Dental Implant Treatment Planning: A Prosthodontist's Perspective

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Objectives

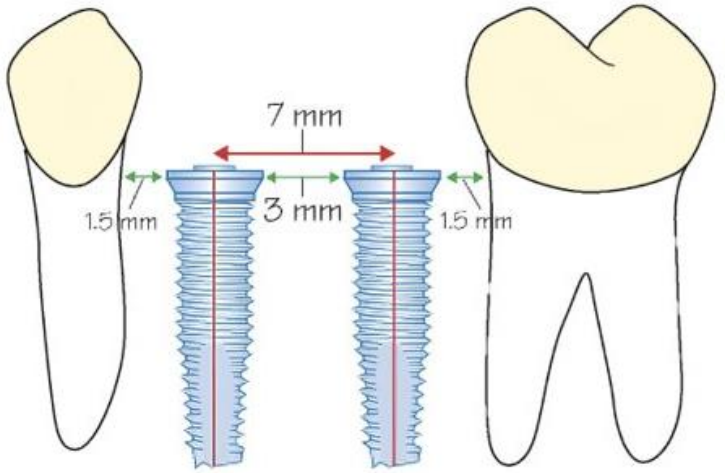
1. Identify appropriate implant size and diameter selection for various sites
2. Understand ideal abutment and implant crown design
3. Understand prosthetic space requirements for various implant restorations and recognize prosthetic complications that may arise from it

Appropriate diameter selection

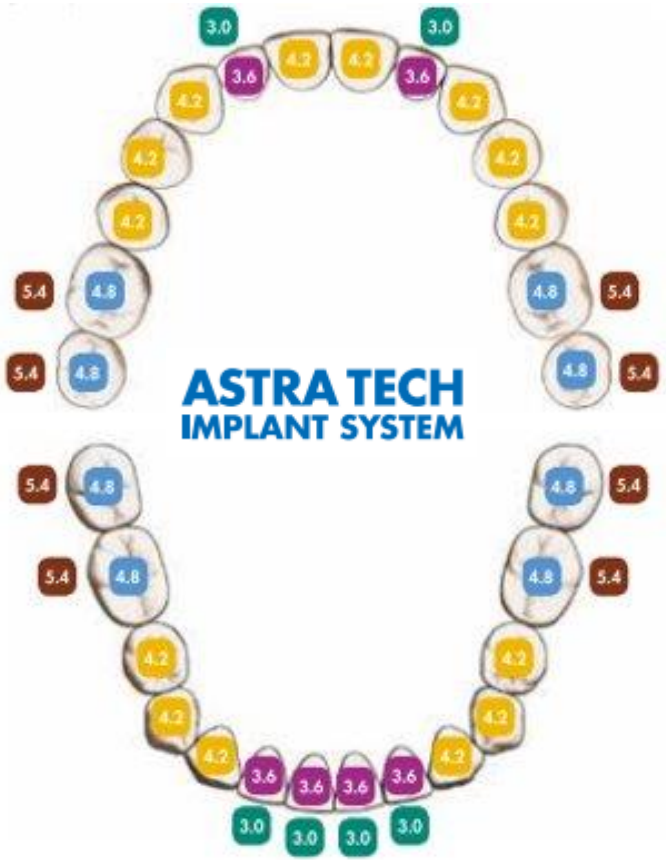
Recommend use of largest implant diameter so there is, at ***minimum***:

- 1.5 mm buccal bone plate
- 1.5 mm lingual bone
- 1.5 mm spacing from adjacent roots
- 3 mm spacing from adjacent implants

Larger Diameter = BETTER



What is the appropriate implant diameter for each site?



Implant manufactures will make recommendations for their system

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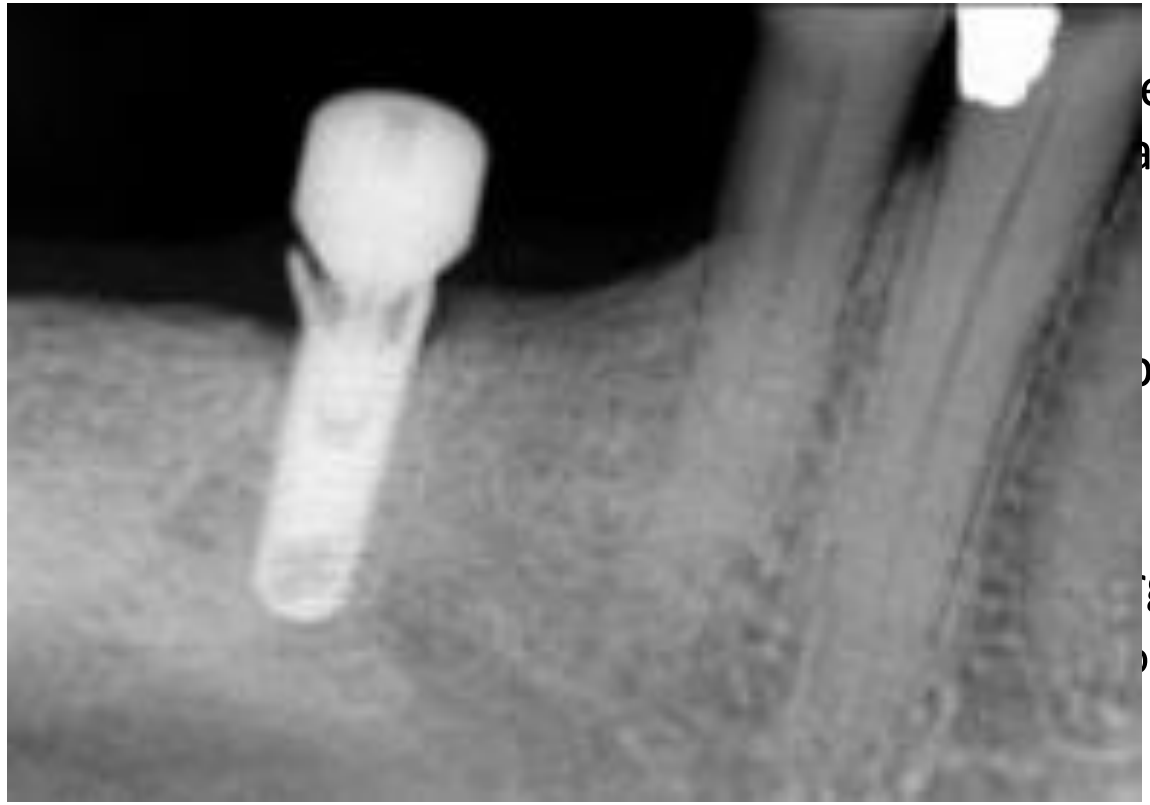

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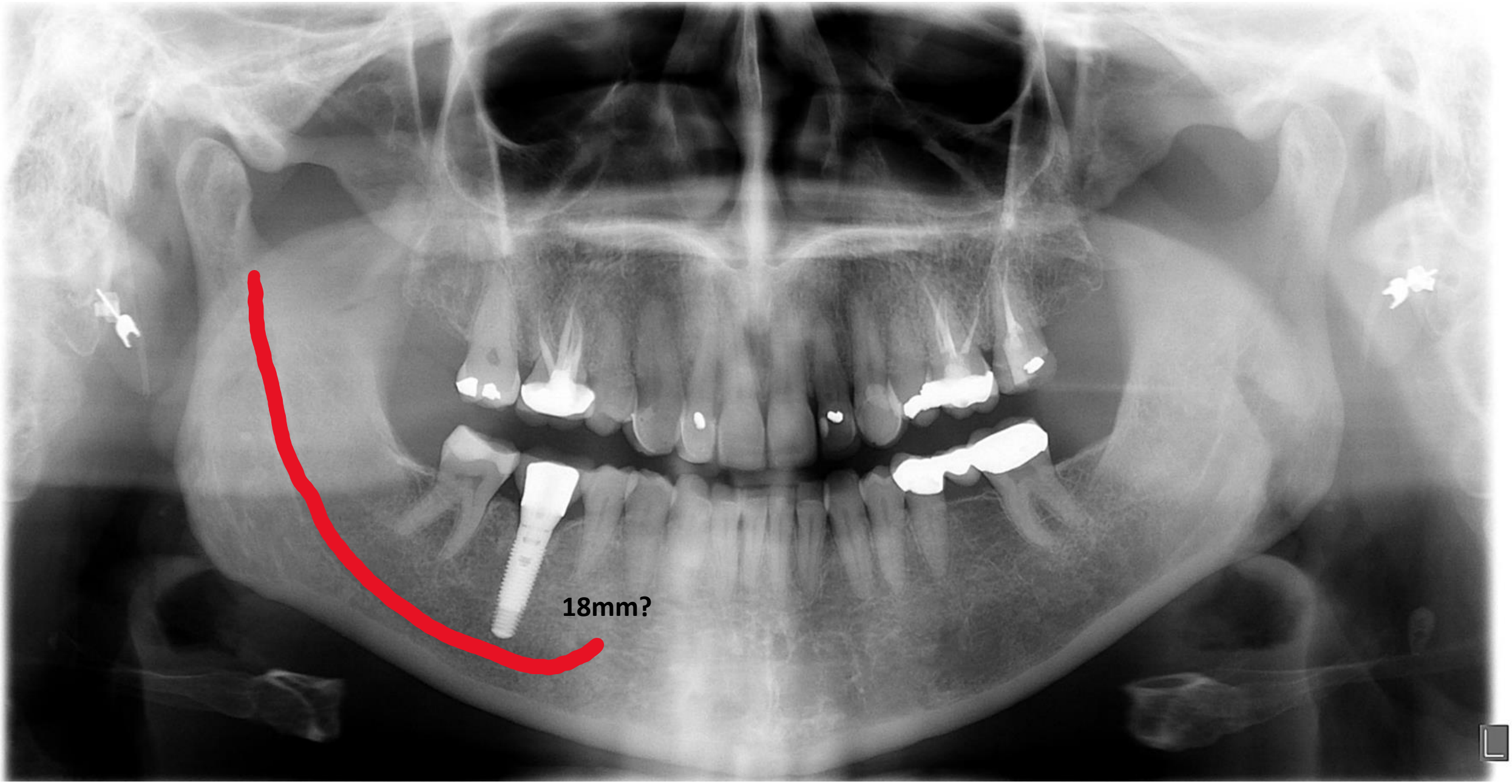
What is the appropriate length for implant?

- Historically, recommended longest length possible
  - With improved implant surfaces, no longer recommend
  - Longer sizes (16-18mm) designed for immediate placement to achieve primary stability w/ osteotomy preparation
- At minimum, recommend placement of ≥ 8mm length
- Reserve 6 mm length in resorbed posterior maxilla/mandible and restore with locator abutments
- The concept of ideal crown-to-root ratio doesn't apply to implant restorations like natural dentition
  - Implant crown/abutment height should not exceed implant length to minimize tipping forces and prosthetic complications


18mm?

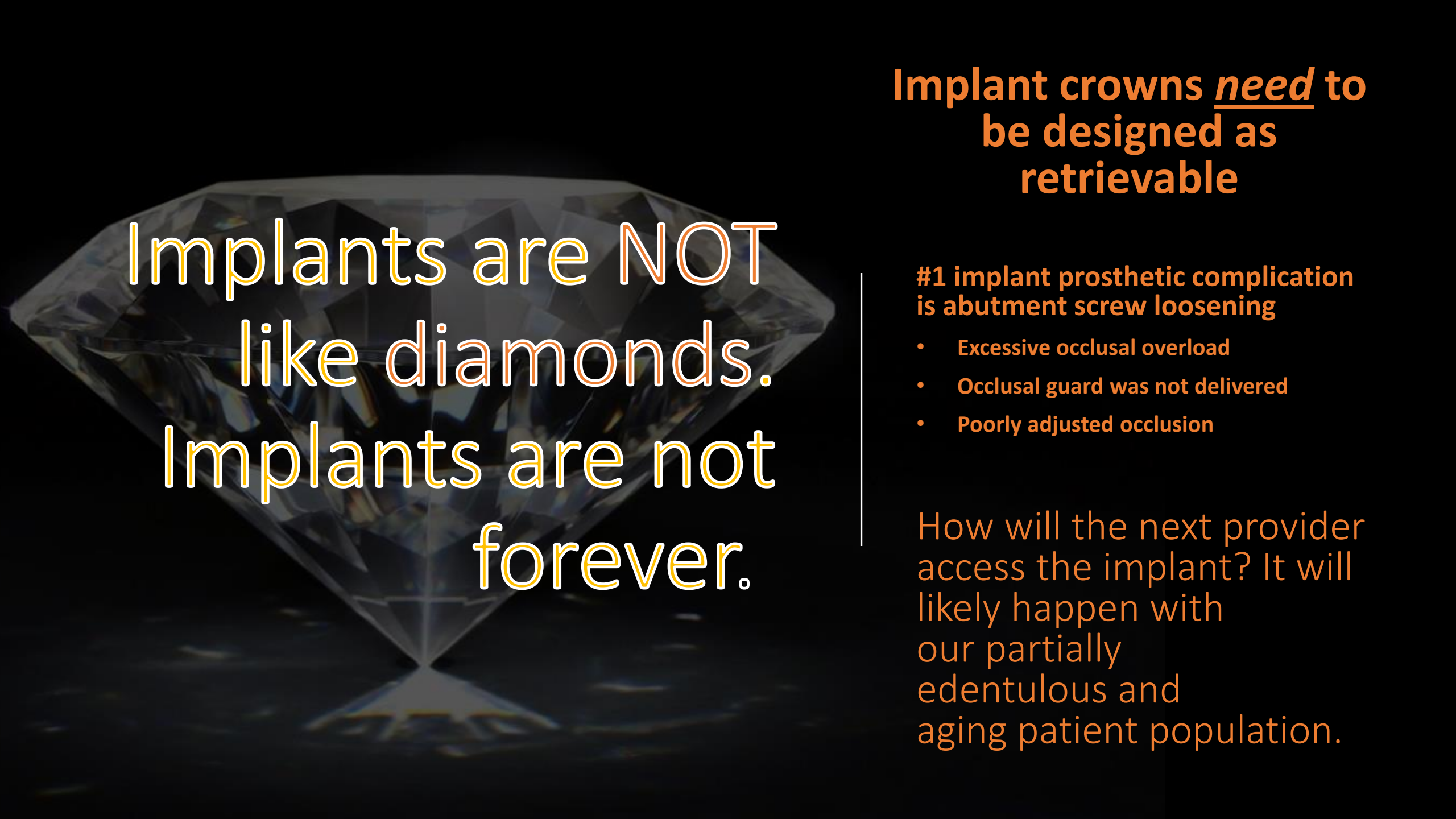
Prosthetic Space Requirements

Interocclusal height: distance from opposing tooth (occlusal) to implant platform

5mm is absolute minimum requirement

Anything less is non-restorable

- **5mm** can only be restored with screw-retained crown (UCLA cast abutment)
  - **Only** options are PFM or gold crown restoration
- **≥7.5 mm** can be restored with custom abutment and crown material of choice



Implants are NOT like diamonds. Implants are not forever.

Implant crowns *need* to be designed as retrievable

#1 implant prosthetic complication is abutment screw loosening

- **Excessive occlusal overload**
- **Occlusal guard was not delivered**
- **Poorly adjusted occlusion**

How will the next provider access the implant? It will likely happen with our partially edentulous and aging patient population.

How do I identify all these random implants?

FLOWCODE
PRIVACY.FLOWCODE.COM

https://whatimplantisthat.com/implants

Abutment Screw Torque and Driver

Manufacturer	Torque N-cm							Driver	
© 2018 genieoss.com	15	20	24	25	30	35	45	Titanium Screw	Gold Screw
Atlantis™ titanium and zirconia abutments utilize the same torque and driver setting as the original implant manufacturer									
Astra 3.0	X							0.050"- 1.27mm hex	
Astra 3.5-4.0		X						0.050"- 1.27mm hex	
Astra 4.5-5.0				X				0.050"- 1.27mm hex	
Astra EV 3.0, 3.6, 4.2, 4.8, 5.4				X				0.050"- 1.27mm hex	
BioHorizons® External, Internal, Internal Tapered					X			0.050"- 1.27mm hex	
Biomet 3i™ External Hex						X		0.048"- 1.22mm hex	Square
Biomet 3i™ Certain® *		X						0.048"- 1.22mm hex	
BlueSkyBio One Stage					X			Star & 0.048" hex	
BlueSkyBio Trilobe					X			Unigrip & 0.048" hex	
BlueSkyBio Internal Hex & Molar					X			0.050"- 1.27mm hex	
BlueSkyBio Conus 12 & Three					X			0.050"- 1.27mm hex	
BlueSkyBio Max					X			0.048"-1.22mm hex	
BlueSkyBio Quatro					X			0.048"-1.22mm hex	
Brånemark (Nobel Biocare)						X		Unigrip	Square
Camlog™ & Conelog®		X						0.050"- 1.27mm hex	
Dentium Super Line & Implantium					X			0.050"- 1.27mm hex	
Dentsply Friadent/Frialit & Xive			X					0.048"-1.22mm hex	
Dentsply Ankylos® C/X	X							0.039"-1mm hex	
Glidewell iNCLUSiVE® Tapered 3.7, 4.7, 5.2						X		0.050"- 1.27mm hex	
Hiossen/Osstem HG mini (3.5)		X						0.048"-1.22mm hex	
Hiossen/Osstem HG standard (4.0, 4.5, 5.0)					X			0.048"-1.22mm hex	
Imtec® 3M Endure™						X		0.050"- 1.27mm hex	
Implant Direct™					X			0.050"-1.27mm hex	
Keystone/Lifecore Genesis* & Prima™ *					X			Square	
Keystone/Lifecore Renova®					X			0.048"-1.22mm hex	
Keystone/Lifecore Restore®					X			0.048"-1.22mm hex	Square
Mega'Gen EZ Plus						X		0.048"-1.22mm hex	
Mega'Gen Rescue							X	0.048"-1.22mm hex	
Mega'Gen ExFeel internal (3.5)				X				0.048"-1.22mm hex	
Mega'Gen ExFeel internal (4.1, 4.8, 5.5)						X		0.048"-1.22mm hex	
Mega'Gen ExFeel external (3.3)				X				0.048"-1.22mm hex	
Mega'Gen ExFeel external (3.75, 4.0,4.5, 5.0, 5.5)						X		0.048"- 1.22mm hex	
MIS® Biocom & Seven					X			0.050"-1.27mm hex	
NEODENT® CM	X							0.035"- 0.9mm hex	
NEODENT® CM					32			0.048"-1.22mm hex	
NEODENT® CM					32			0.063"-1.6mm hex	
Neoss					X			Unigrip (not compatible with Nobel)	
NobelActive™ & Replace™						X		Unigrip	
NobelActive™ 3.0	X							Unigrip	
OCO Biomedical					X			0.050"-1.27mm hex	
Southern Implant External						32		0.048"-1.22mm hex	Square & Unigrip
Southern Implant Tri Nex						32		Unigrip	
Southern Implant Octa						32		Star/Torx	
Straumann® Bone & Tissue Level						X		Star/Torx	
Sybron Pitt Easy				X				0.067"-1.7mm hex	
Thommen SPI® 3.5	X							Four lobe	
Thommen SPI® 4.0, 4.5, 5.0, 6.0				X				Four lobe	
Thommen SPI® zirconia abutment		X						Four lobe	
Zimmer®					X			0.050"- 1.27mm hex	

* Biomet 3i™ Certain® screws are gold plated only. Keystone Genesis and Prima™ abutment screws are made of titanium and have a titanium nitride coating.

How to identify the appropriate implant driver and torque values for multiple implant systems

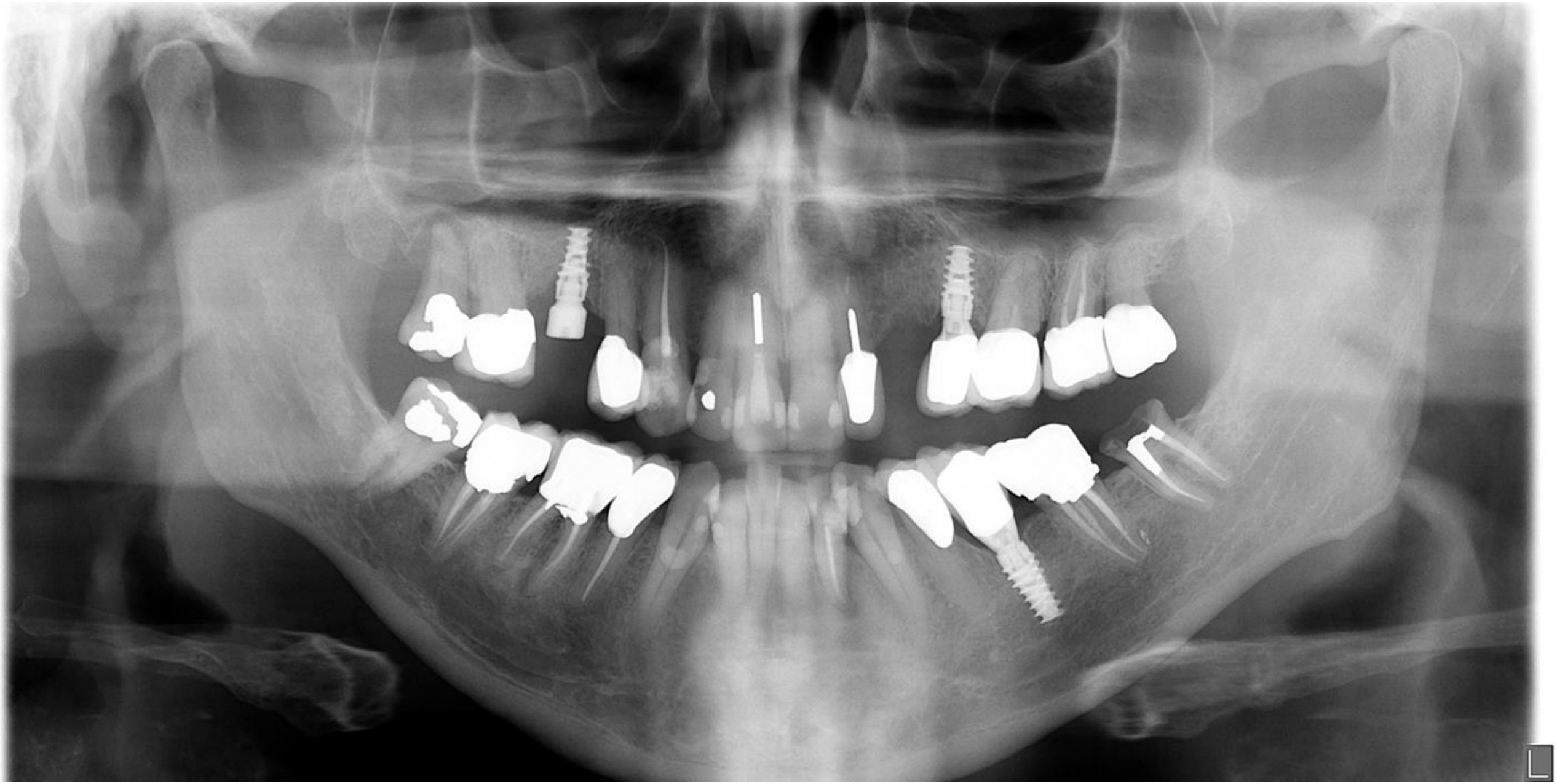
www.genieoss.com/abutmenttorque.html

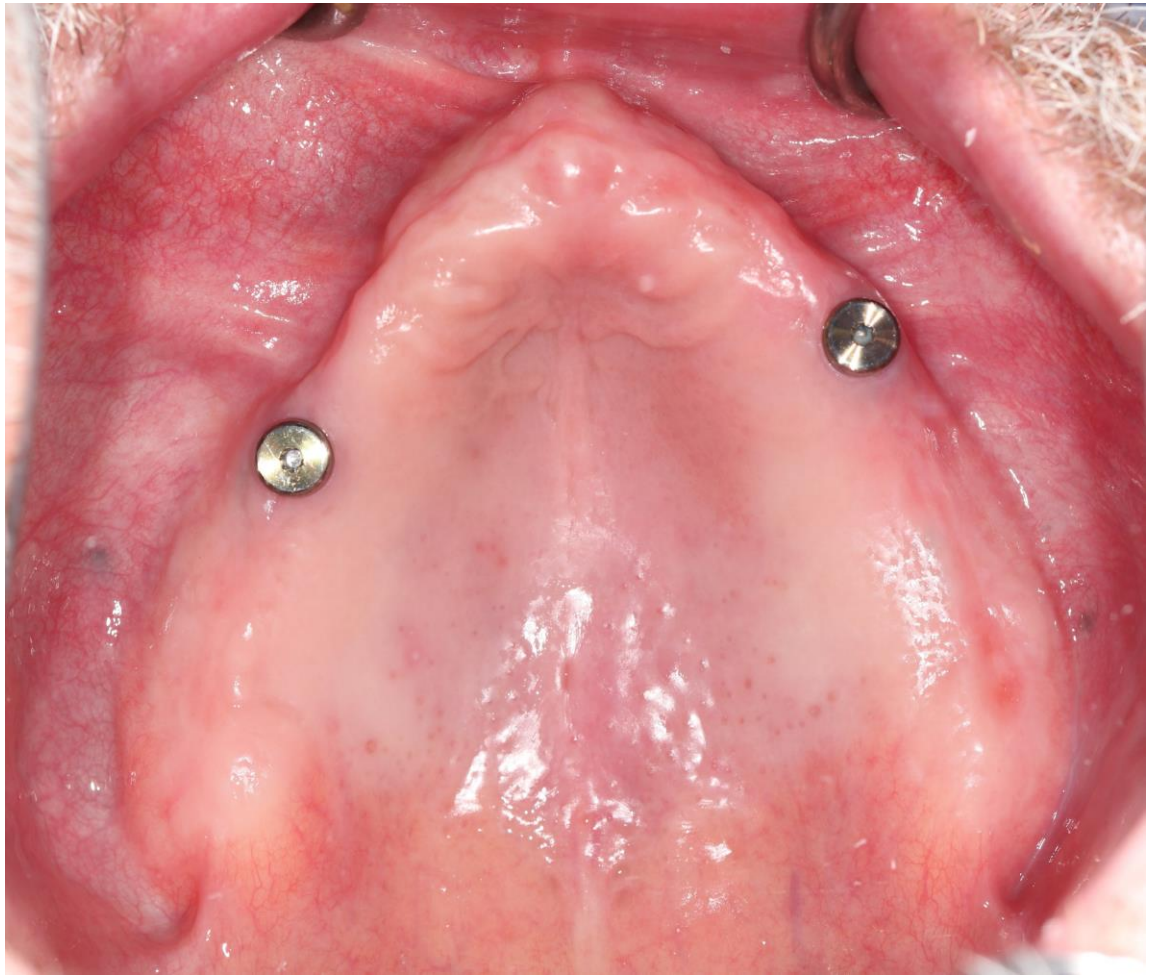
Can we reuse old implants once a patient converts to partial or completely edentulous

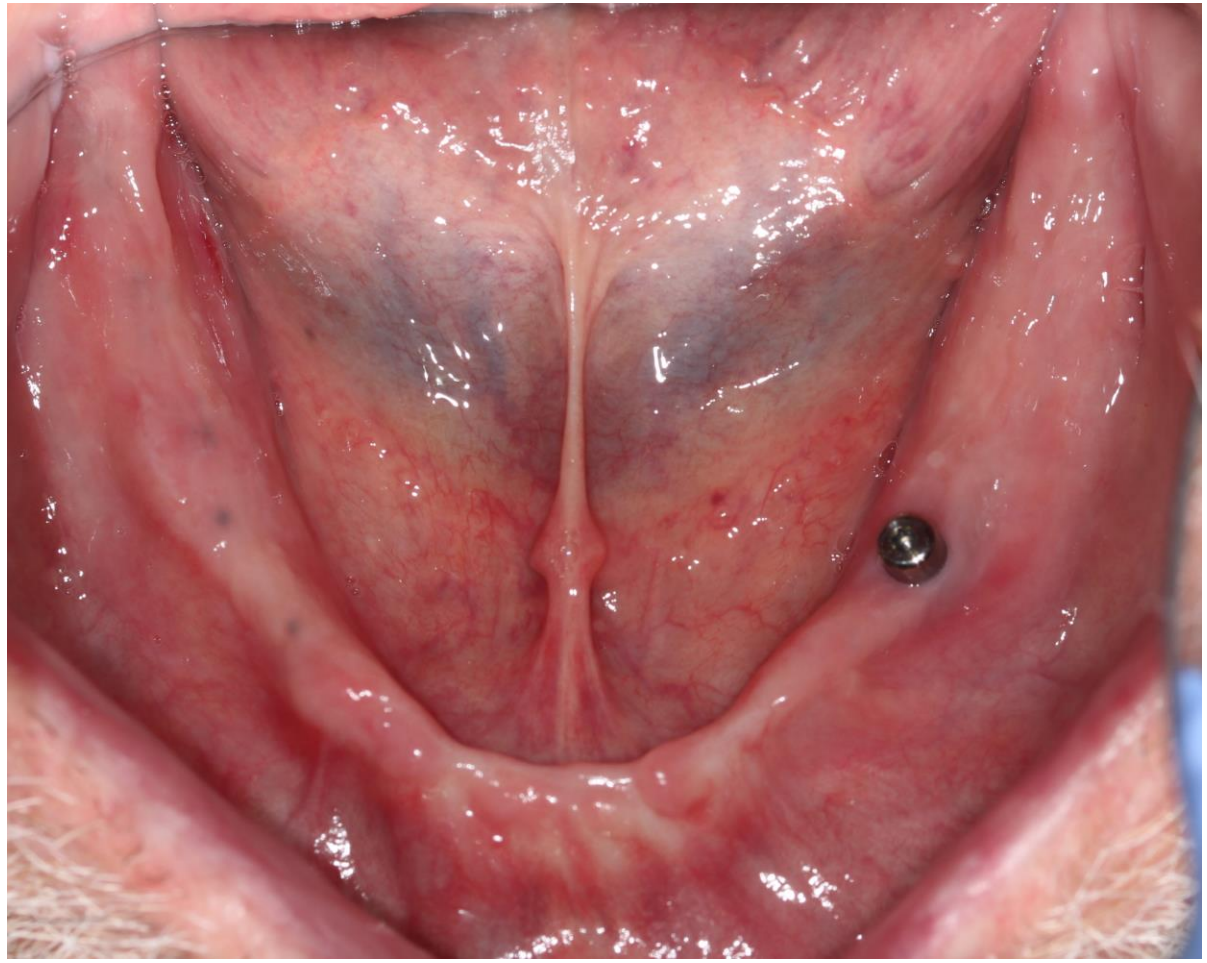
It depends....

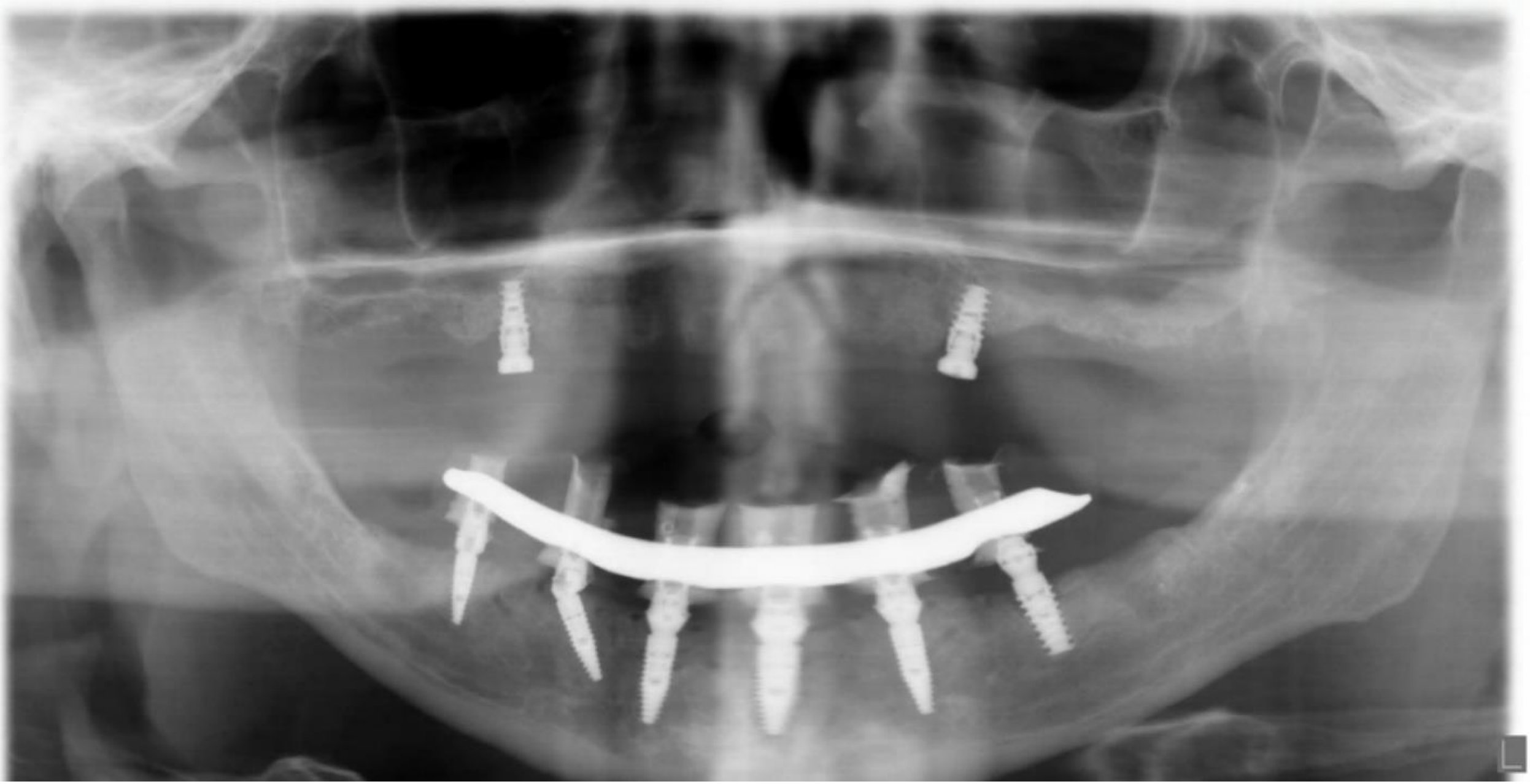
- Does the implant have marginal bone loss?
  - Keep in mind, adjacent tooth extractions will induce further bone loss
- Implant placed in the correct angulation?
  - Can I place additional implants that are parallel?
  - Is there a multiunit abutment available to correct it?
- For full arch prosthetics, are the implant placed "deep" enough to allow the proper prosthetic space

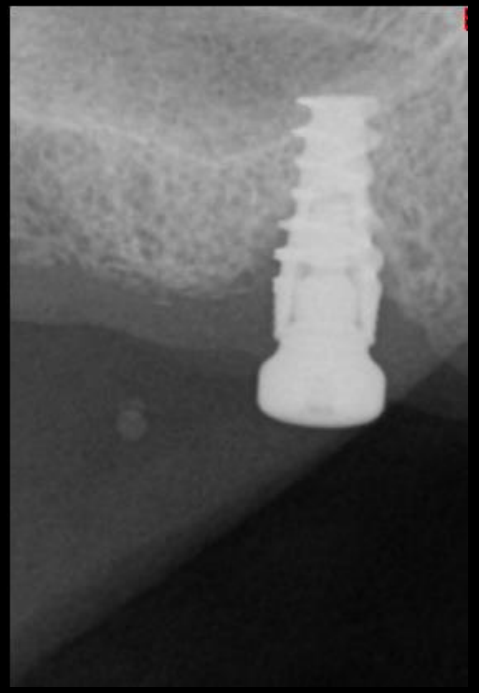
Please Note: Not all implant systems/narrow platforms have manufactured locator abutments or multi-units (angle-correcting)

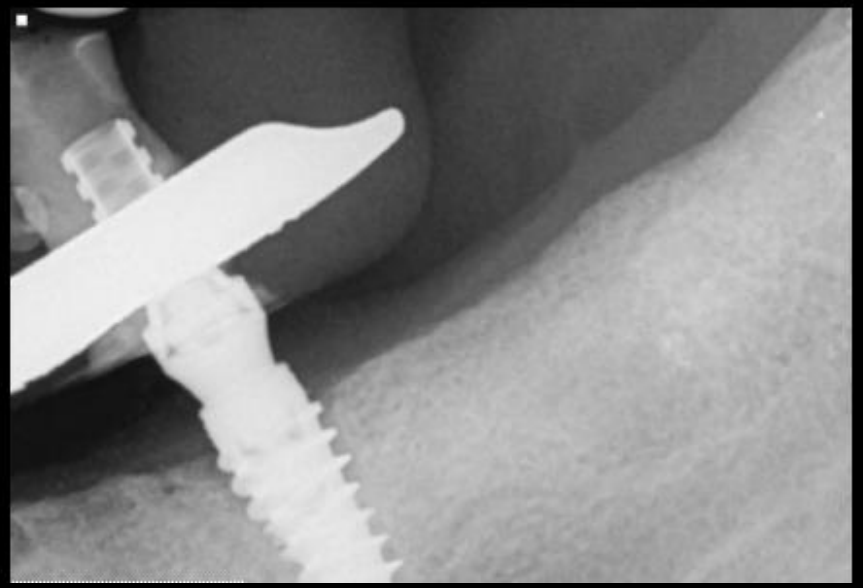


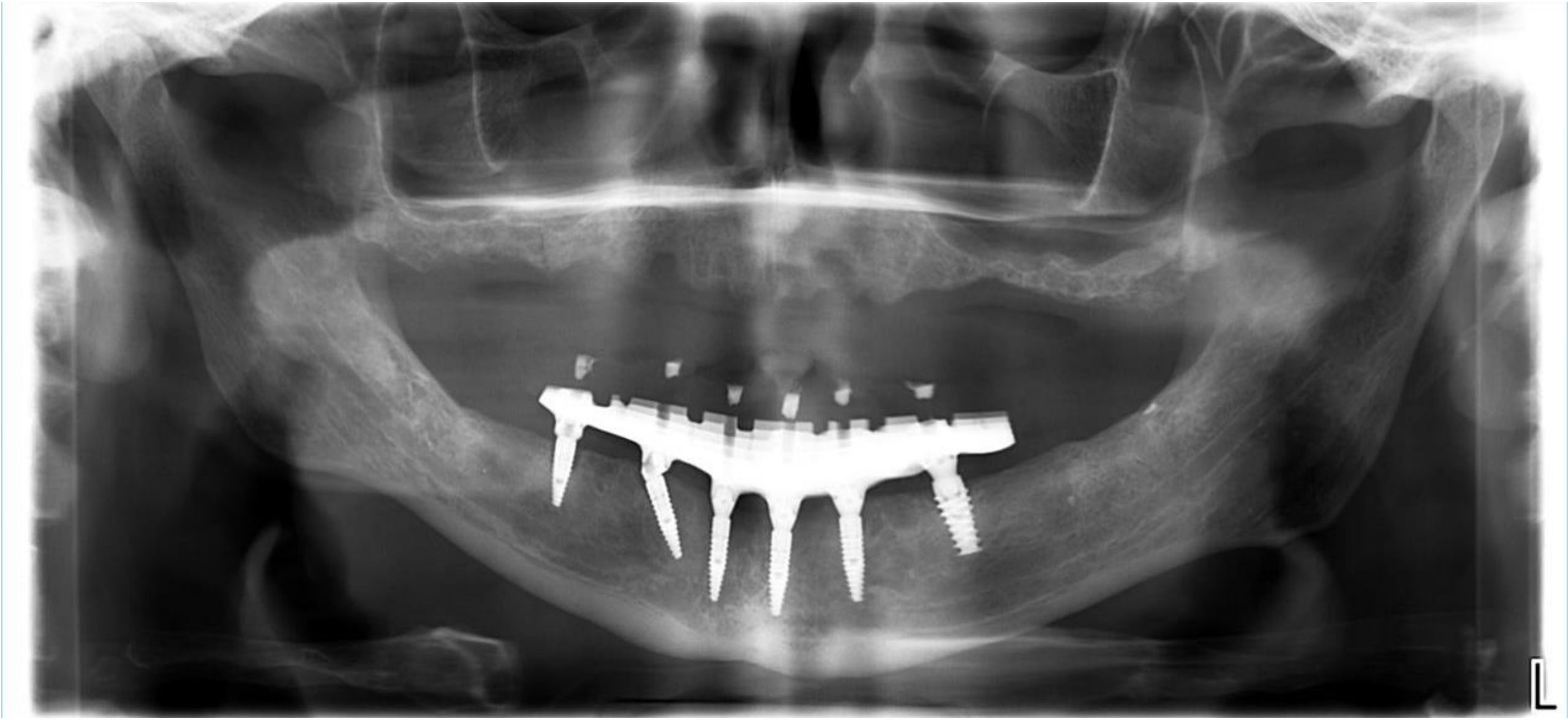






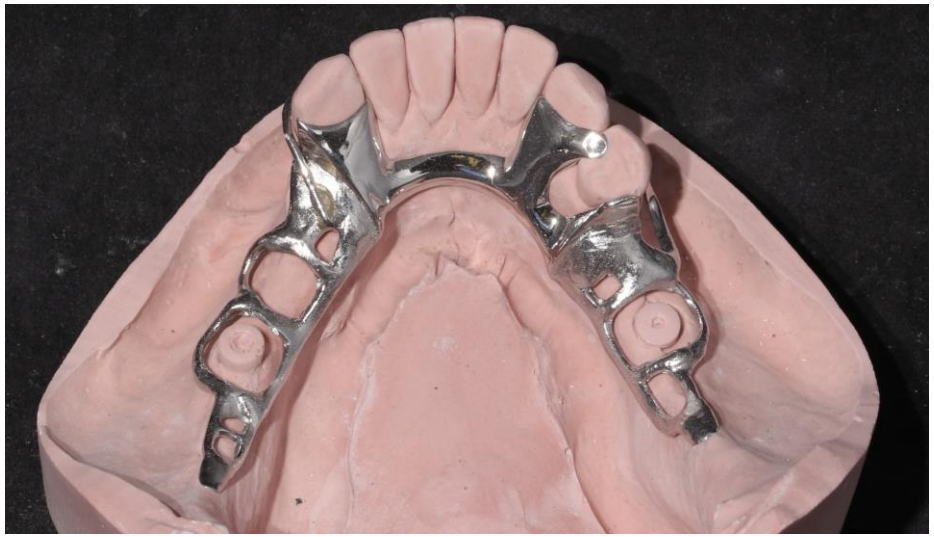


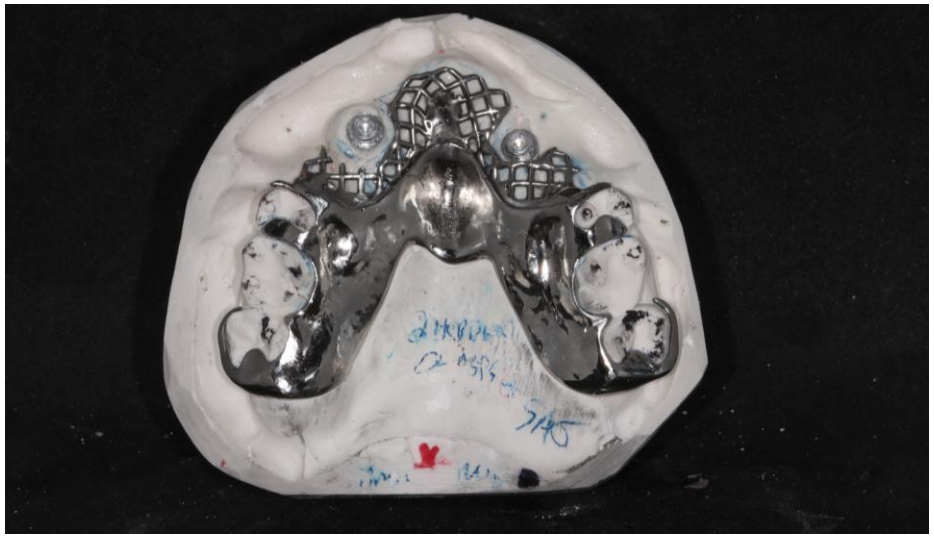


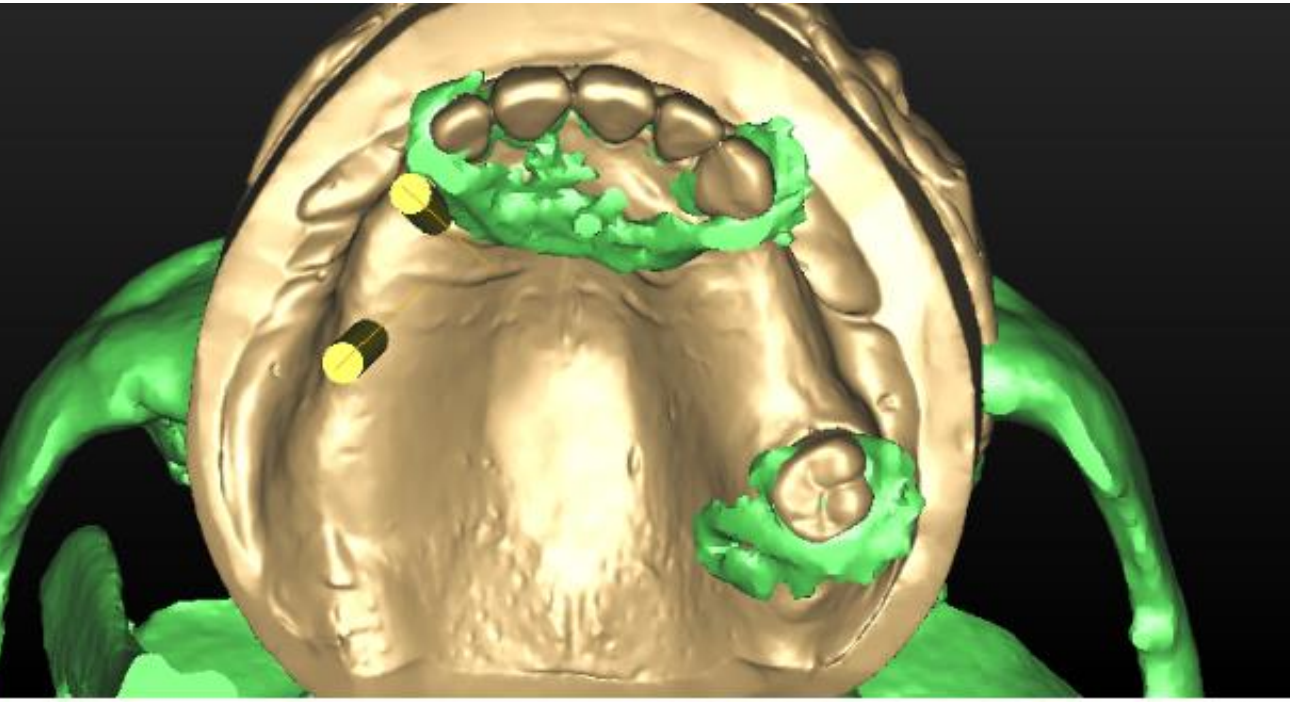


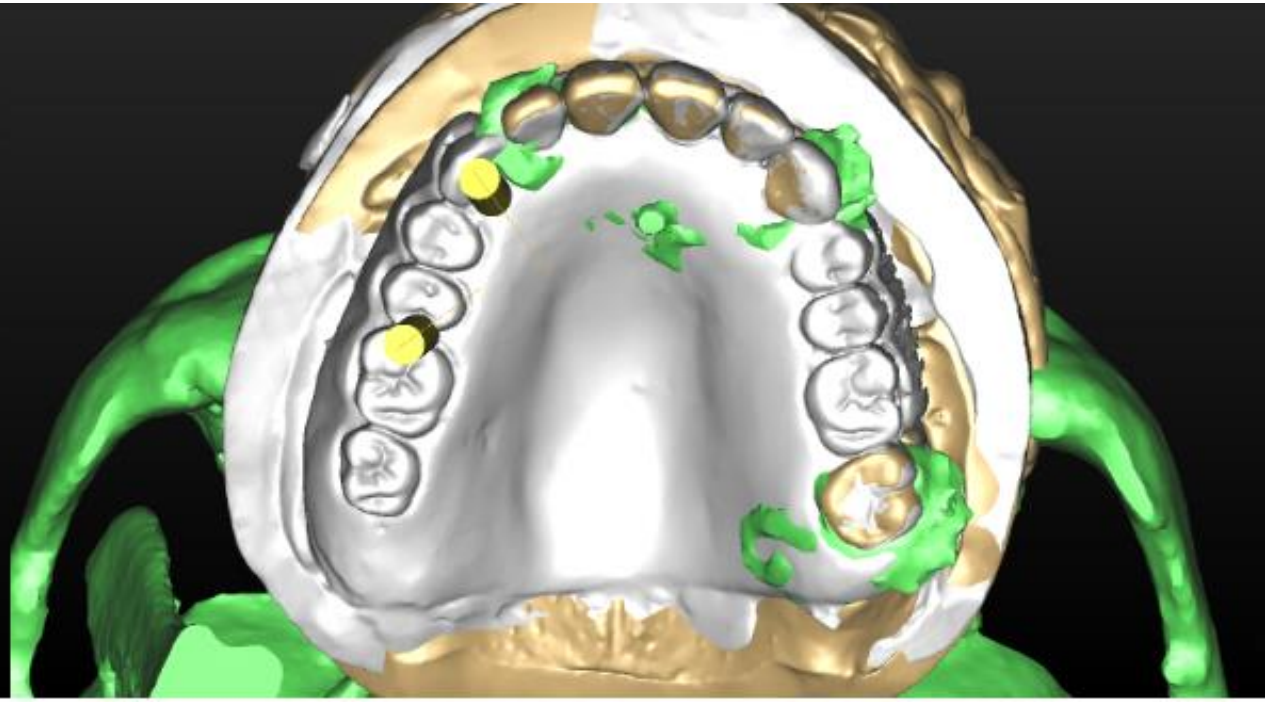
Implants in Partially Edentulous Cases

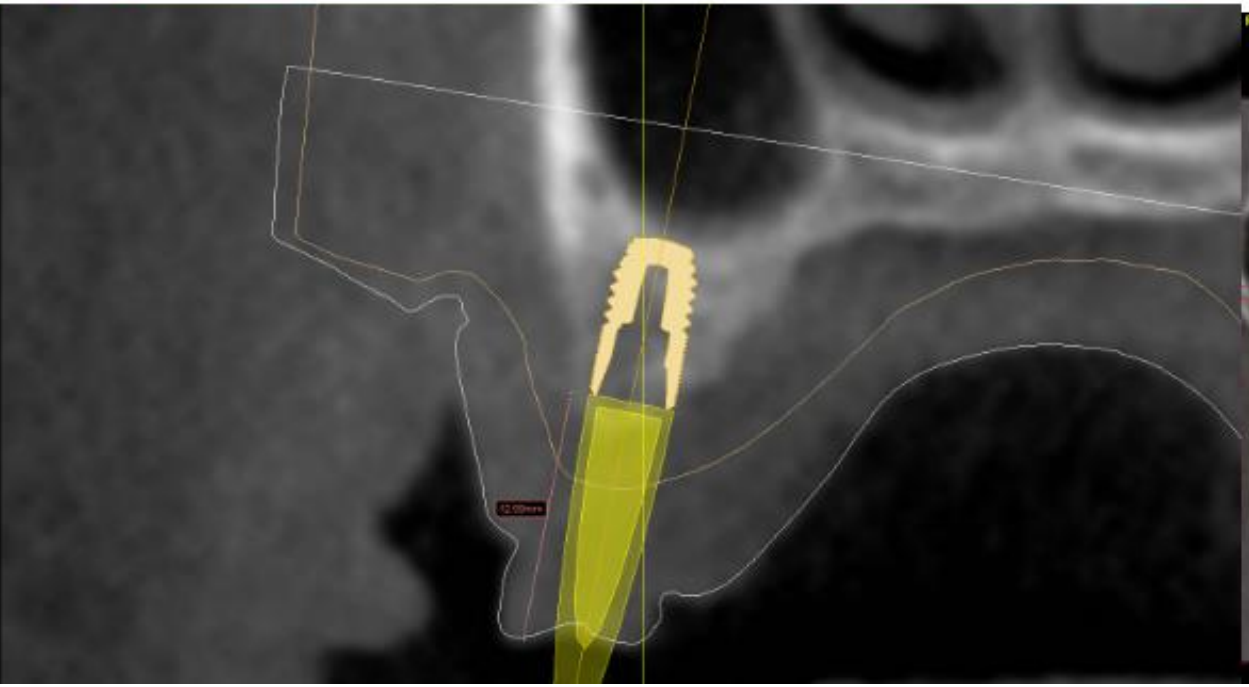
- Can strategically place implants to replace critical RPD abutment teeth (canine position)
- Can place implant in posterior edentulous regions and restore with locator abutments
  - Introduce clasp-less designs – can eliminate clasps adjacent to terminal abutment tooth
- Convert previous implant crowns into locator abutments – but path of locator abutment must parallel path of framework insertion

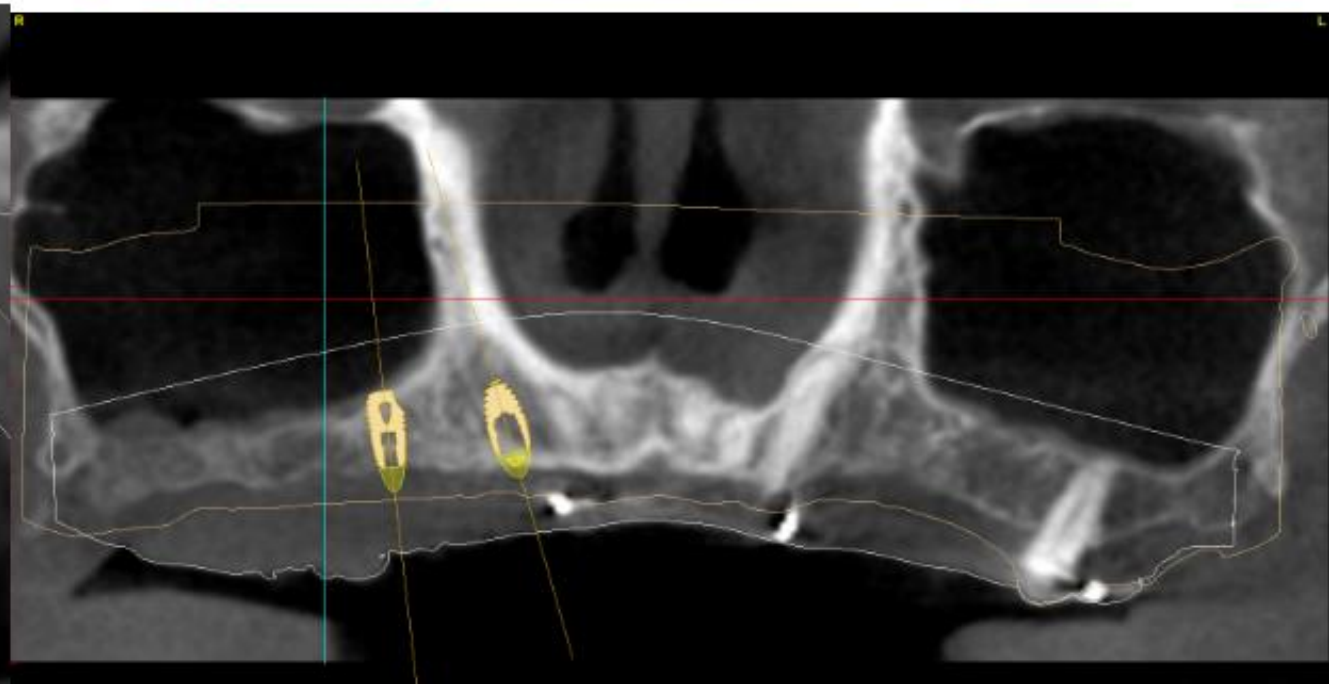


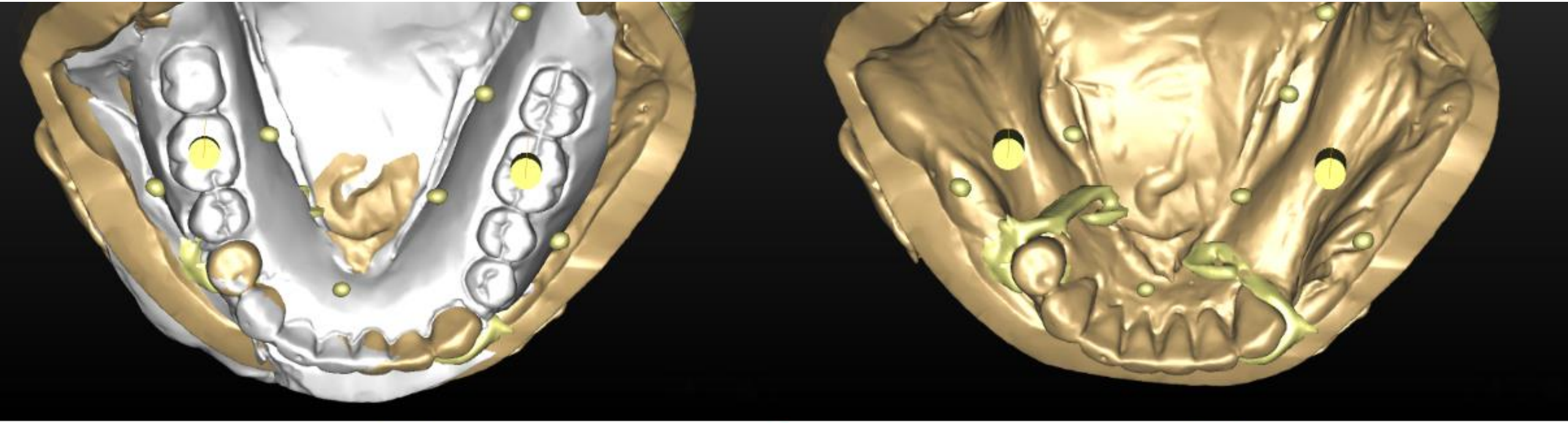


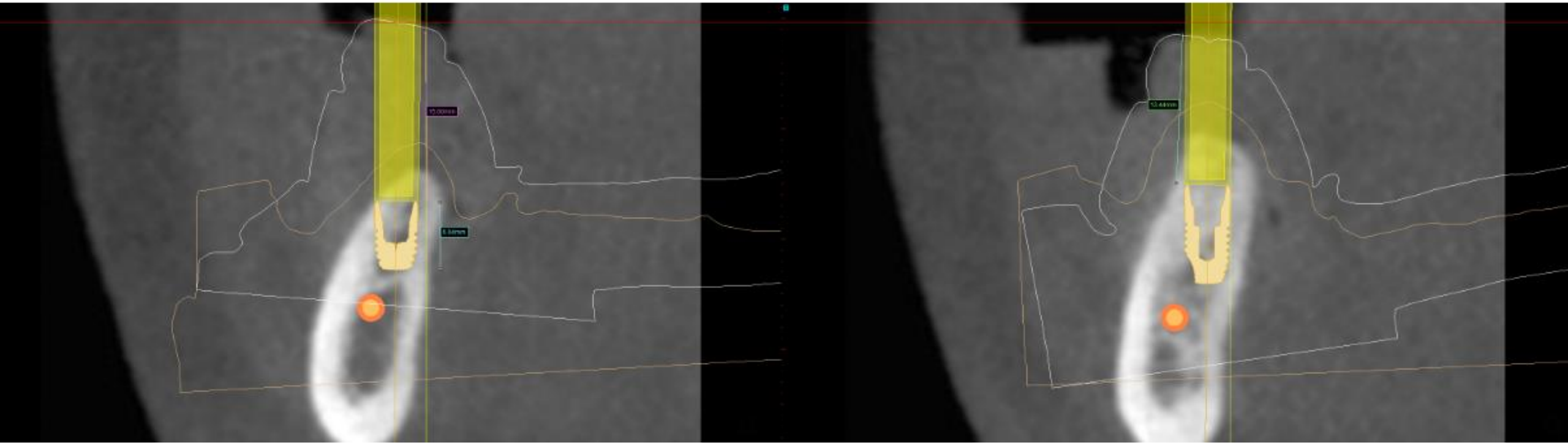












Ideal Implant Crown & Abutment Designs

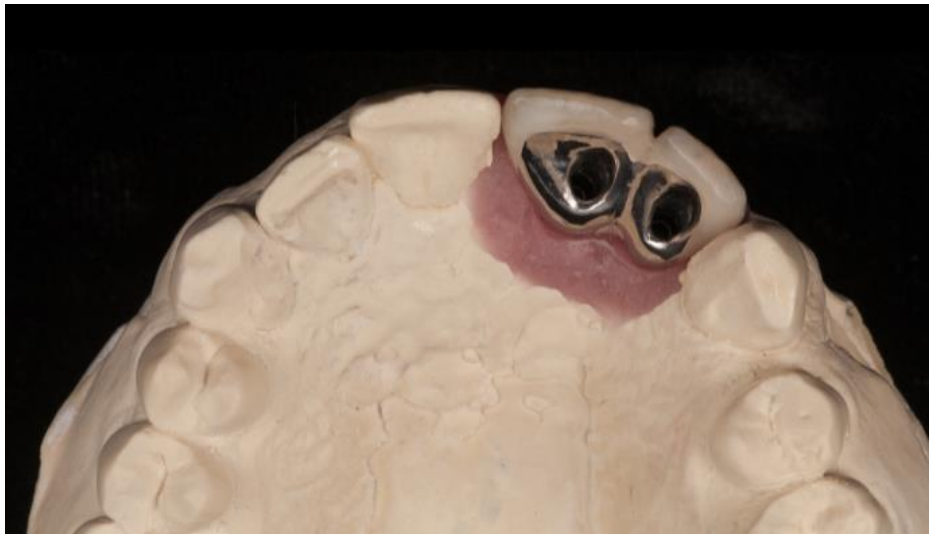
The idea implant crown should be designed as screw-retained for retrievability

Should avoid cement-retained crowns. Only to be reserved for poor screw access angulation in highly esthetic areas.

- Excess cement around the margin of crown is #1 cause of peri-implantitis and marginal bone loss
- Recommend use "temporary" cement, RMGI, or zinc phosphate for luting
    - Always obtain post-delivery radiograph to confirm complete removal of residual cement

Ideal Screw Access Hole Design

- For **posterior teeth**, the screw access hole should be placed through the center of the crown, through the central fossae
- For **anterior teeth**, the screw access hole should be placed at the cingulum (behind the incisal edge)



Abutment Designs

- **Screw-retained crown**
  - One piece abutment + crown
  - UCLA abutment: abutment platform that is cast to with a wax pattern
    - Gold or PFM
- **Cement-retained crown**
  - 2-piece abutment + crown
  - Only recommend in situations where screw access hole is located within highly esthetic regions
  - Delivering implant FPD in which the implants are not parallel
- **Screw-Cementable ("Screw-mentable")**
  - 2-piece abutment + crown
  - Combination of custom abutment and crown with screw access hole
  - After traditional "try-in" of implant crown, cement extraorally prior to delivery.
  - If there is an issue with insertion path, can cement intraorally and then removal whole unit to clean

Prefabricated (Stock) versus Custom Abutments

Prefabricated (Stock) Abutments:

Pros:

- Inexpensive
- No additional lab time for fabrication

Cons:

- Pre-determined margin
- Pre-determined emergence profile
- Poor resistance retention form

Custom Abutments

Pros:

- Ideal retention/resistance form
- Ideal crown margin placement (control cementation)
  - Can design lingual/palatal margin to be 1mm supragingival to visually confirm seating of implant crown intraoral
- Ideal emergence profile

Cons:

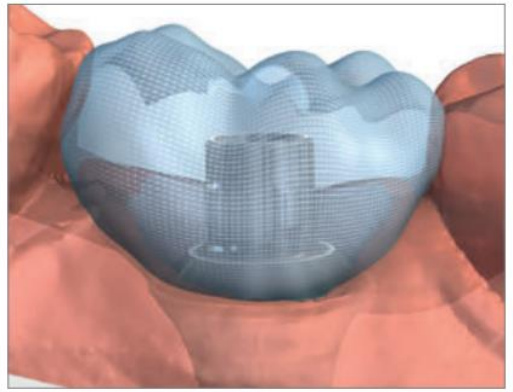
- More expense
- Separate lab fabrication

Stock Abutments Available on the Market:

Ti-Base

- Straumann released Variobase and other implant companies followed suit
- Lab mills zirconia crown directly to Ti-base and held with cement adhesive (Note: Cement is the weak leak)

- Limited abutment heights (3.5 & 5.5mm) - compromised retention
- Can be used for cement or screw/cement-retained situations
- Great for highly esthetic zone with thin biotype - avoid metal show-through
- Can convert into custom zirconia abutment with Ti-base



Custom Abutments Available on the Market:

Custom Titanium abutments

- Design as a cut-back of future implant crown for optimal retention/resistance form
- Can be anodized gold to improve esthetics

Custom Zirconia abutments

- Designed for esthetic zone where patients have thin biotype – metal collar show through
- Platform of abutment is zirconia
- Don't recommend
  - History of fracturing because zirconia is brittle in this application
  - Studies have soon mismatched zirconia-titanium connections cause accelerated wear on internal titanium platform (Mizumoto R, Malamis D, et al. JPD 2020)

Custom Zirconia-milled abutments on Ti-base

- Highly recommend for esthetic and translucent restorations like E.max
- Lab mills custom abutment and lutes to stock Ti-base
- Zirconia has low bacterial adhesion – healthier peri-implant tissues

Angulated Screw Channels

Several implant companies have released stock or custom abutments with angulated screw channels that can reposition screw access channel >20° to a more favorable position

Pros:

- Non-esthetic or poorly-angulated screw access channels that could only be restored as cement-retained crowns can be converted to screw-retained
- Can reposition channel for limited mouth opening situations

Cons:

- Purchase special driver
- Torque with caution
- Screw access hole is larger because of the driver angulation

Recommend placement of special colored teflon tape

Angulated Screw Channel Options

Implant Company	Abutment Company	Angulation Correction	Driver	Recommend Torque	Abutment Options
Nobel Biocare	NobelProcera	Up to 25°	Omnigrip	35 Ncm	Ti base or Custom titanium
Astra **Limited to Astra EV	Atlantis	Up to 30°	Atlantis angulated driver	15 Ncm "Hand-tightened"	Custom titanium **offer gold hue
Straumann	Straumann CARES	Up to 25°	Straumaan AS driver	35 Ncm	Ti base (Variobase) or Chrome-cobalt custom abutment
Zimmer BioMet 3i	BellaTek	Up to 20°	Zimmer Angled Screwdriver	Certain – 20 Ncm TSV – 30 Ncm	Ti base (BellaTek Flex & Express) - comes in 12mm height

3rd Party Systems:

PREAT Dynamic Abutment (UCLA style for screw-retained)
Dess (Ti Base)
Atlantis (Custom titanium abutment)
Compatible with **most major implant systems

Implant Crown Occlusion

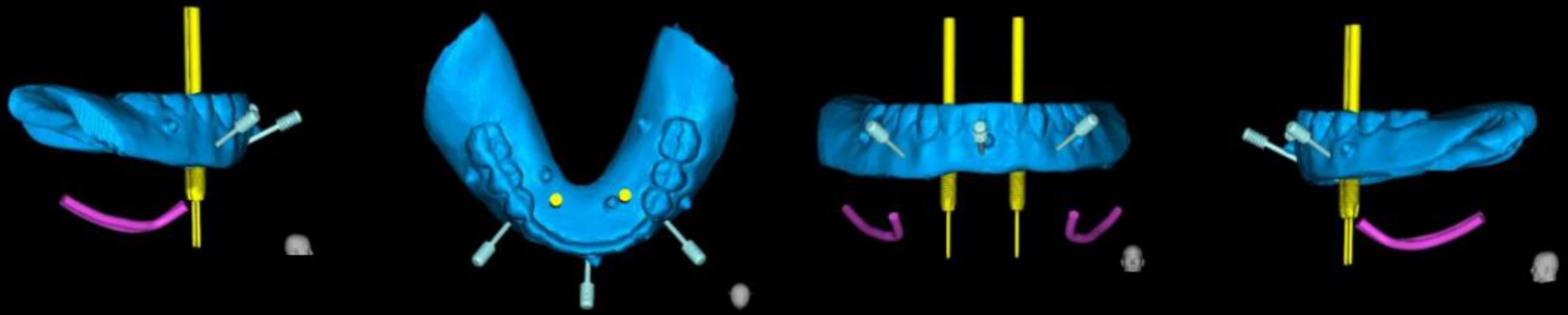
Abutment screw loosening is the #1 prosthetic complication for implant crowns due to poorly adjusted occlusal schemes upon delivery

- Lightened single centric contact (drags shimshock)
- NO eccentric contacts
  - For posterior teeth, absolutely no contact in working, non-working or protrusive movements
  - For anterior teeth –may have slight contact in protrusive. Should "share" the load with other incisors

Space Requirements for Full Arch Cases

Required Prosthetic Space (measured from incisal edge to implant platform):

PFM Crown-Bridge	7-9 mm
Non-splinted Locator overdenture	9-12mm
Overdenture with Conus attachments	10.5-12mm
Zirconia hybrid	12mm-15mm
Metal-Acrylic Hybrid (titanium bar)	15mm-17mm
Splinted Locator overdenture with bar design	15mm-18mm

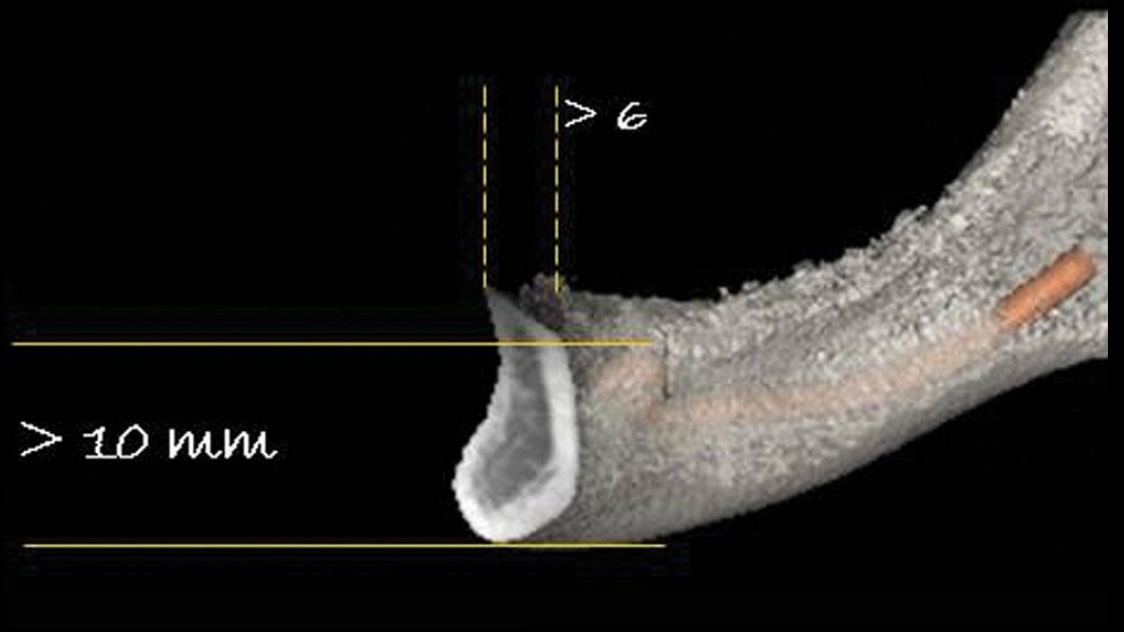


Guidelines for Treatment Planning Implant Overdentures

- Recommend placement of two implants at #22 and #27 canine sites placed parallel to each other
  - Intra-foraminal sites are preferred
    - Locator abutment ideally located within lateral/canine lingual embrasure
  - Located 3mm mesial to mental foramen
    - Mental nerve anterior loop – varying anatomy

Guidelines for Treatment Planning Implant Overdentures

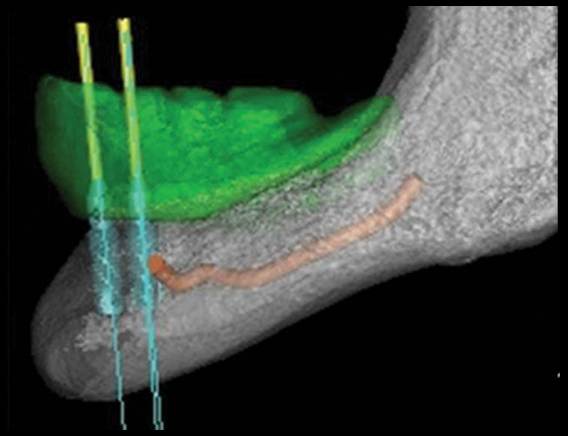
- Mandibular alveolar bone height must be at minimum 10mm in the superior-inferior dimension and at least 6mm buccal-lingual dimension

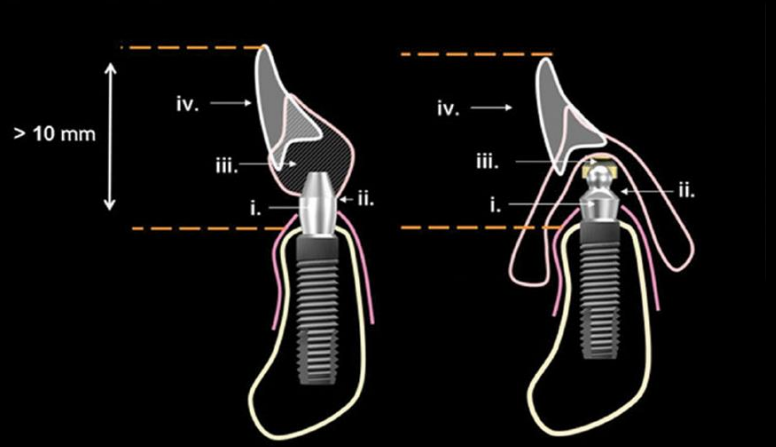


Guidelines for Treatment Planning Implant Overdentures

Restorative space must be at minimum 10mm (measured from incisal edge of denture tooth to implant platform)

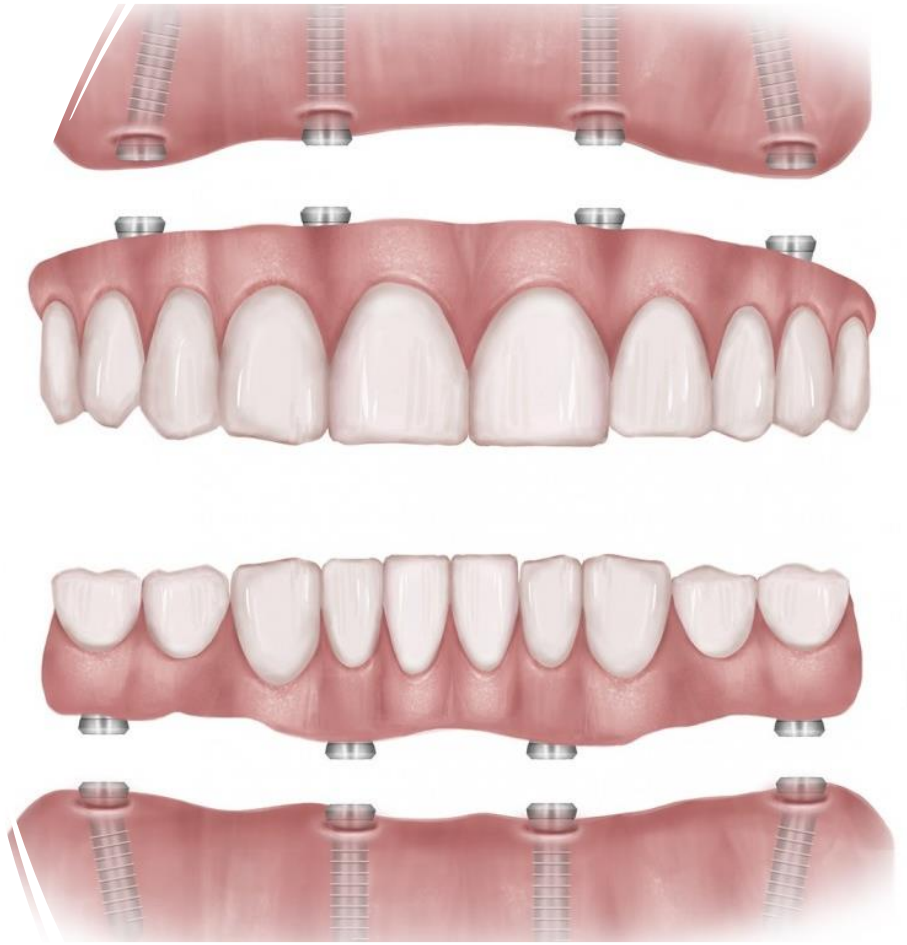
- Adequate space for locator abutment, metal housing, nylon, denture teeth & acrylic)





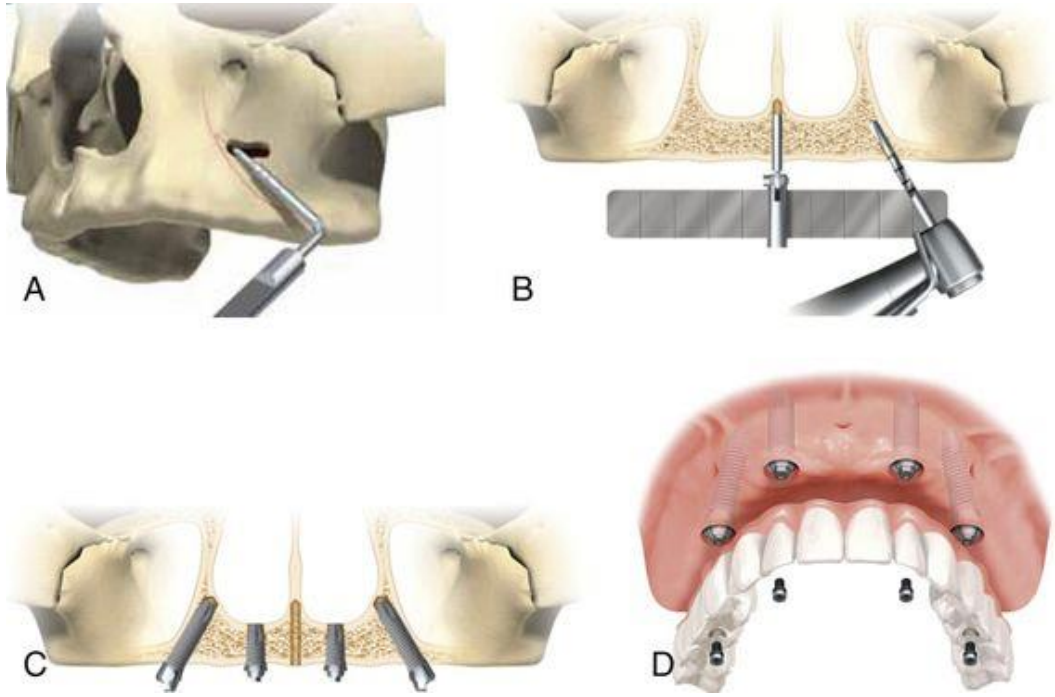
All on 4:

- Full arch fixed rehabilitation with 4 implants per arch.
- Strategic placement of two anterior vertical implants, and two posterior angled implants.
- Malo and colleagues introduced the all-on-four concept in 2003.



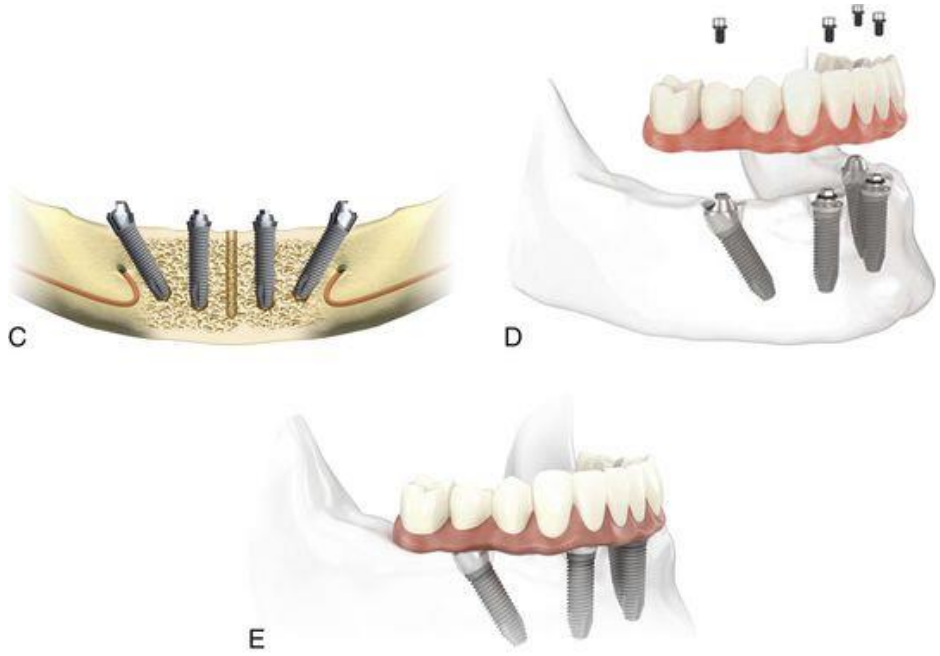
Maxilla:

- Distal maxillary implants are angled parallel to the anterior wall of the maxillary sinus, thus providing the 30° angulation.



Mandible:

In the mandible, the two posterior implants are placed just anterior to the mental foramina and angled distally about 30° relative to the occlusal plane.



Angle correcting multi-unit abutments:

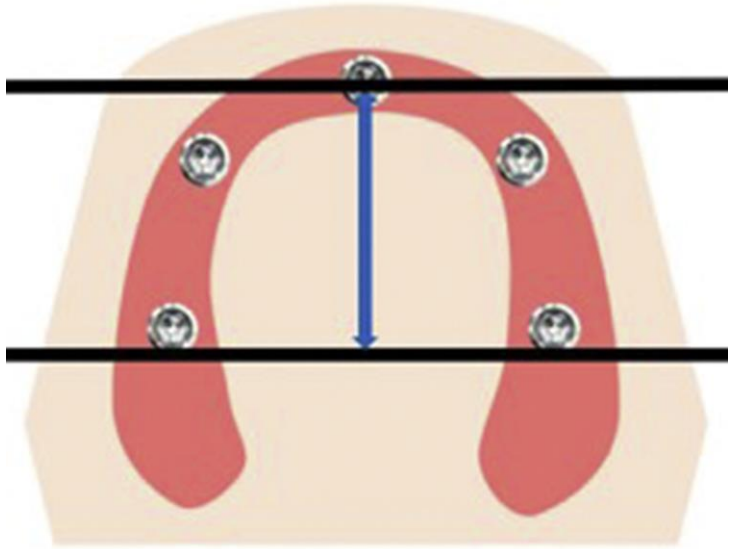
Straight

17º

30º

Antero-posterior spread:

The AP spread is defined as ***the mesiodistal distance between the middle of most anterior implant to the distal of most posterior implant.***

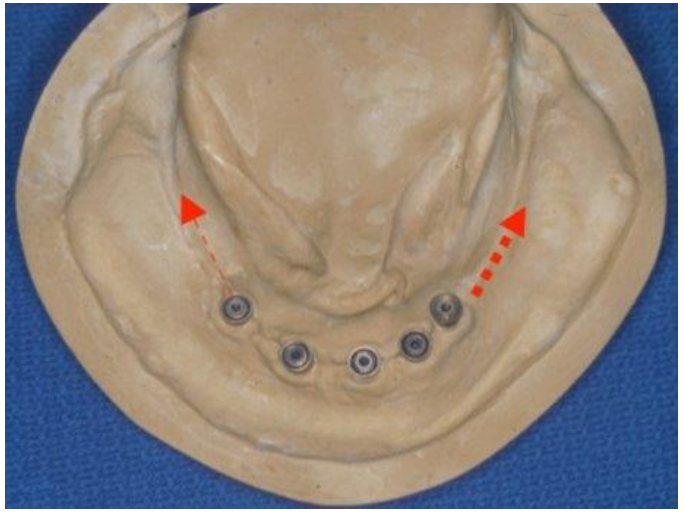


Maximize A-P spread, avoid large cantilevers

English CE. Critical A-P spread. Implant Soc. 1990 Mar-Apr;1(1):2-3. PMID: 2073515.

- For the mandible, distal cantilever should not exceed 1.5x A-P-spread
- For the maxilla, distal cantilever should be reduced to 6-8mm due low bone density.

Prosthetic Complication: Fractured distal cantilever due to minimal A-P spread and unable to accommodate its length

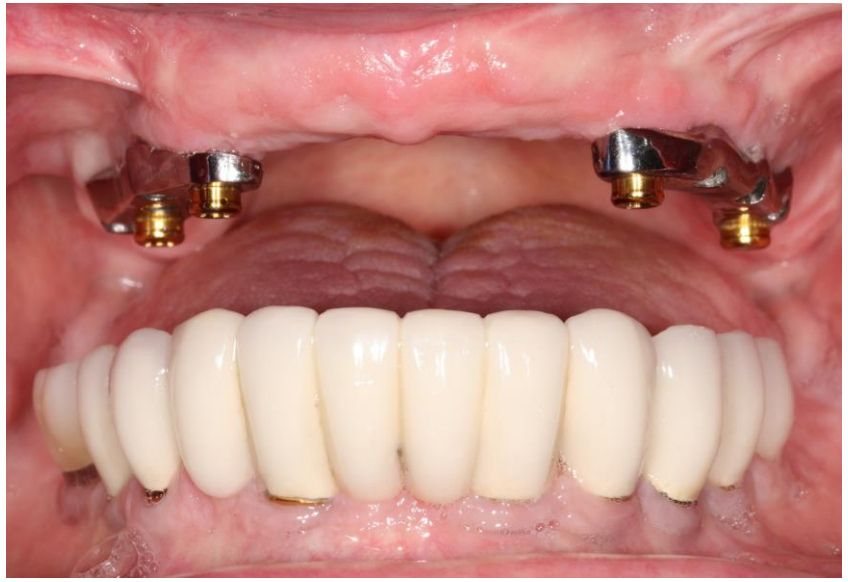


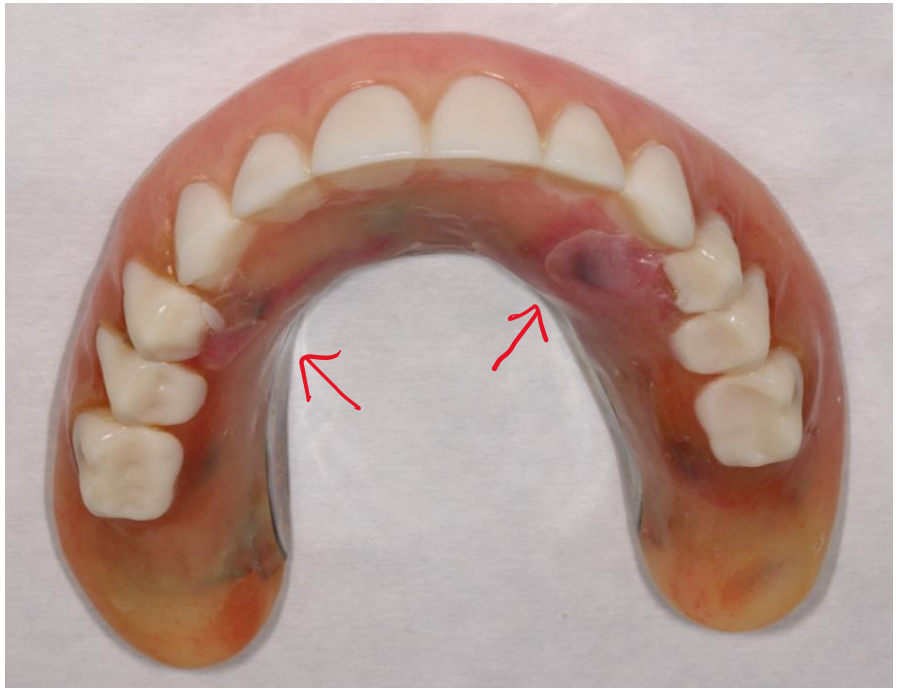
English CE. Critical A-P spread. Implant Soc. 1990 Mar-Apr;1(1):2-3. PMID: 2073515.

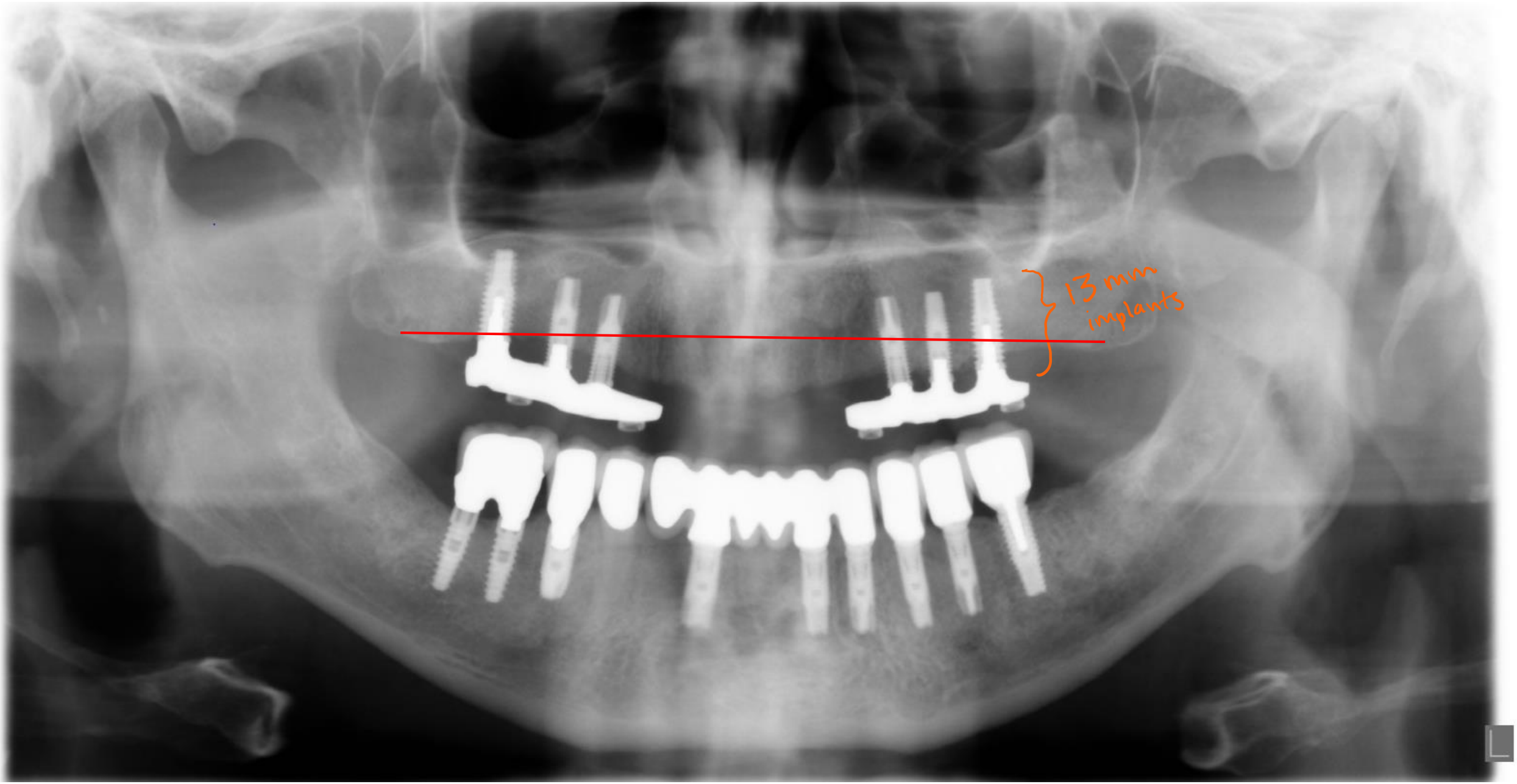
Courtesy: Dr. Hall

Prosthetic Complications with Poorly Designed Full Arch Implant Cases

- **Limited prosthetic space** – improper ridge reduction and implant platforms were placed at inappropriate depths
  - Prosthetic fracture due to minimal space available for metal housings, acrylic, denture teeth, frameworks, porcelain, etc.






13 mm
implants

Prosthetic Complications with Poorly Designed Full Arch Implant Cases

Inaccurate final impressions → poor fit of milled titanium bars

- Zirconia hybrid prosthesis are fracturing from improper fit
- Fracture/loosening of prosthetic screws

THE JOURNAL OF PROSTHETIC DENTISTRY

RESEARCH AND EDUCATION

Accuracy of 3 different impression techniques for internal connection angulated implants

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ABSTRACT

Statement of problem. Making implant impressions with different angulations requires a more precise and time-consuming impression technique.

Purpose. The purpose of this in vitro study was to compare the accuracy of nonsplinted, splinted, and snap-fit impression techniques of internal connection implants with different angulations.

Material and methods. An experimental device was used to allow a clinical simulation of impression making by means of open and closed tray techniques. Three different impression techniques (nonsplinted, acrylic-resin splinted, and indirect snap-fit) for 6 internal-connected implants at different angulations (0, 15, 25 degrees) were examined using polyether. Impression accuracy was evaluated by measuring the differences in 3-dimensional (3D) position deviations between the implant body/impression coping before the impression procedure and the coping/laboratory analog positioned within the impression, using a coordinate measuring machine. Data were analyzed by 2-way ANOVA. Means were compared with the least significant difference criterion at $P<.05$.

Results. Results showed that at 25 degrees of implant angulation, the highest accuracy was obtained with the splinted technique (mean ±SE: 0.39 ±0.05 mm) and the lowest with the snap-fit technique (0.85 ±0.09 mm); at 15 degrees of angulation, there were no significant differences among splinted (0.22 ±0.04 mm) and nonsplinted technique (0.15 ±0.02 mm) and the lowest accuracy obtained with the snap-fit technique (0.95 ±0.15 mm); and no significant differences were found between nonsplinted and splinted technique at 0 degrees of implant placement.

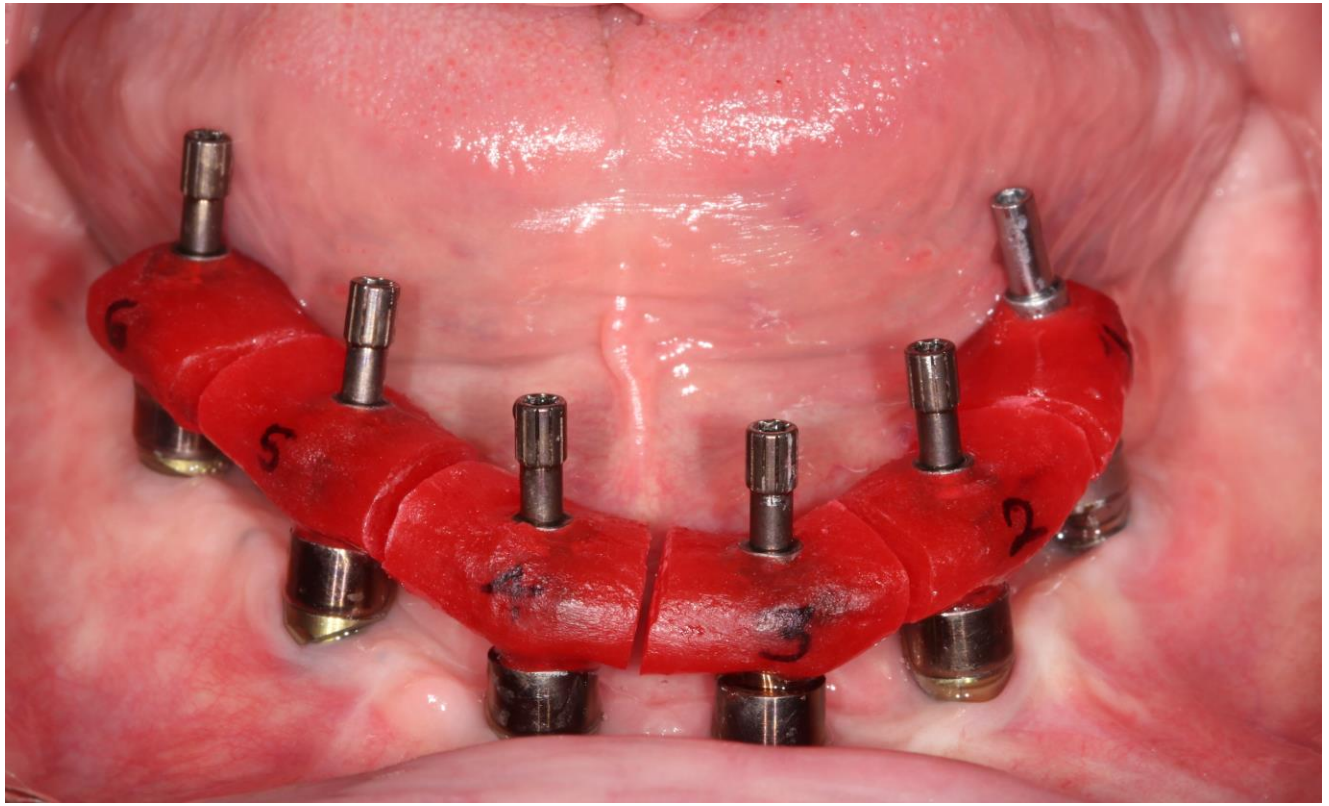
Conclusions. Splinted impression technique exhibited a higher accuracy than the other techniques studied when increased implant angulations at 25 degrees were involved. (J Prosthet Dent 2015;114:517-523)

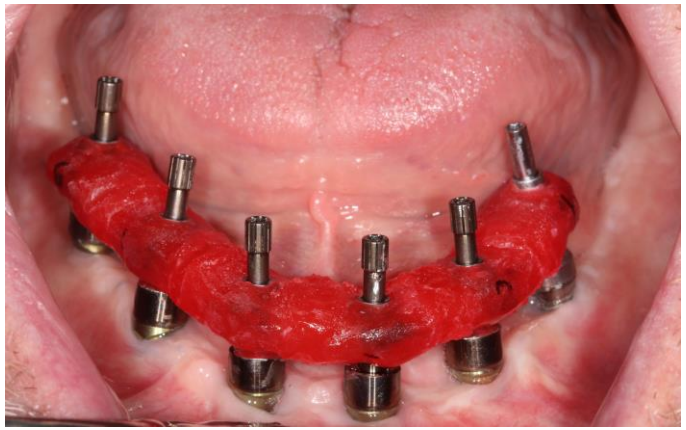
Impression making is an important procedure during implant prosthodontic treatment, as it directly affects the accuracy of the definitive cast and the passive fit of the implant-supported superstructure.[1,2] Several studies have investigated the clinical factors affecting the accuracy of implant impressions, such as direct (open tray) or indirect (closed tray) impression techniques,[3] different impression materials,[4] necessity and method of splinting the impression copings,[5,6] implant angulation, and prosthetic connection features.[7-10] Different implant angulations may create an undesirable path of placement and subsequently an inaccurate impression, especially when multiple implants are used.[7,9]

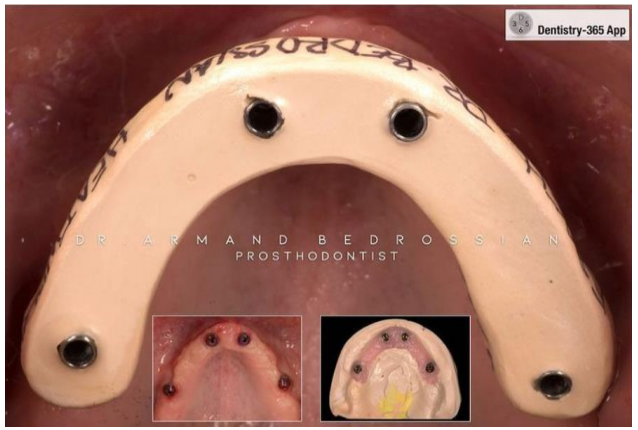
Step #1: Preliminary impression

Step #2: Lab fabrication of sectioned verification jig with GC pattern resin and open tray copings

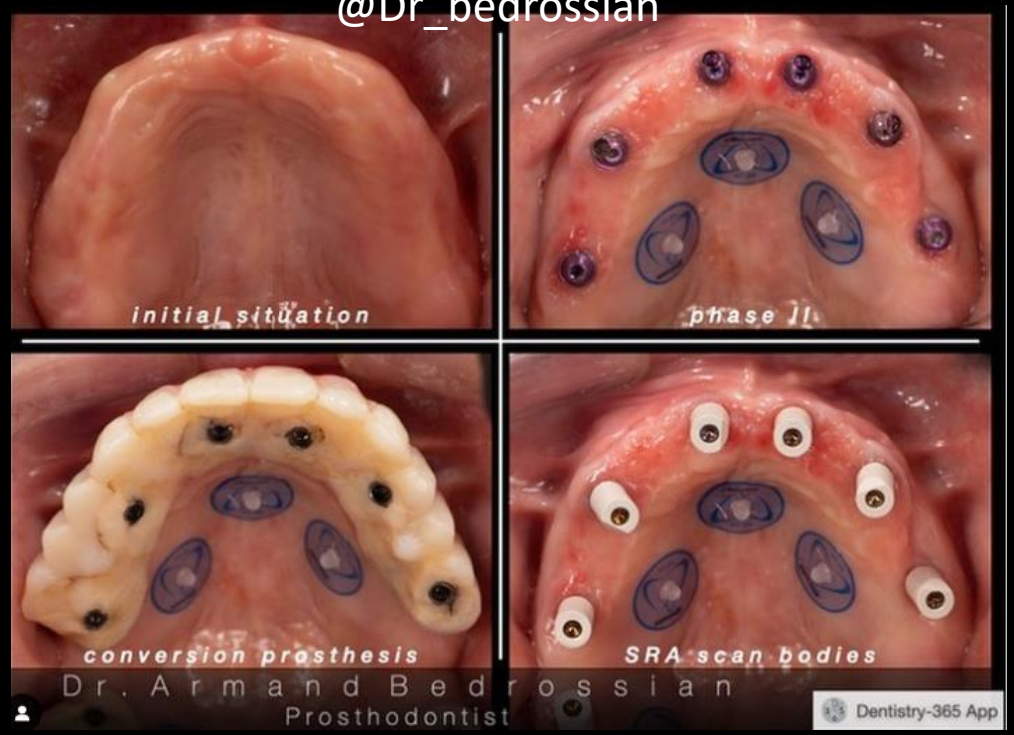
Step #3: Split copings intraorally (confirm seating with x-rays) and final impression







@Dr_bedrossian



@DRSINADA

Implant Prosthesis Opposing Natural Dentition

- Denture resin teeth have accelerated wear
- Common for anterior denture teeth to delaminate
- Any prosthesis with resin denture teeth needs to respect and follow complete denture occlusal schemes!!!
  - Bilateral Balanced occlusion
  - No anterior centric or excursive contacts.
  - Incisal edges of #8/9 may barely contact #24/25 in protrusive

Recommended Fixed Hybrid Occlusal Schemes

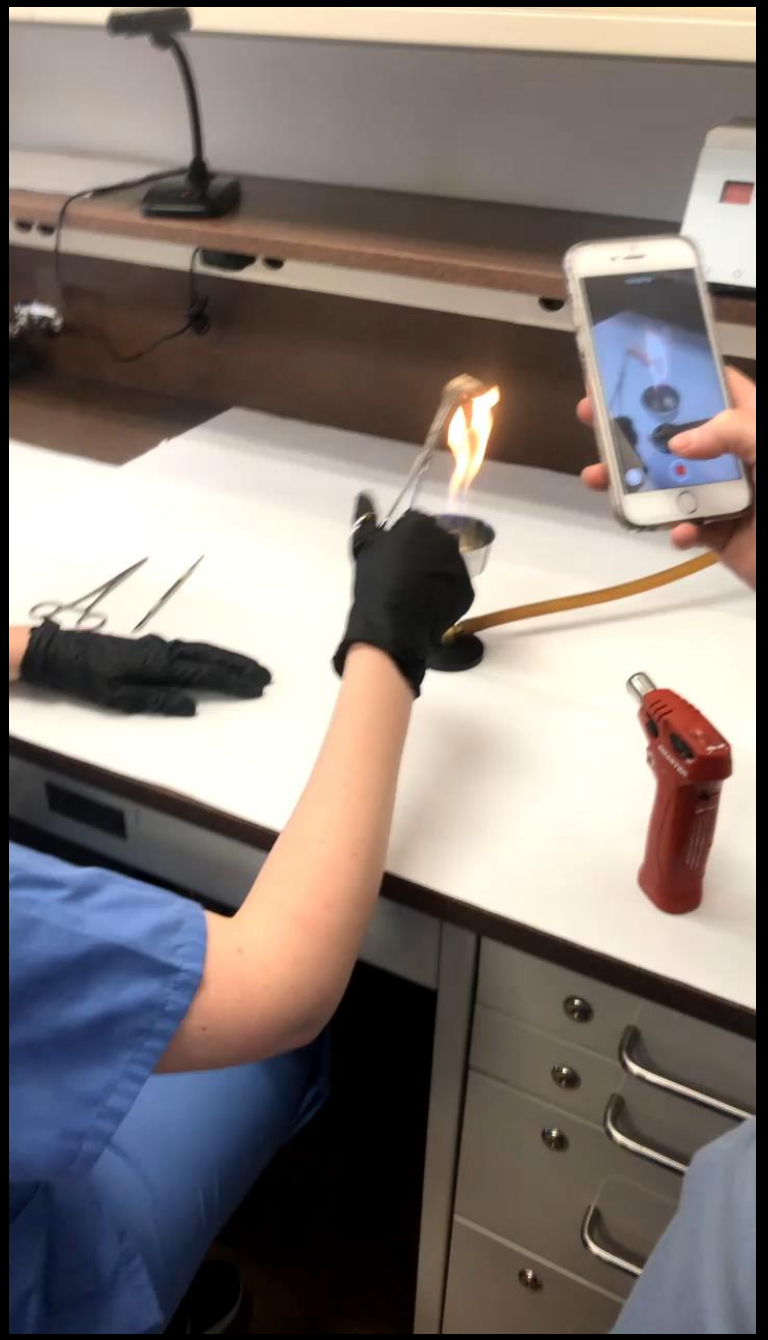
- **Should restore alike materials to minimize wear of opposing materials**
  - For example, resin denture teeth should oppose each other
- **Zirconia full arch prosthesis should not oppose denture teeth.**
  But rather, oppose natural dentition or opposing zirconia occlusal surfaces

Titanium Bar Designs

Maxillary arch: recommend wrapping bar with acrylic for intimate tissue contact with pink acrylic to prevent air escape

Mandibular arch: recommend **highly polished** metal bar on tissue and lingual surfaces to minimize plaque accumulation (rationale for zirconia). The prosthesis shouldn't contact tissue intimately to allow hygiene ("high water design")

Tissue surface of prosthesis should be **convex** for cleansability



Thank you!

Questions @ ashleyhauger@creighton.edu