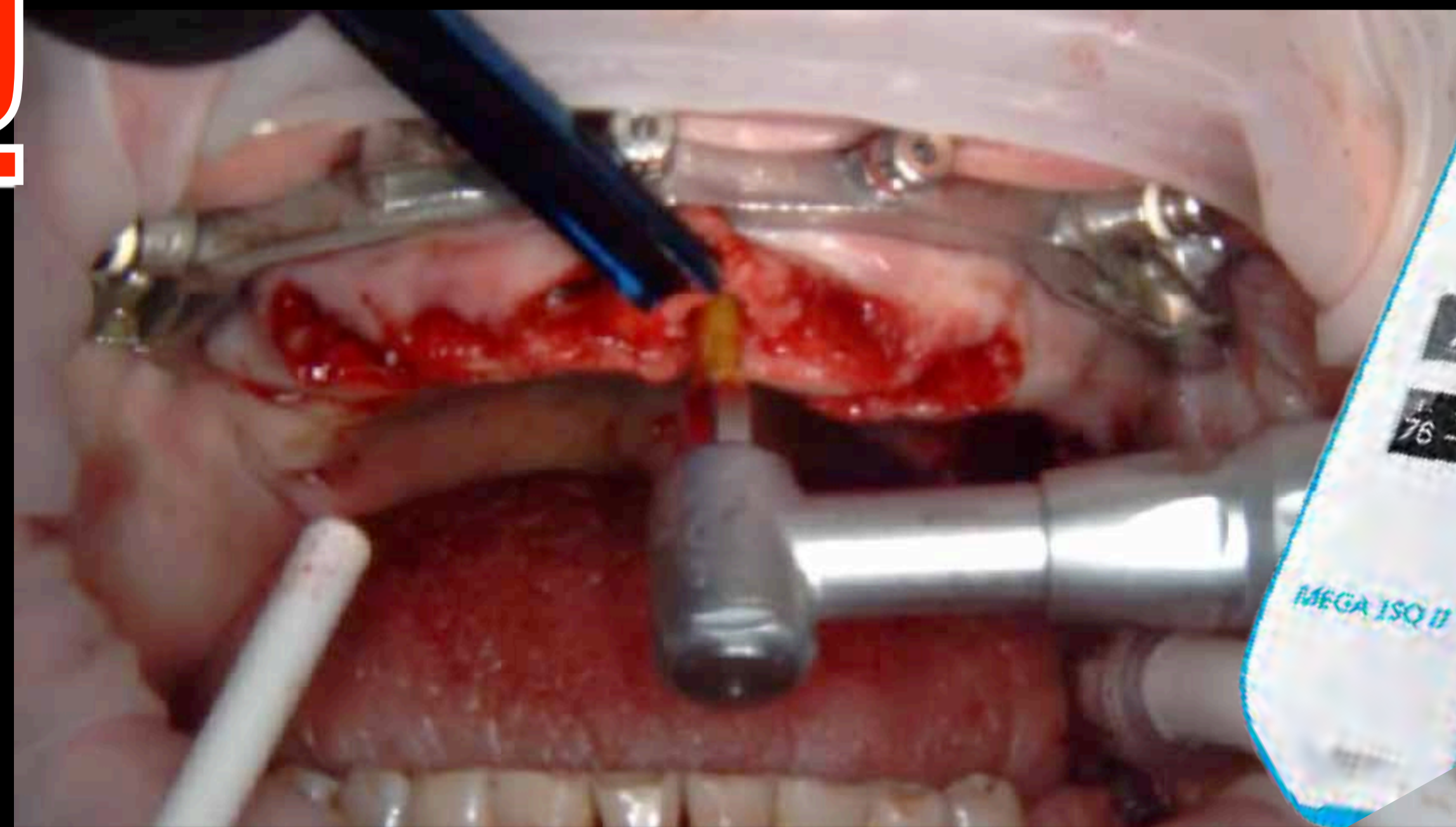
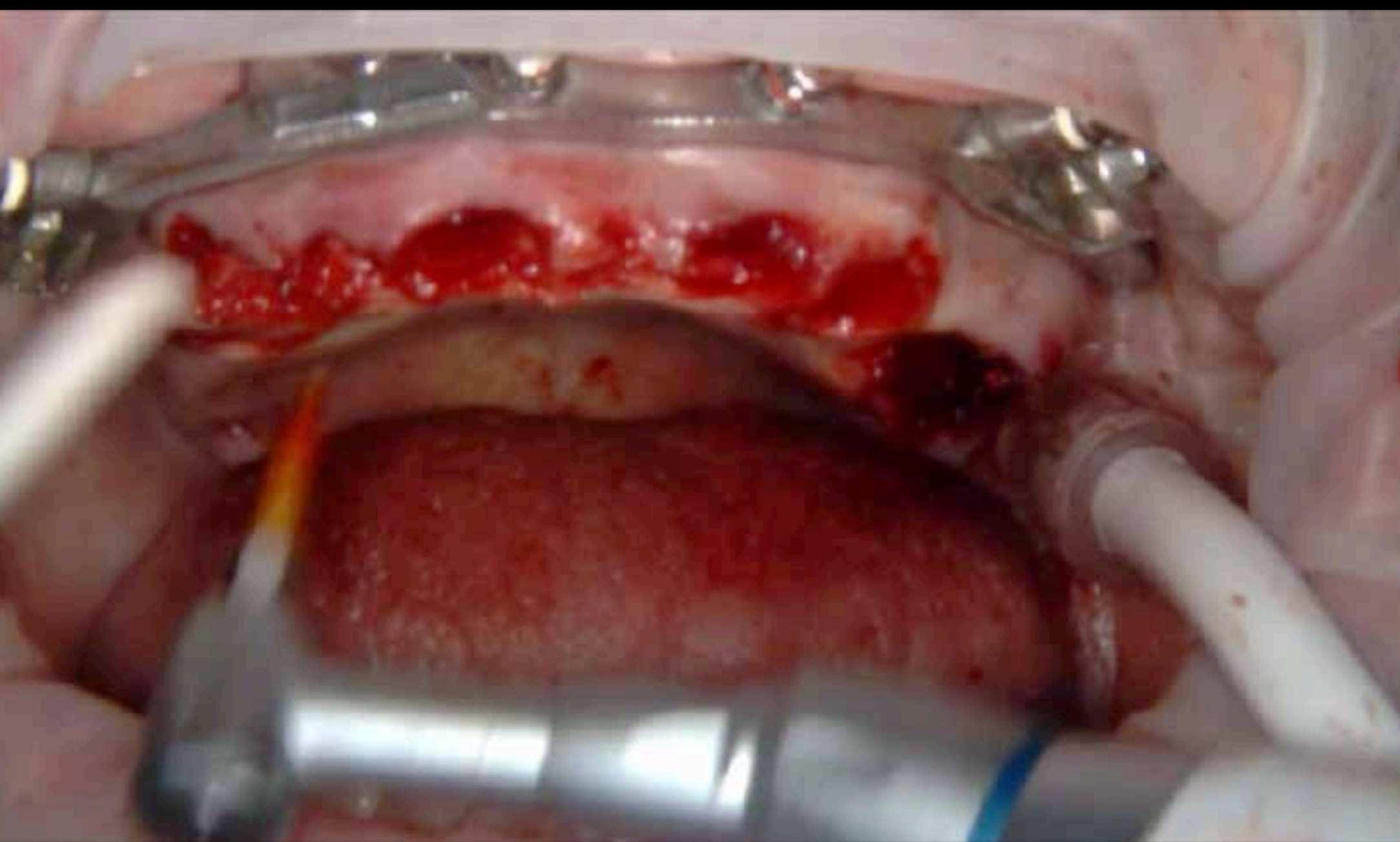
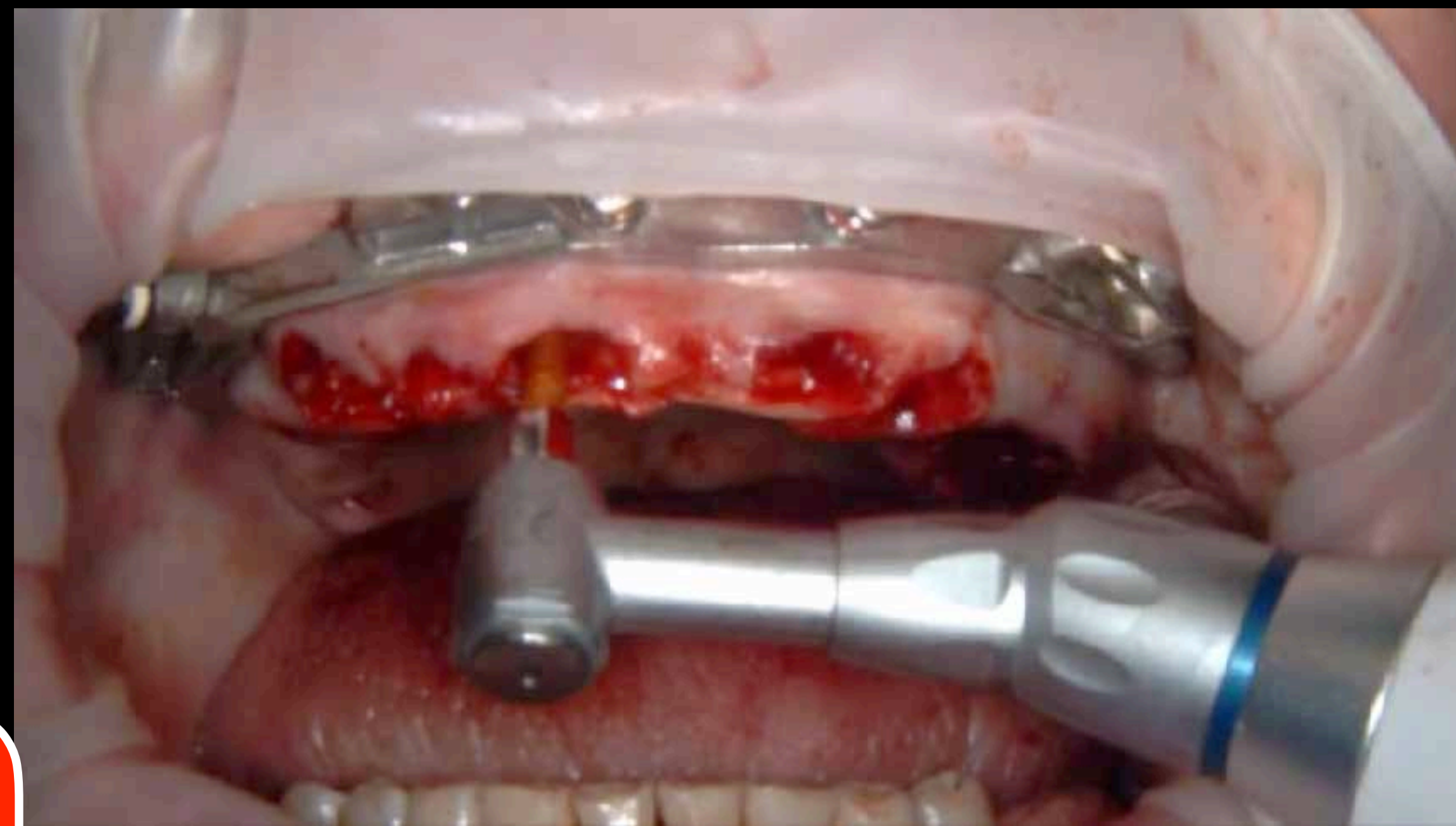


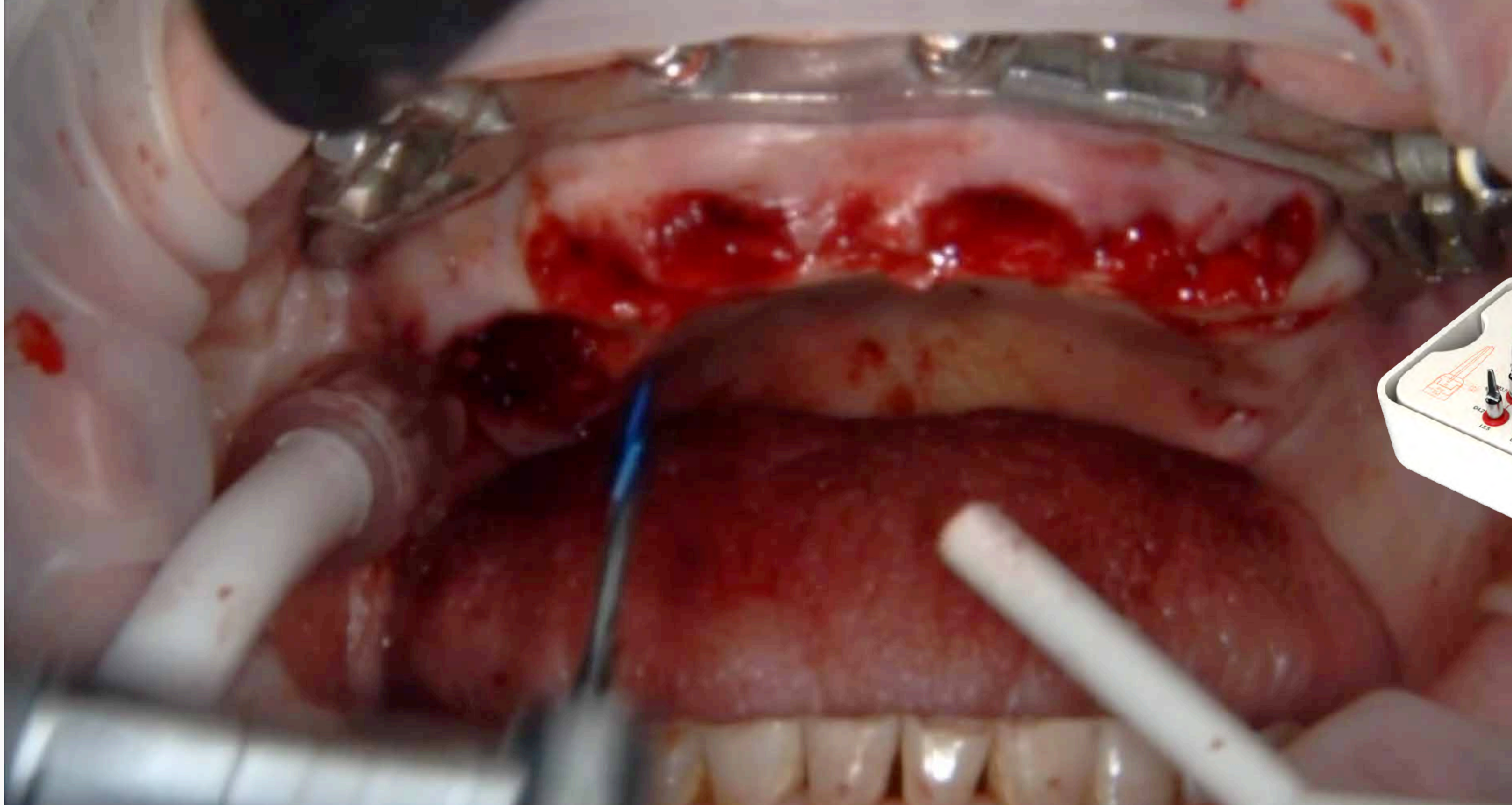
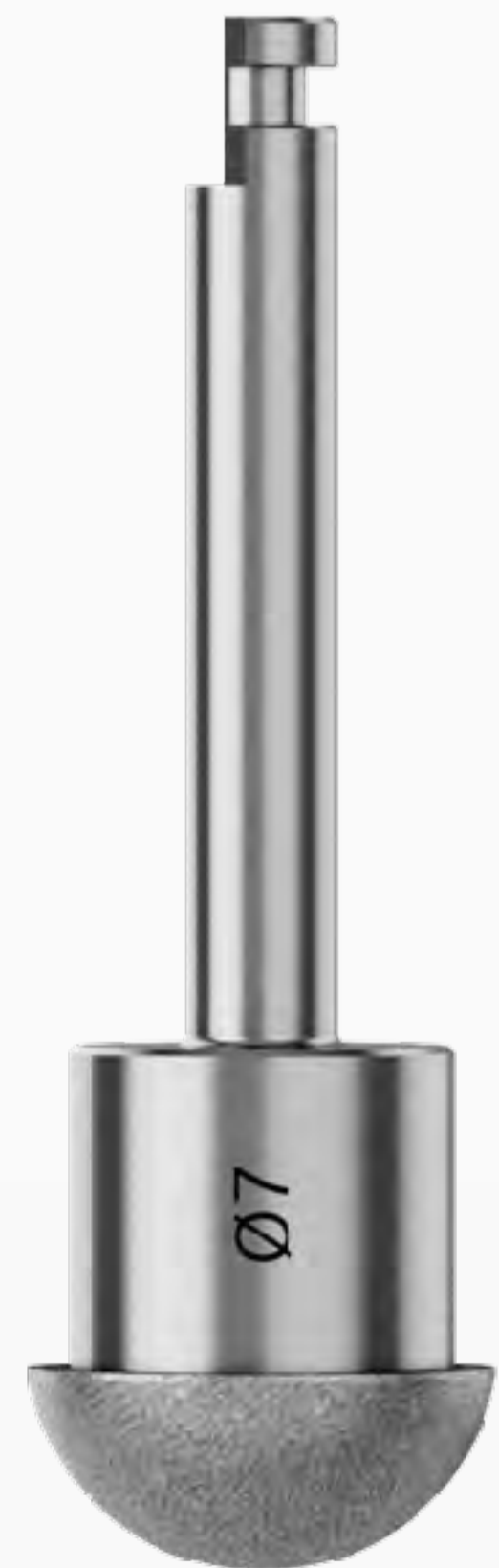
ANYRIDGE[®]

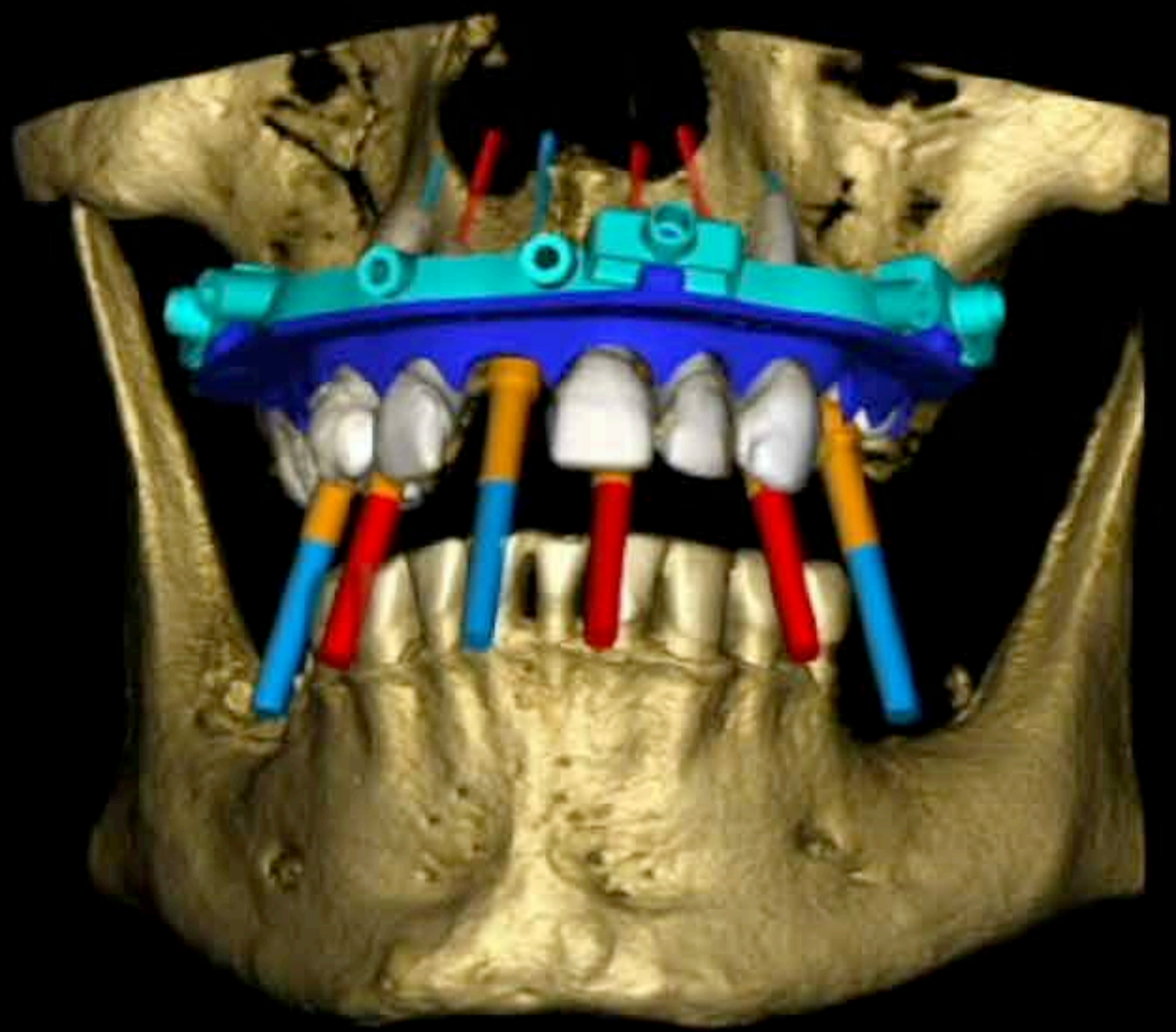
by MEGA'GEN



ISQ



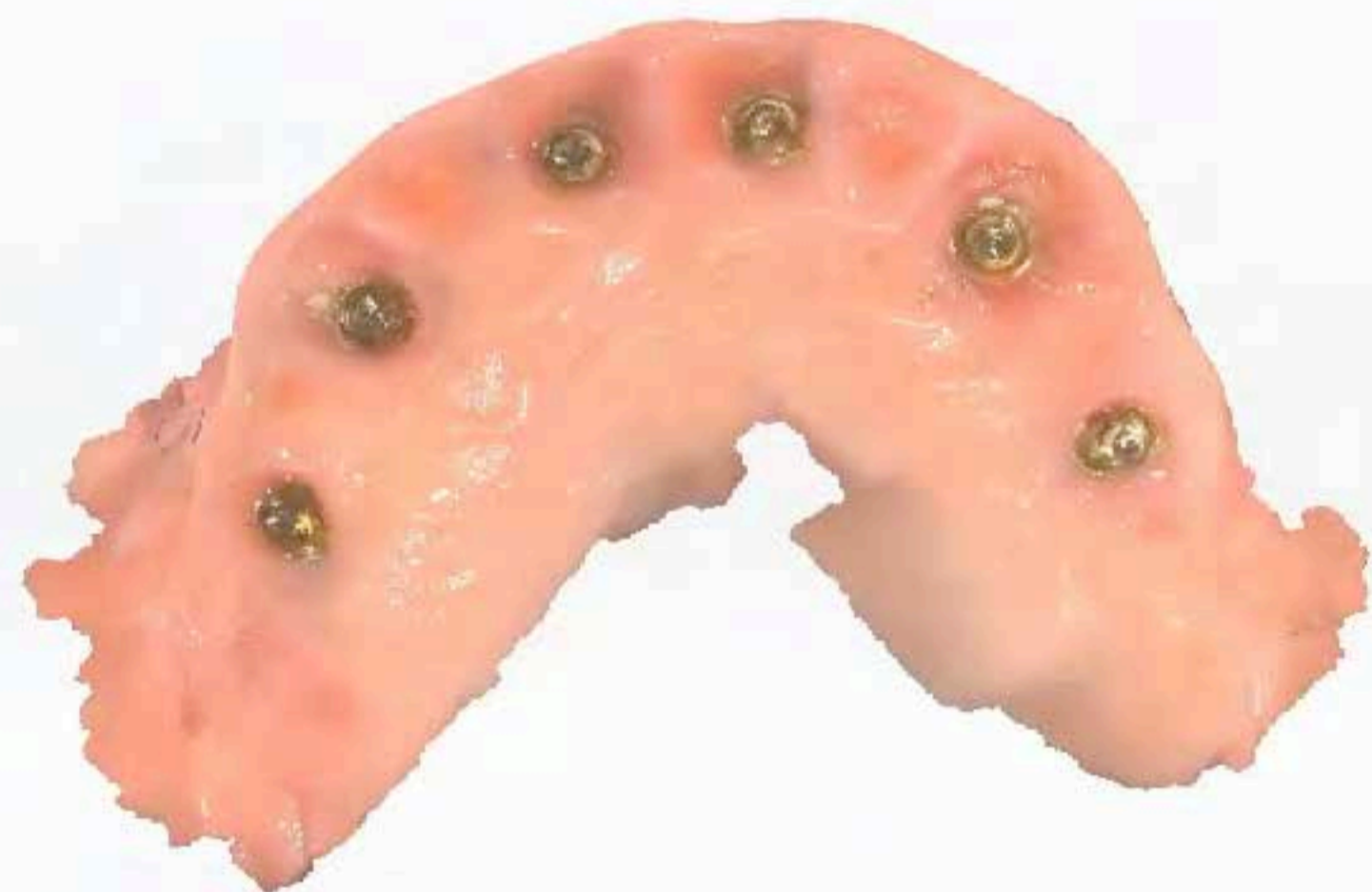






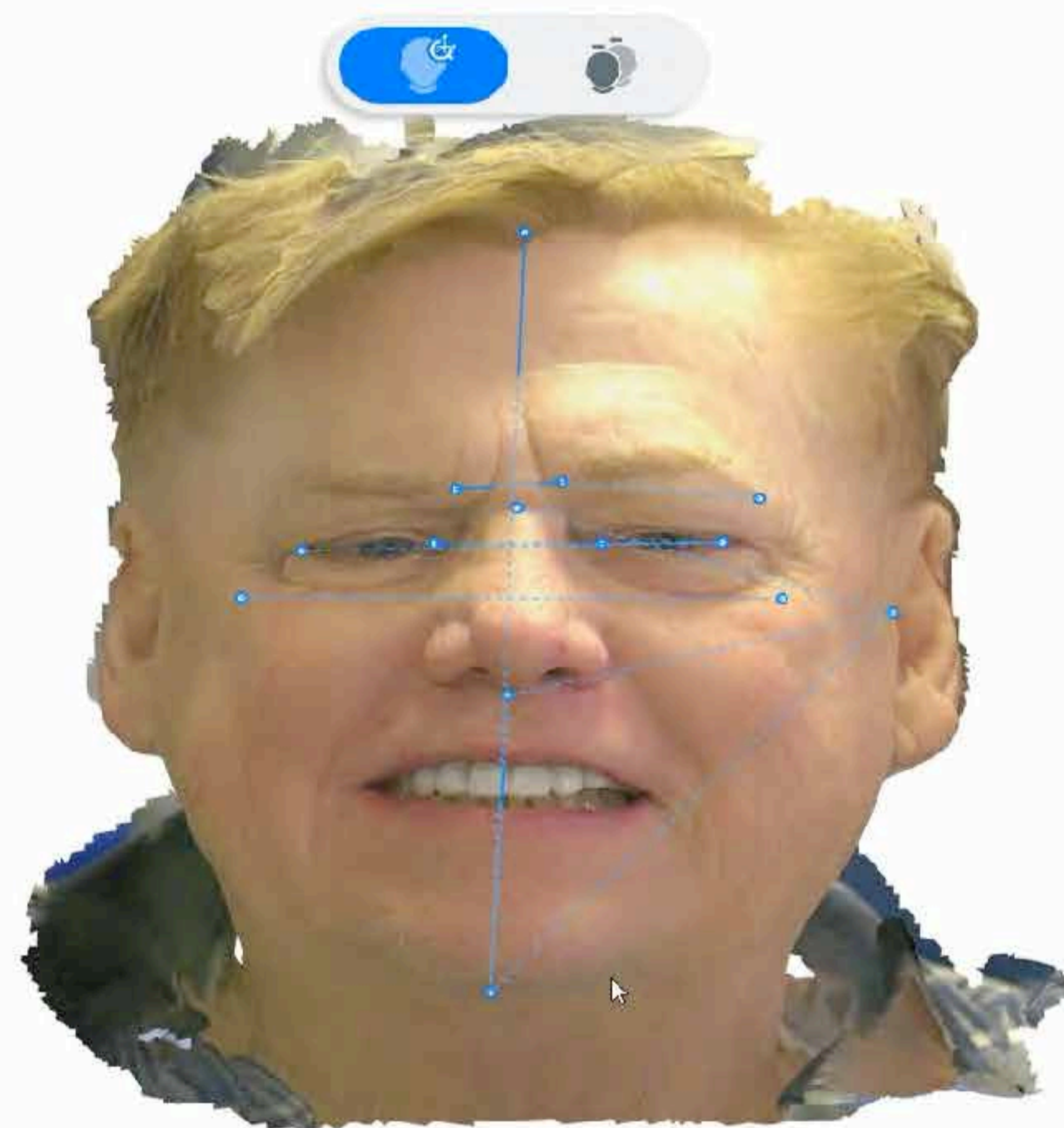
**How can we repair
Quickly & Accurately?**

TISSUE



Golden ratio

Measurement point	Marking points	Measurements (mm)	Reference (mm)
Upper facial ...	Tr-M-M	53.56 ↑	53.64±4.9
Middle facial...	Sn-M-M	52.59 ↓	70.81±3.55
Total facial h...	Tr-Me	186.92	187.05±8.2
Lower facial ...	Sn-Me	71.23 ↑	62.60±4.27
Space betwe...	M-M	23.39	-
Bizygomatic ...	Zy-Zy	119.35 ↓	136.9±0
Horizontal le...	M-M'	42.02	-
intercanthal ...	En-En	36.79	36.29±3.1
Biocular width	Ec-Ec	92.82 ↑	88.81±4
Horizontal le...	En-Ec	26.29	26.26±1.5

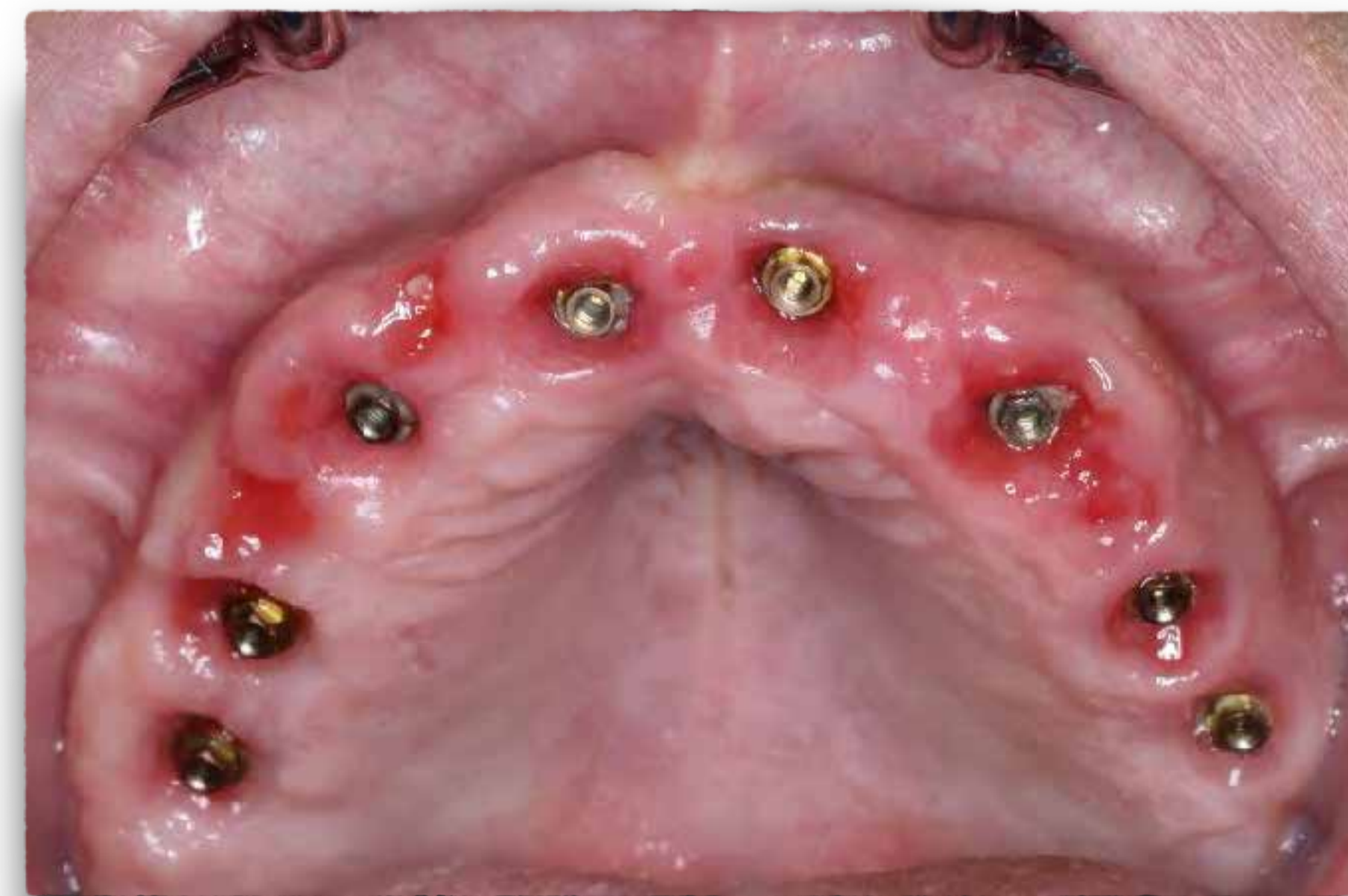
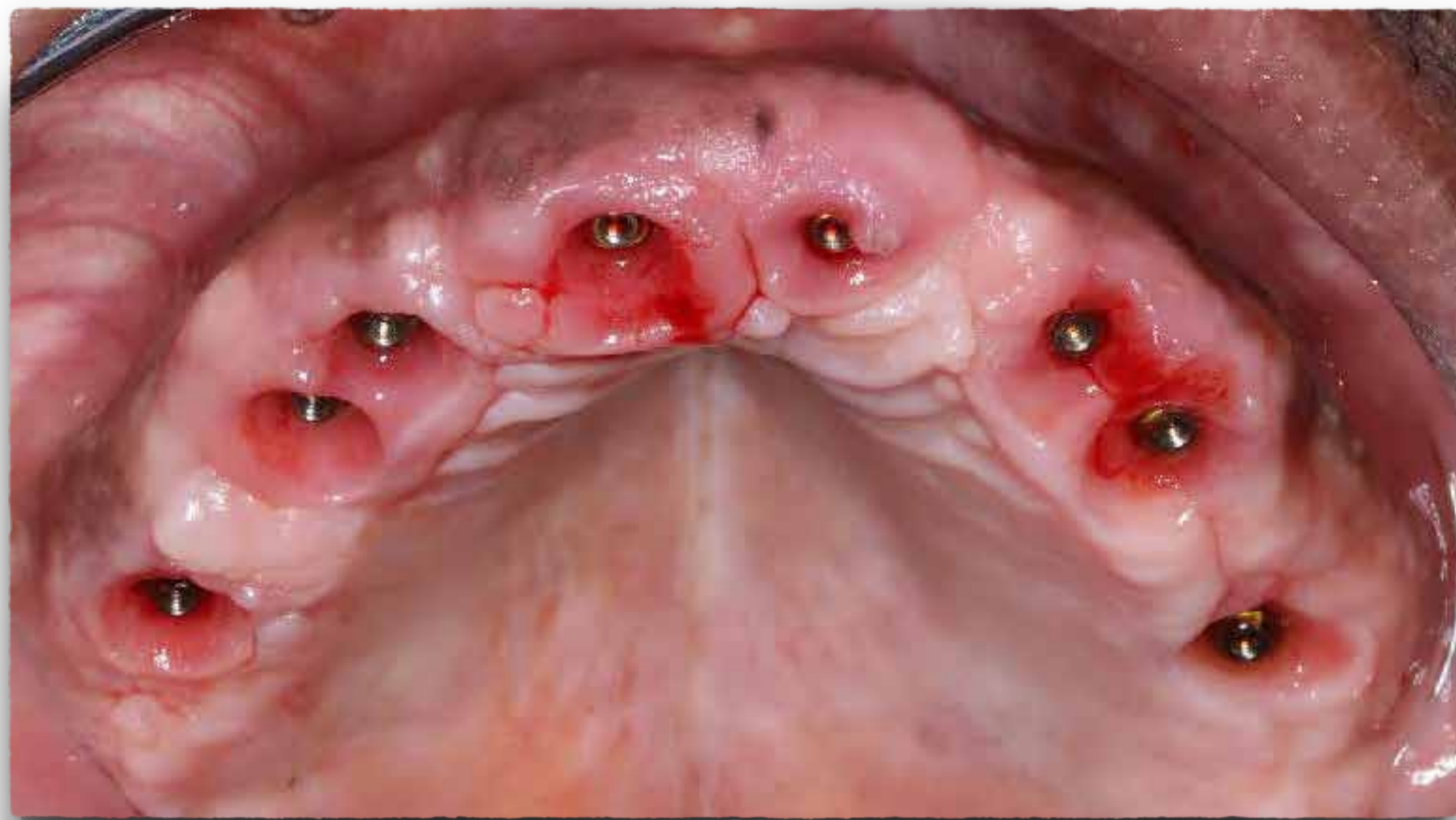


MEASUREMENTS

FACIAL SCAN



How do we capture/finish?
Full arch implants?



2023

Research

UNSTABLE SCAN PATHS

may show varying results *in vivo*. A completed scan does not necessarily equate to an accurate scan.



In vivo trueness and precision of full-arch implant scans using intraoral scanners with three different acquisition protocols

Robert Nedelcu¹, Pontus Olsson^{1,2}, Måns Thulin¹, Ingela Nyström¹, Andreas Thun³

¹Department of Maxillofacial Prosthetics, Faculty of Oral and Maxillofacial Surgery, Uppsala University, 751 85 Uppsala, Sweden
²Department of Information Technology, Centre for Data Analytics, Uppsala University, Box 218, 751 21 Uppsala, Sweden
³School of Medicine and Health Science for Rehabilitation Science, University of Gävle, Jönköping University, 801 82 Gävle, Sweden
⁴Faculty of Health Sciences, University of Western Australia, Perth, WA 6000, Australia

ABSTRACT

Objective: To evaluate an *in vivo* reference acquisition method for implant positions on complete edentulous maxillae using an intraoral scanner and following it by *in vivo* trueness analysis of the reference workflow. To assess the trueness and precision of intraoral scanners (IOS) using different acquisition protocols, further more, to compare IOS trueness with impression-based models and implant-supported fixed dentures (ISF) in a parallel study on the same cohort using the same *in vivo* reference scan.
Methods: Six scan-protocols measured in two different acquisition in two different reference scanners (IOS) using an indirect method. Subjects were scanned with IOS three times using three different paths (A, B, and C), normal face, sagittal (DF), and axillary (AF). IOS, CAD files of scan bodies with three aligned analogues were geometricaly aligned to the ISF and SP. Scandocubes were aligned to ISF and ISF in proprietary dental laboratory software and exported with analogue positions. Resulting six CAD-models per scan were Globally Aligned using a consistent geometry-based alignment. Deviations were computed after a Reference Point System Alignment in the implant/position platform for Cartesian axes with a linear threshold.
Results: Residual trueness was CT: 41.11 µm, DF: 49.22 µm, SF: 55.8 µm. Residual precision was CT: 46.27 µm, DF: 50.7 µm, SF: 42.5 µm.
Conclusions: This method is applicable for assessing *in vivo* of maxillary full-arch implant scan *in vivo*. The CT protocol was most accurate. CT trueness showed no difference to digitized impression based models in parallel study. CT was more accurate than ISF in a parallel study. CT displayed similar numerical variance as existing *in vivo* studies.
Clinical application: Using IOS to acquire full-arch implant scans is controversial. In modified protocol in this study three promising results in the maxilla where great care was taken to arrange scan-protocol trueness after a modified scanning system was used. However, silver IOS may show varying results *in vivo*. A completed scan does not necessarily equate to an accurate scan.

1. Introduction

To produce an implant fixed denture (IFD) by Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM), the intermediate position in the three-dimensional (3D) space requires a digitalization process. The conventional method for nearly six decades has been an indirect digitization of models deriving from conventional impressions.
Methods for direct *in vivo* digitization are available through stereo-photogrammetry (SPM) and intraoral scanners (IOS). Evaluation of SPM has shown promising results as a mode of acquisition primarily in complete edentulous cases [1, 2]. However, the SPM method lacks the ability of acquiring data of soft tissues.
Scanning full arches with IOS to manufacture IFDs is a clinical controversy as there is conflicting *in vivo* evidence regarding the use of IOS for complete fixed restorations [3, 4]. Although manufacturers of implants and frameworks for IFDs do not recommend this type of acquisition based on limited clinical evidence, the dental industry is aware of the occurrence.

* Corresponding author: Dr. Edlinweghka Kluitens, Akademiska sjukhuset 751 85 Uppsala, Sweden
E-mail address: edlinweghka.kluitens@med.uu.se (E. Kluitens).

Received 29 September 2021; Received in revised form 28 August 2022; Accepted 22 September 2022
Available online 5 December 2022
1360-3070/© 2022 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Original article
Full arch digital scanning systems performances for implant-supported fixed dental prostheses: a comparative study of 8 intraoral scanners
Adalfo Di Fazio^a, Roberto Meneghelli^b, Lorenza Graiff^c, Giancarlo Savio^d



Evaluation of complete-arch implant scanning with 5 different intraoral scanners in terms of trueness and operator experience

Giffin Revell^a, Roland Simon^b, DMD^c, Anthony Merrill^b, DMD^d, Zachary F. Evans^b, DMD, PhD^e, Walter Hertz^b, DMD, PhD^f, Mark Ludlow^b, DMD, MS^g and János Vög^b, DMD, PhD^h

Abstract
The trueness of intraoral scanners for complete-arch implant scanning has been investigated with a wide range of objectives. The purpose of this *in vivo* study was to compare the trueness of a selected scanner in capturing complete arch bodies and soft tissues in an edentulous mouth and to investigate the effects of operator experience.
Methods and results: The maxilla was scanned twice: a fresh volume, 5 intraoral scans and a reference scan made. Eight scans were made by experienced operators and 8 by an

Research article
BMC Oral Health

Trueness of 12 intraoral scanners in the full-arch implant impression: a comparative *in vitro* study

Giuseppe Carrà, Margherita Di Gregorio, Roberto Meneghelli, Annalisa Zambelli, Riccardo Di Fazio, and Carlo Mangano

Background: The literature has not yet validated the use of intraoral scanners (IOS) for full-arch (FA) implant impression. Hence, the aim of this *in vitro* study was to assess and compare the trueness of 12 different IOS in FA implant preparation.
Methods: A simulated model of a partially edentulous maxilla with 12 implant analogues and a stainless steel wax scan bed with a custom scanner (Friedman Ltd) to capture a reference model (RM) and with 11 IOS (ITERO CLIMAX DMS 2P, TRIUMPH and OHM CAM[®] C2 300P and C2 300P, TRIUMPH 500P, ORALDIP 5P and ORALDIP VERTU VANO[®] and DWIP, TRUESDIP, QJOSCAM[®]). Ten scans were taken using each IOS, and each was compared to the RM, to evaluate trueness. A mesh/mesh method and a mesh/skull method were used to evaluate the overall trueness of the scans. Inter- and cross-distances between the files were used to evaluate the local trueness of the scans. The analysis was performed using reverse engineering software (SolidWorks, Geomagic, Magi[®], Materialise). A statistical evaluation was performed.
Results: With the mesh/mesh method, the best results were obtained by QJOS (mean error: 30.4 µm) followed by ITERO CLIMAX DMS 2P (41.1 µm), OHM CAM[®] C2 300P (42.4 µm), TRIUMPH 500P (42.4 µm), TRIUMPH 300P (44.4 µm), VERTU VANO[®] (45.8 µm), TRIUMPH C2 300P (46.2 µm), DWIP (46.2 µm), ORALDIP VERTU VANO[®] (46.2 µm), TRIUMPH 500P (46.2 µm), TRIUMPH 300P (46.2 µm), TRIUMPH C2 300P (46.2 µm), TRIUMPH 500P (46.2 µm), TRIUMPH 300P (46.2 µm), TRIUMPH C2 300P (46.2 µm). Statistically significant differences were found between the IOS. Linear and cross-distances between the files (local trueness analysis) confirmed the best (that emerged from the overall trueness analysis).
Conclusions: Different levels of trueness were found among the IOS evaluated in this study. Further studies are needed to confirm these results.
Keywords: Intraoral scanner, Full-arch implant impression, Scandocube, Trueness, Comparative study

2022

In Vivo Complete-Arch Implant Digital Impressions: Comparison of the Precision of Three Optical Impression Systems

Jaime Orejas-Perez¹, Beatriz Gimenez-Gonzalez², Ignacio Ortiz-Collado^{1,3}, Israel J. Thuisard¹ and Andrea Santamaria-Laorden^{1,4*}

¹ Faculty of Biomaterials and Health Sciences, Department of Clinical Dentistry, Universidad Europea de Madrid, 28670 Madrid, Spain; jorejas@uea.es (J.O.-P.); bgimenez@uea.es (B.G.-G.); iortiz@uea.es (I.O.-C.); ithuisard@uea.es (I.J.T.); asantamaria@uea.es (A.S.-L.)

Abstract: (1) Multiple in vitro studies assessed measurement accuracy of various complete-arch multiple implant impressions. The aim of the study is to assess three IOSs: PIC dental (Pic dental, Intra North West SL), TRIOS 3 (3Shape), Midmark Corporation) and the influence of several factors in the edentulous and mandibular arch. (2) A fully edentulous patient with eight implants in the mandibular jaw was selected. Five impressions were taken per system and an arc was designed on each digital working cast. The precision was analyzed on 28 distances and seven relative angulations of the abutments of all the design. The descriptive statistics, the Student's *t*-test, and the ANOVA test were used ($\alpha = 0.05$). (3) Significant differences were observed when comparing the IOSs in arch angulations. (4) The increase in the distance between implants affected the T and TD systems. The type of arch did not affect the PIC precision, but it performed worse in the mandibular arch. The system with the best precision by TD and then T.

Keywords: optical impression; optical scanners; photostereoscopy; complete arch; dent

1. Introduction
The majority of studies that evaluate IOSs are performed in vitro and, therefore, lack the challenges that the IOSs face in vivo [1–3]. Despite having less clinical relevance, in vitro studies help to develop protocols and to analyze parameters that are not possible in vivo, such as accuracy [6–8]. The heterogeneity of these study designs makes the interpretation of the conclusions and clinical recommendations difficult [1,9–11].
The different IOSs in the market compete to achieve the best accuracy, defined as how closely the obtained measurements resemble the real arch measurements, and the best precision, defined as how similar the obtained measurements of the repeated scans are [9,10,12,13]. Evaluating the precision in vivo is key, because there are many factors that can affect the result in the clinical setting, making the outcomes inconsistent and therefore difficult to predict. A large challenge is that there is no consensus regarding the range of acceptable misfit and the way to correctly measure the misfit clinically [4,13–17]. When the number of implants in the same structure increases, the tolerance of the error in the axis (X, Y, Z) and the angulations decrease [18]. Furthermore, we must consider the manufacturing

*Correspondence: asantamaria@uea.es

5. Conclusions

Within the limitations of the present in vivo study, the following conclusions were reached:

1. The system that obtained better precision was PIC, followed by TD, and then T.
2. The precision of T and TD decreased as the distance between the implants increased; however, this variable did not affect the PIC system.
3. The arch did not affect PIC precision, but the T and TD systems performed worse in the mandibular arch.

Re



Digital versus conventional impressions for complete-arch implant impressions: An evaluation of accuracy

Amin Marghalani BDS, MS¹, Hans-Yukio Kudara CDT, MDT², Khaled El...



Photogrammetric measurements of implant positions. Description of a technique to determine the fit between implants and superstructures

A. Lie, T. Jemt
First published: March 1994
✉ Torsten Jemt, The Bränemark Implant Center, Bränemark, Sweden



Comparison of conventional, photogrammetry, and intraoral scanning accuracy of complete-arch impression procedure

Marta Revilla-León DDS, MSD^{1,2}, Mutlu Özcan DDS, RMD, PhD², Jeffrey Rubens...



Trueness and precision of complete-arch photogrammetry implant scanning assessed with a coordinate measuring machine

Photogrammetric and Intraoral Digital Impression Technique for the Rehabilitation of Multiple Unfavorably Positioned Dental Implants: A Clinical Report

Pedro Molinero-Mourelle, DDS, MDS; Walter Lam, BDS, MDS; Rocio Cascos-Sánchez, DDS, MDS; Luis Azevedo, DDS; Miguel Gómez-Polo, DDS, PhD
J Oral Implantol (2019) 45 (5): 398–402.
<https://doi.org/10.1563/aaid-joi-D-19-00140>



PHOTOGRAMMETRY



PHOTODIAGNOSTICS

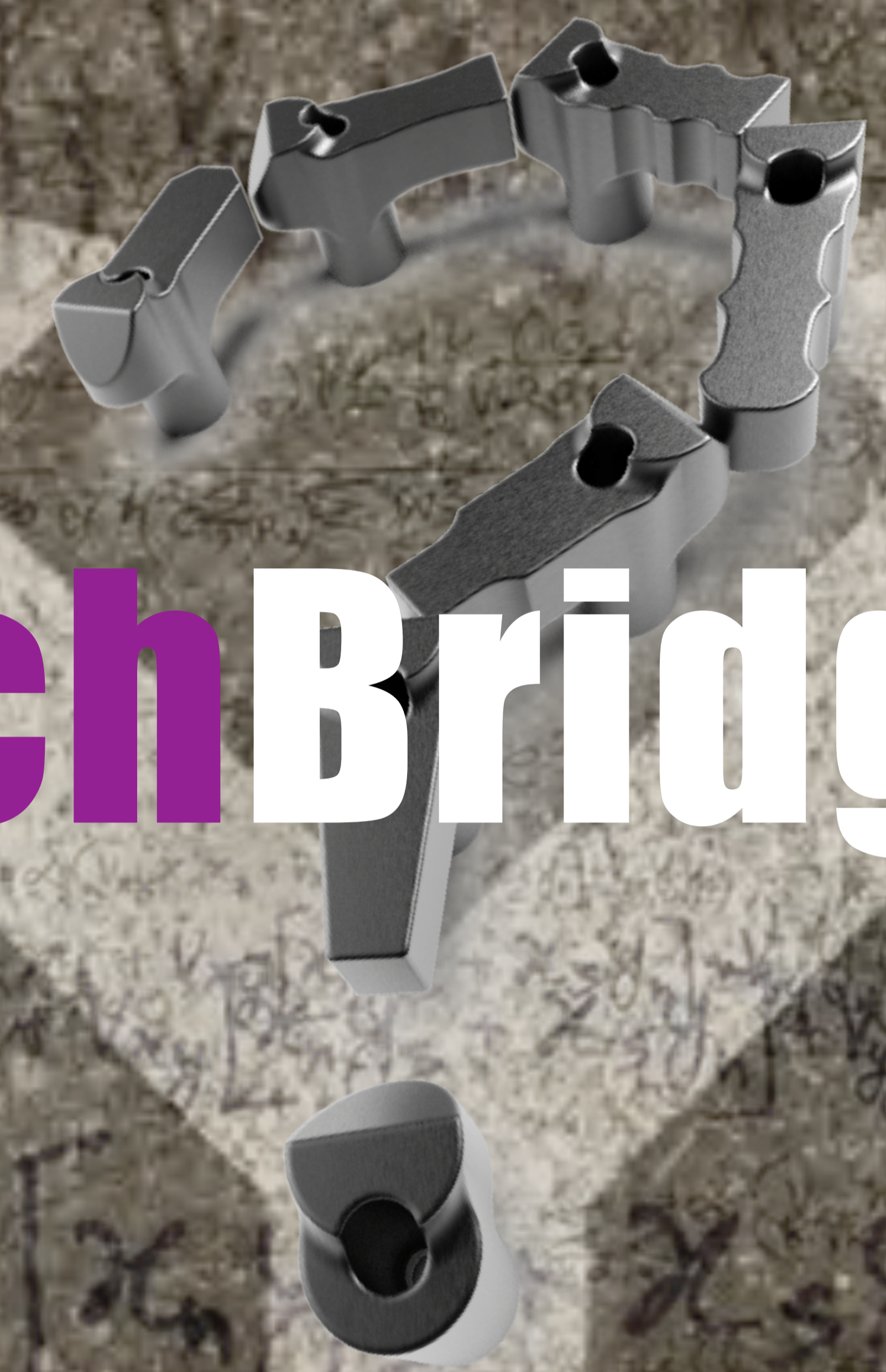
Imetric4D

MICRONMAPPER





ArchBridge™





UNIQUE DESIGN

IN-CONTACT

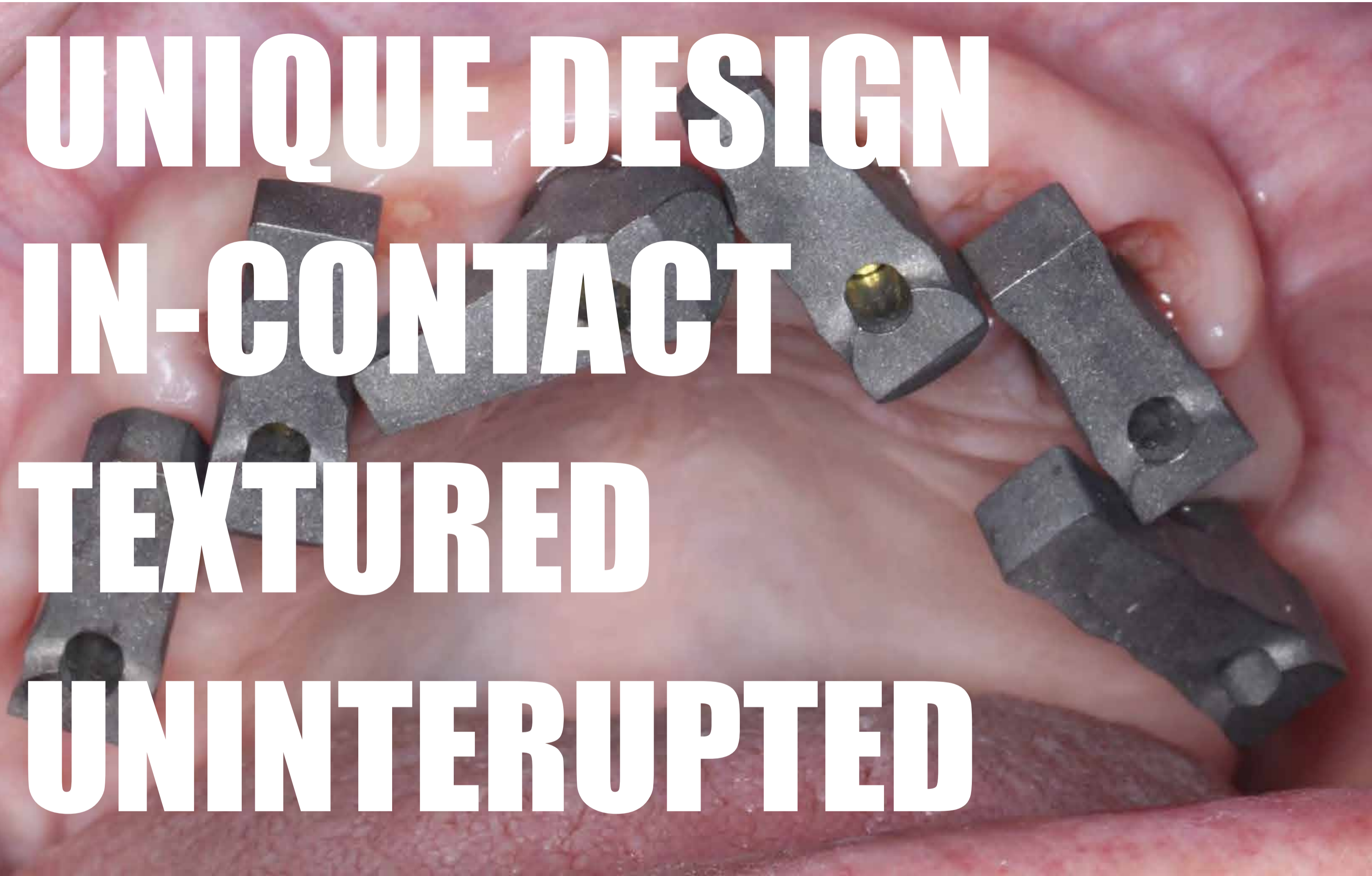
TEXTURED

UNINTERRUPTED

ArchBridge™

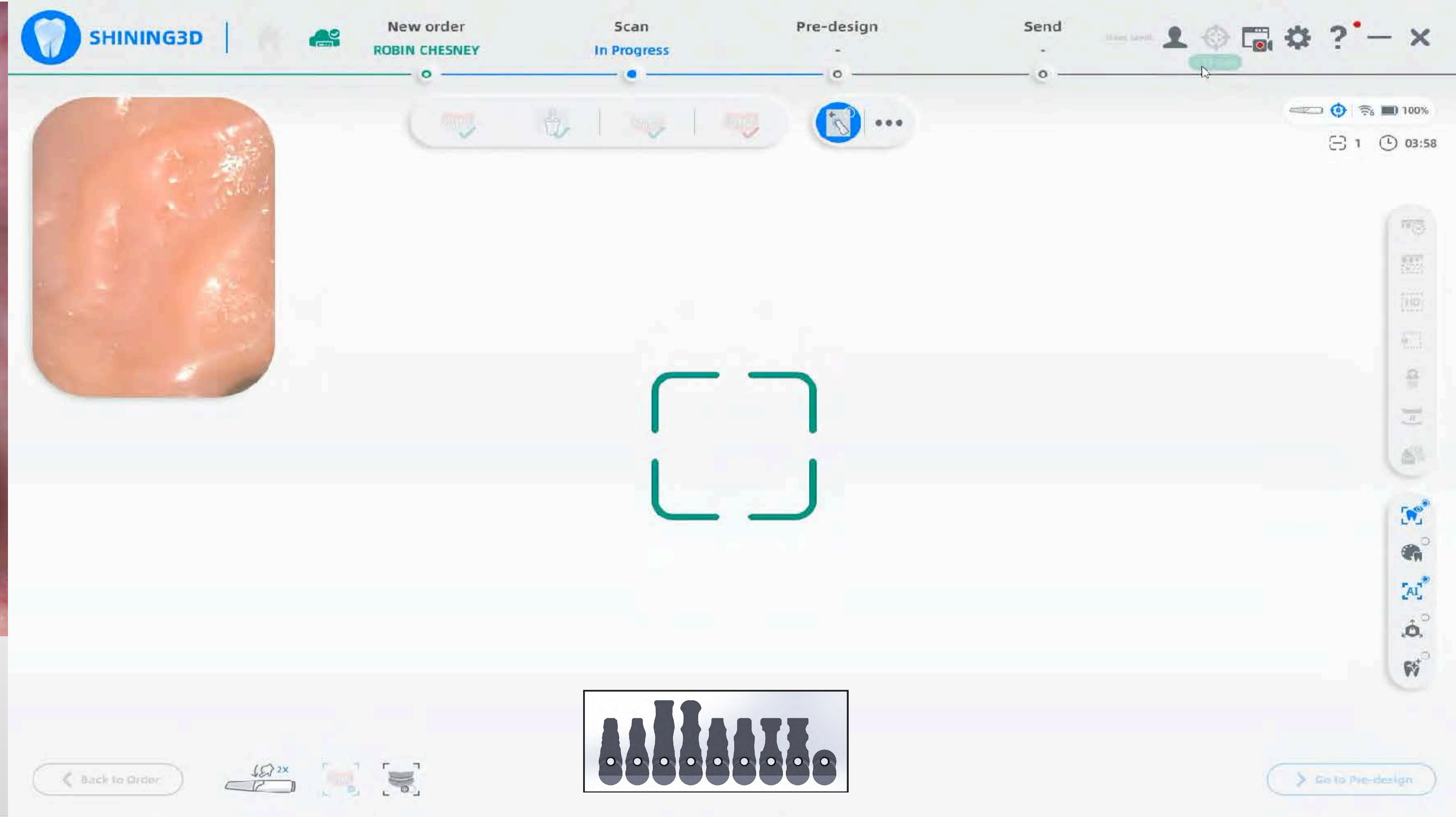


ArchBridge™

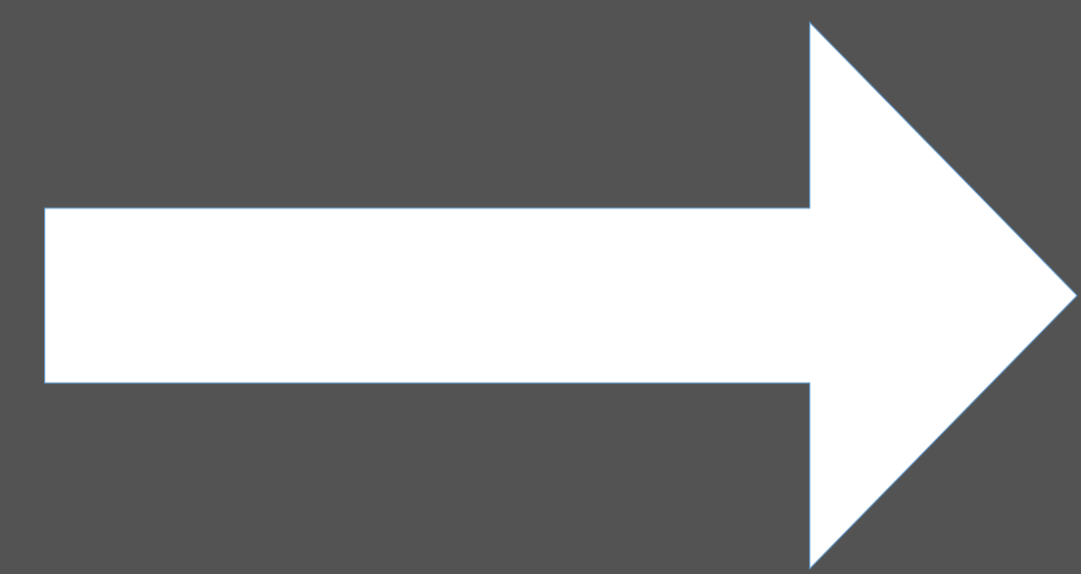


**UNIQUE DESIGN
IN-CONTACT
TEXTURED
UNINTERRUPTED**

ArchBridge™

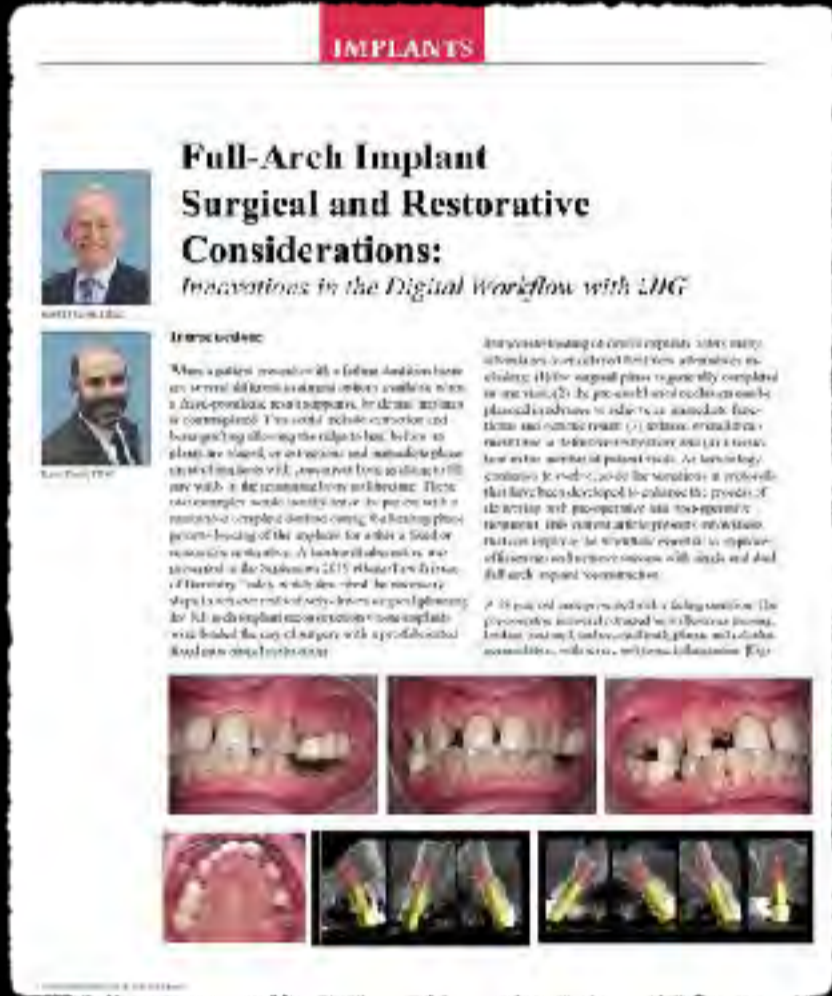


REPAIR




iJig

captures tooth position in relation to implant and tissue



SHINING3D | Home | New order robin chesny | Scan In Progress | Pre-design | Send +0 Days

Upper Jaw Scan



- Please place the model as shown above.
- Click "Start Scan" or space key to start.

[New order](#)

[Go to Pre-design](#)

Windows Taskbar: 12:16 PM 3/25/2024





US011589963B2

(12) **United States Patent**
Watson

(10) **Patent No.:** **US 11,589,963 B2**
(45) **Date of Patent:** **Feb. 28, 2023**

(54) **INTERMEDIATE PROSTHESIS FOR DENTAL PROSTHESIS INSTALLATION**

(71) Applicant: **Jason Watson, La Crescenta, CA (US)**

(72) Inventor: **Jason Watson, La Crescenta, CA (US)**

(73) Assignee: **WATSON GUIDE IP LLC, La Canada, CA (US)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 680 days.

(21) Appl. No.: **16/251,069**

(22) Filed: **Jan. 17, 2019**

(65) **Prior Publication Data**
US 2019/0216581 A1 Jul. 18, 2019

Related U.S. Application Data
(60) Provisional application No. 62/618,424, filed on Jan. 17, 2018.

(51) **Int. Cl.**
A61C 13/00 (2006.01)
A61C 13/01 (2006.01)
A61C 13/34 (2006.01)
A61C 8/00 (2006.01)
A61C 9/00 (2006.01)
A61C 13/107 (2006.01)

(52) **U.S. Cl.**
CPC *A61C 13/0004* (2013.01); *A61C 13/0006* (2013.01); *A61C 13/01* (2013.01); *A61C 8/0001* (2013.01); *A61C 9/0006* (2013.01); *A61C 9/0053* (2013.01); *A61C 13/0001* (2013.01); *A61C 13/34* (2013.01)

20 Claims, 9 Drawing Sheets

(58) **Field of Classification Search**
CPC .. *A61C 13/0004*; *A61C 13/0006*; *A61C 13/01*; *A61C 13/0001*; *A61C 13/34*; *A61C 13/0003*; *A61C 13/00*; *A61C 9/0006*; *A61C 9/0053*; *A61C 9/0046*; *A61C 9/004*
USPC 433/199, 199.1
See application file for complete search history.

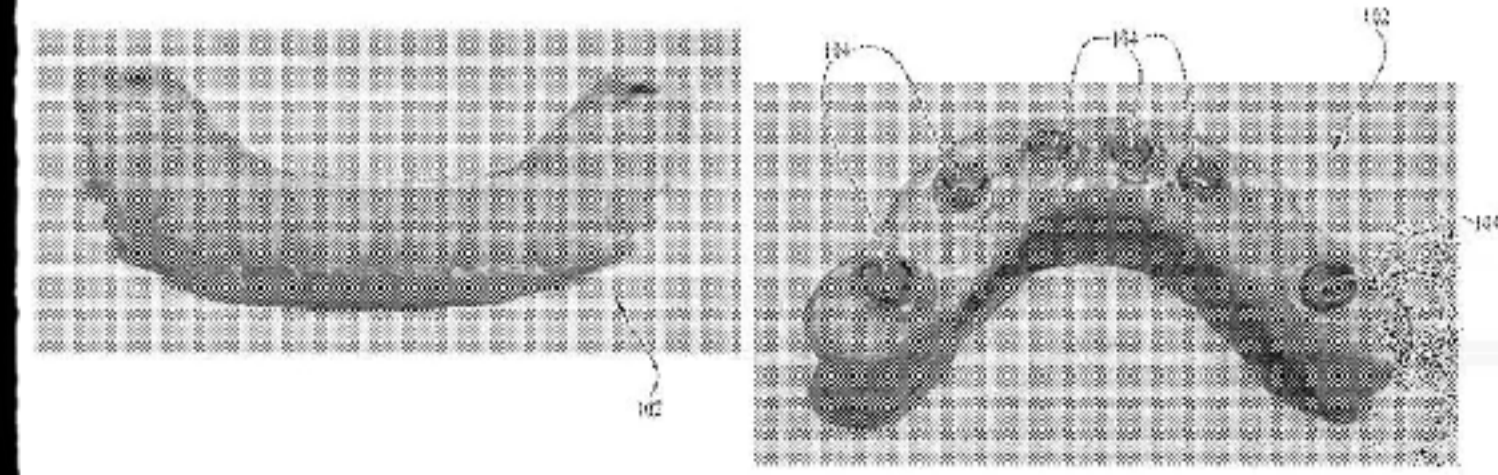
(56) **References Cited**
U.S. PATENT DOCUMENTS

2018/009584 A1* 1/2018 Schuler C08L33/08
* cited by examiner

Primary Examiner — Ralph A Lewis
Assistant Examiner — Mirayda A Aponte
(74) *Attorney, Agent, or Firm* — Karish & Djorgum, PC

(57) **ABSTRACT**

Methods for generating and providing a full arch prosthesis from a pre-existing prosthesis are presented, starting from the pre-existing prosthesis. This prosthesis is removed from the mouth, scanned, and replaced within the mouth. An intermediate prosthesis is generated from the scan, and modified to match a final physiological target configuration of the patient's mouth. The intermediate prosthesis is used to generate a final virtual representation of the target configuration, from which final virtual representation the final working prosthesis is fabricated. The intermediate prosthesis is mounted in the patient's mouth in sections. For desirable repositioning, sections then being bonded together. Copings can be digitally subtracted to create press fit new copings to be installed. Alternatively, the intermediate prosthesis can include integrated false copings. The intermediate prosthesis is scanned to generate a final digital model or virtual representation of the desired final prosthesis. The final working prosthesis may then be fabricated using the final virtual representation.



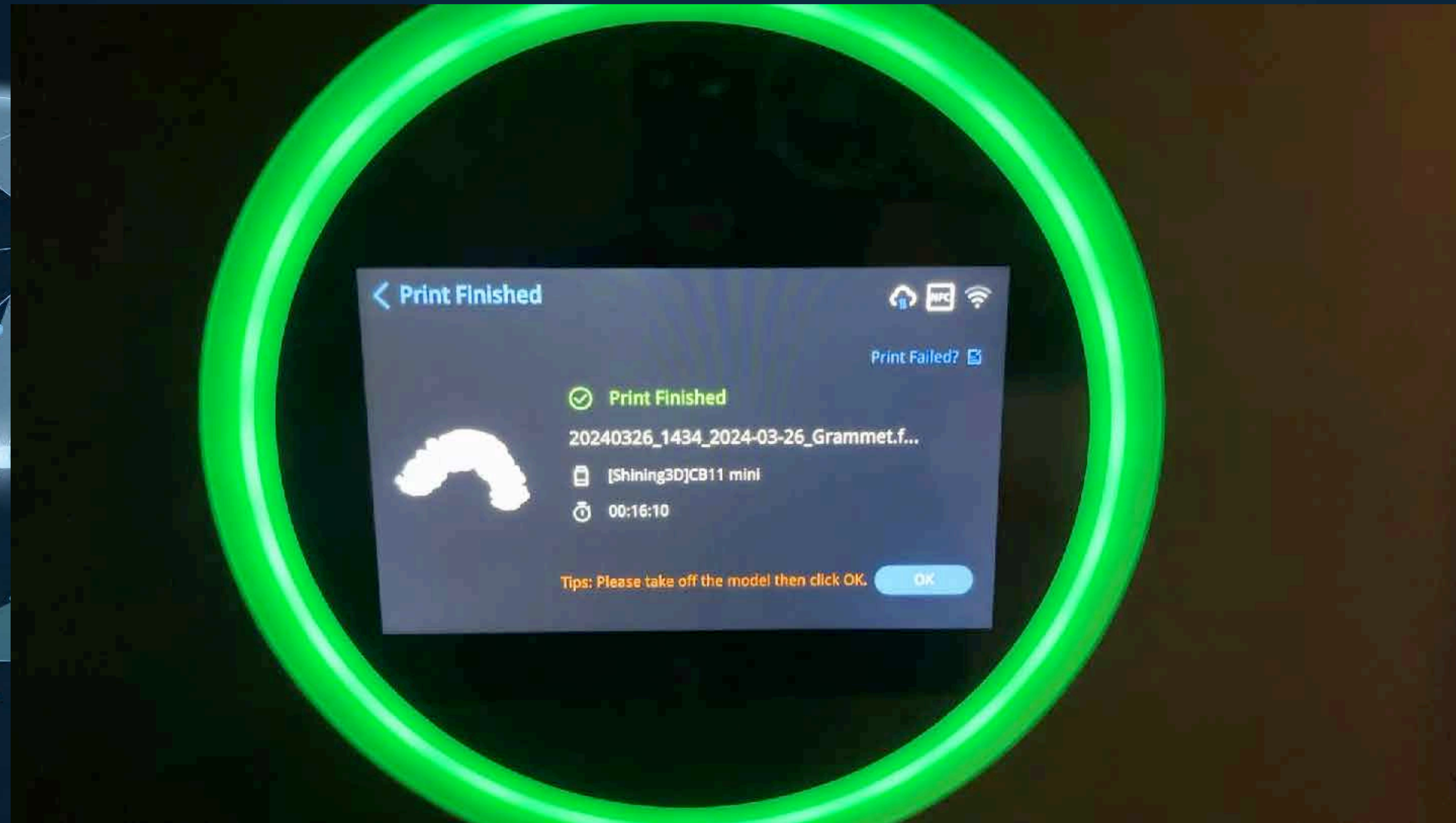
Methods for generating and providing a full arch prosthesis from a pre-existing prosthesis are presented, starting from the pre-existing prosthesis.

This prosthesis is removed from the mouth, scanned, and replaced within the mouth. The intermediate prosthesis is scanned to generate a final digital model or virtual representation of the desired final prosthesis

ijiG



PRINT

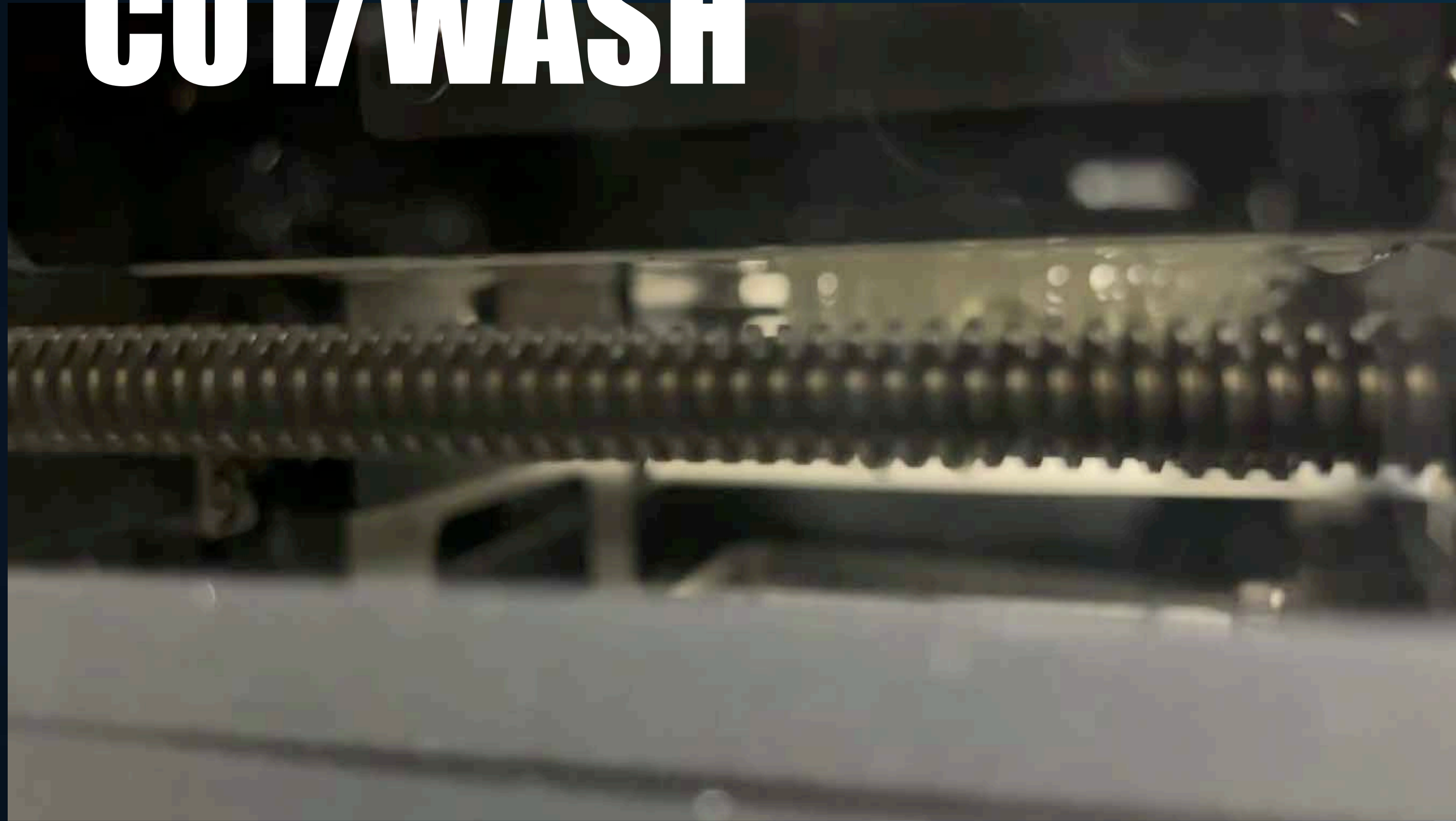


AccuFab-CEL



SHINING 3D
DENTAL

CUT/WASH



AccuFab-CEL



SHINING 3D
DENTAL

CURE




AccuFab-CEL

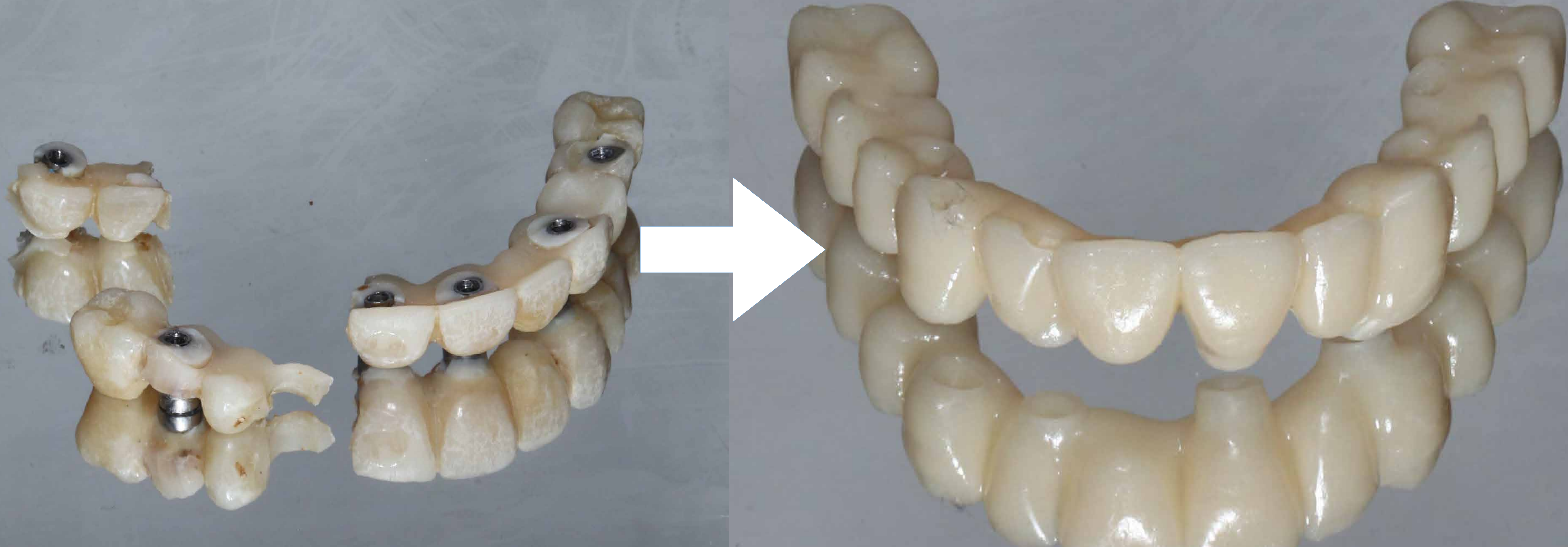


SHINING 3D
DENTAL

Printer Comparison

Printer	AccuFab CEL	AccuFab L4D	Pro 55S	Pro 95S	Max	SOL
Brand	Shining3D	Shining3D	Sprint Ray	Sprint Ray	Asiga	Ackuretta
Image						
Technology	LCD	LCD	DLP	DLP	DLP	LCD
Print Volume (mm)	194 x 120 x 180	192 x 120 x 180	105 x 59 x 200	182 x 102 x 200	119 x 67 x 75	128 x 80 x 120
Resolution	6K	4K	1080p	1080p	1080p	4K
Accuracy	35 Microns	50 Microns	55 Microns	95 Microns	62 Microns	49 Microns
Speed	~100 mm/h	~10-50 mm/h	~50 mm/h	~50 mm/h	~60 mm/h	~45 mm/h
Verified Resin Brands	21	21	6	6	49	20
Estimated Print Time (ortho model)	12 min	42 min	44 min	35 min	N/A	48 min
Price (USD)	Affordable	Affordable	Expensive	Expensive	Expensive	Expensive

*Data gathered from manufacturer websites and designated slicing software estimations



16min PRINT



Print Finished



Print Failed? 

 Print Finished

20240326_1434_2024-03-26_Grammet.f...



 [Shining3D]CB11 mini

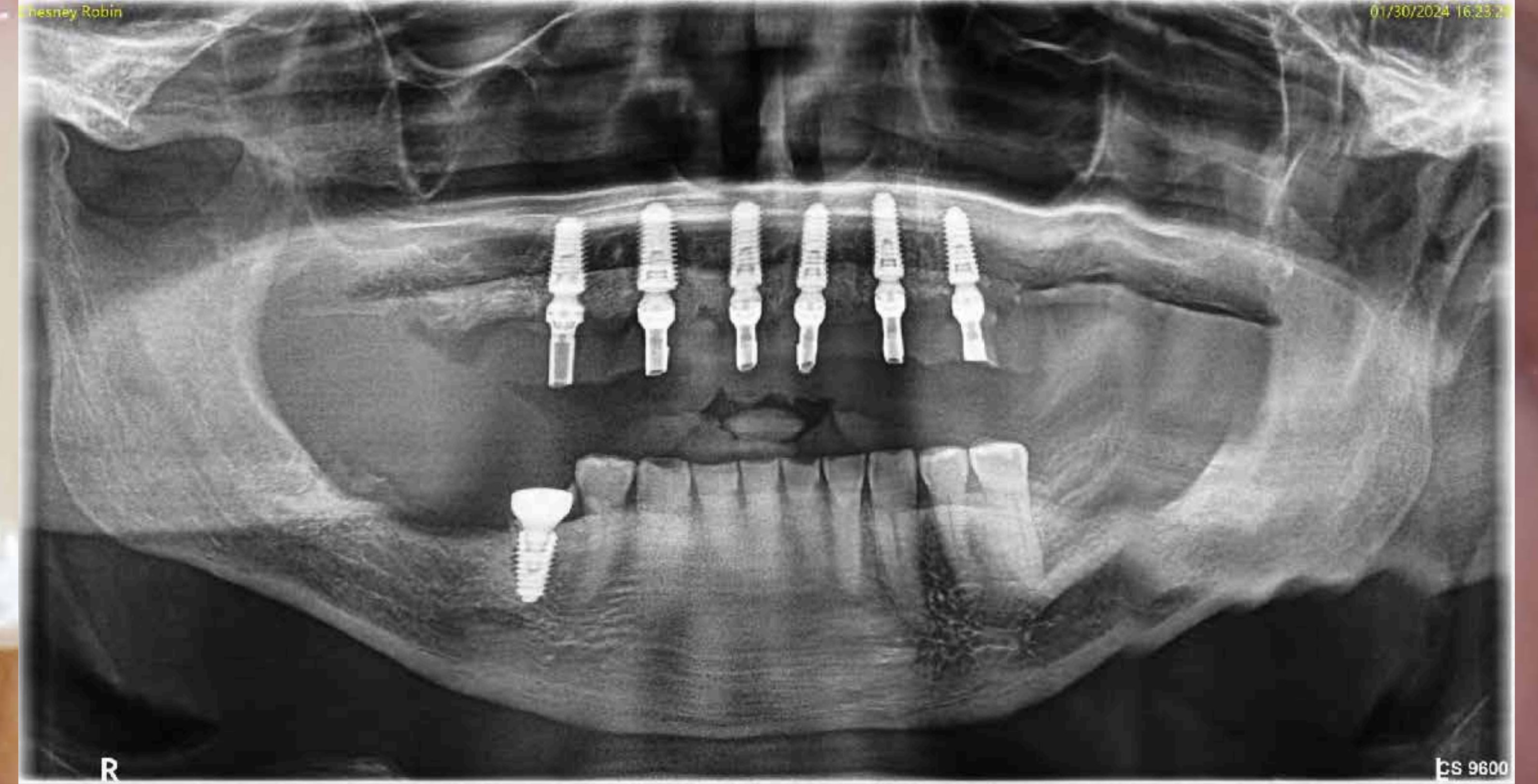
 00:16:10

Tips: Please take off the model then click OK.

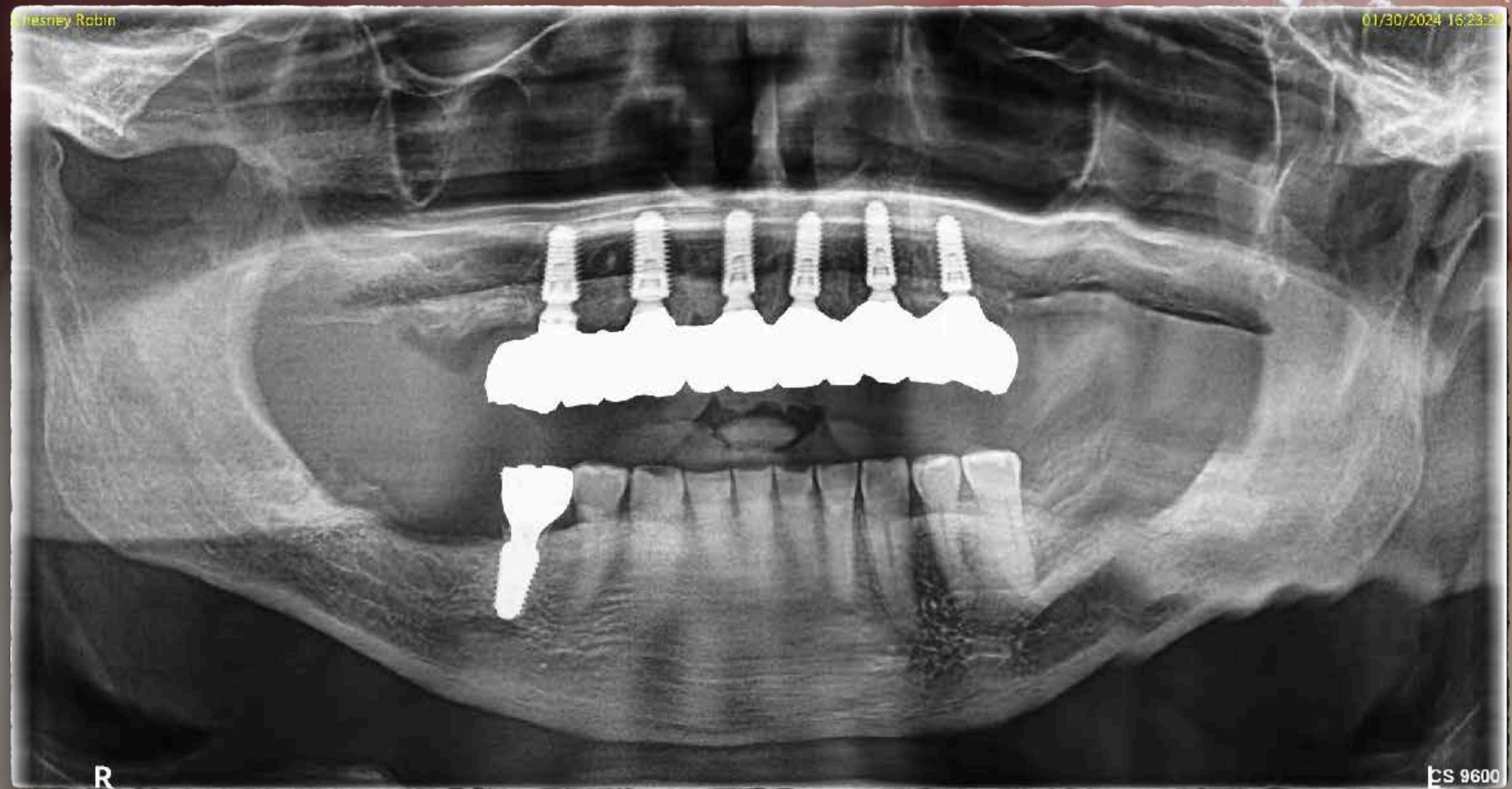
OK



INSERTION





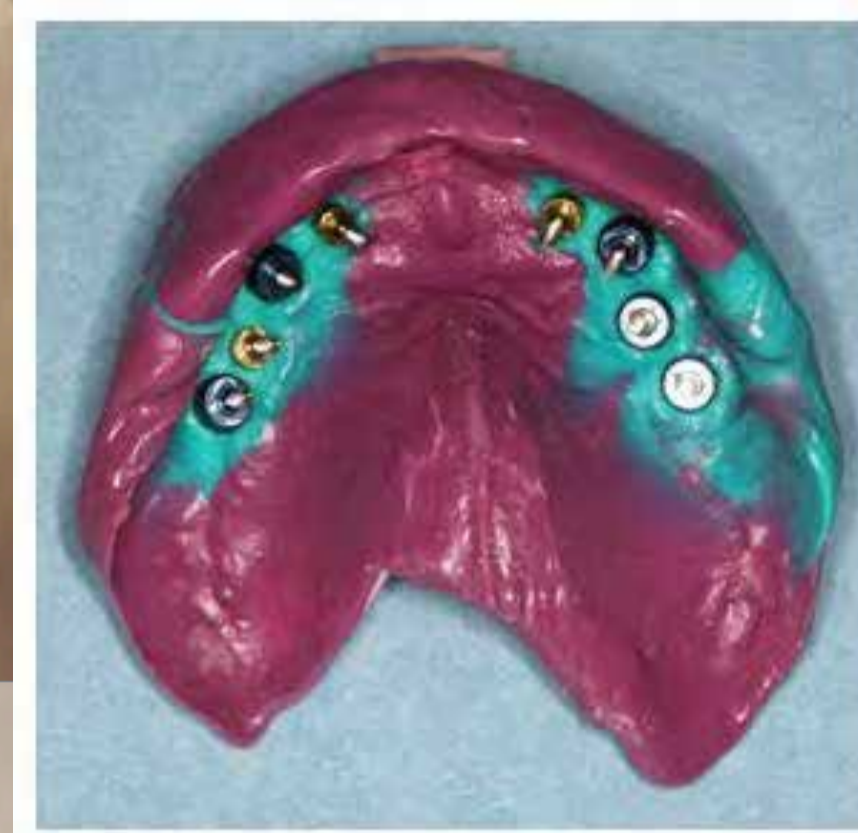


Changing lives one smile at a time

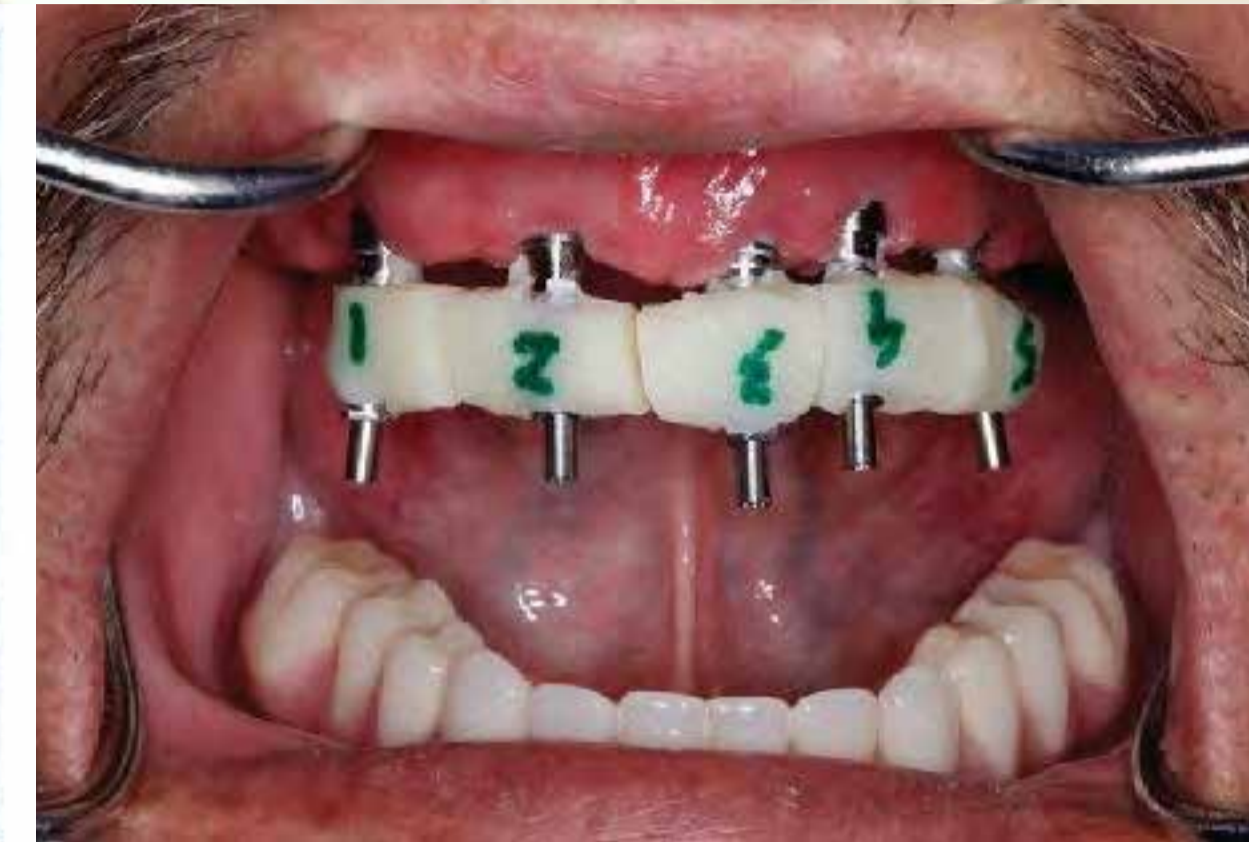
Traditional Method is 7 appointments over 2 ½ - 3 ½ Months



Appt 1 Stock Tray



Appt 2 Implant Impression



Appt 3 Fit Gig & Bite Block



Appt 4 Screw Down Set-up



Appt 5 Screw Down Set-up on Ti Bar



Appt 6 Reset



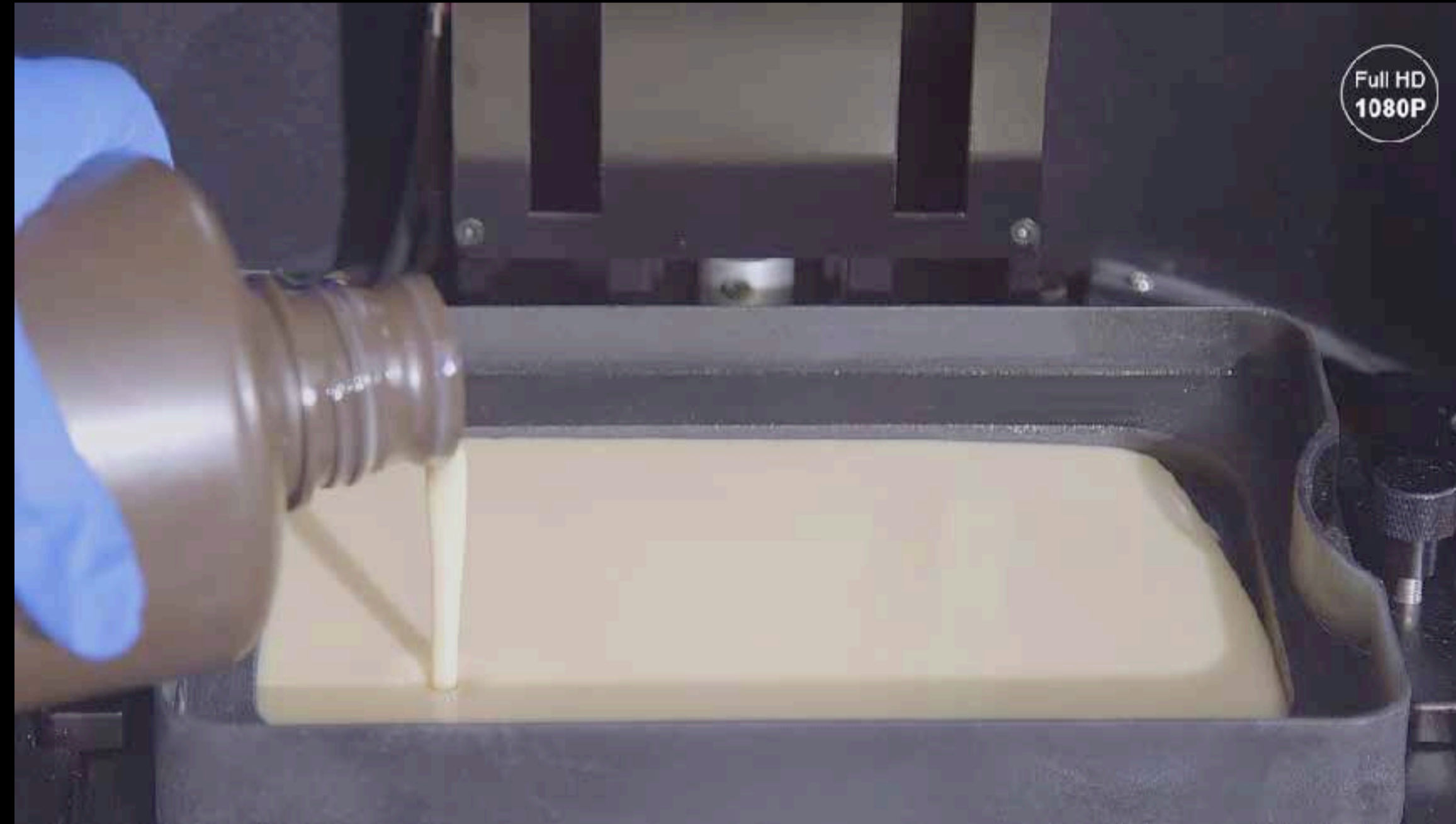
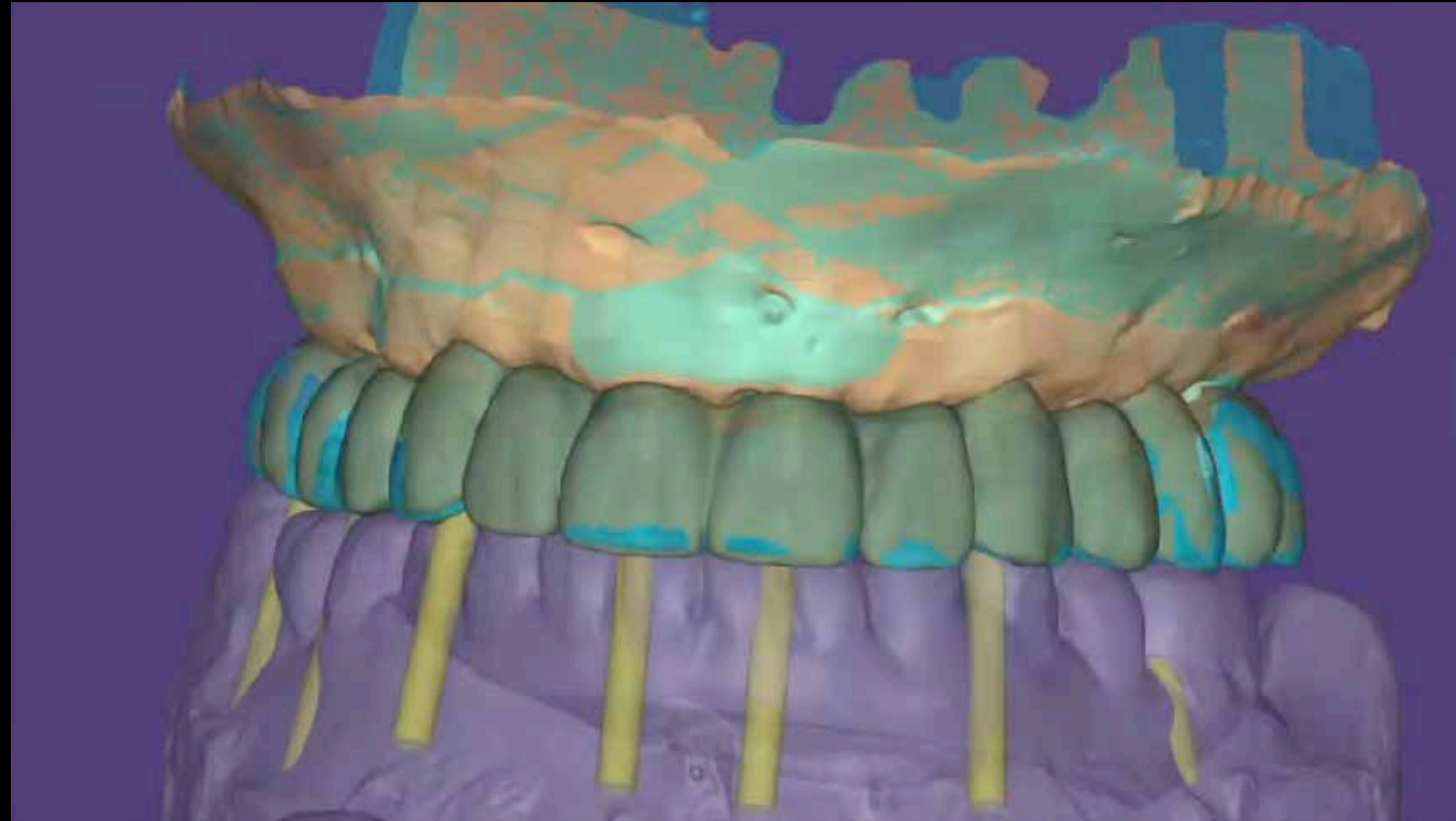
Appt 7 Final Seating

TRADITIONAL



Cad-Cam

2-3 Visits



Design

Print

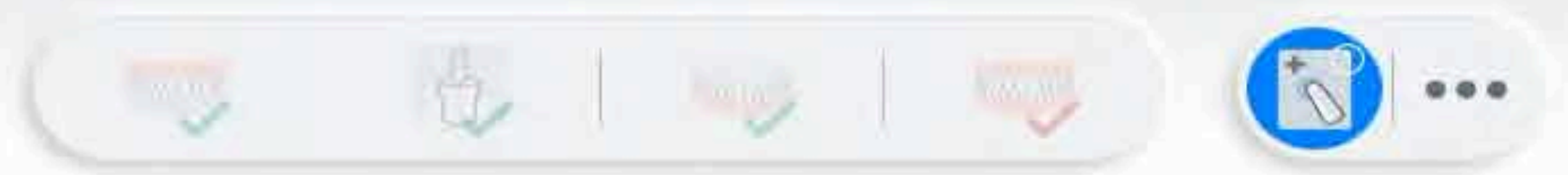
Mill



Jan 2020



Reverse scanning of patients temps



Contacting scan bodies to provide stable scan path



May 2023



IMPLANTS

Full-Arch Implant Surgical and Restorative Considerations:

Innovations in the Digital Workflow with iJig



Scott D. Ganz, DMD

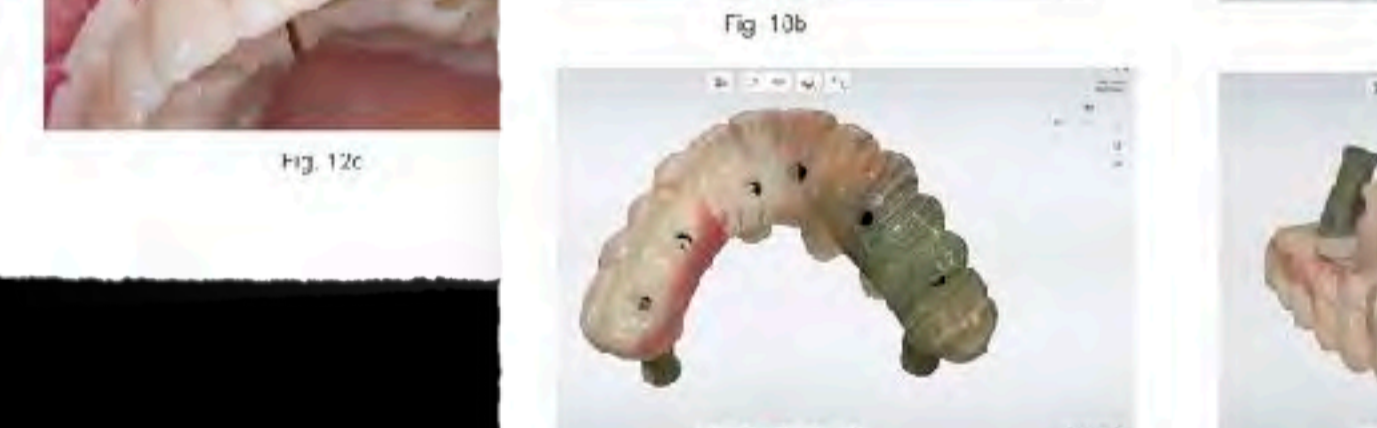
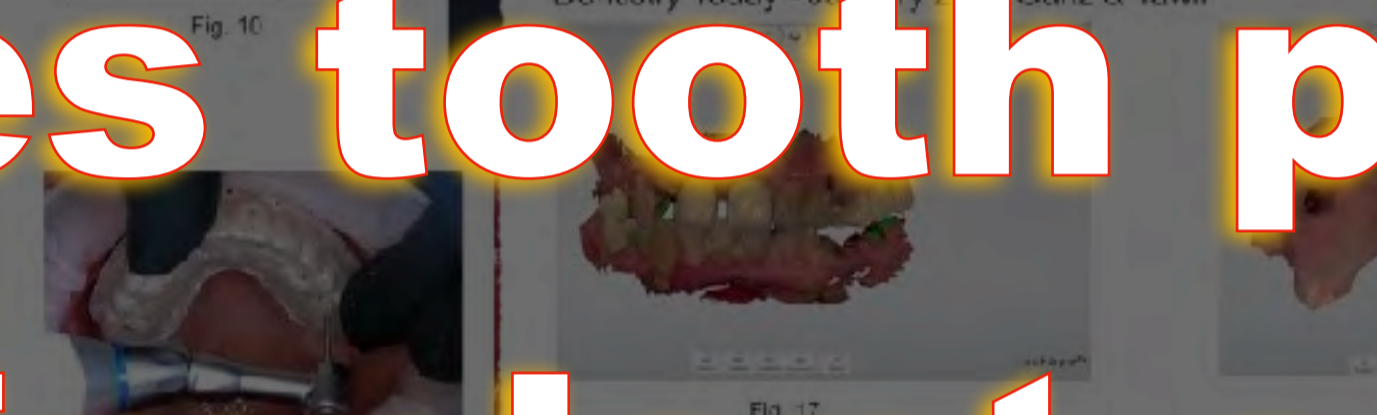
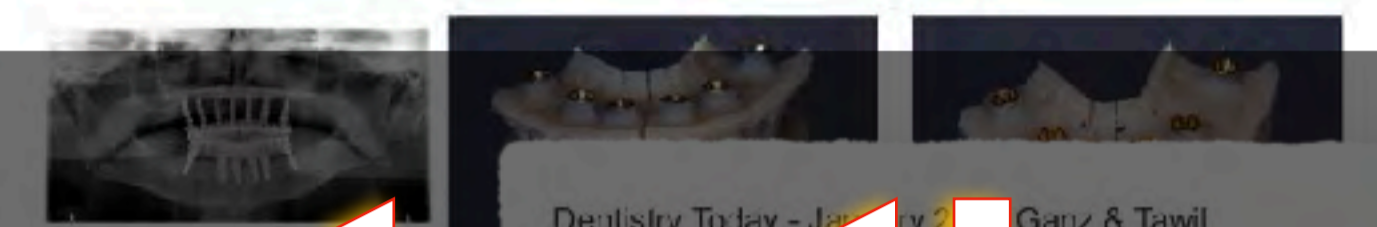
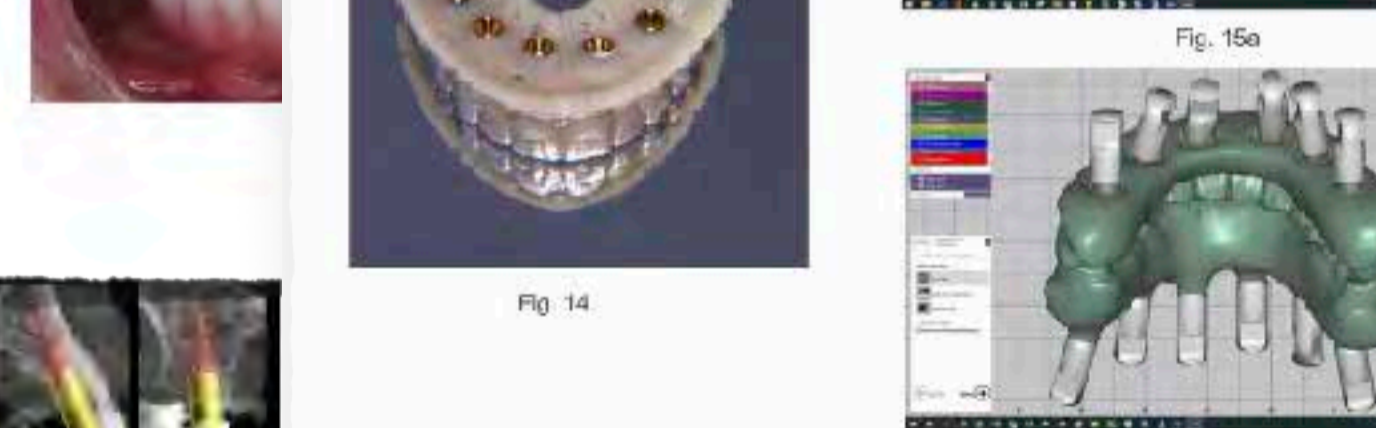
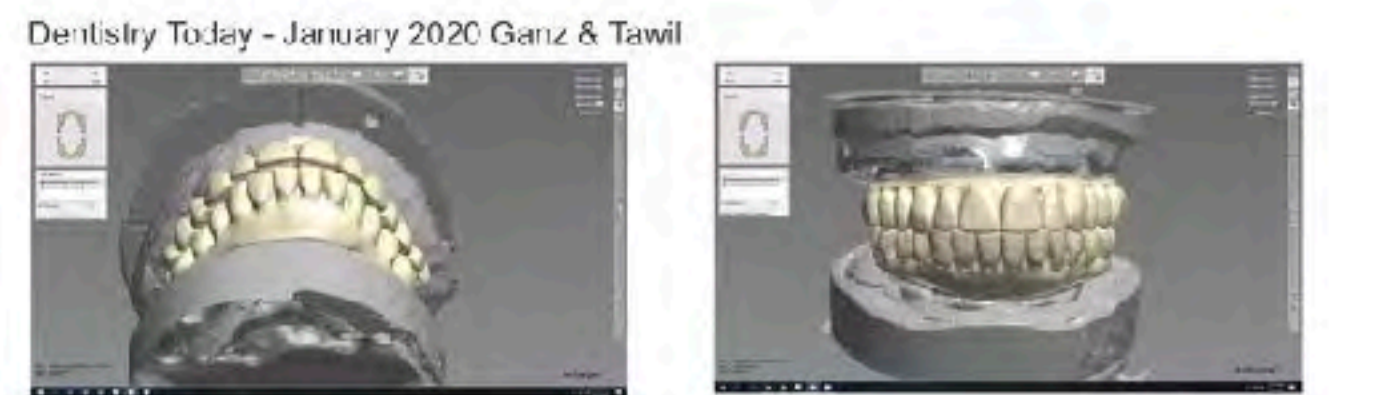


Jason Tawil, DMD

Introduction:

When a patient presents with a failing dentition there are several different treatment options available when a fixed-prosthetic result supported by dental implants is contemplated. This could include extraction and bone grafting allowing the ridge to heal before implants are placed, or extractions and immediate placement of implants with concurrent bone grafting to fill any voids in the remaining bony architecture. These two examples would usually leave the patient with a removable complete denture during the healing phase prior to loading of the implants for either a fixed or removable restoration. A treatment alternative was presented in the September 2019 (Ganz-Tawil) issue of Dentistry Today which described the necessary steps to achieve restoratively-driven surgical planning for full arch implant reconstruction where implants were loaded the day of surgery with a pre-fabricated fixed provisional restoration.

Immediate loading of dental implants offers several advantages over delayed treatment including: (1) the surgical phase is in one visit; (2) the pre-established plan in advance to achieve functional, and esthetic result; (3) reduction in time to definitive restoration in the number of patient visits; (4) the ability to evolve, so do the restorations that have been developed to enhance the patient's quality of life. Both pre-operative and intra-operative digital workflows are essential to achieve effective and efficient full-arch implant reconstruction. A 58 year old male presented with a pre-operative intra-oral scan of a broken, fractured, and decayed teeth accumulation, with severe soft tissue



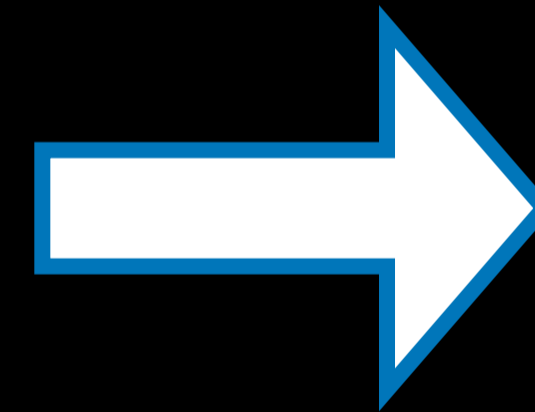
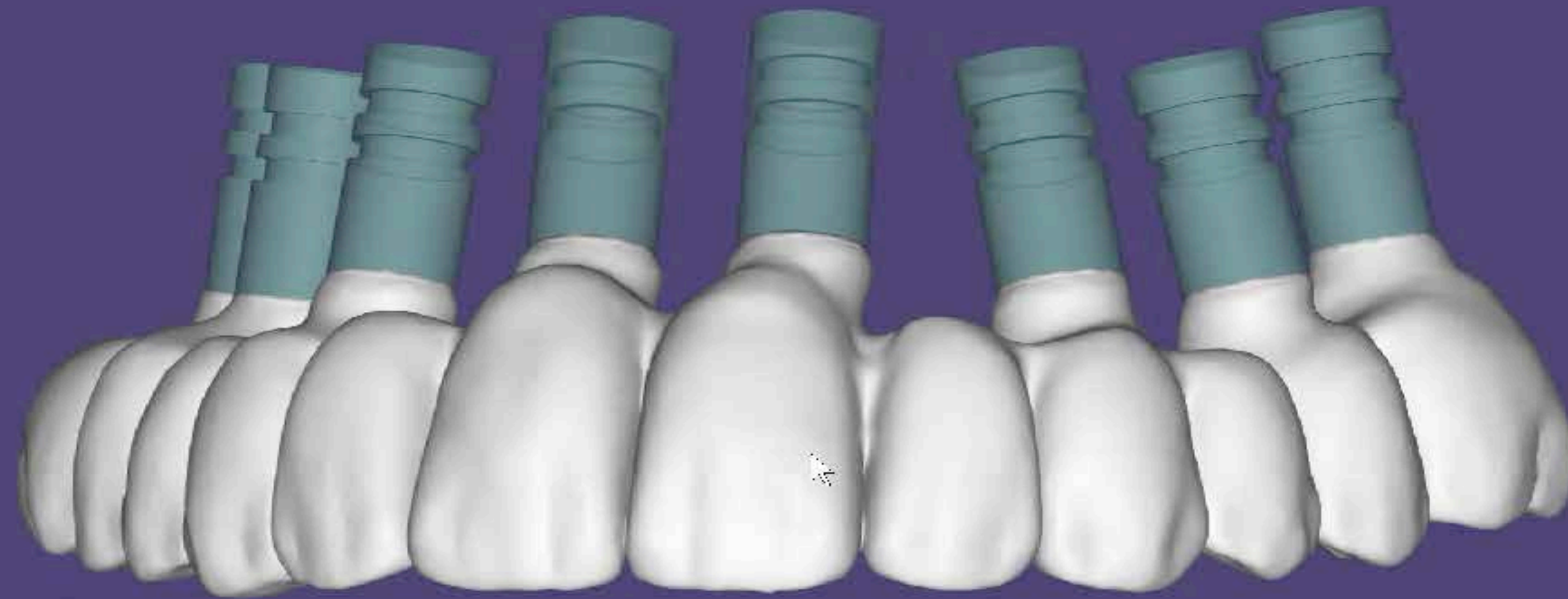
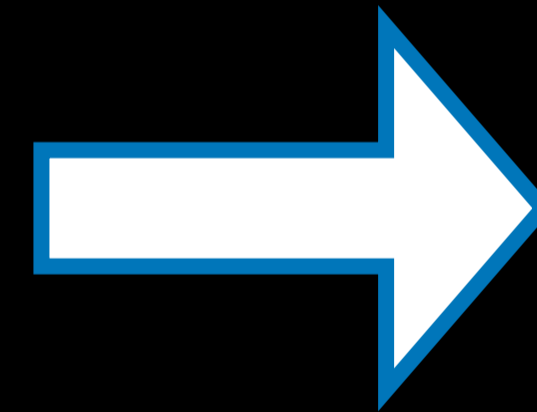
iJig captures tooth position in relation to implant and tissue



Design



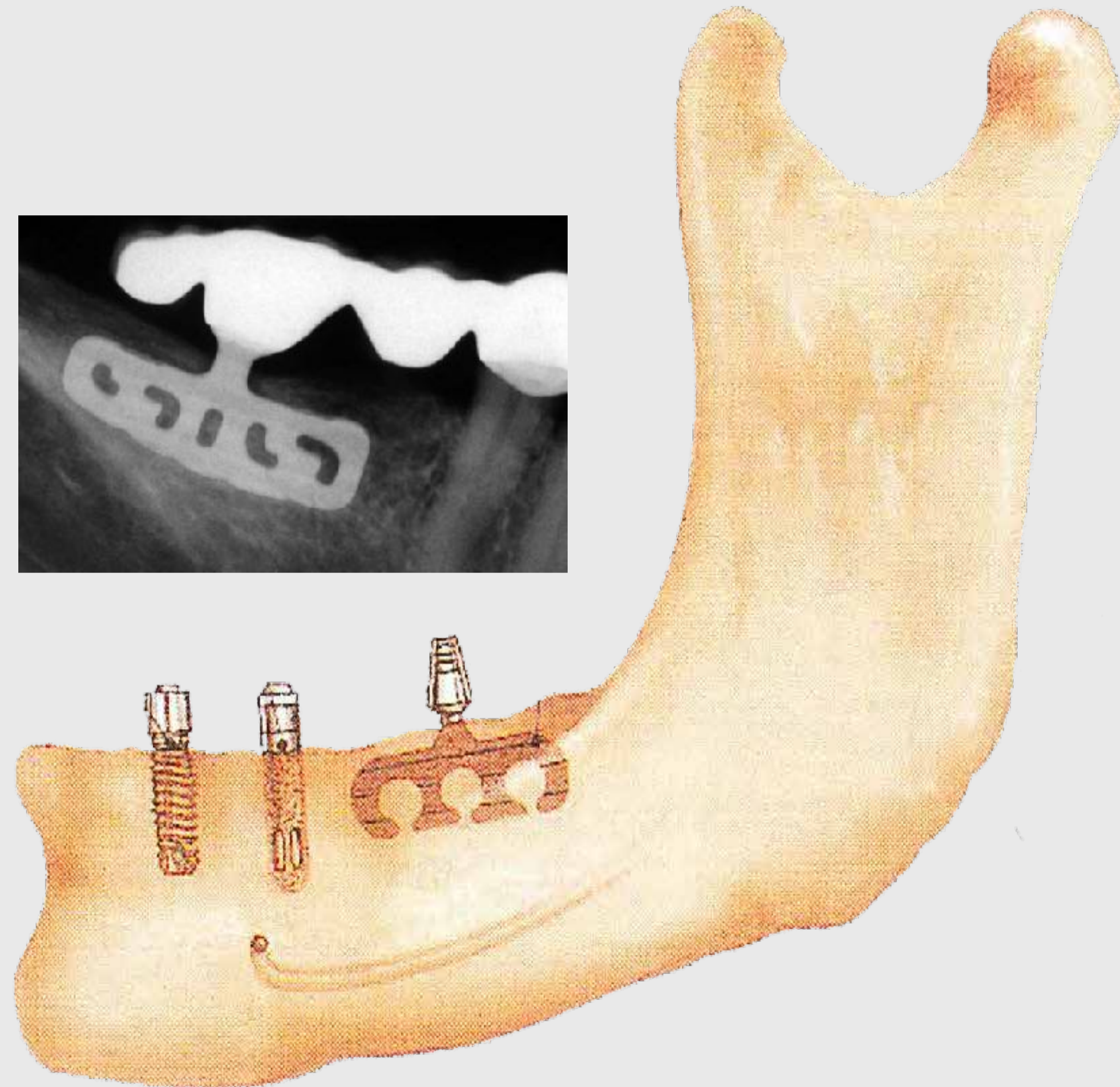
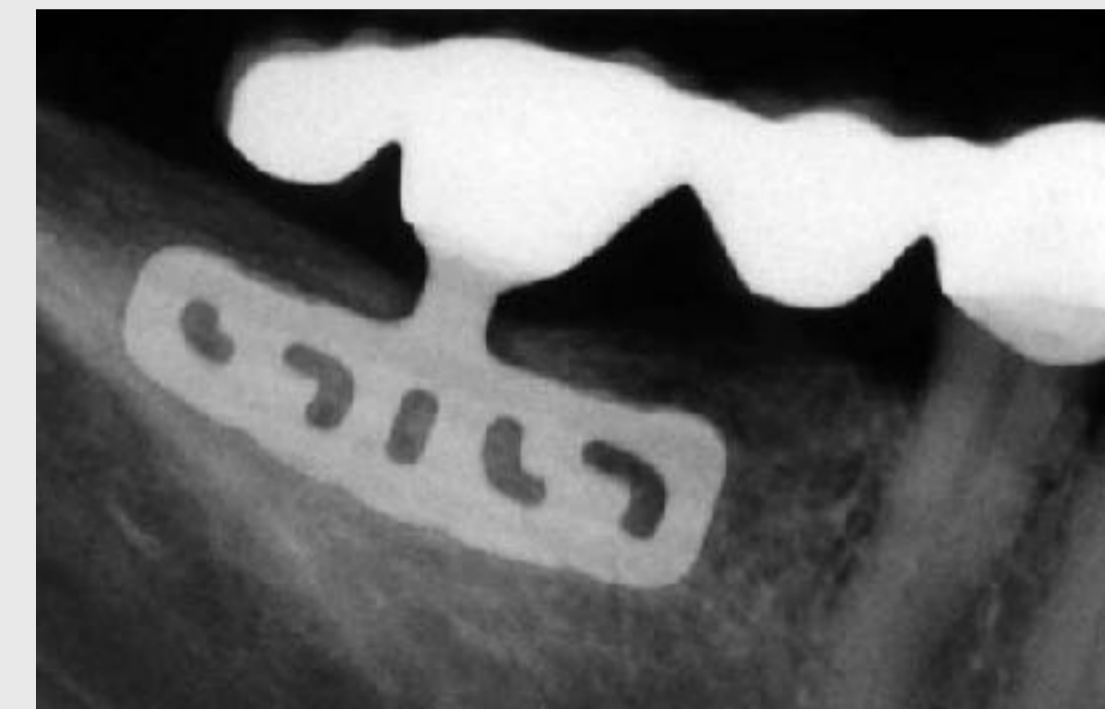
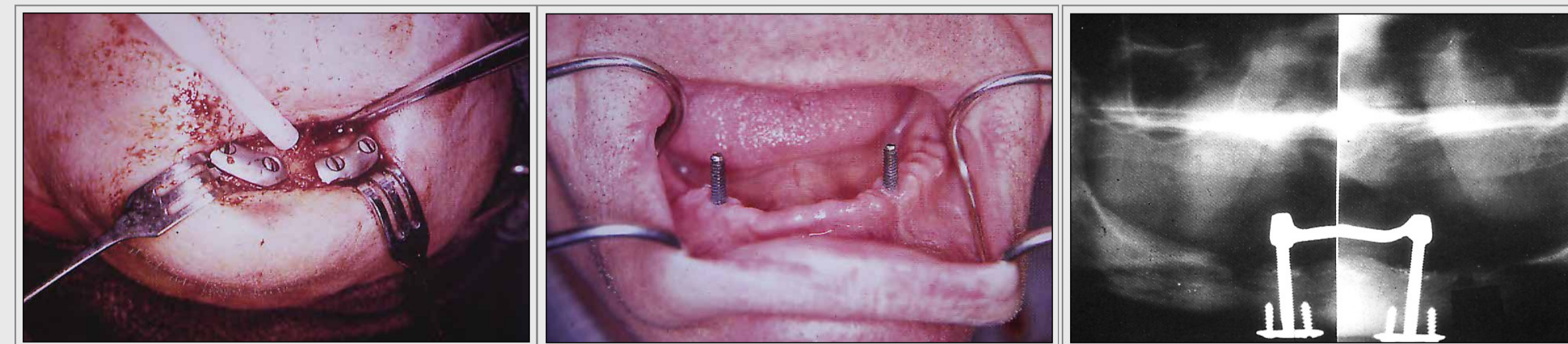
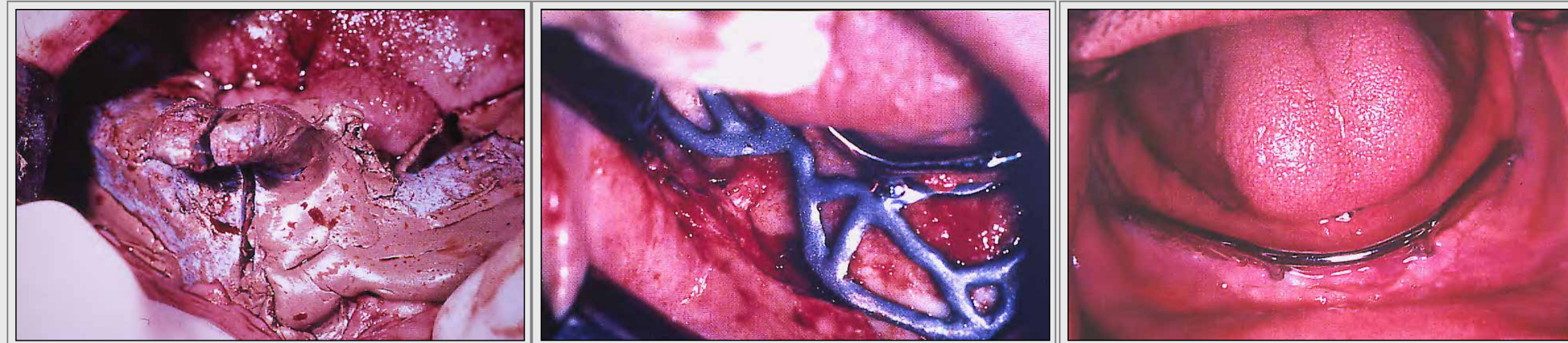
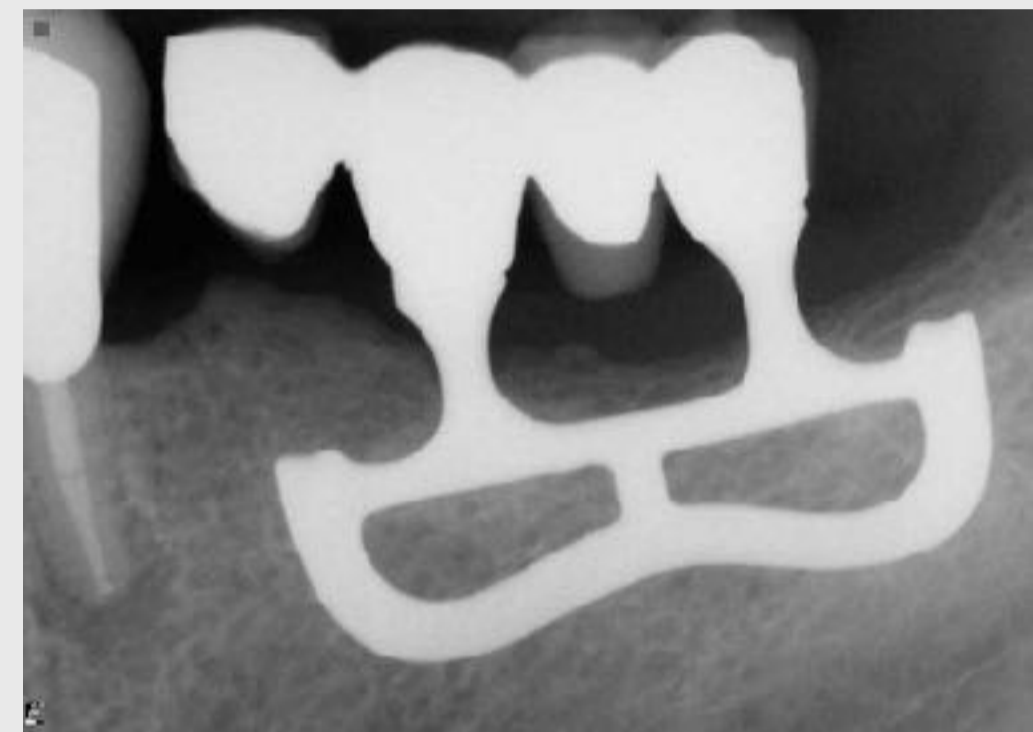
Capture



PRINT/MILL

PROPER IMPLANT PLACEMENT

Where we started



- Subperiosteal
- Transosteal
- Blade
- Disc



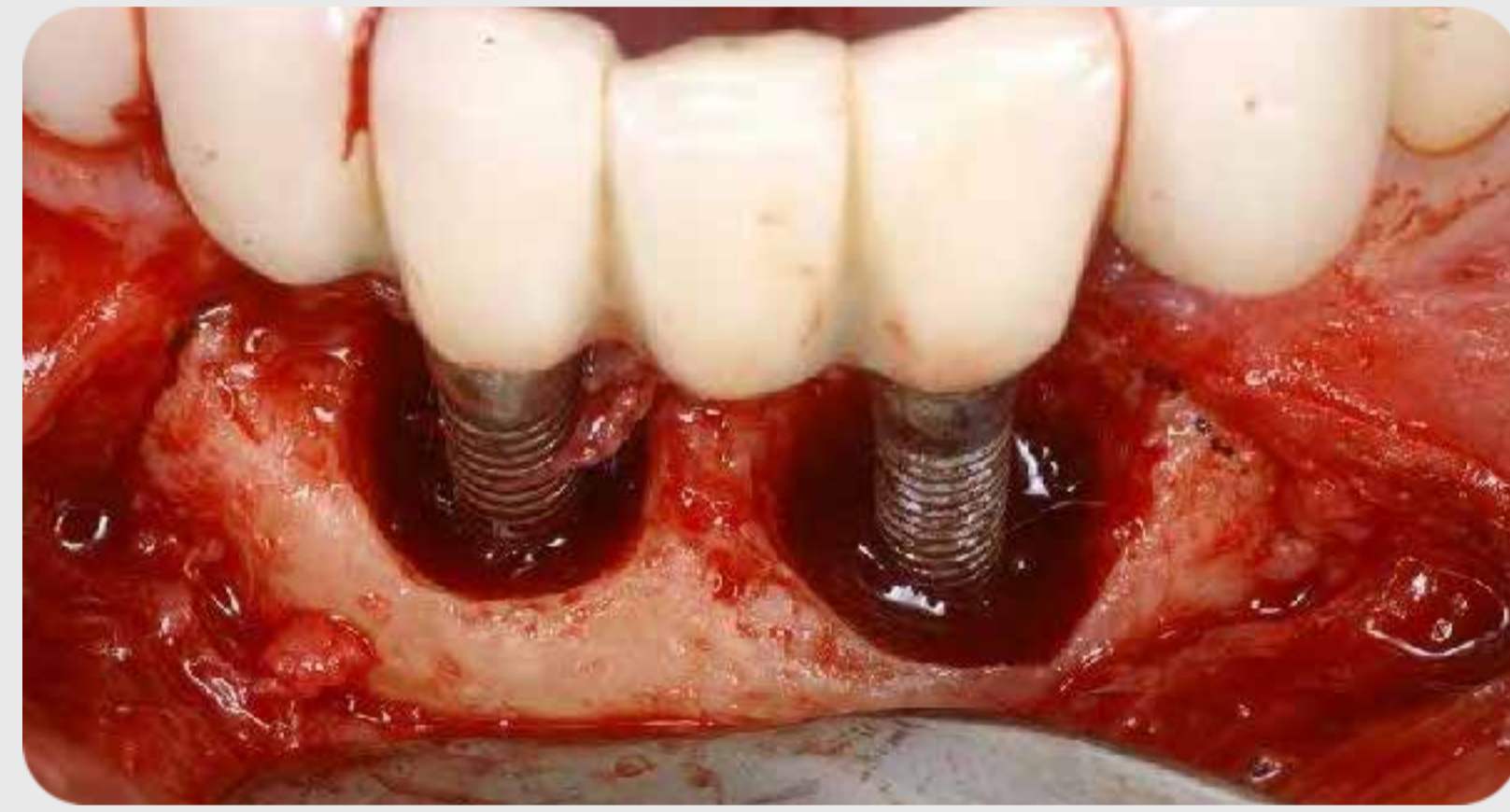
Older Designs

Root Form

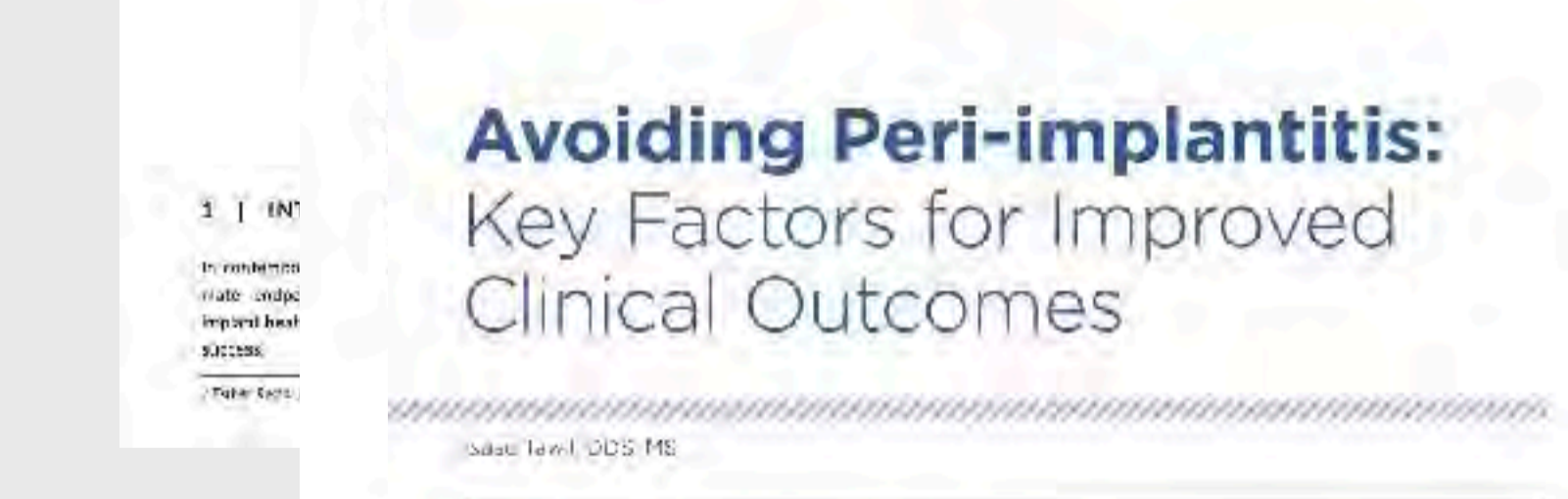


Peri-Implantitis

had some form of inflammatory response and a prevalence of peri-implantitis from 28% to 51%



- Risks Of Peri-Implantitis
- History of periodontitis
- Poor oral hygiene
- Residual peridontal pockets with BOP
- Lack of maintenance
- Tobacco/Alcohol use
- Malocclusion, Malpositioned
- Previous Contamination Of The Implant Site
- Implant Surface Contamination
- Inadequate restorations



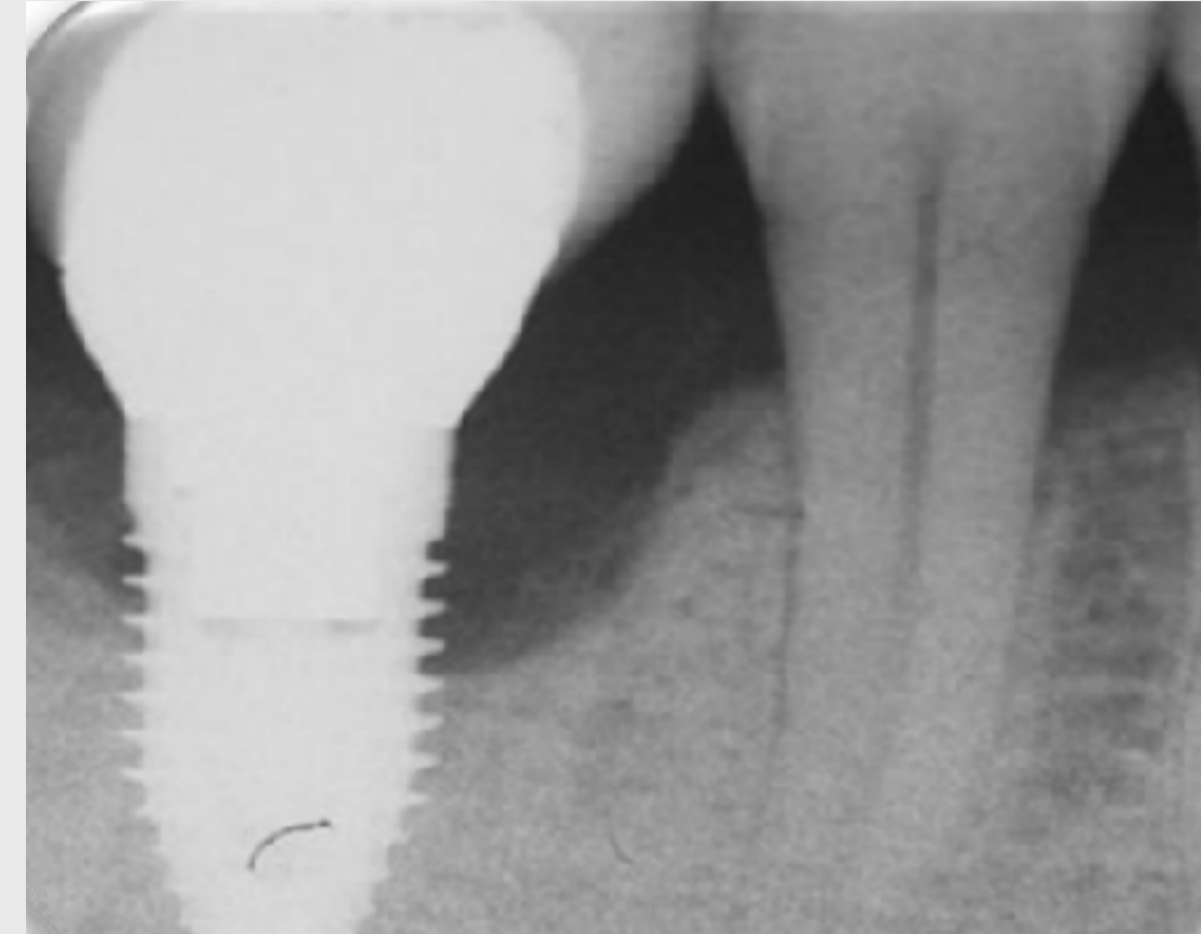
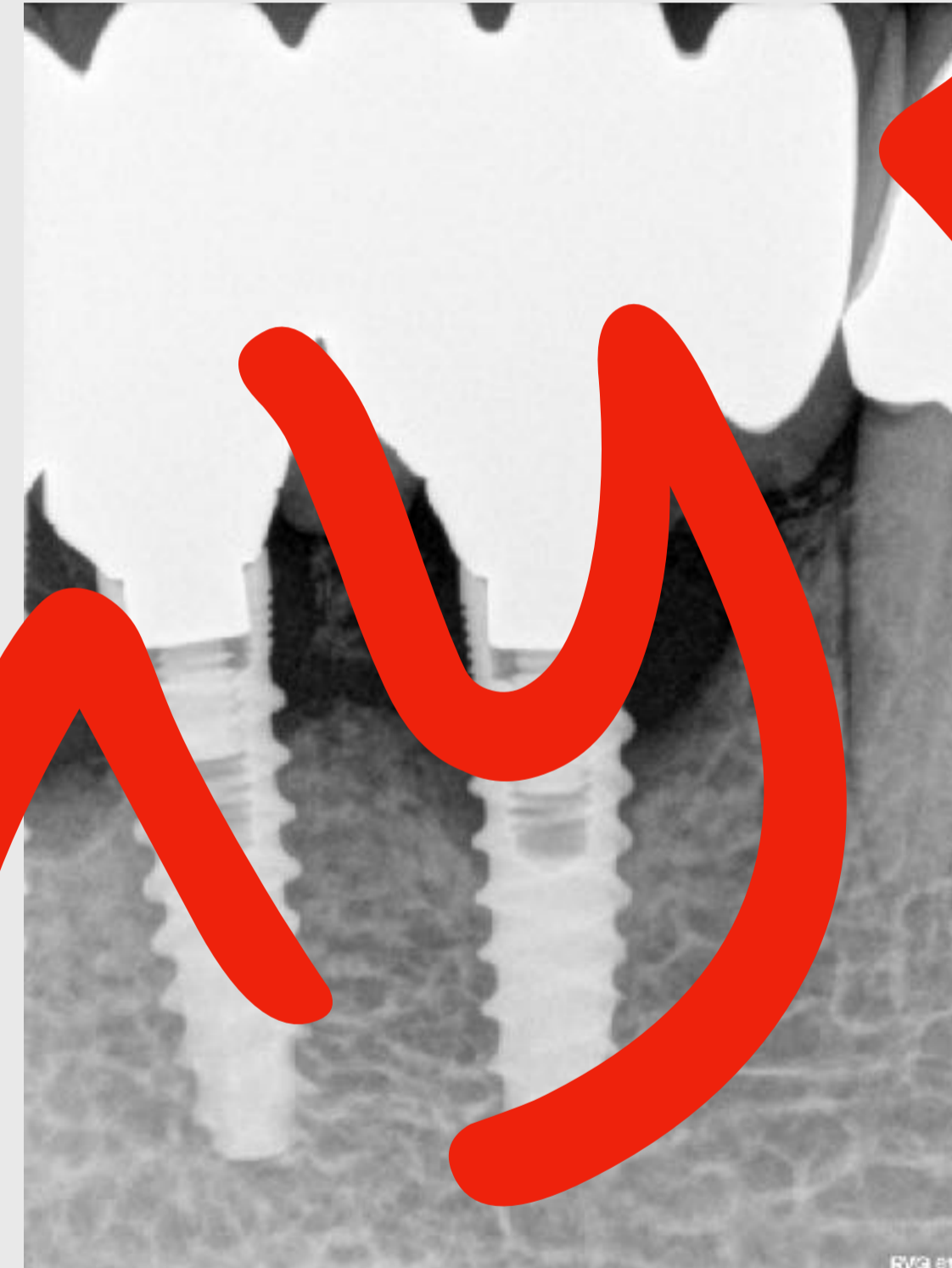
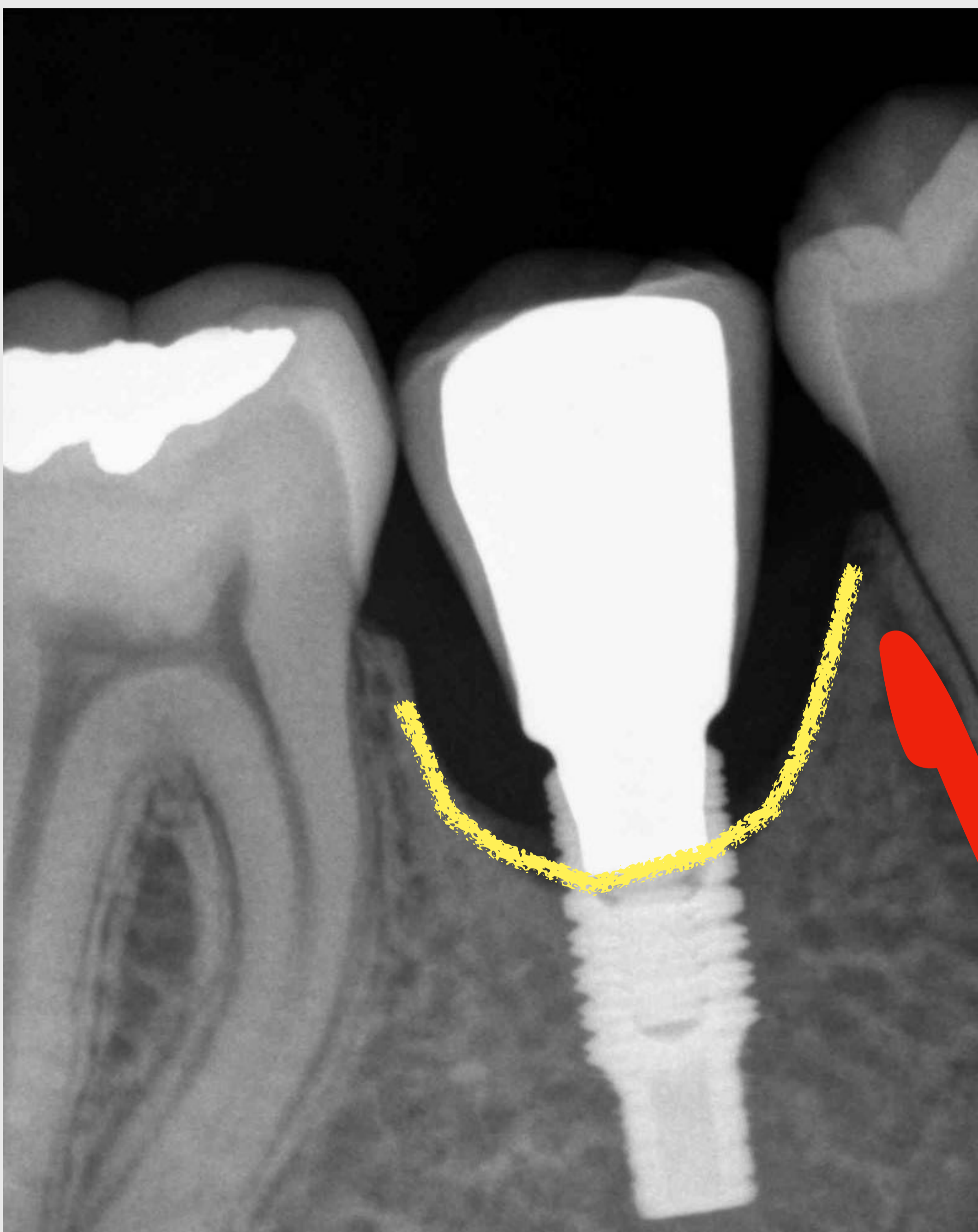
Dental implants have emerged as the standard of care for replacing a single tooth in healthy patients. In the US alone more than 25 million Americans are edentulous and 1.8 million are missing at least one tooth. According to the Lower group it is estimated that the number of dental implants received by patients will increase by 200,000 each year, almost 50% annually.¹

An iDent[®] search will show that dental implants are now a 1.4 billion dollar industry and growing rapidly. The recent surge in implant dentistry can be closely associated with the reduction in price of cost. As the use of dental implants have increased and the look and skill of dentists, more and more patients are requesting dental implants as the permanent solution to their missing teeth. In 2015 general dentists (GPs) in the US served 1.6 million number of implant cases, which is

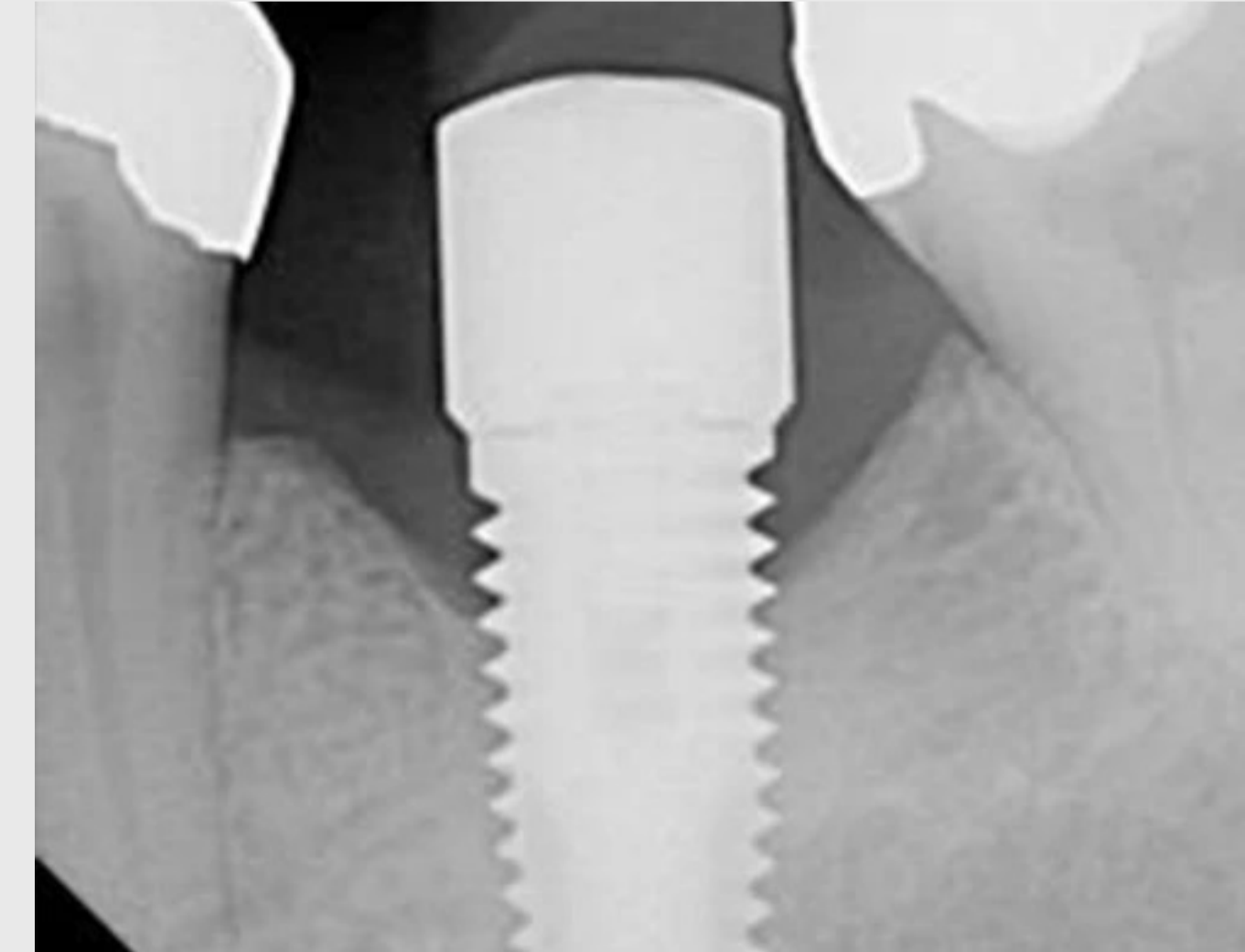
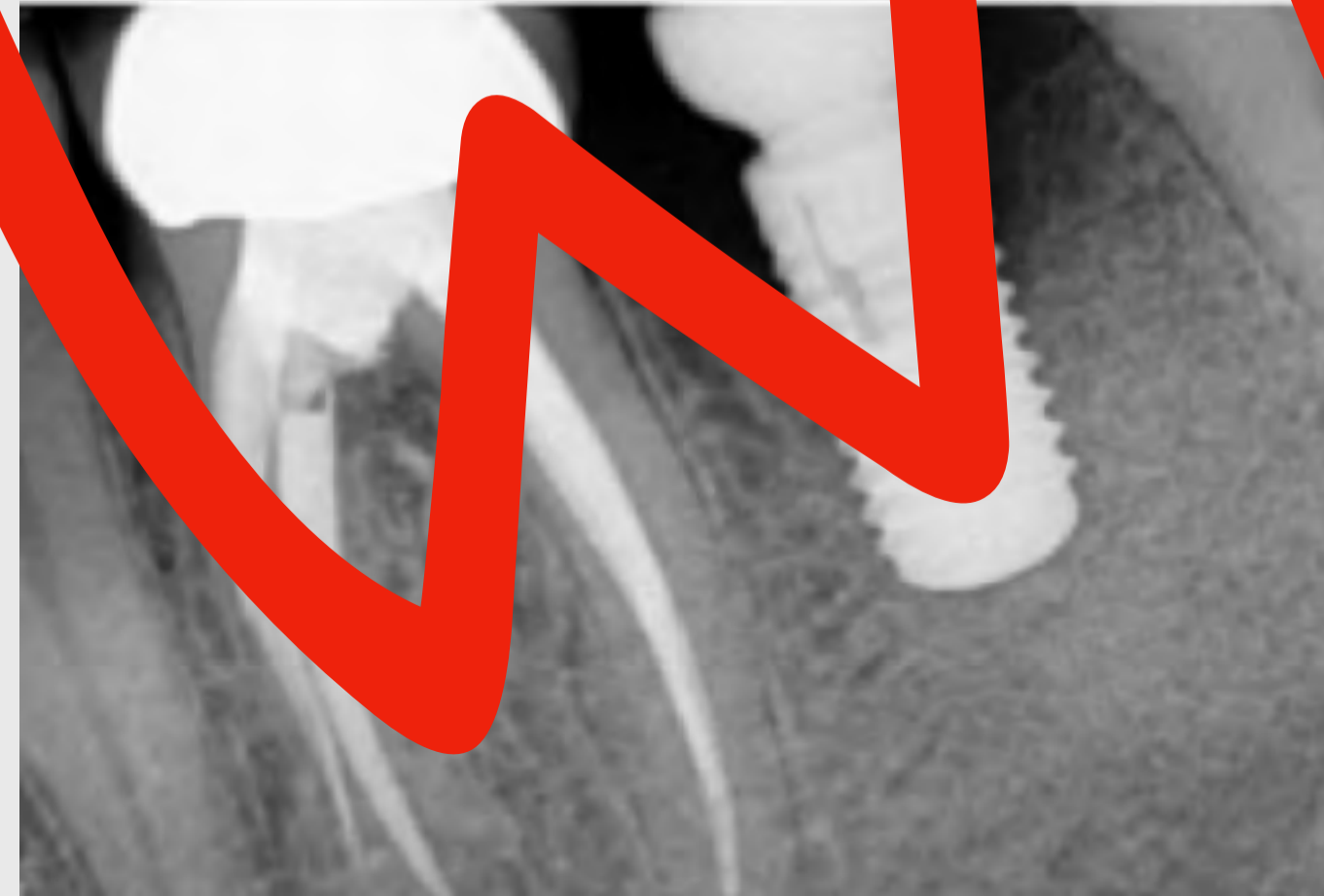
disrupted implant, leading to the loss of supporting bone. The treatment of this disease has become a hot topic for discussion. It occurs that at almost every conference, seminar, and journal meeting, there is at least one presenter discussing this topic.

There is a remaining job in the dental community that remains to be done in a room, and requires a consistent patient will get 9 different answers. These are often different treatments in country that can yield similar results. This fact is no exception. Non-surgical treatments, including mechanical debridement, localized and/or systemic antimicrobial therapy and the use of dental laser therapy have been researched and employed. In addition, surgical intervention with the use of bone graft agents, bone regeneration, occluding or retaining implant threads, soft tissue augmentation and more have been used. All these treatments are still undergoing long-term studies. To date there is no clear consensus on how to treat these cases.

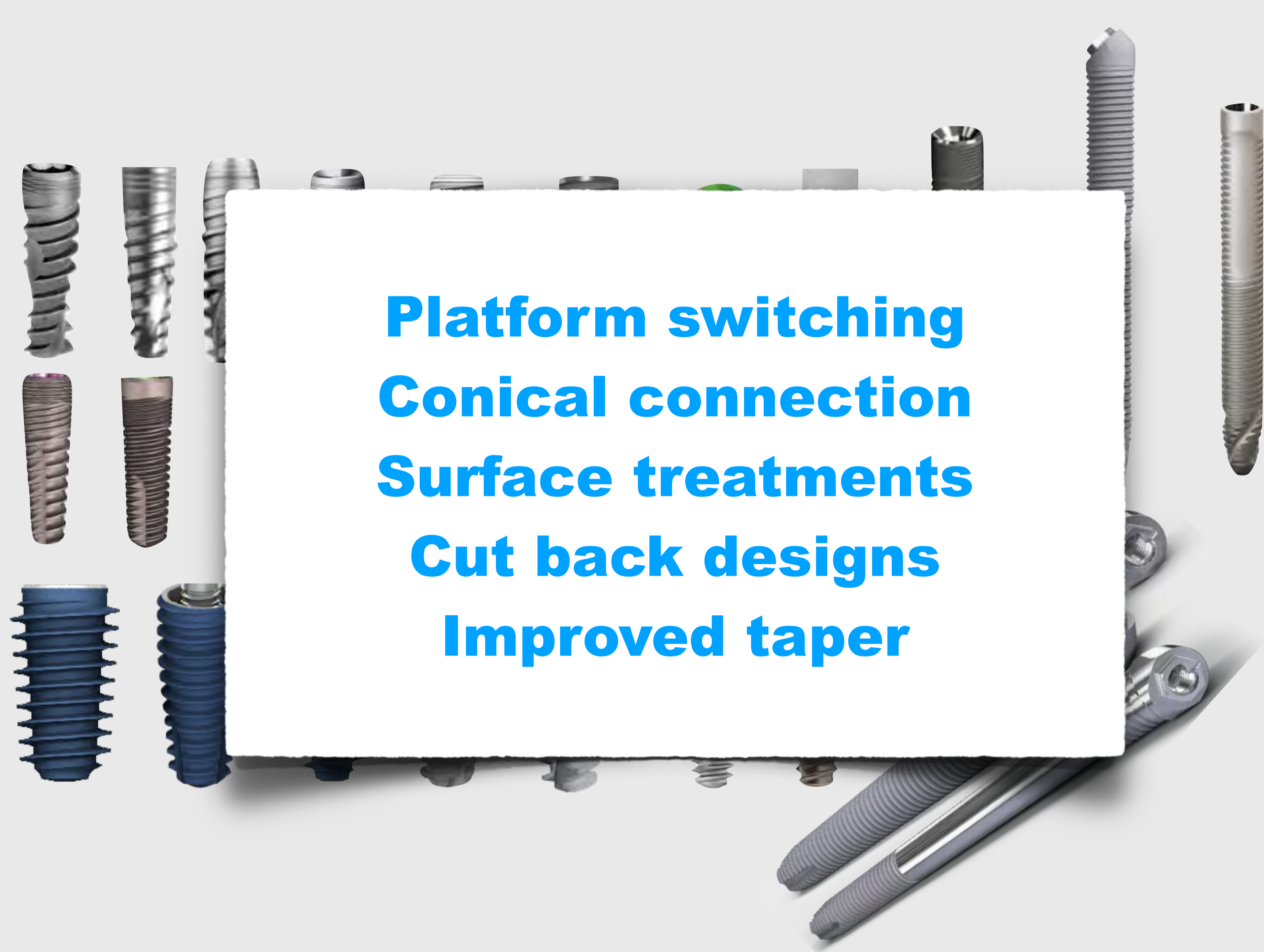
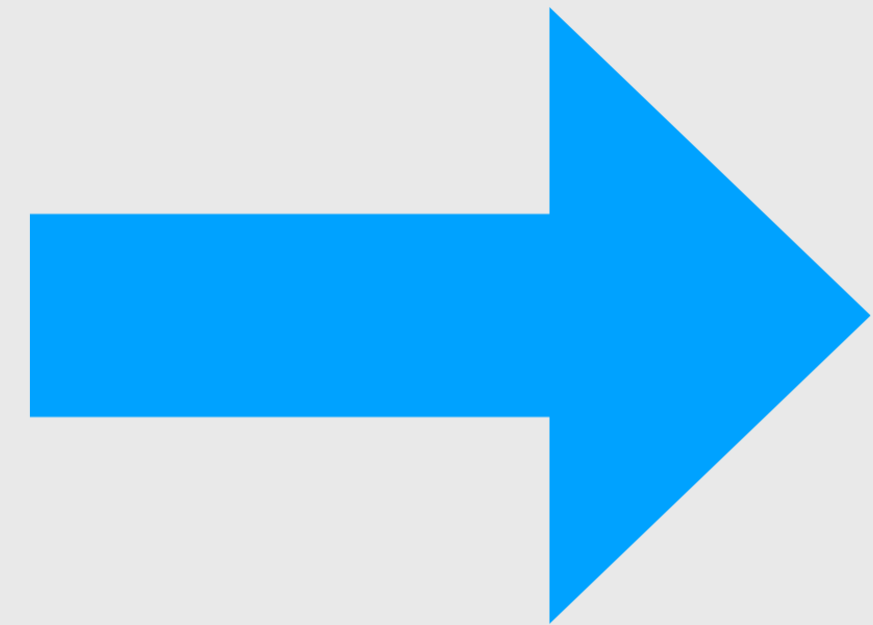
Peri-Implantitis



Die Back = Bone Loss



Older Designs



Platform switching
Conical connection
Surface treatments
Cut back designs
Improved taper

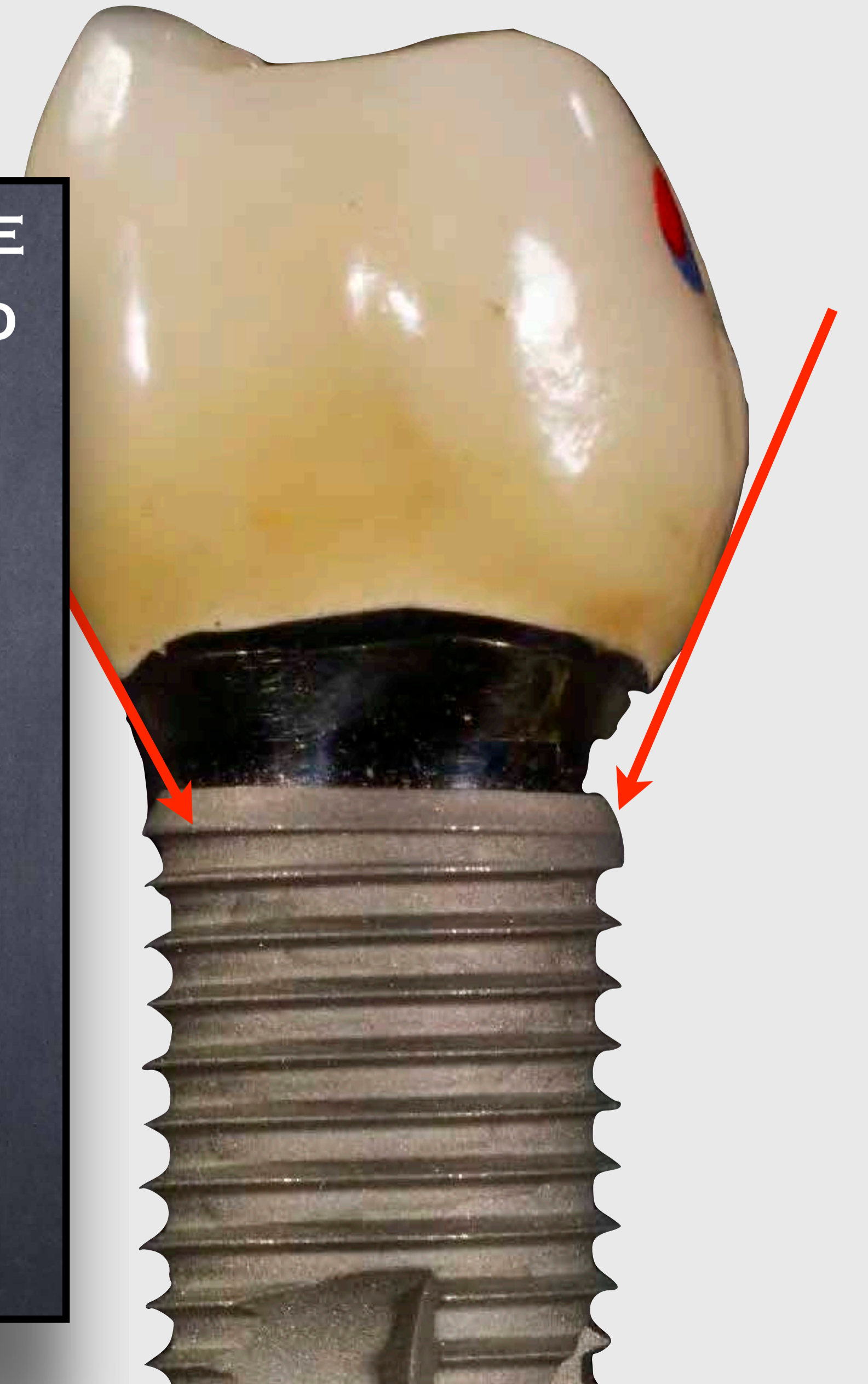
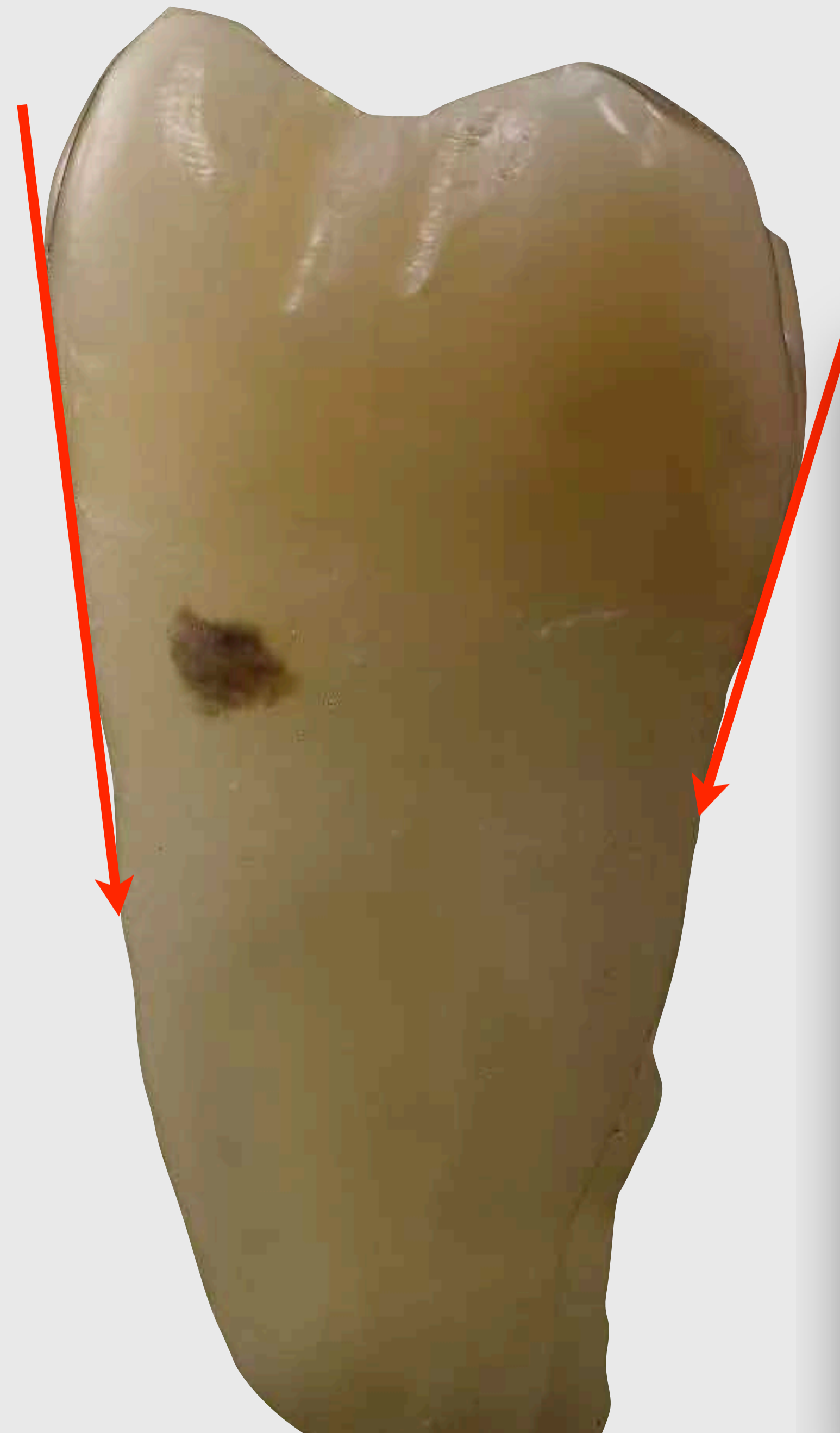
Newer Designs

Conceptual Changes

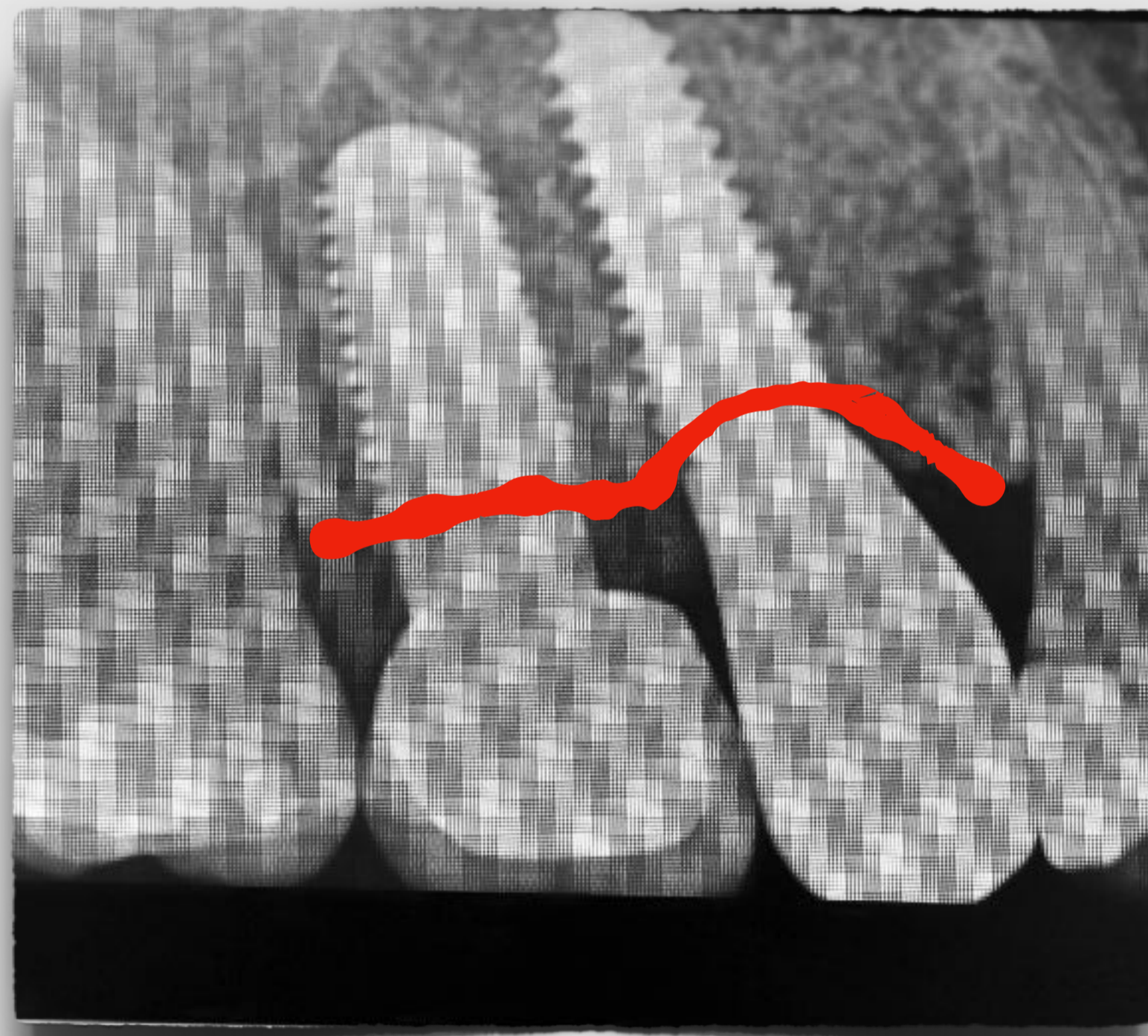
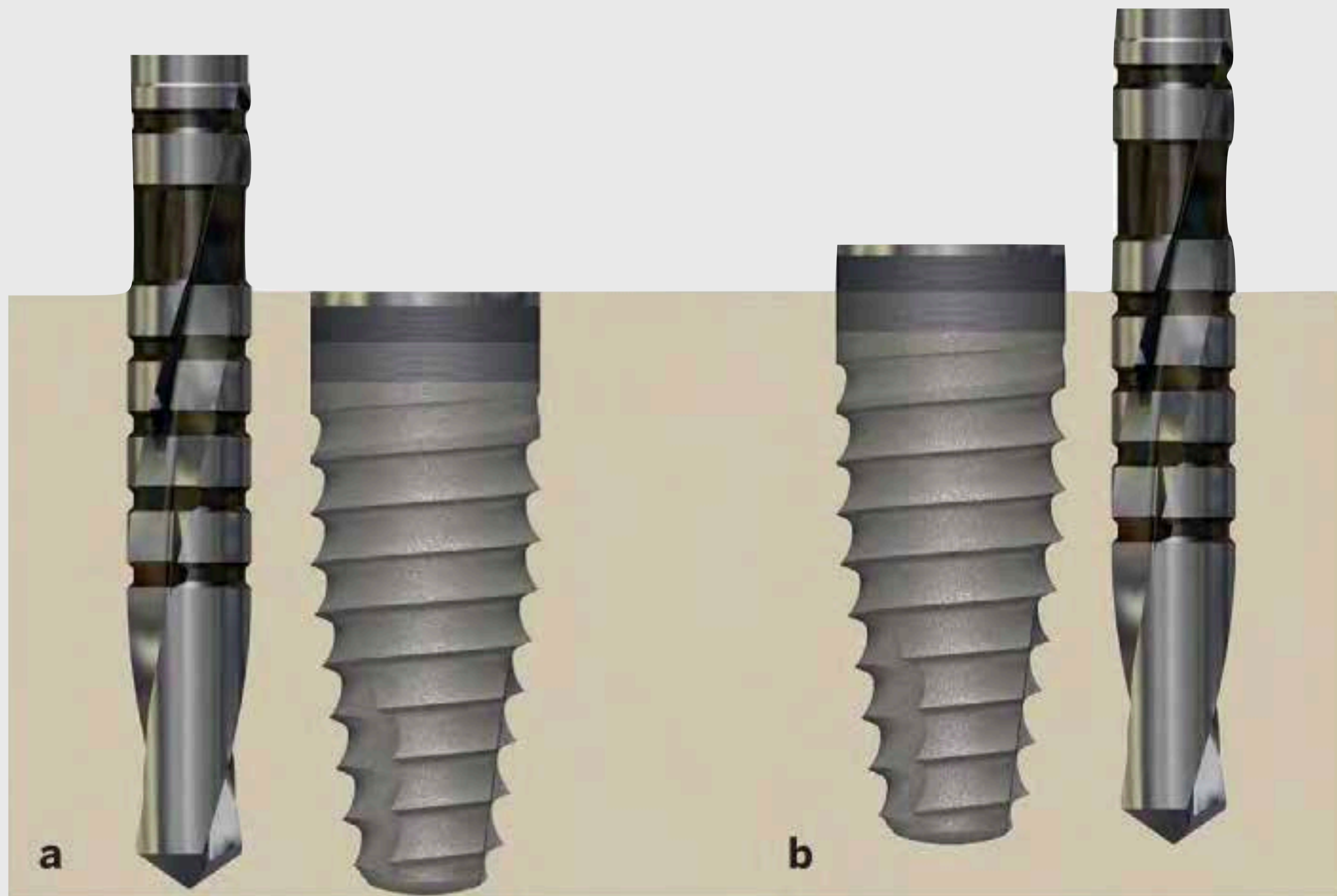
RESULTED FROM A MISTAKE WHEN WIDE IMPLANTS WERE USED AND **MIS-MATCHING** ABUTMENTS WERE PROVIDED TO THE CLINICIANS.

AFTER THESE ABUTMENTS WERE DELIVERED, DURING THE OBSERVATIONAL PERIOD, THE **MARGINAL BONE LOSS WAS NOT PRESENT** IN ALMOST EVERY CASE (LAZZARA & PORTER 2006).

- ✦ **SHIFTS THE INFLAMMATORY CELL INFILTRATE INWARD & AWAY FROM CRESTAL BONE**
- ✦ **DECREASES INFLUENCE OF MICRO GAP ON CRESTAL BONE**
- ✦ **MAINTENANCE OF BIOLOGIC WIDTH**
- ✦ **DECREASES STRESS LEVEL IN PERI IMPLANT BONE**



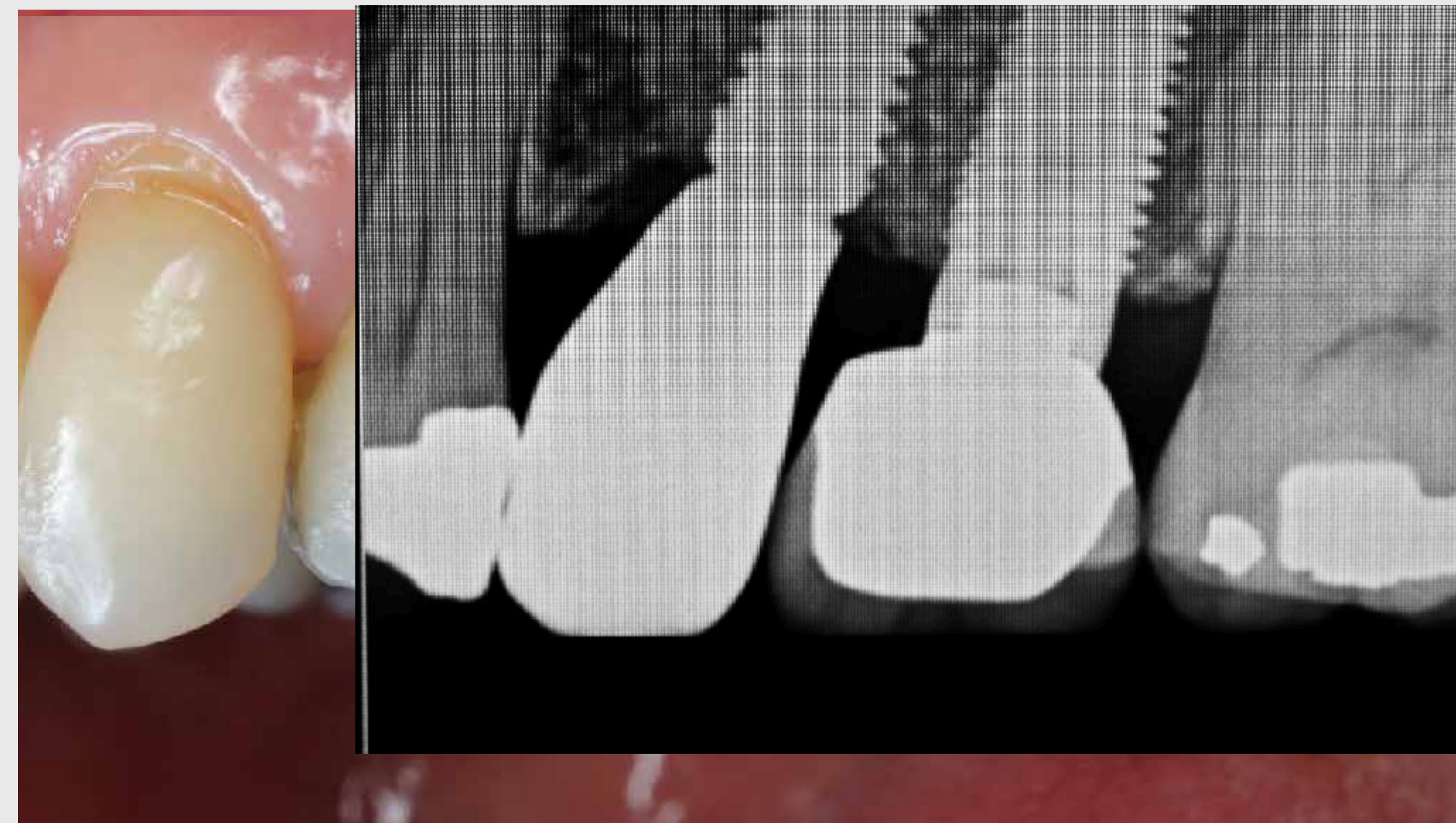
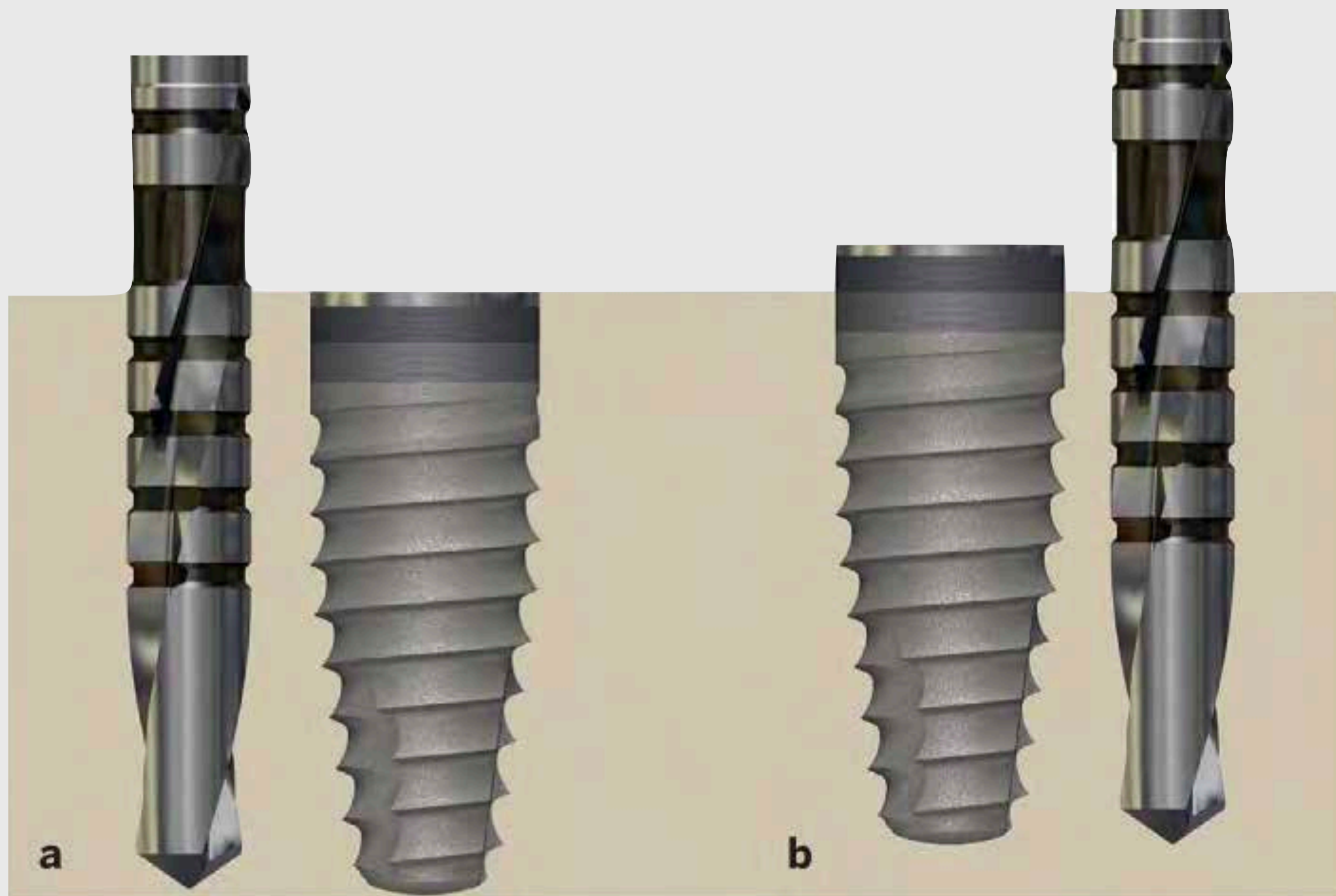
Conceptual Changes



2011

Implant Depth

Conceptual Changes



2021

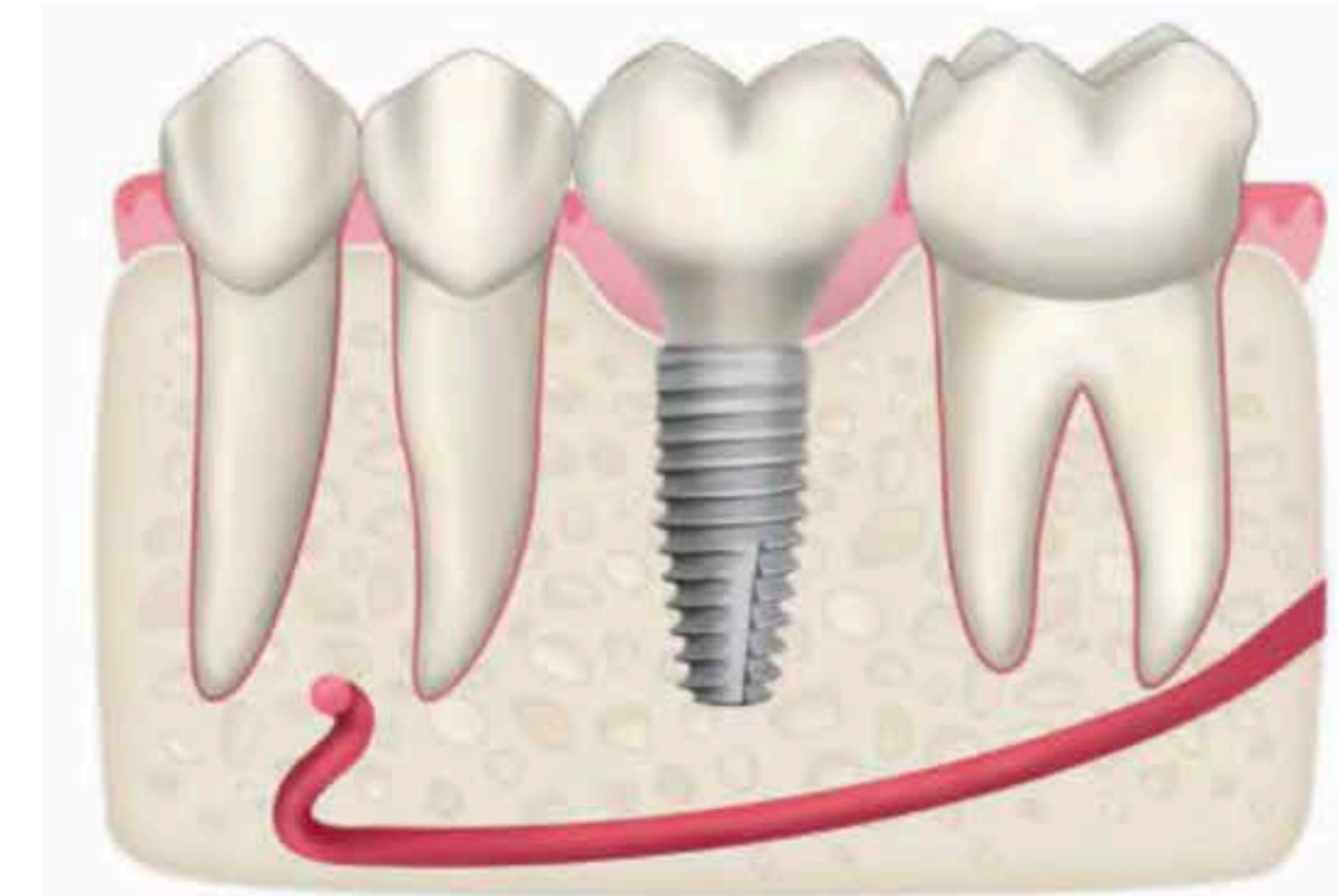
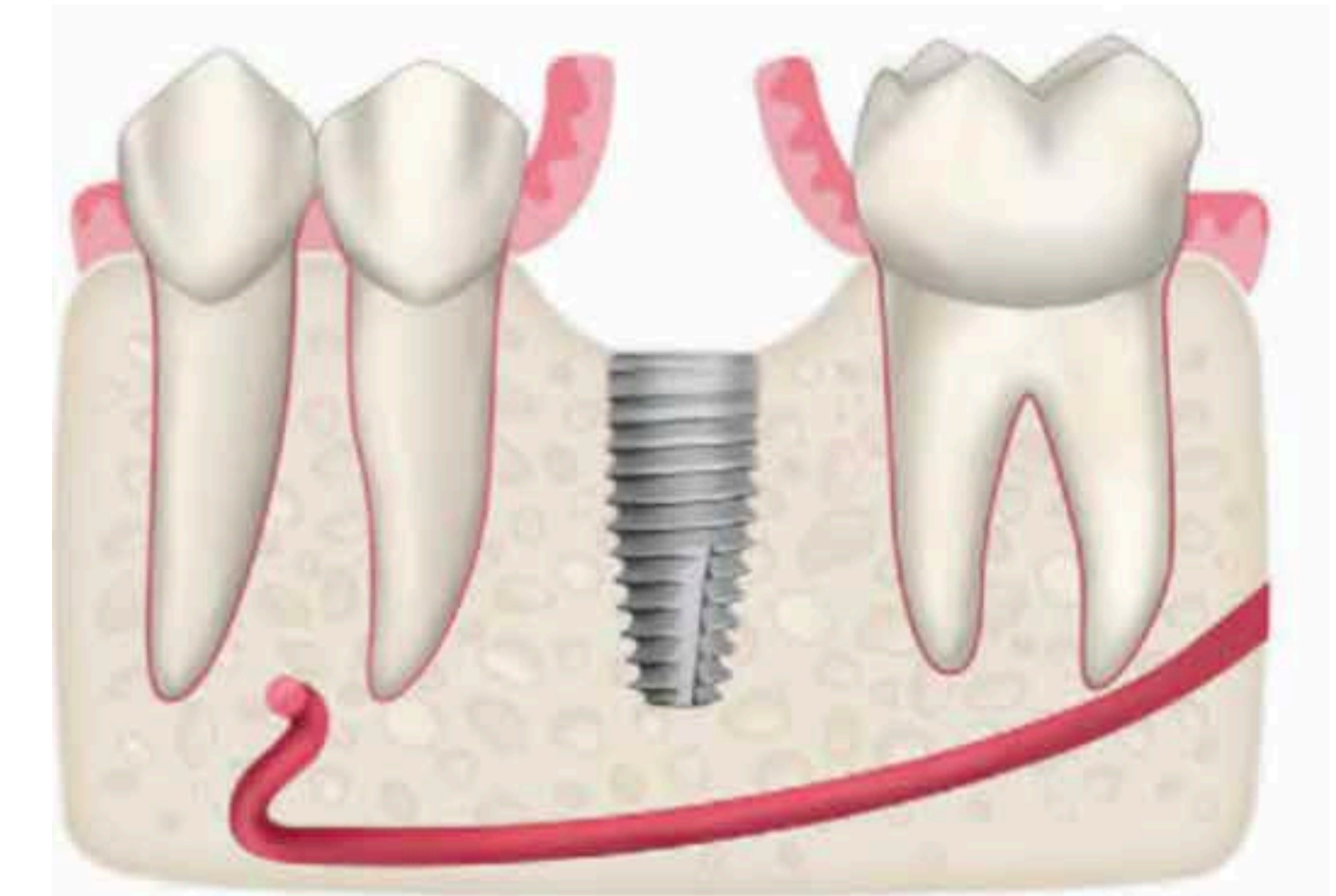
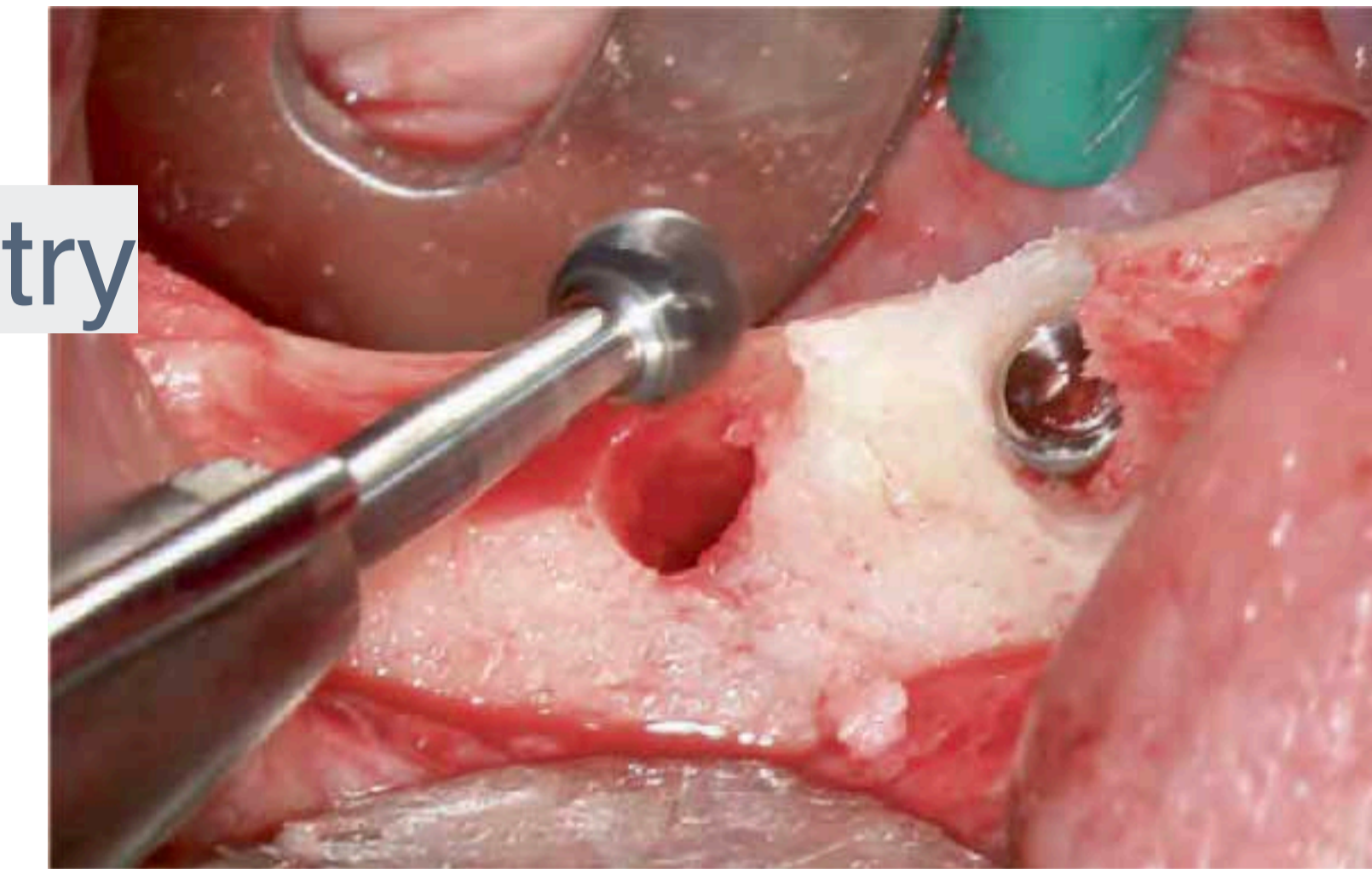
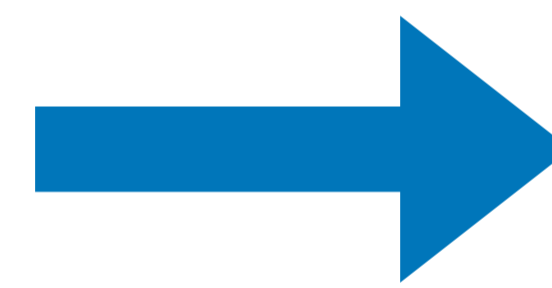
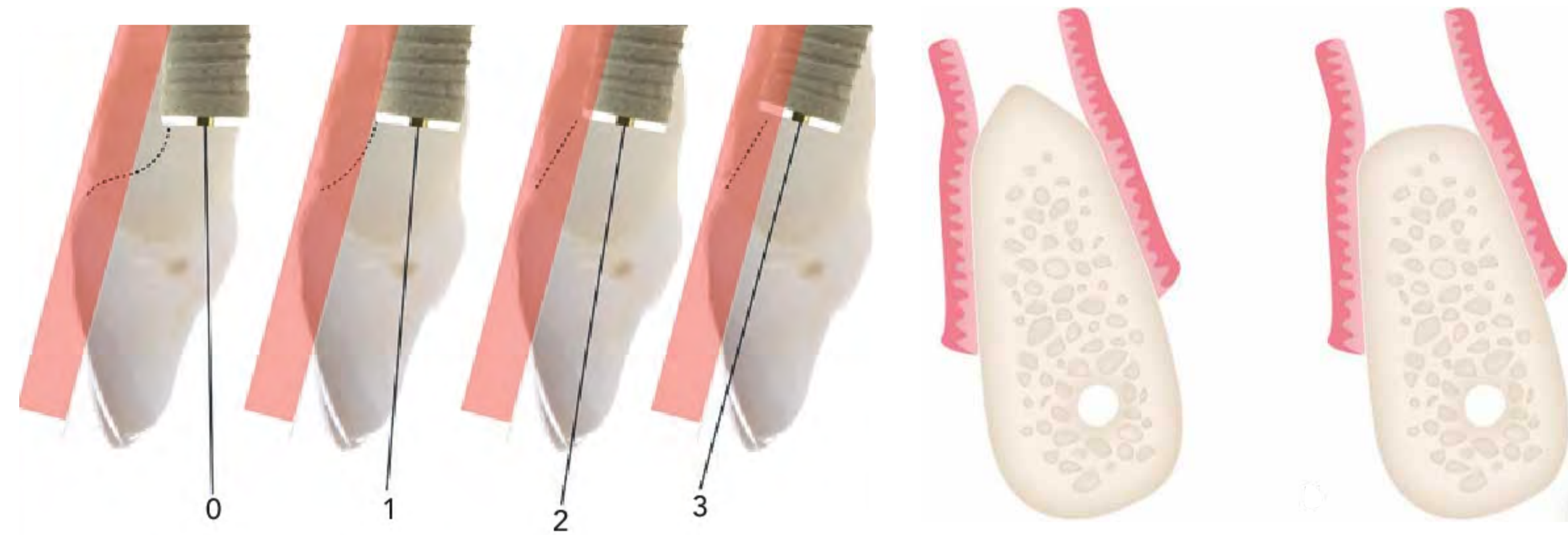
Implant Depth

The Impact of 3D Implant Position on Emergence Profile Design.

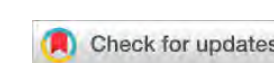
January 2021

The International journal of periodontics & restorative dentistry

Preparation



3D Position



Association of prosthetic angles of the Implant Supracrestal Complex with peri-implant tissue mucositis

Piboon Rungtanakiat¹ | Natchaya Thitaphanich¹ | Wareerat Chengprapakorn¹ |
Martin Janda² | Mansuang Arksomnukit¹ | Nikos Mattheos^{3,4}

¹Department of Prosthodontics, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand

²Department of Prosthodontics, Faculty of Odontology, Malmö University, Malmö, Sweden

³Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand

⁴Department of Dental Medicine, Karolinska Institute, Stockholm, Sweden

Correspondence

Nikos Mattheos, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Chulalongkorn University, 34 Henri Dunant Rd, Wangmai, Patumwan, Bangkok 10330, Thailand.
Email: nikos@mattheos.net

Funding information

Faculty of Dentistry and the 2nd Century Fund, Chulalongkorn University, Bangkok, Thailand

Abstract

Objectives: The aim of this study was to investigate the association of the Mucosal Emergence Angle (MEA) with peri-implant tissue mucositis.

Material and Methods: Forty-seven patients with 103 posterior bone level implants underwent clinical and radiographic examination. Three-dimensional data from Cone Beam Computer Tomography and Optica Scan were transposed. Three angles were defined: MEA, Deep Angle (DA) and Total Angle (TA) and measured at six sites for each implant.

Results: There was a significant correlation between MEA and Bleeding on Probing for all sites with an overall odds ratio of odd ratio 1.07 (95% confidence interval [CI] 1.05–1.09, $p < 0.001$). Sites with MEA $\geq 30^\circ$, 40° , 50° , 60° , and 70° had a higher risk for bleeding with an odds ratio of 3.1, 5, 7.5, 11.4 and 33.55, respectively. When all 6 sites of an implant prostheses had MEA $\geq 40^\circ$, the risk of having bleeding at all 6 sites was 9.5 times higher (95% CI 1.70–52.97, $p = 0.010$).

Conclusions: Maintaining MEA no wider than 30° – 40° is advisable, while the aim should be to keep this angle as narrow as clinically feasible. Registered in Thai Clinical Trials Registry: <http://www.thaiclinicaltrials.org/show/TCTR20220204002>.

KEYWORDS

dental implants, emergence angle, Implant Supracrestal Complex, peri-implant tissue

1 | INTRODUCTION

There is an emerging body of evidence pointing towards significant interrelations between the condition of the peri-implant tissue and the design of the prosthetic elements (Mattheos, Janda, et al., 2021). Three cross-sectional studies (Katafuchi et al., 2018; Majzoub et al., 2021; Yi et al., 2020) have suggested that prosthesis contour of more than 30° as it appears in periapical radiographs, is correlated with increased risk for peri-implantitis in bone level implants. Two

cross sectional studies which followed similar methodology did not confirm the correlation of wide contour with peri-implantitis (Inoue et al., 2020; Lops et al., 2022). Furthermore, convexity of the prosthesis profile has been correlated with increased recession (Siegenthaler et al., 2022), marginal bone loss (Valente et al., 2020) and peri-implantitis when combined with overcontouring of the prosthesis (Yi et al., 2020). At the same time, defining the complex three-dimensional (3D) structure of the prosthesis contour solely by means of the 2-dimensional interproximal projection on periapical

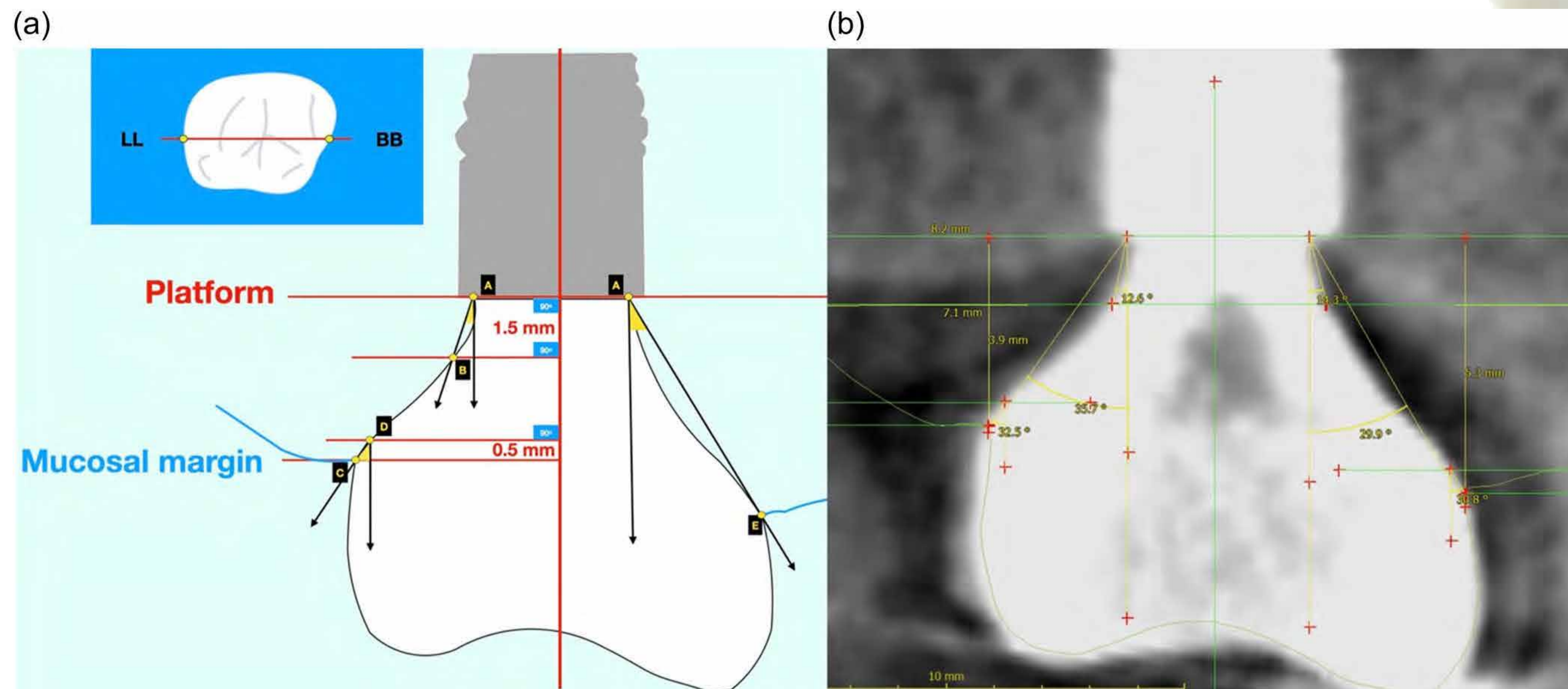
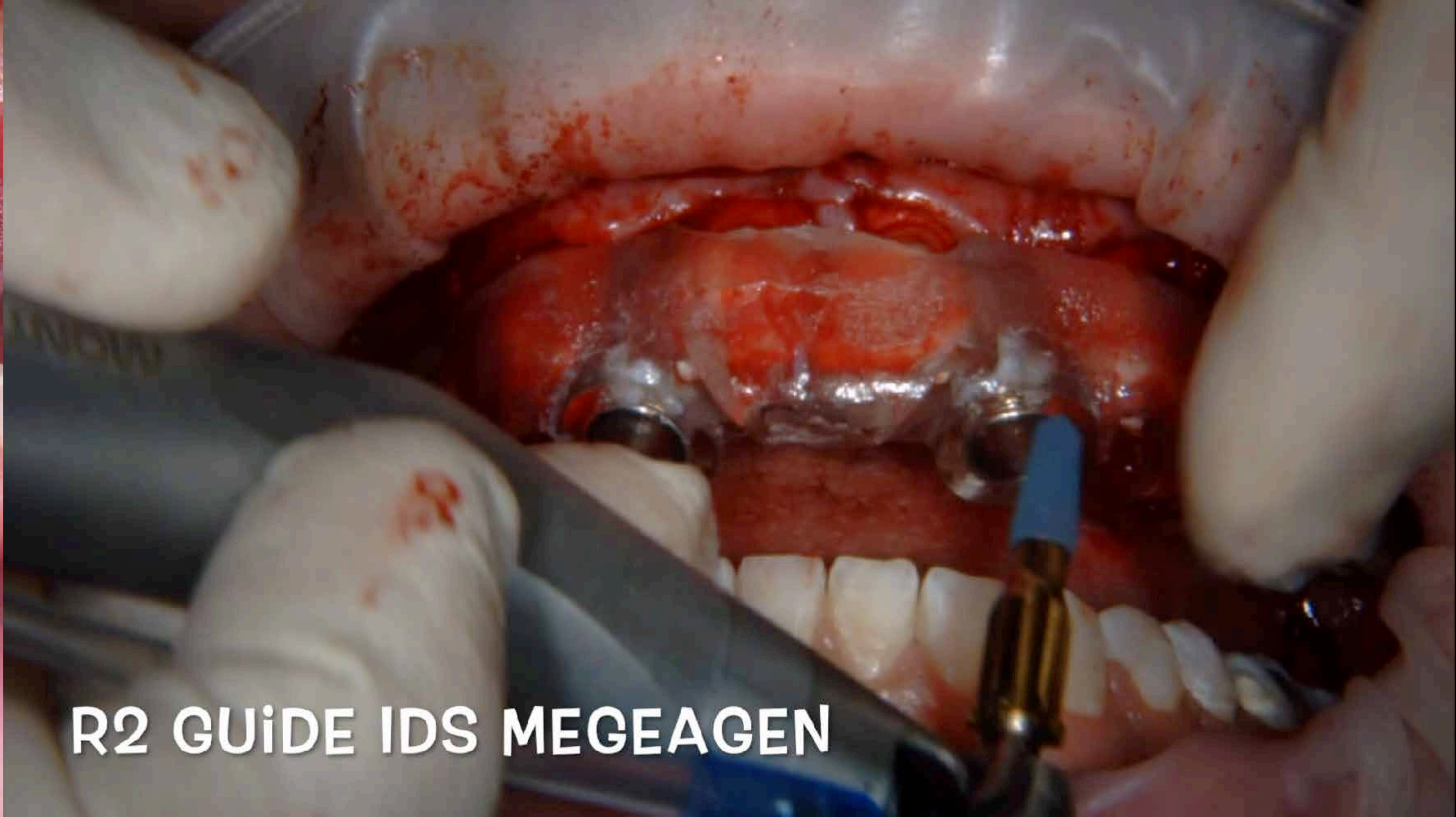


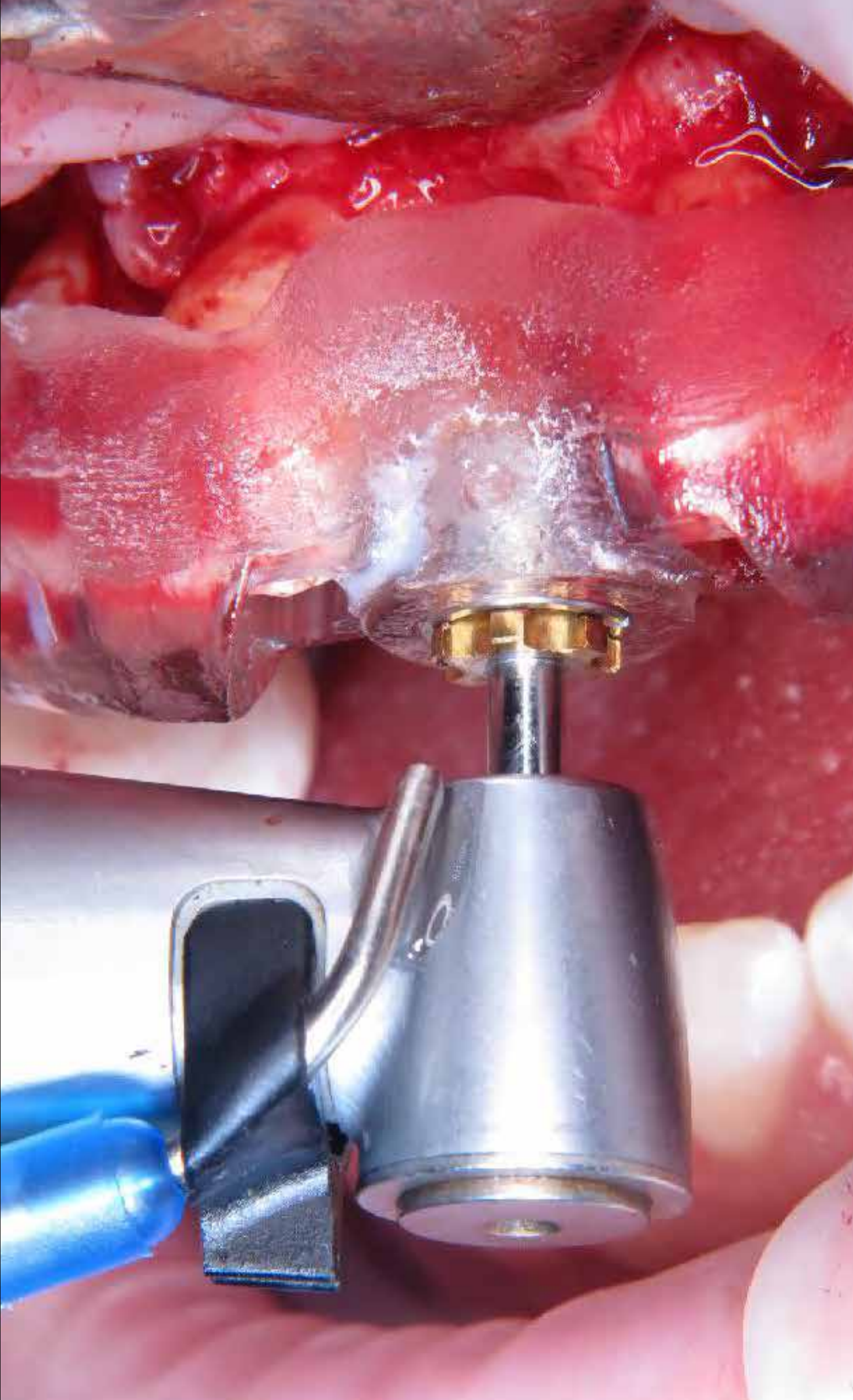
FIGURE 2 (a) Buccal–Palatal slice and definition of 4 horizontal planes perpendicular to implant axis, 5-points (A-E) and the respective 3 angles measured on each side (six sites per implant). (b) sample of actual radiographic measurement screen.

Conclusions: Maintaining MEA no wider than 30° – 40° is advisable, while the aim should be to keep this angle as narrow as clinically feasible.

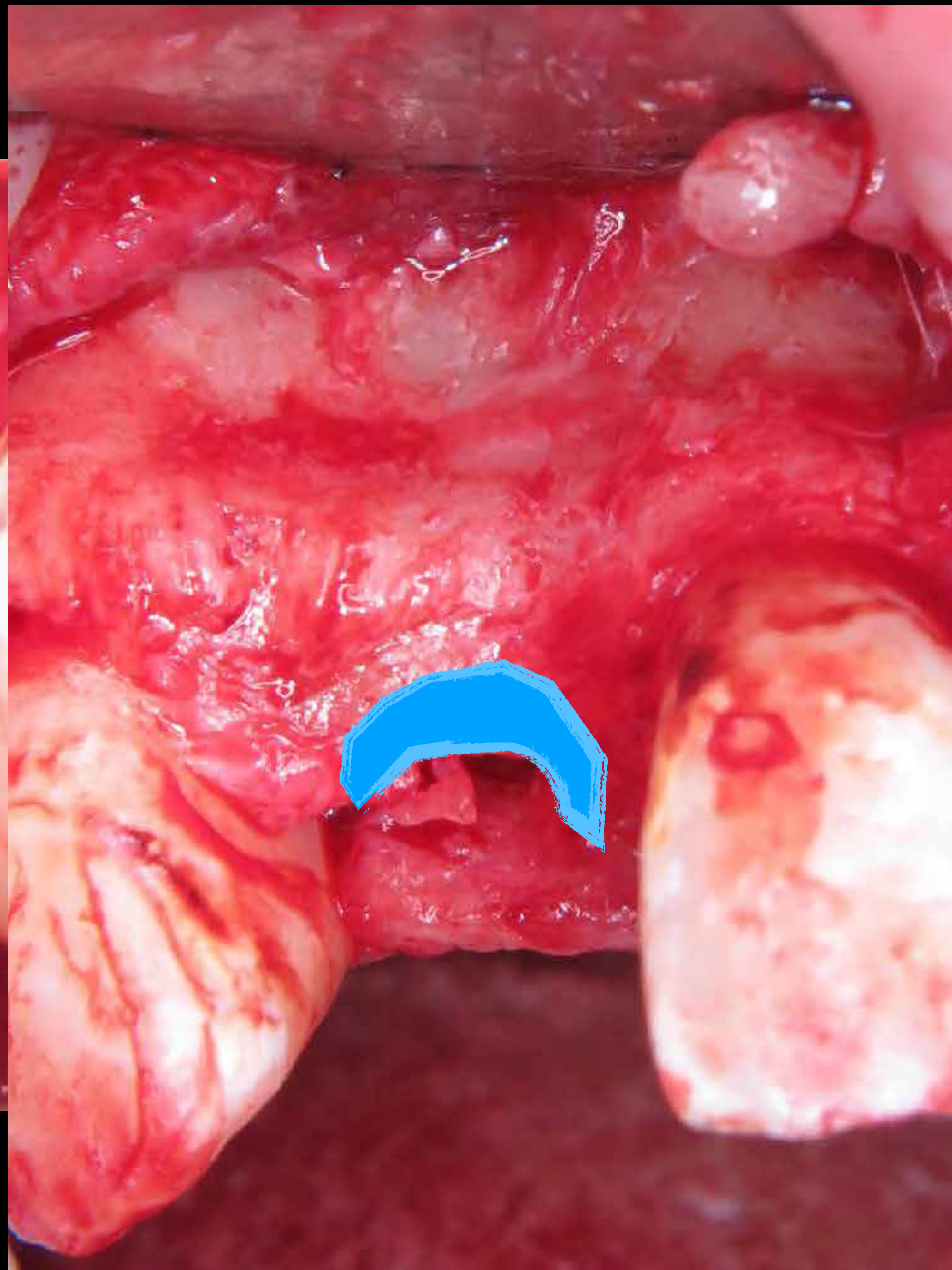
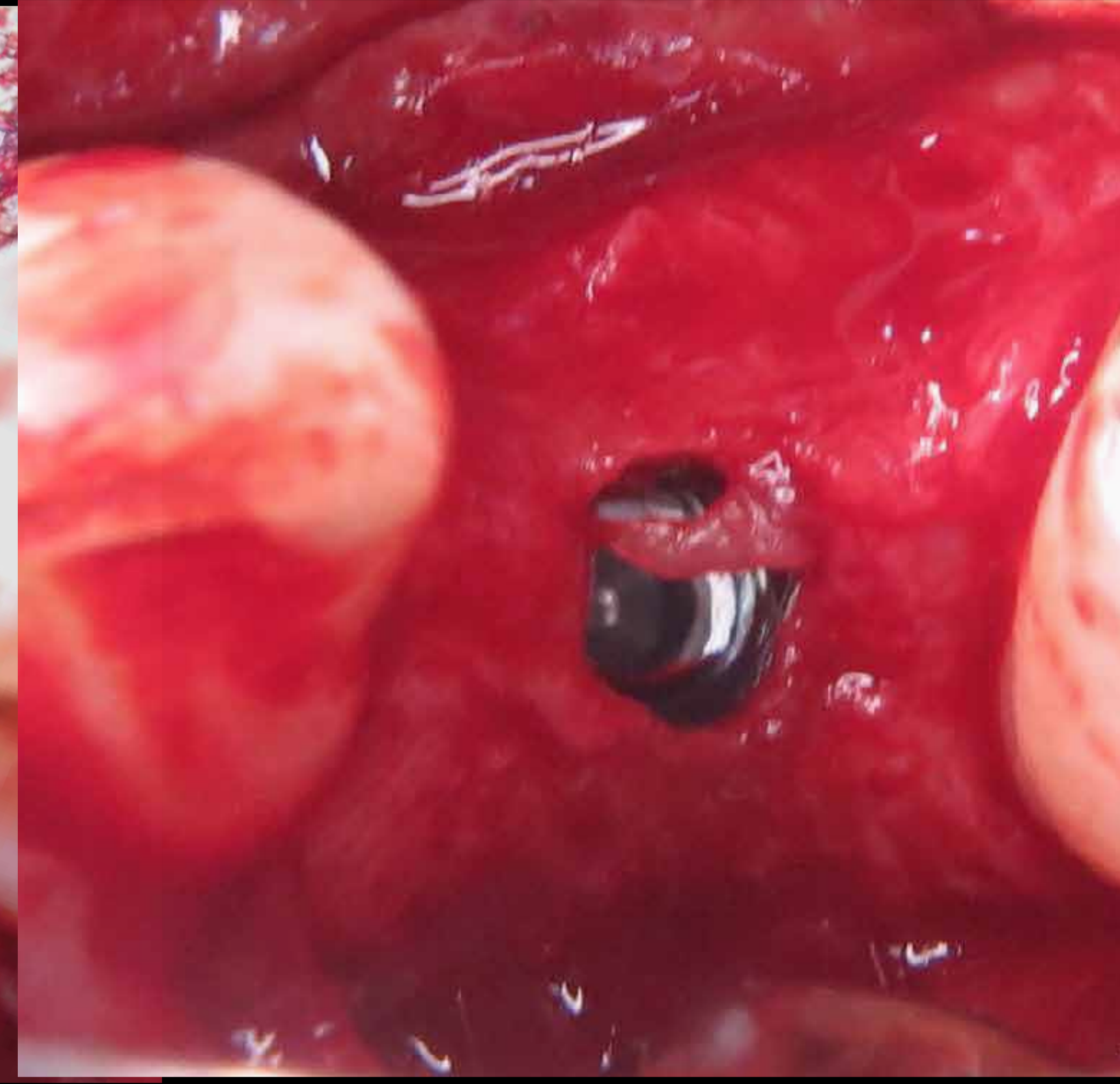
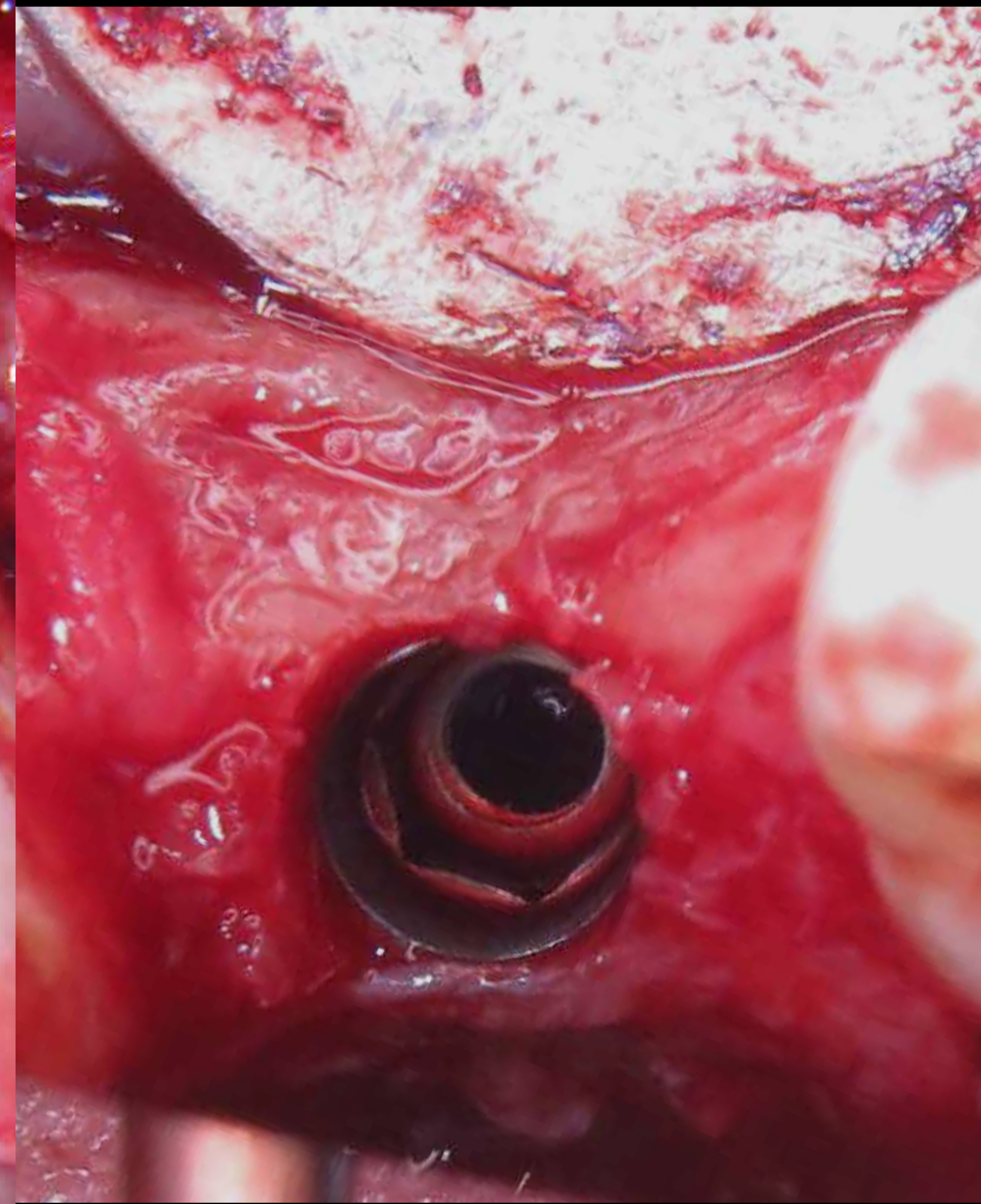
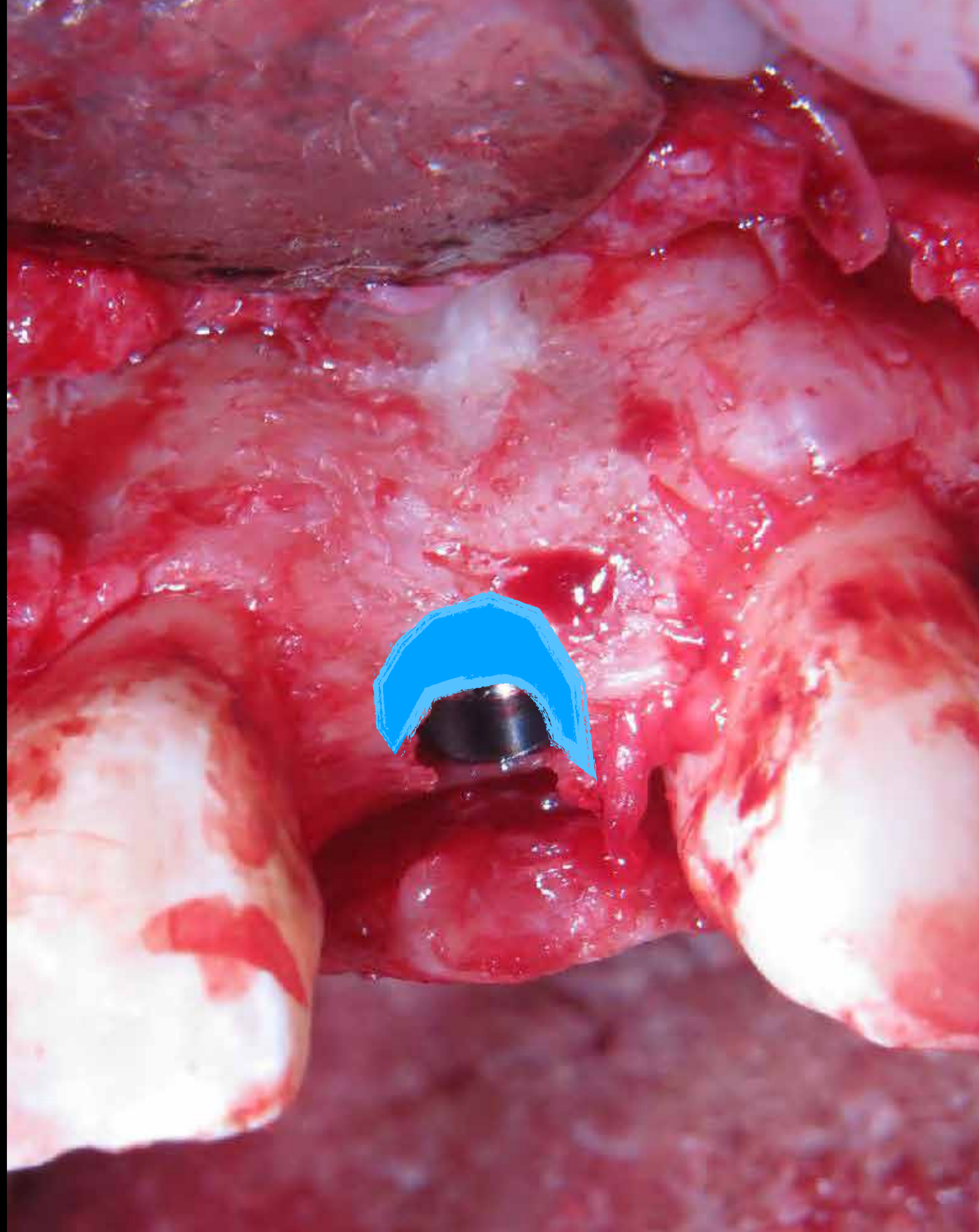
What has changed in
osteotomy preparation?

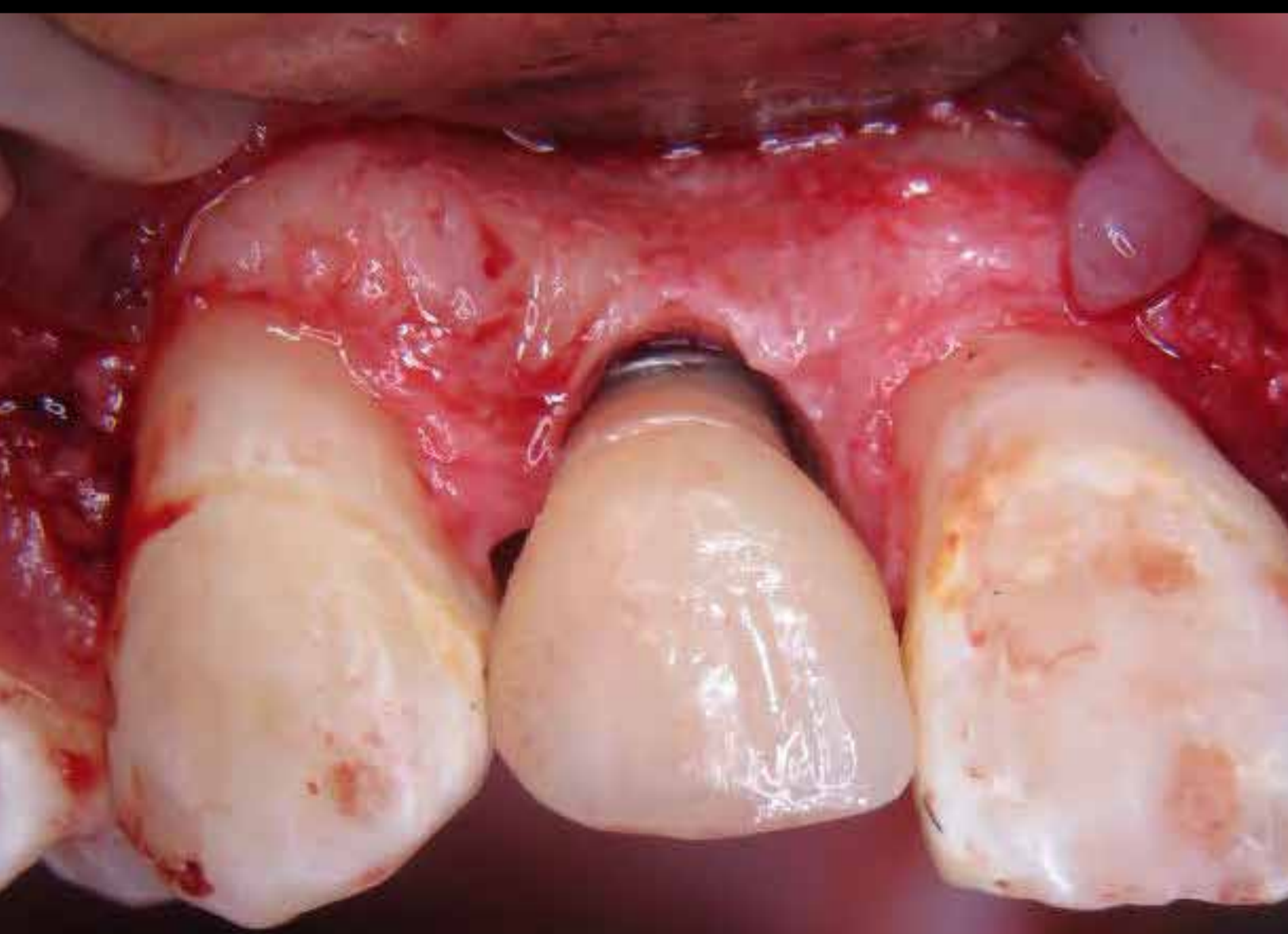


R2 GUIDE IDS MEGEAGEN



Lack of Profile



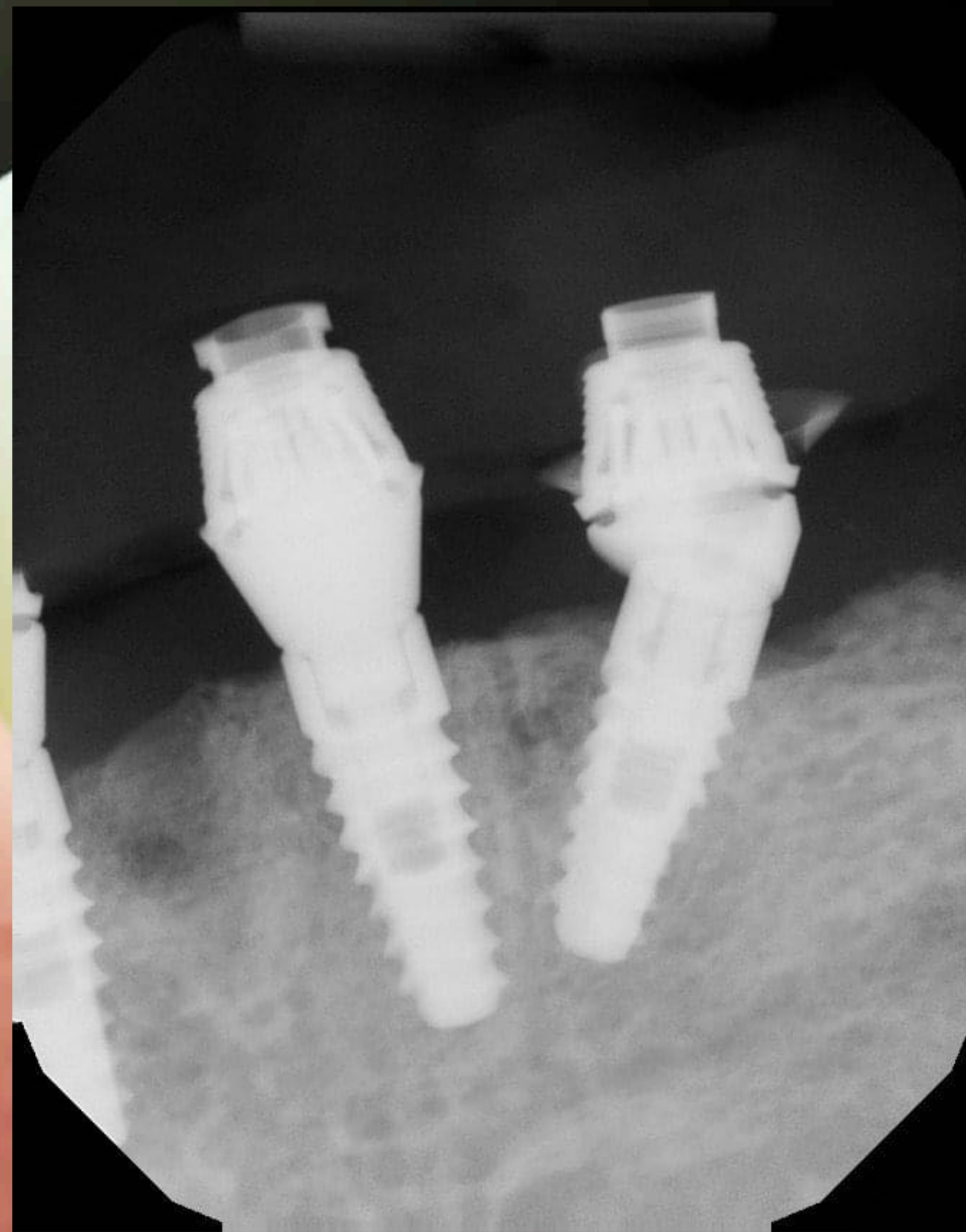
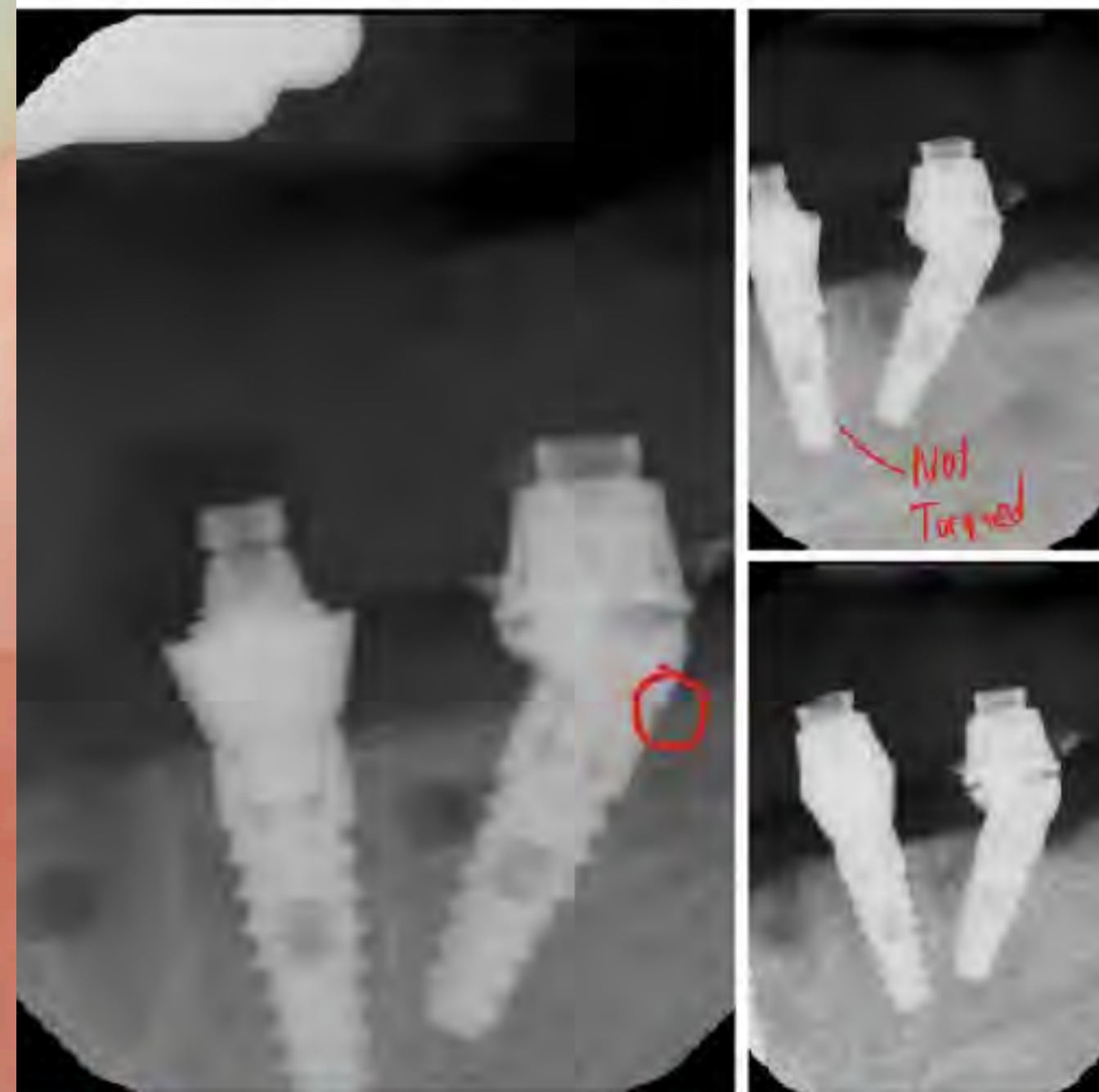


BONE PROFILE



7 YEAR POST OP

PSA regarding Smile Loc. These MUA's are very technique sensitive. I have been using Biohorizons forever and am profiling the same was I always did. If you look at x-ray # 1 the MUA at the day of surgery appears seated. The next pa is at 3 months post op. Notice the distal bone loss. The prosthesis w... See more

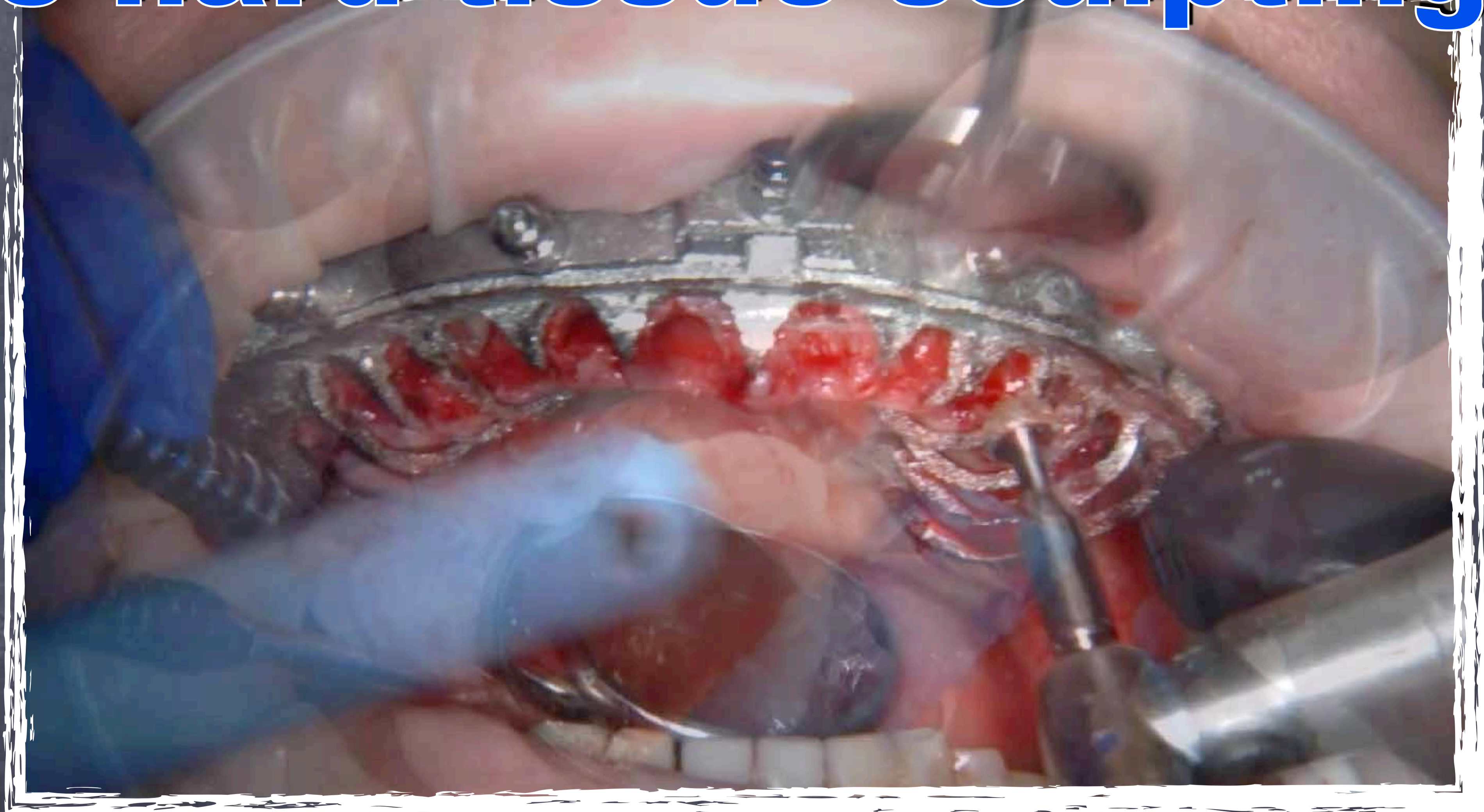


Lack of Bone Profiling - Incomplete Seating

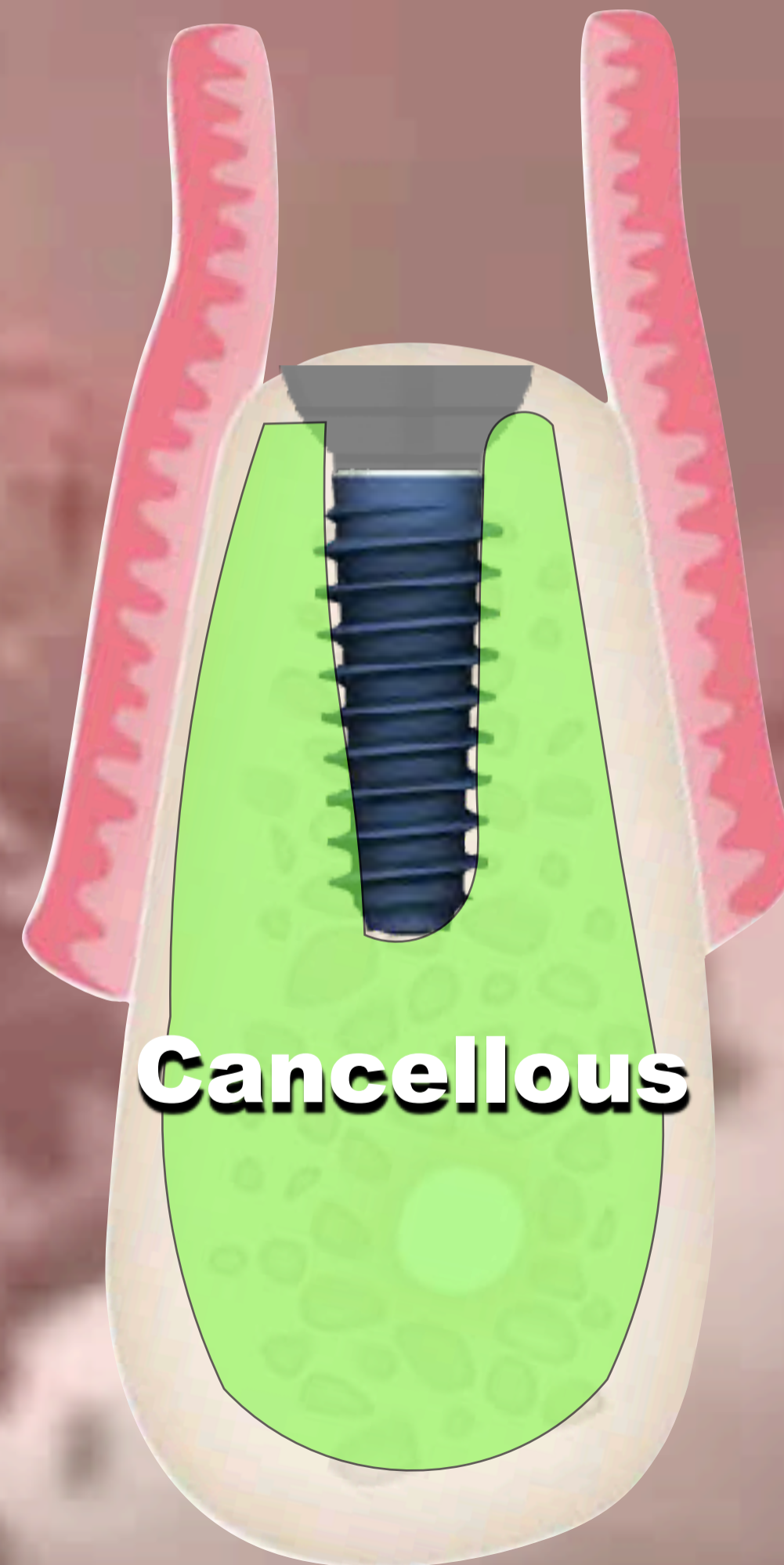
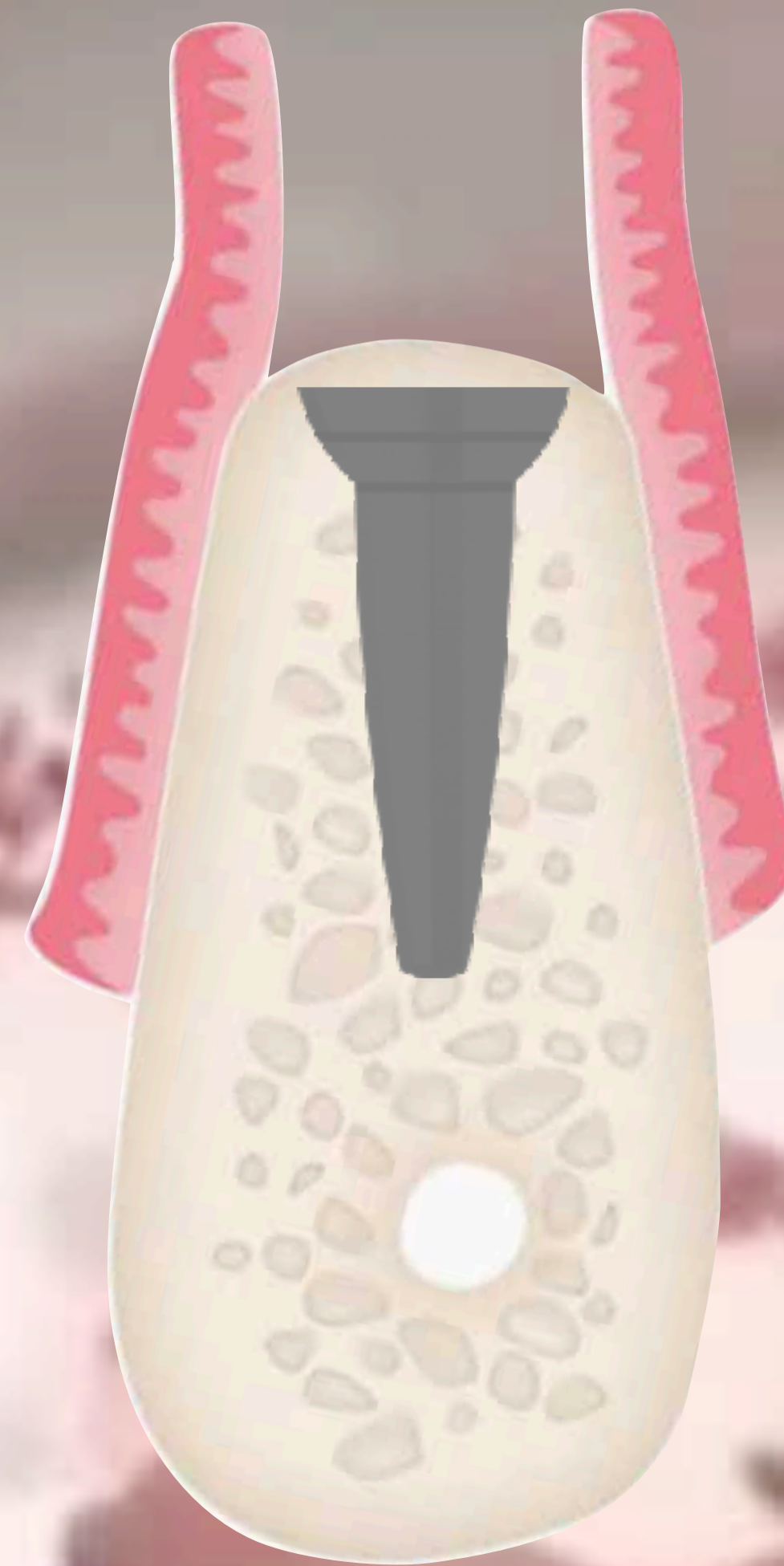
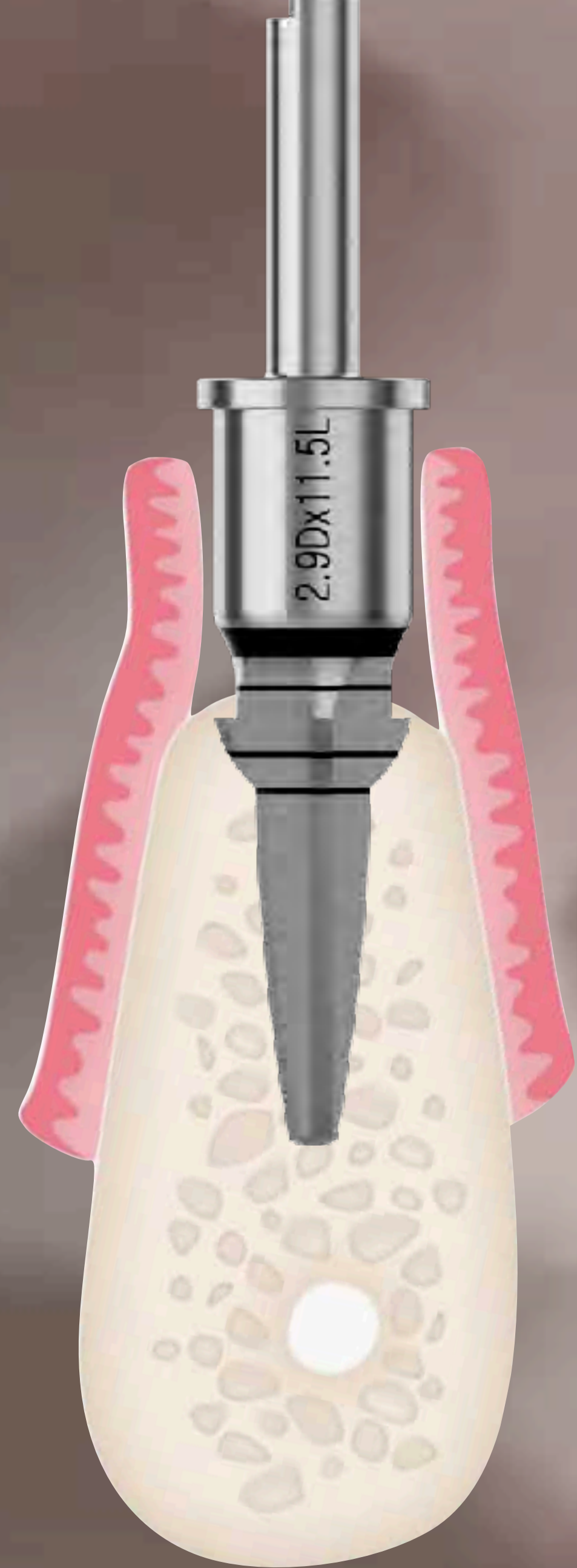
New Concept - Anatomic hard tissue sculpting

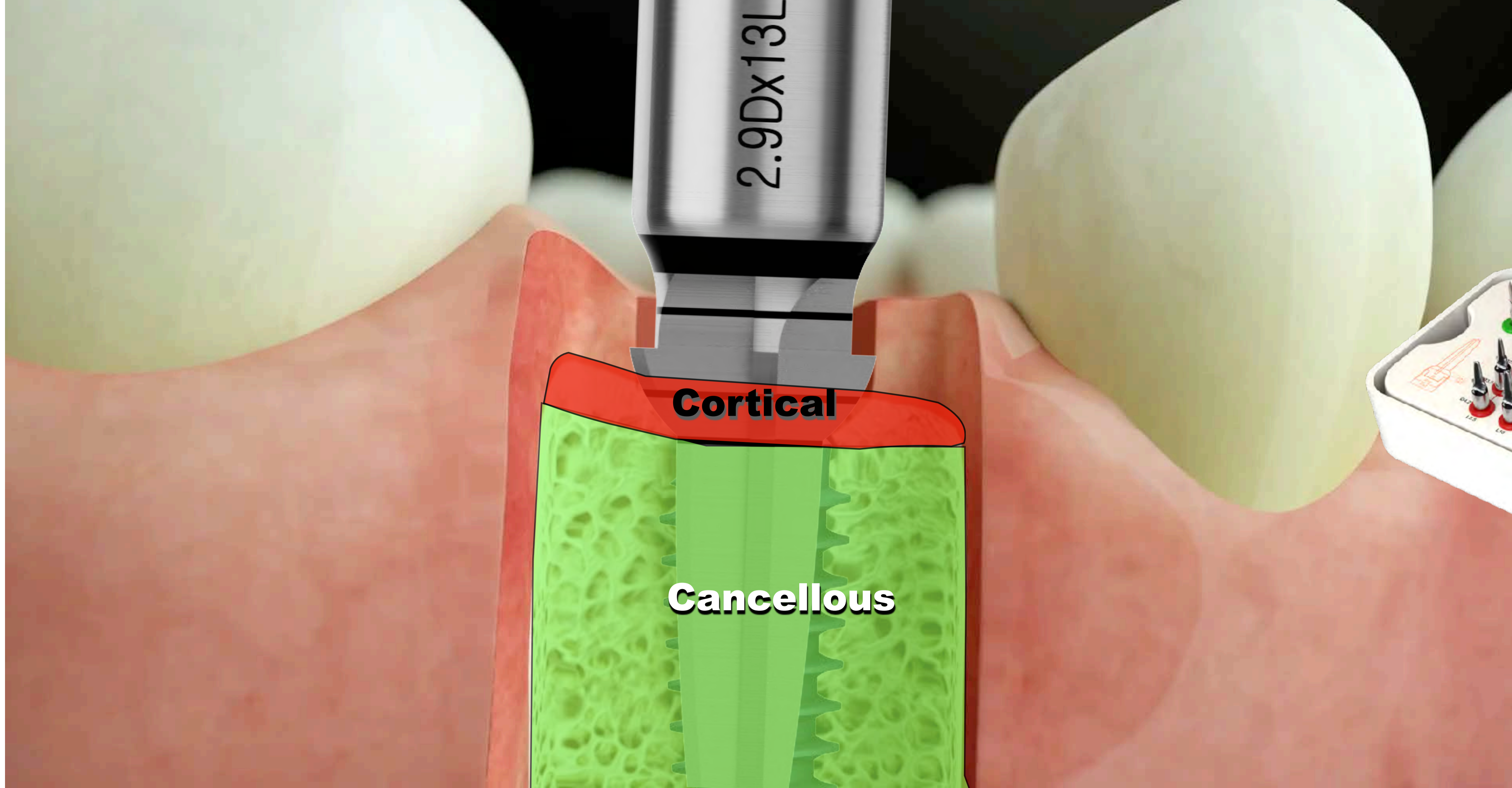


Scalloped
Guide



Maurice Salama, DMD;
Prof. Dr. Alessandro Pozzi;
Wendy AuClair-Clark, DDS,
Marko Tadros, DMD;
Lars Hansson, CDT, FICOI;
Pinhas Adar, MDT, CDT



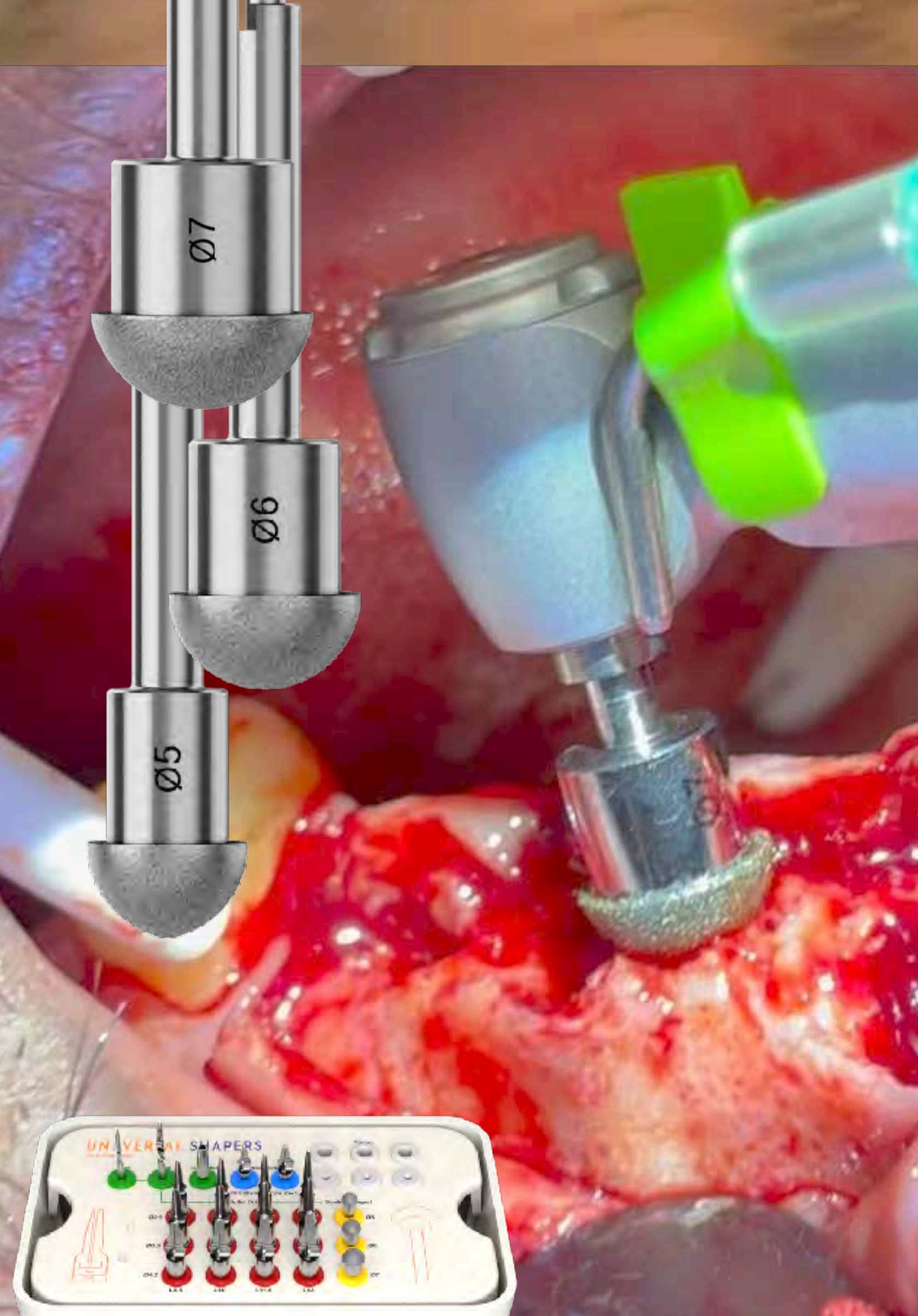


Releasing Zone

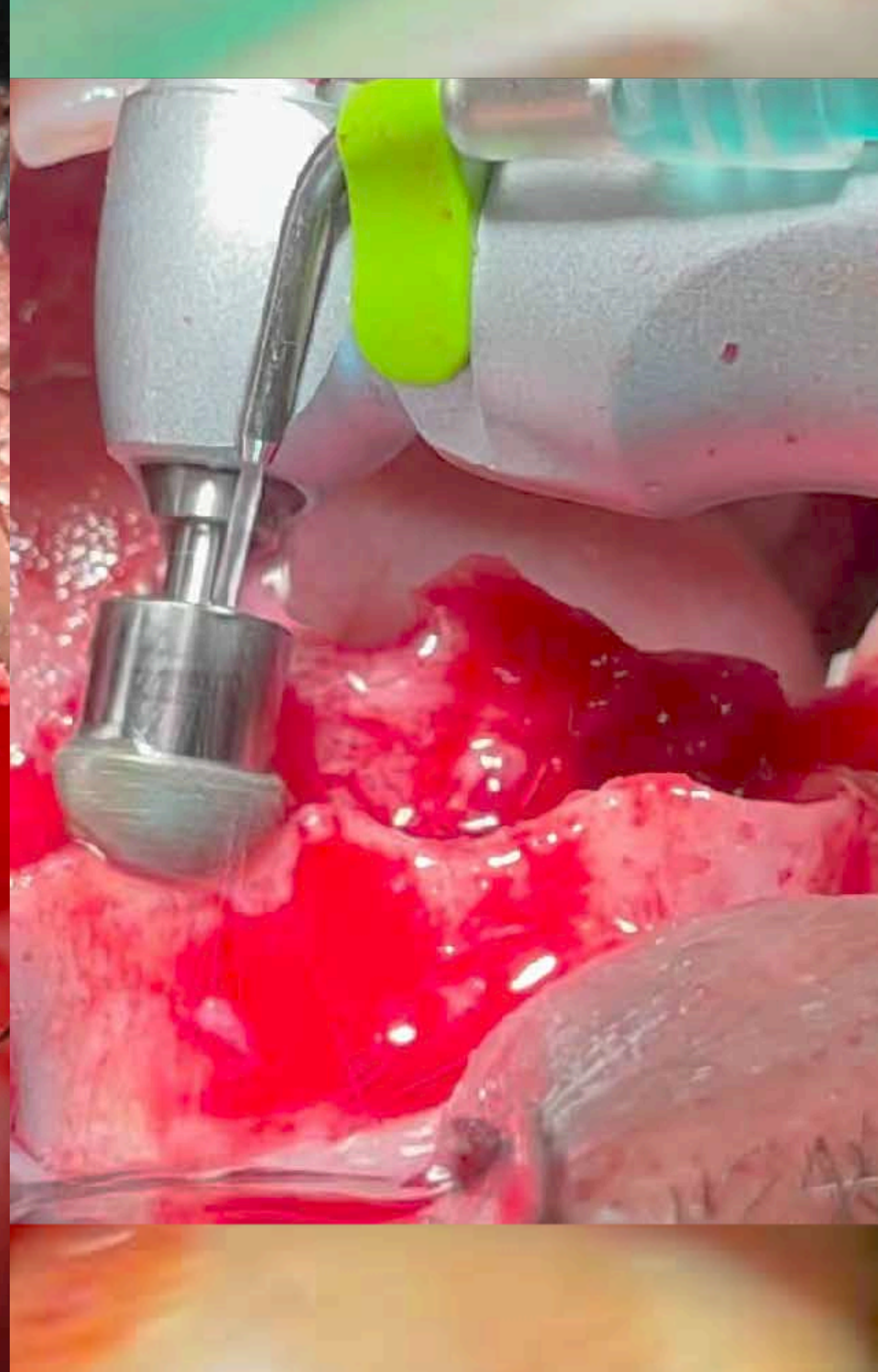


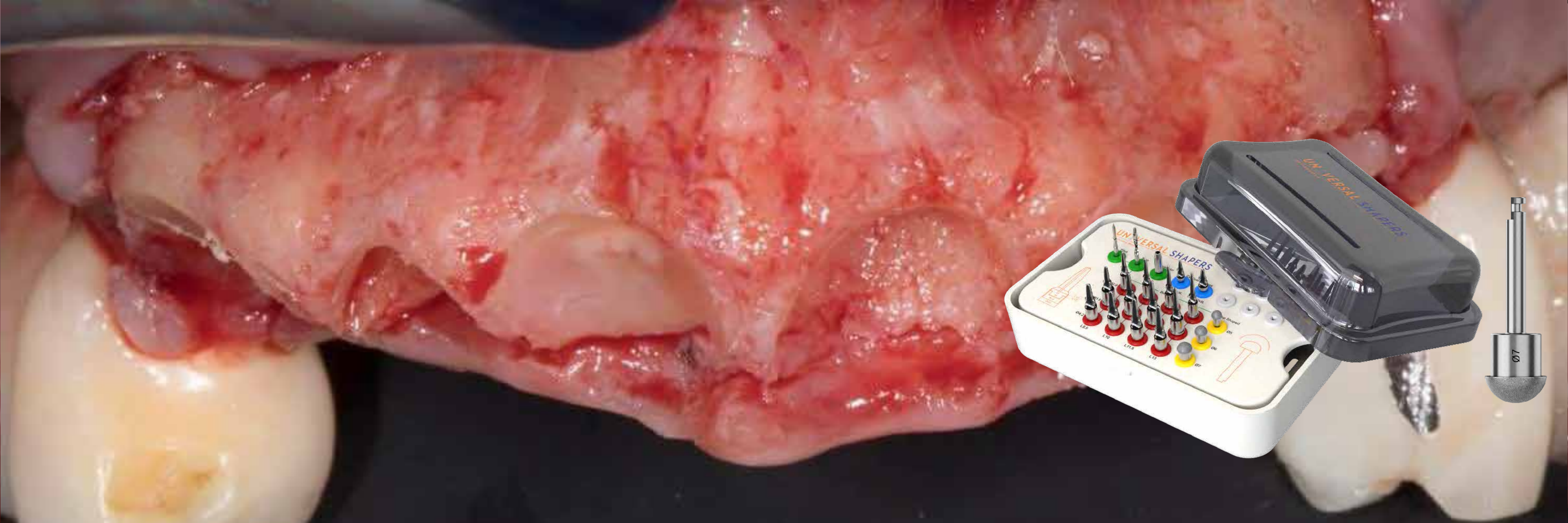
Soft Tissue Outcome



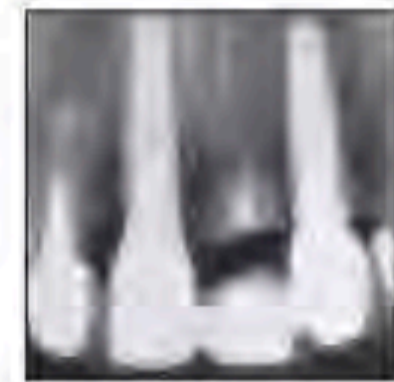


BONE PROFILE



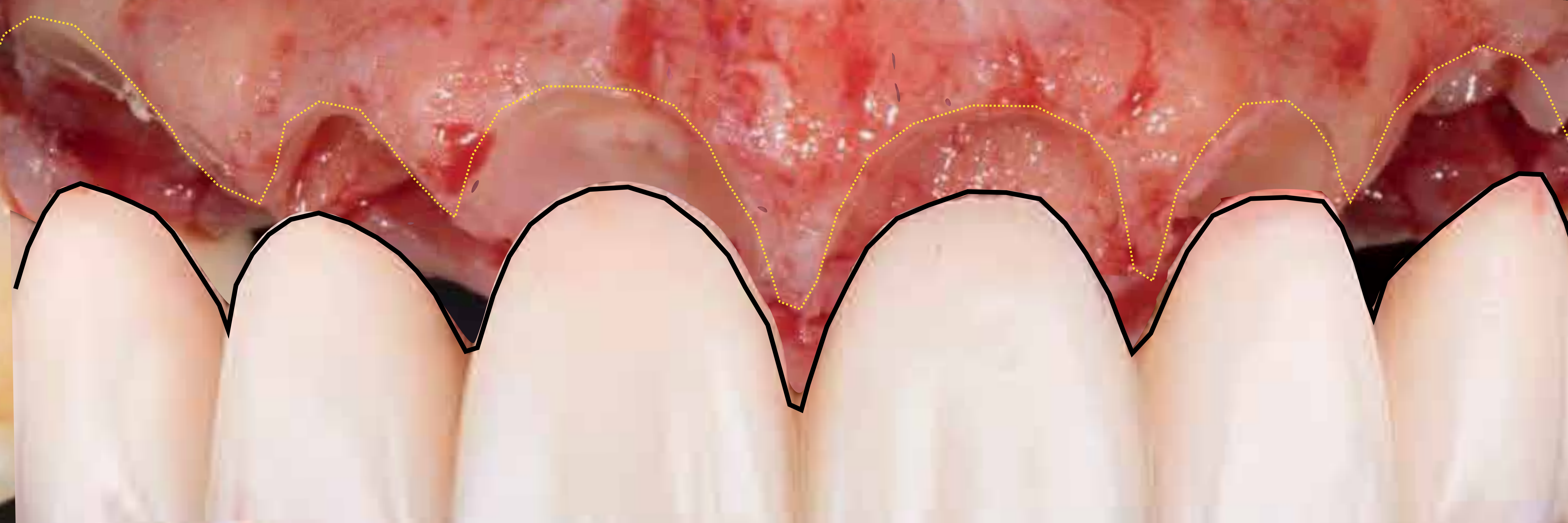


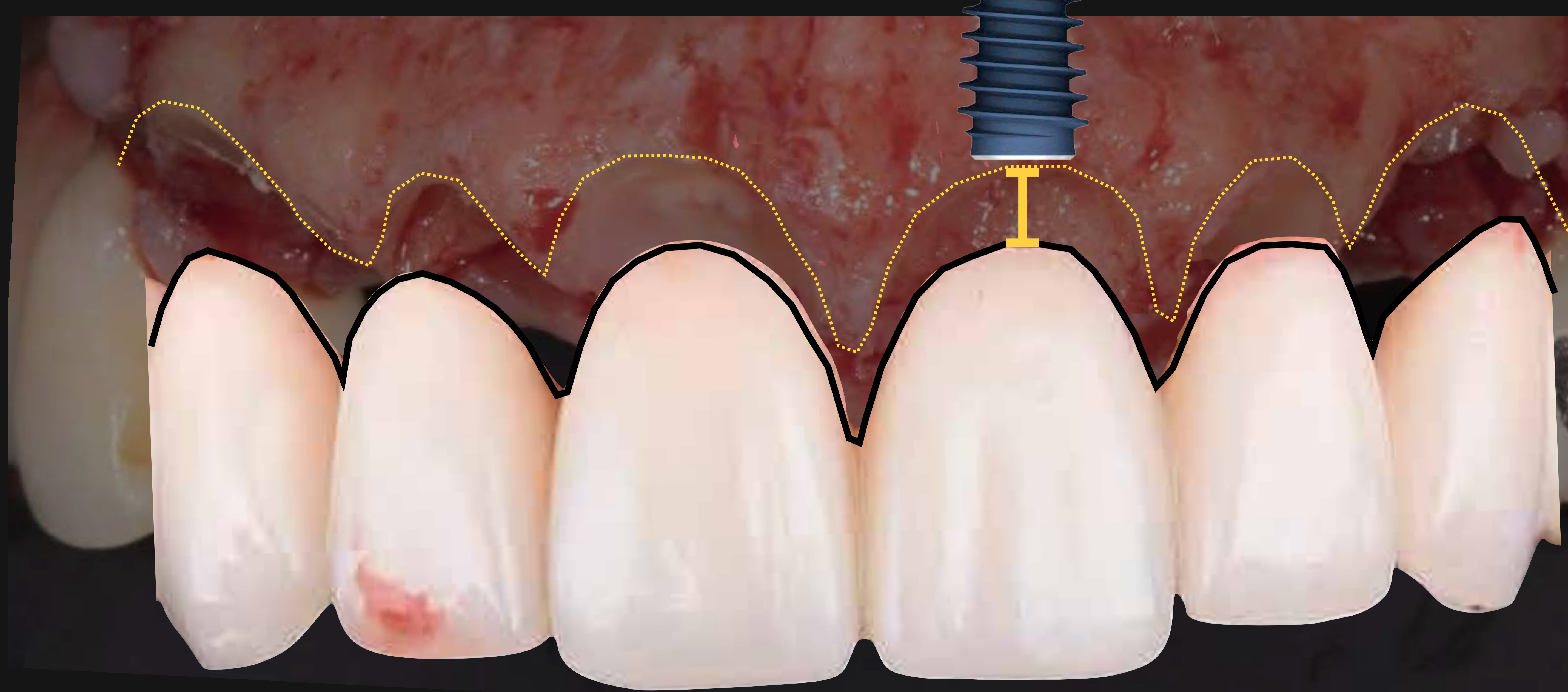
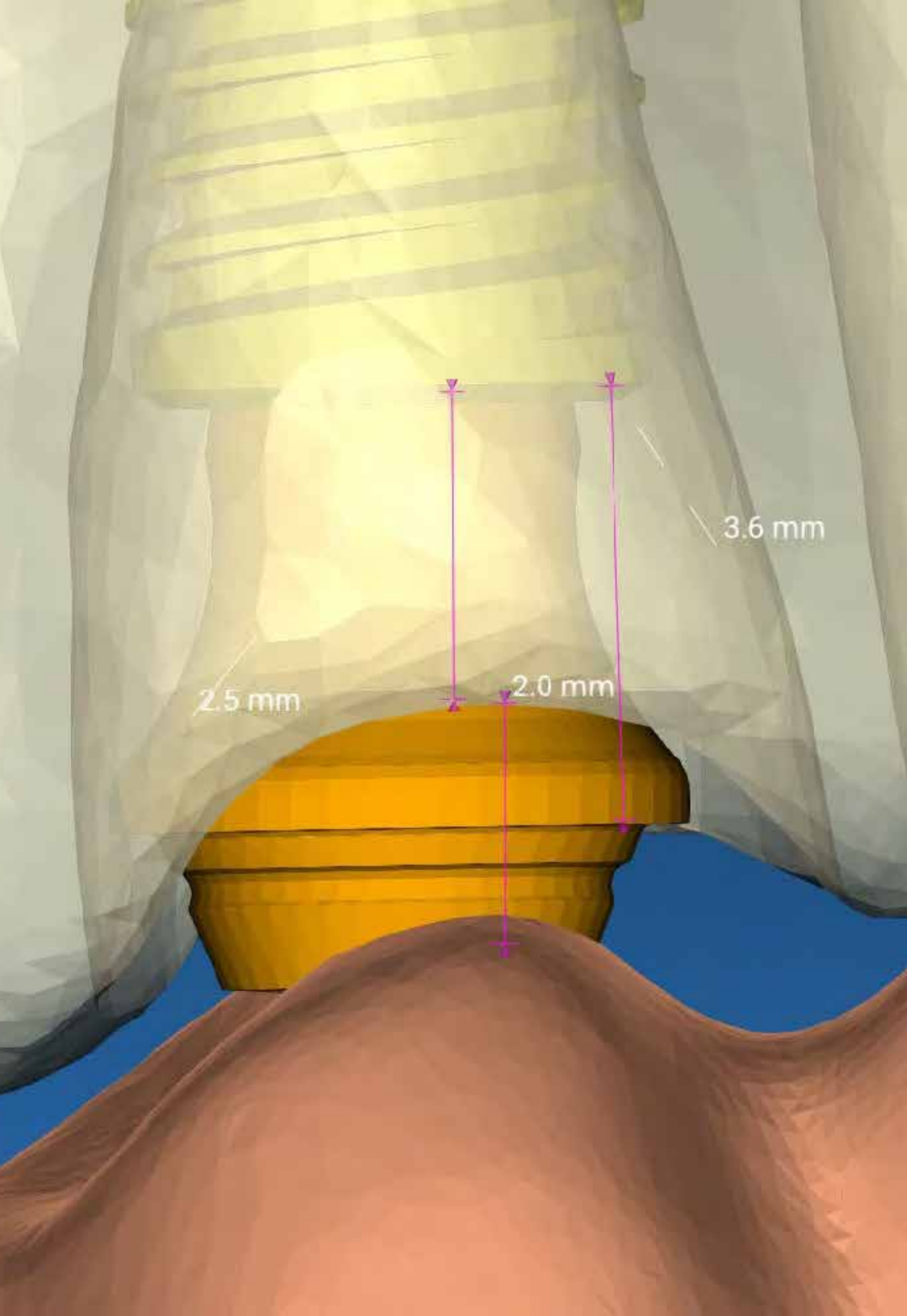
Advantages of the Root Submergence Technique for Pontic Site Development in Esthetic Implant Therapy

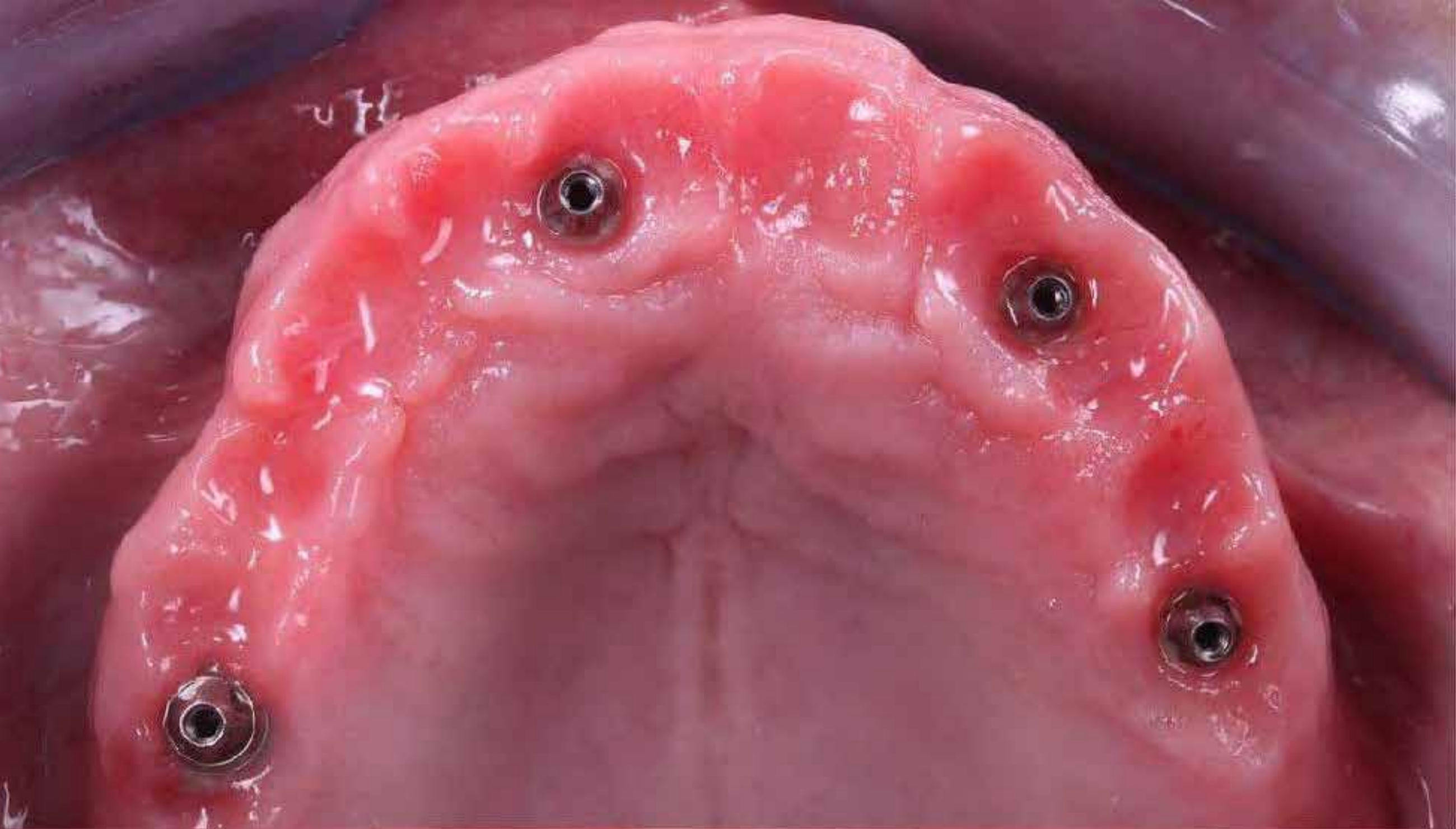


*Maurice Salama, DMD**
*Tomohiro Ishikawa, DDS***
*Henry Salama, DMD****
*Akiyoshi Funato, DDS*****
*David Garber, DMD**









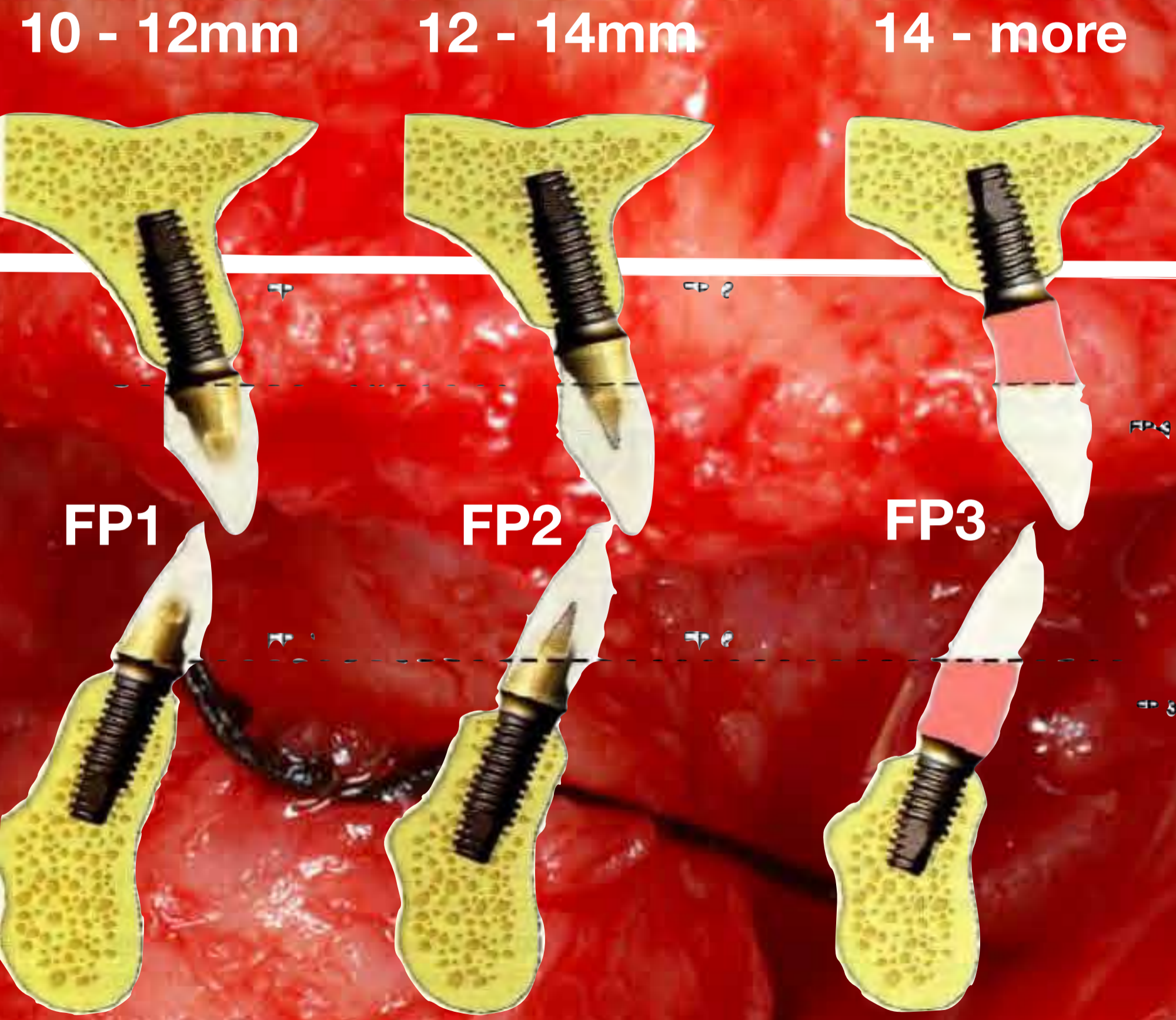
Bone Reduction



Creating Restorative Space?

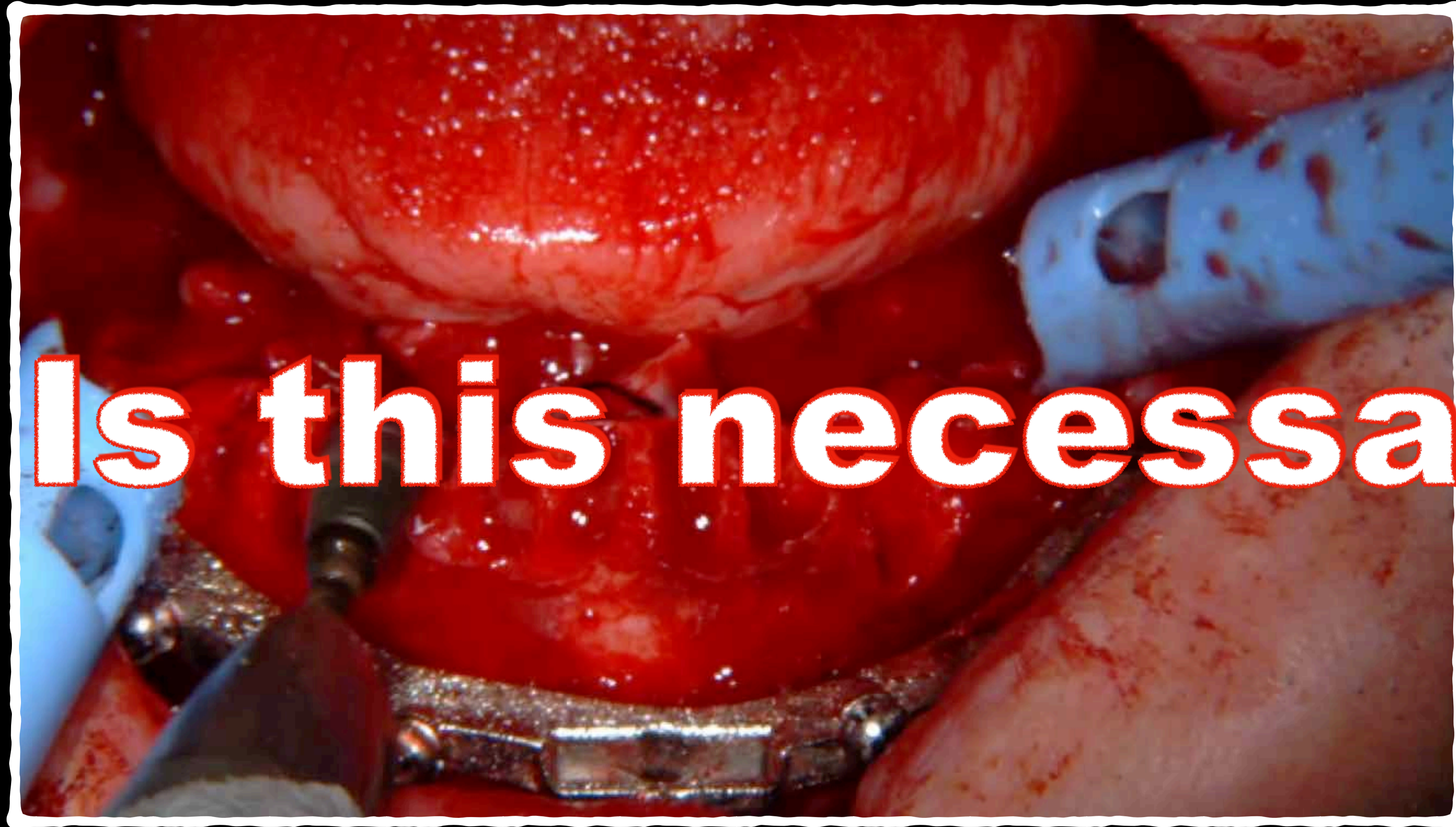
Bone Reduction

How much to reduce???



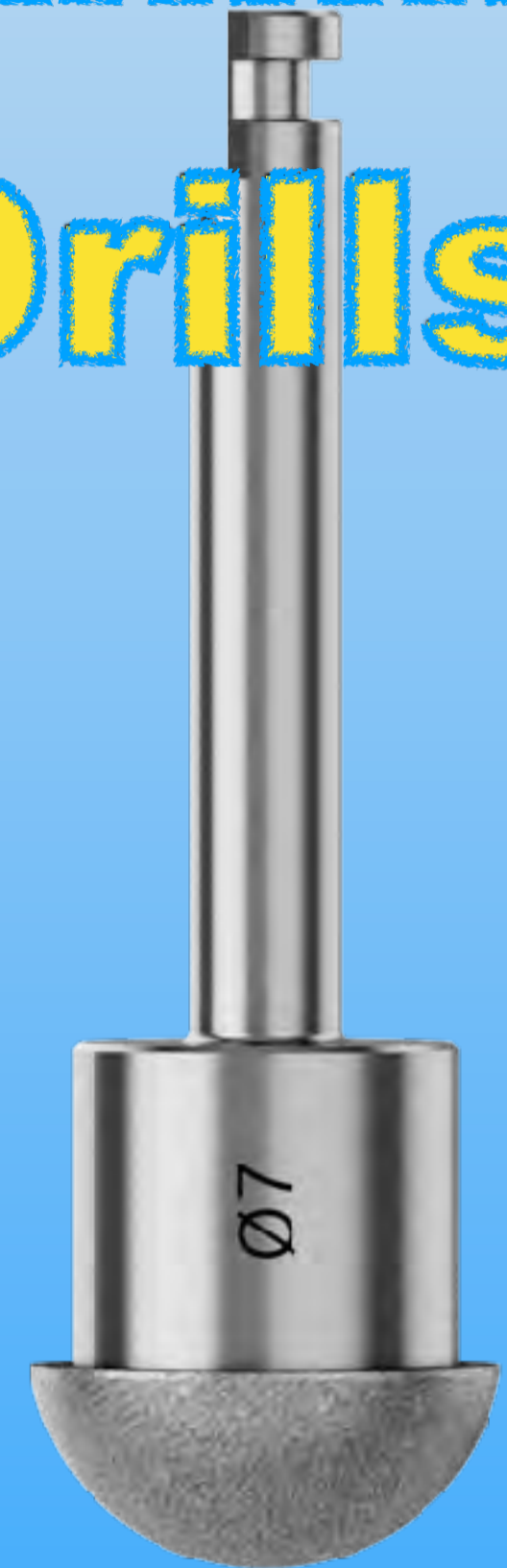
Creating Restorative Space?

Or Biological width?

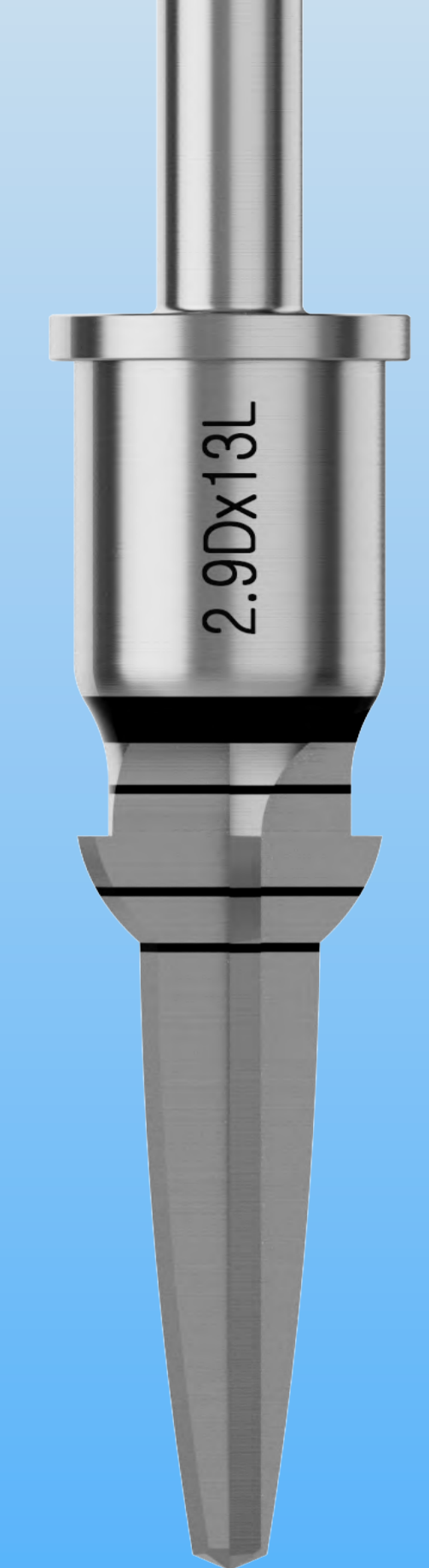
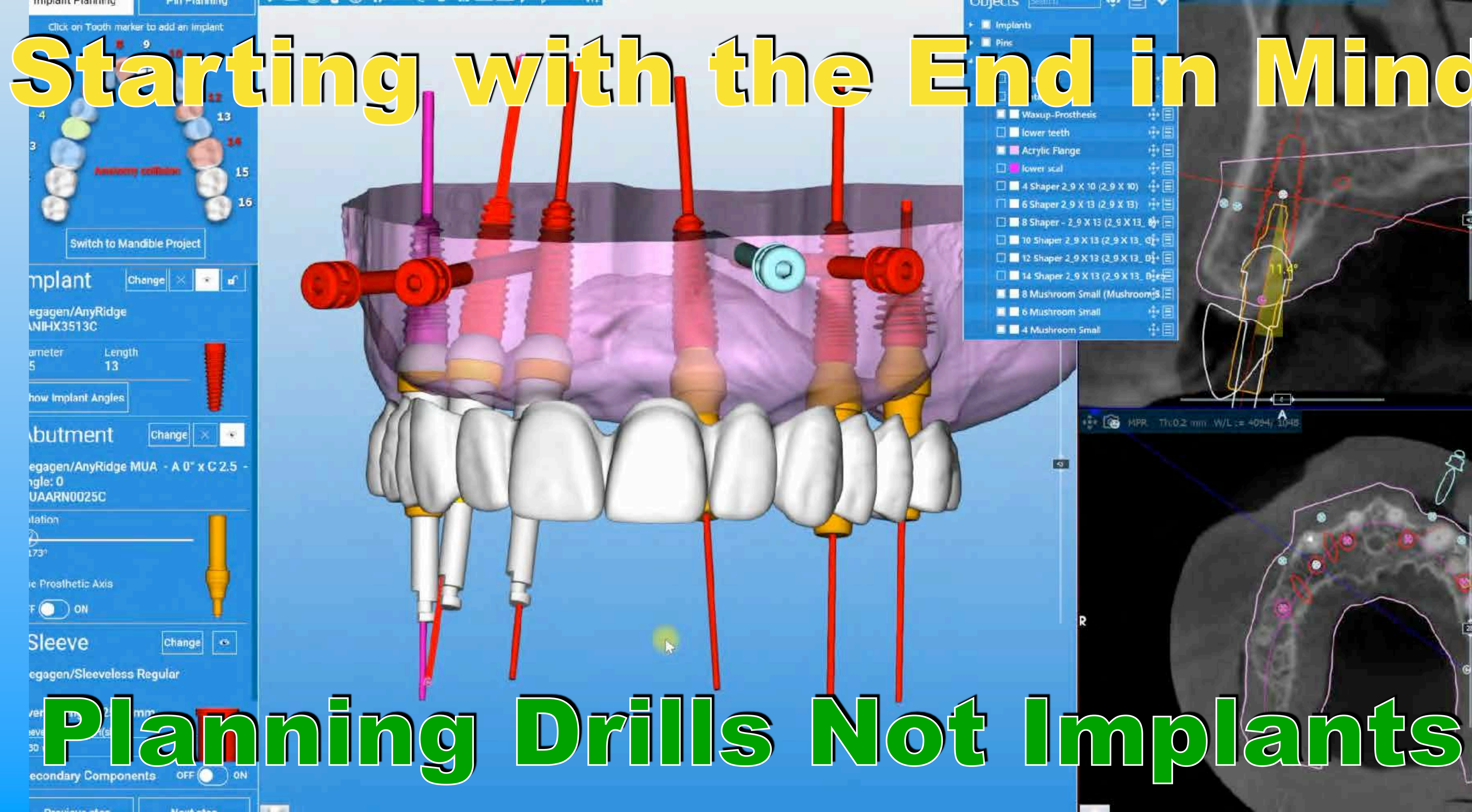


Is this necessary for all cases?

Planning Drills



Starting with the End in Mind



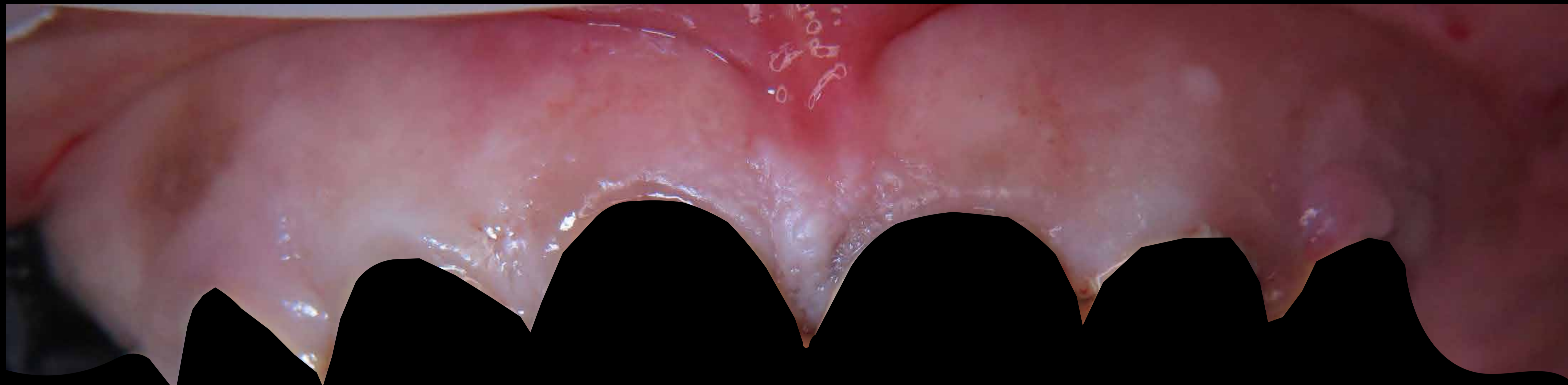
Scalloped suggested rules follow Tarnow's 5mm rule

2-3 mm soft tissue height

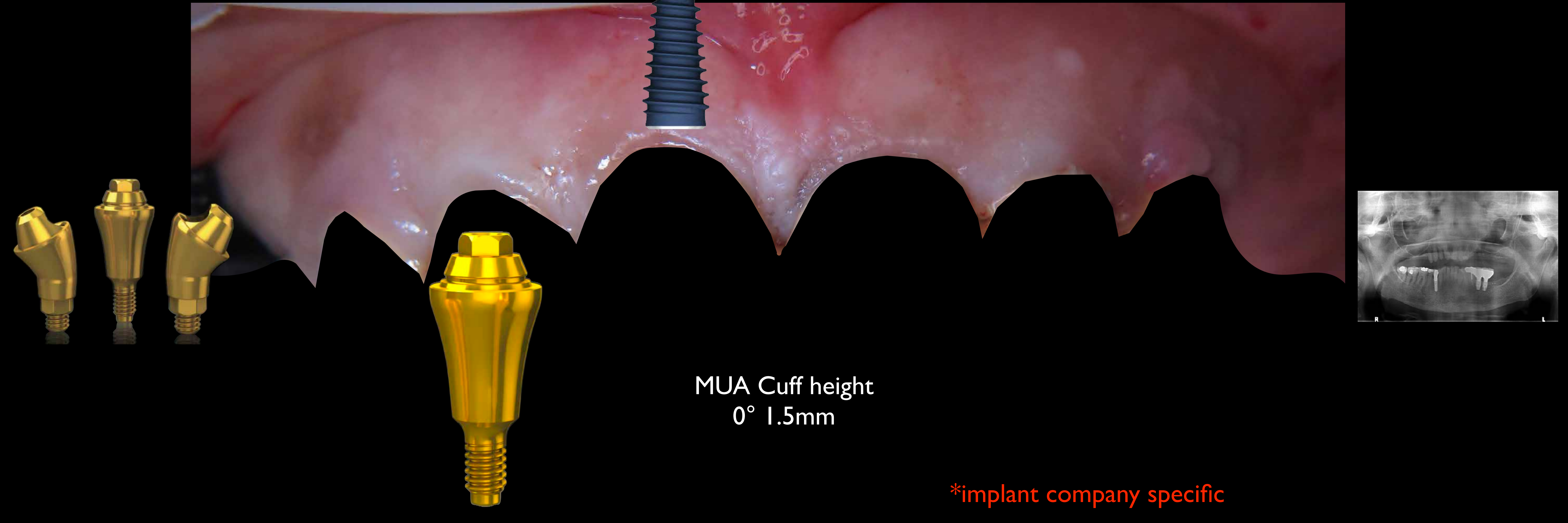
MUA height

Prosthetic space



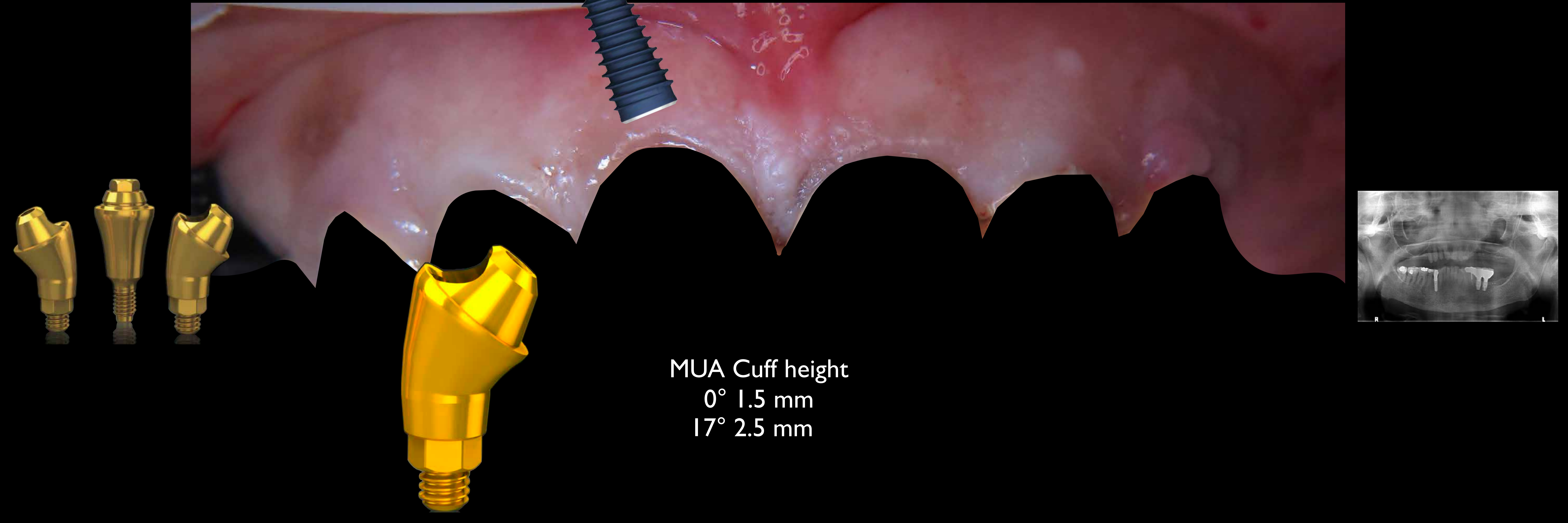


Create Scalloped Model 1-2mm?
dependent on smile line and esthetic concerns

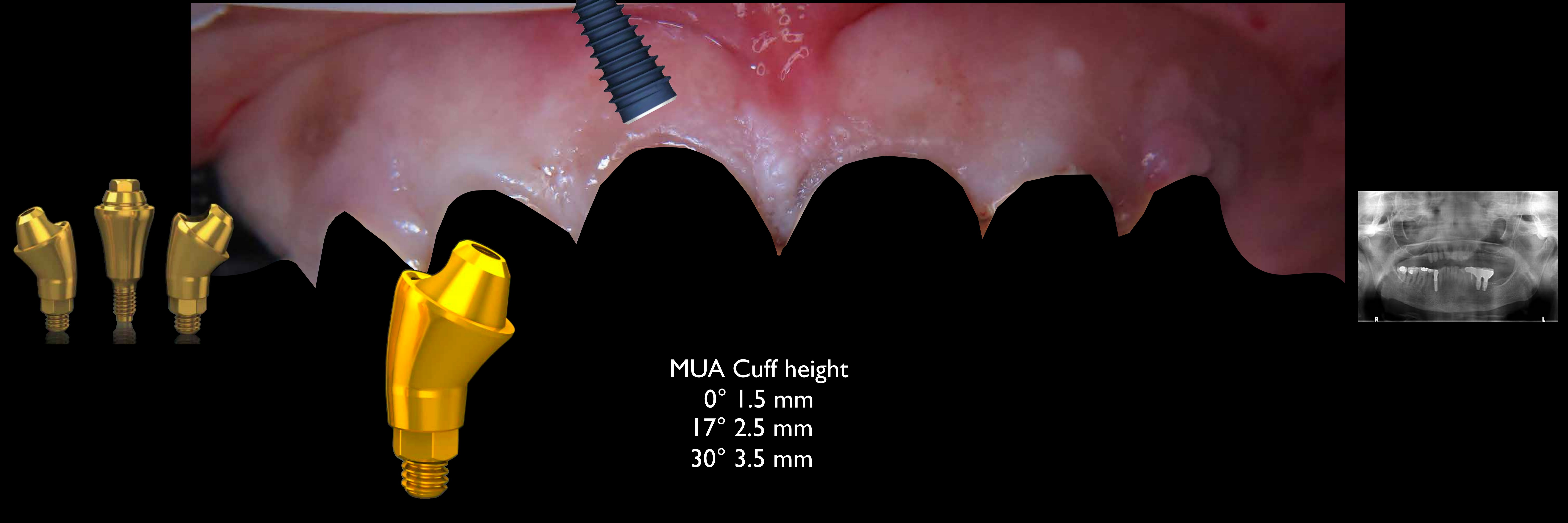


MUA Cuff height
0° 1.5mm

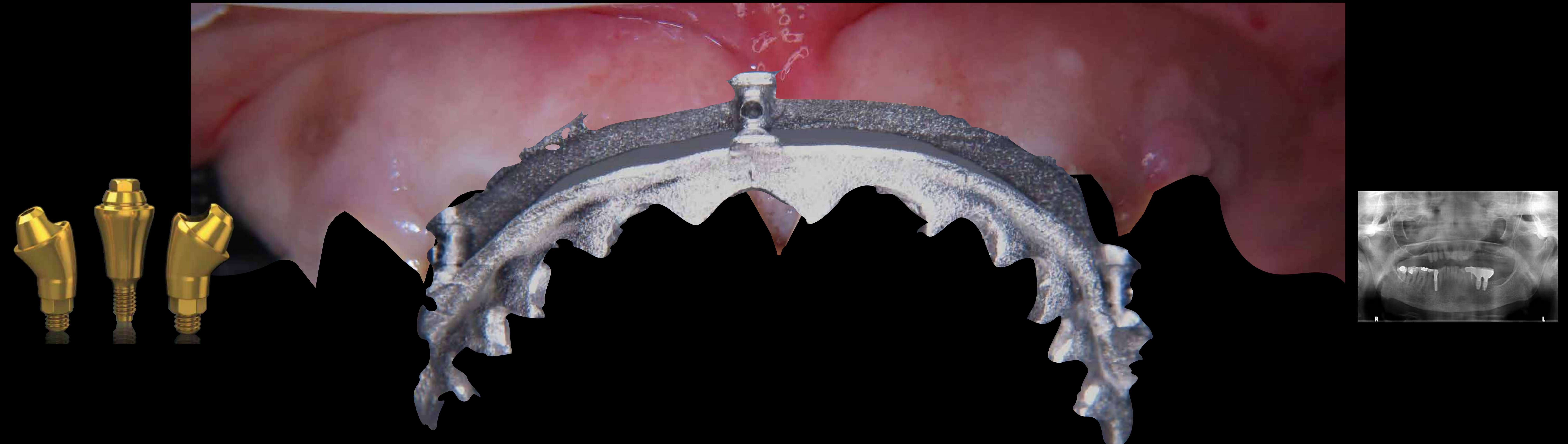
*implant company specific



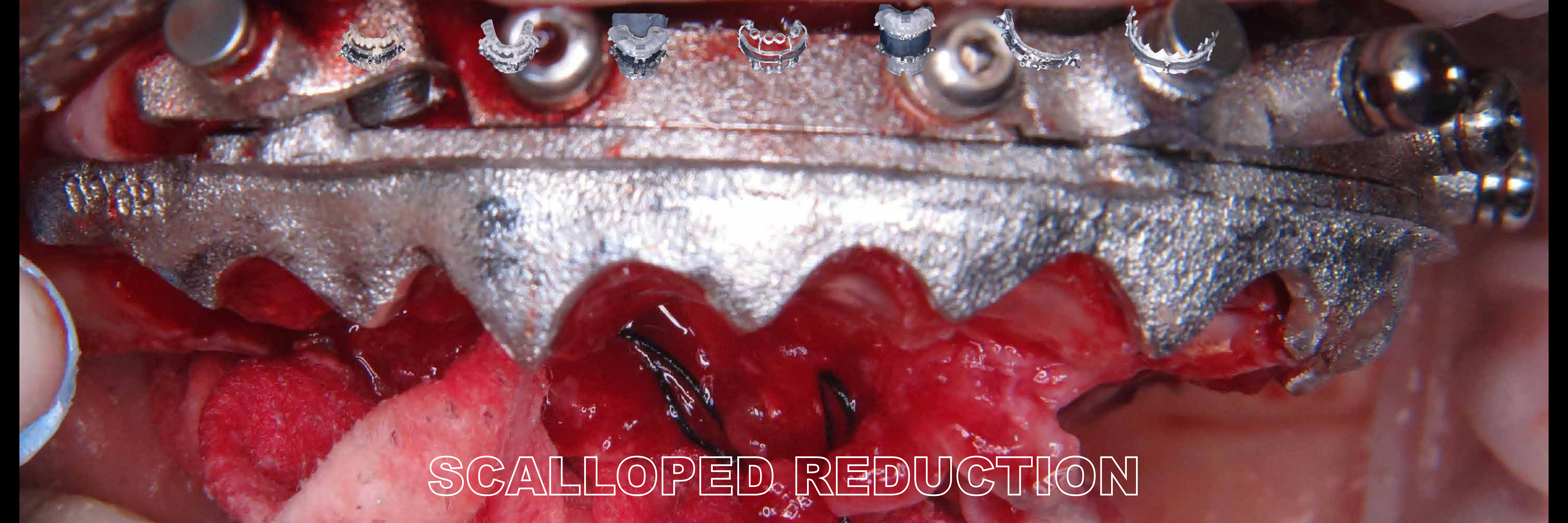
MUA Cuff height
0° 1.5 mm
17° 2.5 mm



MUA Cuff height
0° 1.5 mm
17° 2.5 mm
30° 3.5 mm



SCALLOPED REDUCTION



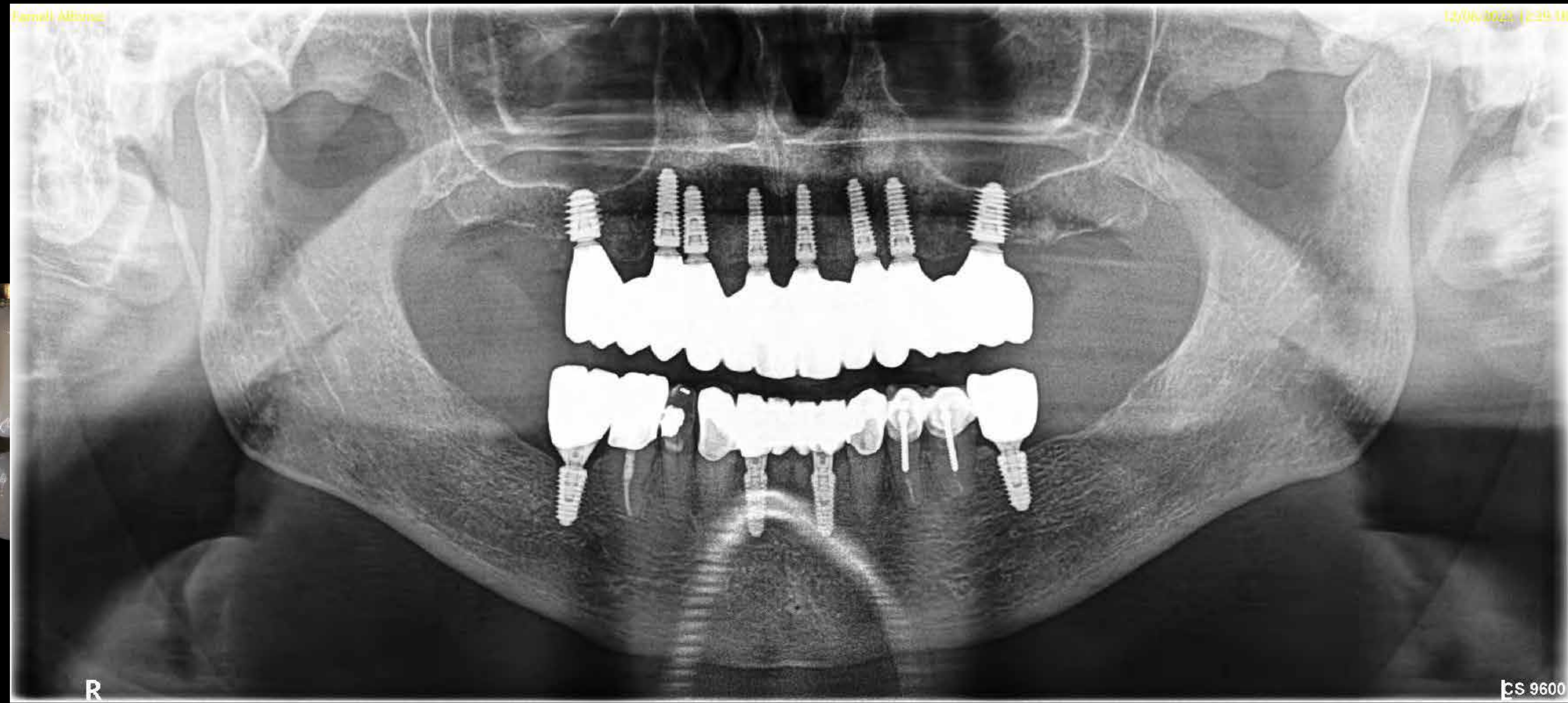
SCALLOPED REDUCTION



Finals



Finals



Partial Extraction Therapy

Extraction - Guide through tissue



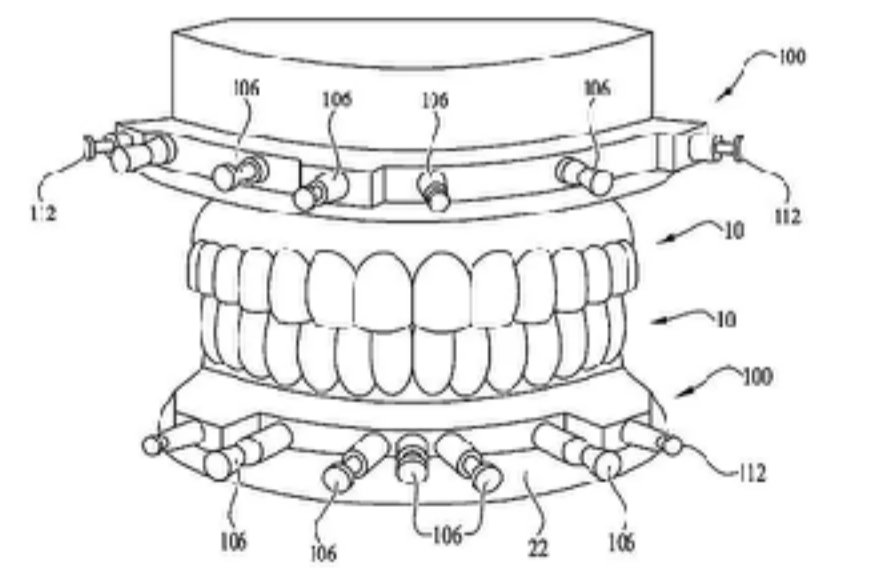
Full Arch Stackable Surgical Guidance



(12) **United States Patent**
Watson
 (10) **Patent No.:** US 11,576,755 B2
 (45) **Date of Patent:** Feb. 14, 2023

(54) **FIXATION BASE AND GUIDES FOR DENTAL PROSTHESIS INSTALLATION**
 (56) **References Cited**
 U.S. PATENT DOCUMENTS
 6,572,370 B2 † 1/2004 Knapo
 9,381,372 B2 † 7/2016 Furrer
 (Continued)
 FOREIGN PATENT DOCUMENTS
 CN 10566888 A † 6/2016
 WO 2009/115283 A1 † 9/2009
 (Continued)
 OTHER PUBLICATIONS
 Zehat et al. WO 2010/01124 A1. Jun. 3, 2010 (Year: 2010).
 (Continued)
 Primary Examiner—Ralph A Lewis
 Assistant Examiner—Mirayda A Aponso
 (74) *Attorney, Agent, or Firm*—James A. Italia; Italia IP

(21) **Appl. No.:** 17/670,362
 (22) **Filed:** Feb. 11, 2022
 (65) **Prior Publication Data**
 US 2022/010473 A1 May 26, 2022
Related U.S. Application Data
 (63) Continuation of application No. 17/503,359, filed on Oct. 18, 2021, which is a continuation of application (Continued)
 (51) **Int. Cl.**
 A61C 8/00 (2006.01)
 A61C 13/225 (2006.01)
 (Continued)
 (52) **U.S. CL.**
 CPC A61C 8/0053 (2013.01); A61C 13/04 (2013.01); A61C 8/0048 (2013.01); (Continued)
 (58) **Field of Classification Search**
 CPC A61C 8/0053; A61C 8/0048; A61C 8/0068; A61C 8/0087; A61C 8/0095; (Continued)
17 Claims, 19 Drawing Sheets



Partial Extraction Therapy



Flap to reduce to bone level

Extraction - Guide through tissue



Extractions due to mobility





The "Scalloped Guide":
A Proof-of-Concept Technique for a
Digitally Streamlined, Pink-Free
Full-Arch Implant Protocol



Maurice A. Salama, DMD¹
Alessandro Pozzi, DDS, PhD²
Wendy Auclair Clark, DDS, MS³/Marko Tadros, DMD⁴
Lars Hansson, CDT, FICO⁵/Pinhas Adar, MDT, CDT⁶

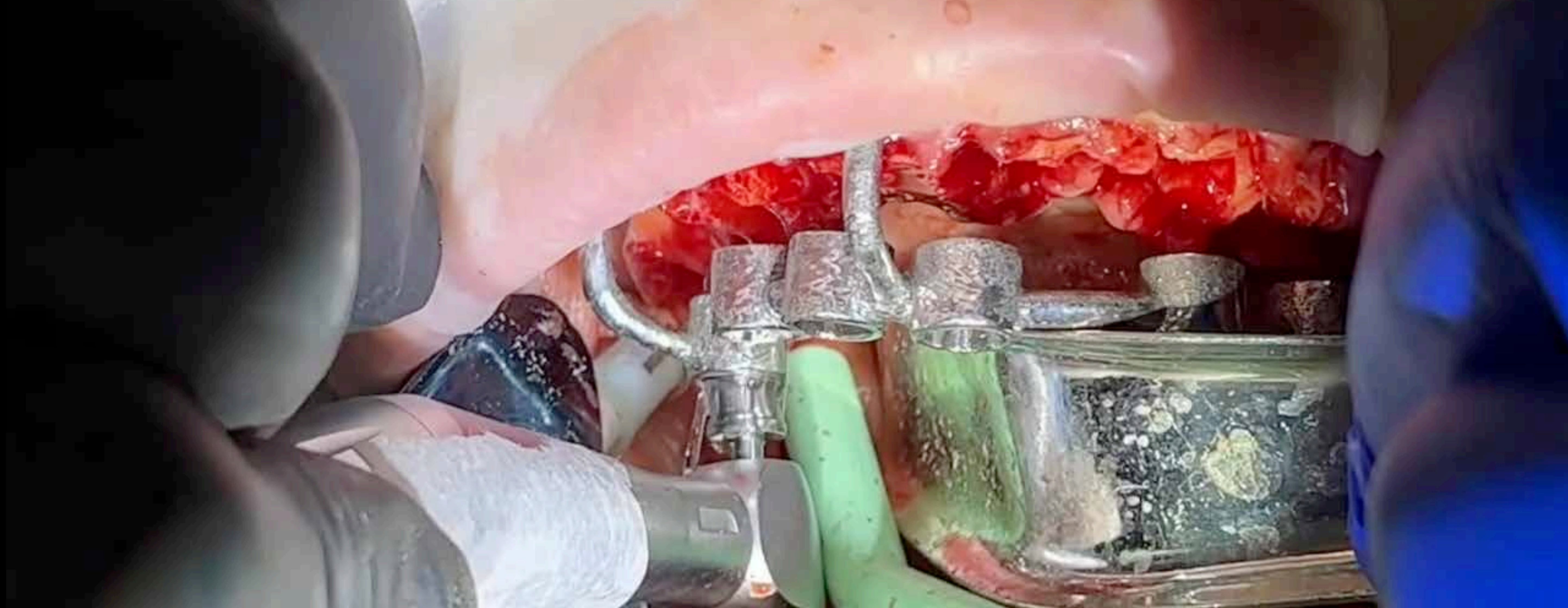
Inadequate restorative space can result in mechanical, biologic, and esthetic

Scalloping

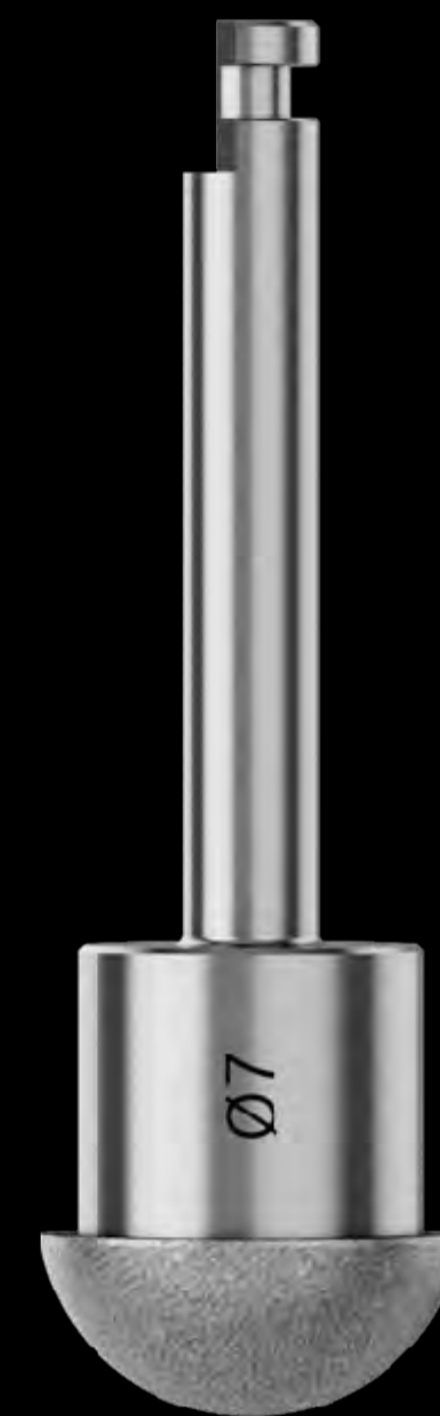




Surgical



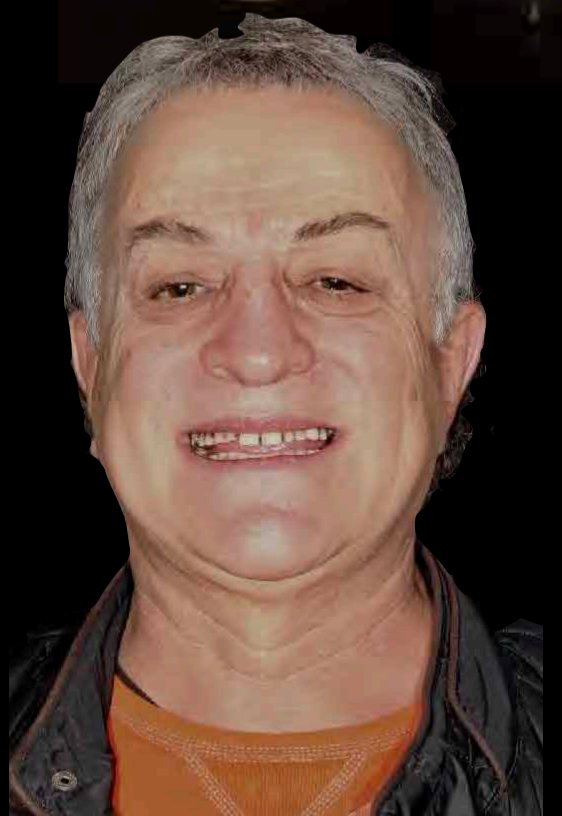
Guidance



UNIVERSAL SHAPERS *Alveolar Sculpting* - **Emergence Profile**



2 week post op



Scalloped

FRP1

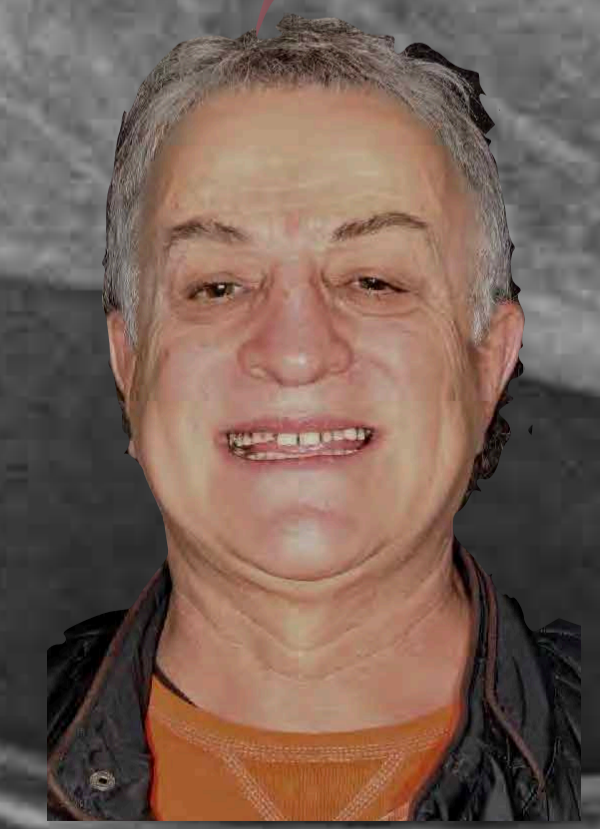
PET

Extraction





Deliver



FPD1





Changing lives one smile at a time

SURGERY AND SAME DAY PRINT?







Order Information

ID: 014 | Create Time: 1/15/24 12:51 PM

Patient Name*: Marsed Dickerson

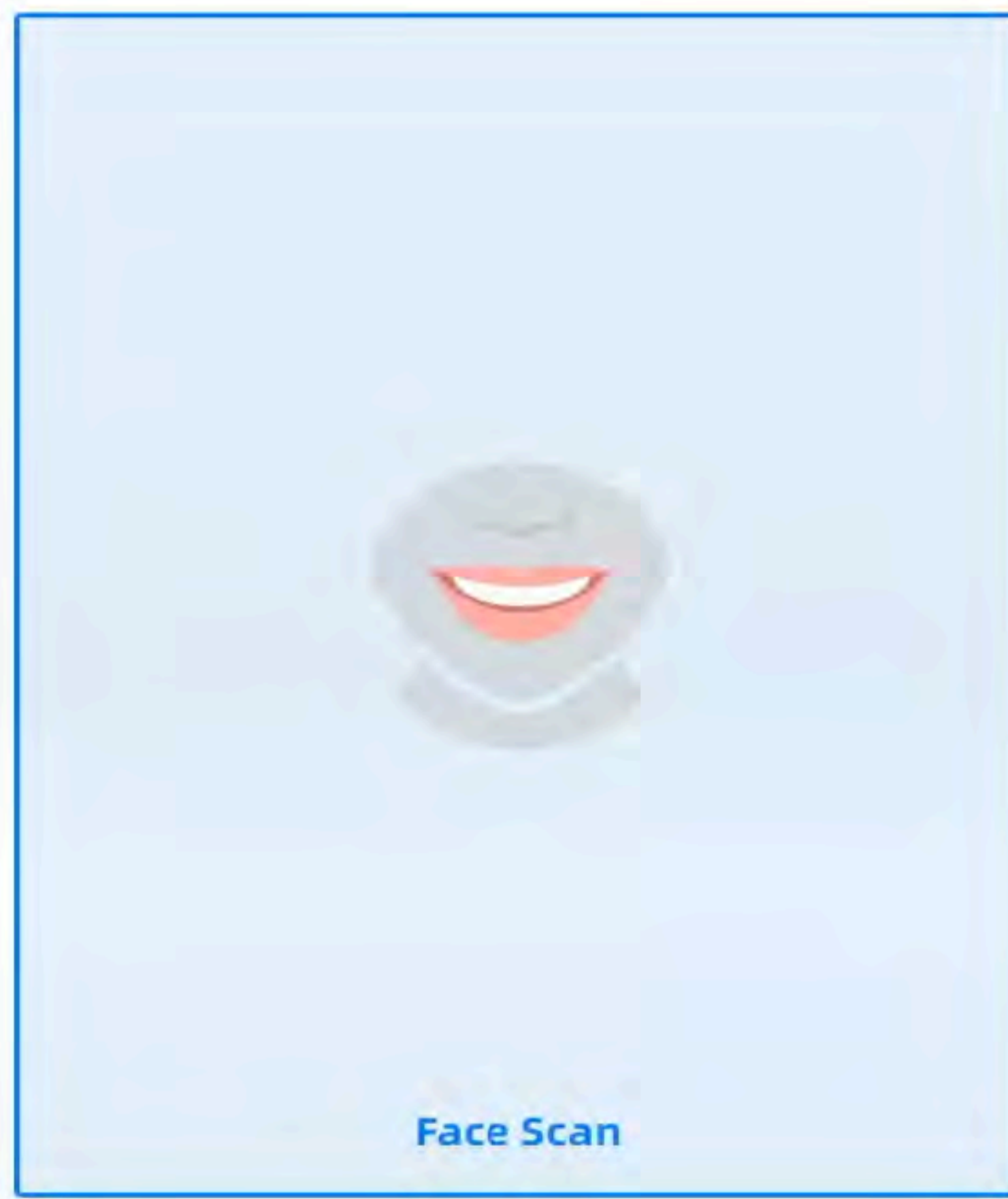
Doctor: isaac tawil/iketawil@

Type: FirstVisit FollowUp

Dentistry Type: Aesthetics Maxillofacial Orthodontics

Notes: Shade: None. Additional comment: None.

Functional module



Data

Import Intraoral data

Import DICOM data

Back

Explore

Save

Scan



**IMPORT
FS/CBCT
SEGMENT**



**PLAN
DESIGN
IOS/SG**

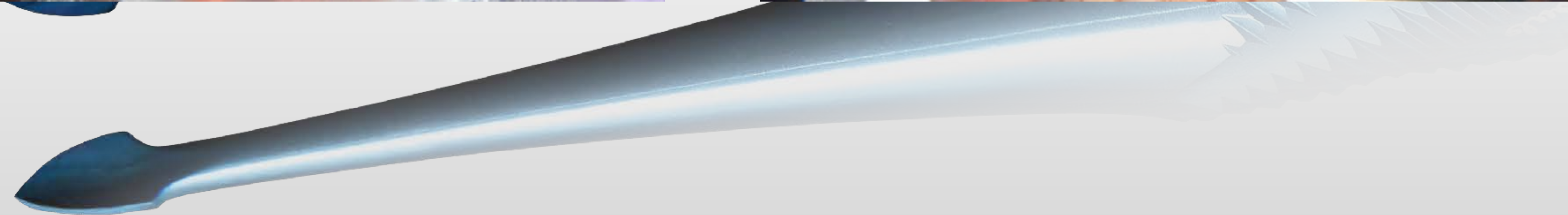
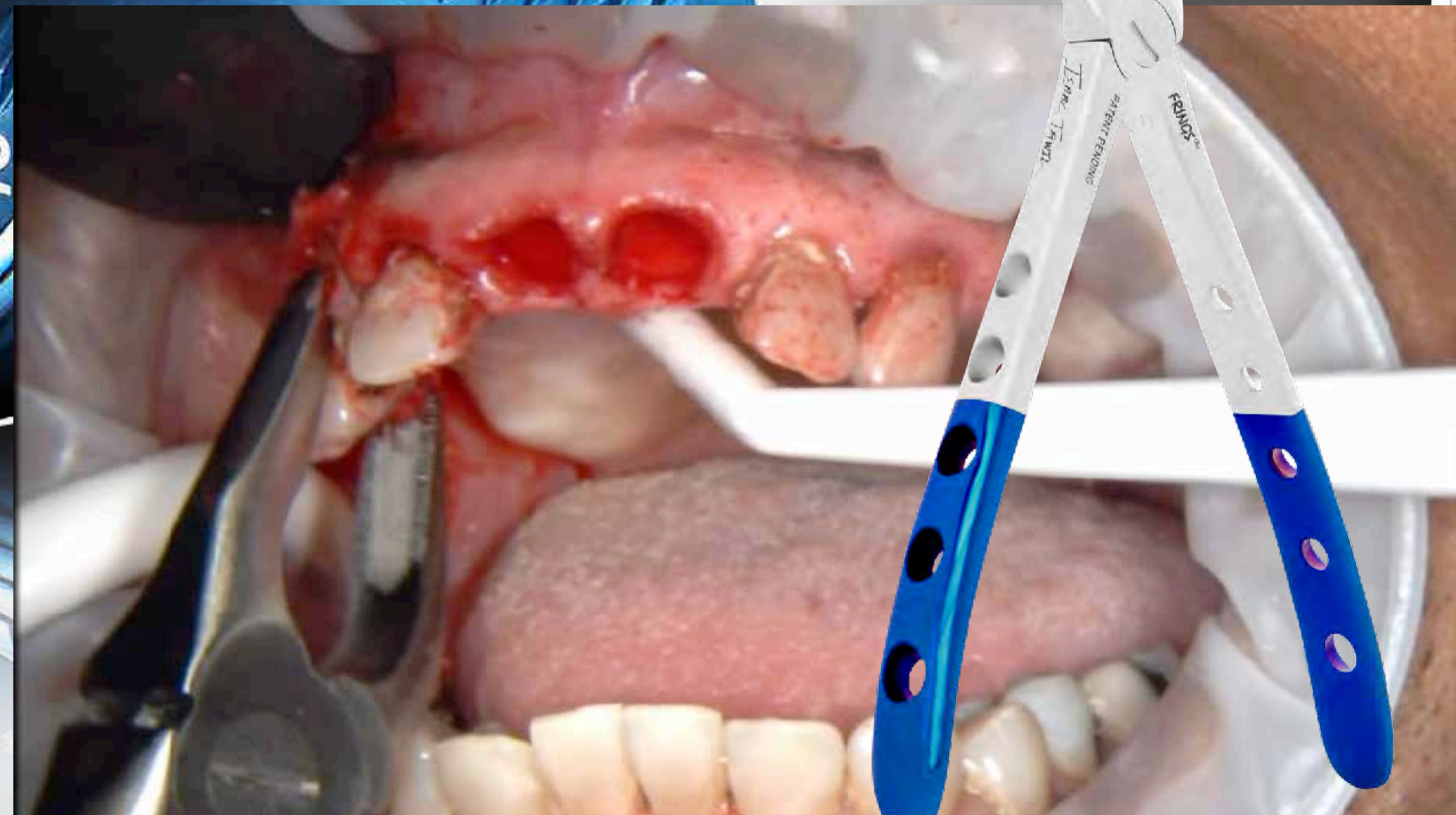
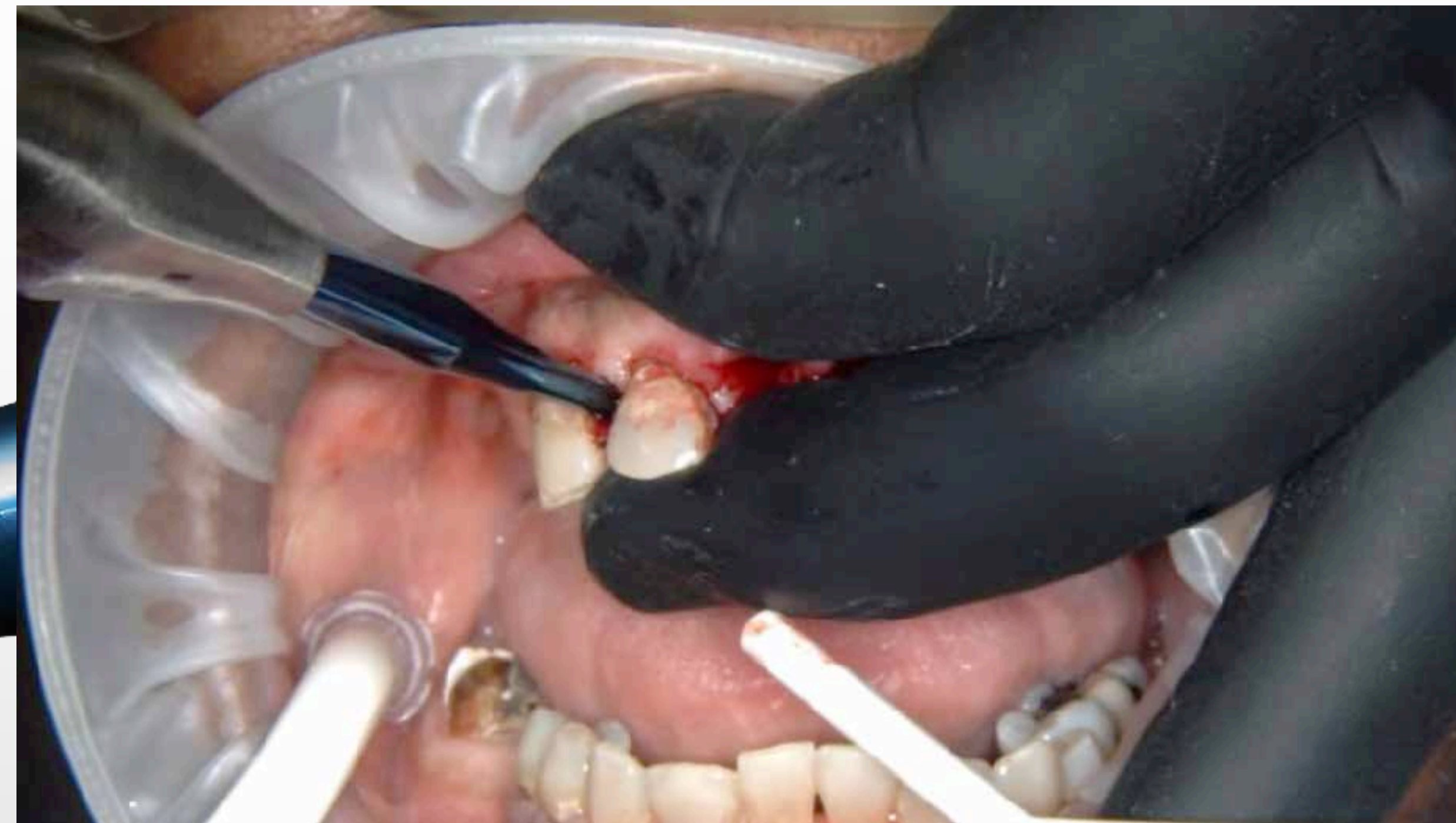




MINIMALLY-TRAMATIC



MINIMALLY-TRAUMATIC



FLAP TO INCREASE SOFT TISSUE THICKNESS



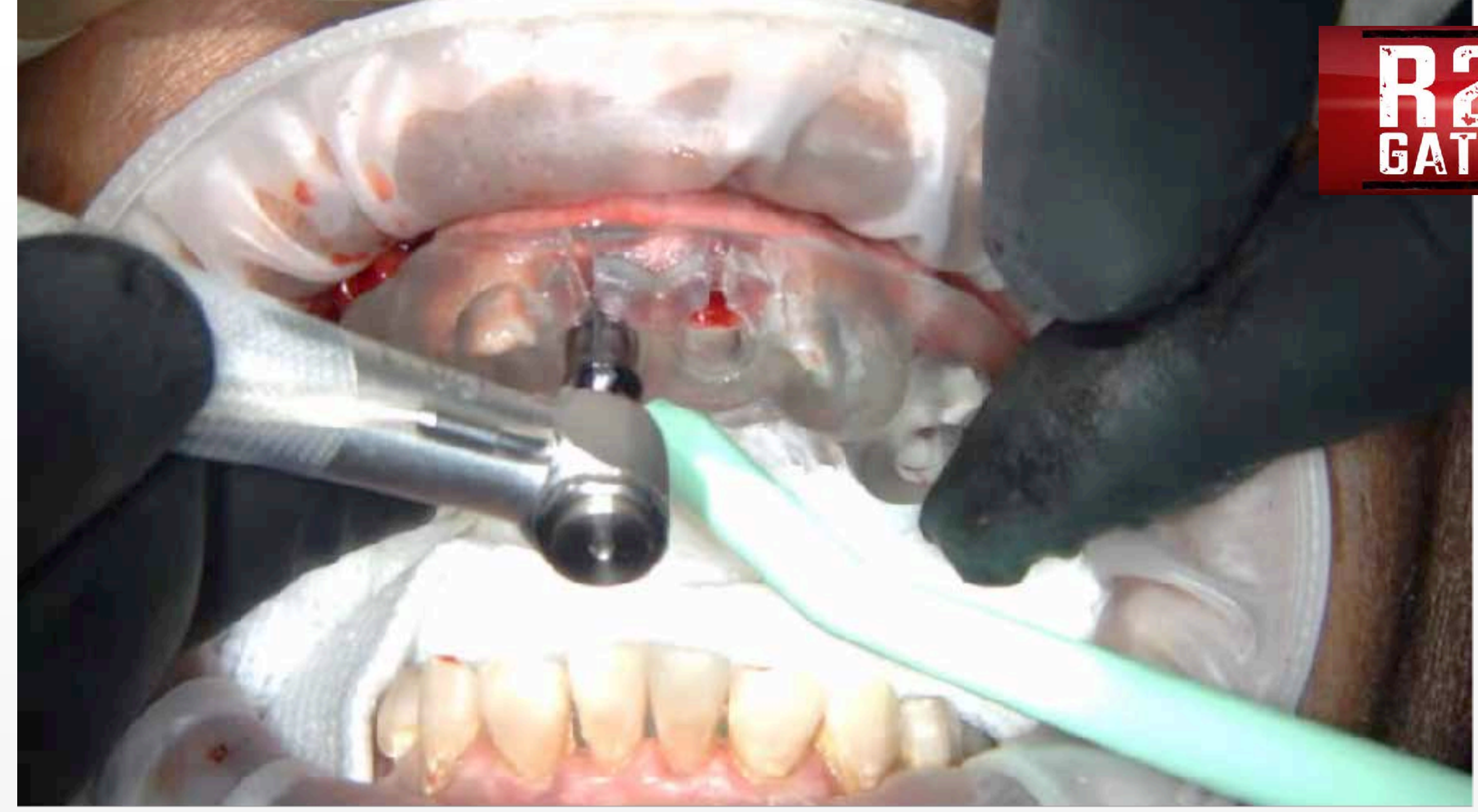
SURGICAL GUIDANCE



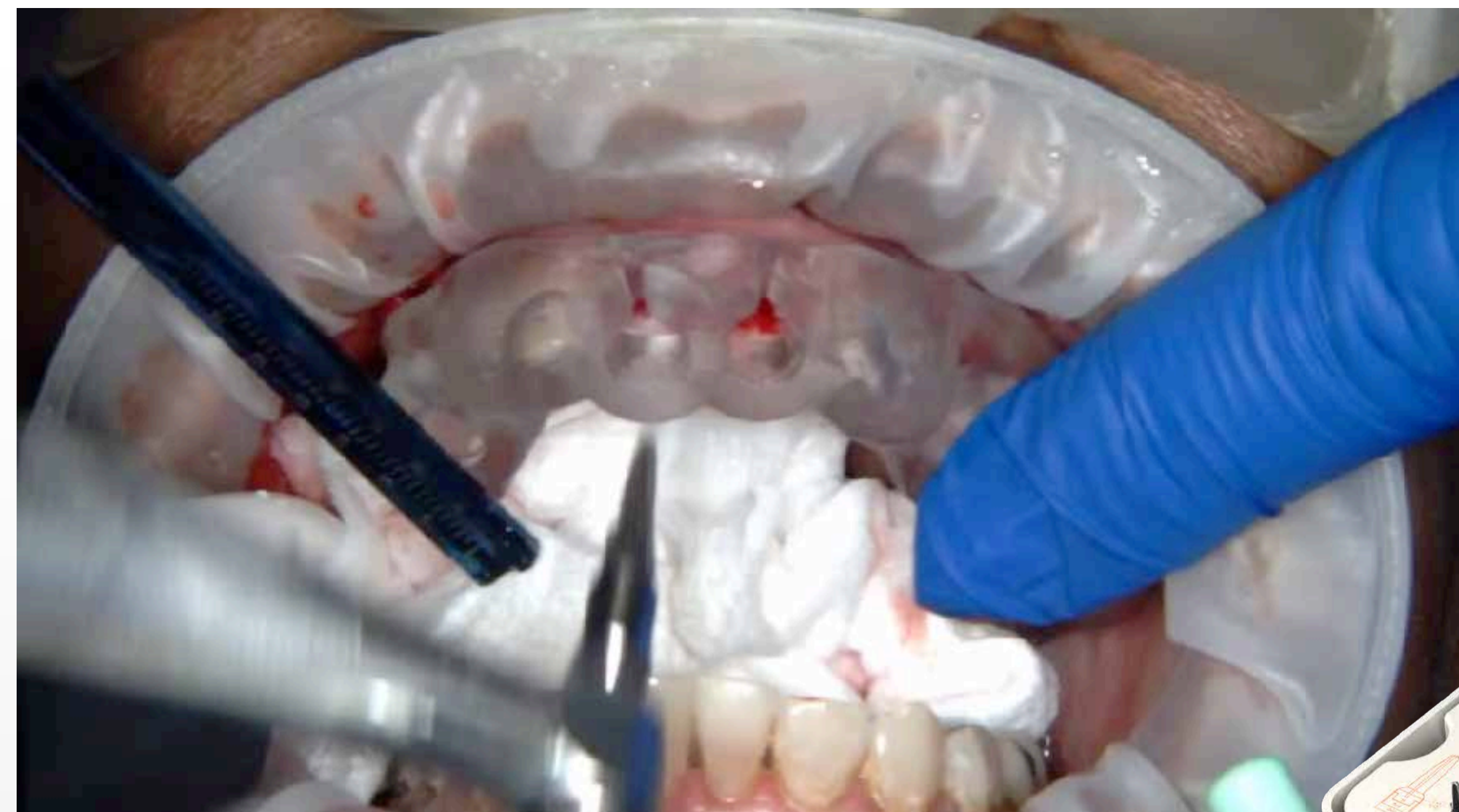
BLUEDIAMOND
IMPLANT

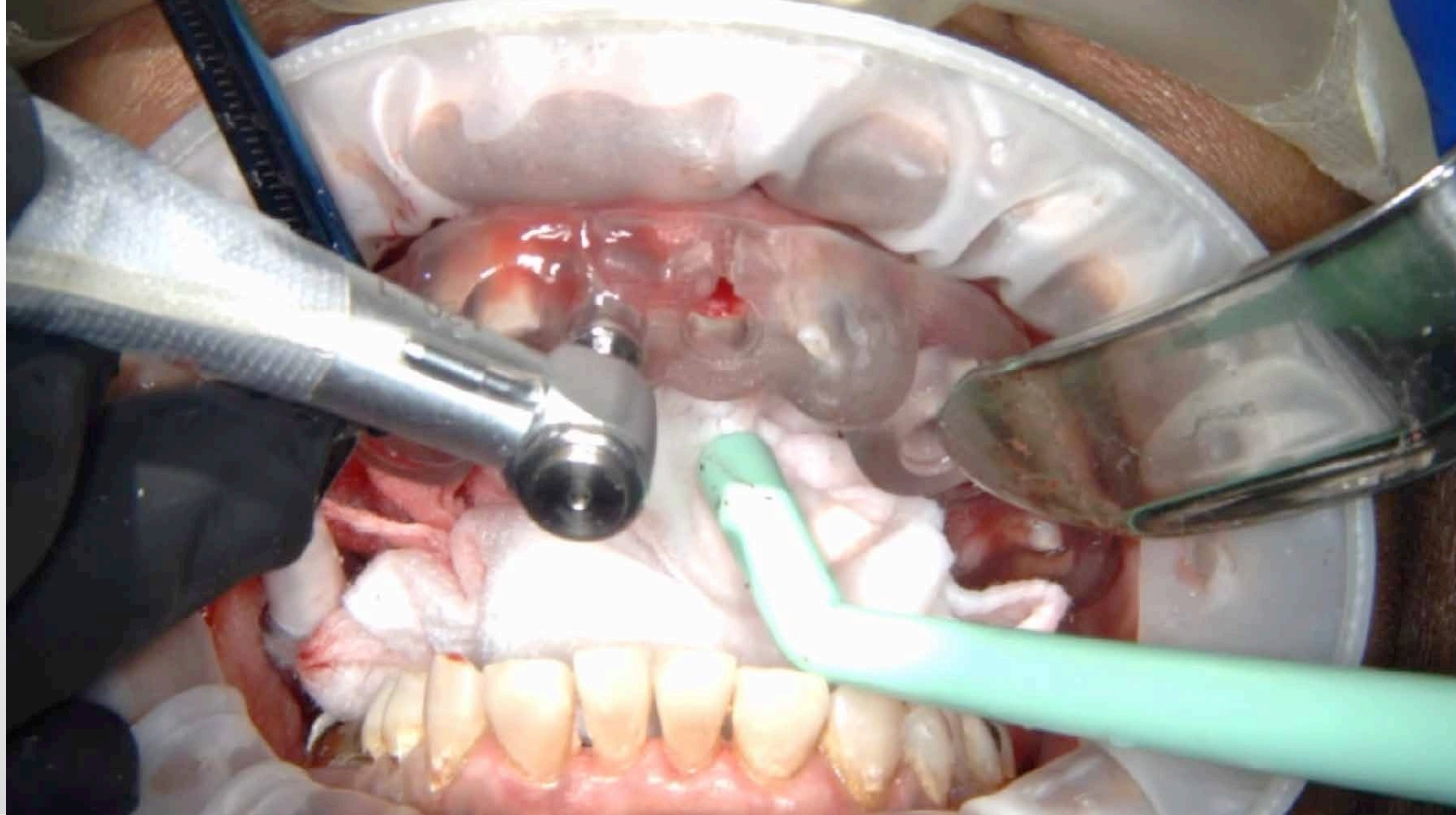


SURGICAL GUIDANCE



BLUEDIAMOND
IMPLANT

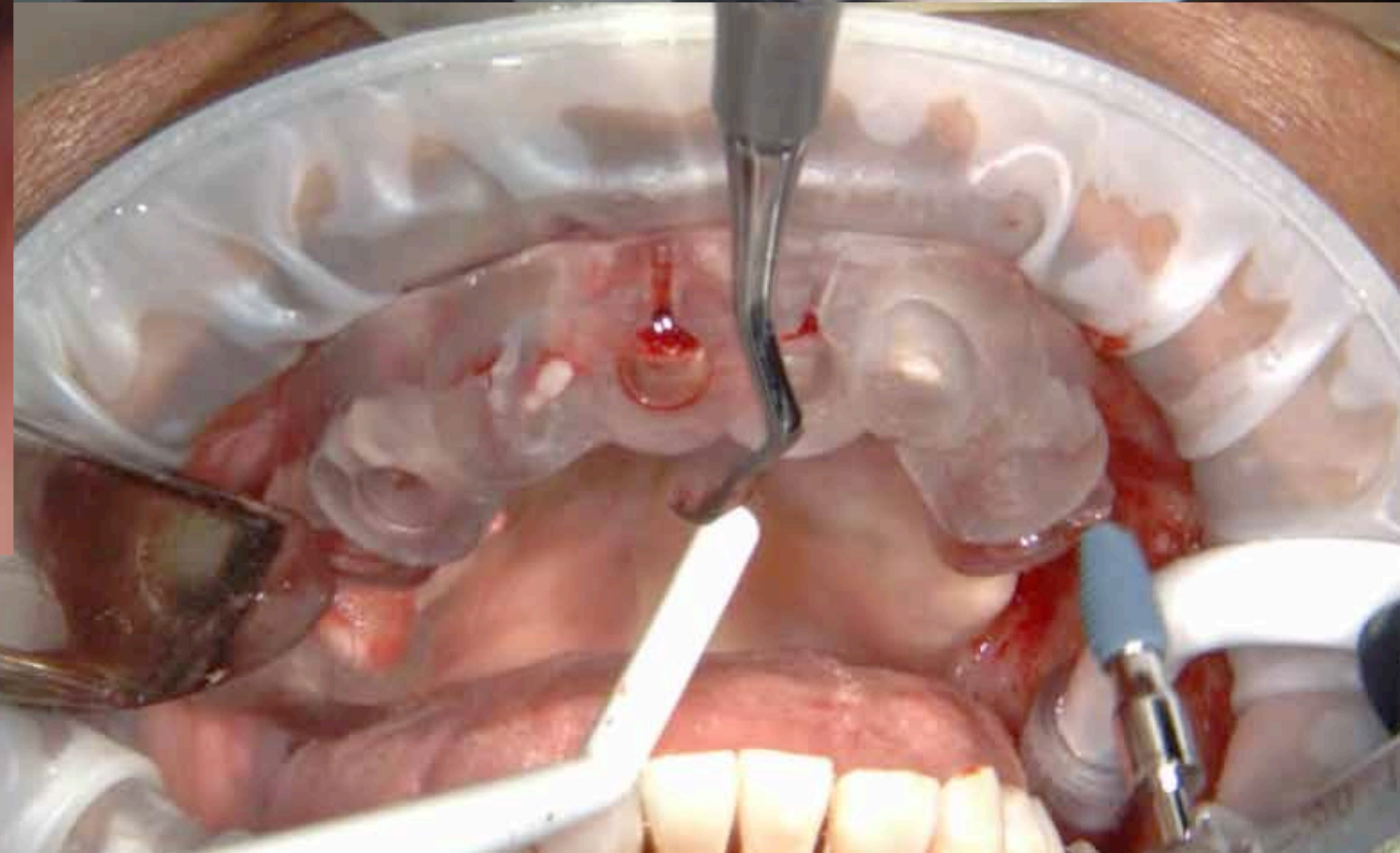
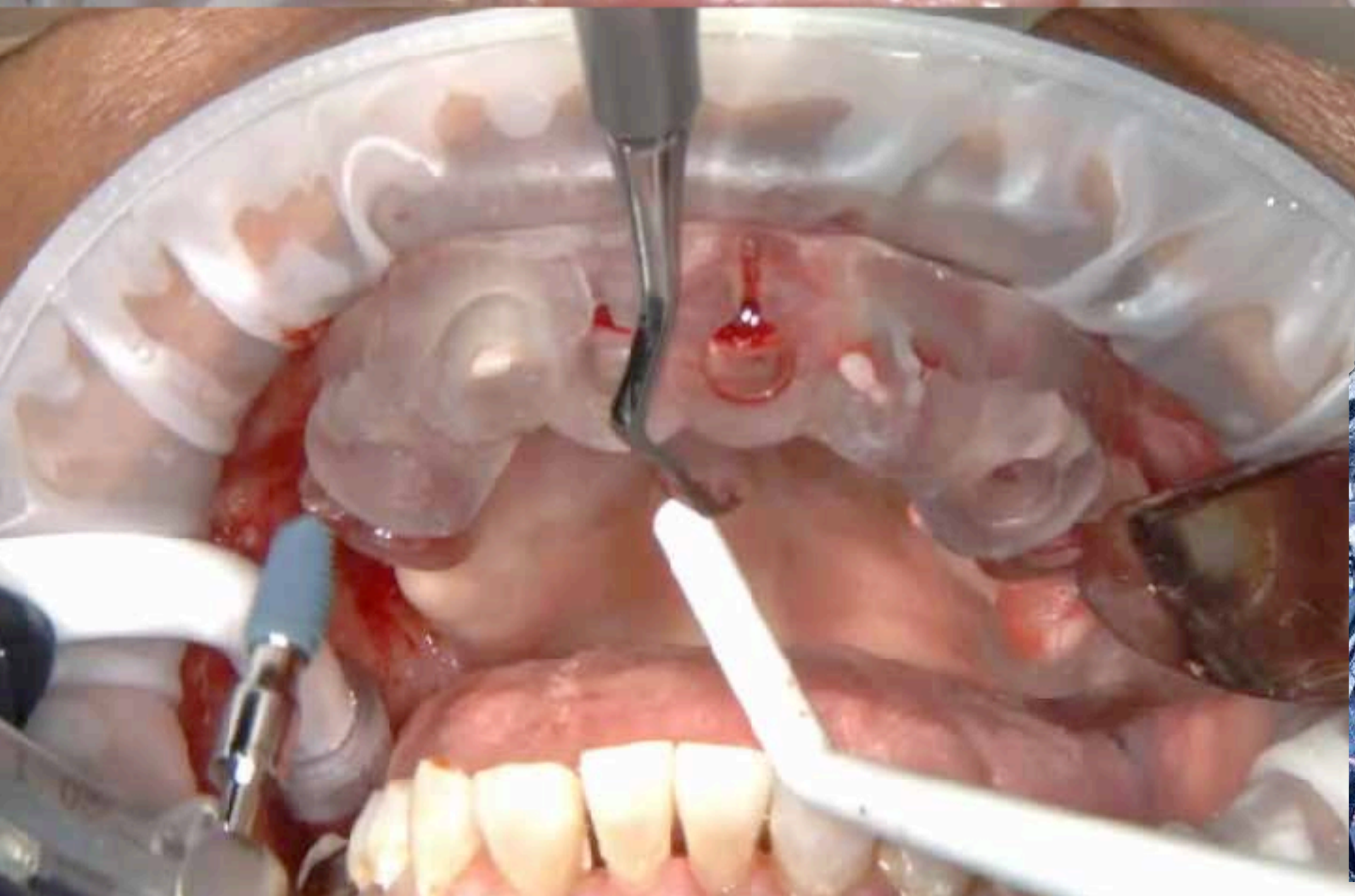


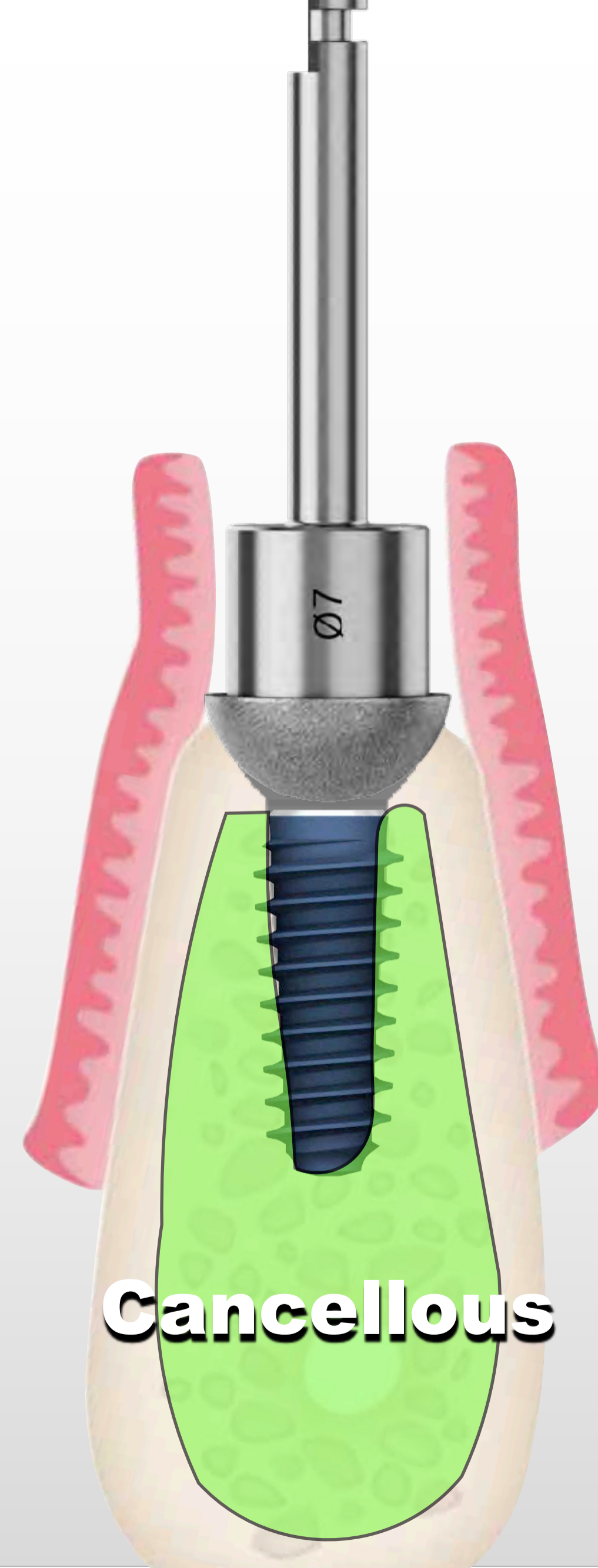
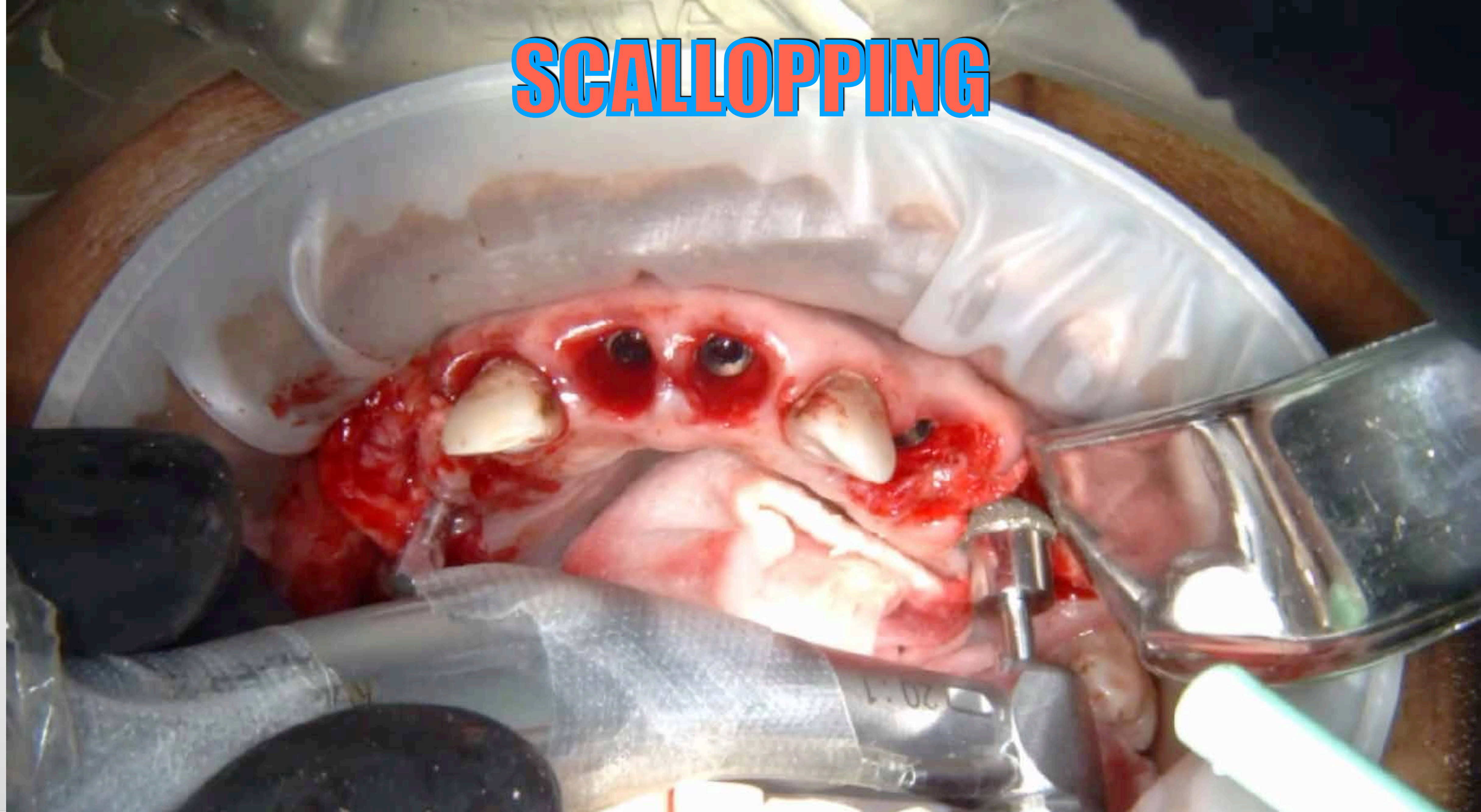


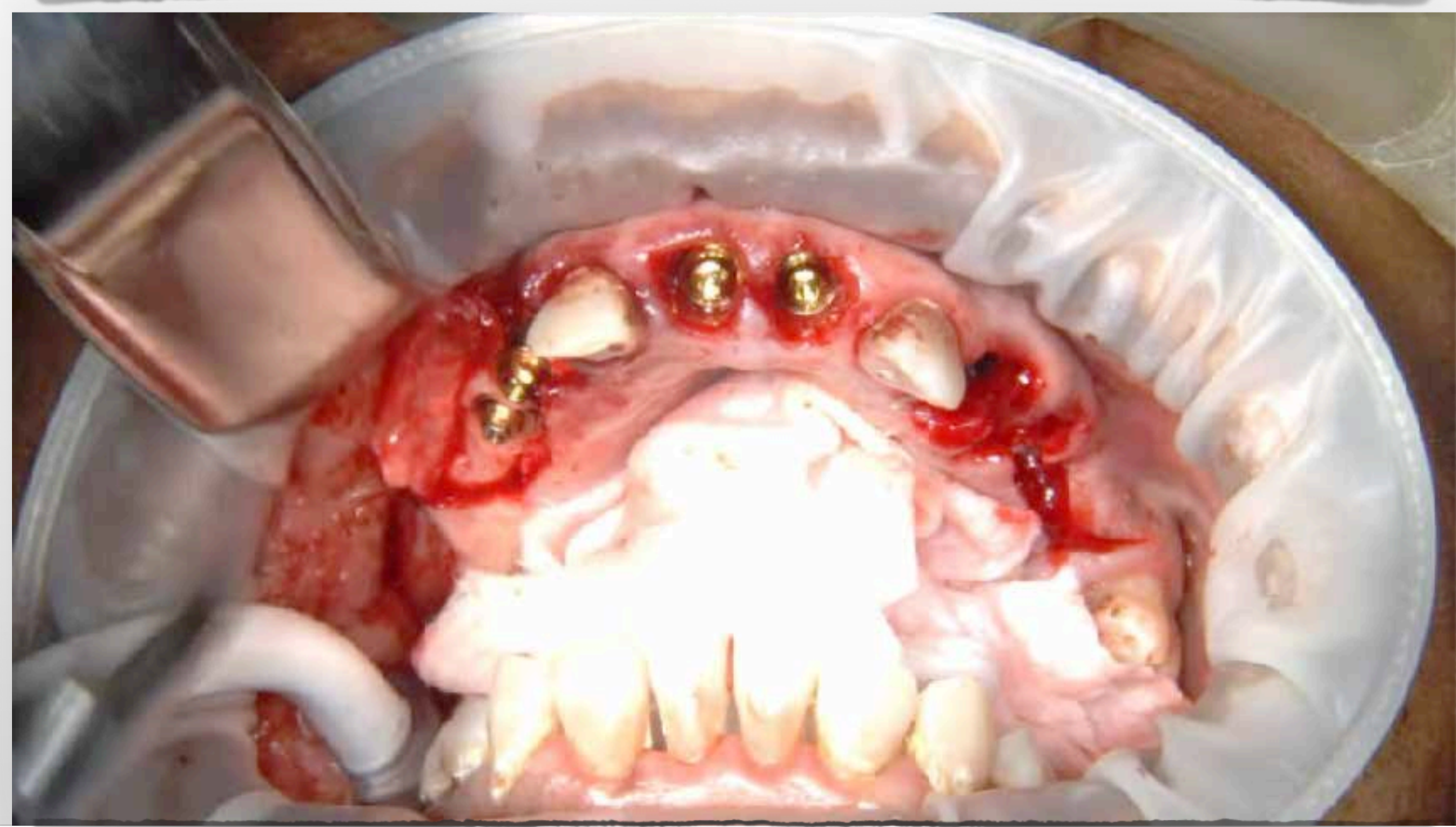
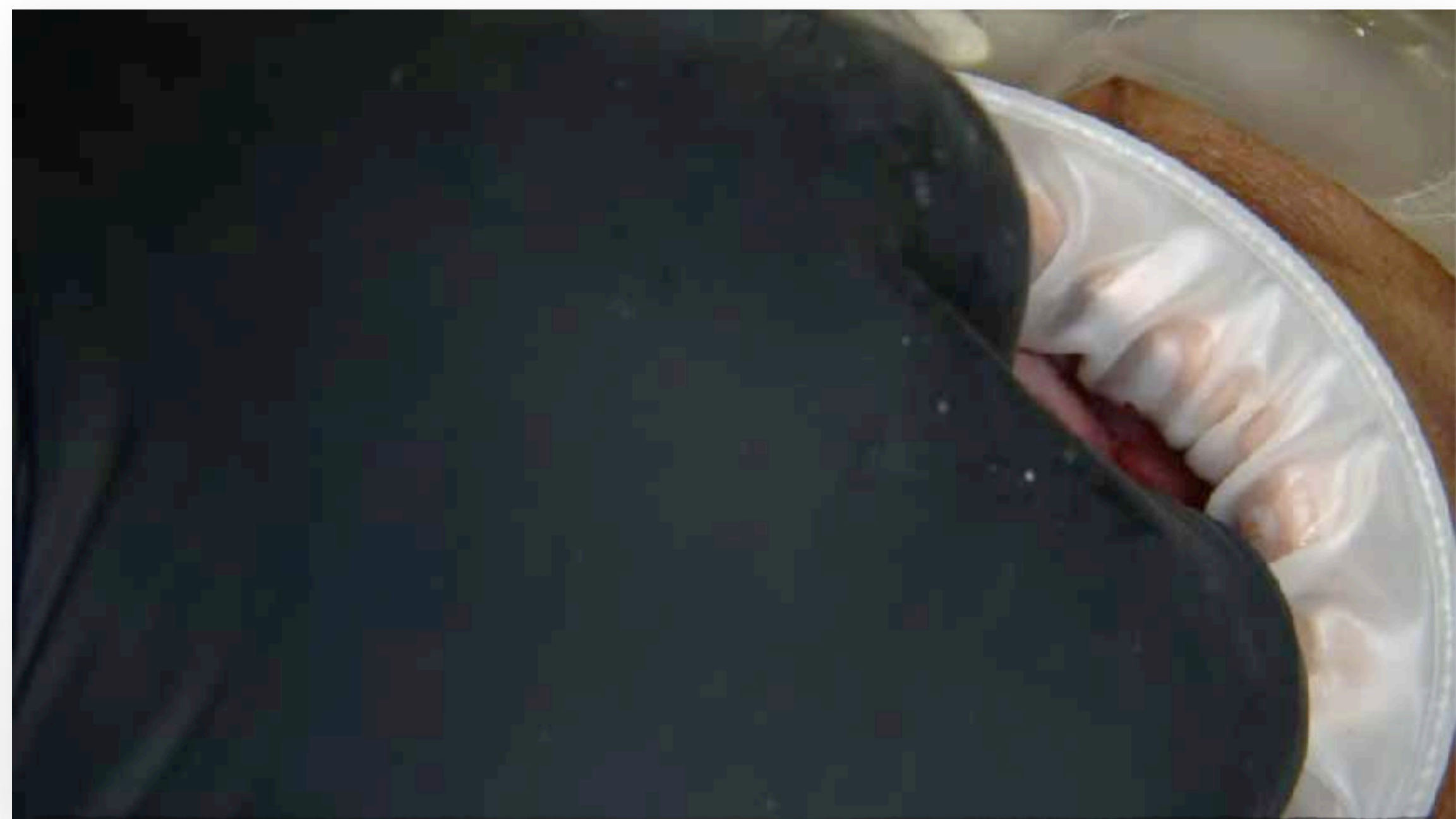
BLUEDIAMOND

IMPLANT

GUIDED OR FREEHAND



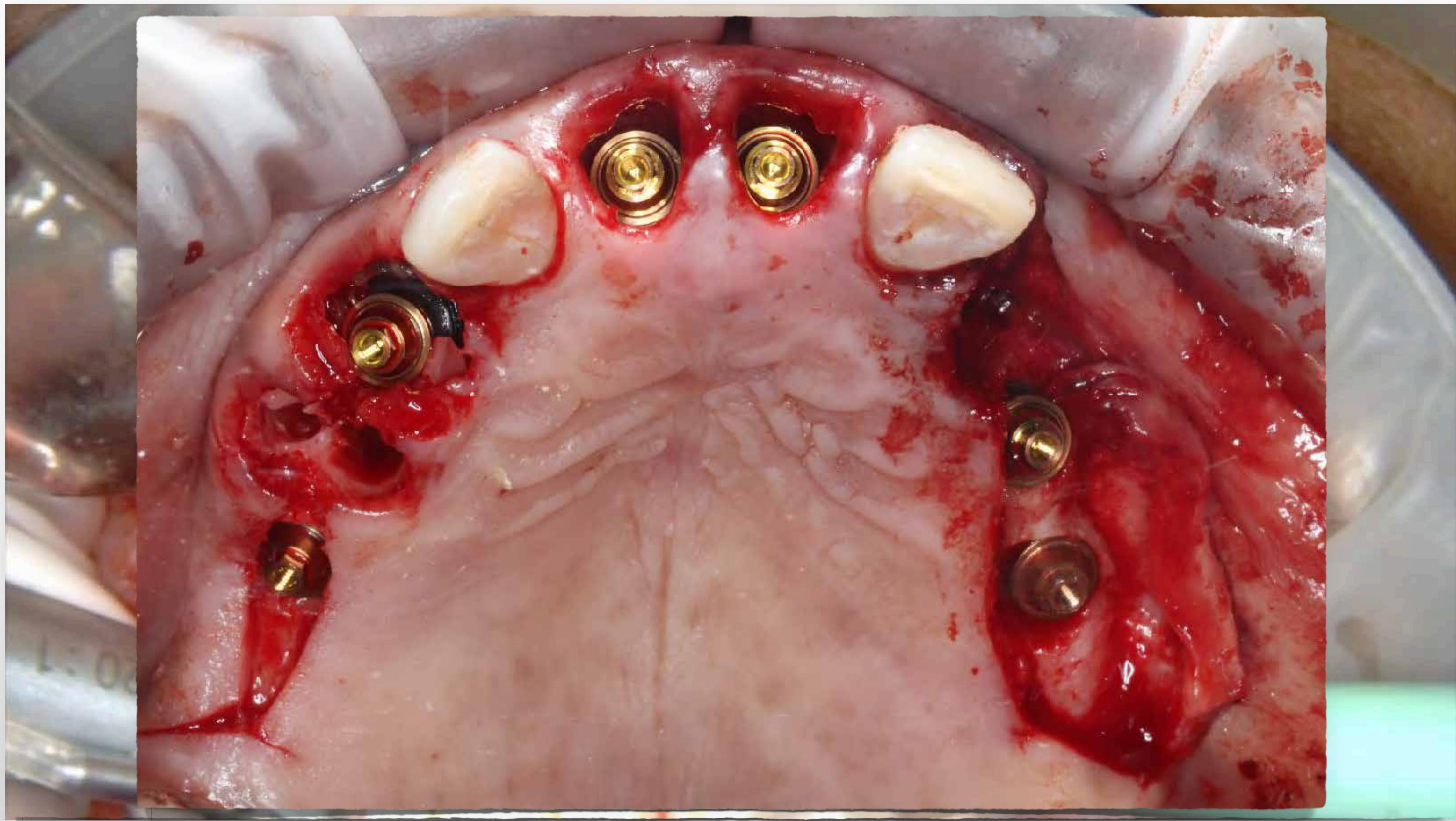


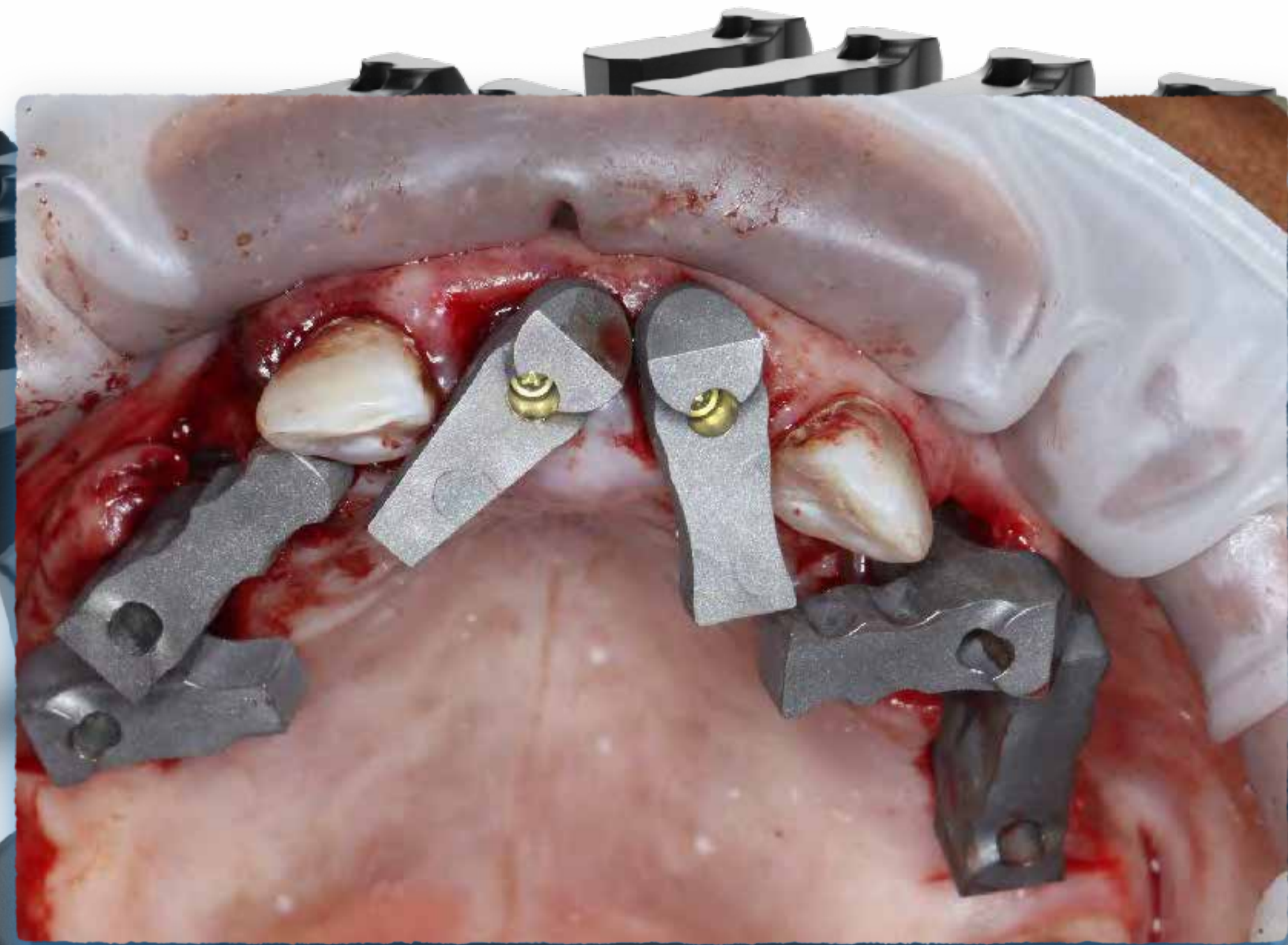


M

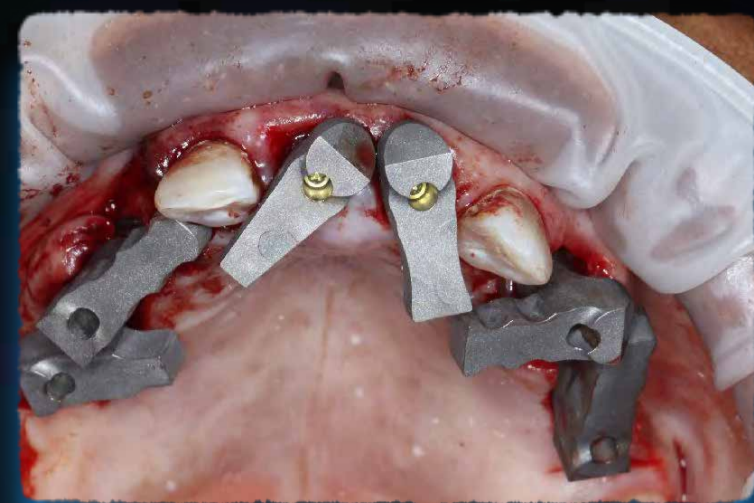
U

A






ArchBridge™



SHINING3D | Home | New order Marsed Dickerson | Scan In Progress | Pre-design | Send

Home Layout | User Profile | Target | Camera | Settings | Help

Upper Jaw

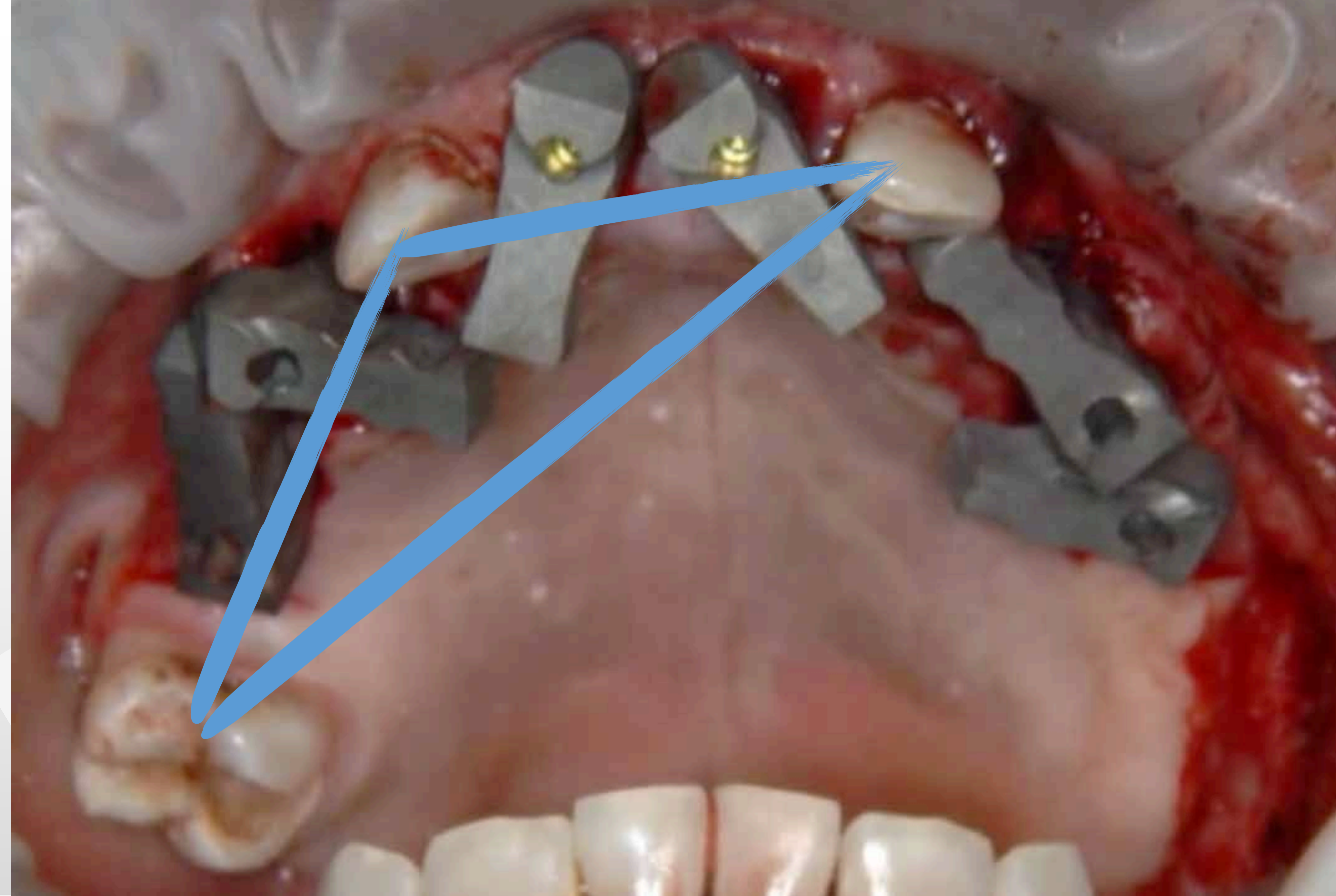


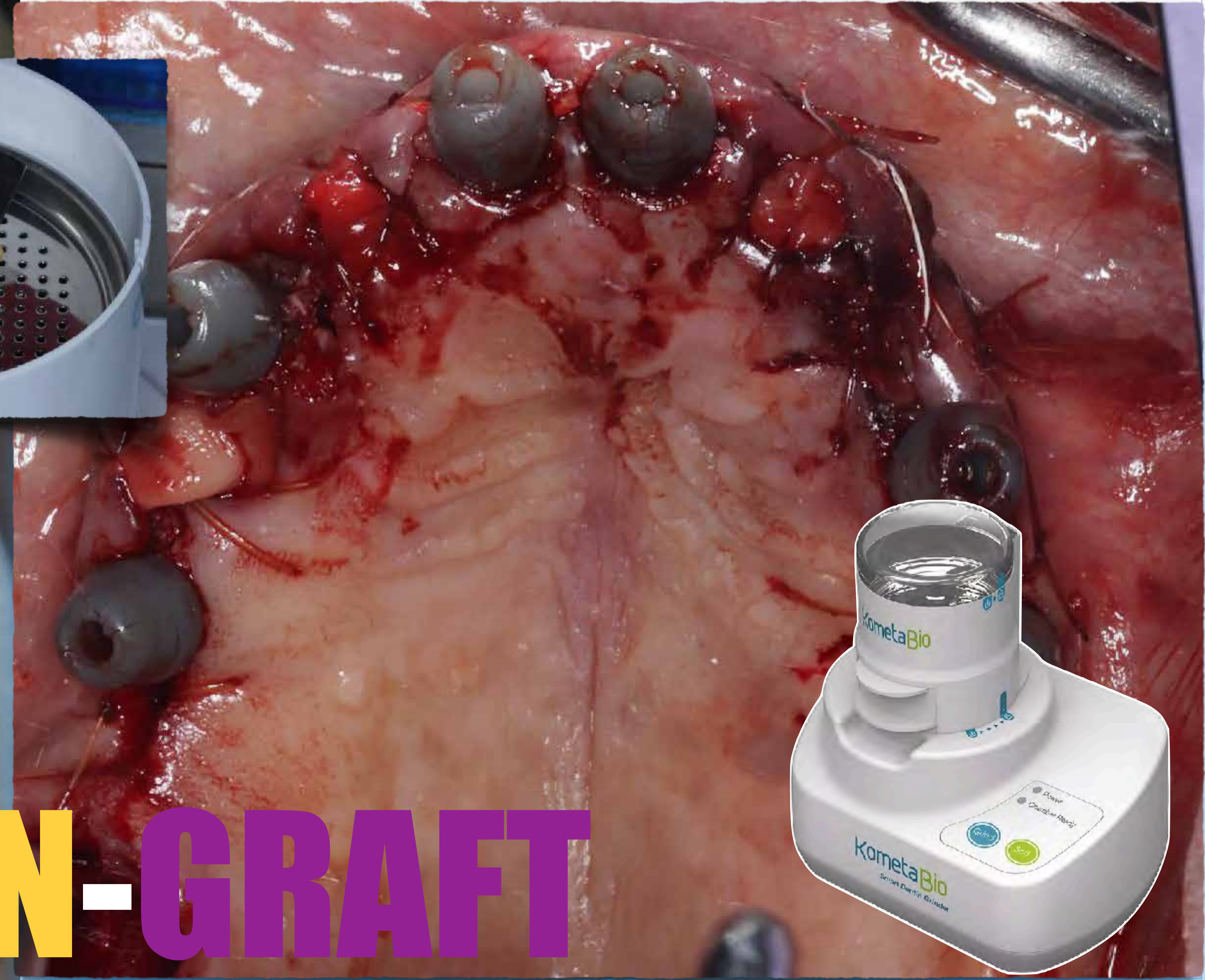
- Please keep moving at a constant speed while scanning.
- It is recommended to keep a distance of 3 to 5mm between the scan tip and the surface of the teeth.

Back to Order | 2x | [Navigation icons]

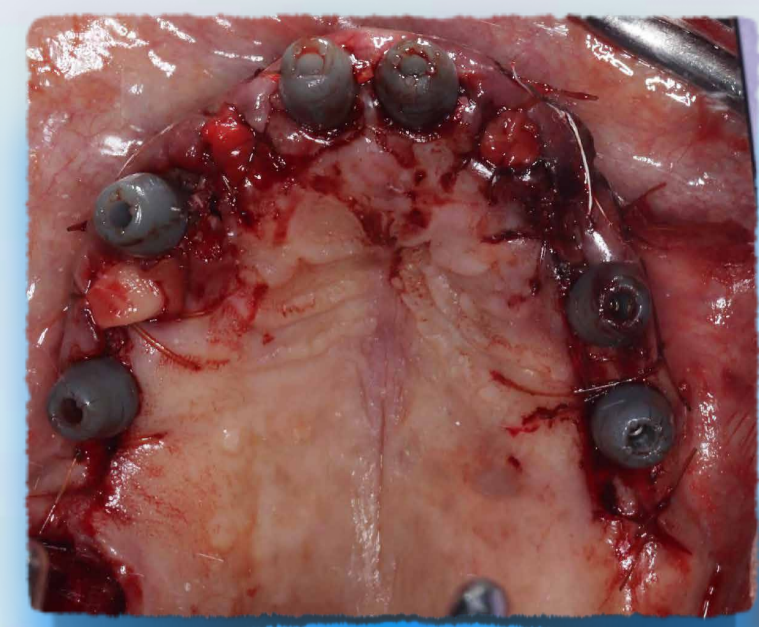
Go to [Next Step]

**T
R
I
A
D**





EXTRACT-DENTIN-GRAFT

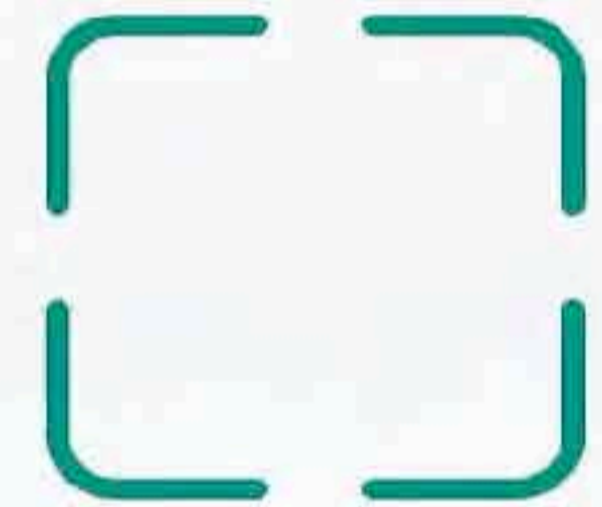
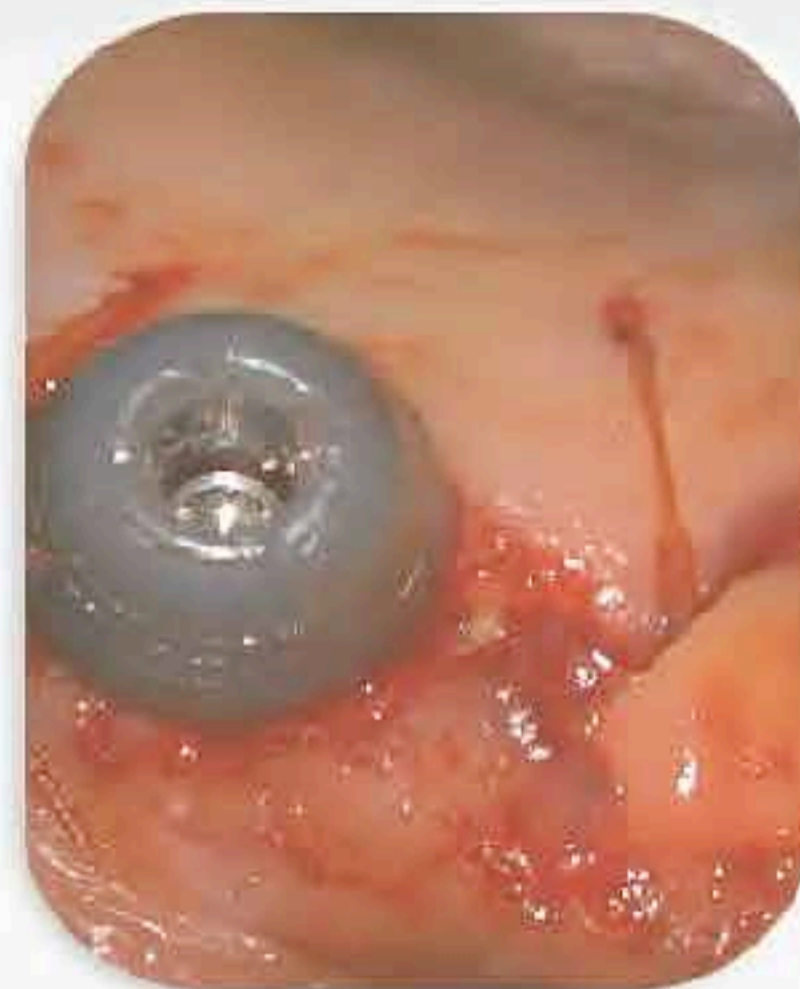


SCAN



SHINING3D | New order Marsed Dickerson | Scan In Progress | Pre-design | Send

Upper Jaw



- Please keep moving at a constant speed while scanning.
- It is recommended to keep a distance of 3 to 5mm between the scan tip and the surface of the teeth.

Back to Order

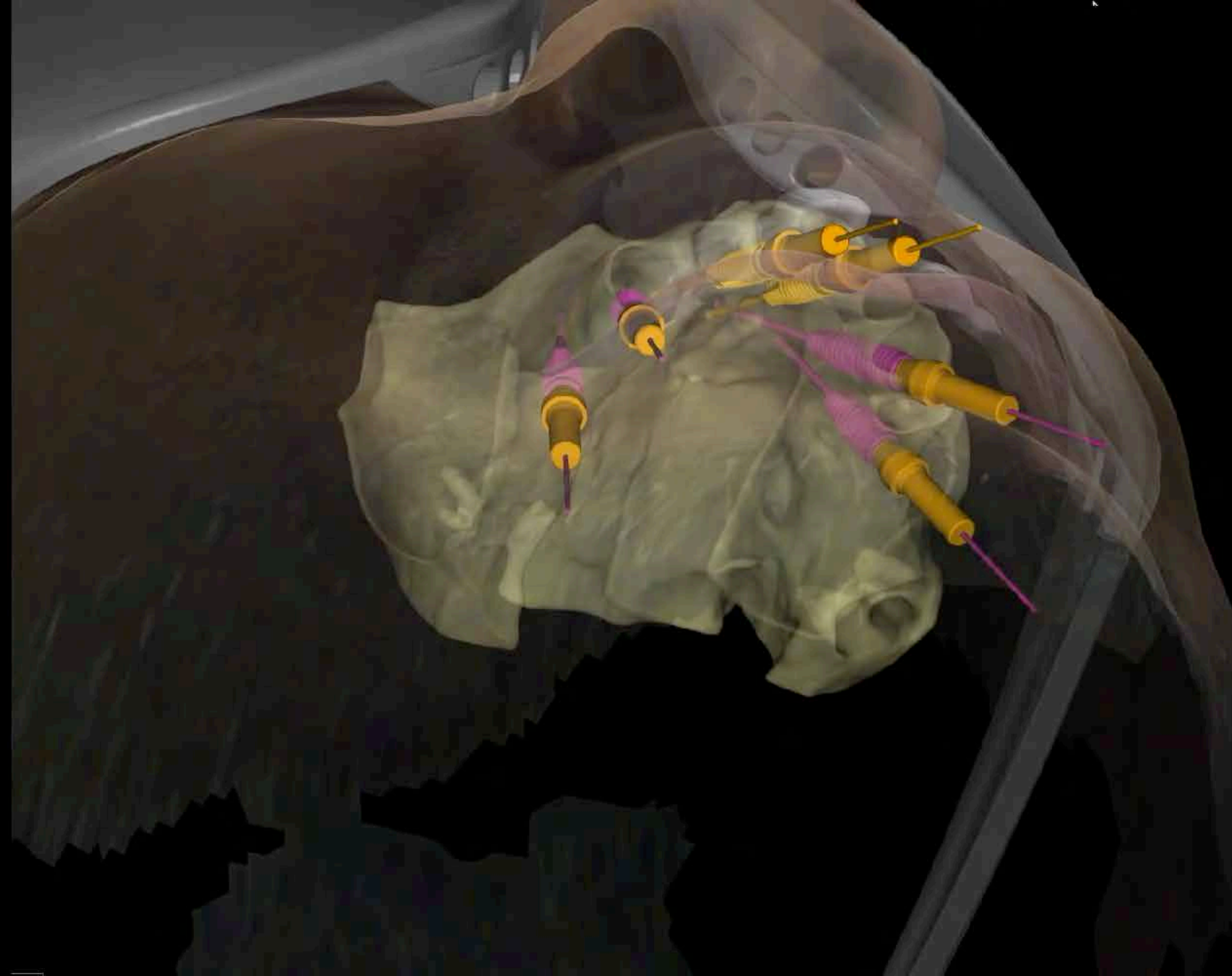
2x

Navigation icons: Copy, Heart, Pause, Refresh, Checkmark

IMPORT

ArchBridge™

TISSUE

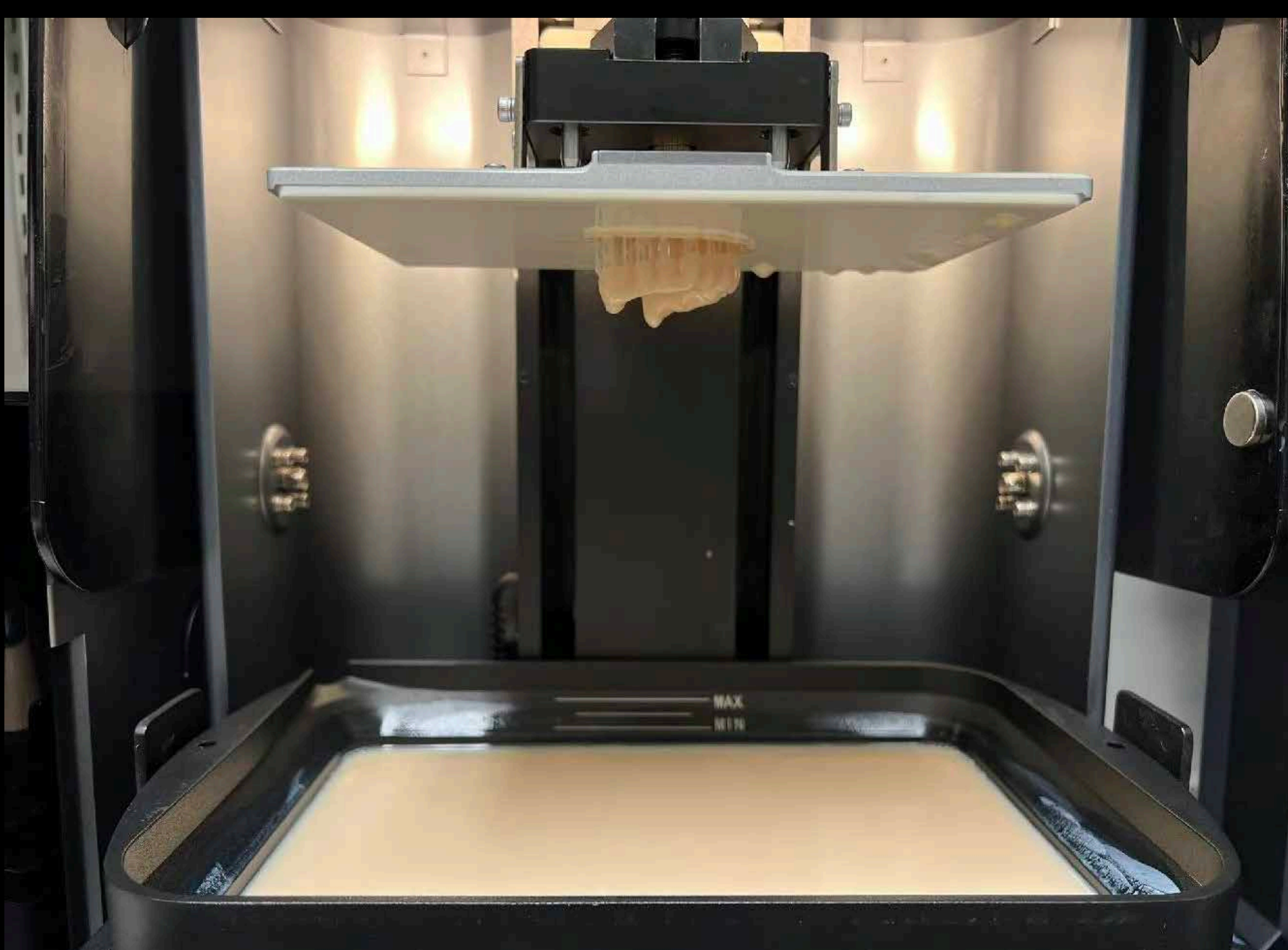


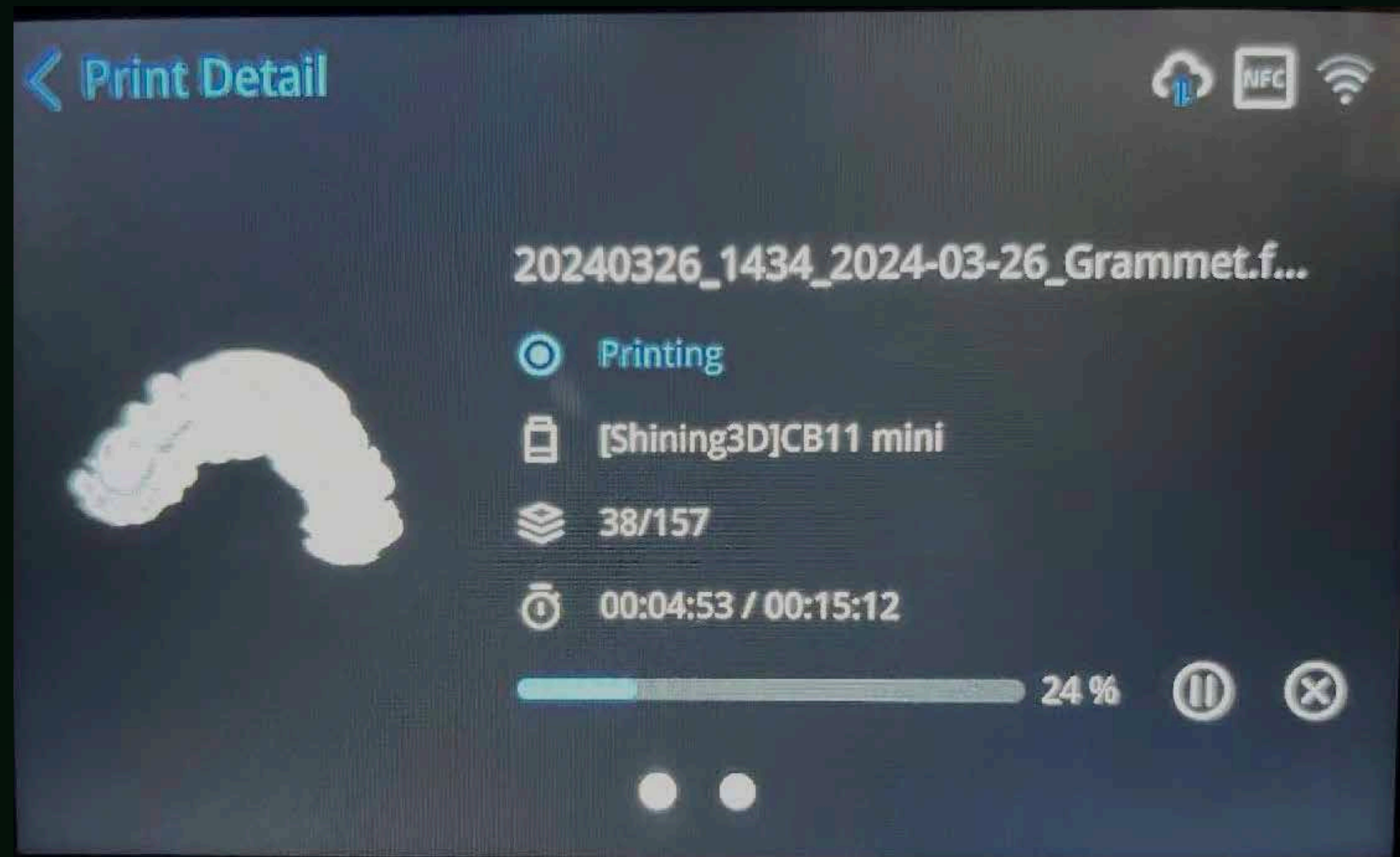
MATCH

PRE-FAB

DESIGN

PRINT-WASH

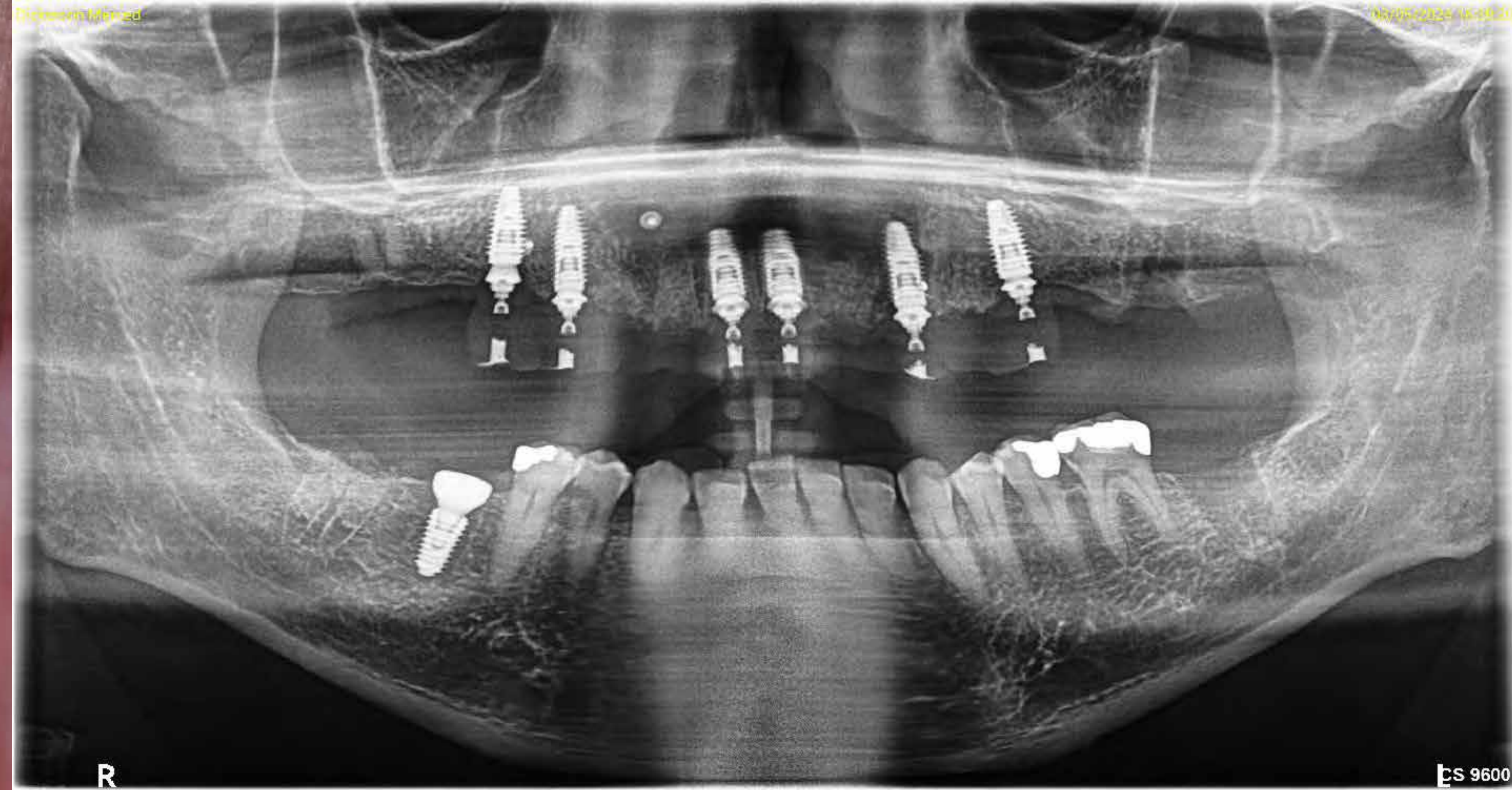


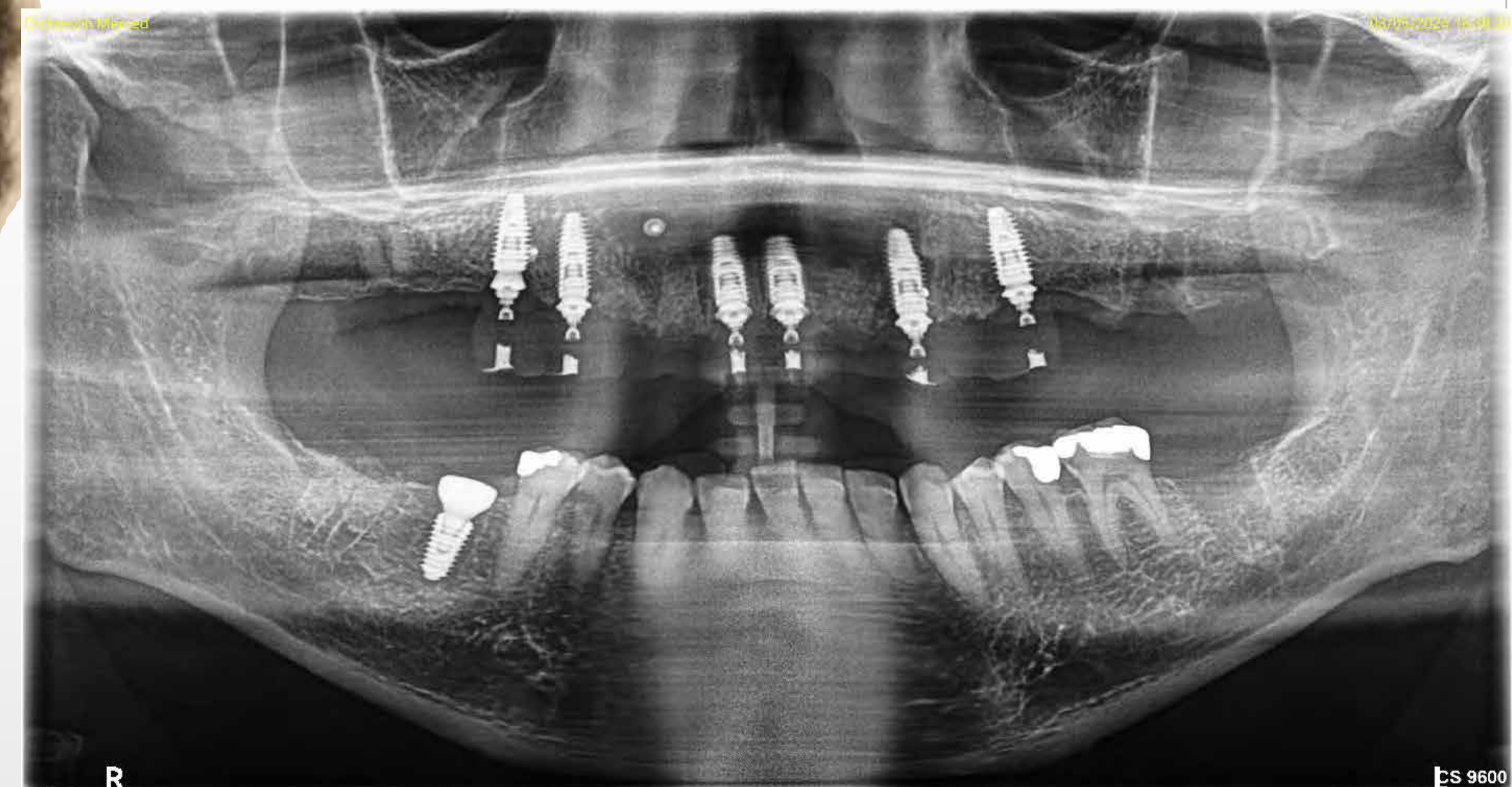


15min Print



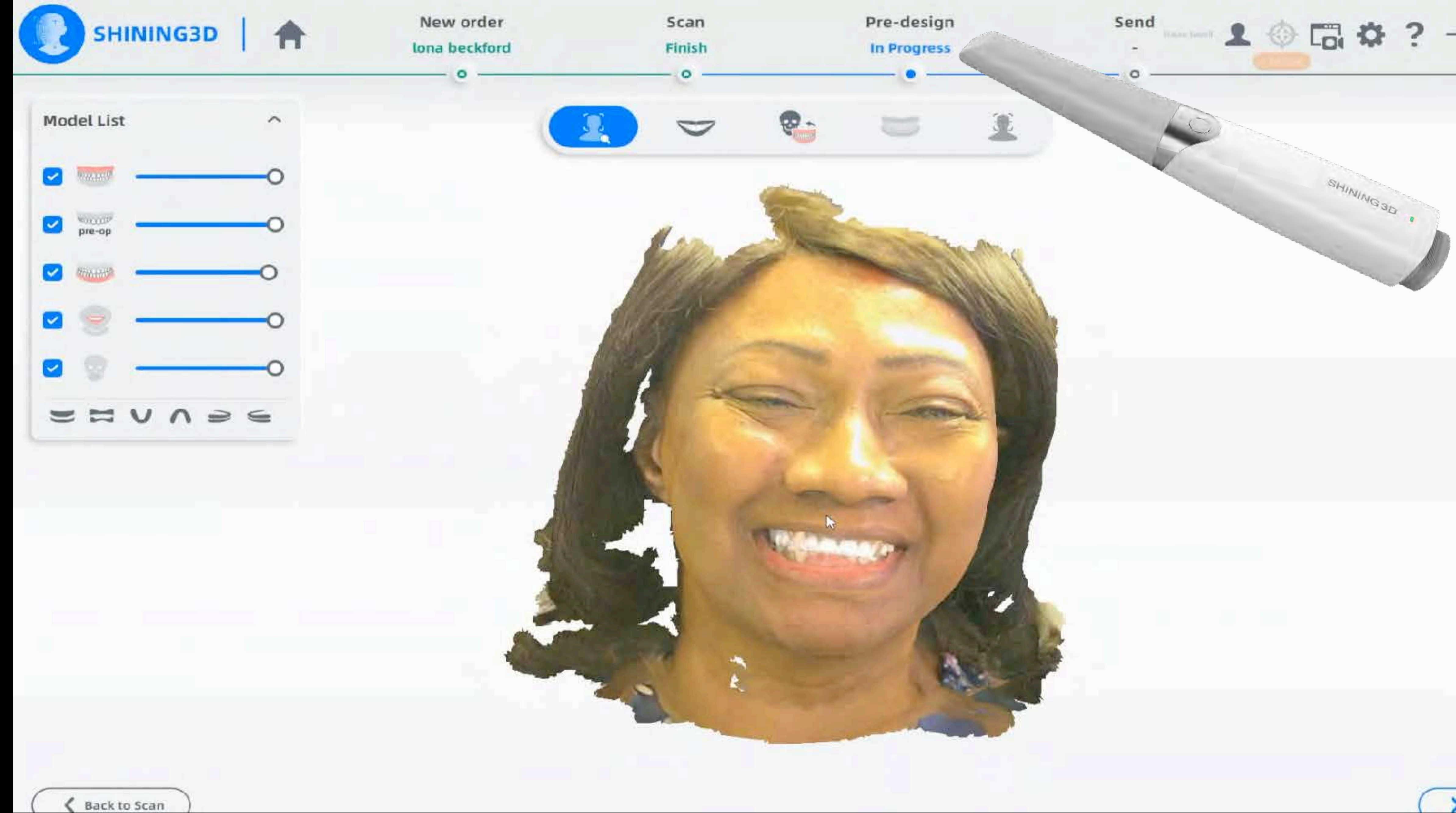




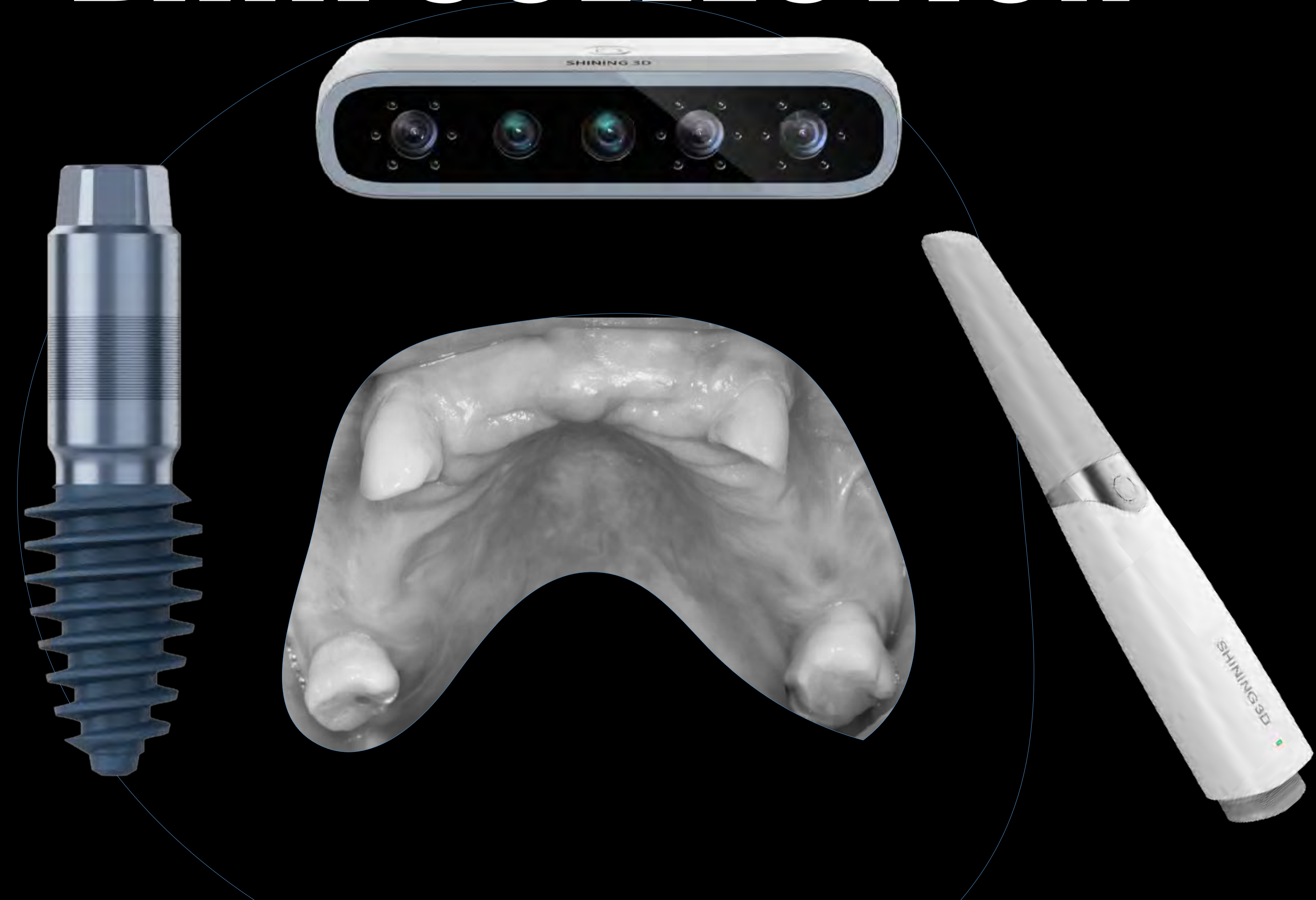


Changing lives one smile at a time

DATA COLLECTION



DATA COLLECTION

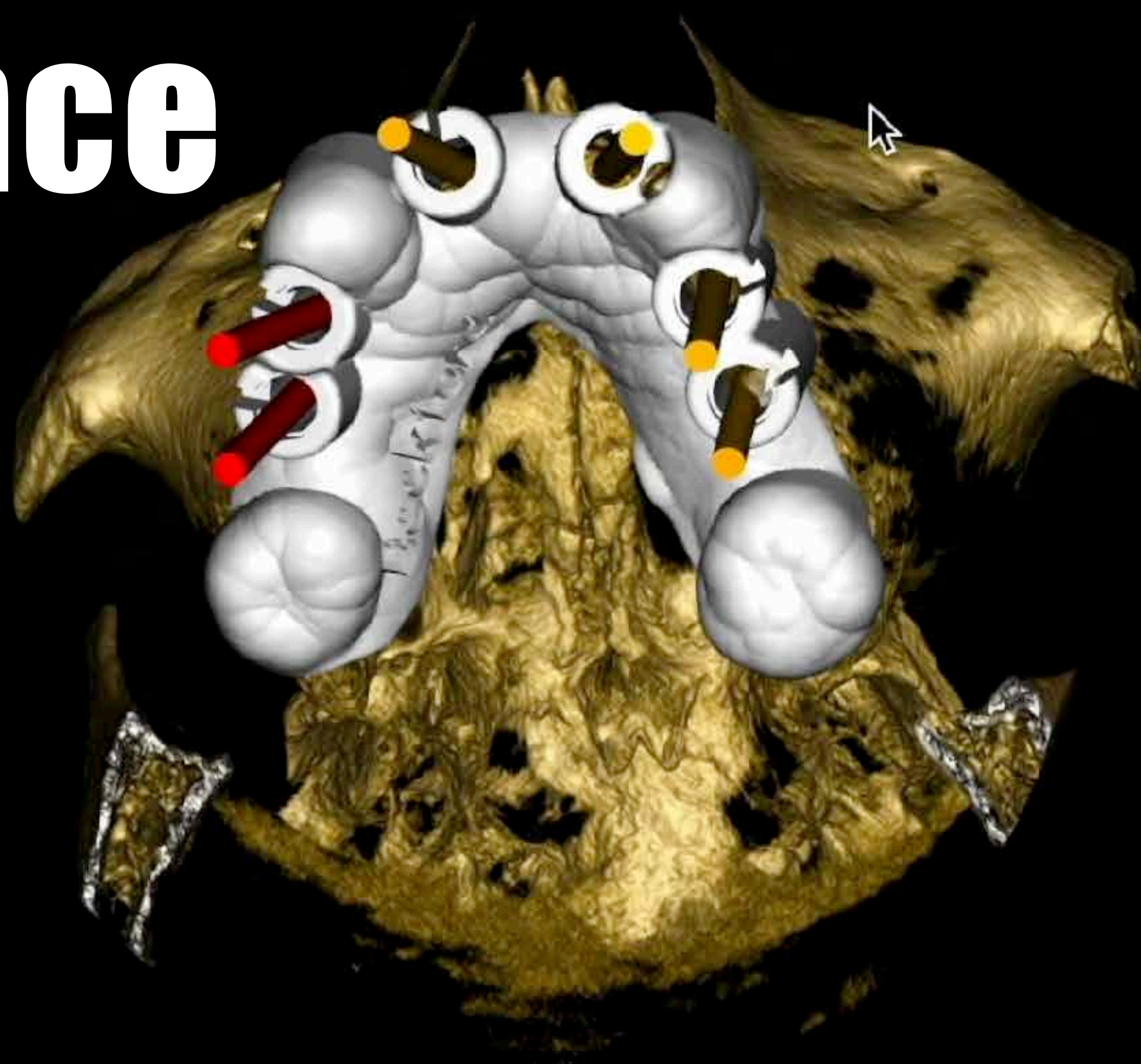


PLAN

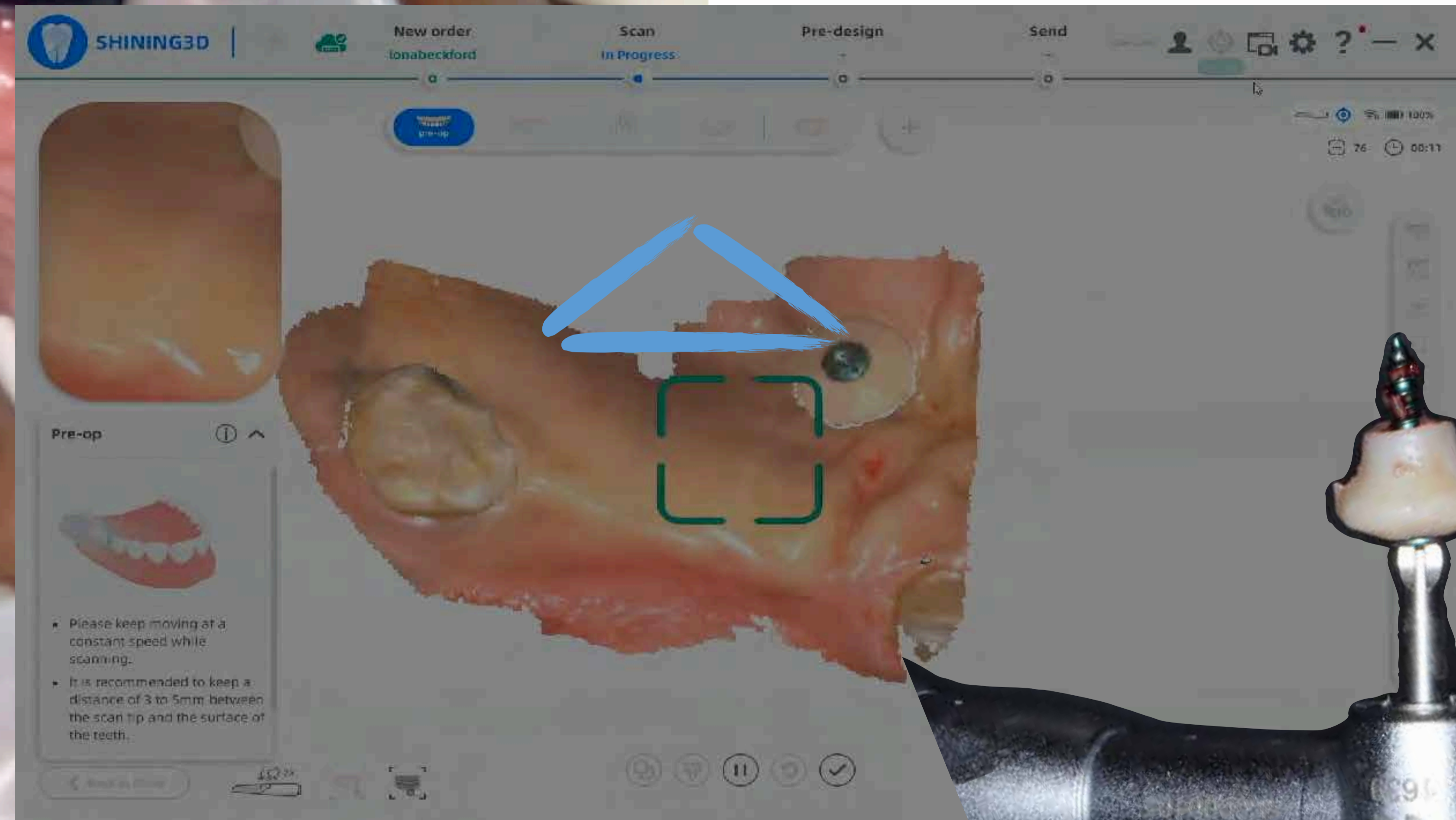
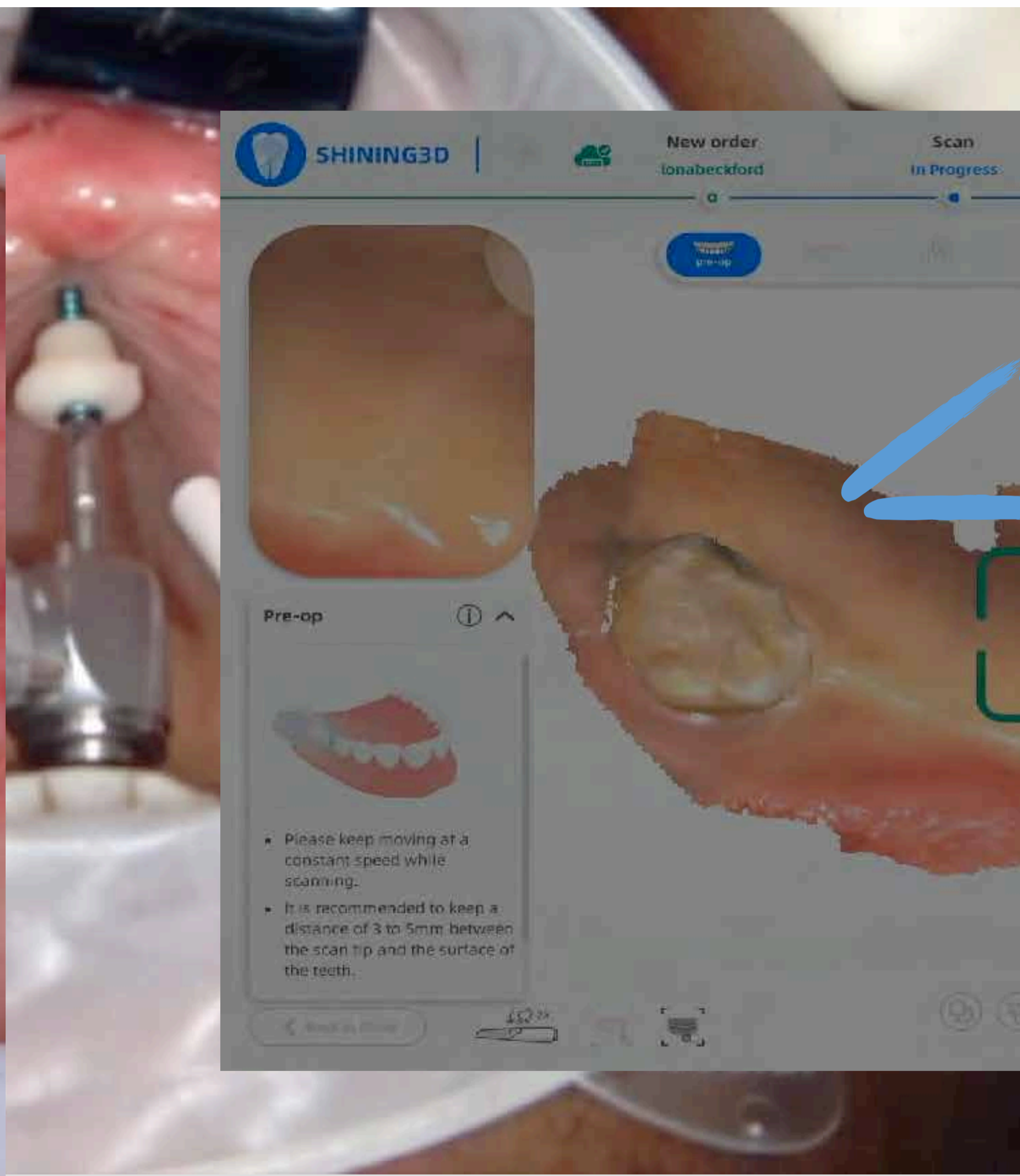
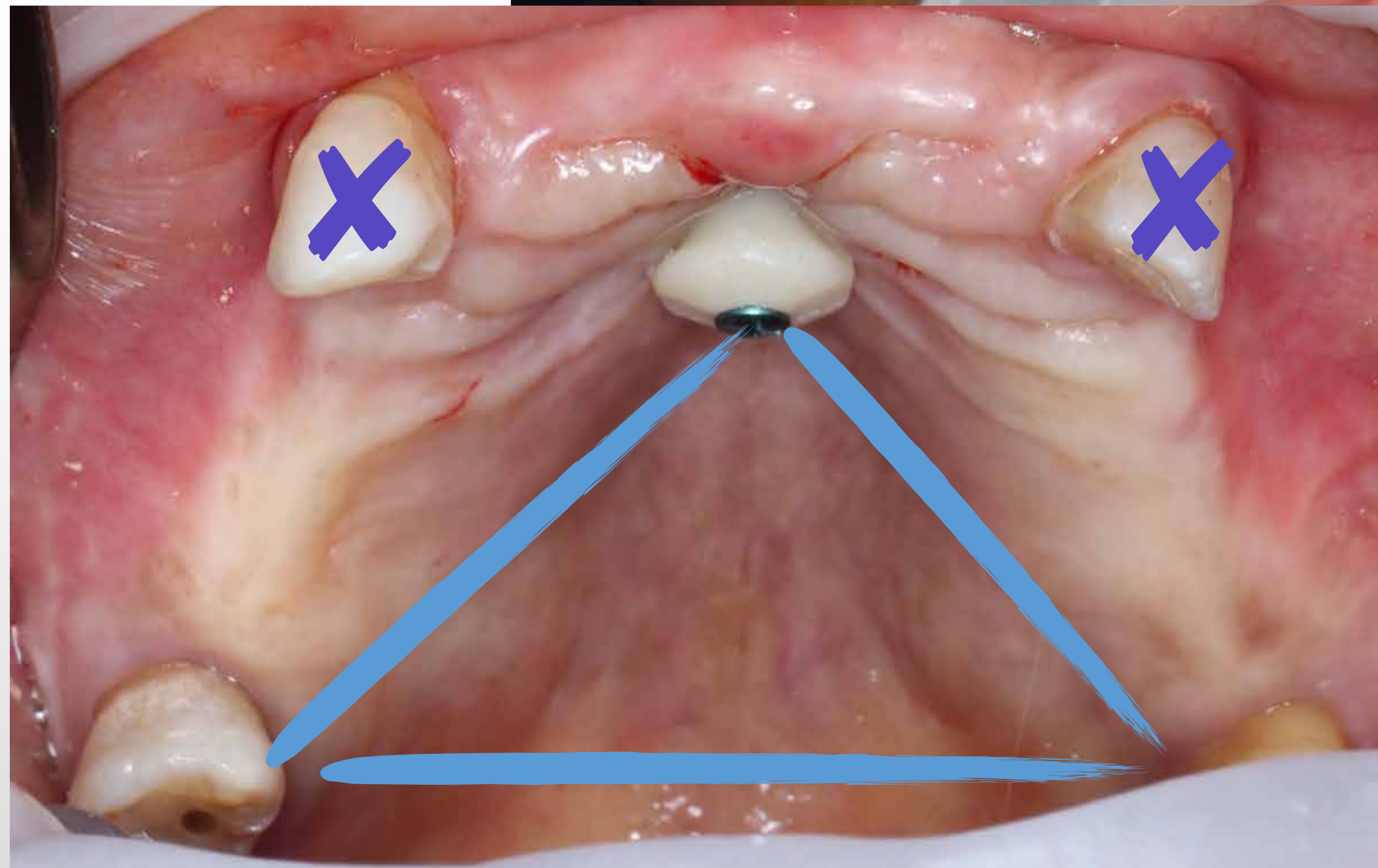


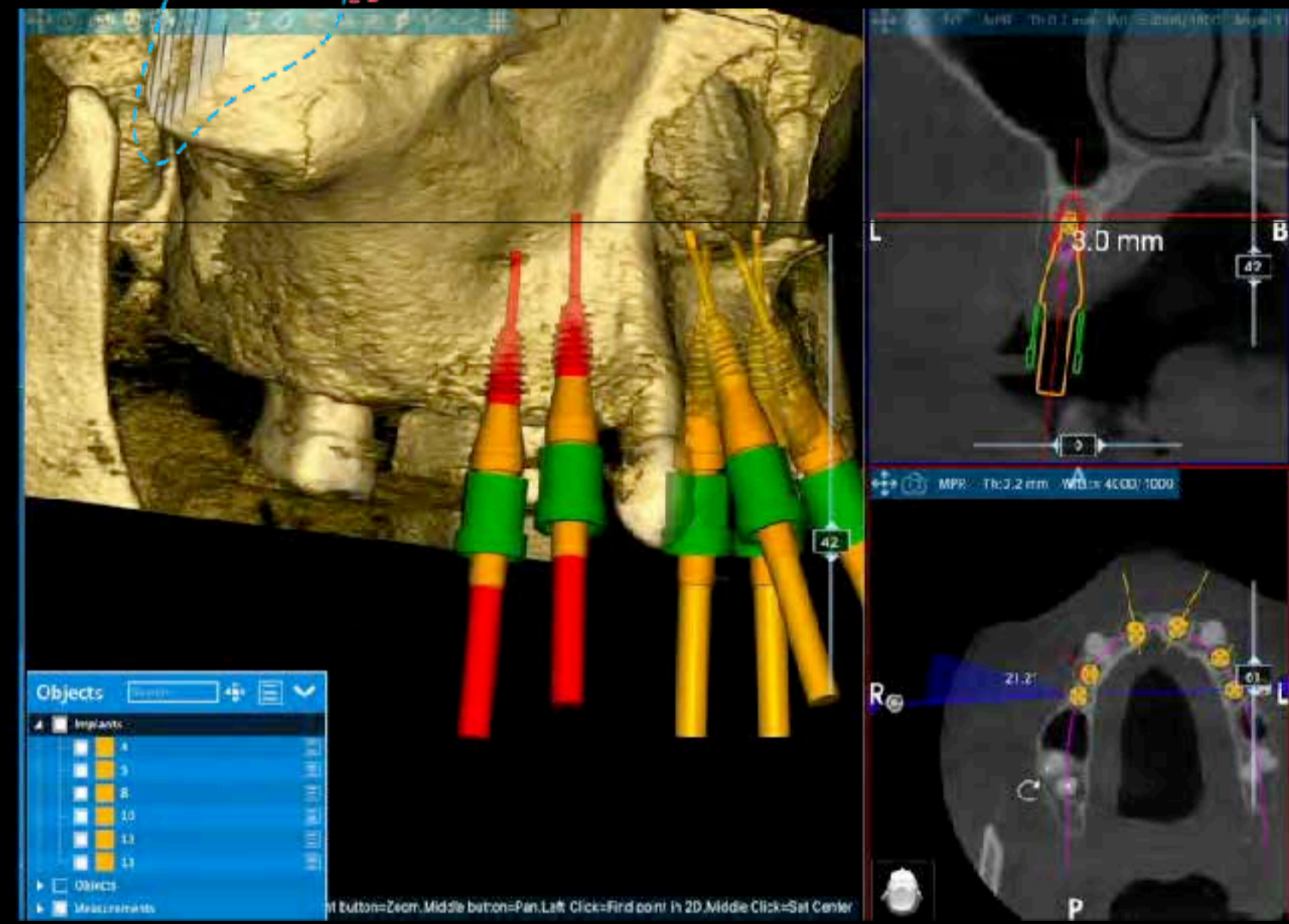
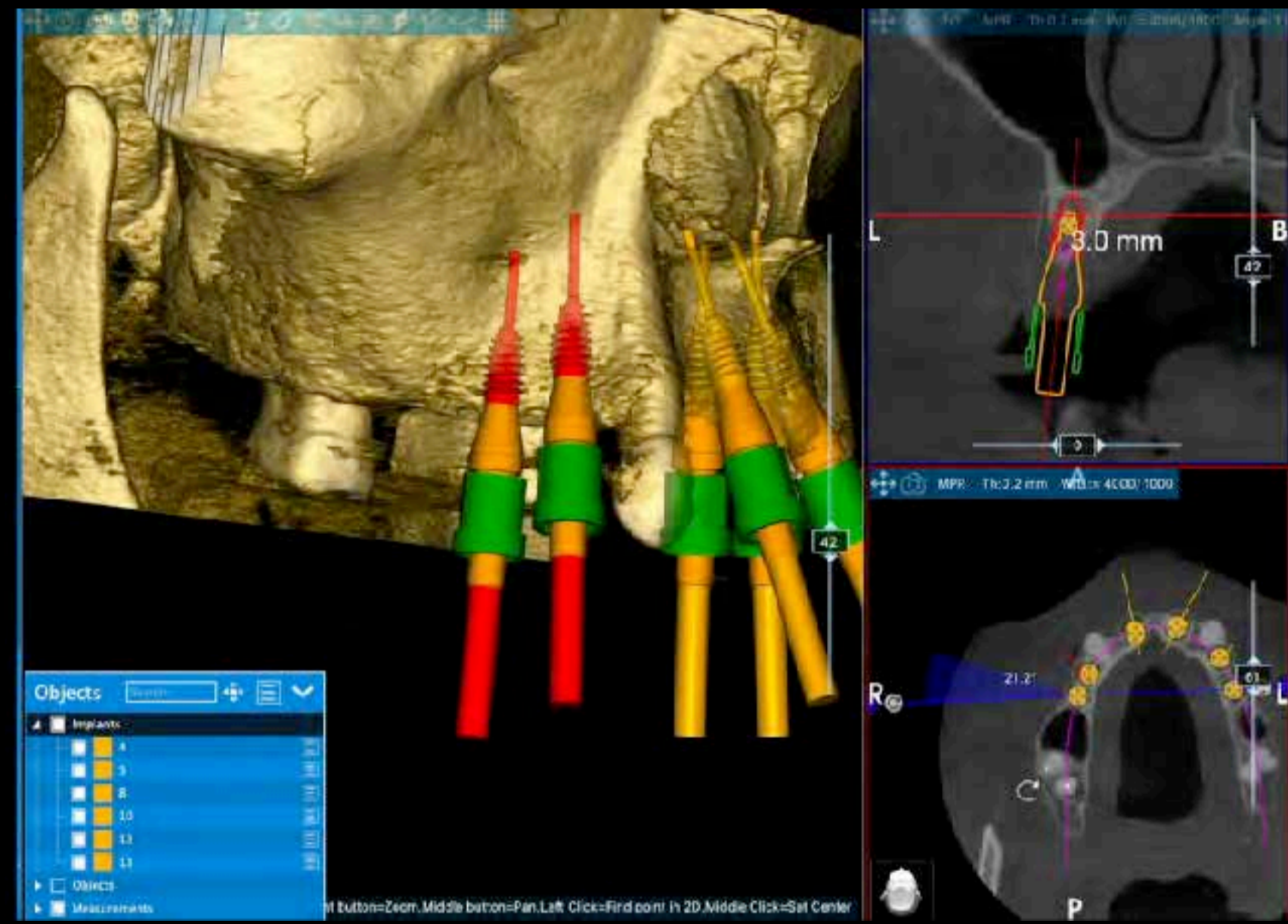
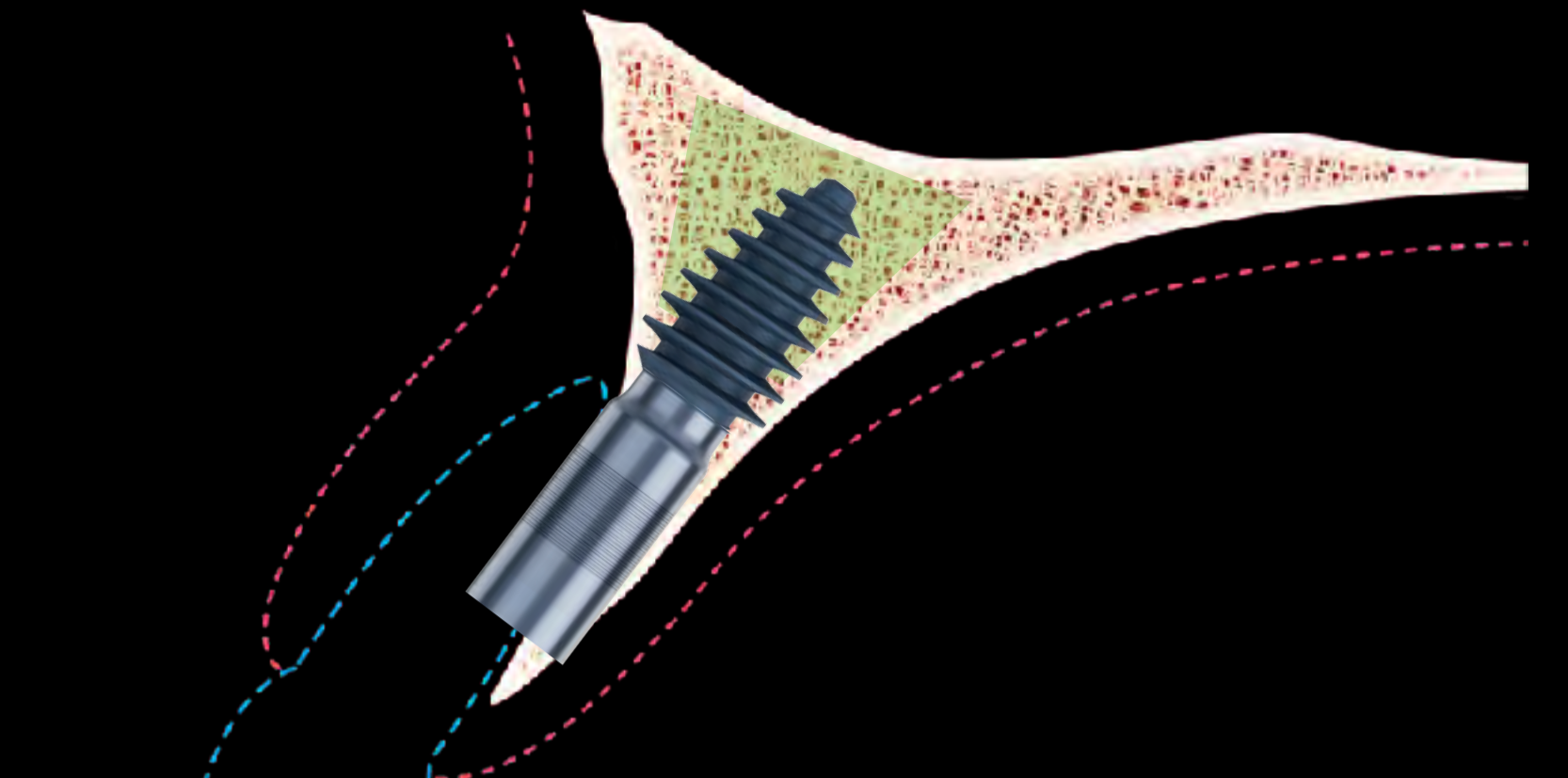
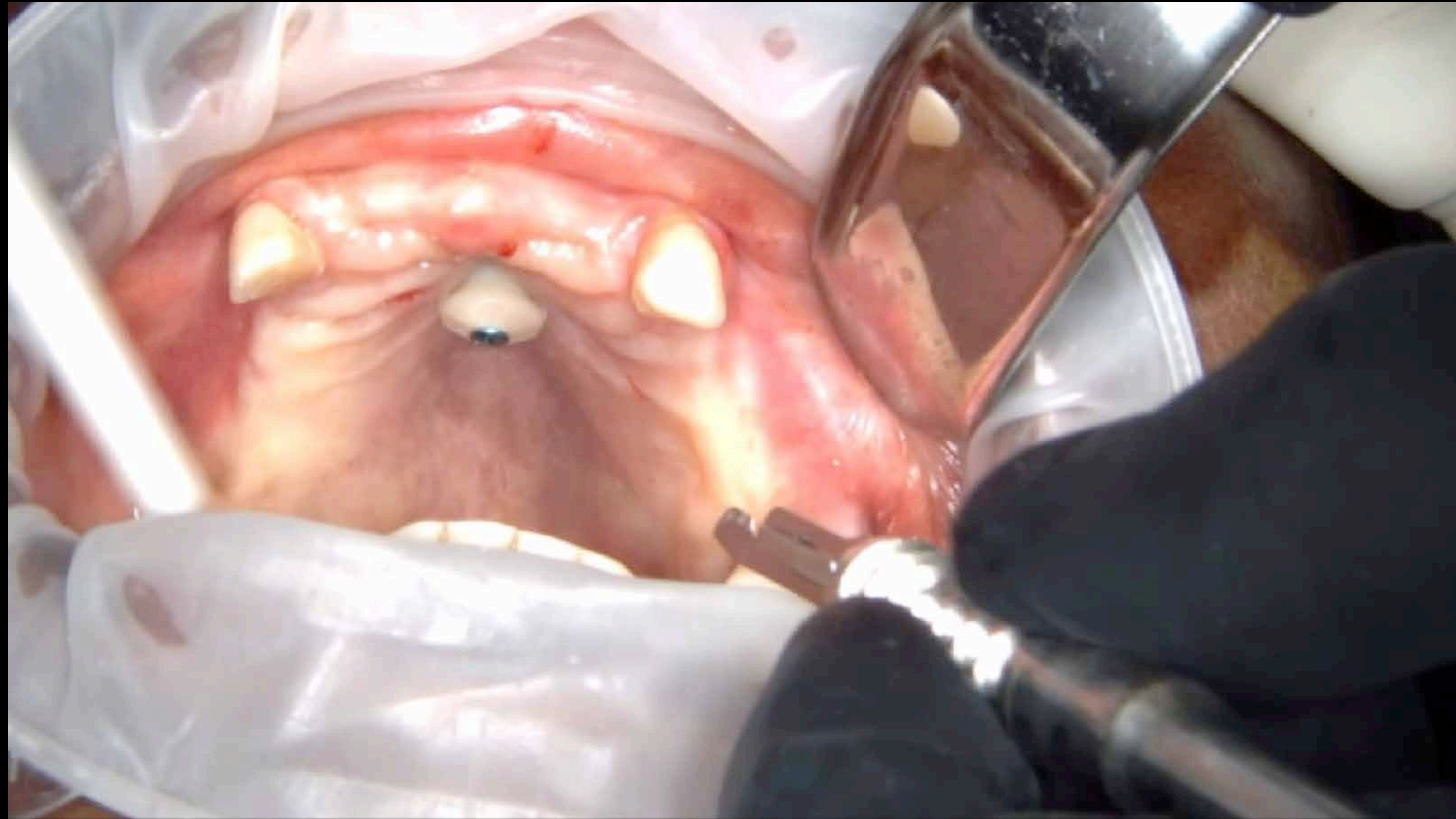
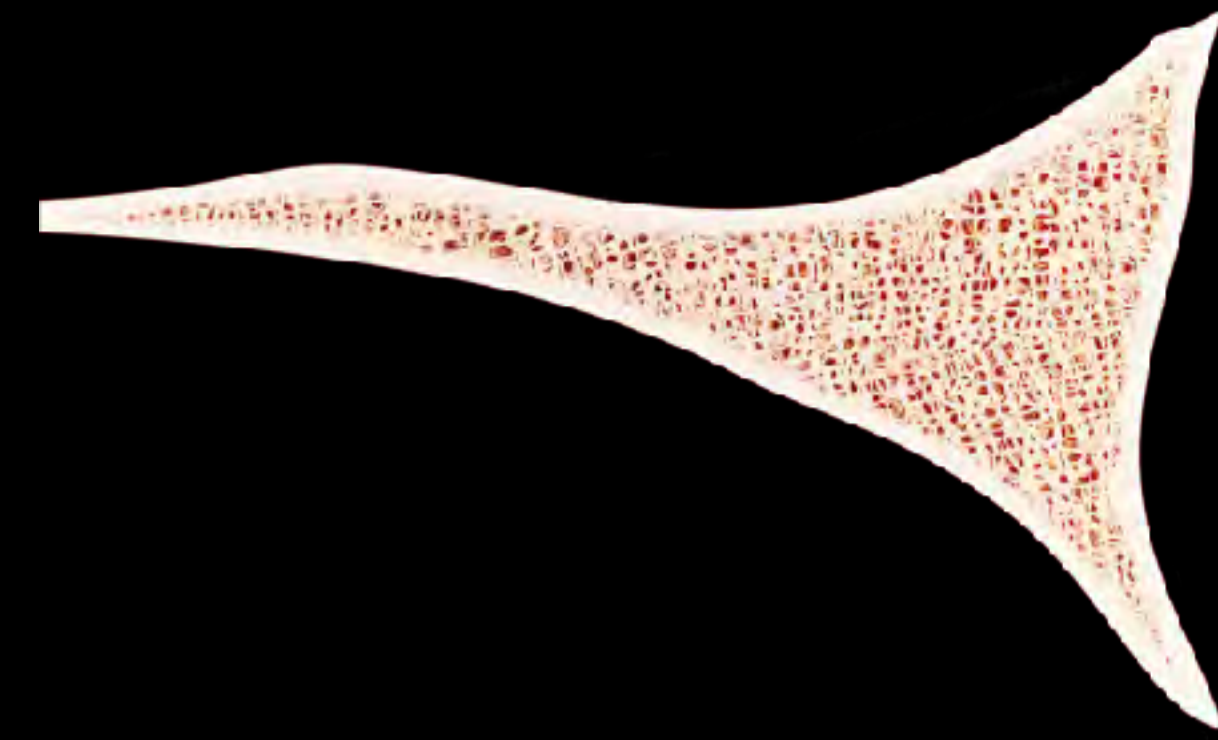
[

Surgical Guidance

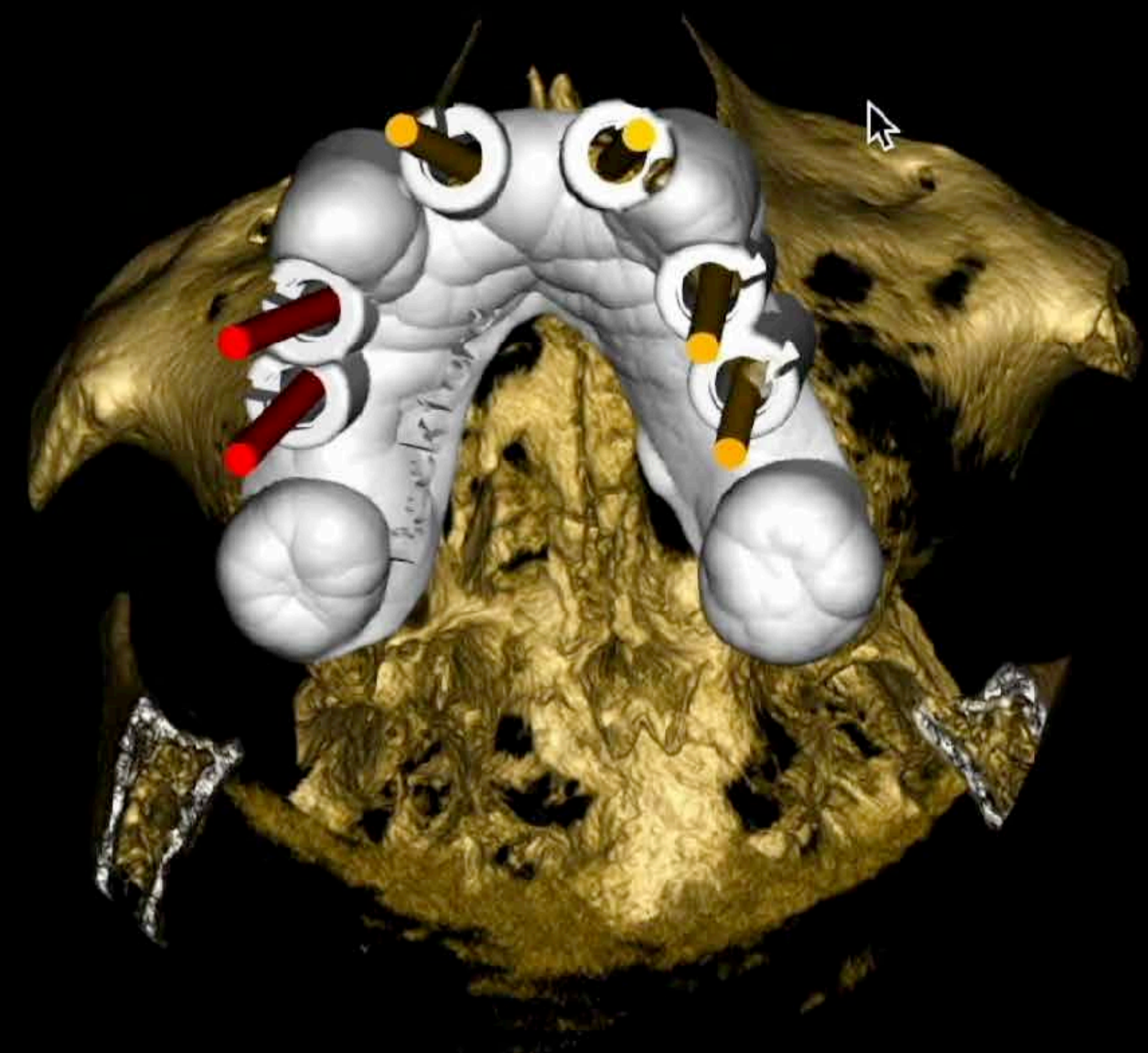
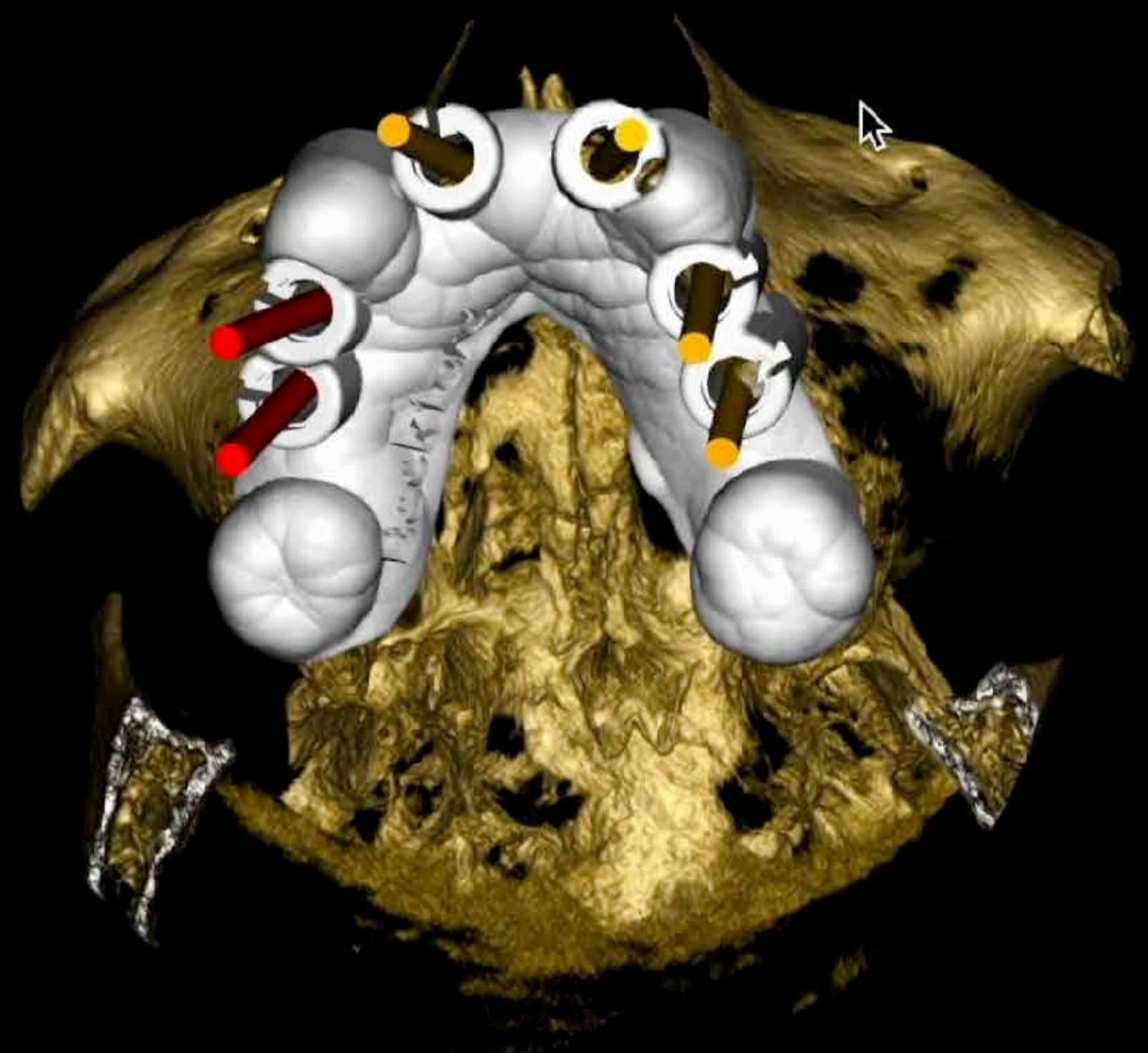


T R I A D

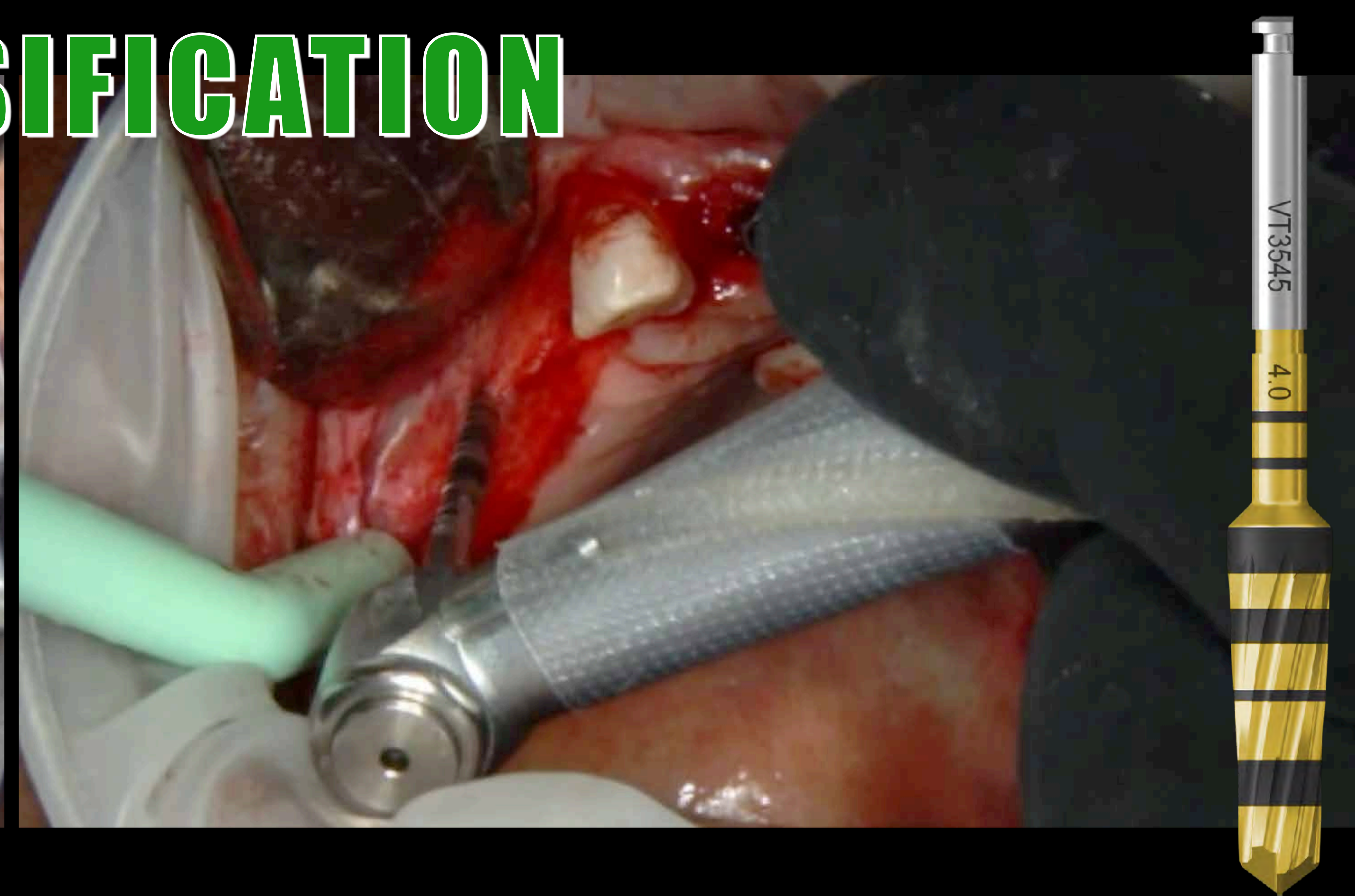


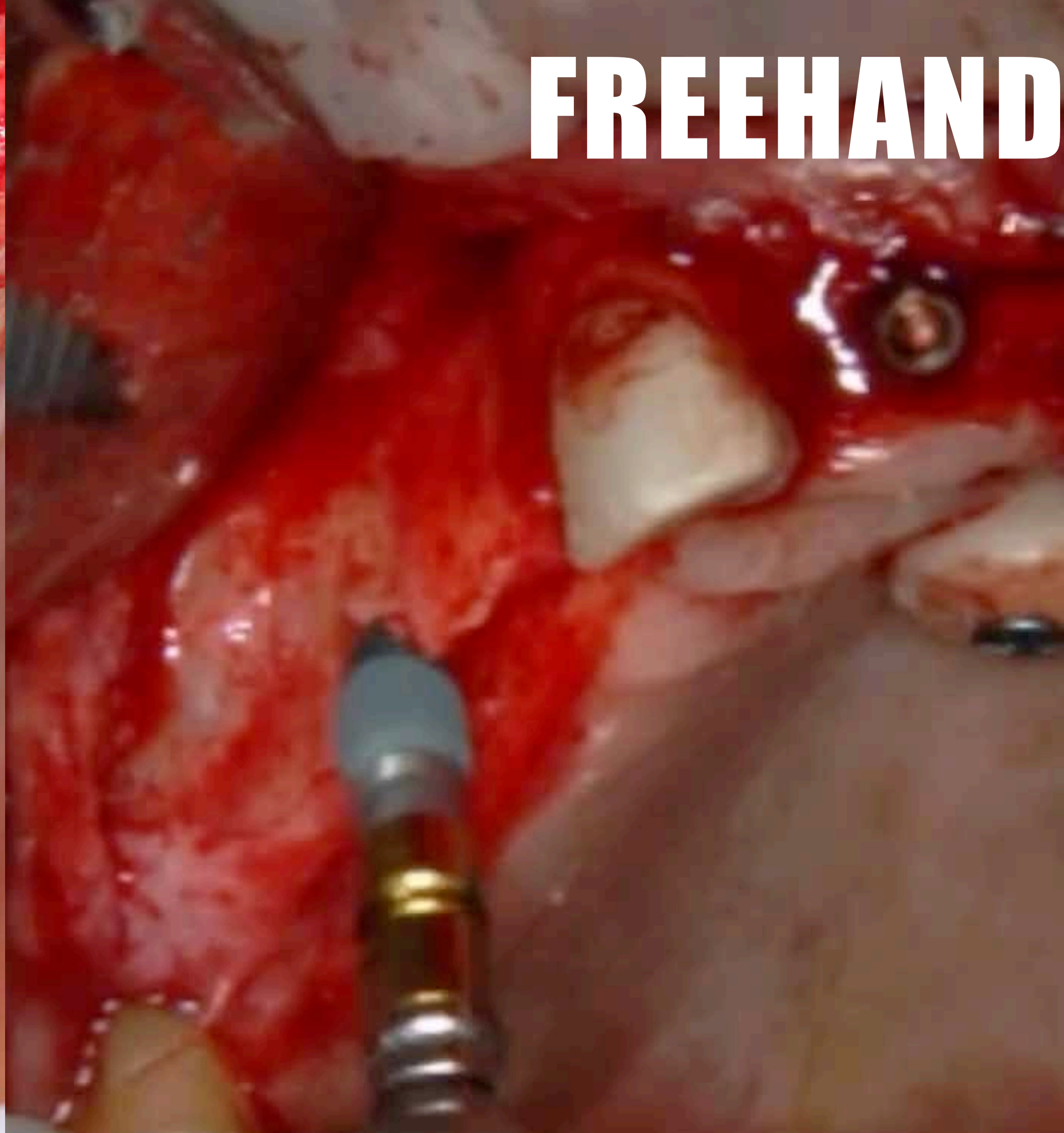
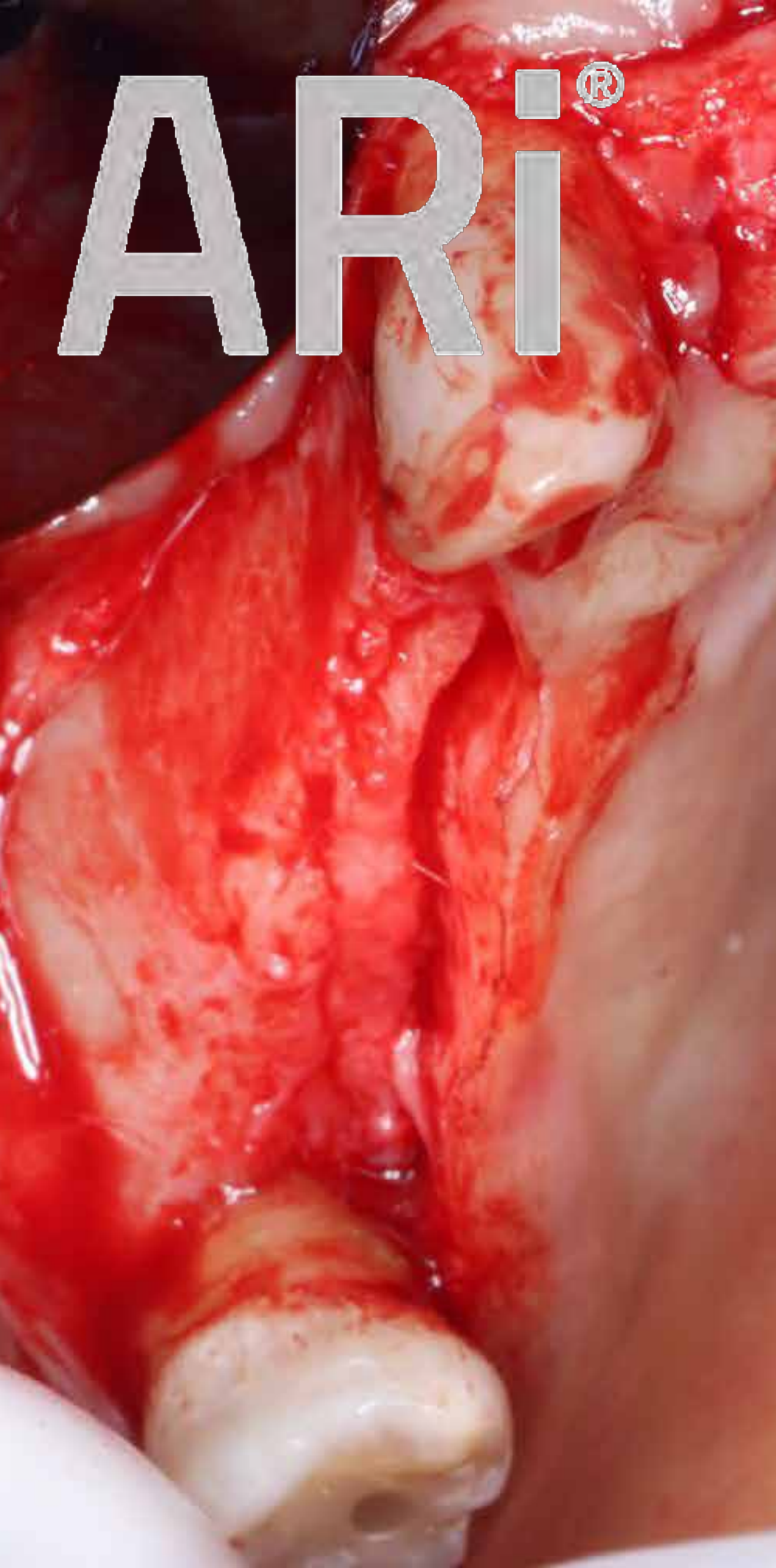


R2
GATE

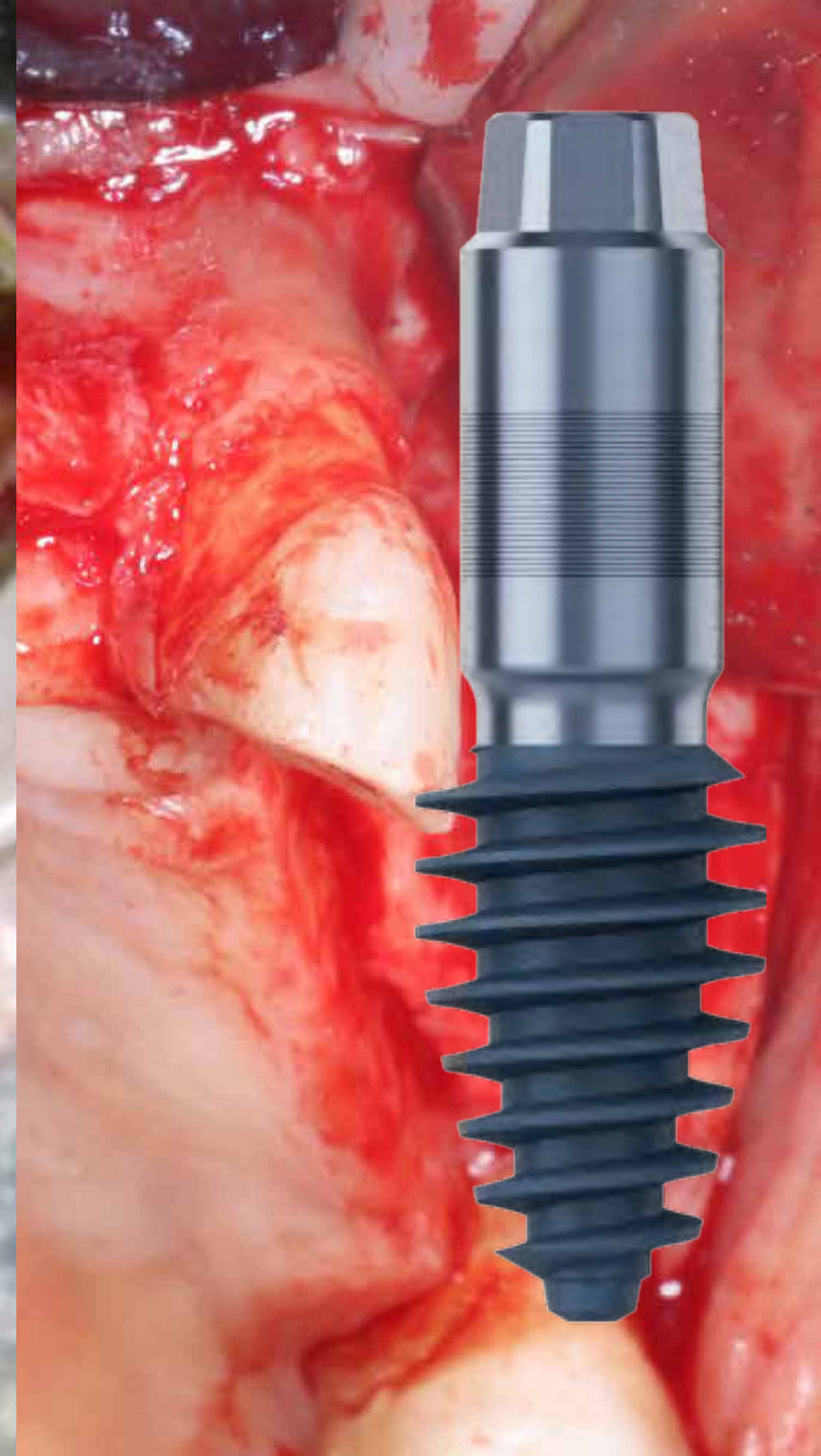
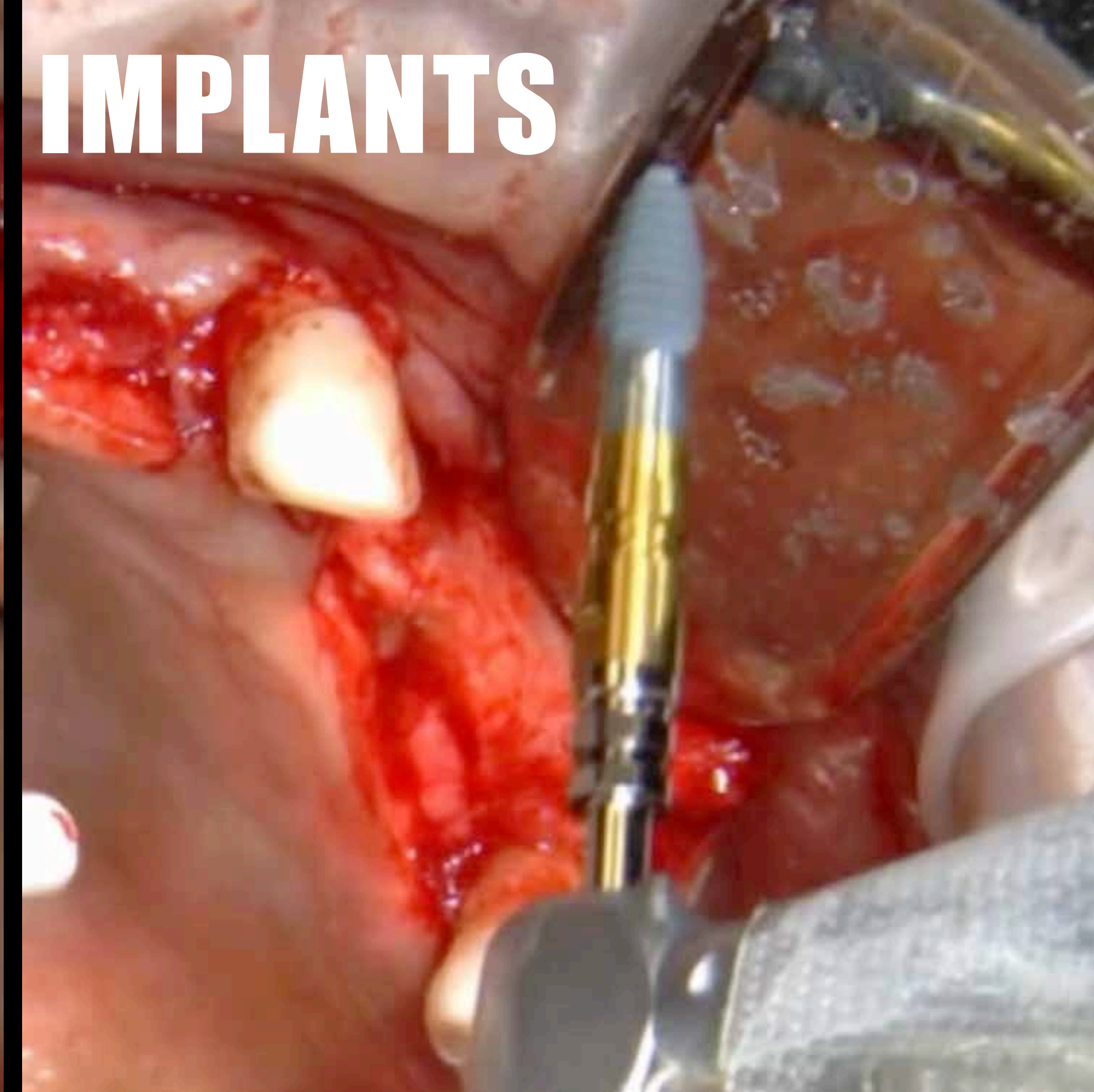


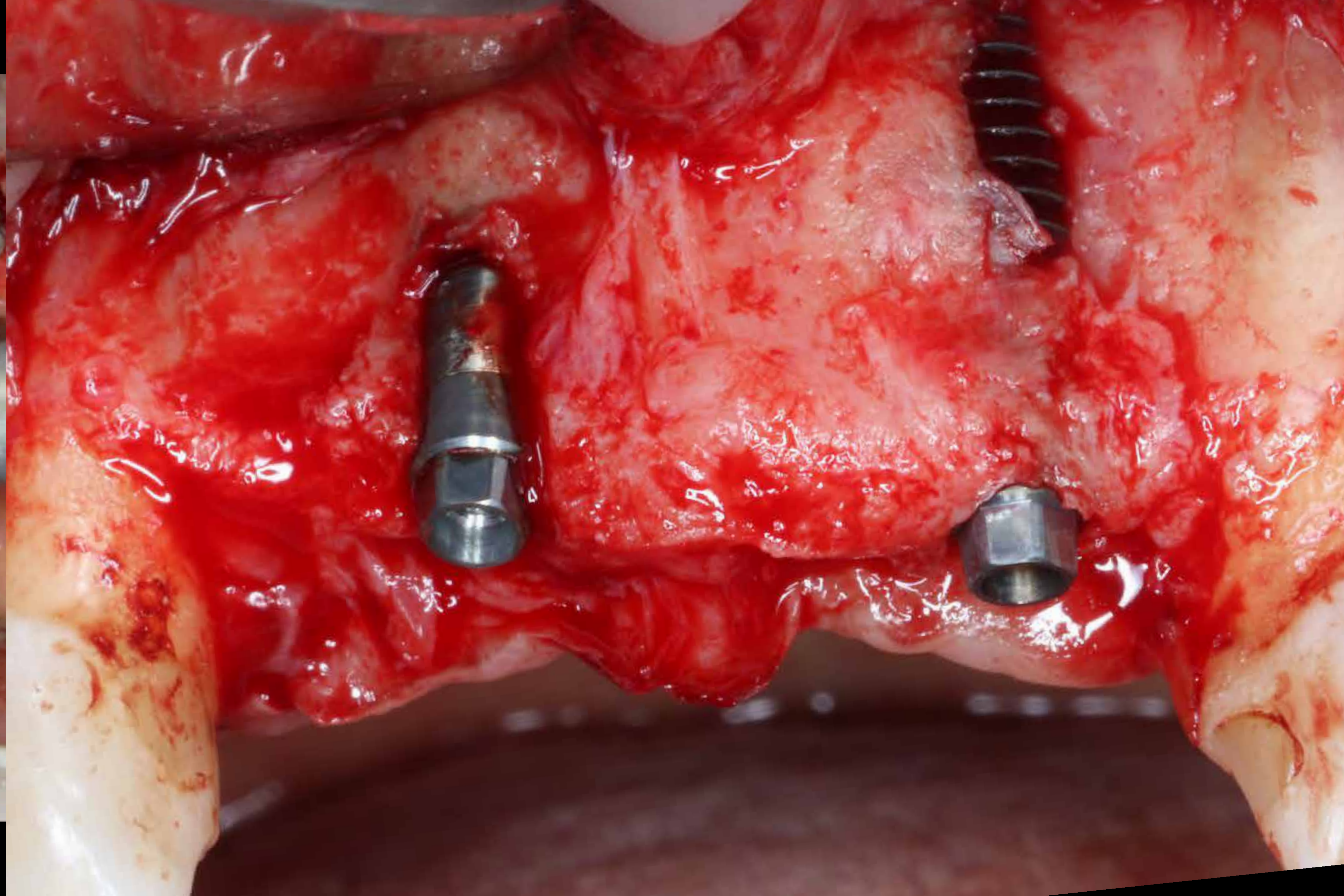
OSSEODENSIFICATION

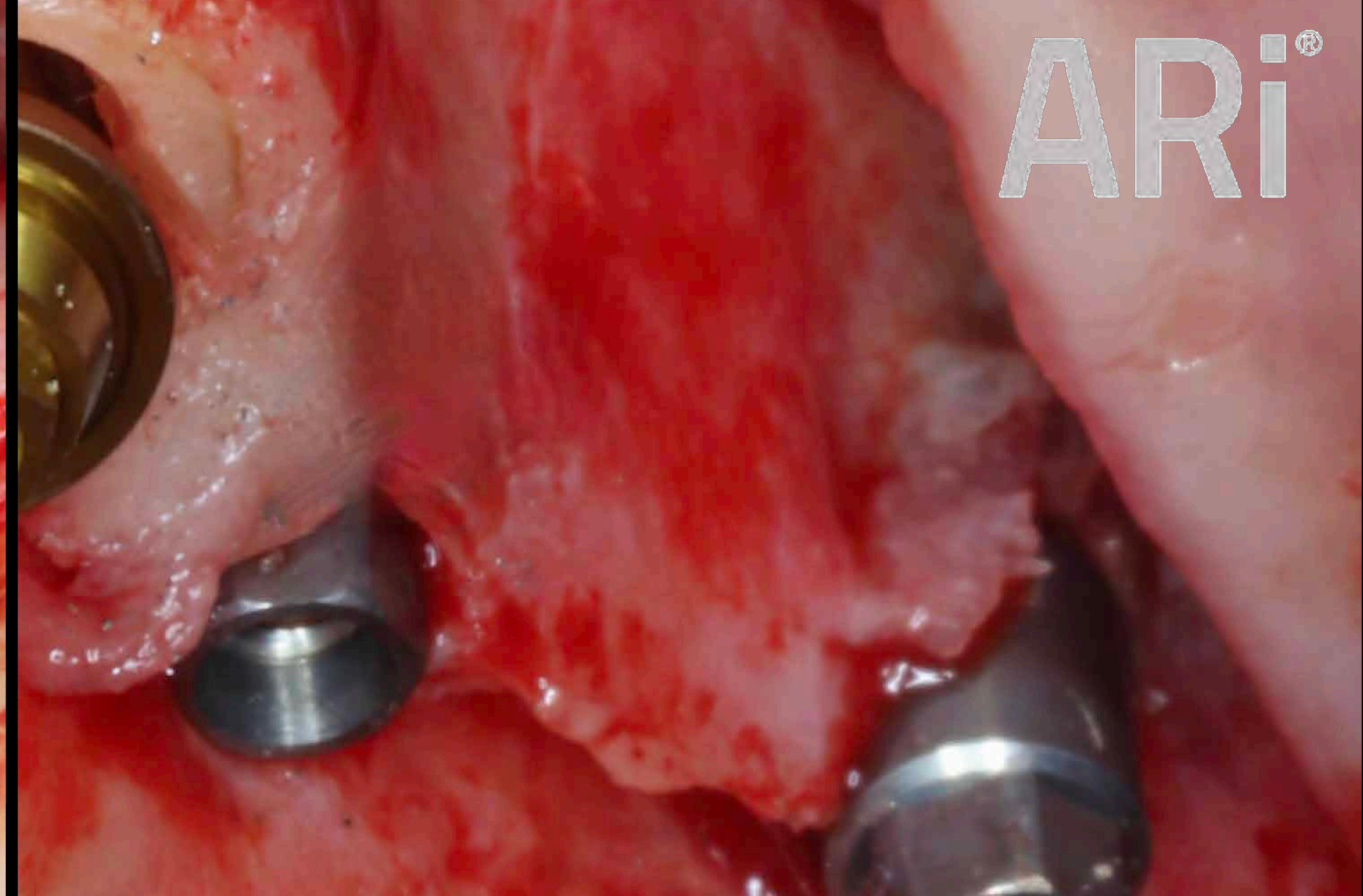
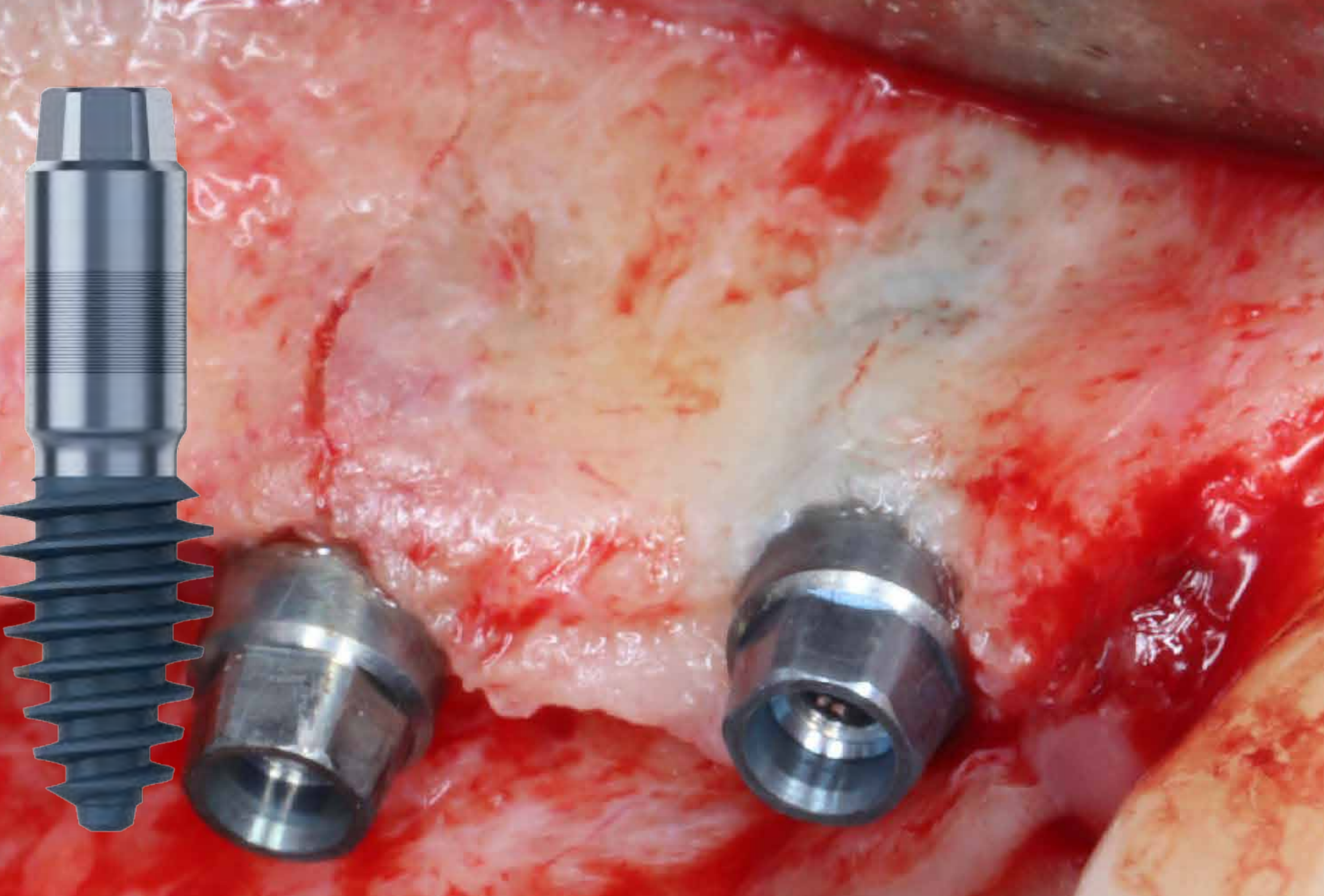




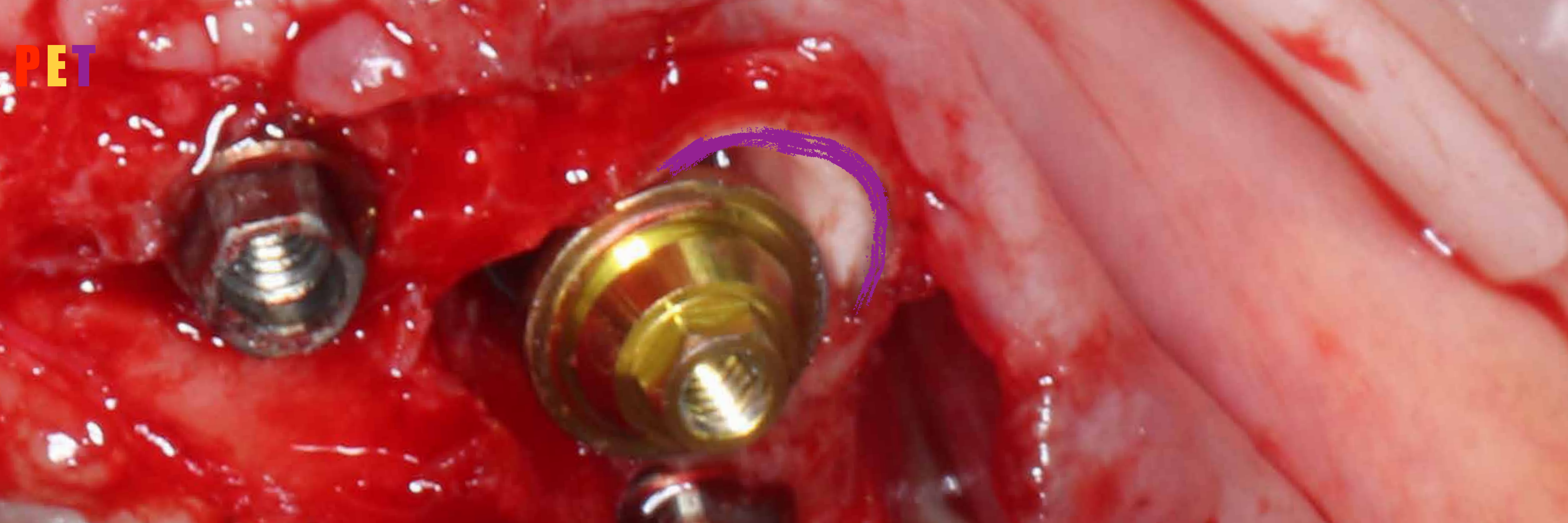
FREEHAND IMPLANTS

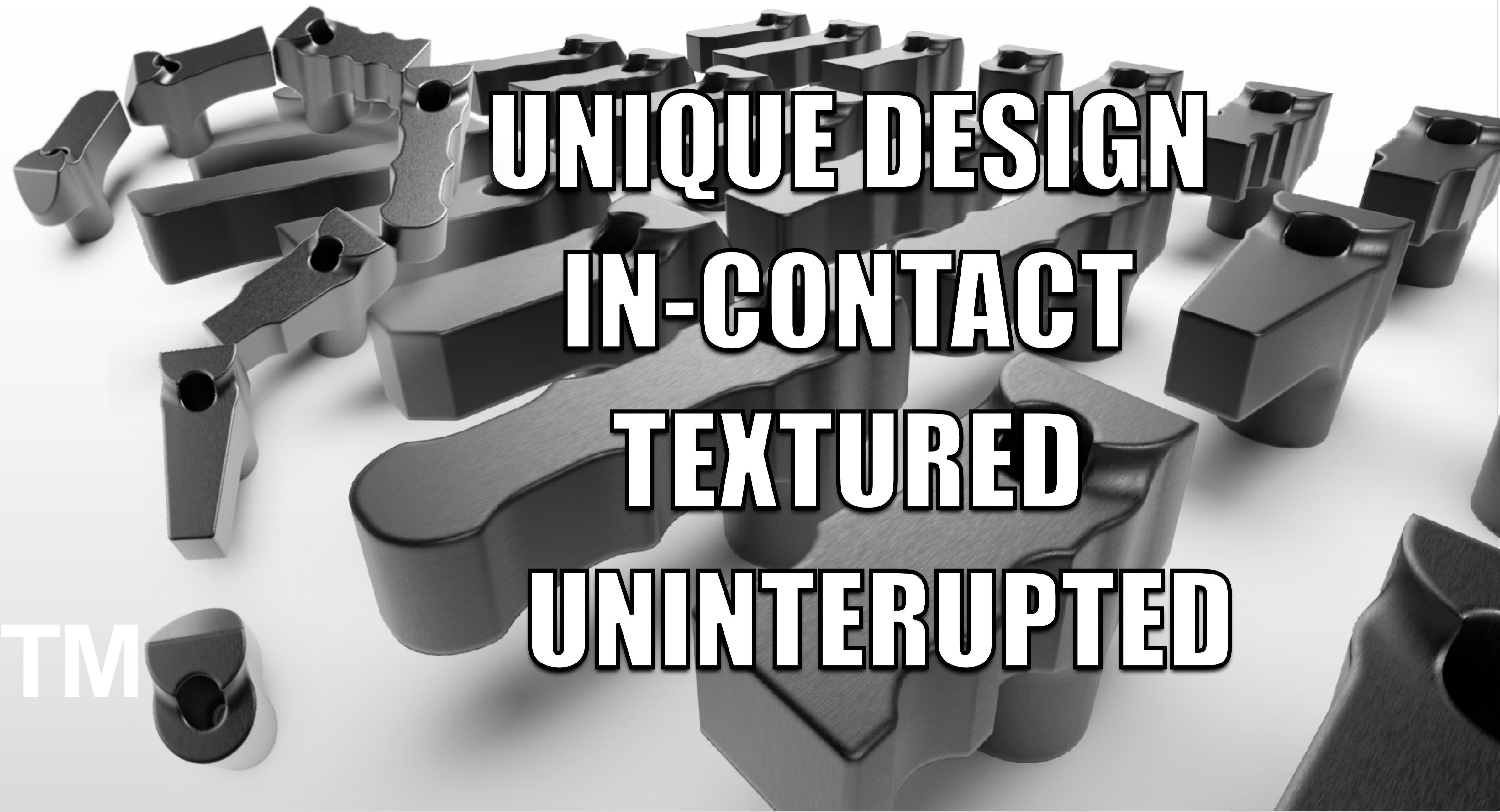






PET



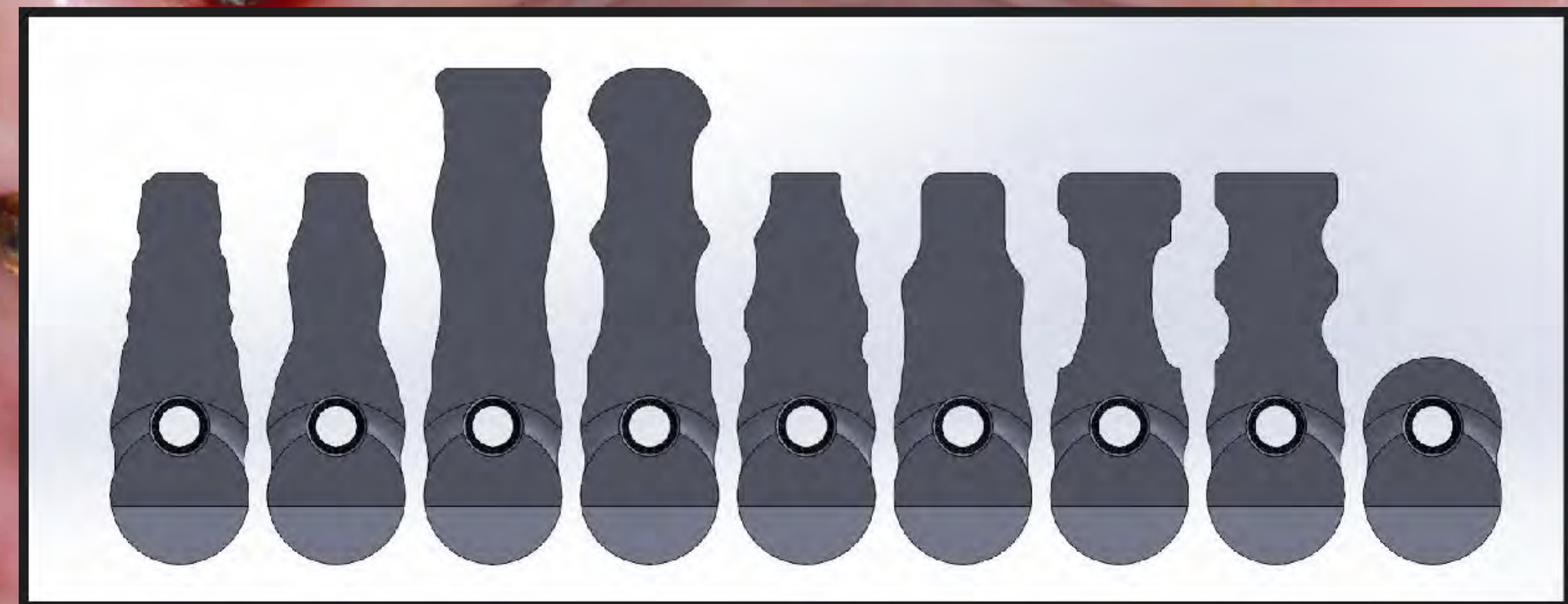


UNIQUE DESIGN
IN-CONTACT
TEXTURED
UNINTERRUPTED

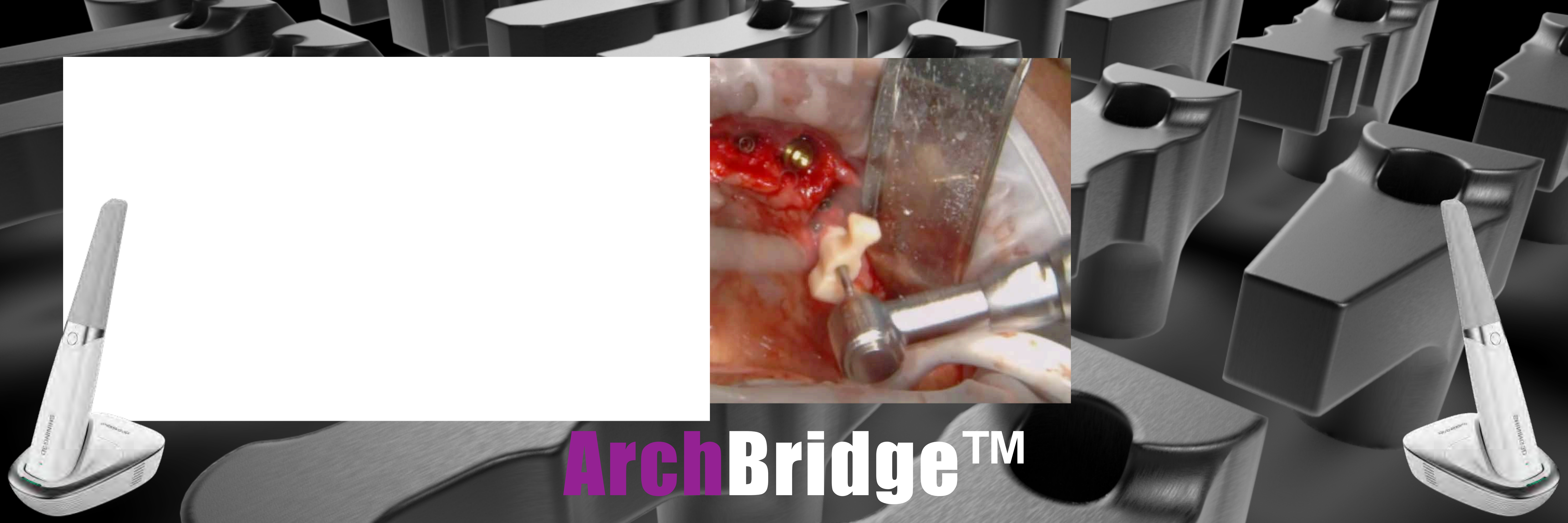
ArchBridge™

Inside Dentistry

June 2024



ArchBridge™



ArchBridge™

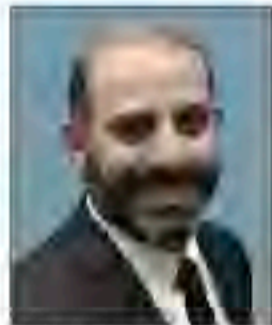
Autologous Tooth Structure as an Adjunct Grafting Modality

INTRODUCTION

Full-arch dental implant reconstruction is a viable treatment choice for patients who are edentulous or who have teeth that are compromised and in need of extraction. Regardless of a free-hand or fully guided surgical protocol, treatment outcomes for full-arch, implant-supported restorations have helped patients regain proper function, aesthetics, and quality of life.^{1,2} Additionally, the ability to place implants immediately after tooth extraction has become a viable treatment modality that can often reduce the time needed to deliver functional restorations.³ However, the residual alveolar ridge may require grafting to fill defects left by extraction sockets or pre-existing concavities.^{4,5} It is well understood that substantial bone resorption and loss of bone volume can occur when extraction sites are not grafted.⁶ Avila-Ortiz et al concluded that “alveolar ridge preservation is an effective therapy to attenuate the dimensional reduction of the alveolar ridge that normally takes place after tooth extraction.”⁷ The gold standard has always been autologous tissue harvested from the patient, which is not always easy or readily accessible. Therefore, most clinicians currently utilize bone and membranes available through tissue banks. Current innovations, however, have fortunately provided a new, previously untapped source for this autologous tissue: the extracted tooth, which is often readily available when full-arch implant reconstruction is planned. This current article will demonstrate that it is possible to provide enough grafting material volume to fill all residual sockets and concavities from selected teeth harvested during immediate implant placement for a dual-arch surgical procedure.



Scott D. Gans, DMD



Isaac J. Davis, DDS

lay complete denture as a mandibular RPD, and (4) implant-supported removable and fixed restorations for both arches. The patient wished to determine if a fixed-type full-arch restoration could be considered for both the maxilla and mandible. The patient’s medical history revealed hyperthyroidism and hip replacement within the prior 5 years.

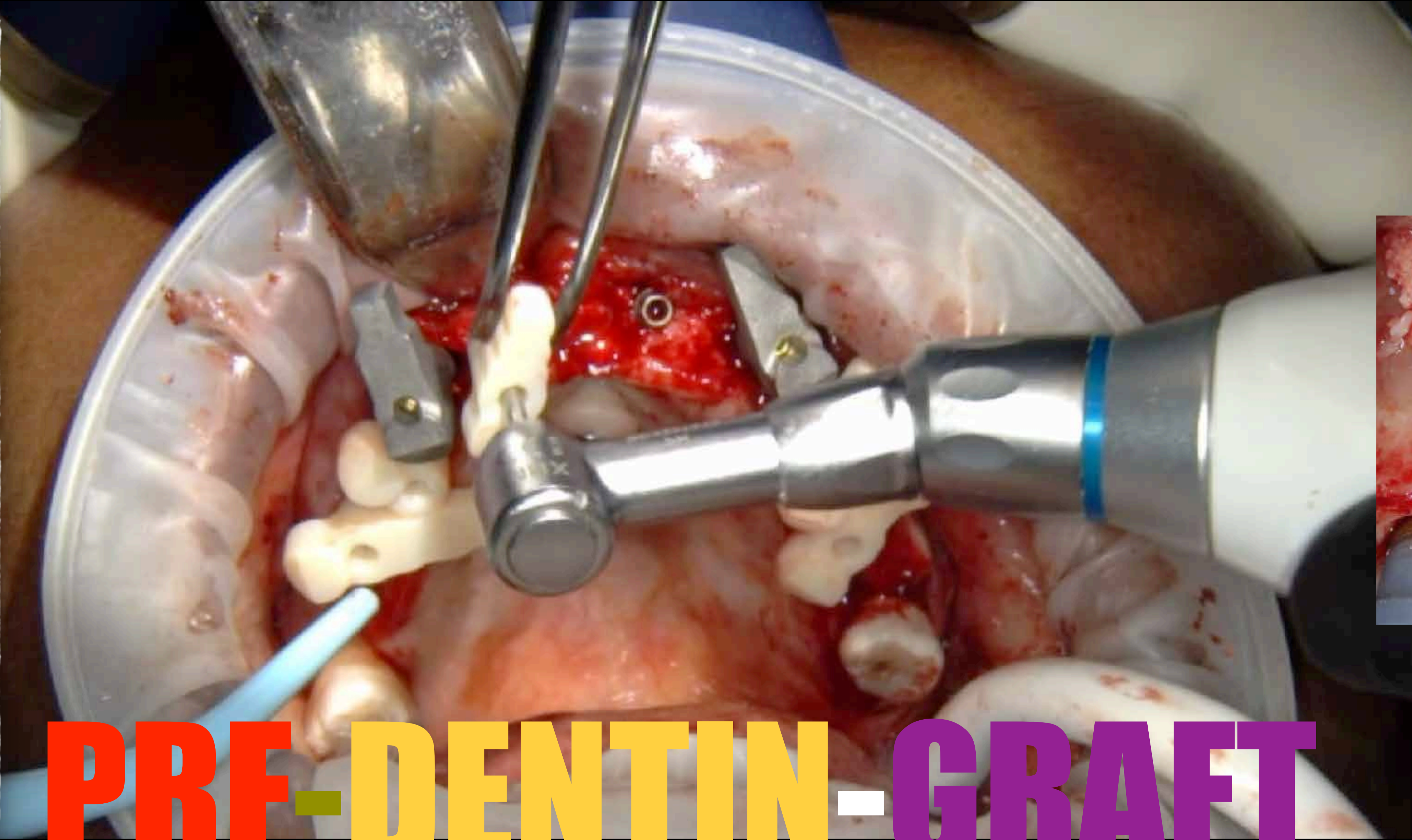
Clinical examination confirmed the diminished condition of the patient’s dentition. The need for a thorough 3D assessment of the patient’s existing anatomical presentation, which could only be accomplished with CBCT, was explained to her. The CBCT allowed for the inspection of the anatomy in multiple views and utilizing the digital tools afforded by the software (CS 3D Imaging (Carestream Dental)) (Figure 1). The panoramic reconstruction served as a “sagittal” film to help visualize the present condition of the patient’s dentition (Figure 2). The upper arch exhibited several fractured teeth, several with previous root canal treatment, one single crown, and a 4-unit posterior bridge on teeth Nos. 12 to 15. Using the embedded link, the original CBCT scan data was then exported into Blue Sky Plan software (Blue Sky Bio). The Blue Sky plan offers additional planning and design tools to aid in accurate diagnosis, treatment planning, and surgical guide fabrication.

The preliminary plan consisted of placing implants in strategic positions to support fixed, implant-supported restorations that would be accurately delivered with the implementation of static, sequential surgical guides (Figure 3). Each potential implant receptor site was designated by tooth number for the maxillary and mandibular arches. Manufacturer-specific simulated implants were then refined within the cross-sectional images, recording diameters and lengths in screenshots for the maxilla (Figure 4) and the mandible (Figure 5) that were utilized during the surgery as color printouts. When assessing the potential mandibular implant receptor sites, the buccal and lingual cortical plates appeared to be well defined. However, careful inspection revealed that a deficient density exhibited within the interdental bone. Yellow “stippling” represented simulated abutment trajectories helpful in the determination of screw access channels within the transitional and final prostheses. It was also possible to place realistic, simulated abutments based on the desired angulation and tissue

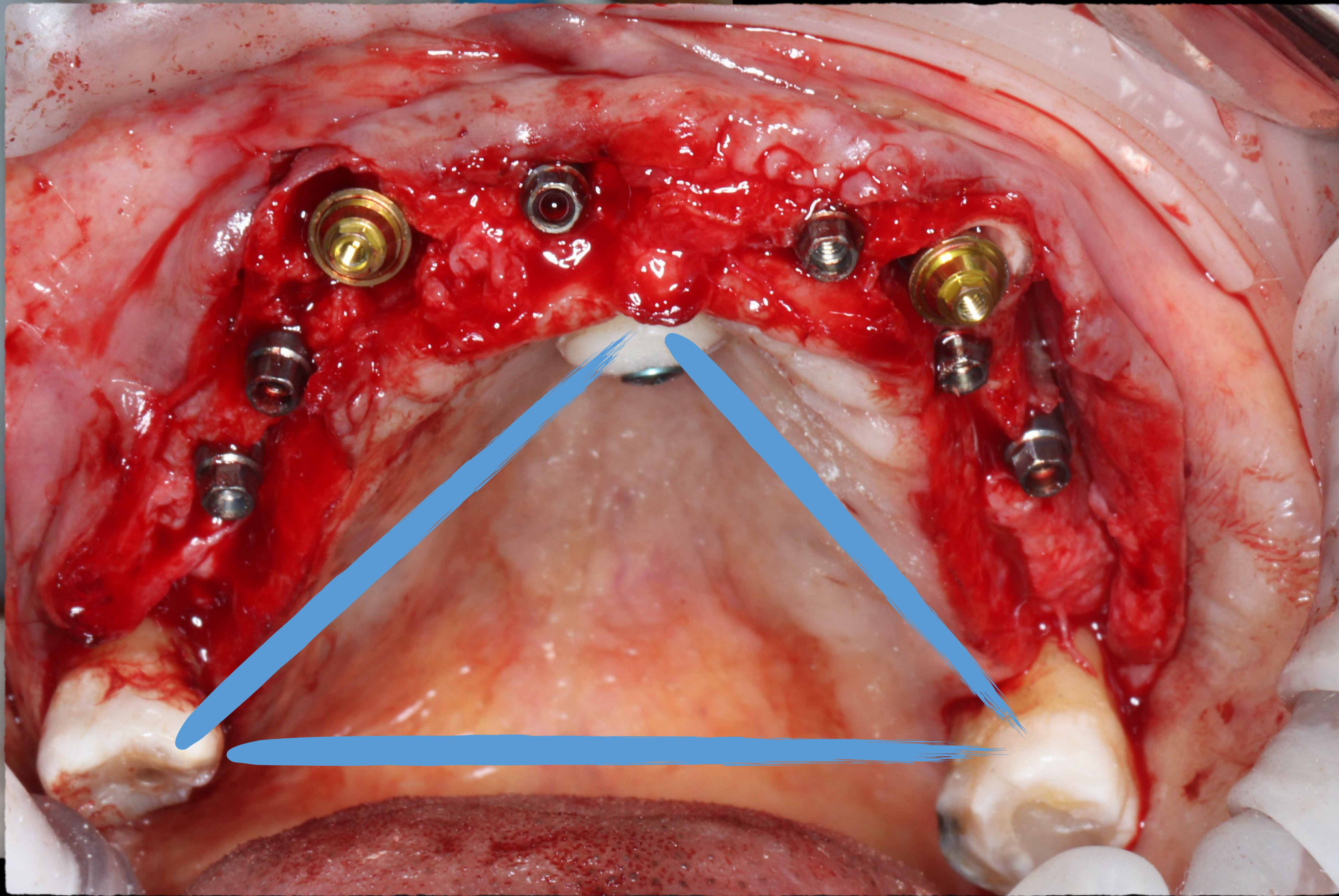
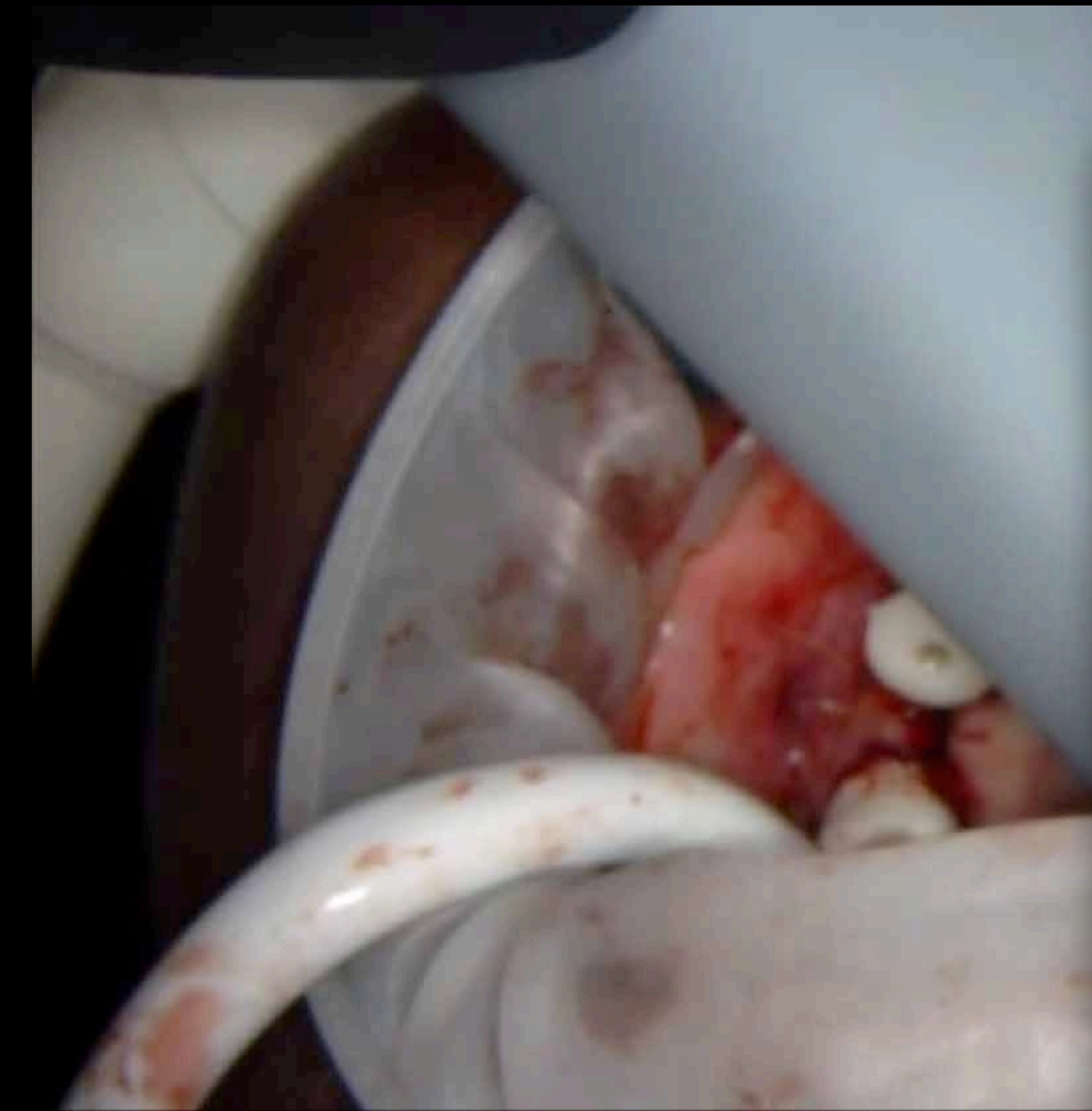
continued on page 72

CASE REPORT

A 68-year-old female presented with failing dentition in the maxillary and mandibular arches due to years of neglect and patchwork dentistry. The patient was unhappy with the condition of her teeth and was embarrassed to go out in public. She had difficulty chewing due to missing and fractured teeth in the maxillary arch, did not have any posterior mandibular teeth, and did not have a repeatable bite position. The patient had been to several dentists who offered differing treatment plans and was very confused regarding potential options to correct the deficiencies to improve her quality of life. Options that were presented included, but were not limited to, (1) removable partial dentures (RPD), (2) a maxil-



PRF-DENTIN-GRAFT

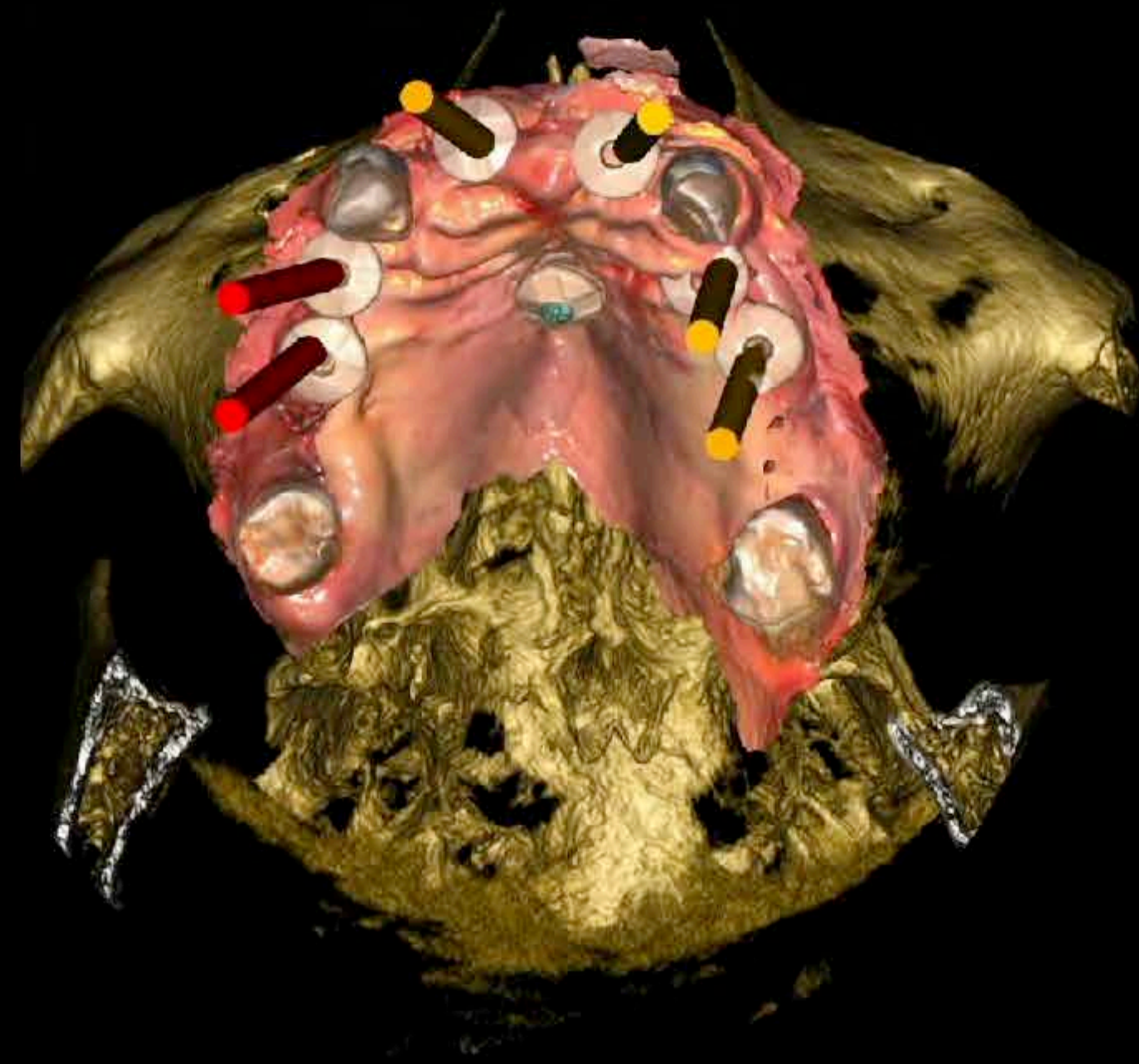


**T
R
I
A
D**

IMPORT

ArchBridge™

TISSUE

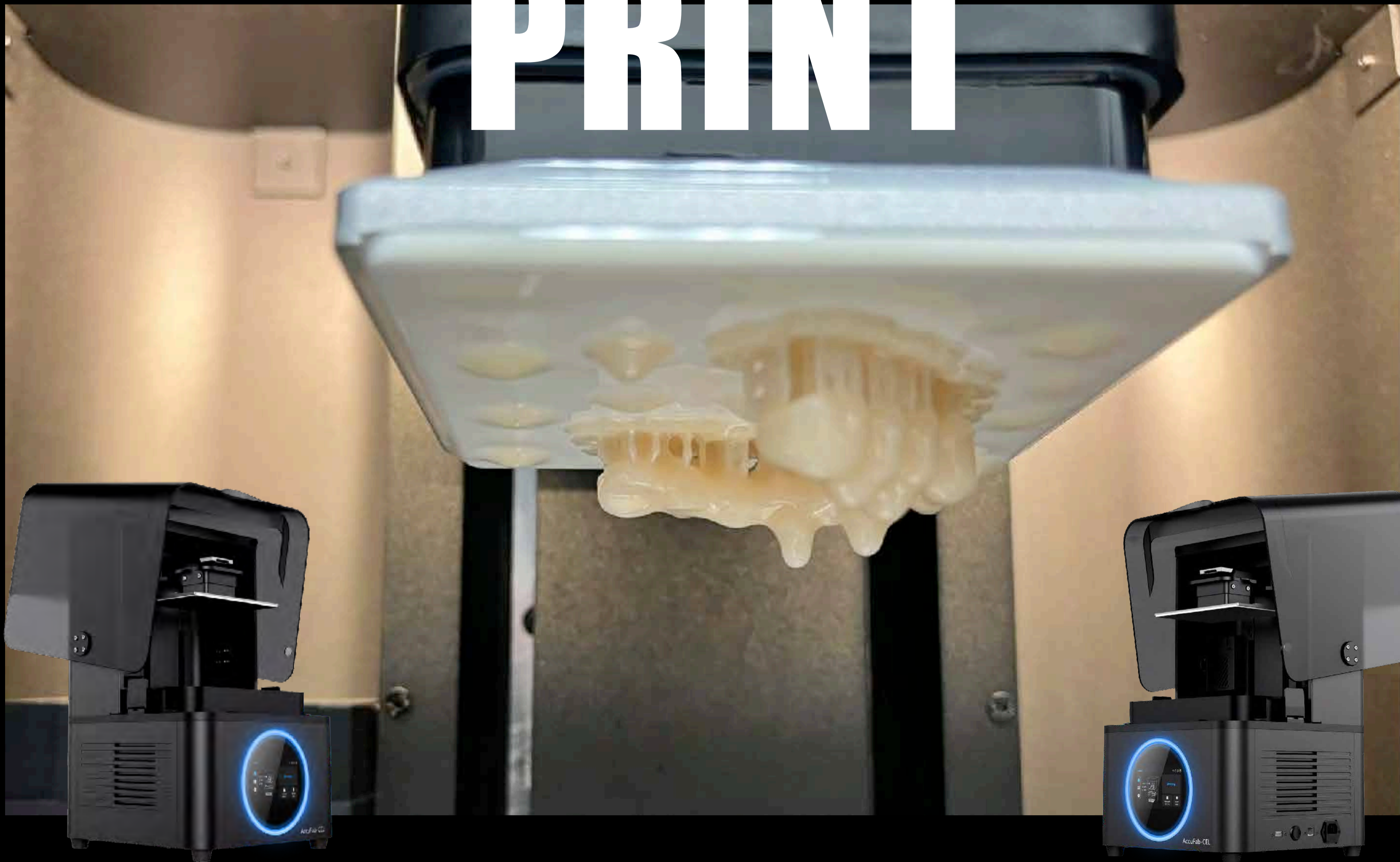


MATCH

PRE-FAB

DESIGN

PRINT



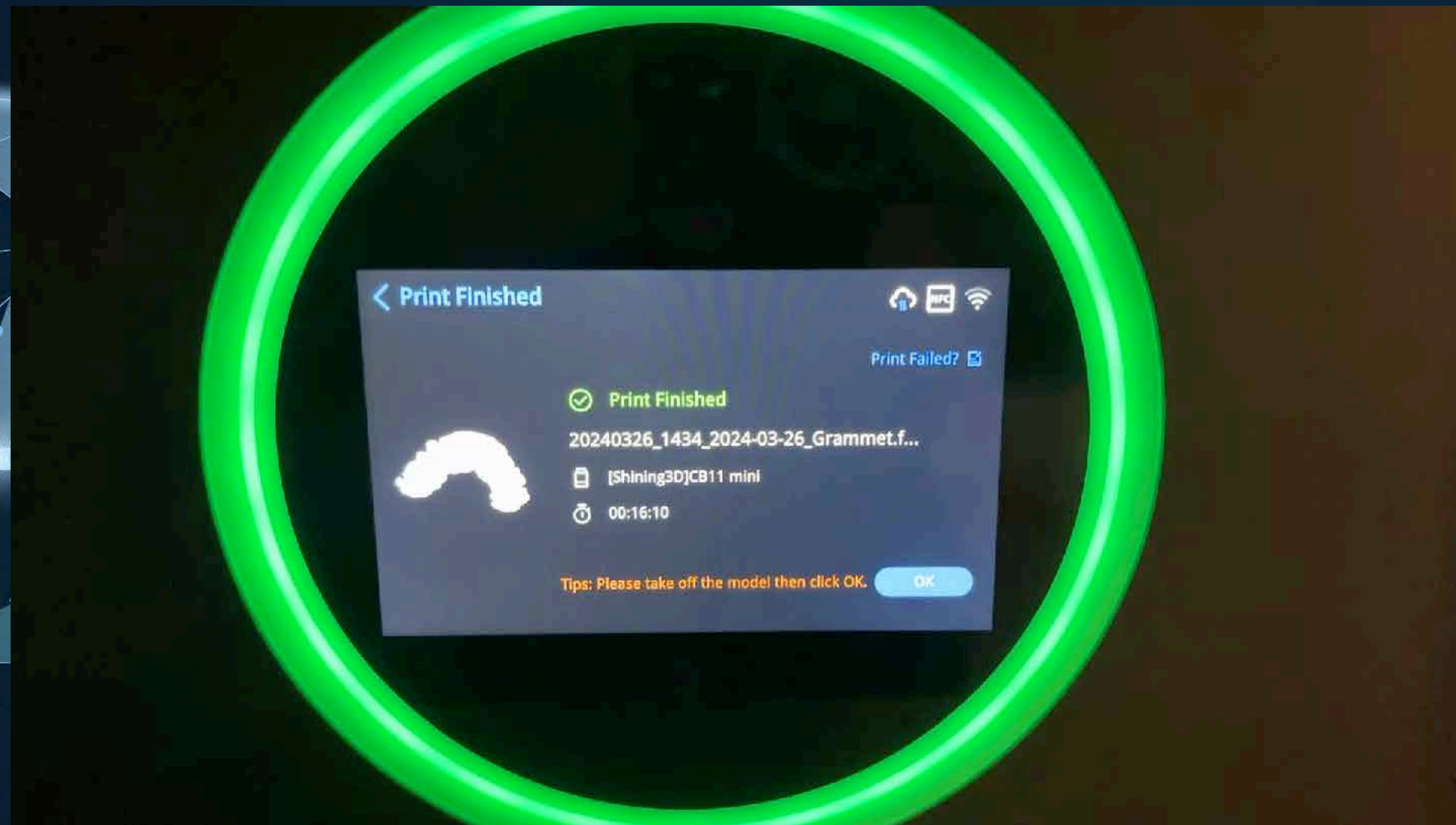
WASH



CURE



PRINT

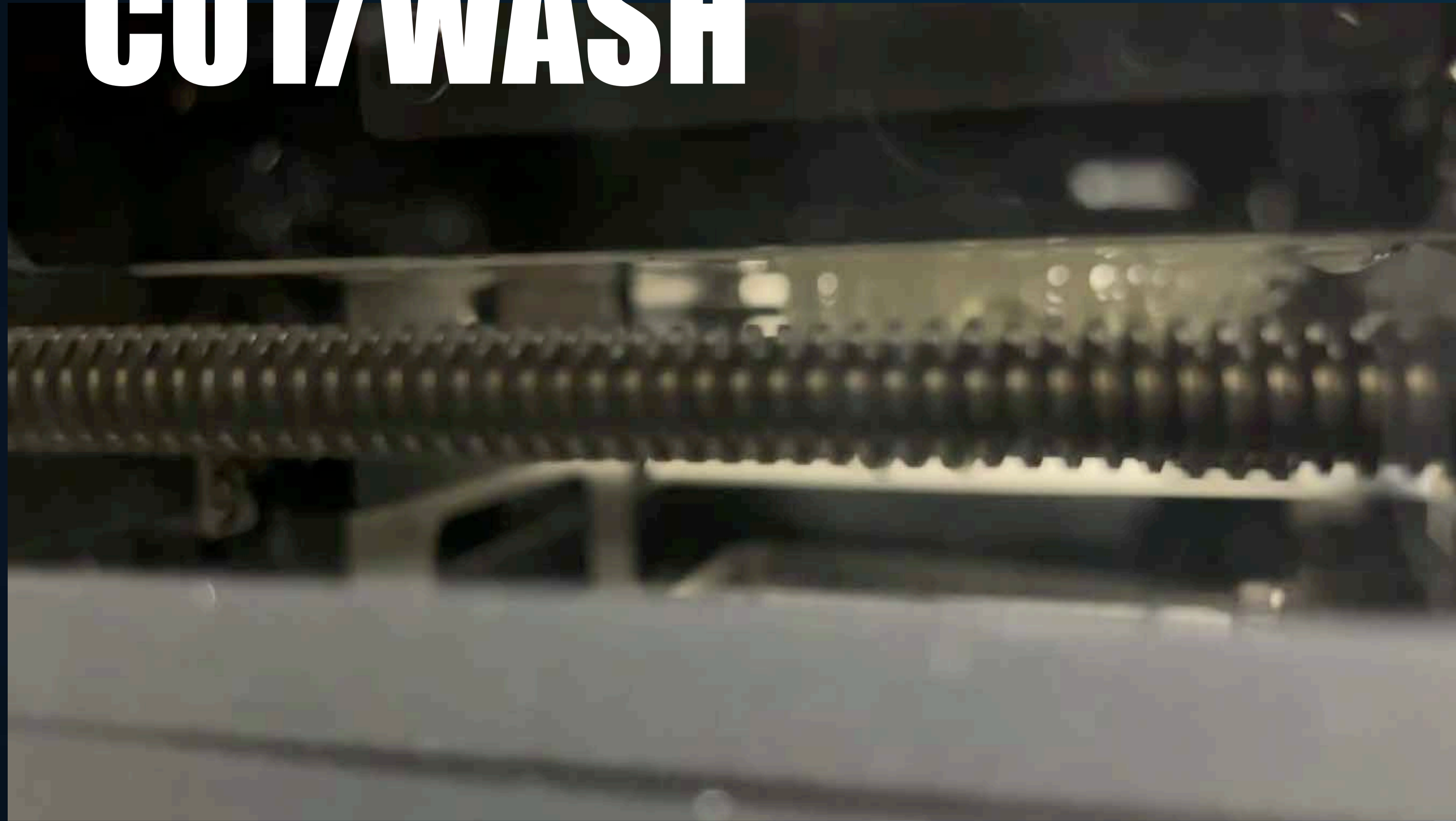


AccuFab-CEL



SHINING 3D
DENTAL

CUT/WASH

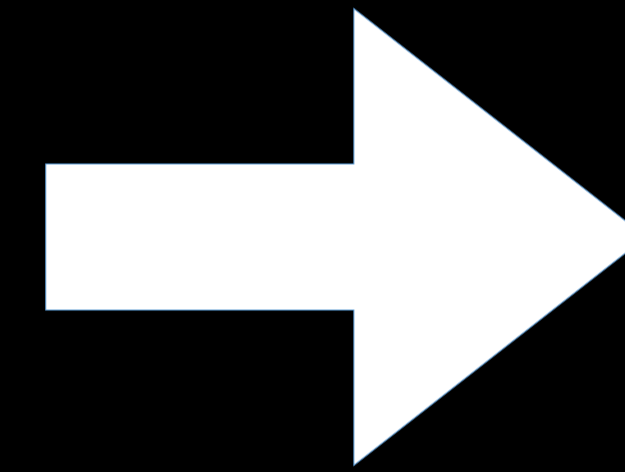


AccuFab-CEL



SHINING 3D
DENTAL

WIDE HEALING CAPS



HOLDS TISSUE POSITON

CURE



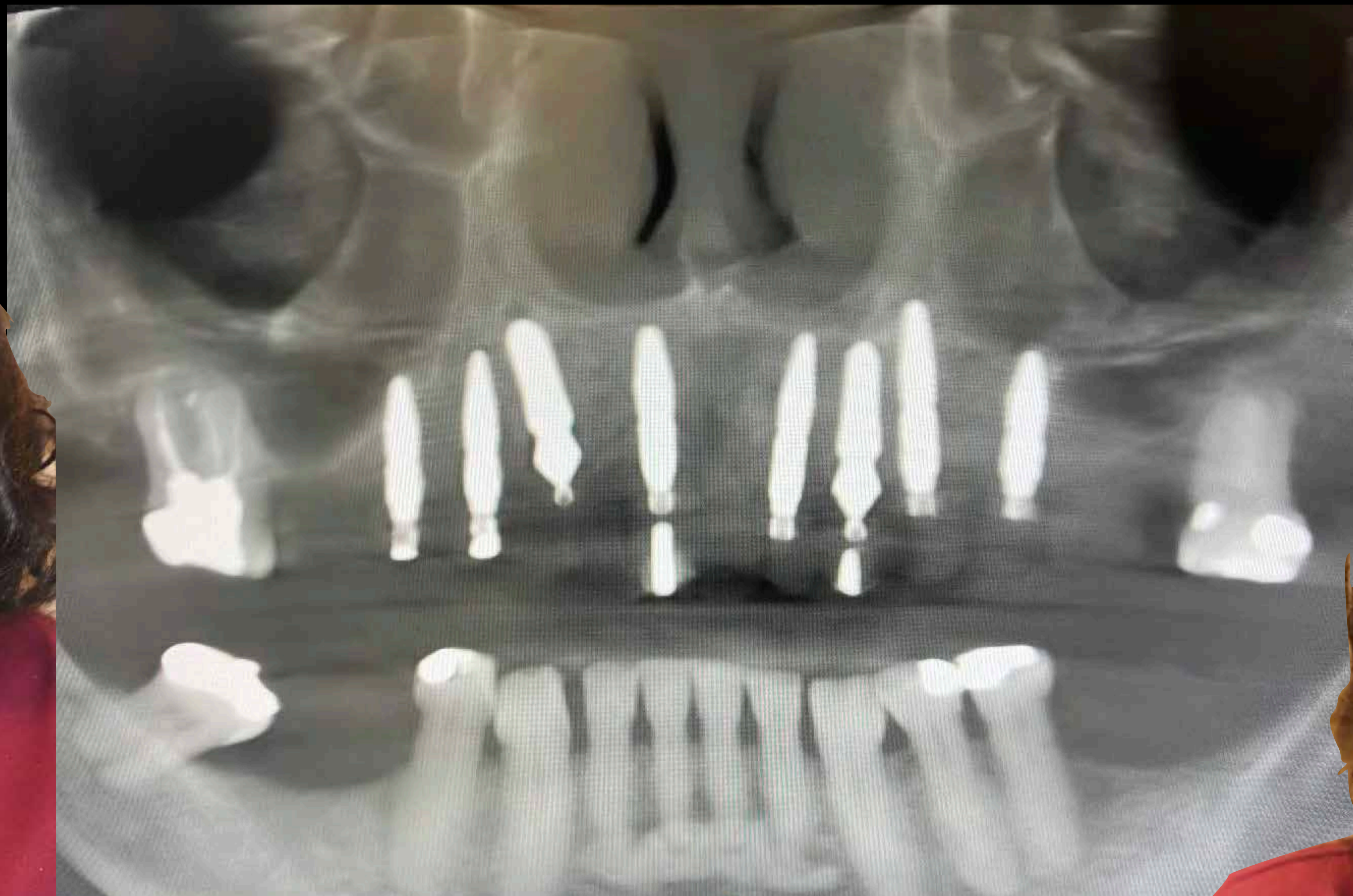
AccuFab-CEL

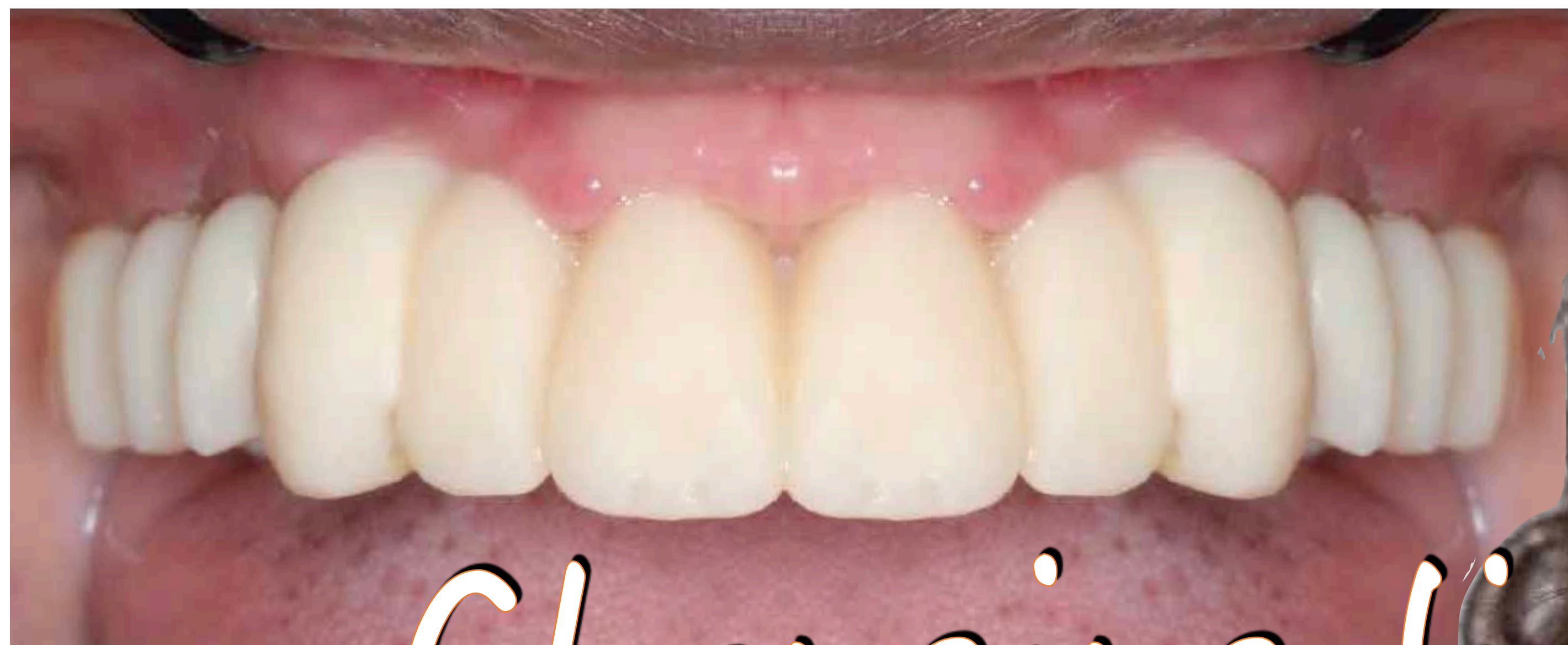
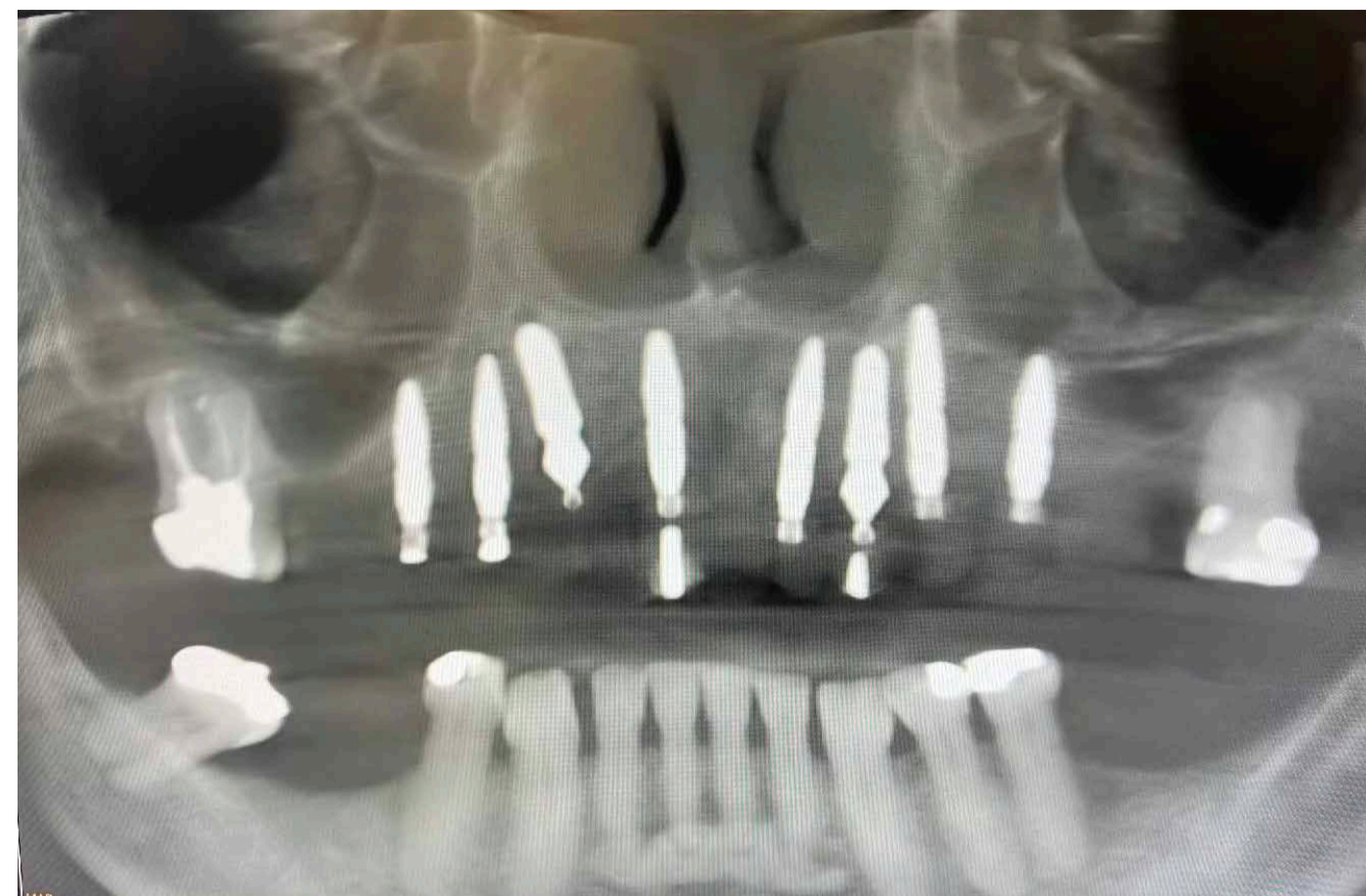


SHINING 3D
DENTAL

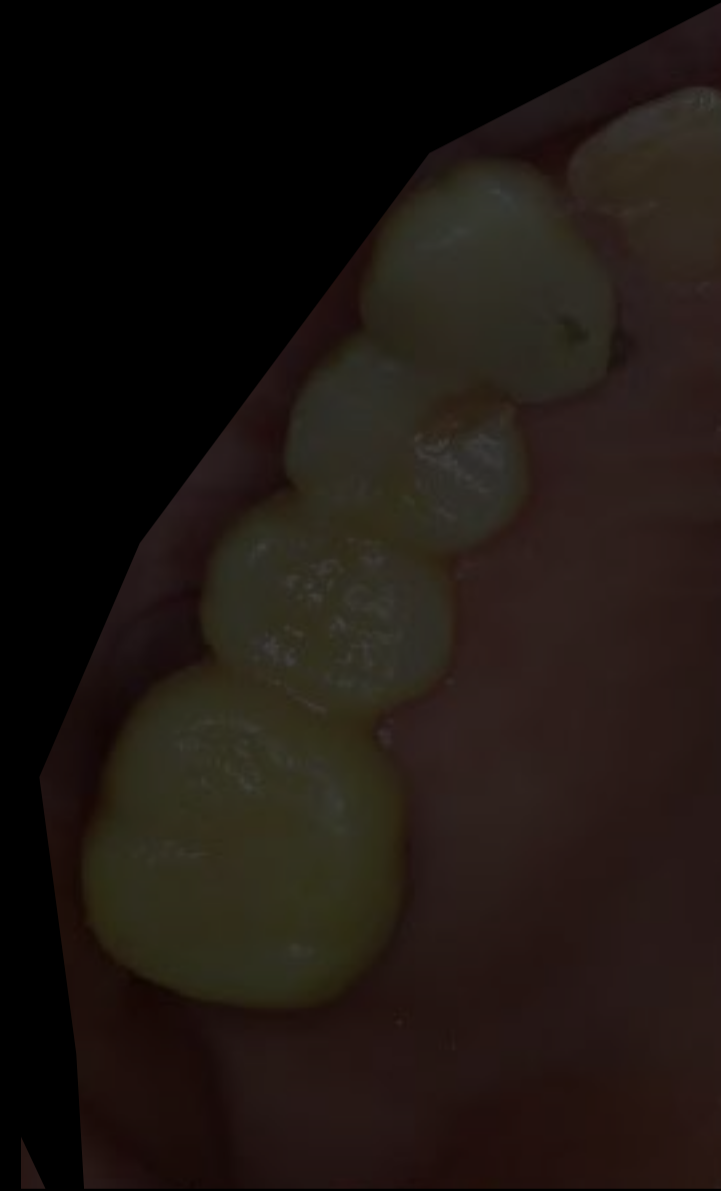
Printed Provisionals







Changing lives one smile at a time





SHINING3D | Home | New order Inderjit Kaur | Scan In Progress | Pre-design | Send

43.2°C | 00:00

0/0

love face to the required area

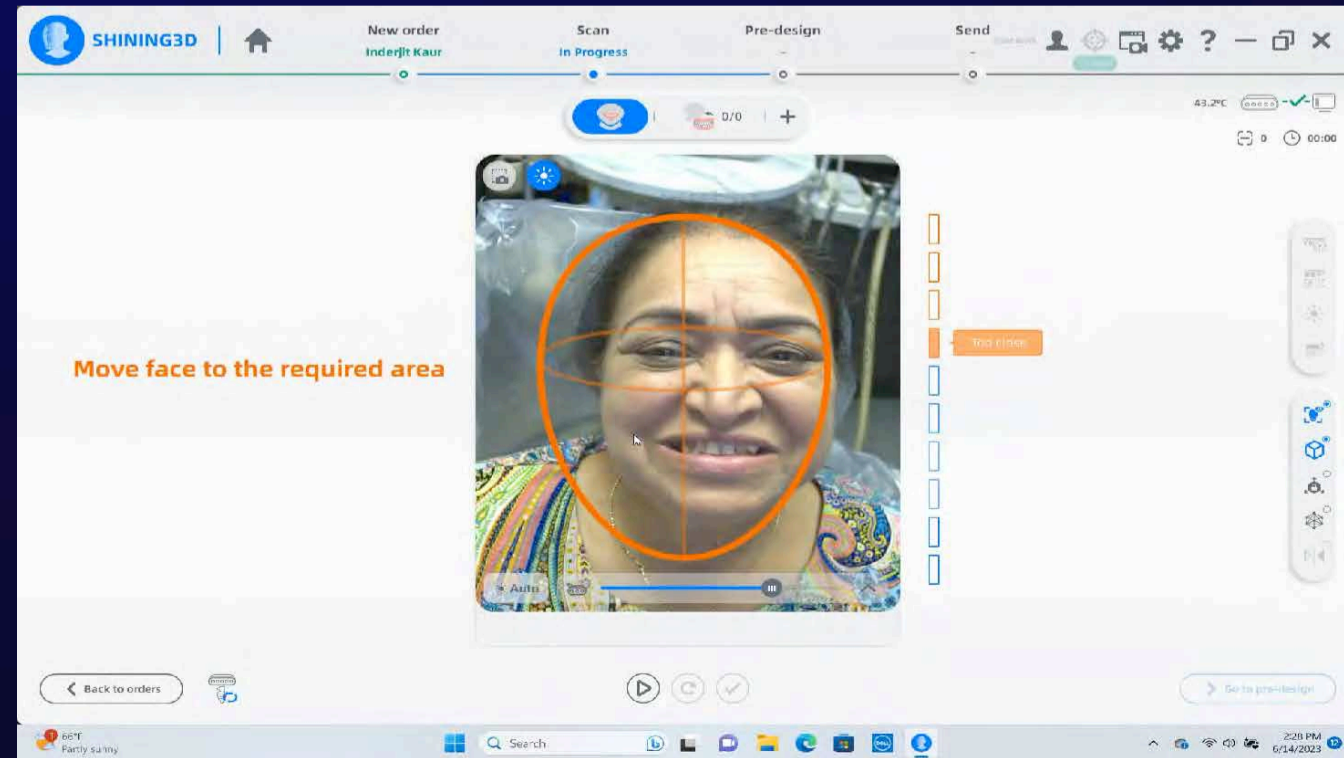
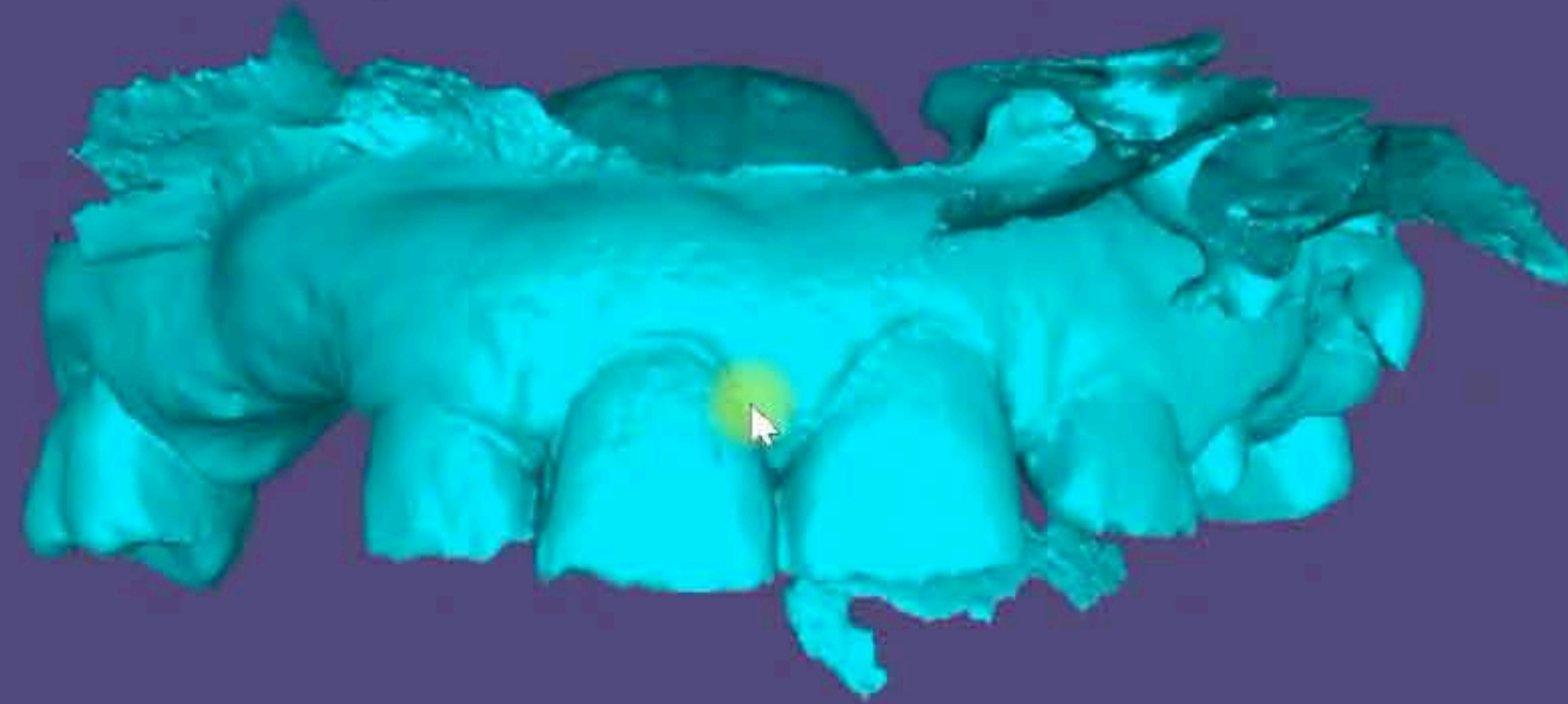
Try it now

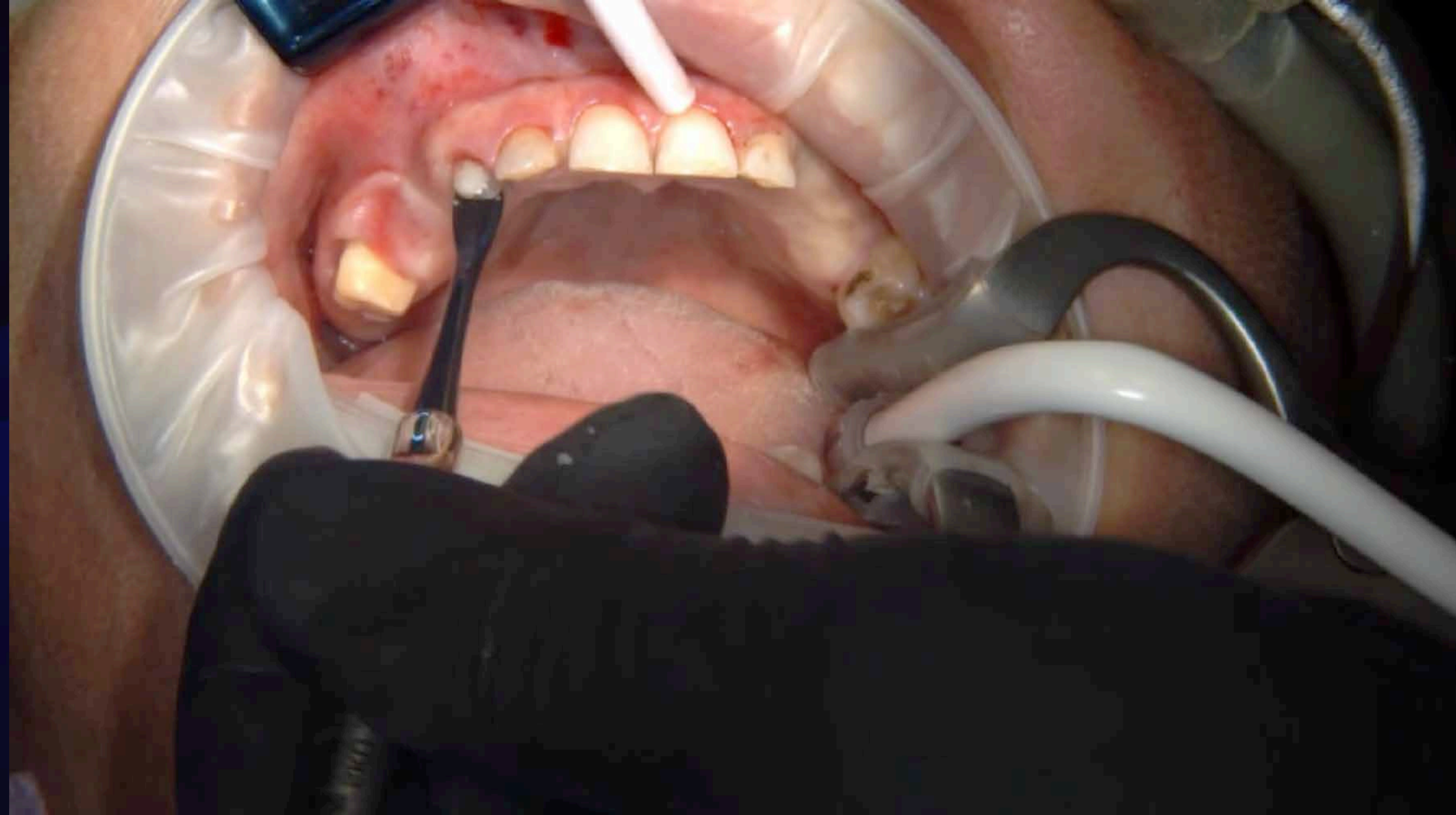
Back to orders | Auto | Go to pre-design

66°F Partly sunny | Search | 2:20 PM 6/14/2023

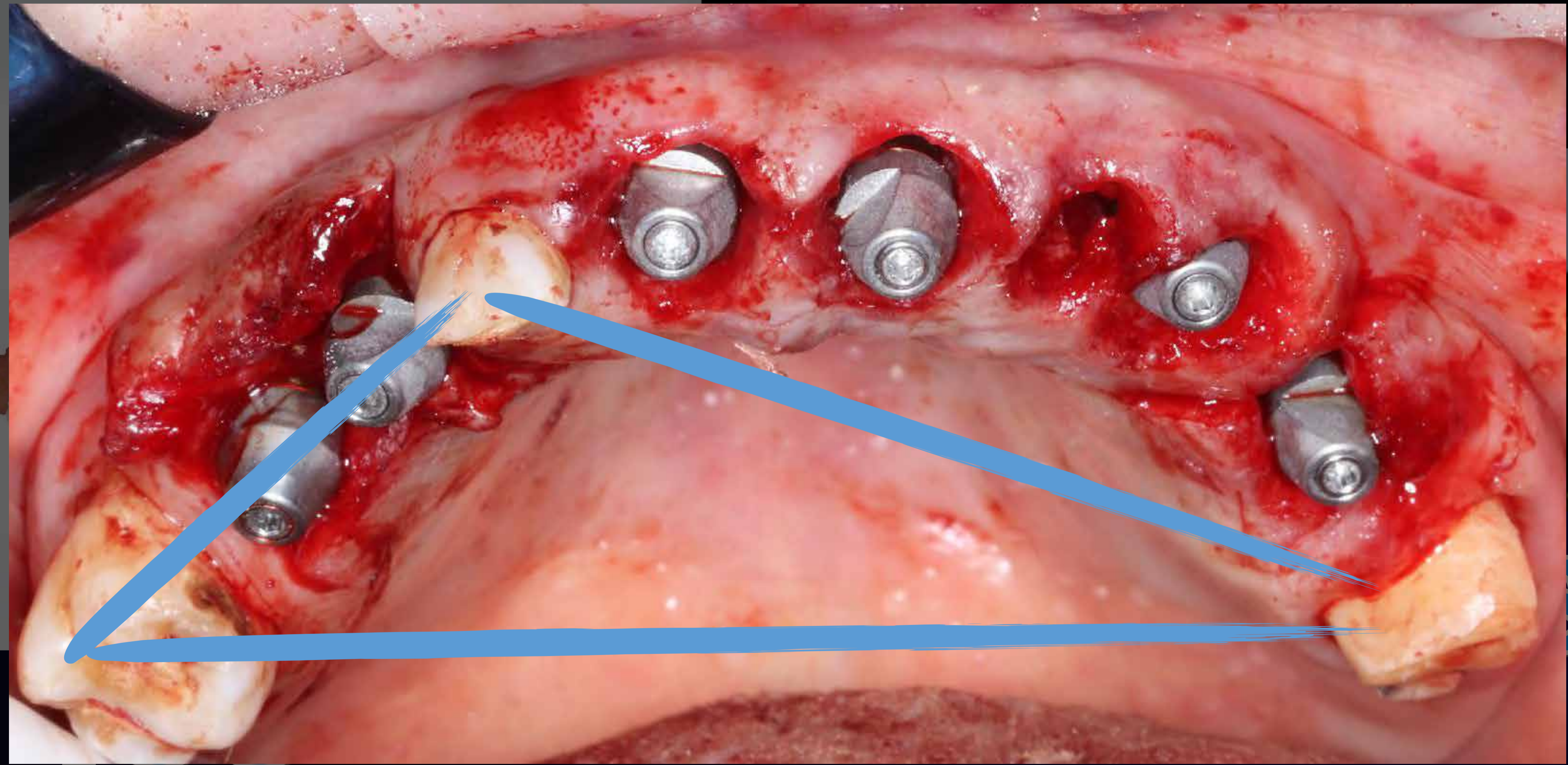
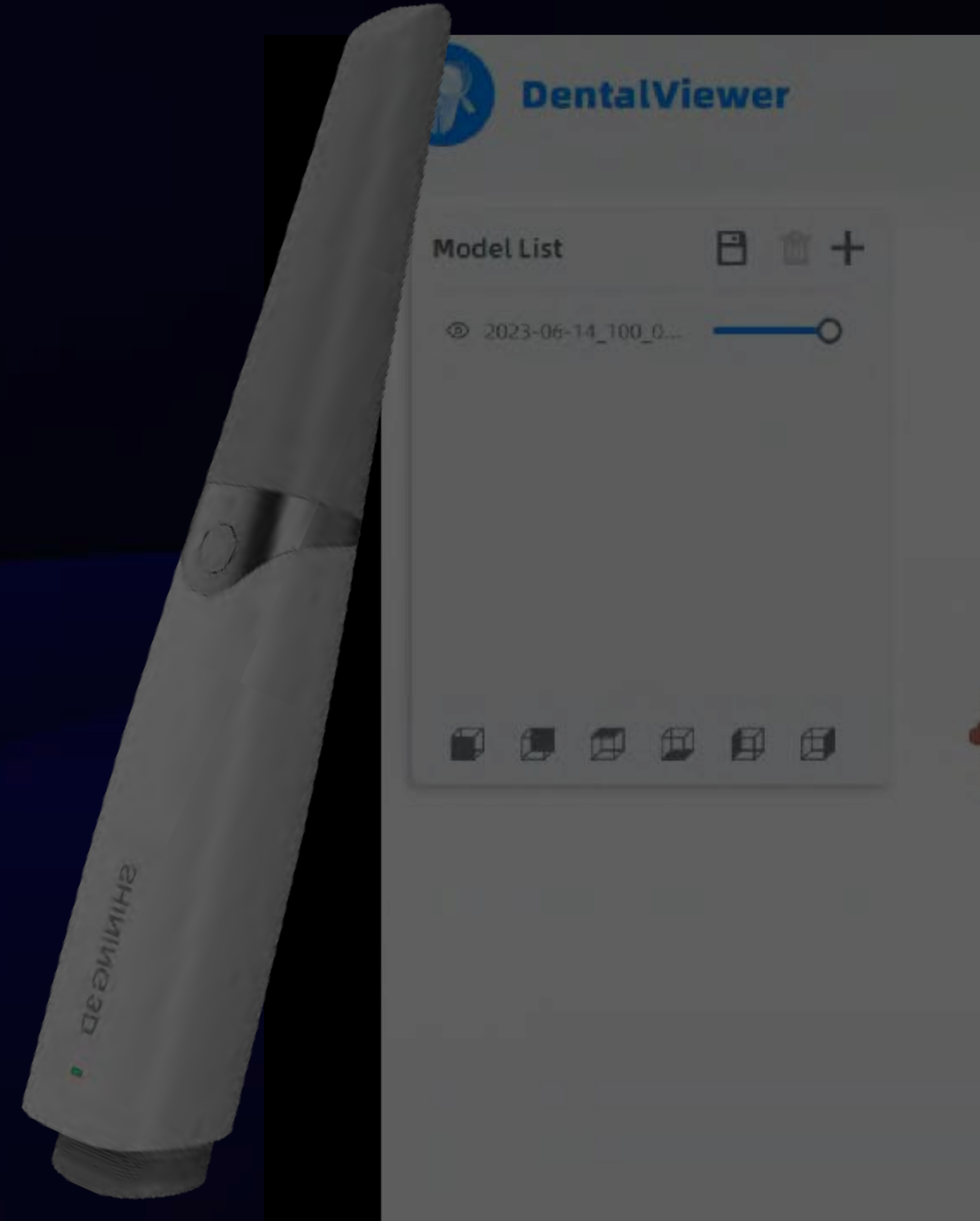


DESIGN





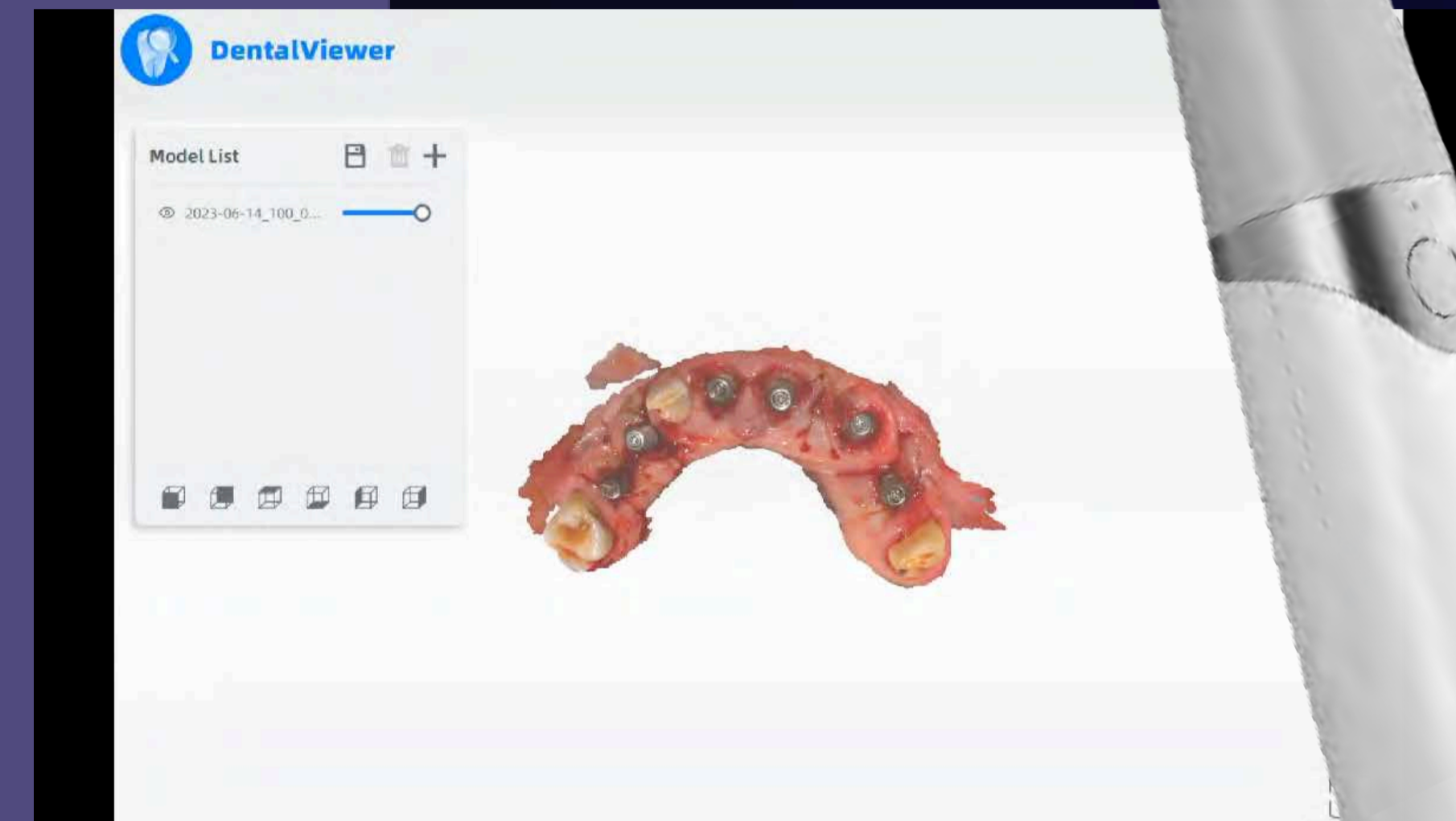
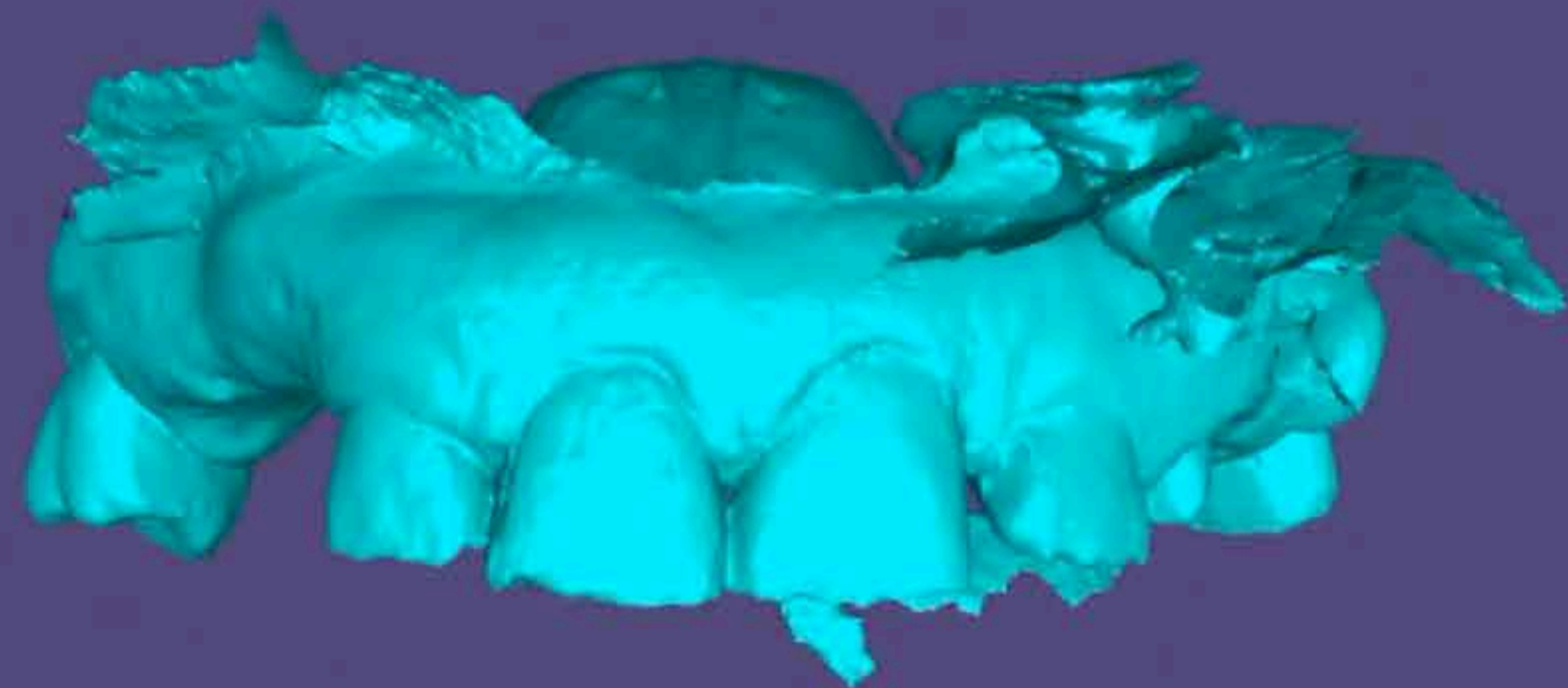
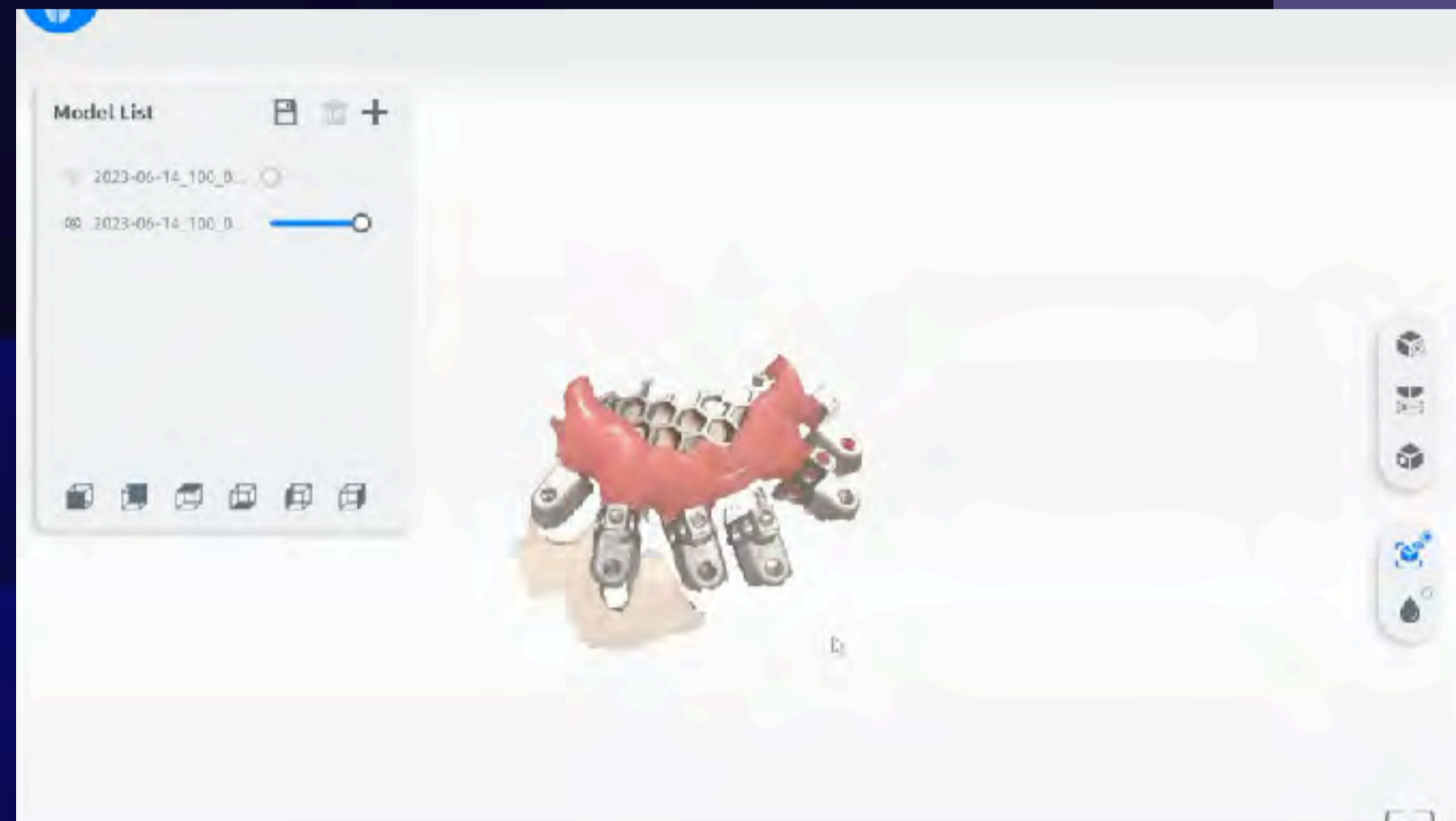
Immediately Post Surgery



Scan

T
R
I
A
D

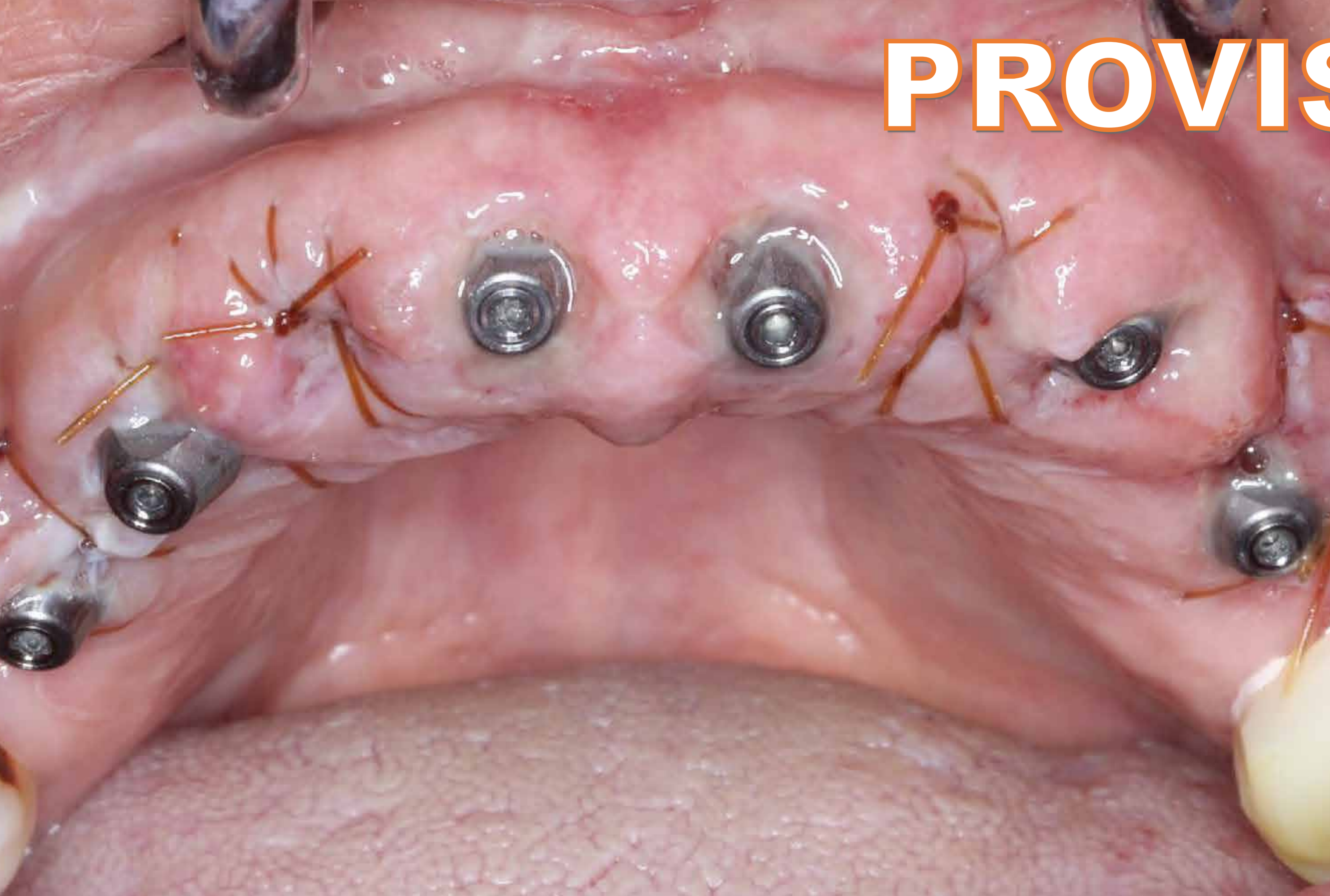
PRE OP MERGE - DESIGN



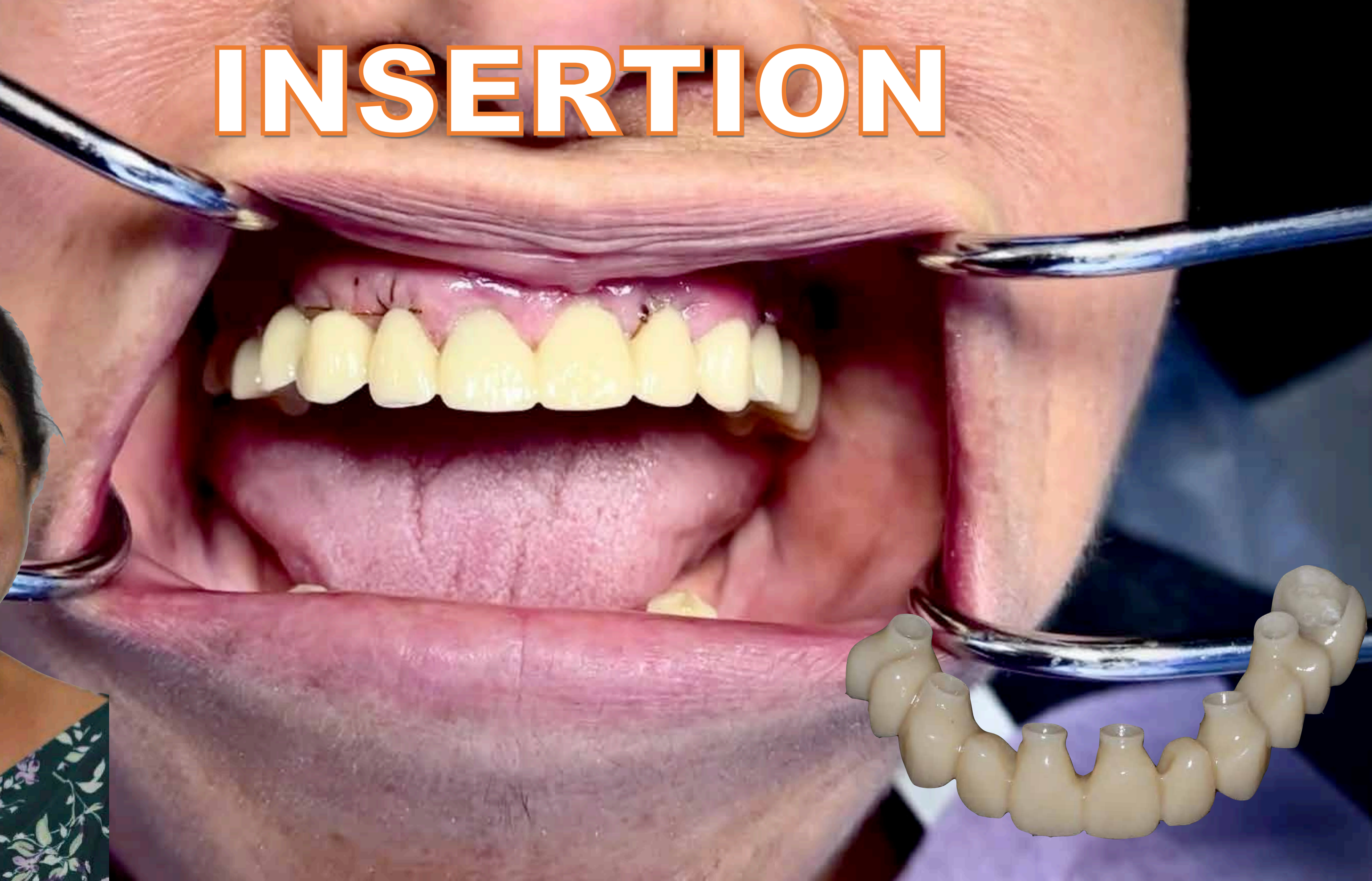
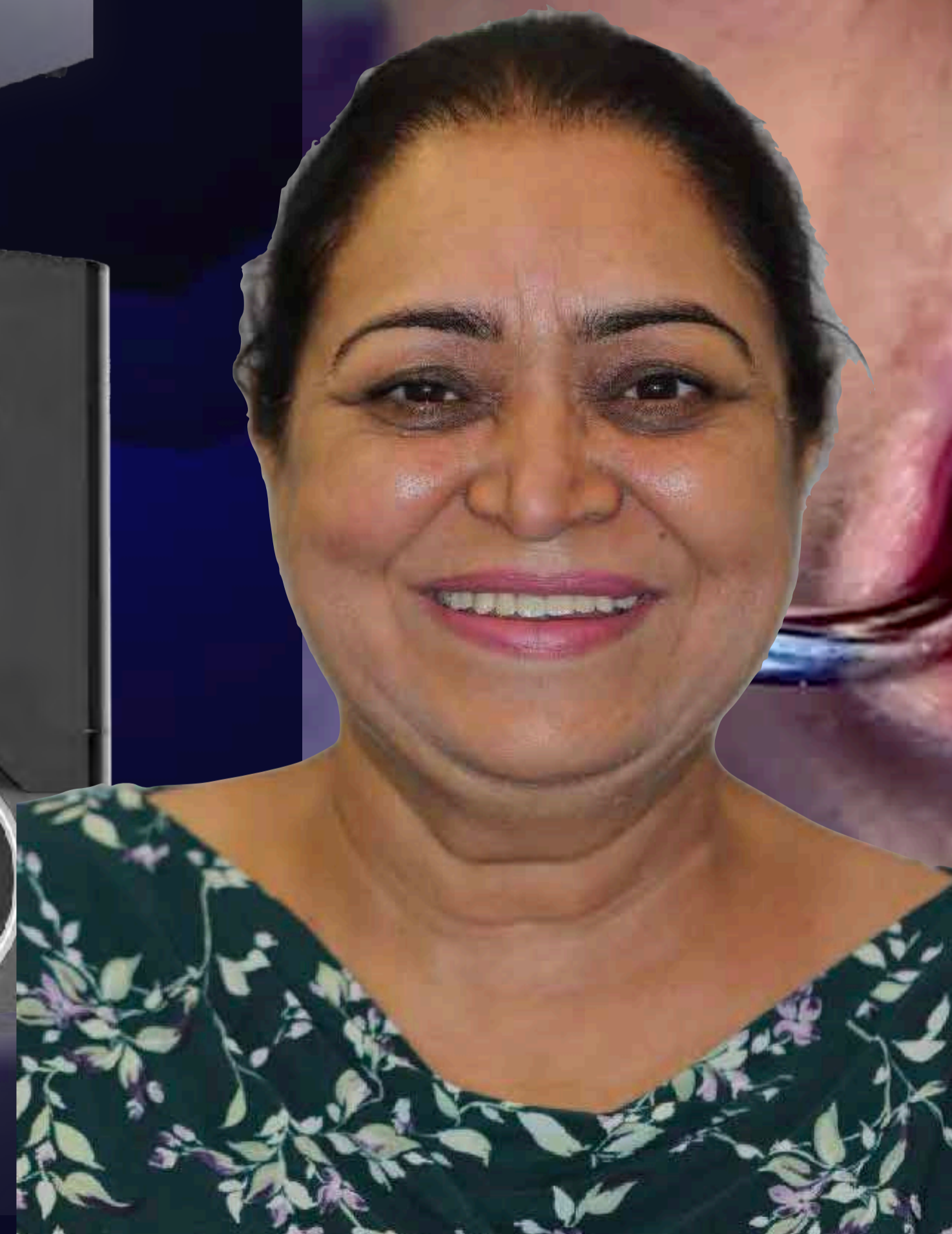


PRINTED TEMPORARIES

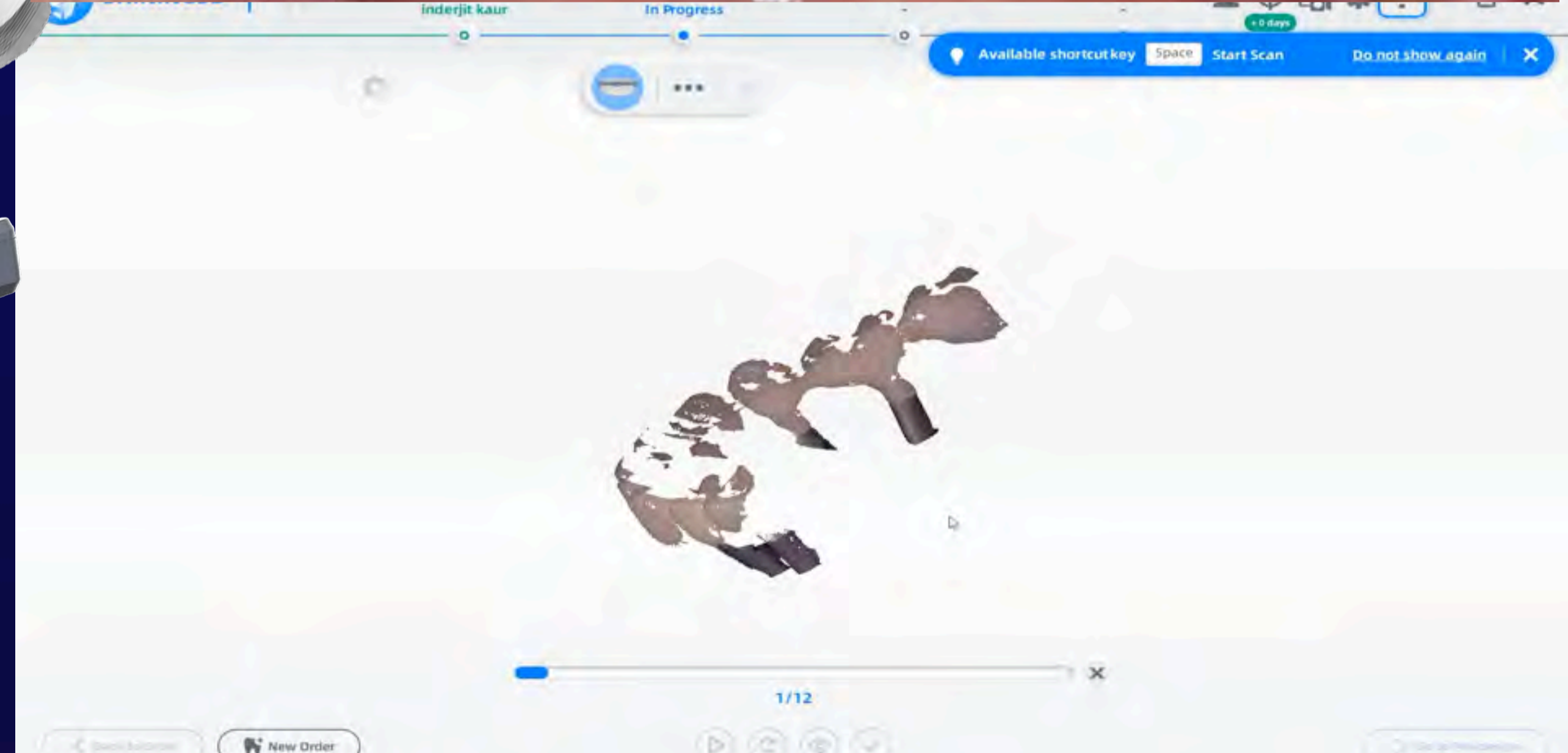
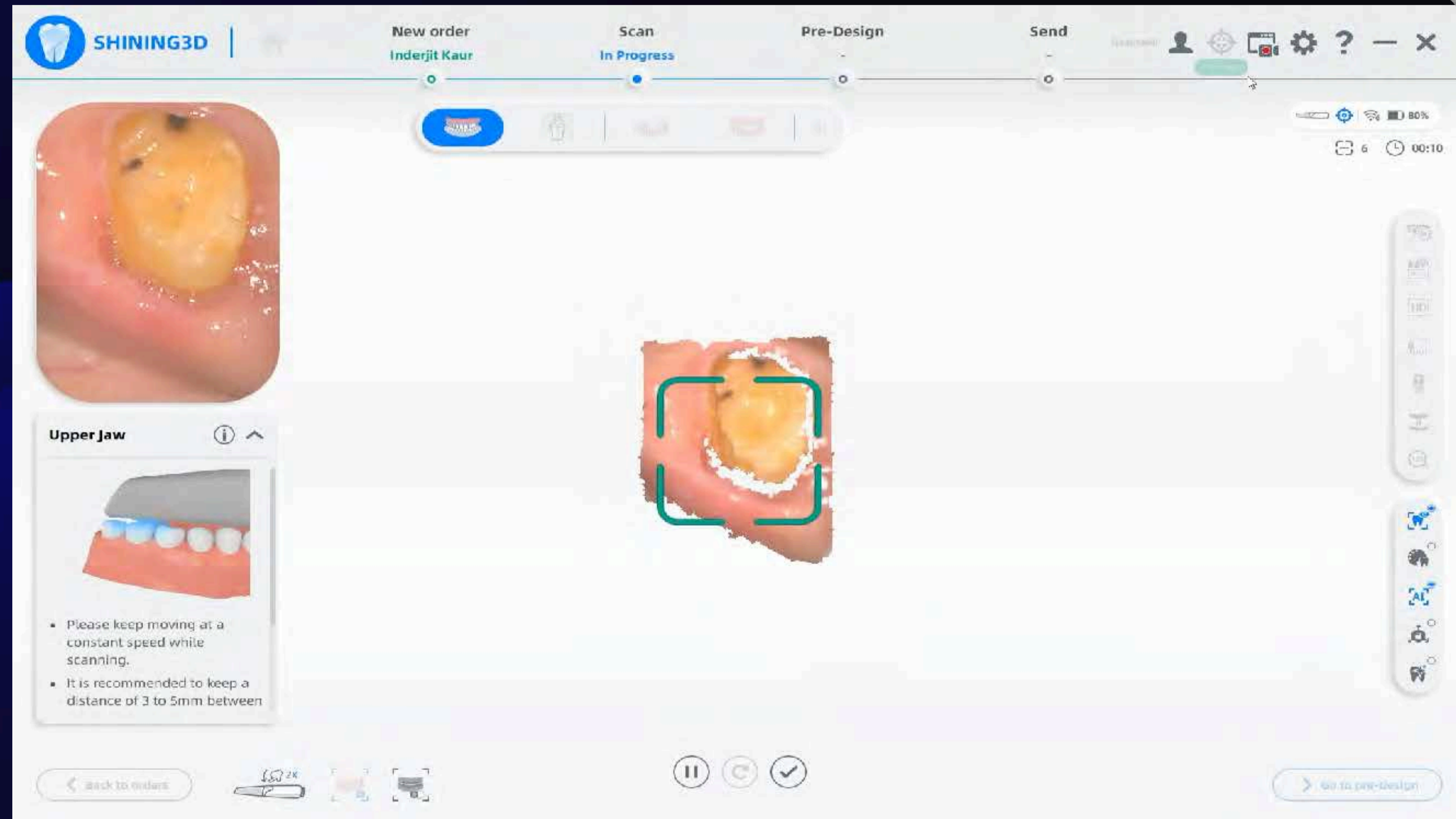
PROVISIONAL



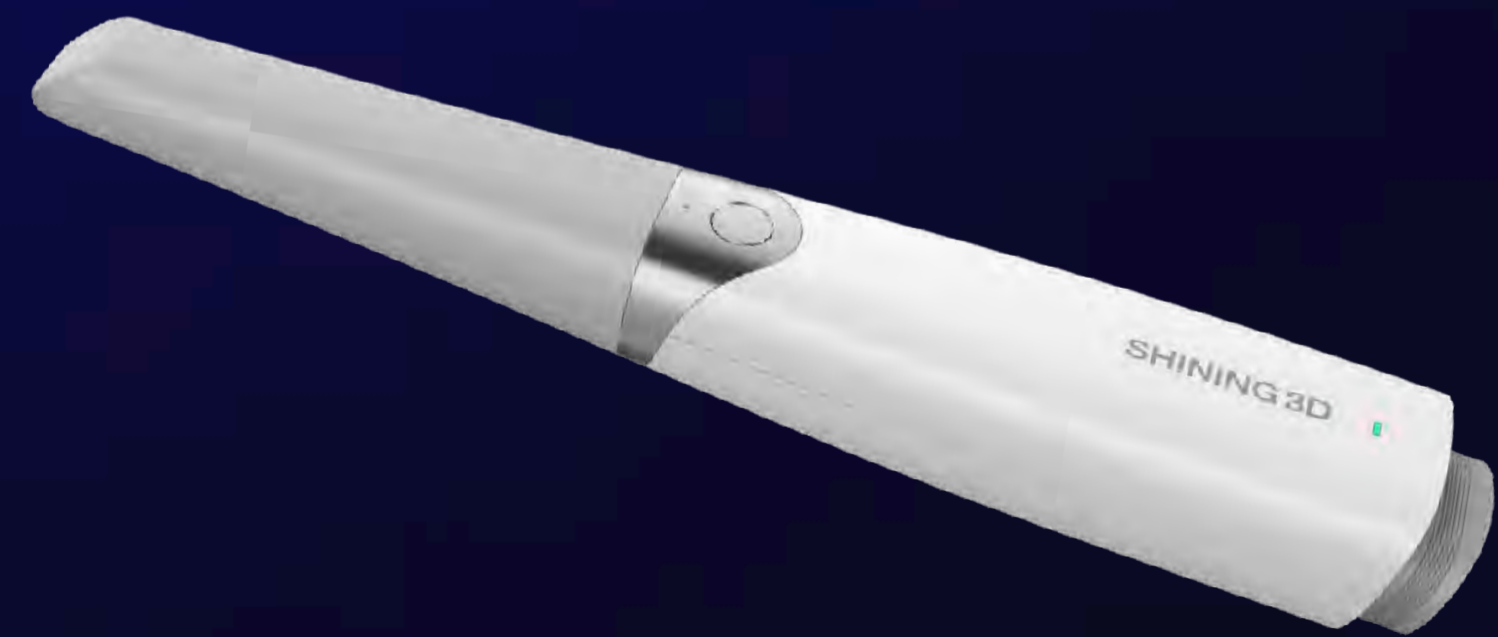
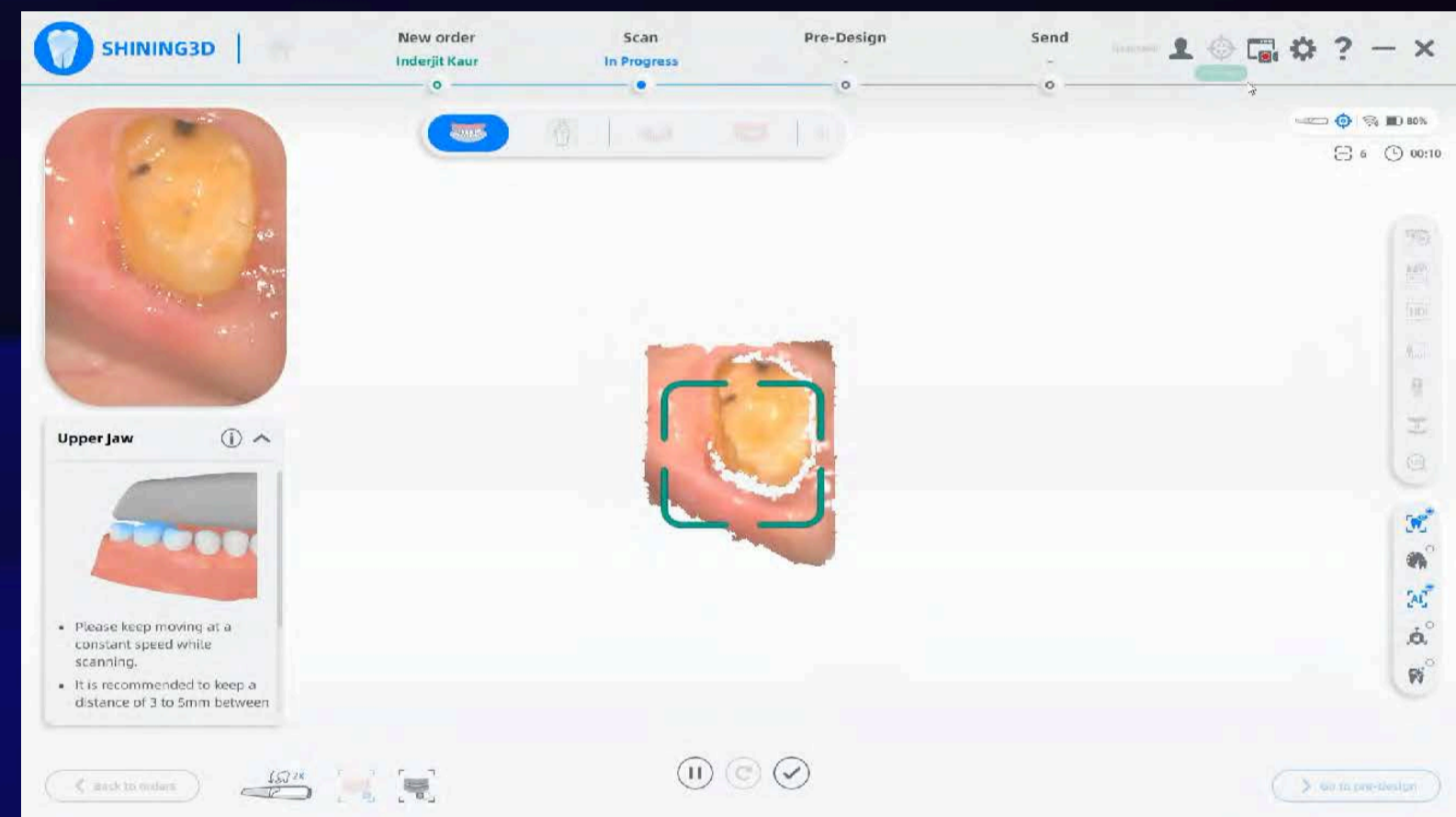
INSERTION



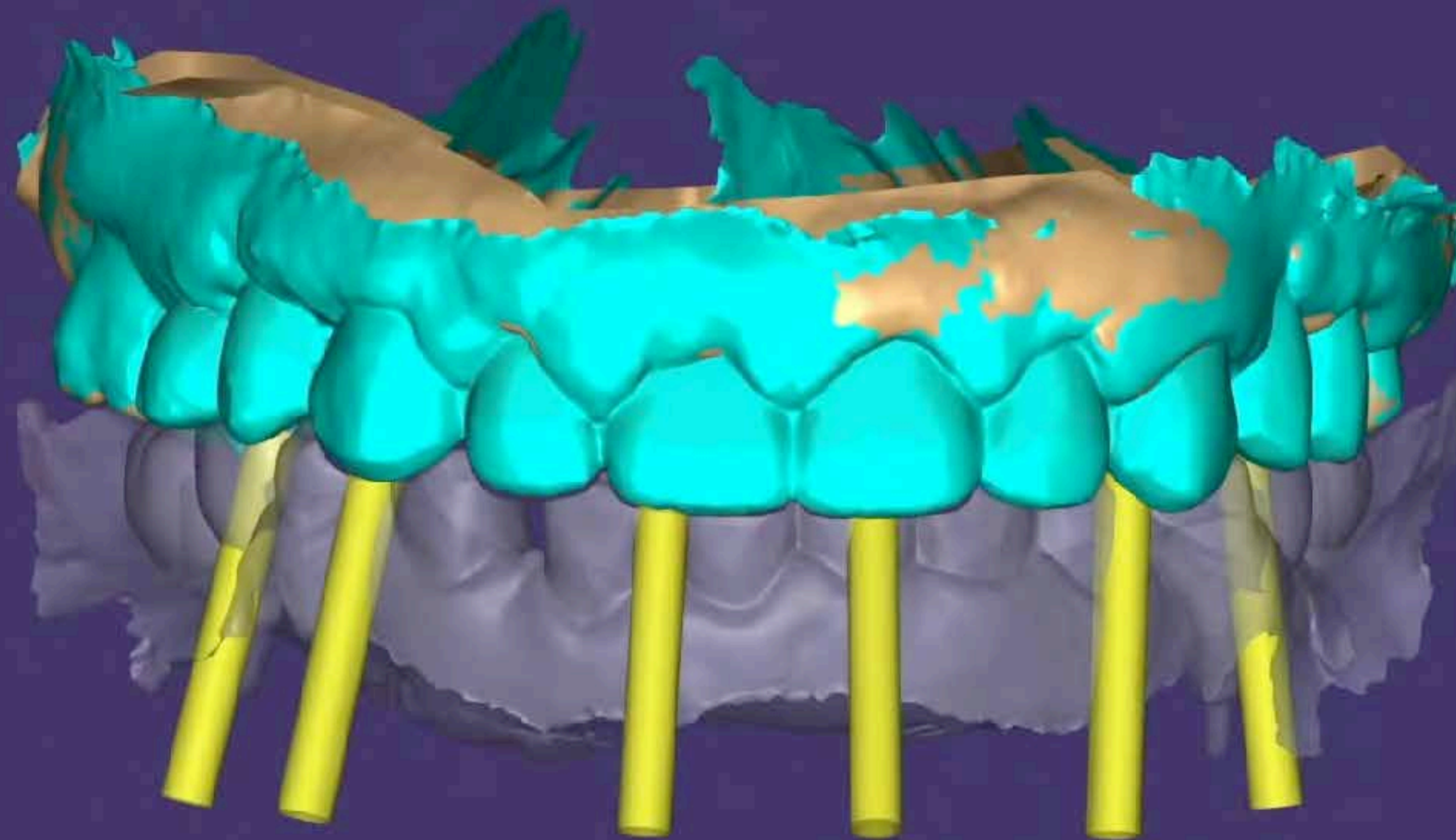
Final Impressions



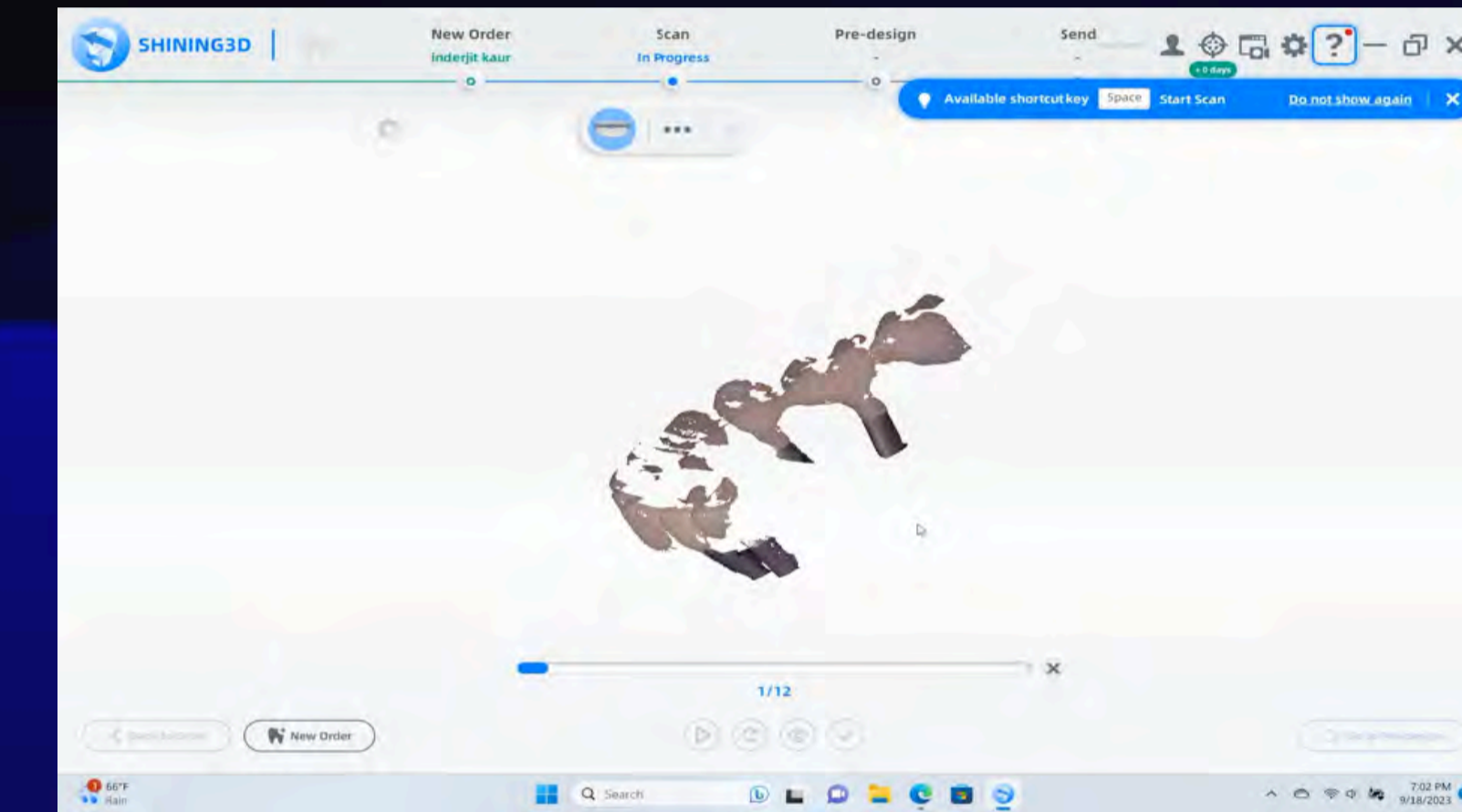
Tissue Scan



FINAL DESIGN

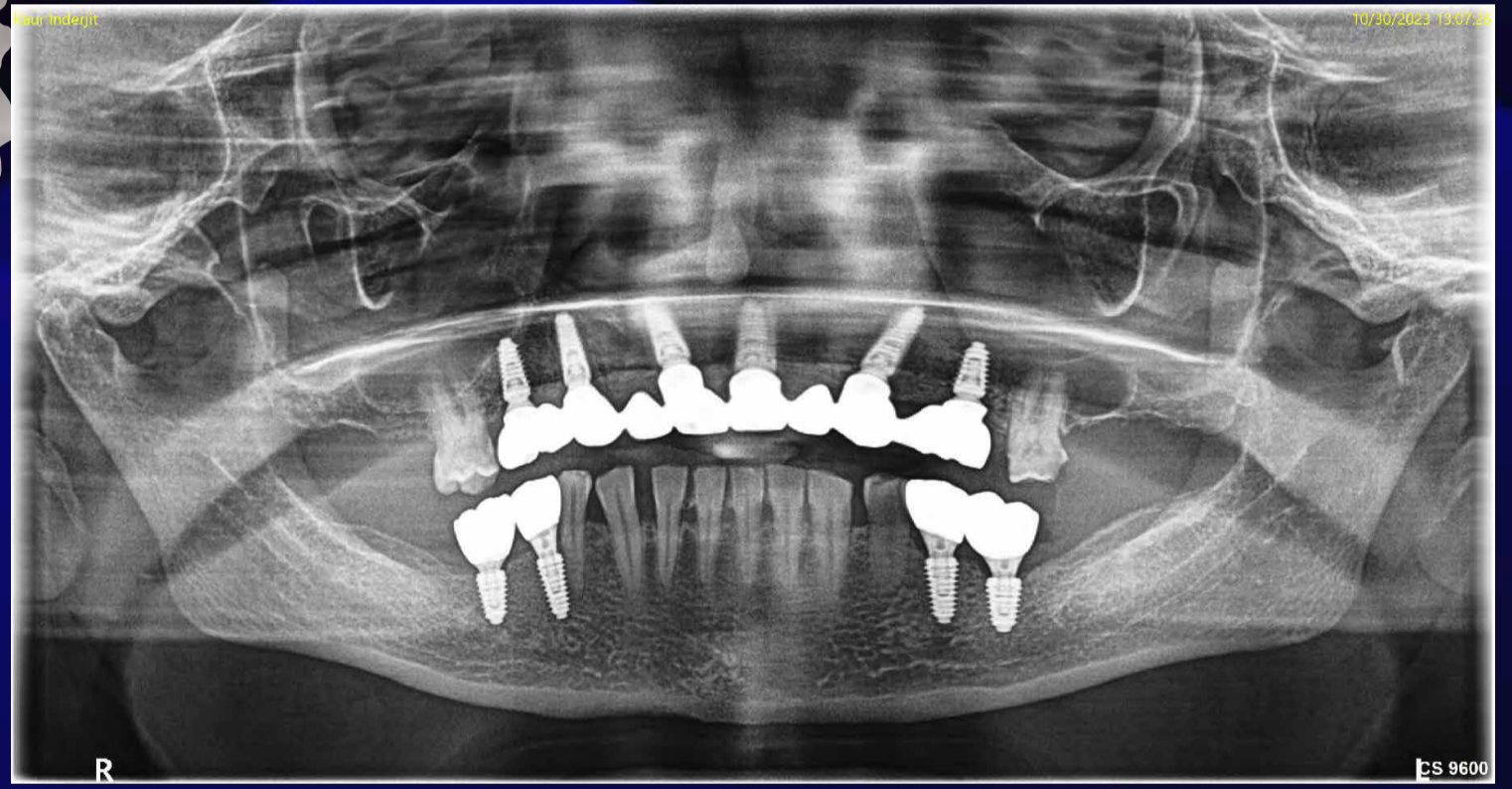


iJig



Finals -Metal Free







Changing lives one smile at a time

Fully Digital Full Arch?

Continued Advancements in Full-Arch Implant Restorations

INTRODUCTION

Full-arch, implant-supported reconstruction continues to provide viable solutions to restore and improve function, enhance aesthetics, and change the quality of life for our patients. All on X implant reconstruction has benefited from new advancements and technical innovations. In this current edition, the authors continue the journey, navigating through new developments that impact the full-arch analog and digital workflows. Our previous articles introduced several elements to aid the clinician in both the surgical and restorative phases of full-arch replacement, including the use of CBCT guided surgical applications¹ and how they have greatly improved the assessment for implant placements relative to the desired restorative positions for preliminary and definitive restorations while also reducing implant complications. The authors have previously described an ancillary surgical protocol that utilizes extracted teeth as an autologous solution² to bone grafting. This has greatly enhanced healing and long-term alveolar stability and provided ample graft volume while significantly reducing biomaterial costs. Subsequent publications also reported on improving the restorative time and treatment outcomes utilizing 3D printing³ and employing small-hole technology⁴ to enhance the physical integrity and anatomy of milled or 3D printed provisional restorations⁵ and improving inter-arch alignment and occlusion. The goal of these articles has been to improve time, efficiency, costs, and long-term results for the betterment of clinicians, laboratory technicians, and patients. This latest article endeavors to provide updates in the acquisition of data necessary to complete the restorations with an emphasis on addressing improvements in screw-retained full arches for monolithic restorations that incorporate multi-unit abutments.



Isaac D. Hines, DDS



Scott D. Goss, DMD

requiring additional applications to achieve fully digital solutions. All-on-X, fixed surgical and restorative protocols require the placement of 4 or more implants with a favorable anterior posterior spread to achieve the necessary long-term support. Capturing the positions of these implants with accurate cross arch intra-oral scanning, especially in the mandible, has been one of the major struggles for clinicians and dental laboratory technicians to overcome. IOS technology requires a stable environment for data to be stitched and captured accurately. Several techniques have emerged to aid the clinician in scanning these difficult environments, including proper retraction, salivary flow, lack of stable, keratinized soft tissues, large distances between scanning objects, and more. The use of splinting scan bands with bands or wires (Figure 1) has facilitated the ability of scanners to continue a scan without interruption by creating a linear path for data capture.⁶ Innovative techniques, such as the sigma composite cure (or surgical intervention of fibular markings fixated to the bone), have also helped improve scanning flow.⁷ While these processes work for some and not for others, developers have created alternative workflows to aid in acquiring accurate intraoral data.

Photogrammetry (PG) in dentistry is a relatively new development that has revolutionized capture and positional analysis.⁸ PG is a diagnostic and research method using an extraoral capture device with specific photogrammetric scanning, abutments to acquire measurements from 2D digital images (Figures 2a and 2b). PG scans allow dental clinicians to acquire precise measurements of individual scan bodies (Figure 2c) secured to dental implants as they are in their natural state⁹ either at the time of surgical placement or after the implants are uncovered. While extremely accurate for recording the spatial positioning of the implants, PG does not acquire the topography of the soft tissue. Therefore, a second scan is required with an intraoral scanner.¹⁰ If the IOS data can then be used to fabricate a virtual 3D model used to measure various parameters of the implant analogs.¹¹ The software correlation of these measurements can be used to assess and validate the correct positioning of implants and the alignment of a patient's occlusion, size, distance, and angle. The combination of IOS and PG data provides the CAD software designer with all of the necessary information to virtually create a provisional prosthesis or a final restoration to be 3D printed or CAM-milled. The advanced capability of this highly accurate tech-

continued on page 52

IMPLANTS



Figure 1. Intraoral scanning of a patient's upper arch with a scan band.



Figure 2. Photogrammetry (PG) scan of a patient's teeth secured to dental implants.



Figure 3. 3D model of a patient's teeth secured to dental implants.



Figure 4. Intraoral scanning of a patient's lower arch with a scan band.



Figure 5. 3D model of a patient's teeth secured to dental implants.

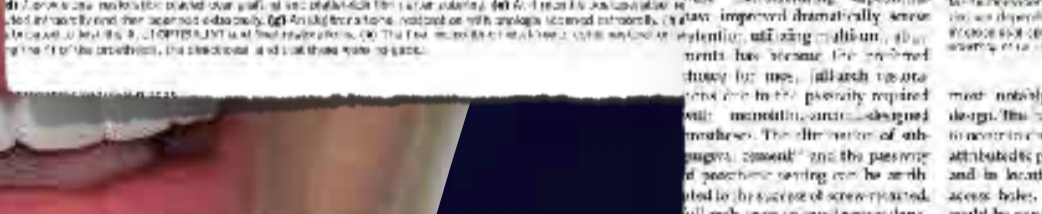


Figure 6. Intraoral scanning of a patient's lower arch with a scan band.



Figure 7. 3D model of a patient's teeth secured to dental implants.



Figure 8. Intraoral scanning of a patient's lower arch with a scan band.

IMPLANTS



Figure 9. Intraoral scanning of a patient's lower arch with a scan band.



Figure 10. 3D model of a patient's teeth secured to dental implants.



Figure 11. Intraoral scanning of a patient's lower arch with a scan band.



Figure 12. 3D model of a patient's teeth secured to dental implants.



Figure 13. Intraoral scanning of a patient's lower arch with a scan band.



Figure 14. 3D model of a patient's teeth secured to dental implants.



Figure 15. Intraoral scanning of a patient's lower arch with a scan band.



Figure 16. 3D model of a patient's teeth secured to dental implants.

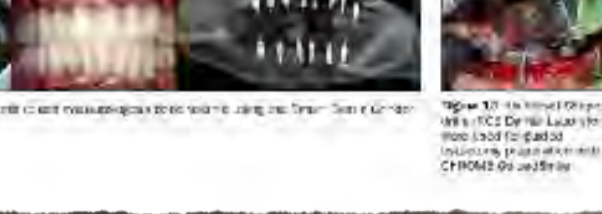


Figure 17. Intraoral scanning of a patient's lower arch with a scan band.

IMPLANTS



Figure 18. Intraoral scanning of a patient's lower arch with a scan band.



Figure 19. 3D model of a patient's teeth secured to dental implants.



Figure 20. Intraoral scanning of a patient's lower arch with a scan band.

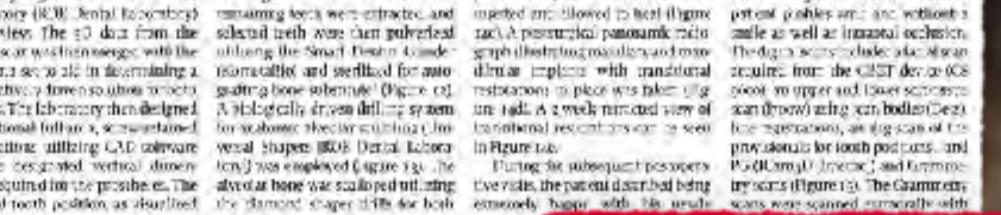


Figure 21. 3D model of a patient's teeth secured to dental implants.



Figure 22. Intraoral scanning of a patient's lower arch with a scan band.

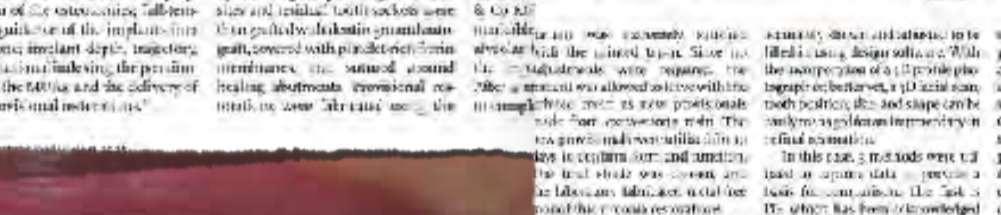


Figure 23. 3D model of a patient's teeth secured to dental implants.



Figure 24. Intraoral scanning of a patient's lower arch with a scan band.

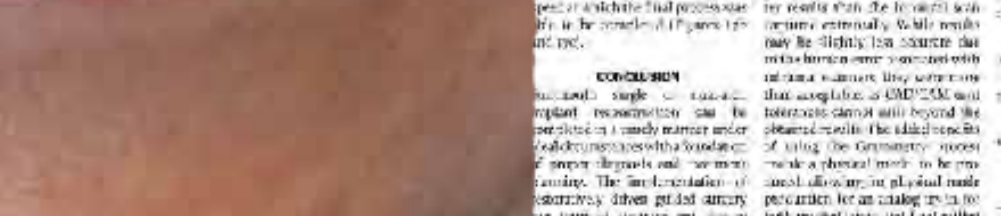


Figure 25. 3D model of a patient's teeth secured to dental implants.

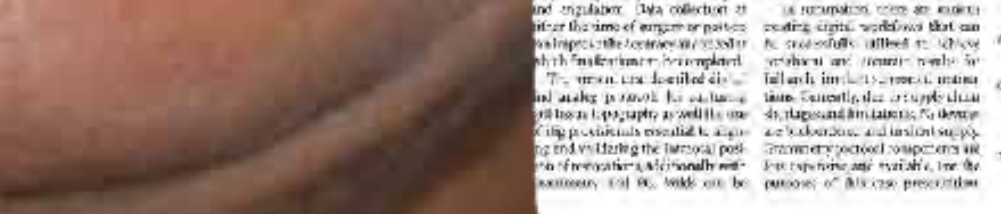


Figure 26. Intraoral scanning of a patient's lower arch with a scan band.

IMPLANTS



Figure 27. Intraoral scanning of a patient's lower arch with a scan band.



Figure 28. 3D model of a patient's teeth secured to dental implants.



Figure 29. Intraoral scanning of a patient's lower arch with a scan band.



Figure 30. 3D model of a patient's teeth secured to dental implants.

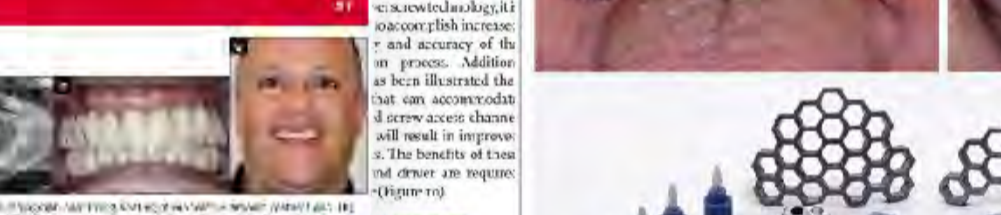


Figure 31. Intraoral scanning of a patient's lower arch with a scan band.



Figure 32. 3D model of a patient's teeth secured to dental implants.



Figure 33. Intraoral scanning of a patient's lower arch with a scan band.



Figure 34. 3D model of a patient's teeth secured to dental implants.



Figure 35. Intraoral scanning of a patient's lower arch with a scan band.

IMPLANTS



Figure 36. Intraoral scanning of a patient's lower arch with a scan band.



Figure 37. 3D model of a patient's teeth secured to dental implants.



Figure 38. Intraoral scanning of a patient's lower arch with a scan band.



Figure 39. 3D model of a patient's teeth secured to dental implants.



Figure 40. Intraoral scanning of a patient's lower arch with a scan band.



Figure 41. 3D model of a patient's teeth secured to dental implants.



Figure 42. Intraoral scanning of a patient's lower arch with a scan band.



Figure 43. 3D model of a patient's teeth secured to dental implants.



Figure 44. Intraoral scanning of a patient's lower arch with a scan band.

Live Hands-On Surgery Program
TIJUANA, MEXICO
 Live Surgery by Participants

Define your goals, and we will attempt to design a program specifically to meet your needs.

April 26-29th, 2023

Info and Registration Online:
www.aiedental.com

Call for information: 718-236-1234

Dr. Scott Goss, Dr. Isaac Hines

Limited Enrollment!
 32 Clinical Hours

ADA CERP
 AACE





AI

DIGITAL
RUPTION

BIG
DATA



**TECHNOLOGY IS
CHANGING DENTISTRY
DONT BE LEFT BEHIND**





WITH THE RIGHT
INSTRUMENTATION
DIGITAL IS NOT
CHANGE IS NOT
EVOLUTION
ONLY POSSIBLE
IT IS EXPECTED





BE A DREAMER LIVING IN THE PRESENT

Isaac D Tawil DDS MS