

2019 UCLA Hawaii Symposium

Implant- enhanced Removable Partial Denture Therapy

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Treatment Options for Replacement of Missing Tooth/or Teeth

- No treatment
- Implant supported restoration
- Fixed partial denture (bridge)
- Removable partial denture (RPD)



*A fixed replacement is usually the preferred treatment of choice.

All treatments produced significant improvement in OHRQoL. The least amount of improvement was observed in patients with RDPs. OHRQoL changes in patients treated with FDPs and ISFPs were comparable.

Swelem et al. Int J Prosthodont. 2014 Jul-Aug;27(4):338-47

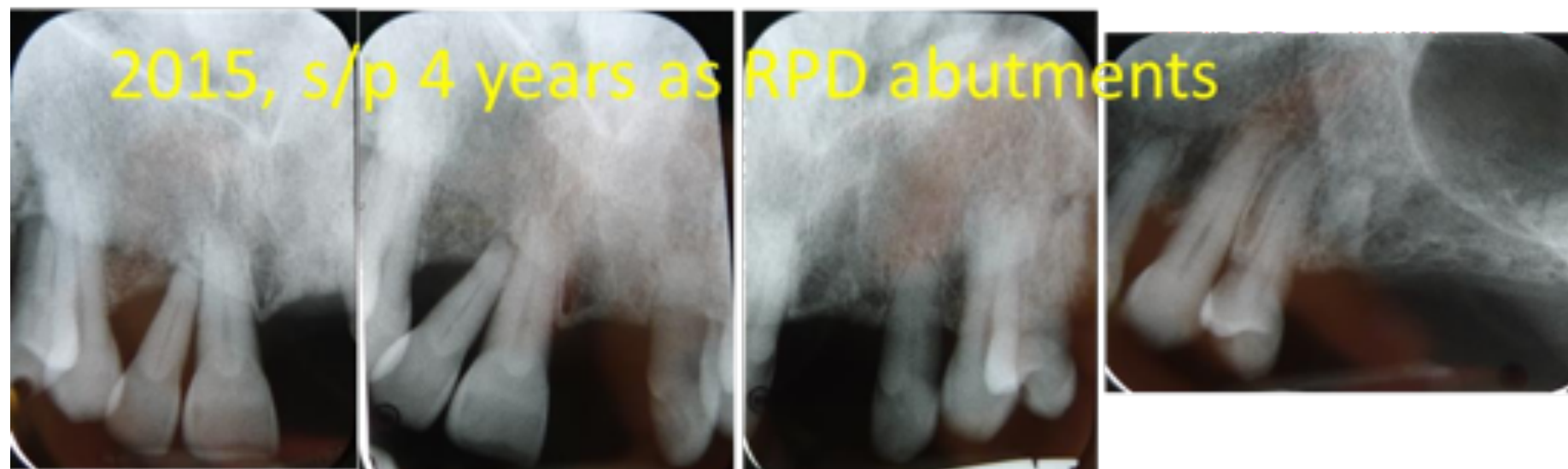
RPD INDICATIONS



1. Long edentulous spans
2. Absence of adequate periodontal support
3. Structurally and anatomically compromised abutments
4. Need for cross-arch stabilization
5. Distal extension
6. Need to restore soft and hard tissue contours
7. Anterior esthetics
8. Age and health
9. Attitude and desires of pt.
10. Ease of plaque removal

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The demand for RPD Therapy is increasing!

- Aging population
- Economic considerations
- Osseointegrated Implants
- ◆ Improved versions of RPD's that use implants for partial support



United States

65 y/o or older: 13% in 2007 26% by 2030

Europe 16% 27% by 2050

Japan 23% 38% by 2050

The proportion of this group who are edentulous has also been steadily falling

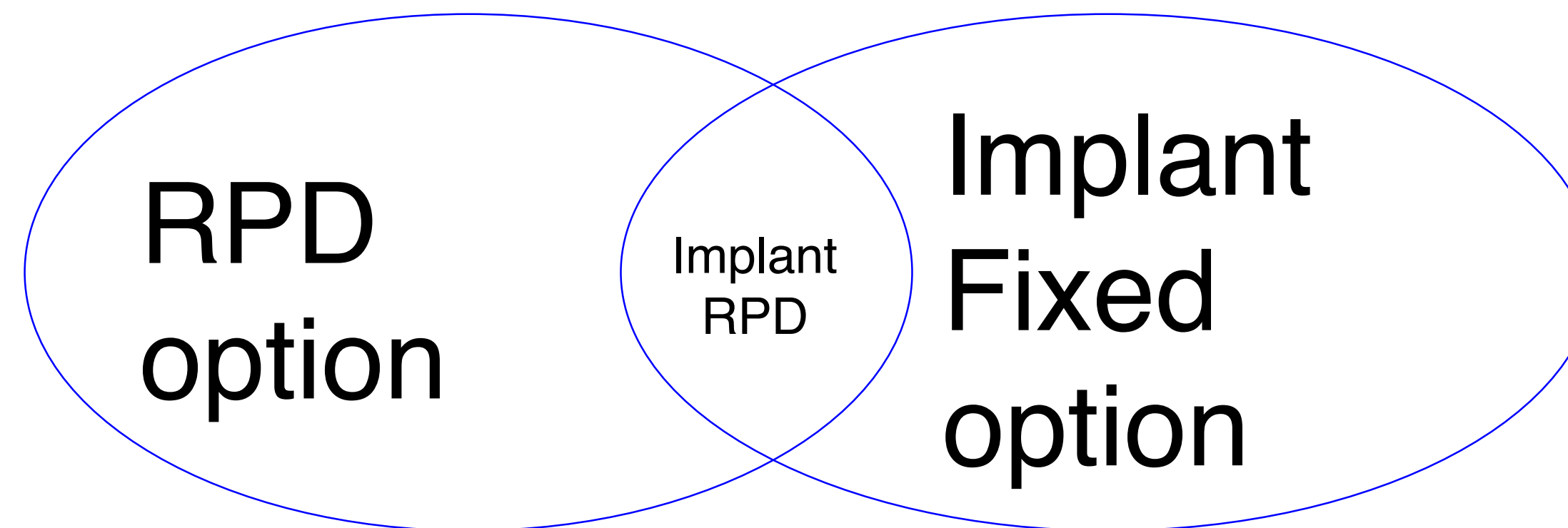
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The demand for RPD Therapy is increasing!

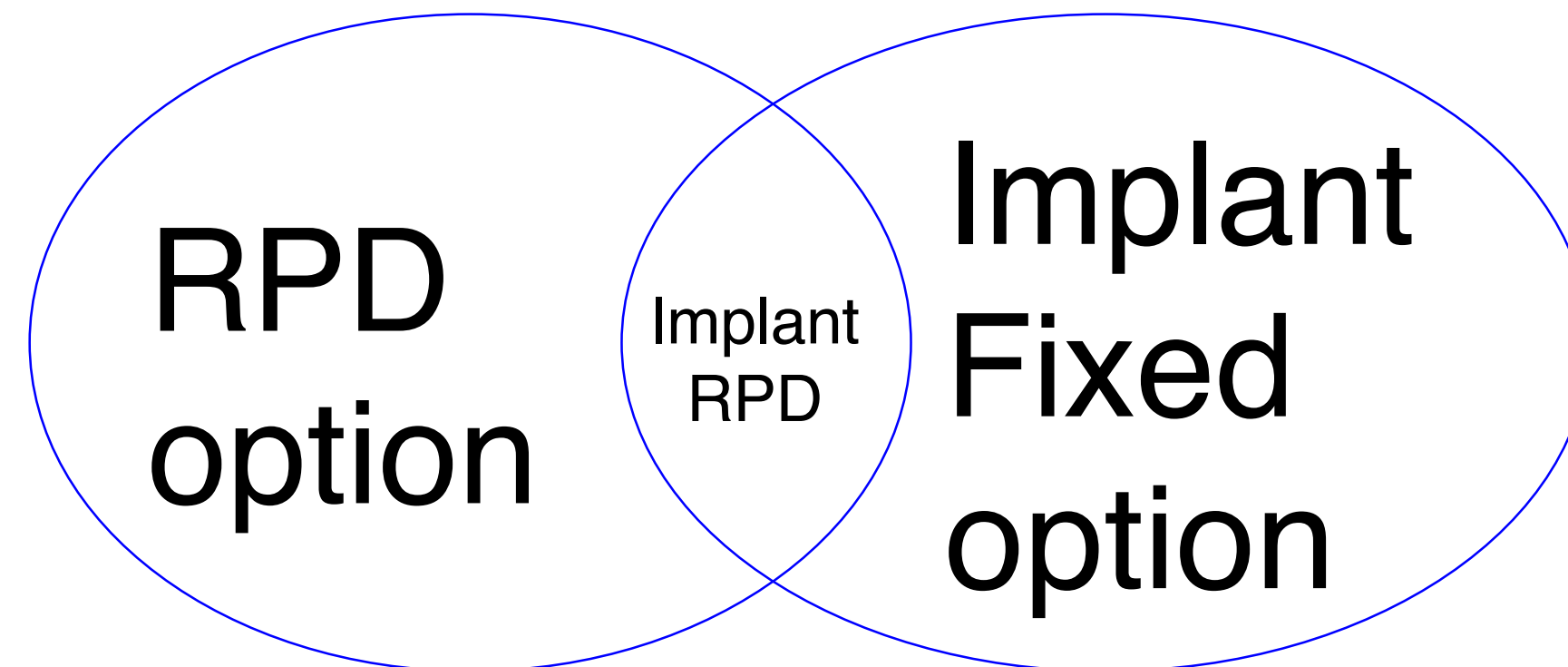
- Aging population
 - Economic considerations
 - Osseointegrated Implants
- ◆ Improved versions of RPD's that use implants for partial support



Pt group that can benefit from the Implant RPD treatment option is largely untapped and has lots of potential to grow.

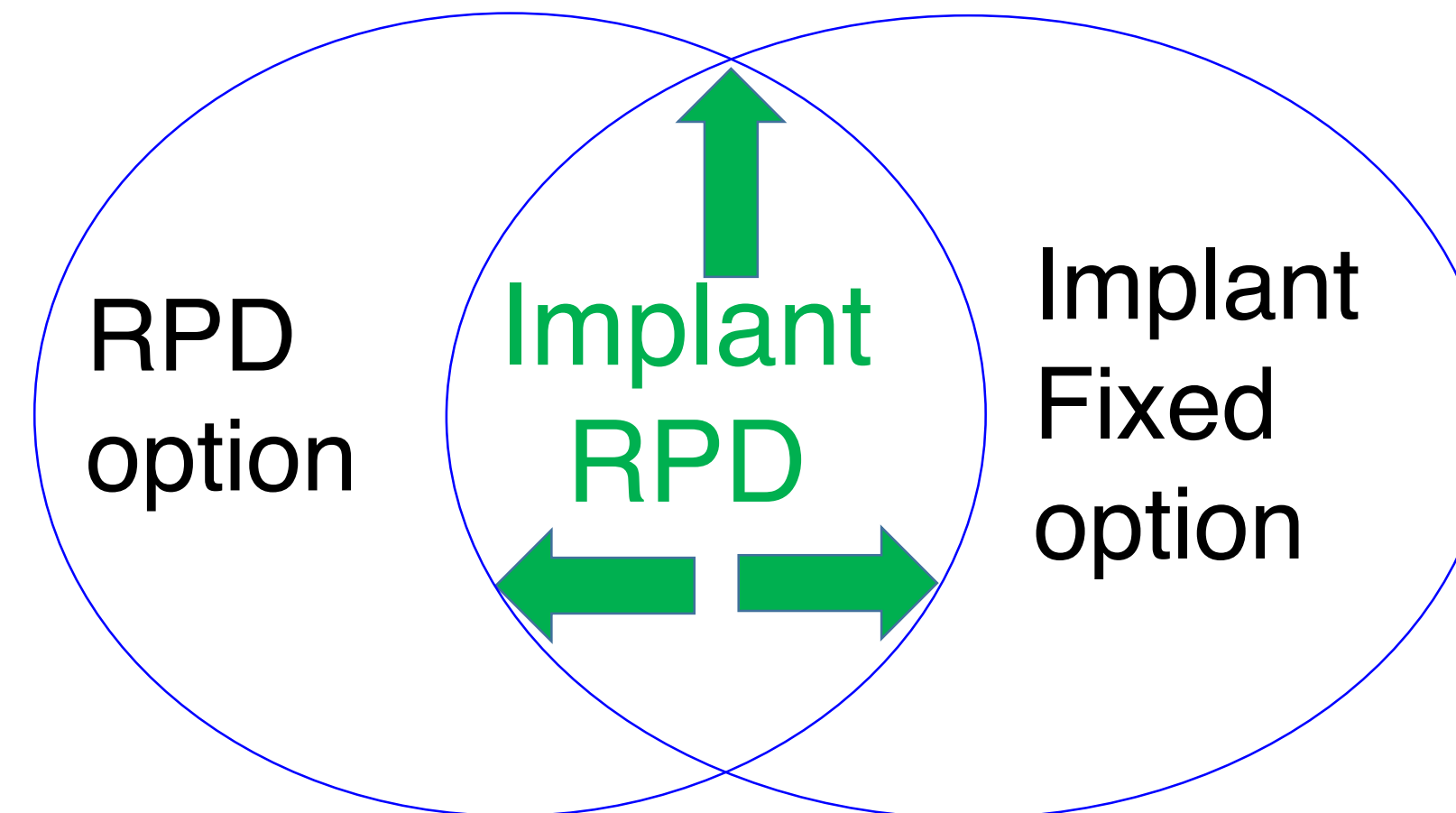
The bottom line:

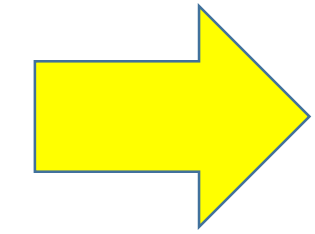
RPD treatment is necessary because patients' needs will remain and continue to grow.
And implants are not likely to replace the need for RPD because of high cost and other factors.



The bottom line:

RPD treatment is necessary because patients' needs will remain and continue to grow.
And implants are not likely to replace the need for RPD because of high cost and other factors.





- The keys of a successful RPD design (with or without dental implants)
- Patient selection for implant-enhanced RPD therapy
- The goal of the implant-enhanced RPD treatment option:
esthetics versus comfort
- Treatment planning considerations: number and location of the implants,
selection of the attachment

Three Key Elements for Long-term Success in RPD Therapy

A RPD should be a well supported, stable, and retentive.

Support- Resistance to occlusal or vertical seating forces

Stability- Resistance to horizontal or torsional forces

Retention- Resistance to vertical dislodging forces

How to design a well supported, stable, and retentive RPD?

Design sequence

Five Parts of Well-Designed RPDs

- Rests
- Minor Connectors/Proximal Plates
- Major Connectors
- Denture Base Connectors
- Retainers



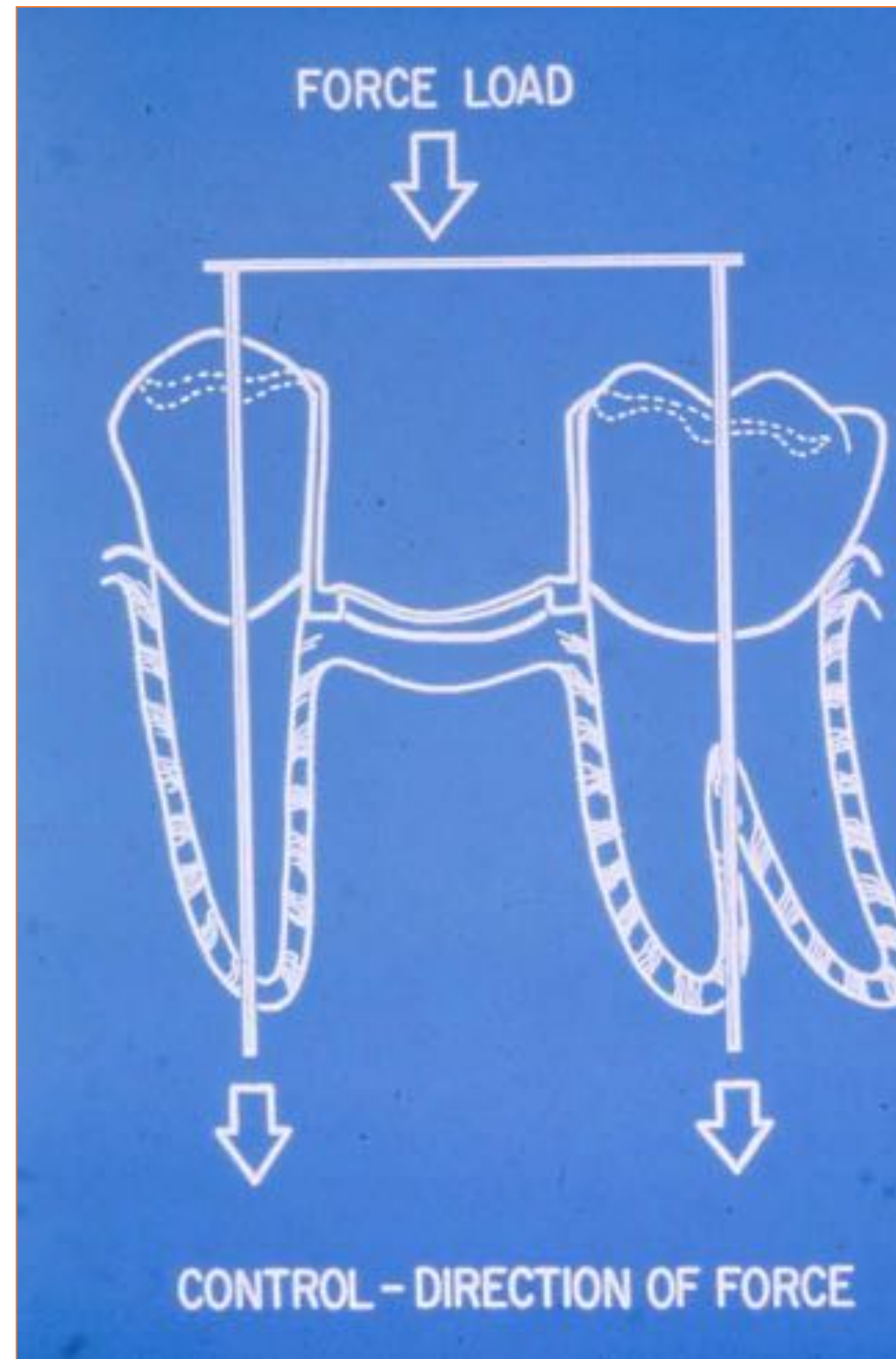
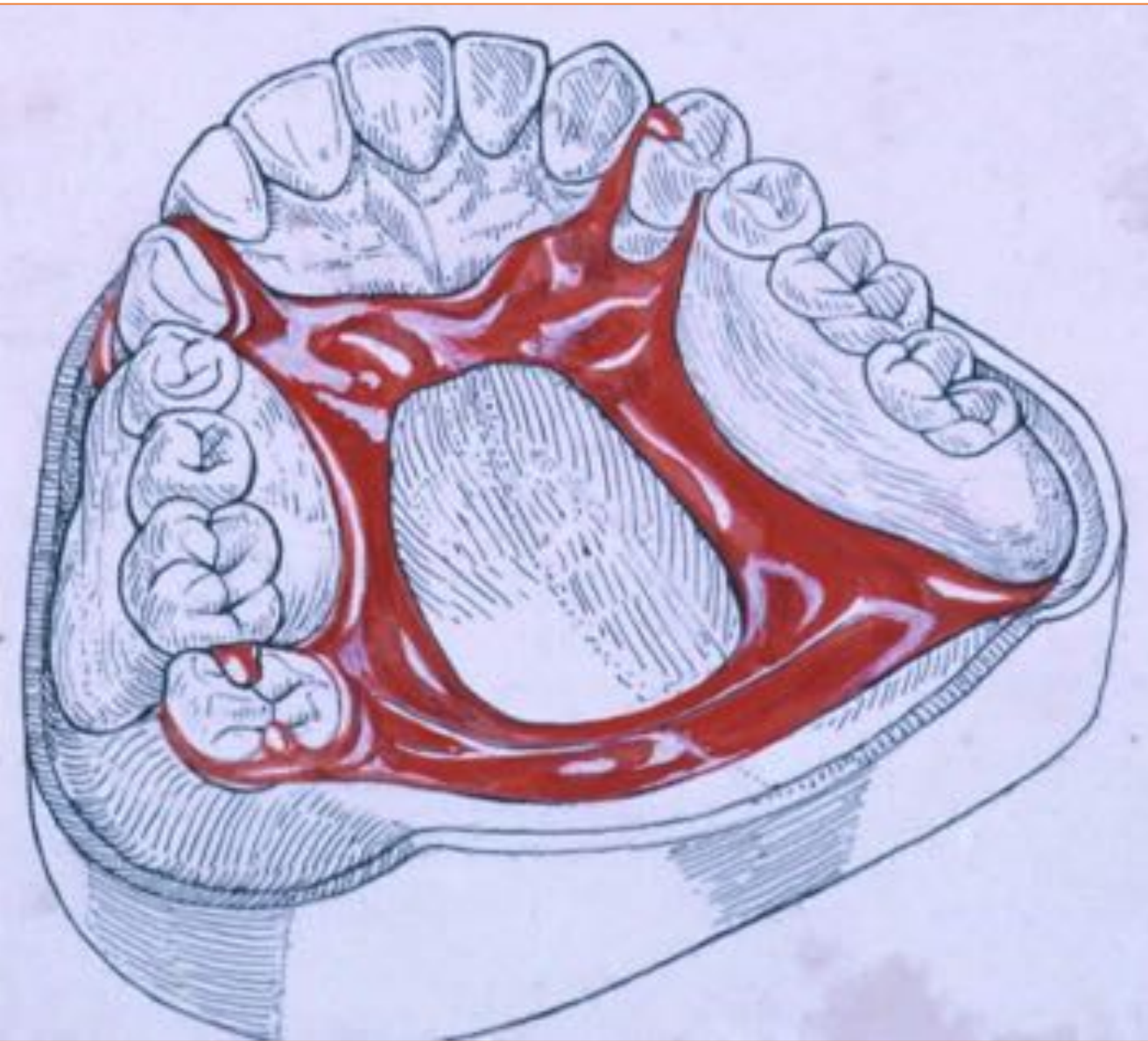


Support-

Resistance to occlusal or vertical seating forces



Of all three SSR support is the most important because a well supported RPD can effectively protect the remaining structures (teeth, mucosa, and underlying bone)



SUPPORT- **Tooth** vs. **Mucosa**

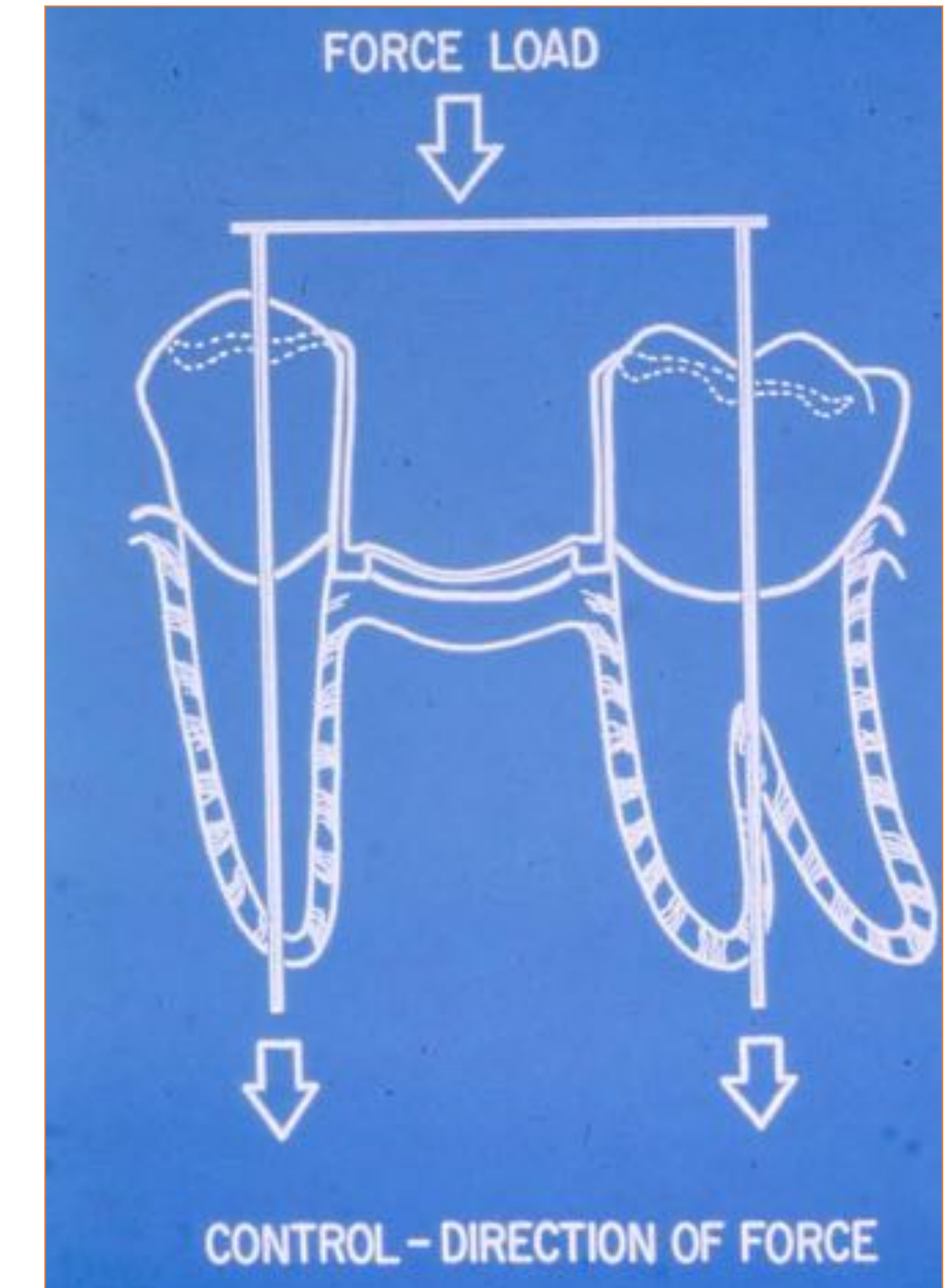
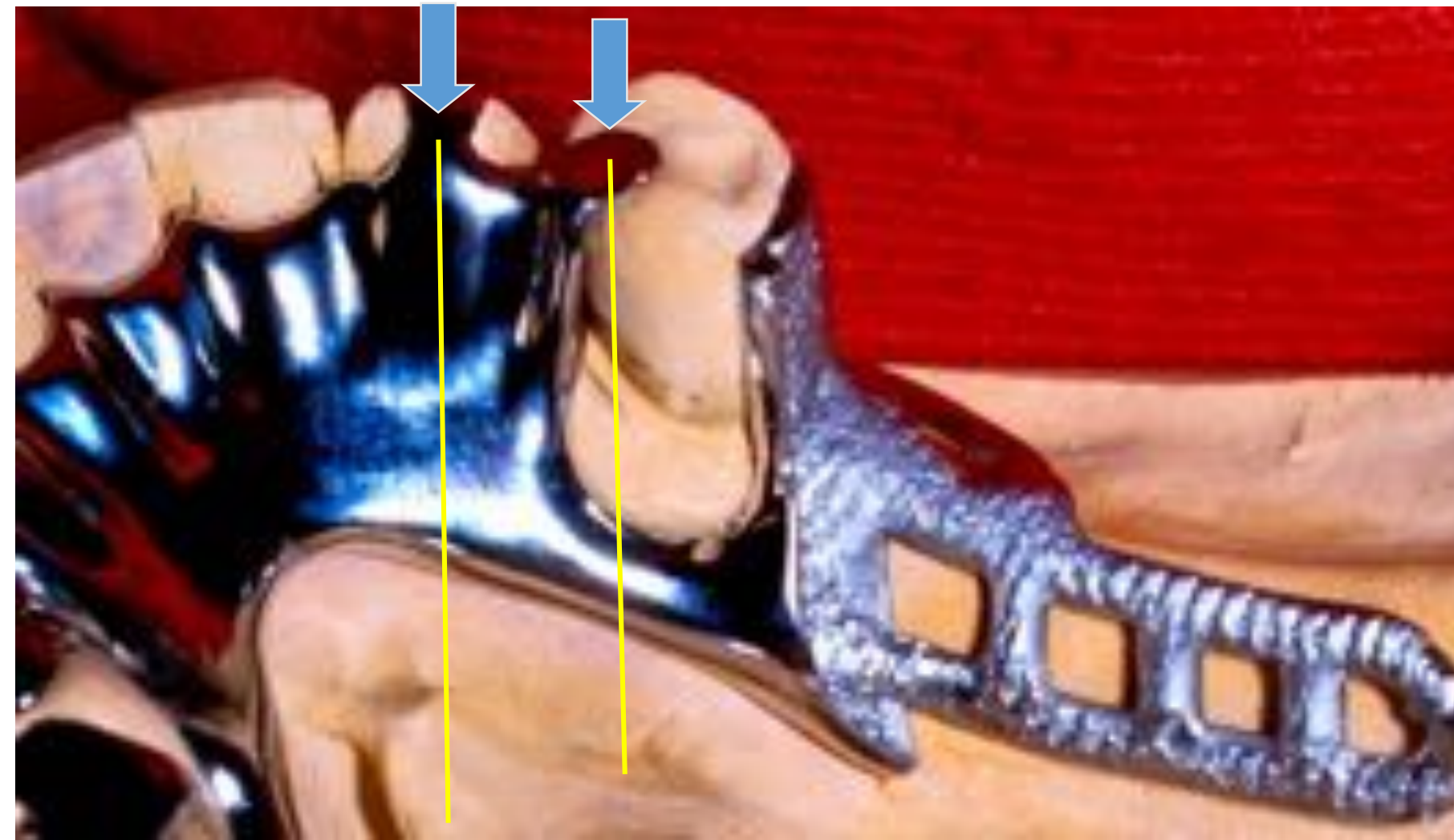
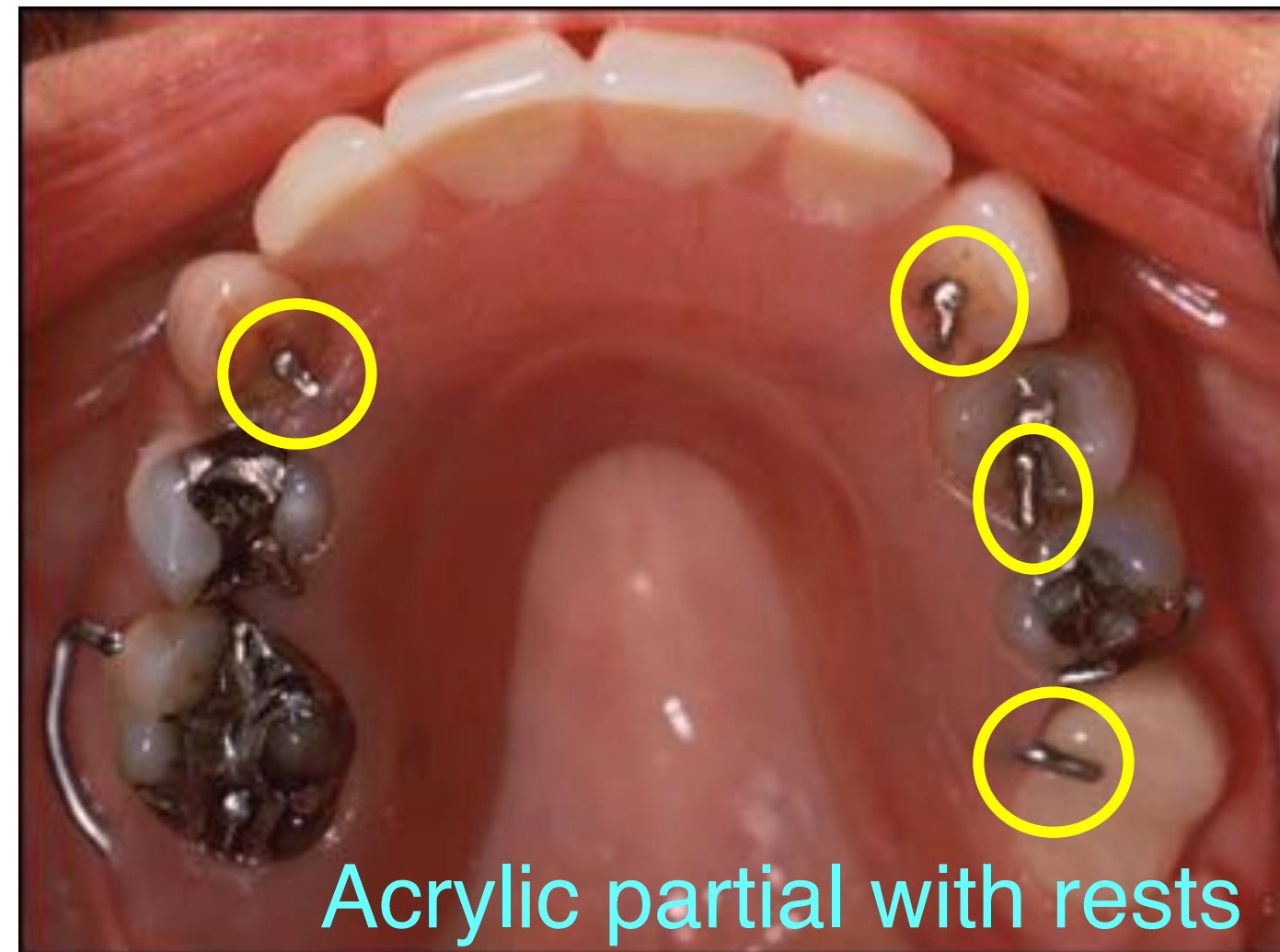
- From:
- **Rests (tooth support)**
 - **Major connectors (mucosal support)**
 - **Denture bases (mucosal support)**

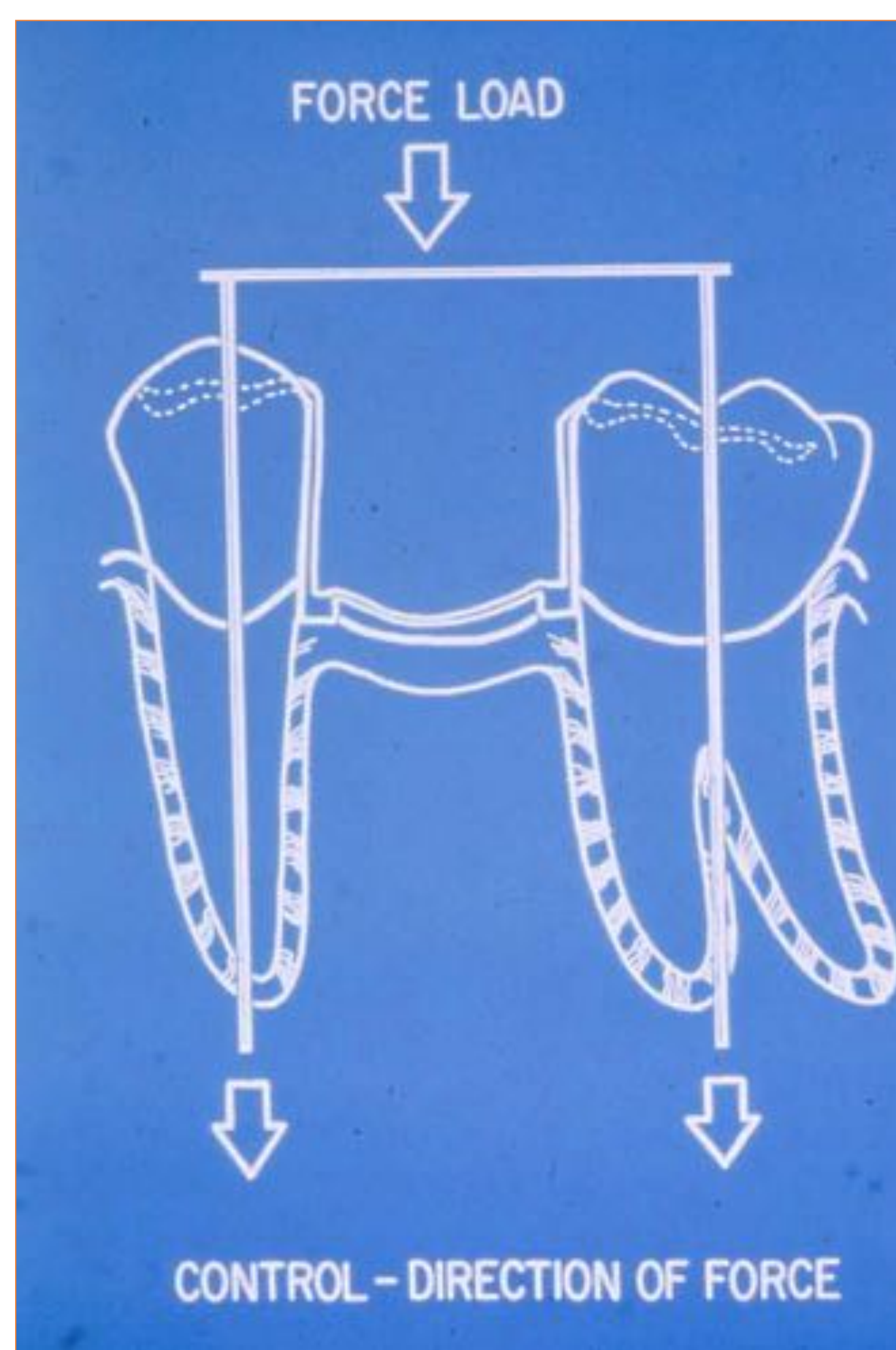
Rests

To control the prosthesis in relationship to the teeth and supporting structures

To provide primary support for RPD

The rest should direct functional forces in the long axis of the tooth.





Imagine a RPD with no rests...

It becomes completely mucosal support

Consequences:

Loss of vertical control

Ridge resorption

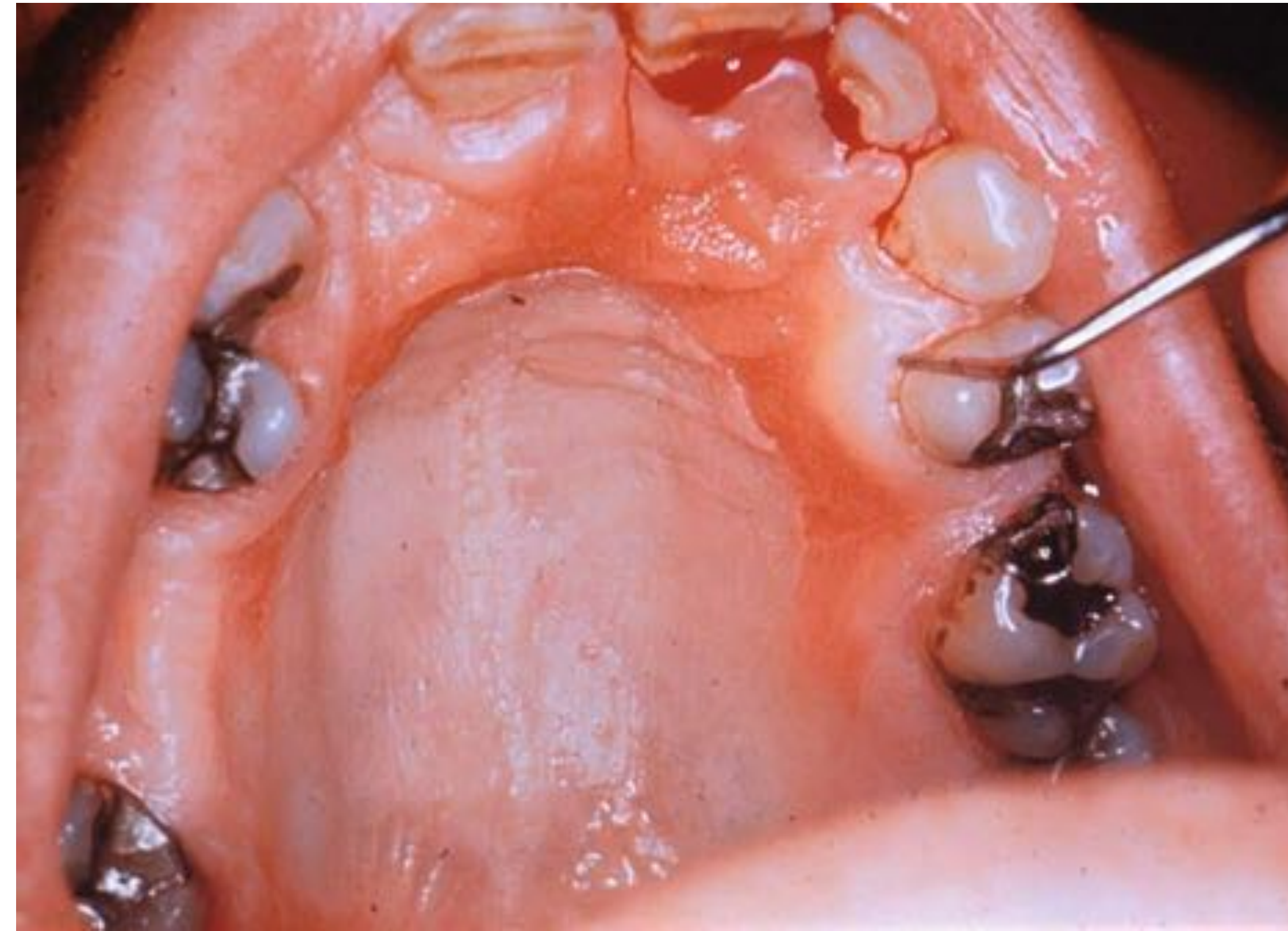
Mal-adaptation



Lack of positive rests results in prosthesis displacement, which can destroy mucosa & periodontal attachment



Pt's existing partial with no positive rest- 100% mucosal support



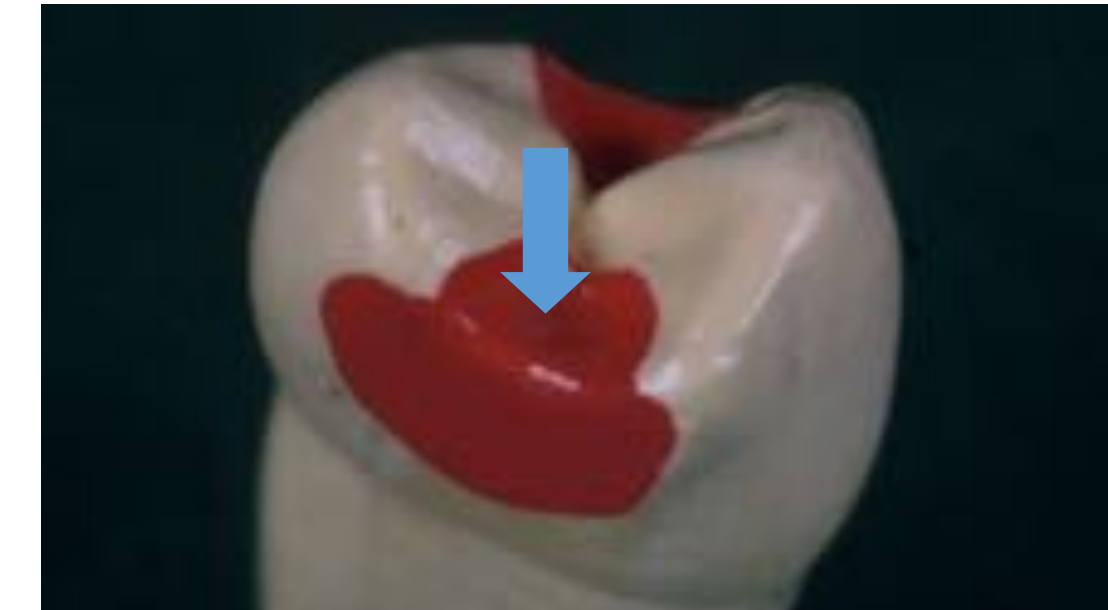
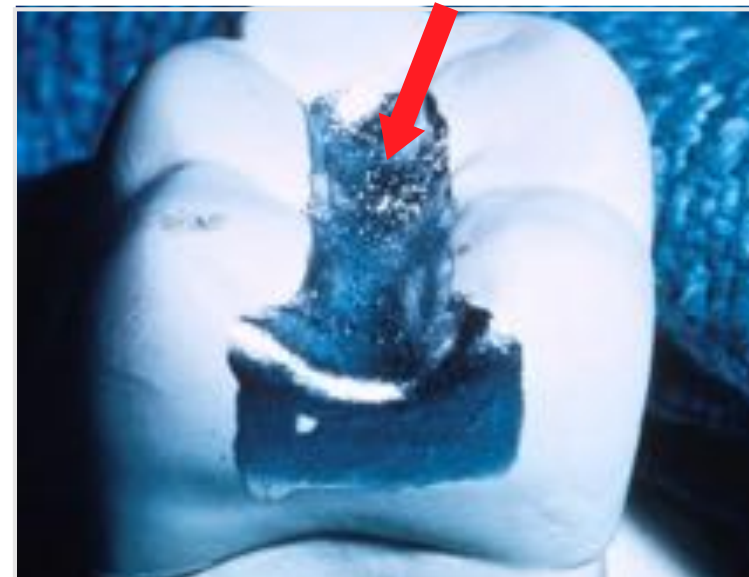
Irritated and traumatized soft tissue resulting from a RPD without positive rests

Positive Rest

A positive rest does not allow the prosthesis slide off the tooth or allow the tooth to move out of existing relationship to other teeth as increased occlusal pressure is exerted.



Rest center is **deeper** than the surrounding area (spoon shape)

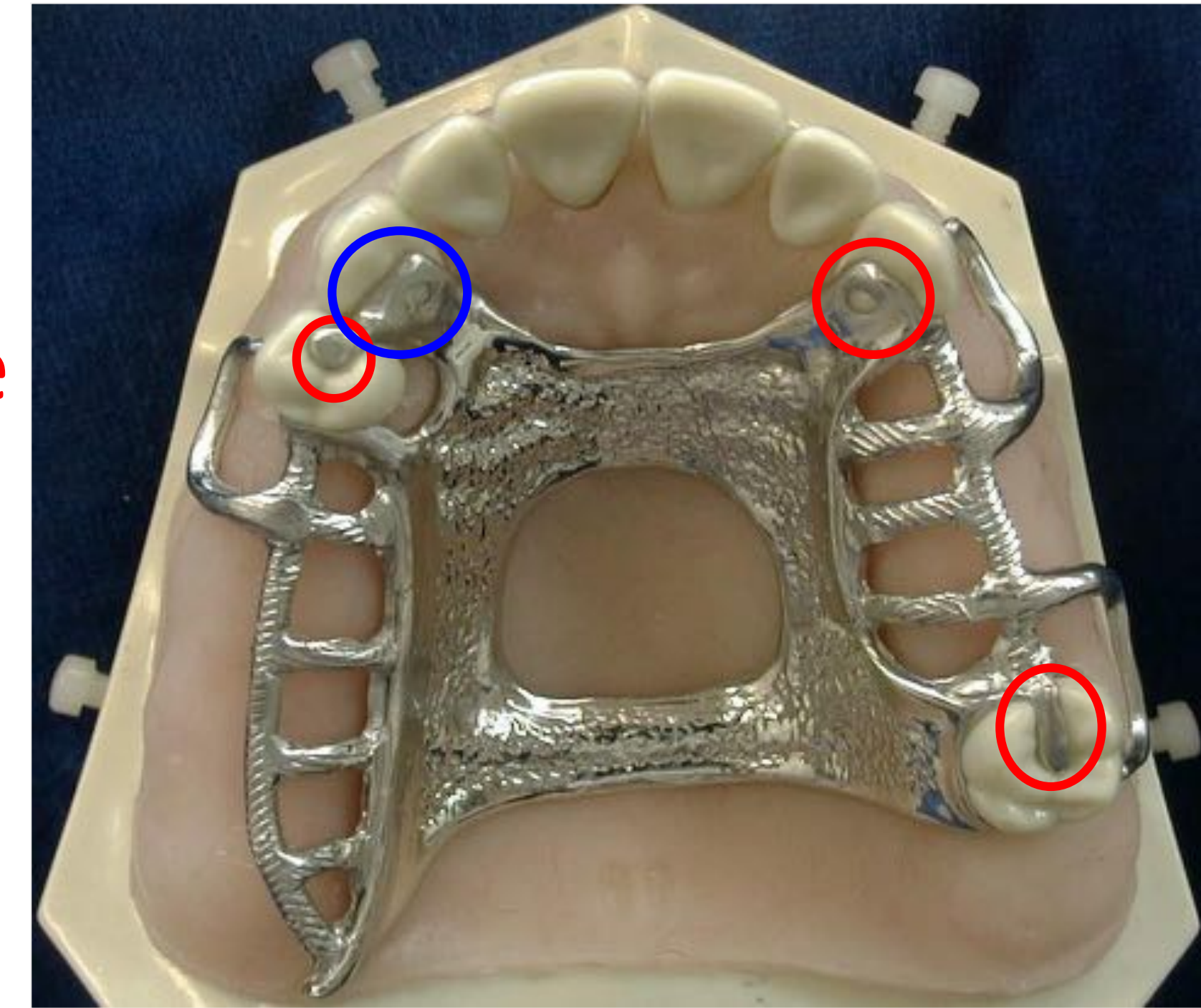




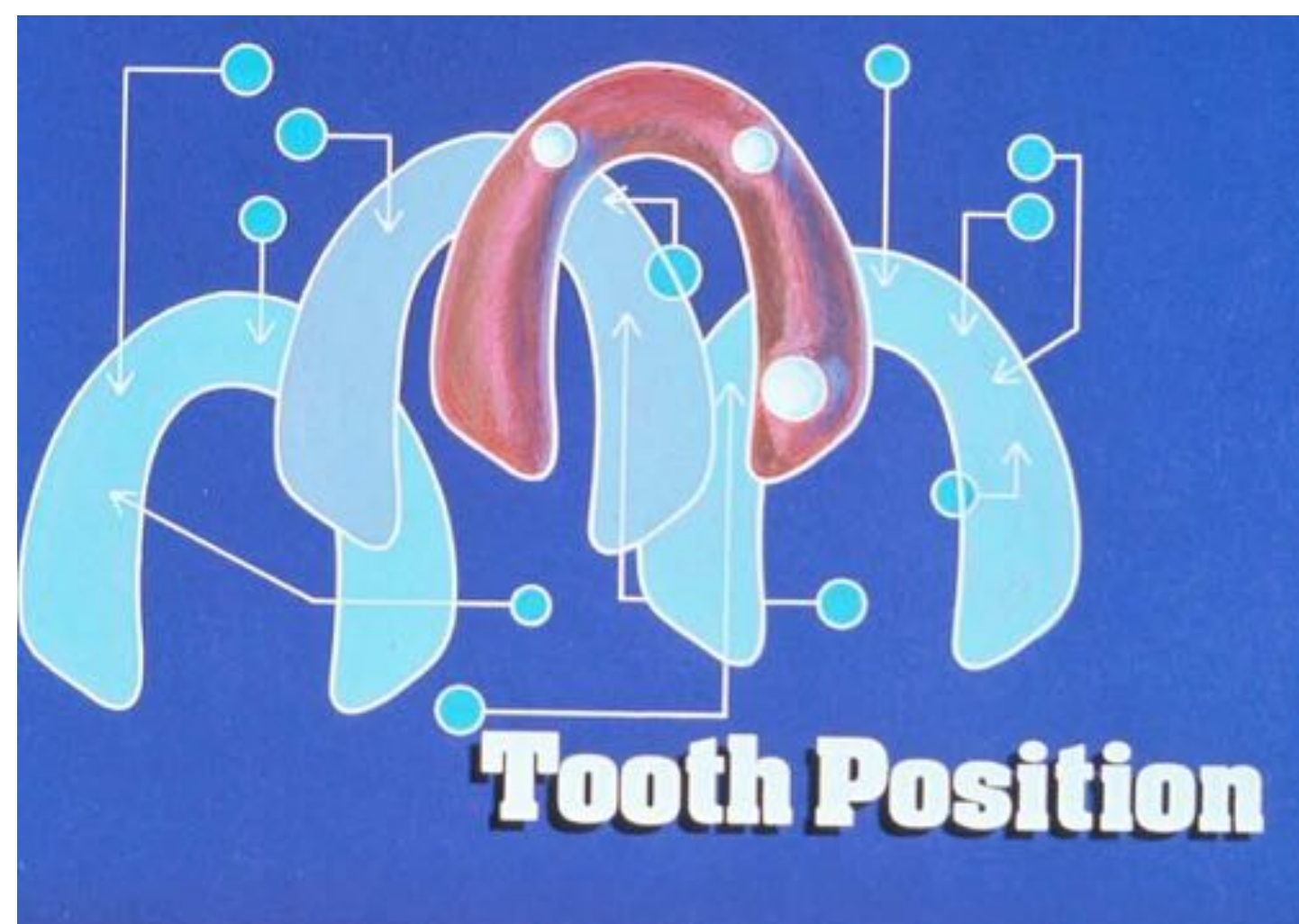
Ideal Locations for Rests

The teeth adjacent to the edentulous space

Additional teeth at the strategic position with excellent root morphology



Symmetrical and Equitable

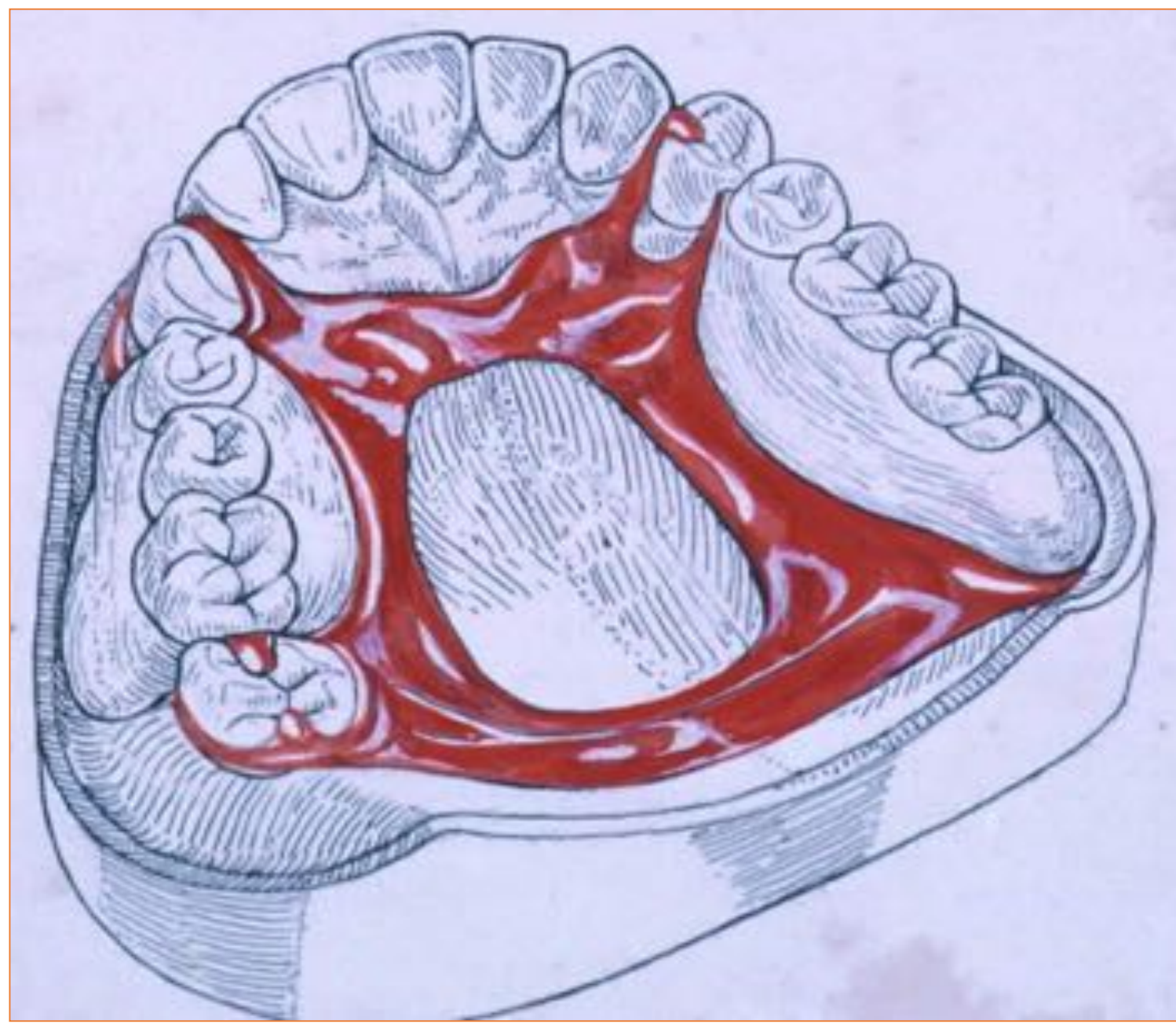


**RPD abutment on one side only
Significant RPD movement is anticipated
Implant should be considered to facilitate RPD therapy**



Ideal bilateral distribution of RPD abutments

SUPPORT- **Tooth** vs. **Mucosa**



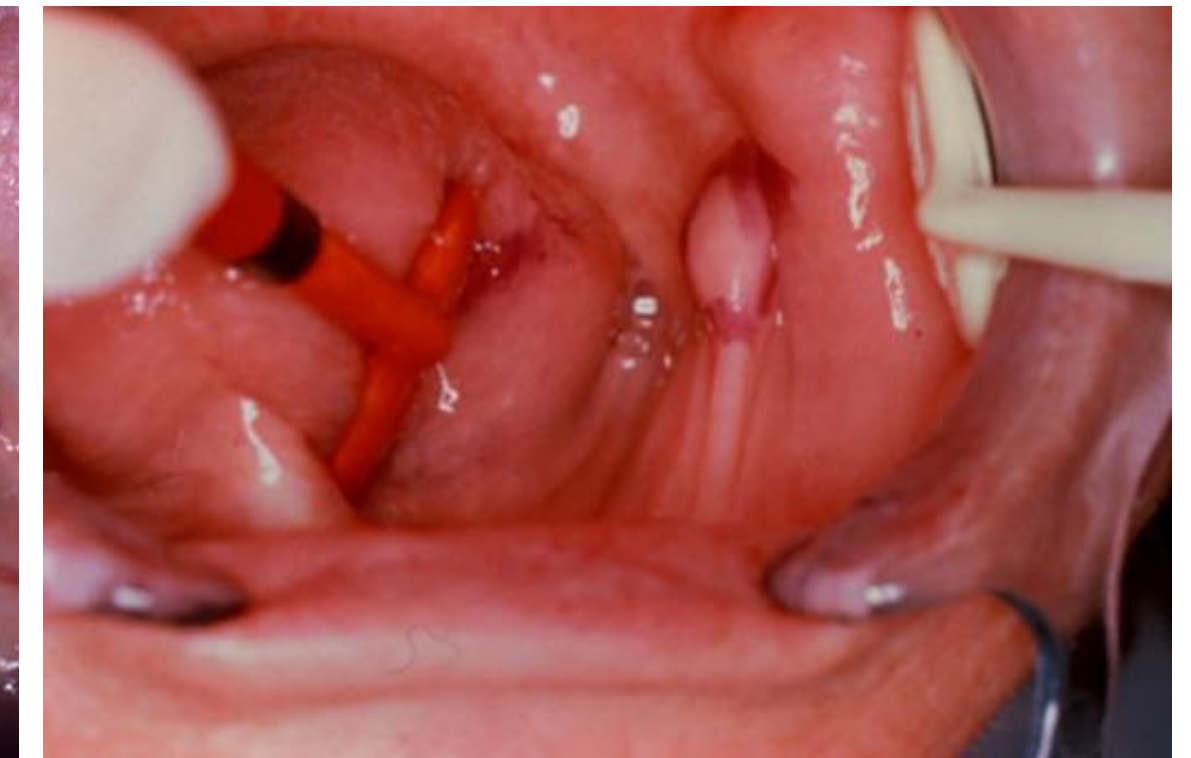
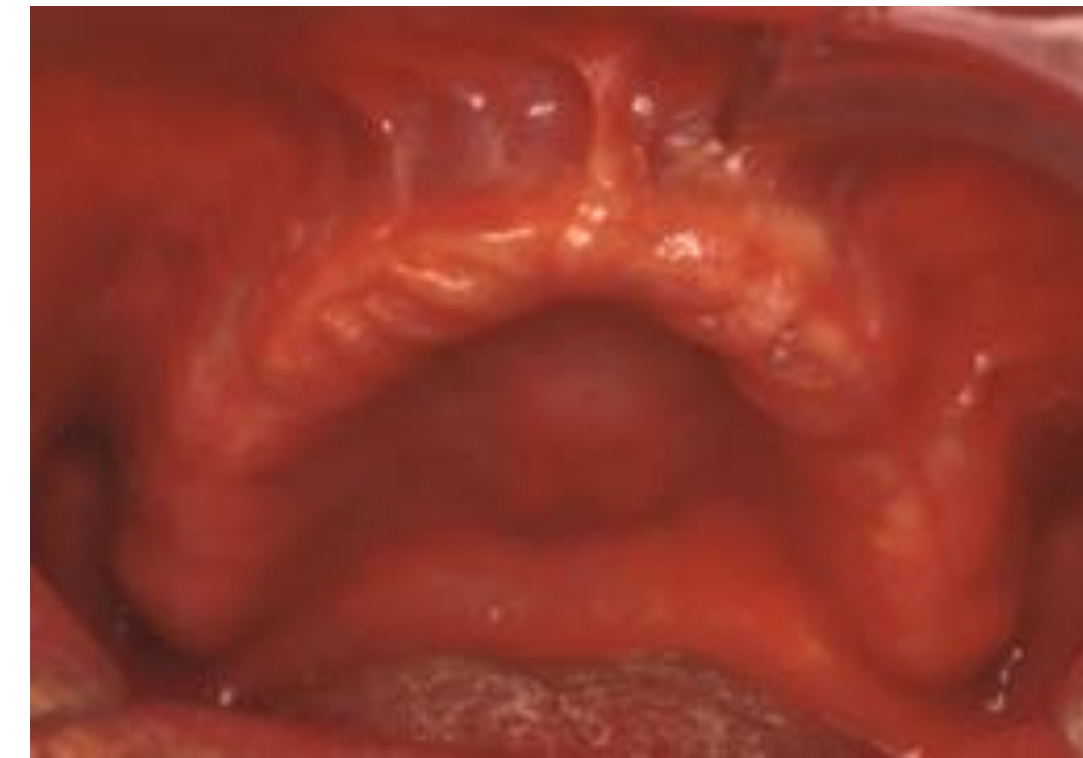
From:

- Rests (tooth support)
- Major connectors (mucosal support)
- Denture bases (mucosal support)



Primary Bearing Surface:

- Tuberosity**
- Buccal Shelves**
- Retromolar pad**



SUPPORT- **Tooth** vs. **Mucosa**

From:

- Rests (tooth support)
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Single strap

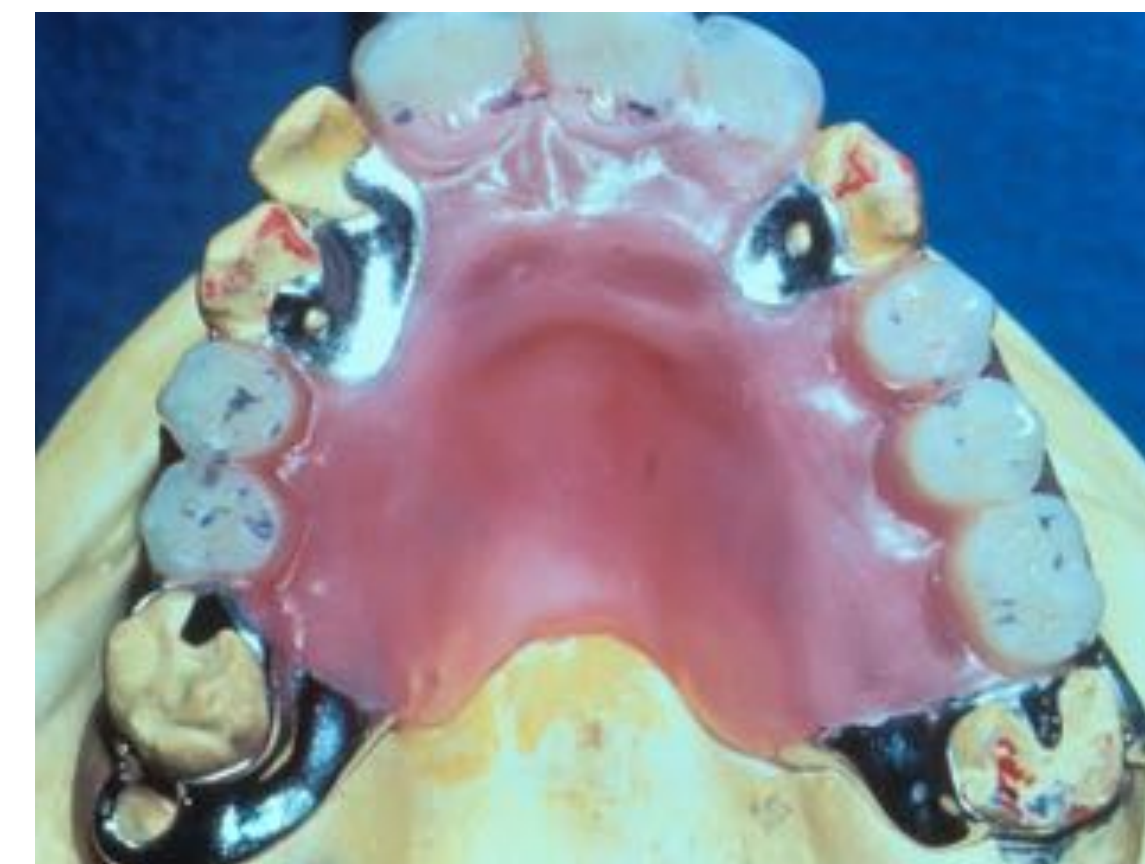


U-shape strap

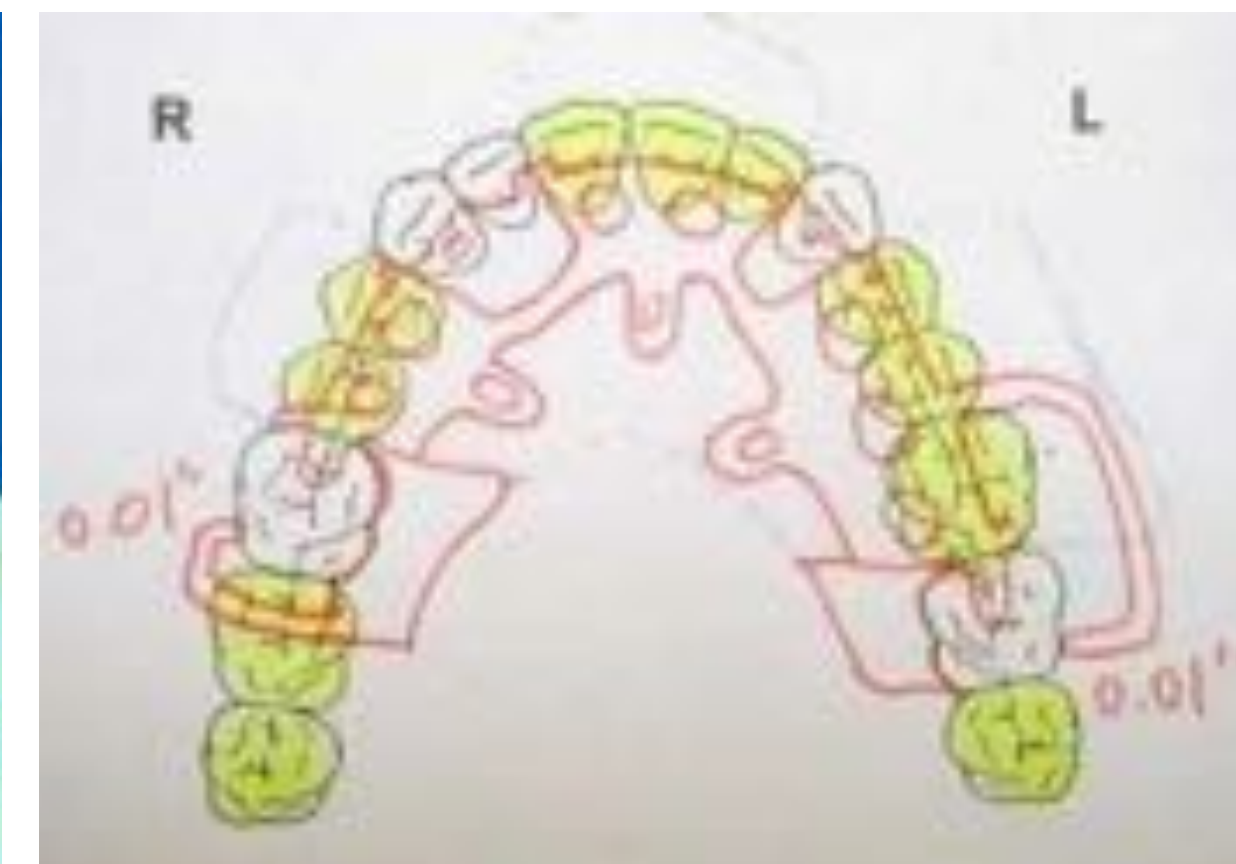


AP palatal strap

Various major connectors provide mucosal support from minimum to **broad** coverage.

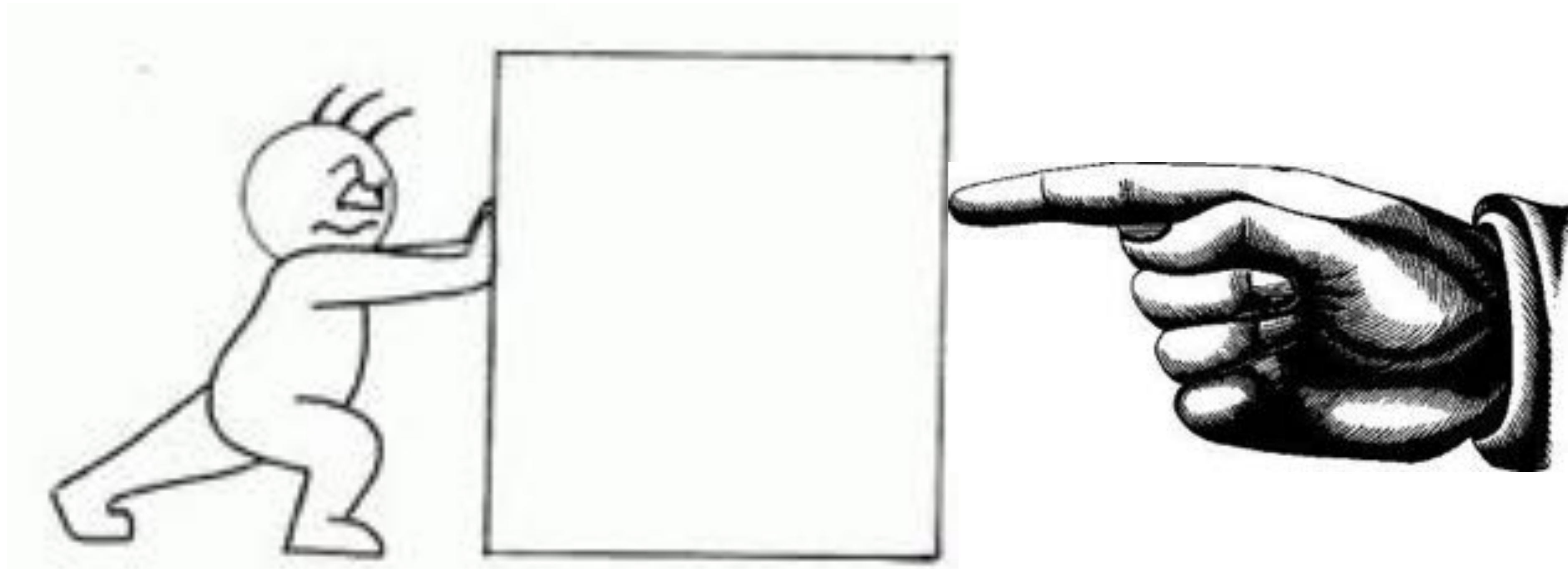


Full palatal coverage



Stability

Resistance to horizontal or torsional forces

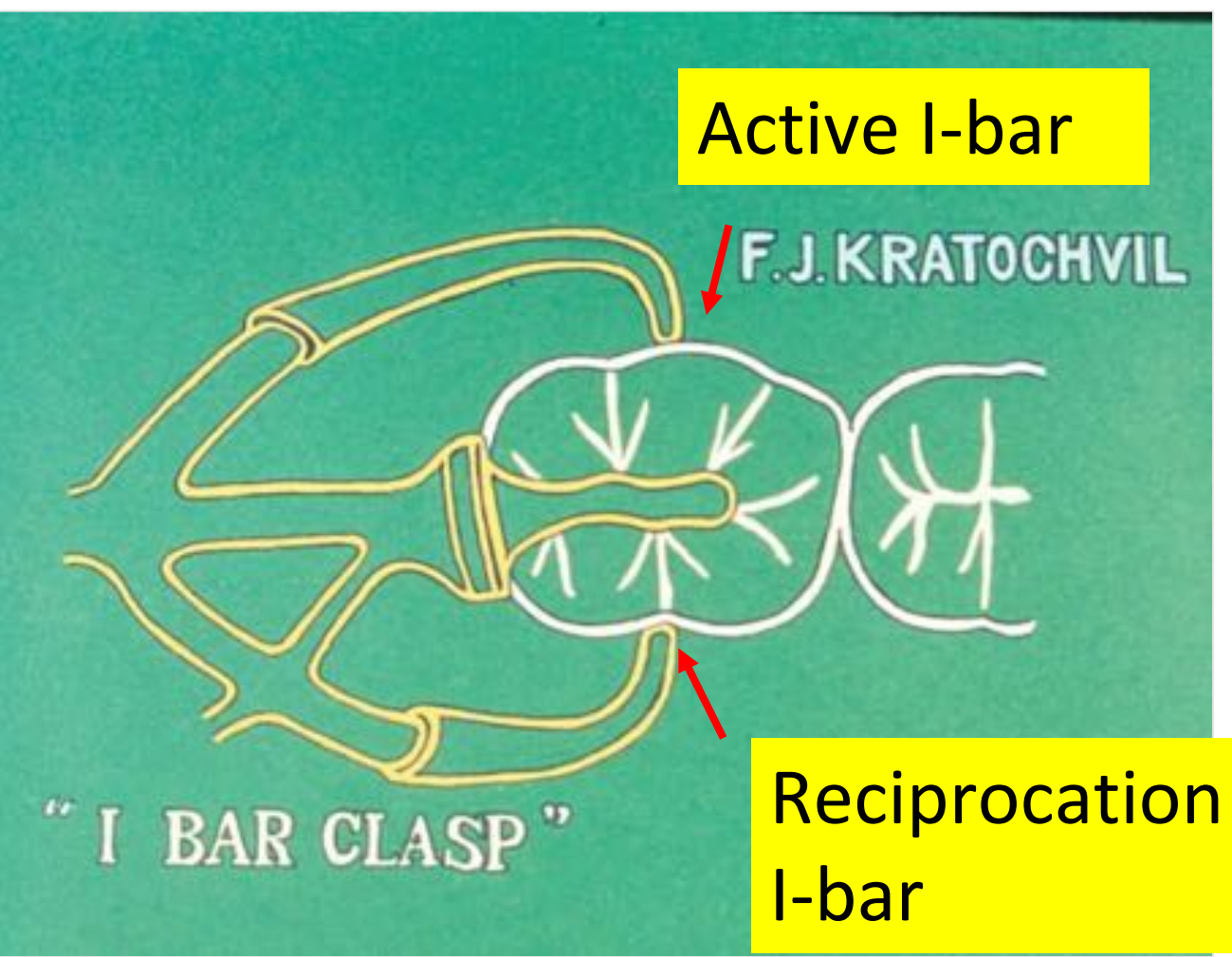


STABILITY

RPD design parts enable the resistance to horizontal forces

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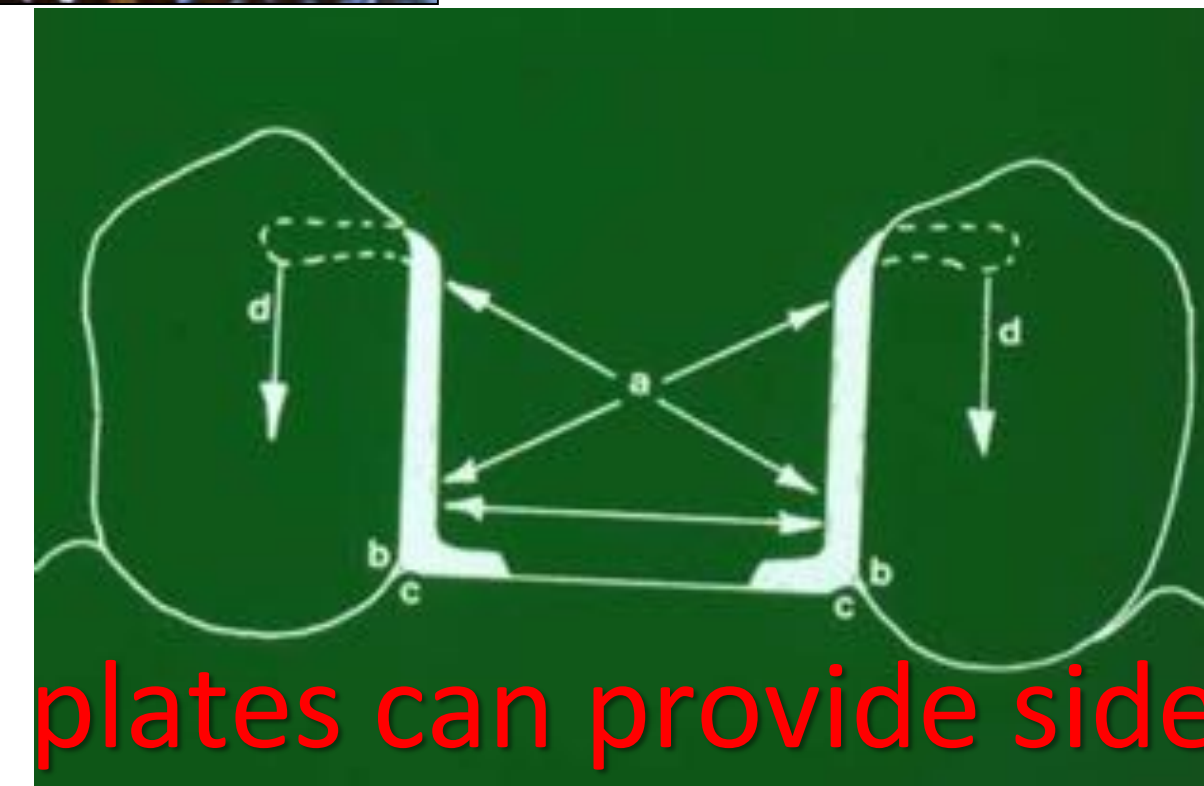
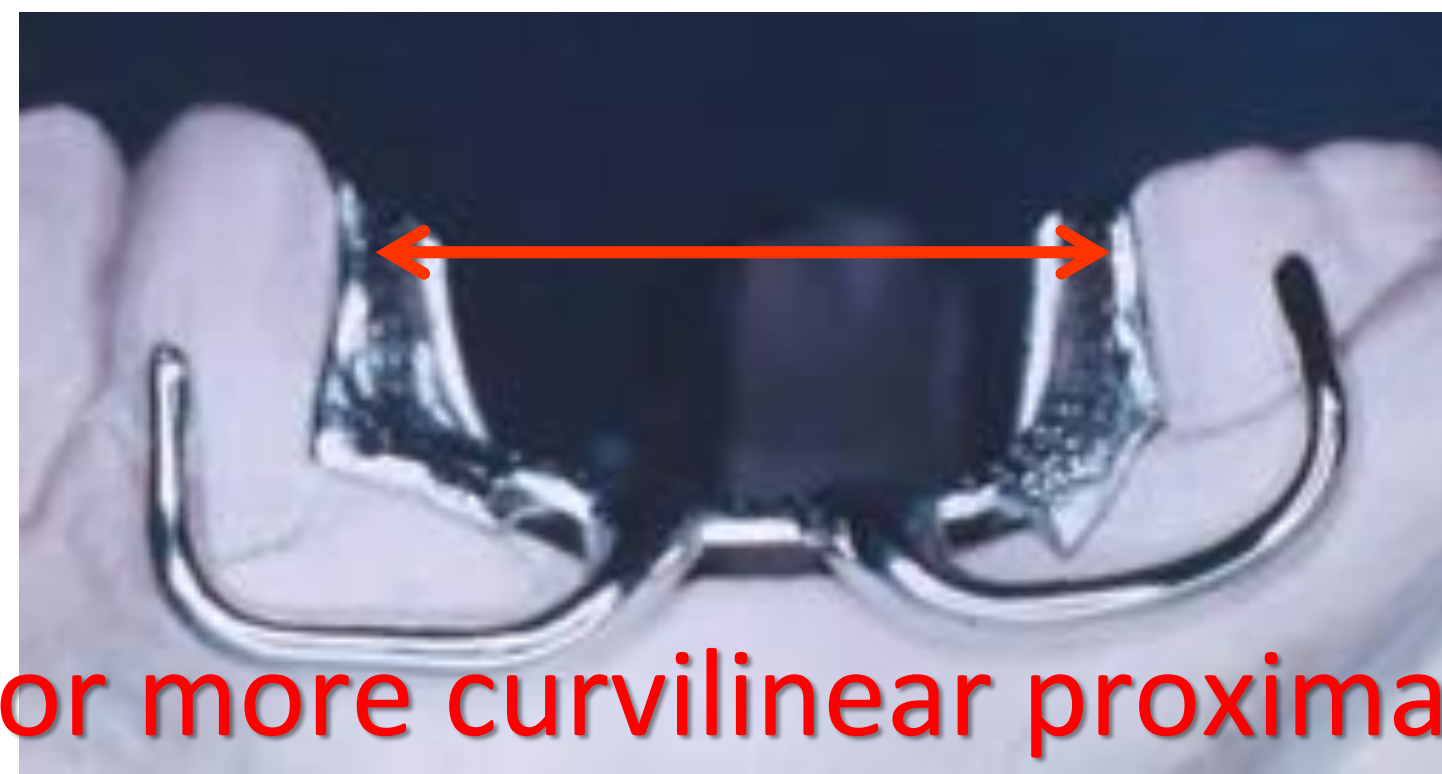
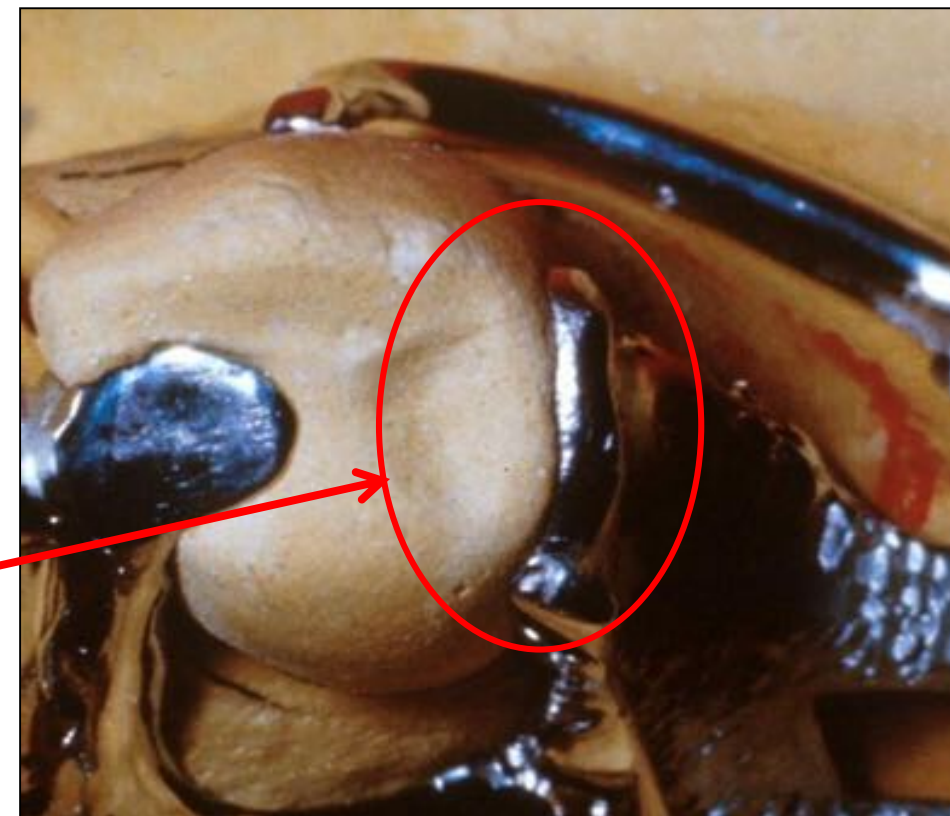
- Proximal Plates
- Bracing clasp arms
- Lingual plates
- Rests
- Denture bases



Proximal Plates

- Maintain arch integrity by anterior- posterior bracing action

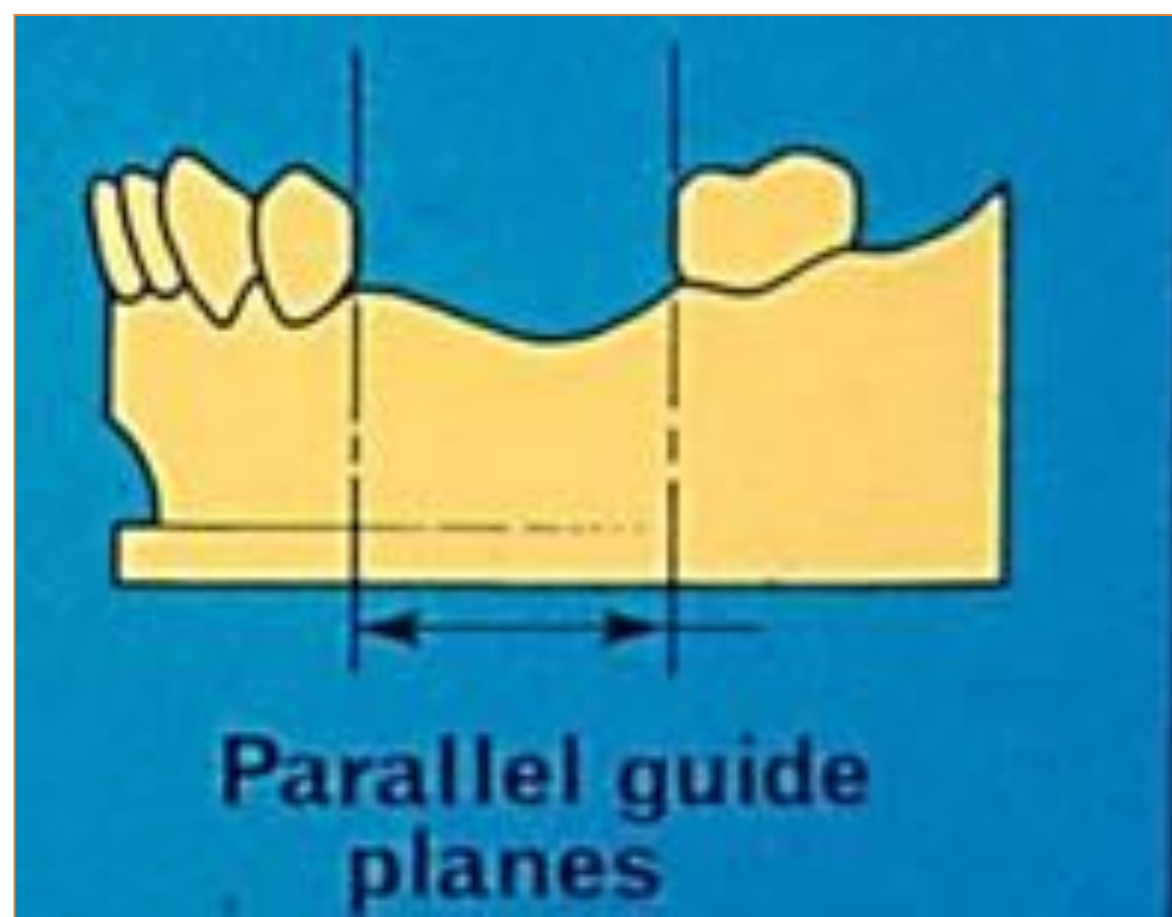
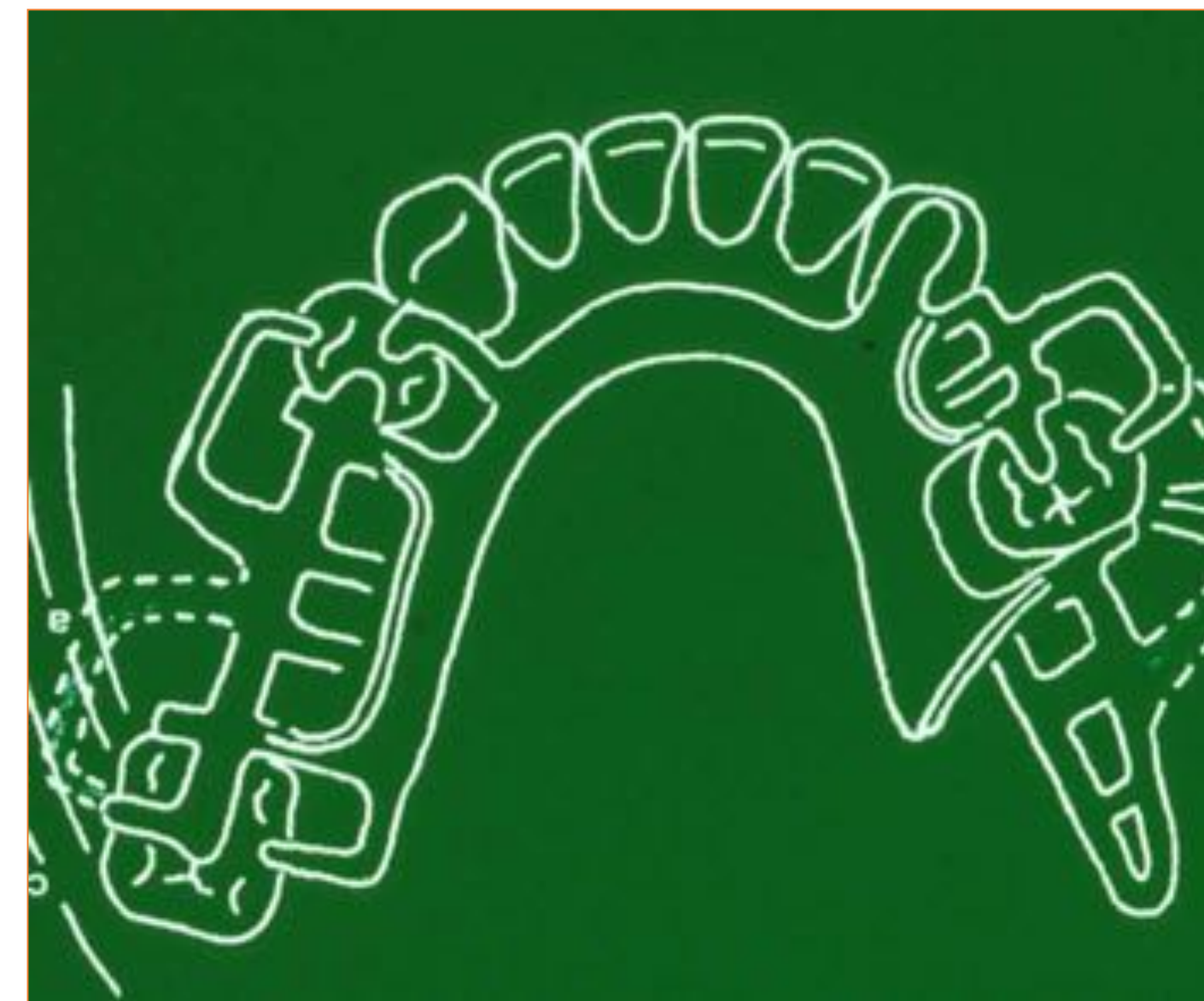
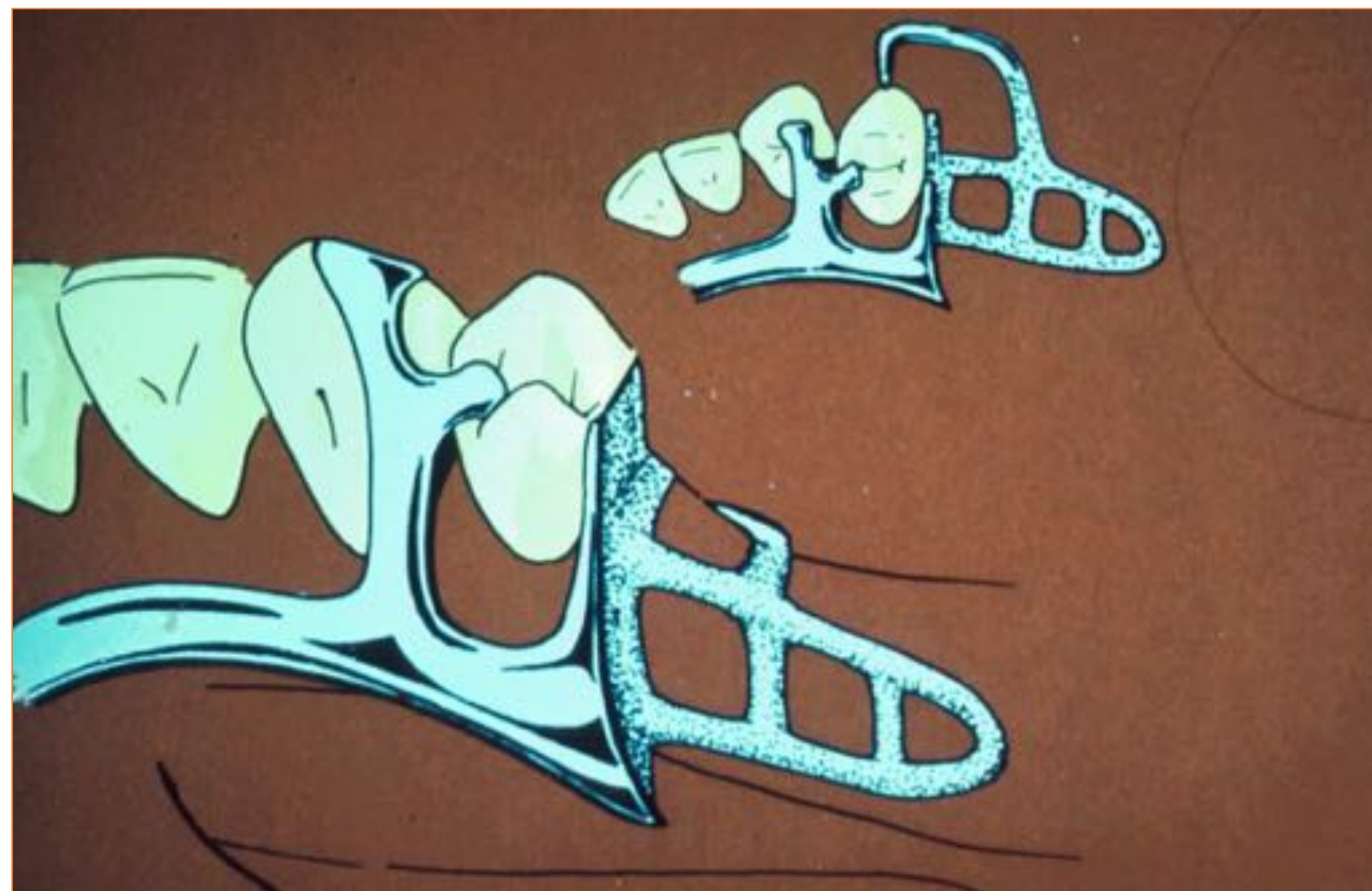
Curvilinear parallel proximal plate



Two or more curvilinear proximal plates can provide side-to-side stability

RETENTION

RPD design parts enable the resistance to vertical dislodging forces



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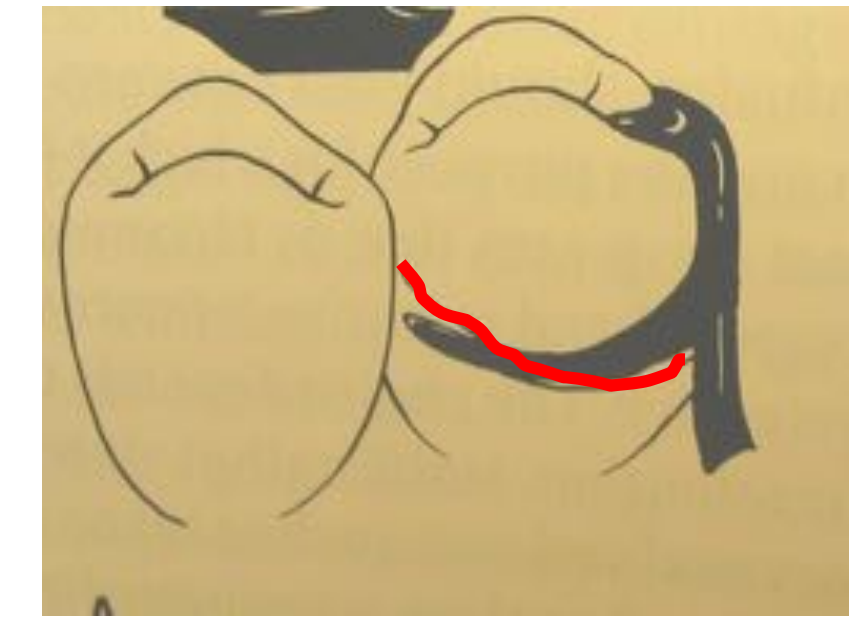
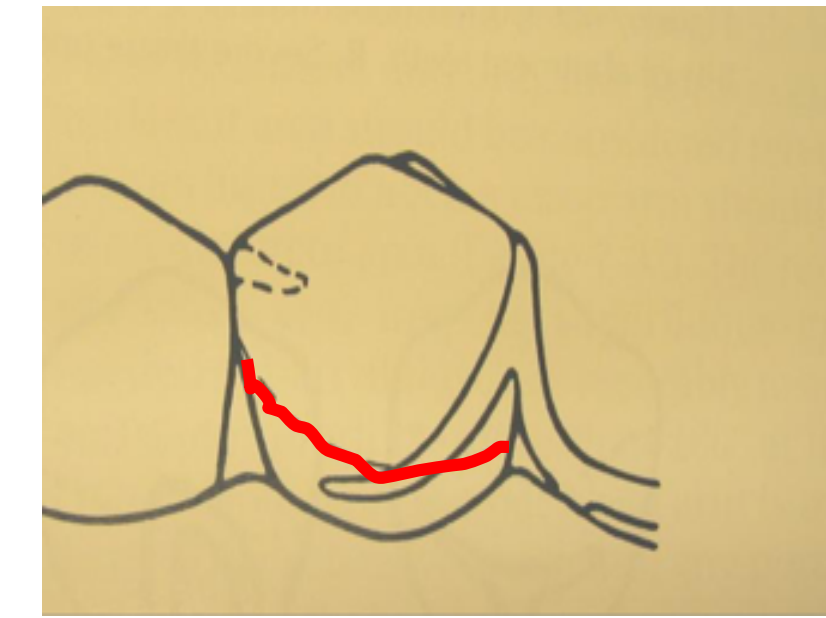
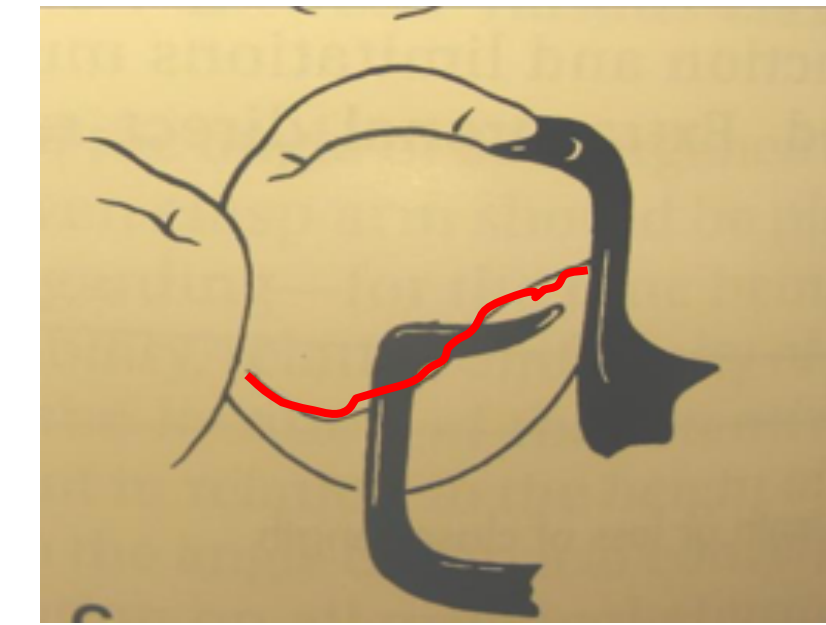
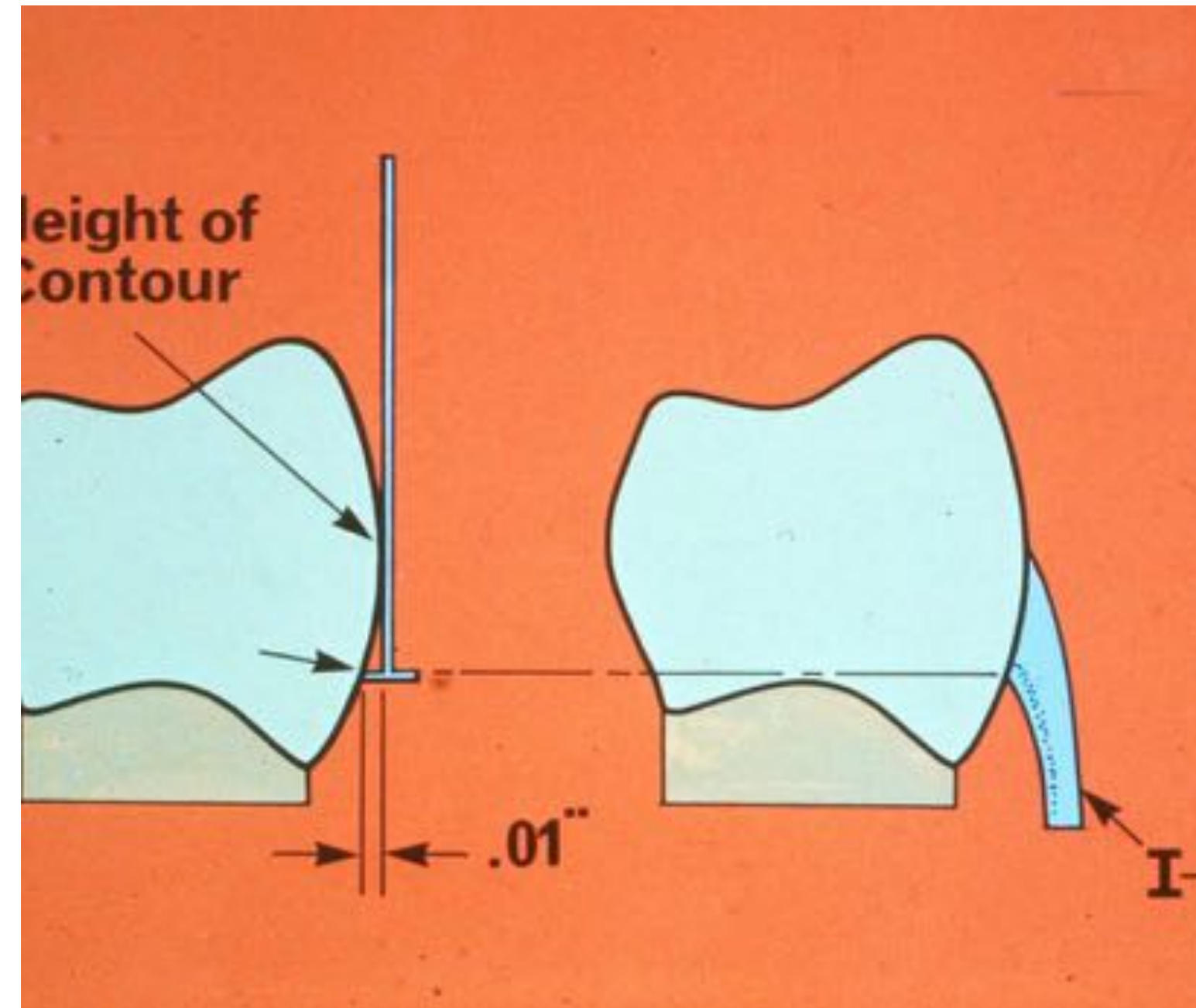
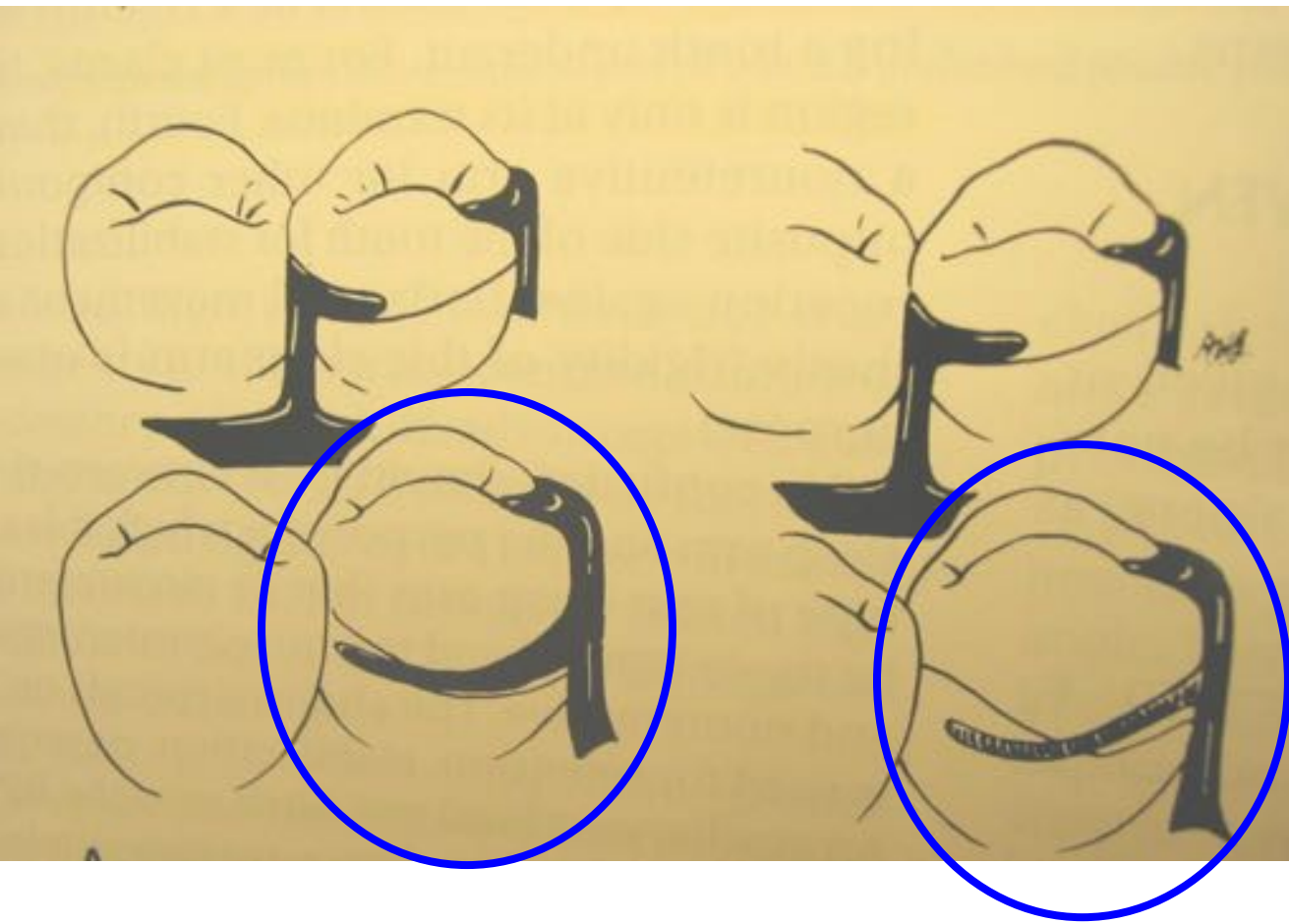
- Retainers/clasps
- Proximal Plates on the RPD (guide planes on the tooth)
- Indirect Retainers (for extension base RPD only)

Active Retainers for Retention

Active retainer (retainer that engages undercut to provide retention for the RPD)

-only **the tip** of the retainer is below the height of contour and engages the desired 0.01-0.02" undercut

--the remaining of the retainer is position at/or above the height of contour (except infra-bulge retainers)



Height of contour of the RPD abutment at a given path of insertion

How to design a well supported, stable, and retentive RPD? Five Parts of Well-Designed RPDs



Design sequence

The RPD design principles remain the same for the implant-enhanced RPD therapy

- Rests (support from teeth)
- Minor Connectors/Proximal Plates (stability)
- Major Connectors (support from mucosa)
- Denture Base Connectors
- Retainers (retention)



Treatment Goals of RPD:

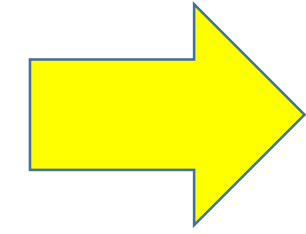
1. Stabilize the individual arch and protect remaining structure

Biomechanical sound design for
Implant-enhanced RPD therapy

2. Organize interarch function (VDO, Occlusal Plane, Centric) and esthetics



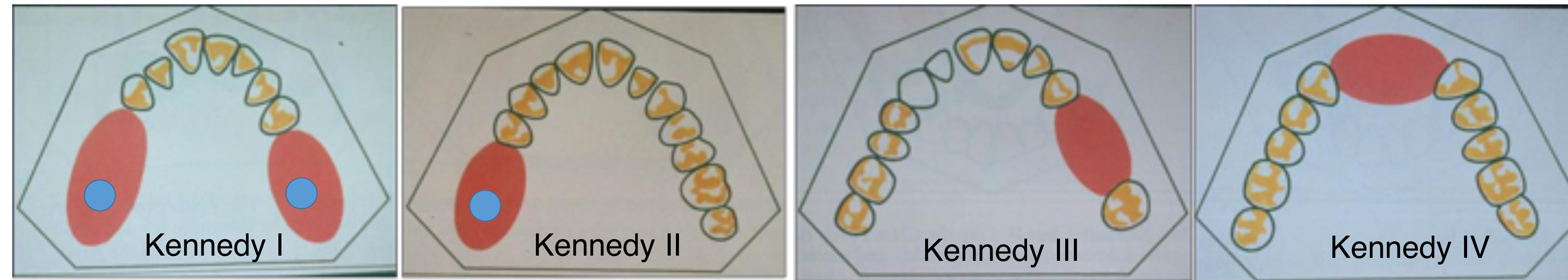
- The keys of a successful RPD design (with or without dental implants)



- Patient selection for implant-enhanced RPD therapy
- The goal of the implant-enhanced RPD treatment option:
esthetics versus comfort
- Treatment planning considerations: number and location of the implants,
selection of the attachment

Implant-enhanced RPD Therapy: Patient Selection

- Kennedy Class I and II (UCLA extension-based RPD):
To obtain a Kennedy Class III (UCLA Tooth-Borne RPD) configuration with the help from implant(s)



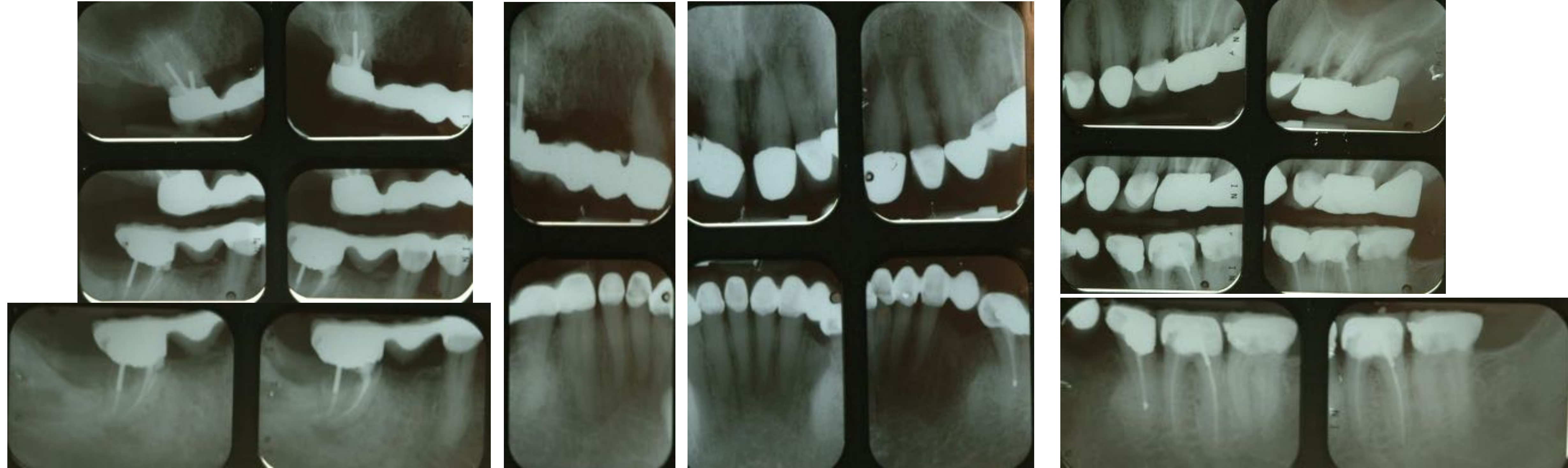
This approach may not be easily achievable due to anatomic limitations

Candidates for Implant-enhanced RPD Therapy

- Kennedy Class I and II (UCLA extension-based RPD)
- Compromised RPD abutment distribution:
 - Lack of bilaterally positioned RPD abutment
- Patients with prior unsatisfied RPD experience
- Patients who are interested in less extensive tooth replacement treatment option (surgically and/or financially)

Case 1: Mr. JC

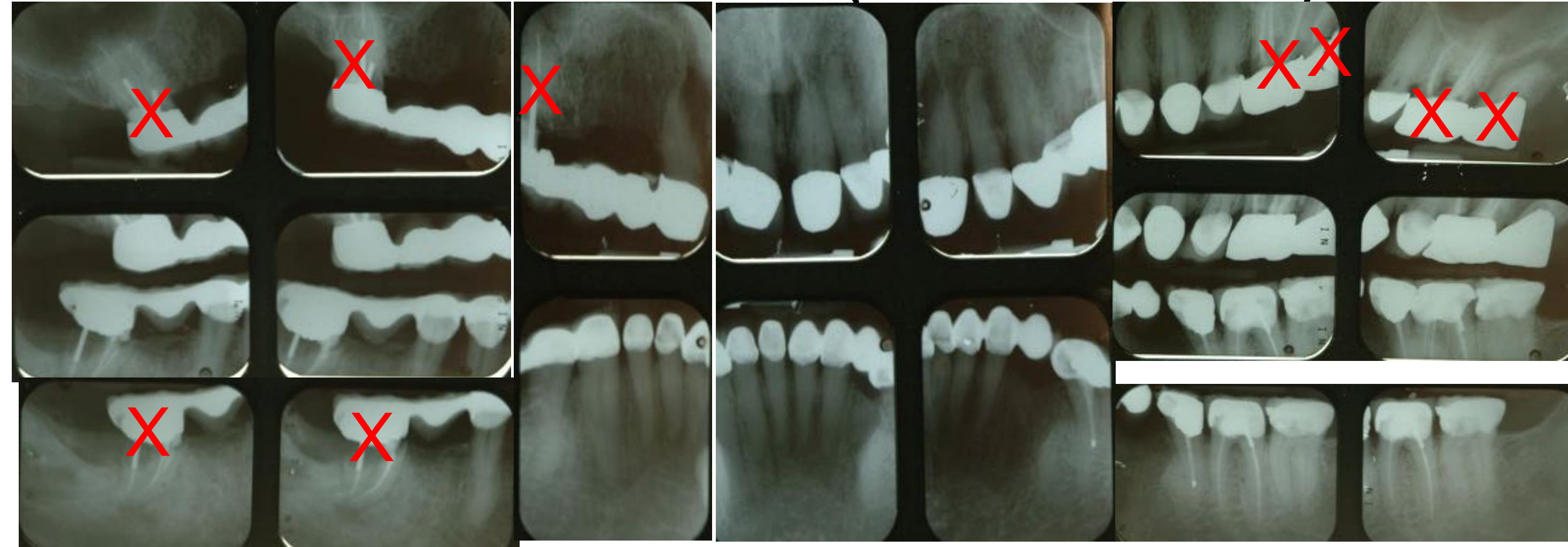
Pt JC before-treatment FMX
(8/5/2005)



Case 1: Mr. JC

Pt JC

before FMX (8/5/2005)



Treatment Plan:

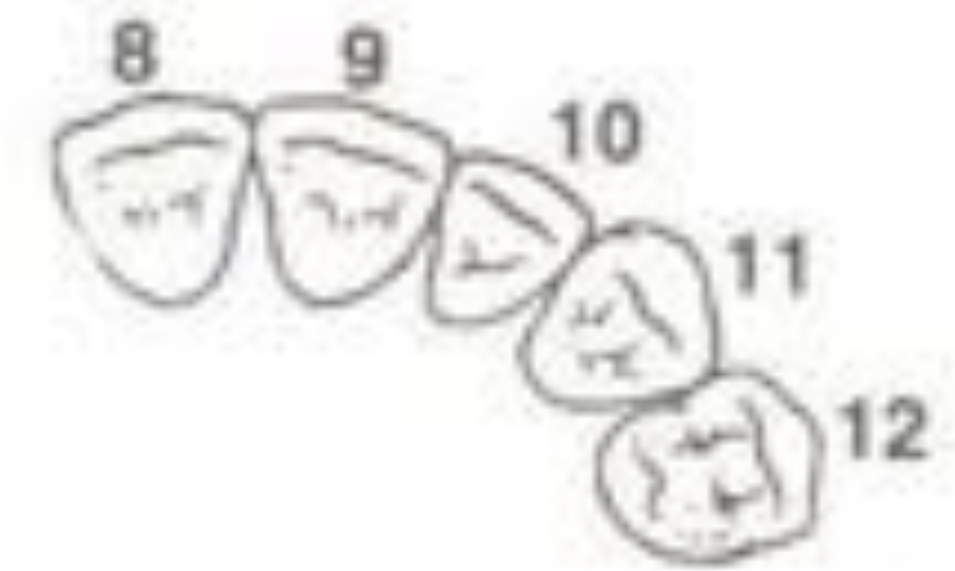
1. Extraction of #3, 5, 14, 15, and 31
2. Maxillary immediate treatment partial
3. Possible implant placement to improve the treatment outcomes of maxillary cast RPD
4. Mandibular cast RPD or implants to replace #30 (and #31).

Case 1: Mr. JC



Maxillary RPD is a distal extension RPD

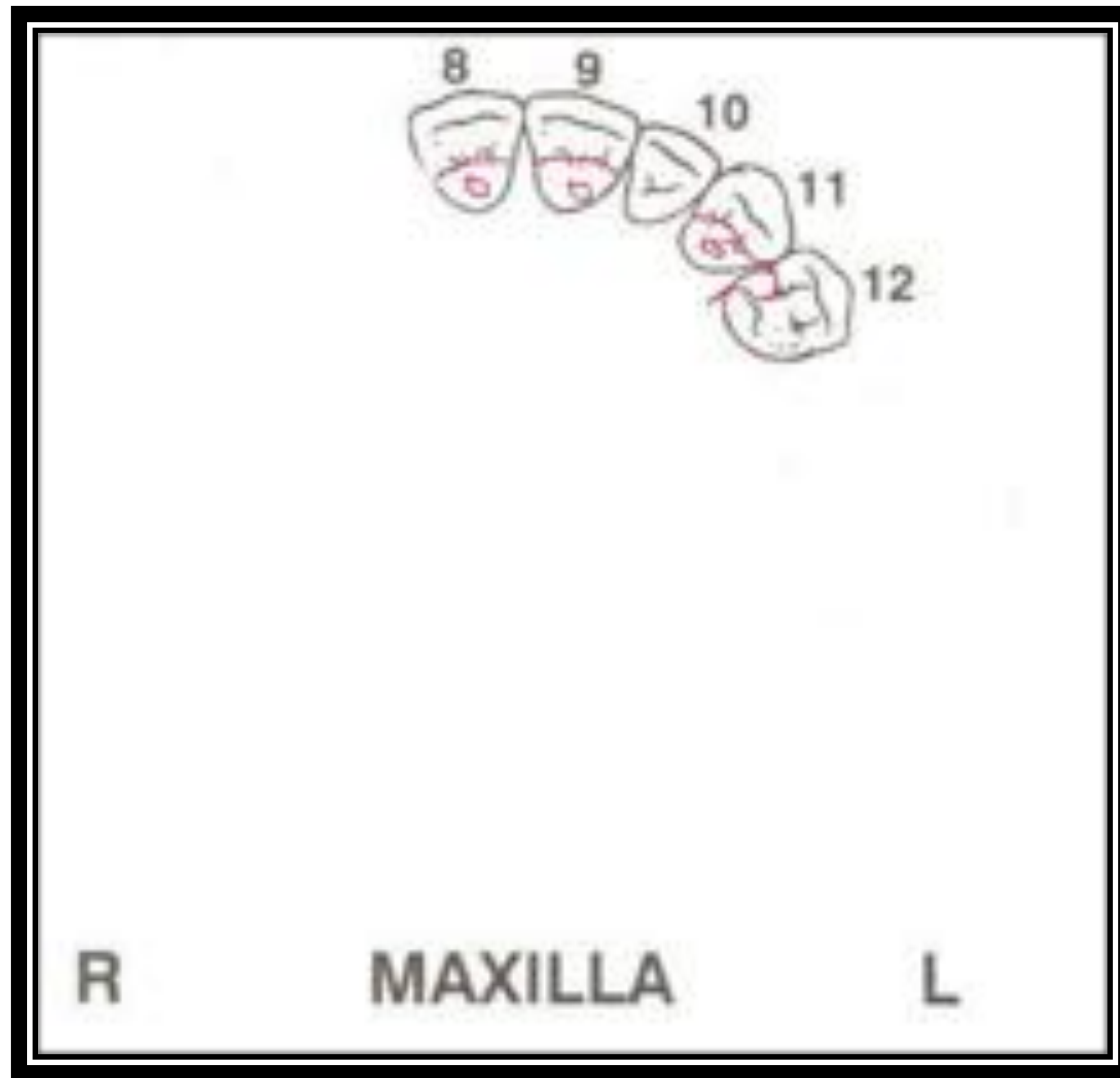
There will be an axis of rotation defined by the two most distal rests



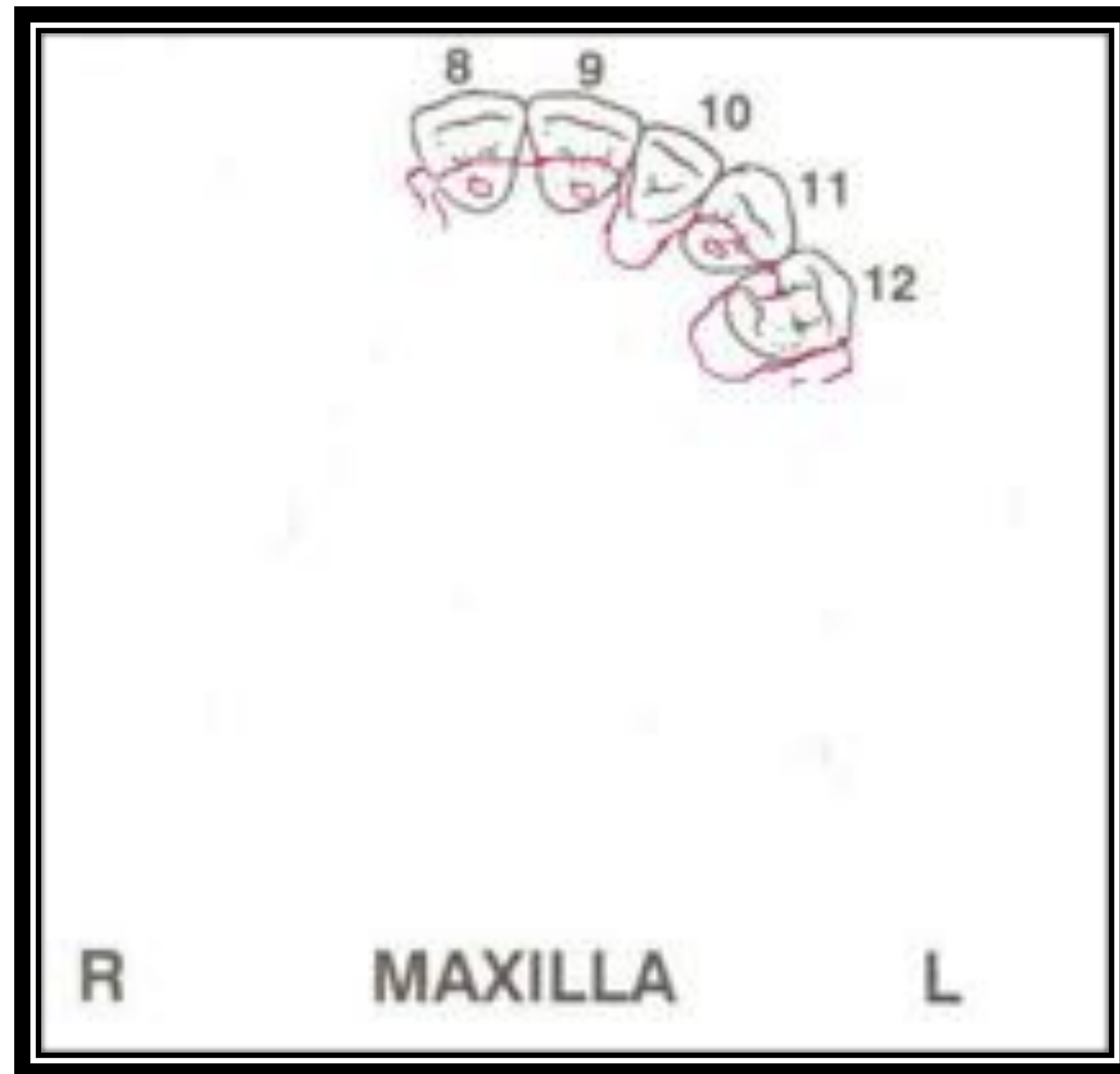
R

MAXILLA

L



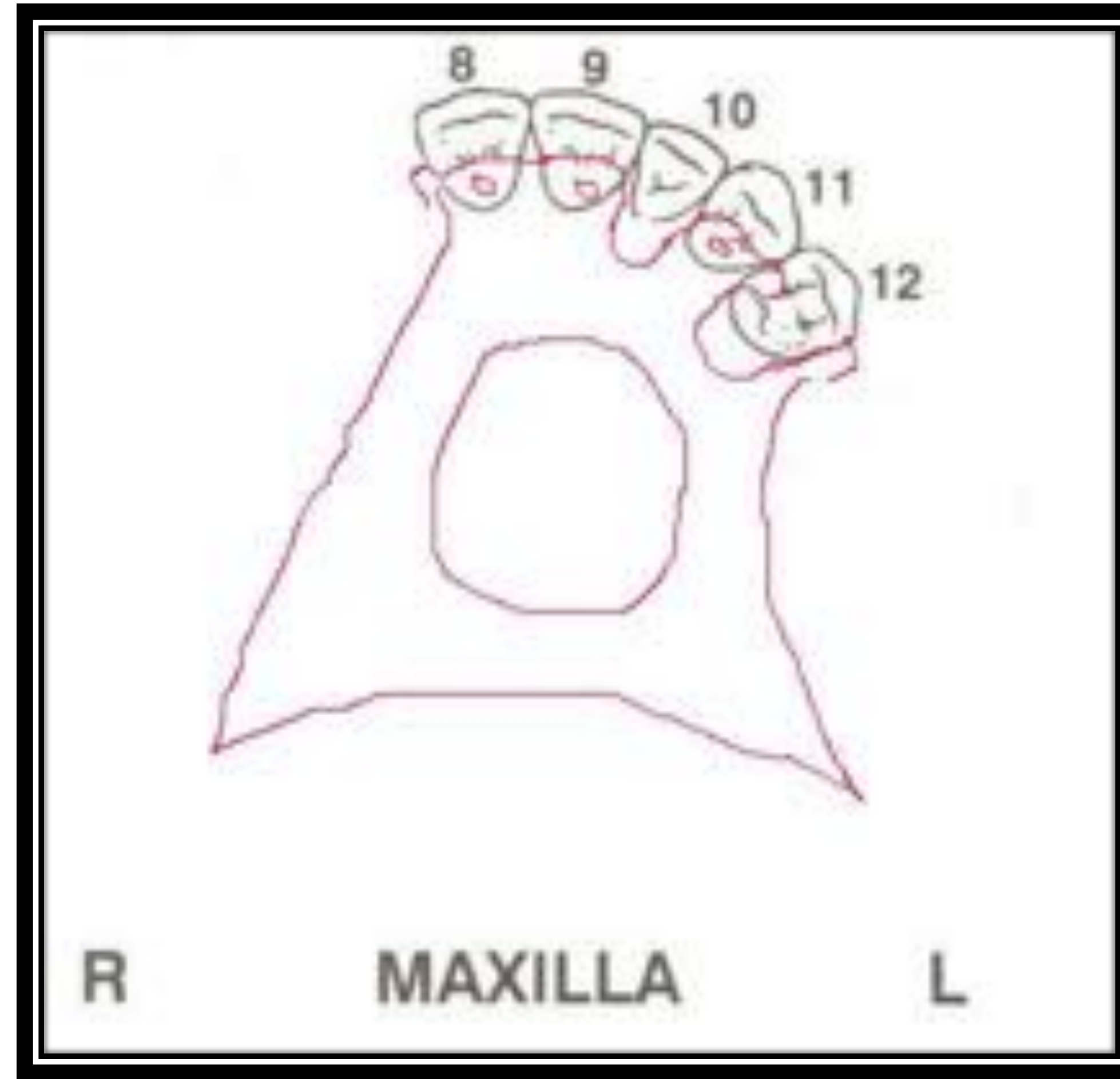
RPD Design Sequence:
1. Rests



RPD Design Sequence:

1. Rests

2. Proximal plates/minor connector

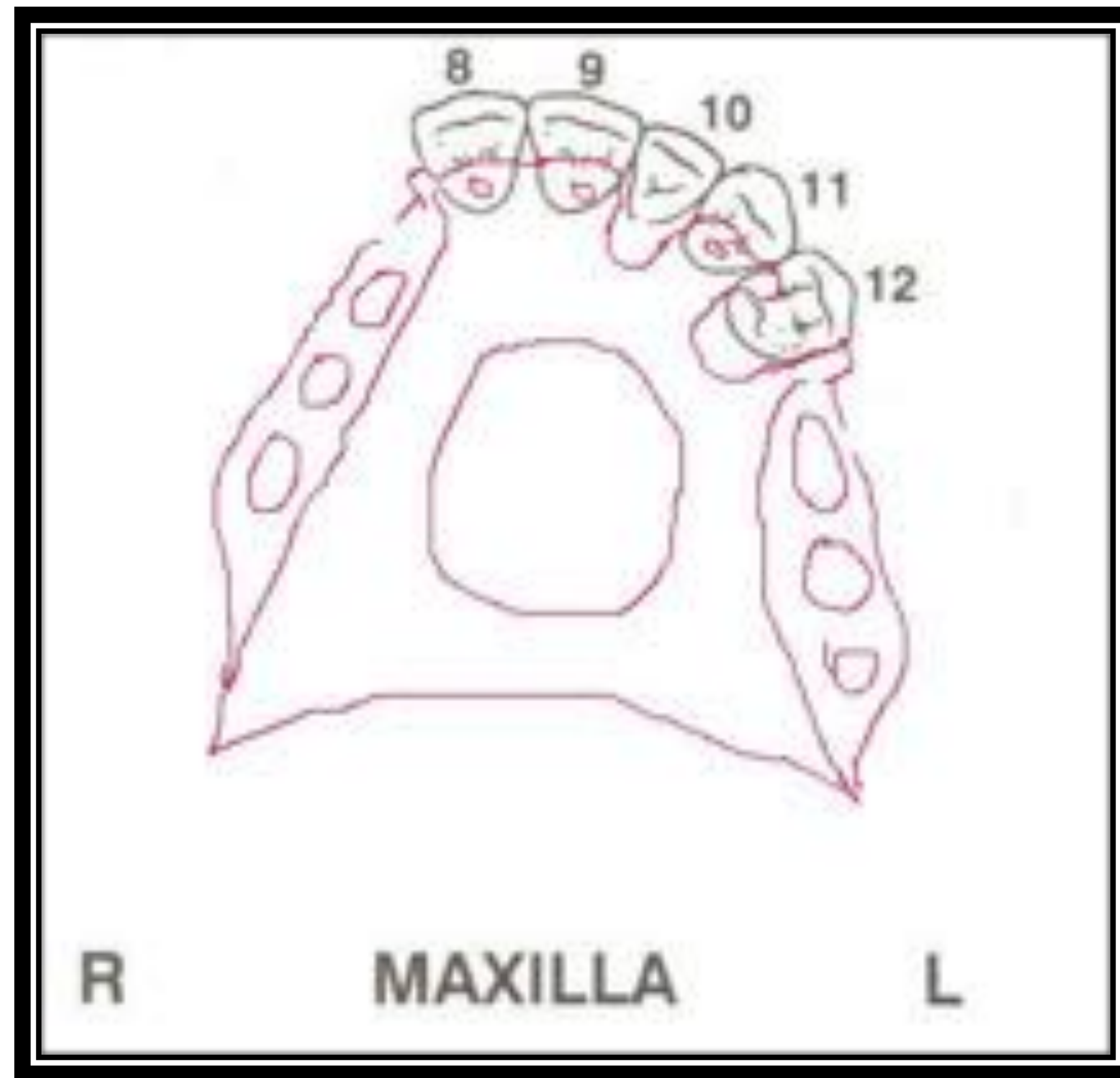


RPD Design Sequence:

1. Rests

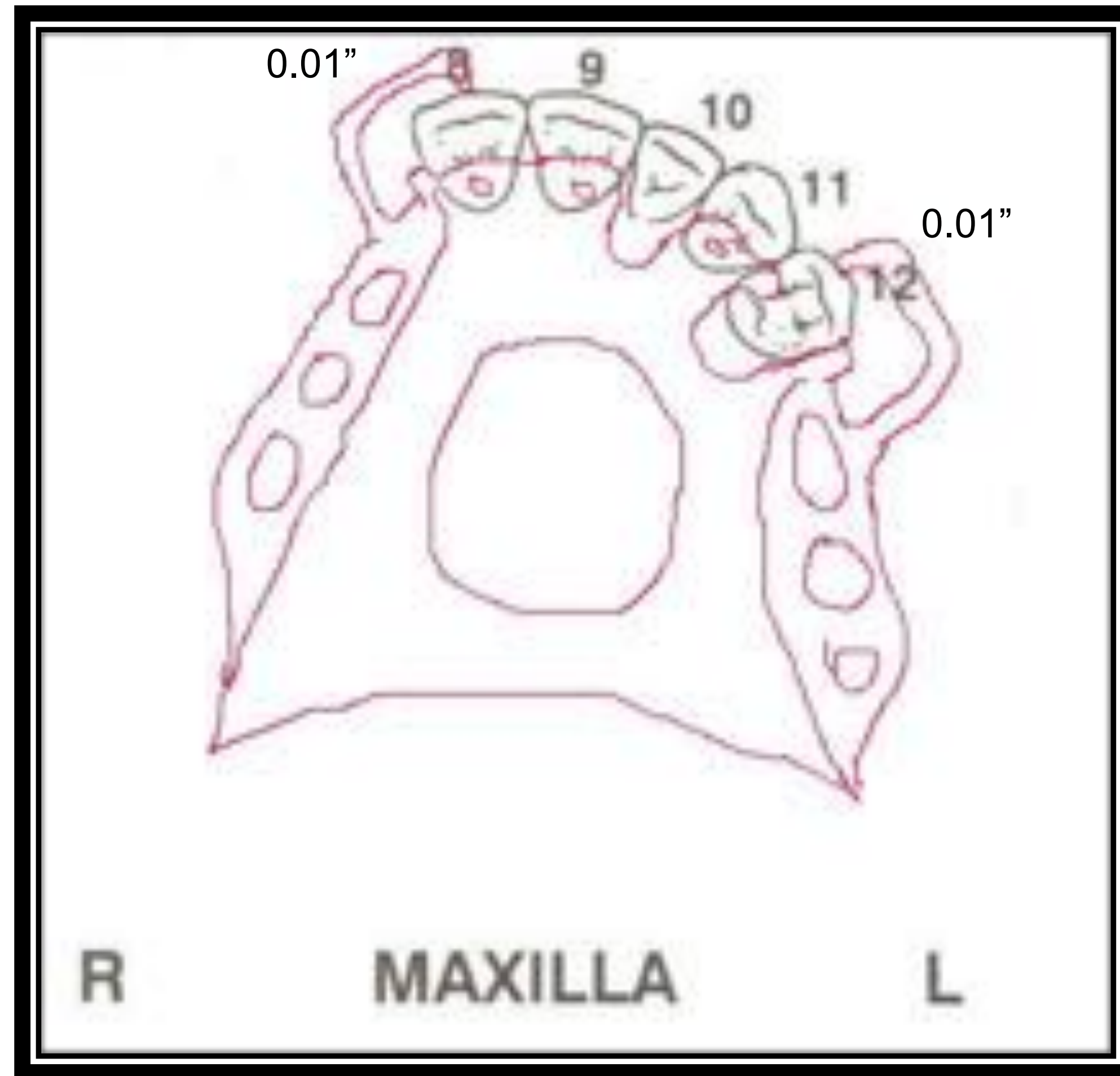
2. Proximal plates/minor connector

3. Major connector



RPD Design Sequence:

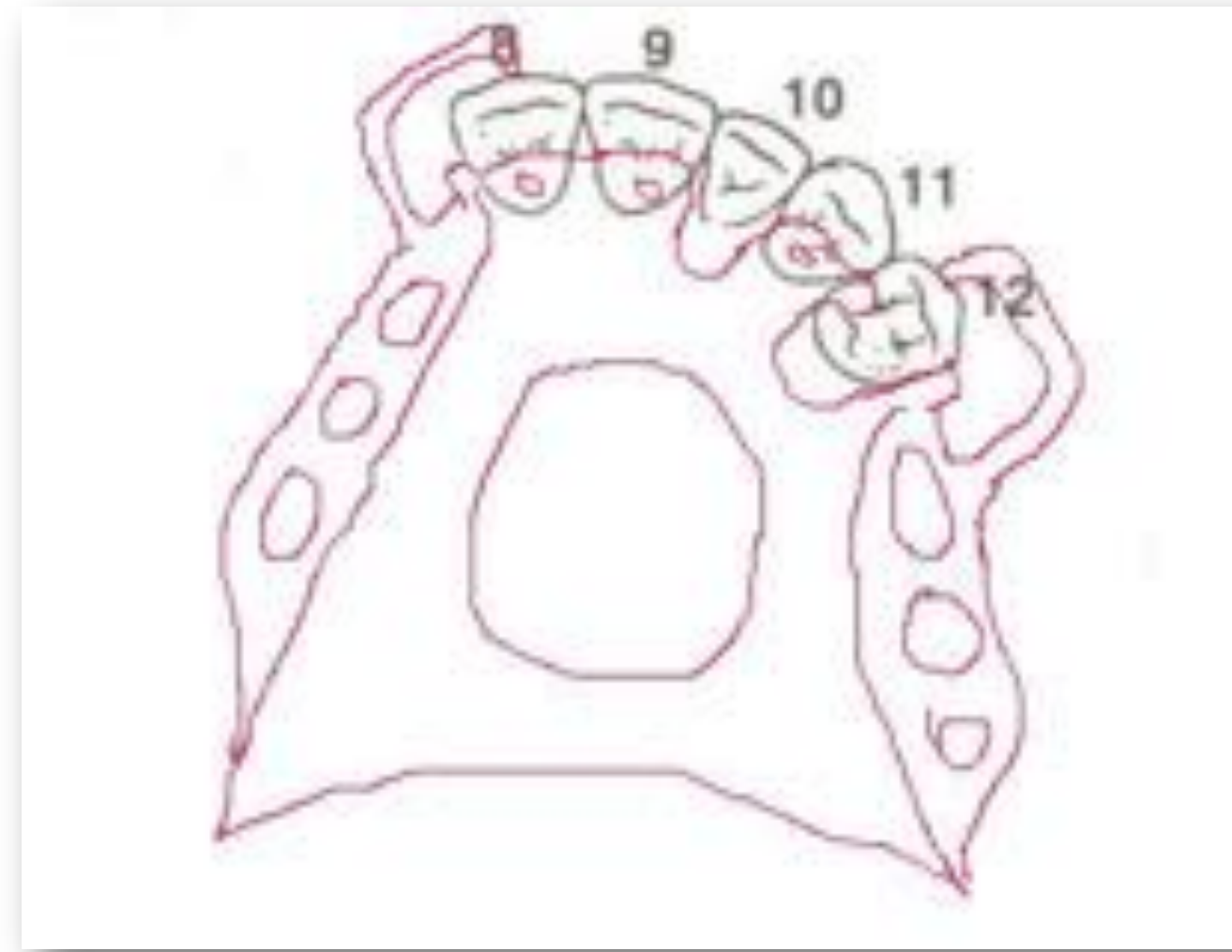
1. Rests
2. Proximal plates/minor connector
3. Major connector
4. Denture base connector



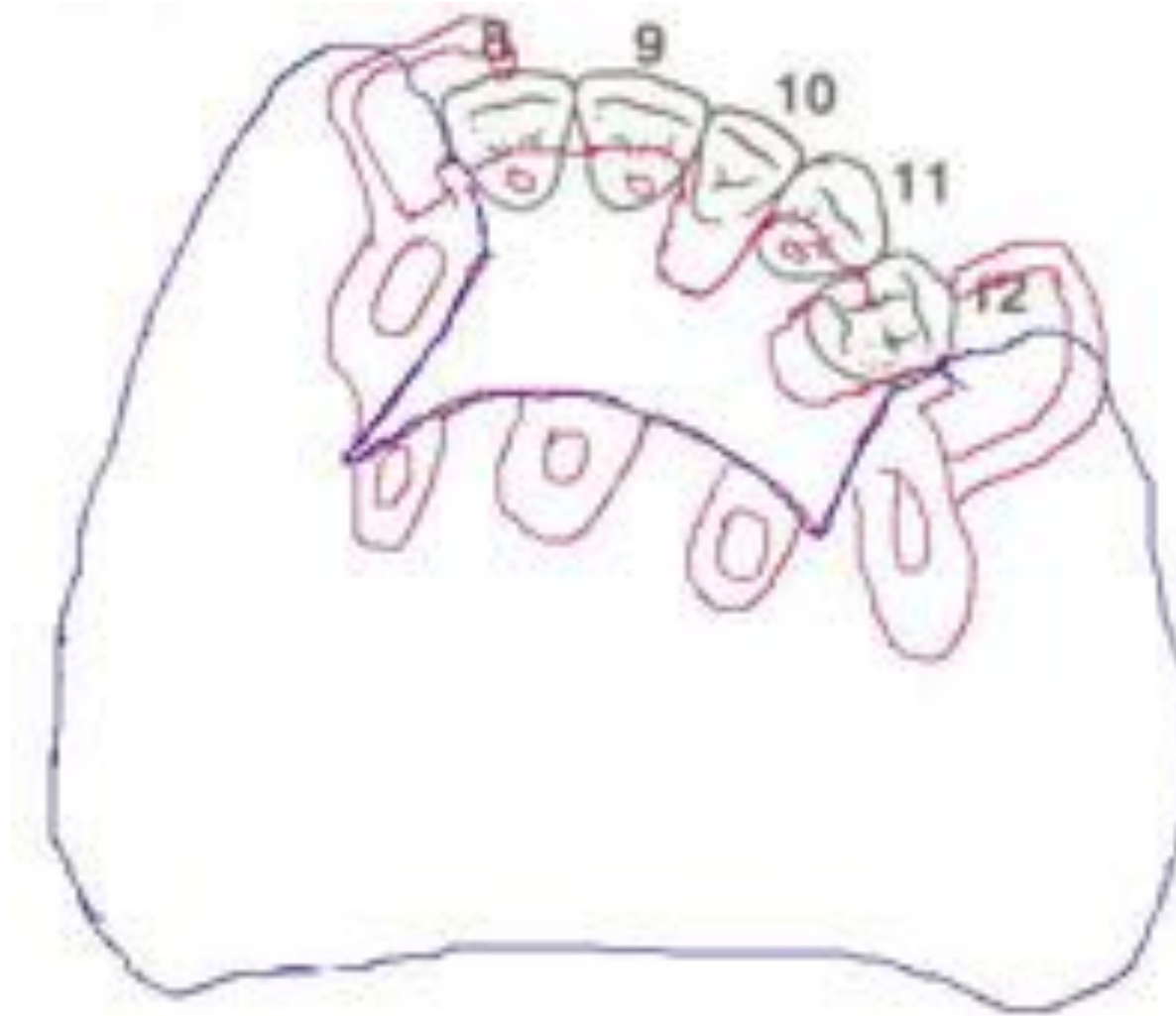
RPD Design Sequence:

1. Rests
2. Proximal plates/minor connector
3. Major connector
4. Denture base connector
5. Retainers

Choice of Major Connectors:



Anterior-posterior
palatal strap



Full palate coverage:
Acrylic vs. Metal

Support from **the teeth:**

Number and the
periodontal status of the
remaining teeth

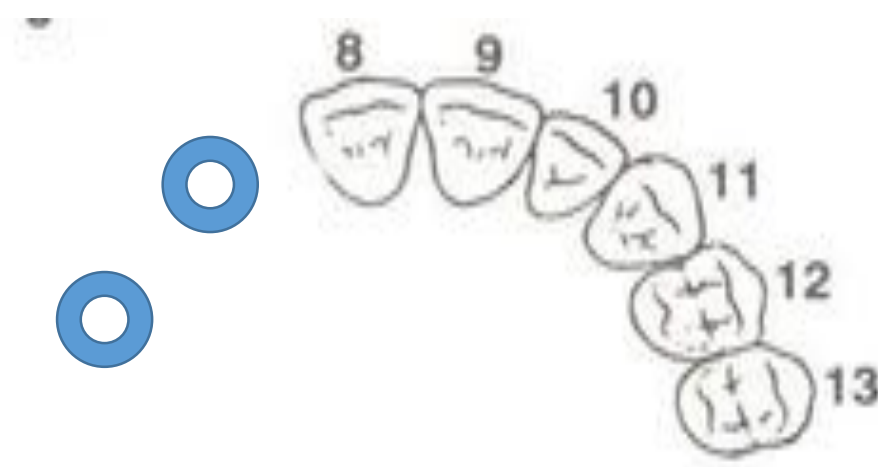
+

Support from **the
mucosa**

=

Sum of Support

Treatment Benefits of This Maxillary Implant-enhanced RPD



R MAXILLA L

Three implants were recommended for this patient due to the large palatal defect (decreased mucosal support)

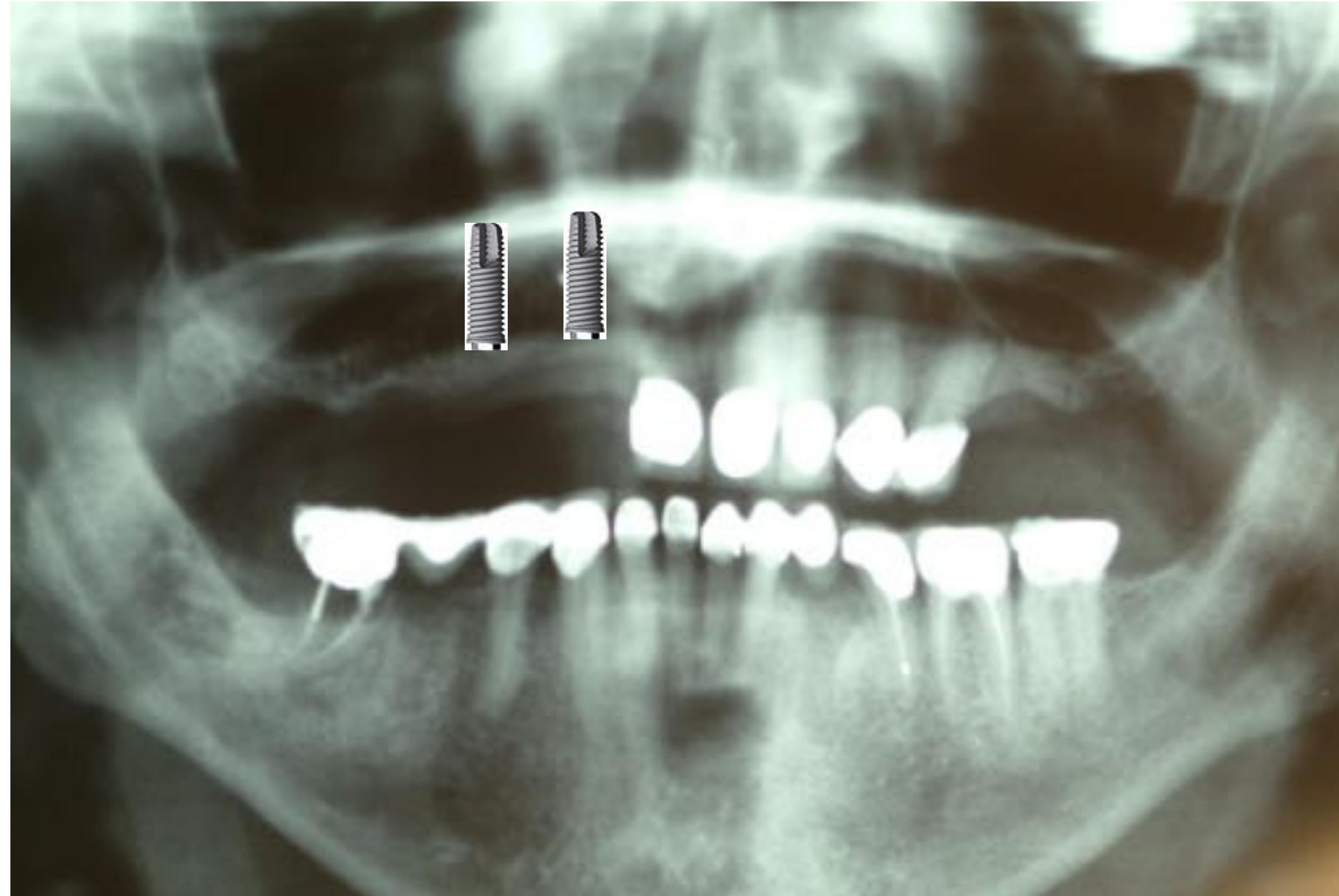
Adding implant to:

1. More even and equal distribution of RPD abutment for support and stability
 2. Attachment(s) on implant(s) to provide retention and eliminate retainer on #8
- More optimal esthetic result

Number of implants needed (1, 2, or 3?)

1. Biomechanical consideration to avoid implant overloading
2. Anatomic consideration
3. Treatment cost
4. Available inter-arch space

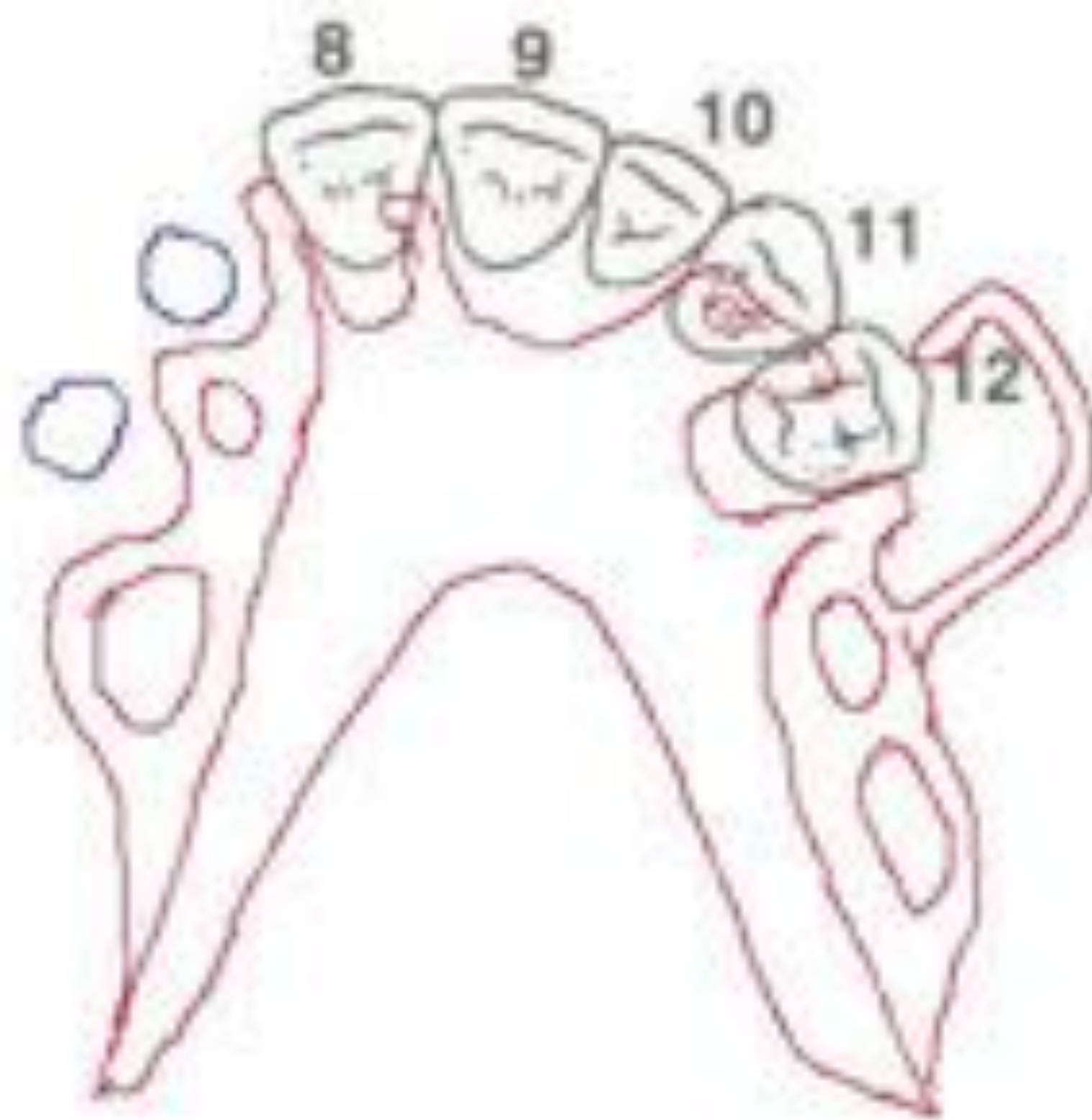
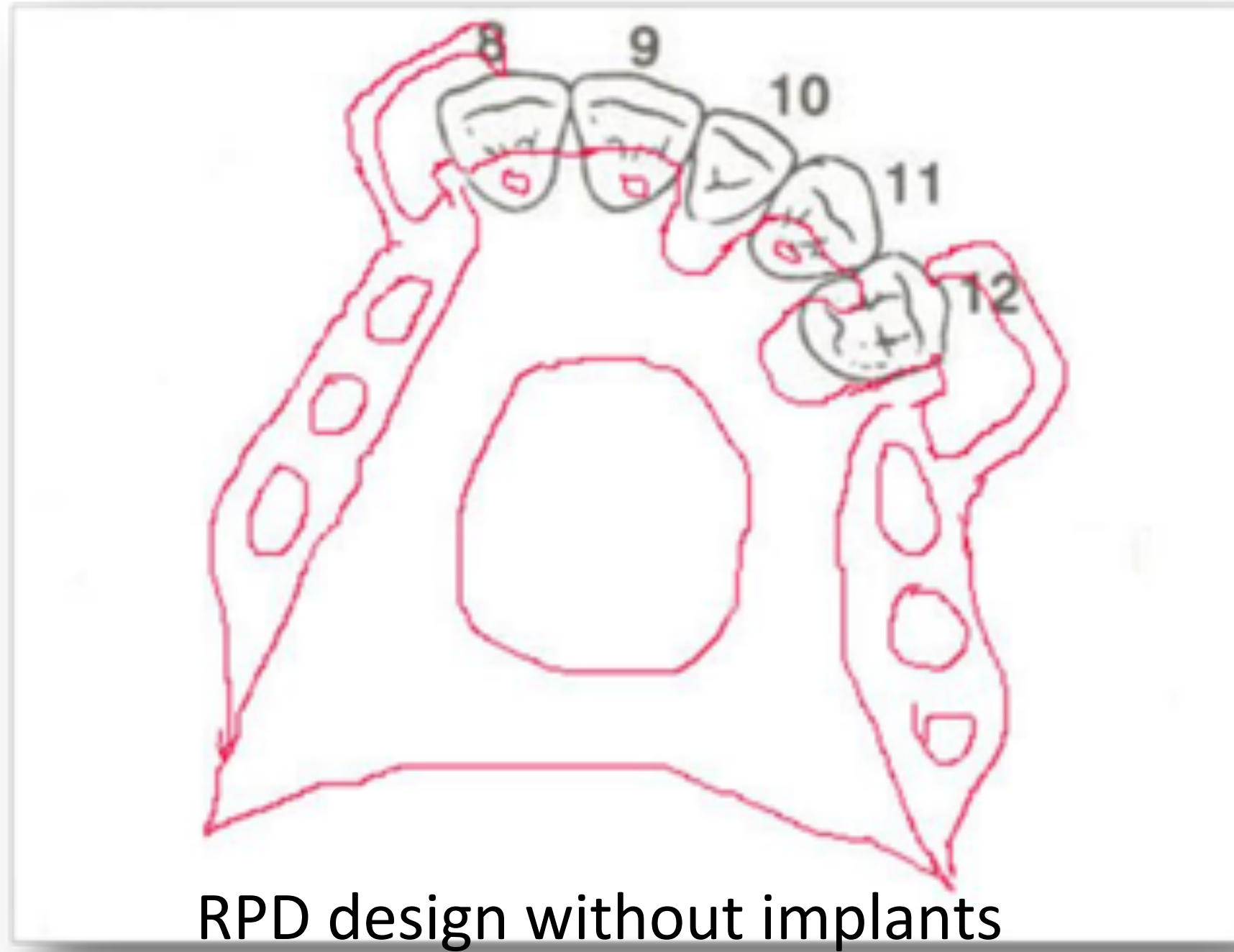
Case 1: Mr. JC



Maxillary veneer graft

Two implants (4mm wide
11.5 mm long) placed
at #5 and 7 sites

Case 1: Mr. JC



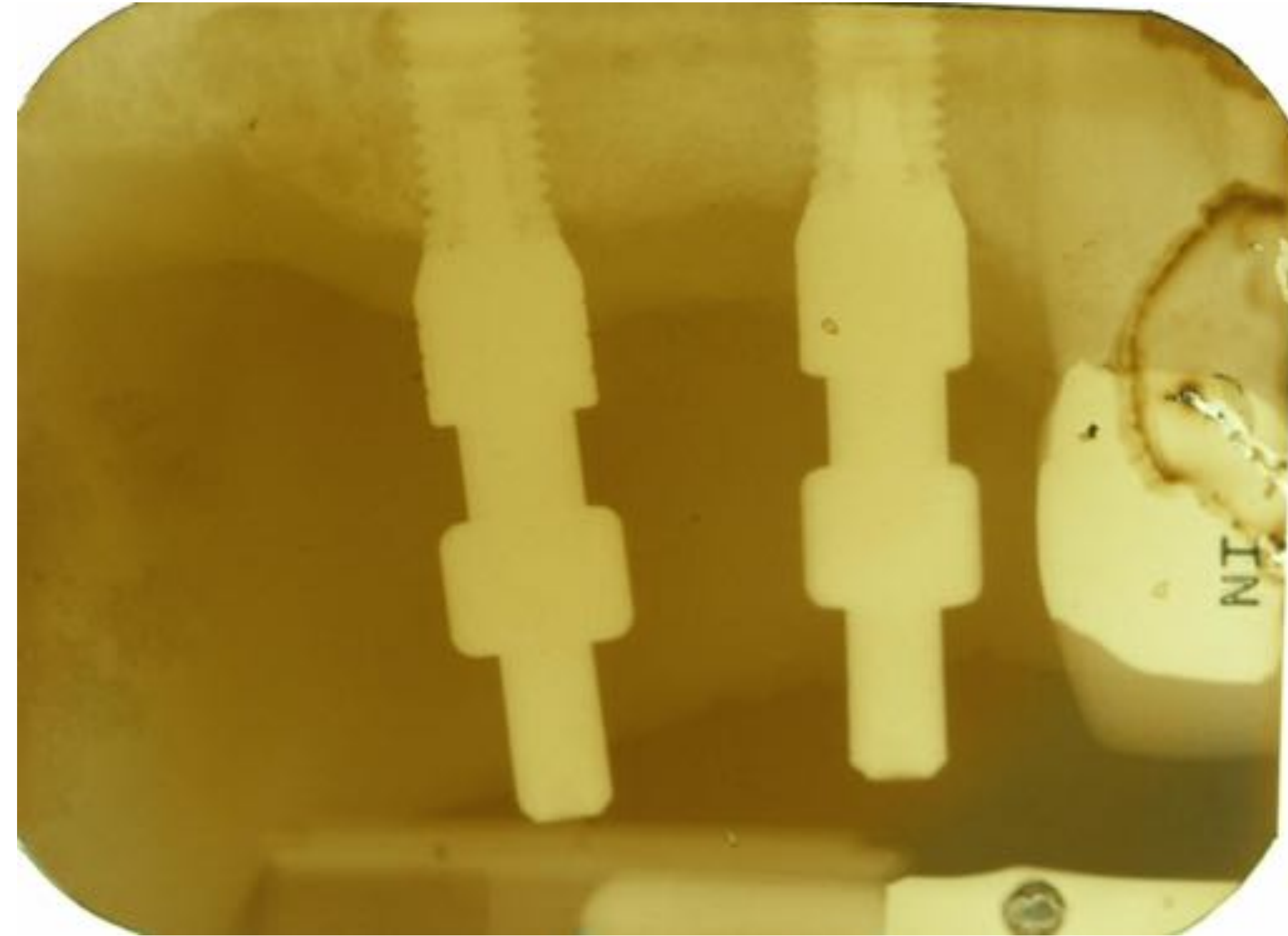
R

MAXILLA

L



November 2008



Pick-up Impression (Open Tray) at implant fixture level



5mm cuff height

3mm cuff height



About ERA attachments...

0.5mm less vertical space and has a diameter of almost 1.0mm less



Different cuff heights, compatible with major implant systems



7° tolerance



Three additional
5°, 11°, and 17°
angled attachments

About ERA attachments...



Black = Processing Male

White = Light Retention

Orange = Moderate Retention

Blue = Heavy Retention

Grey = Very Heavy Retention

Yellow = More retention than grey

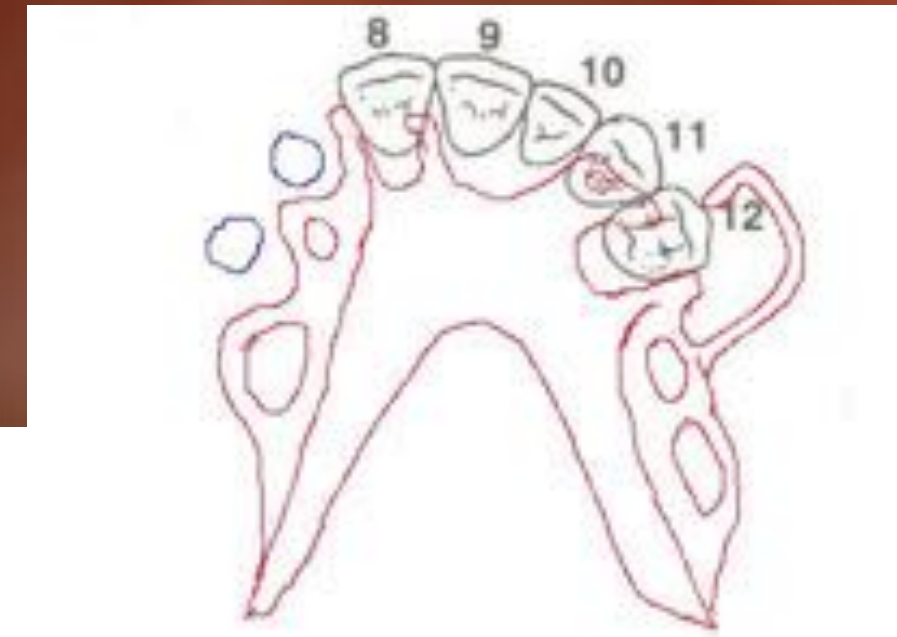
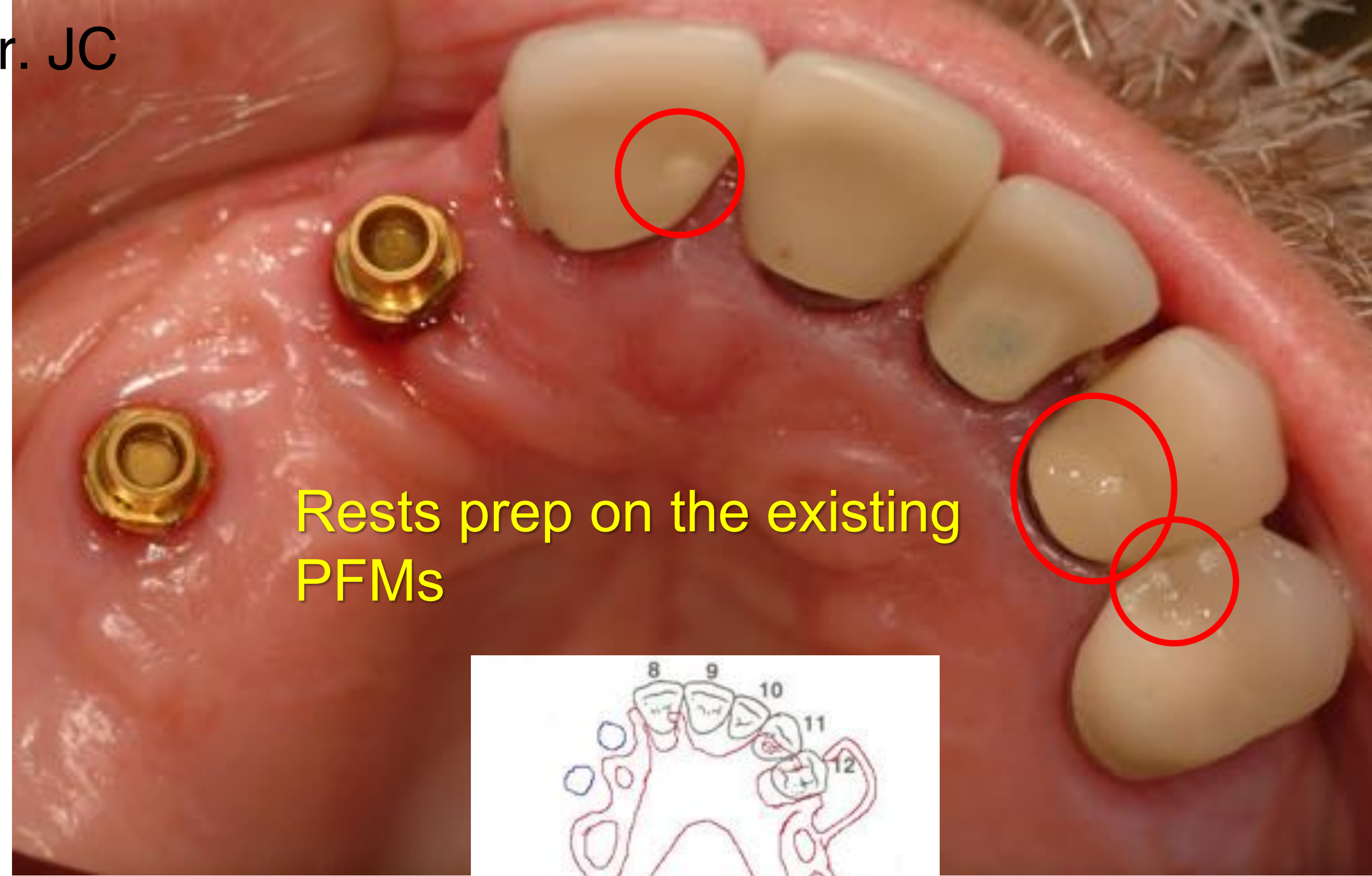
Red = The Most retentive

0.4 mm vertical resiliency

Case 1: Mr. JC



Case 1: Mr. JC



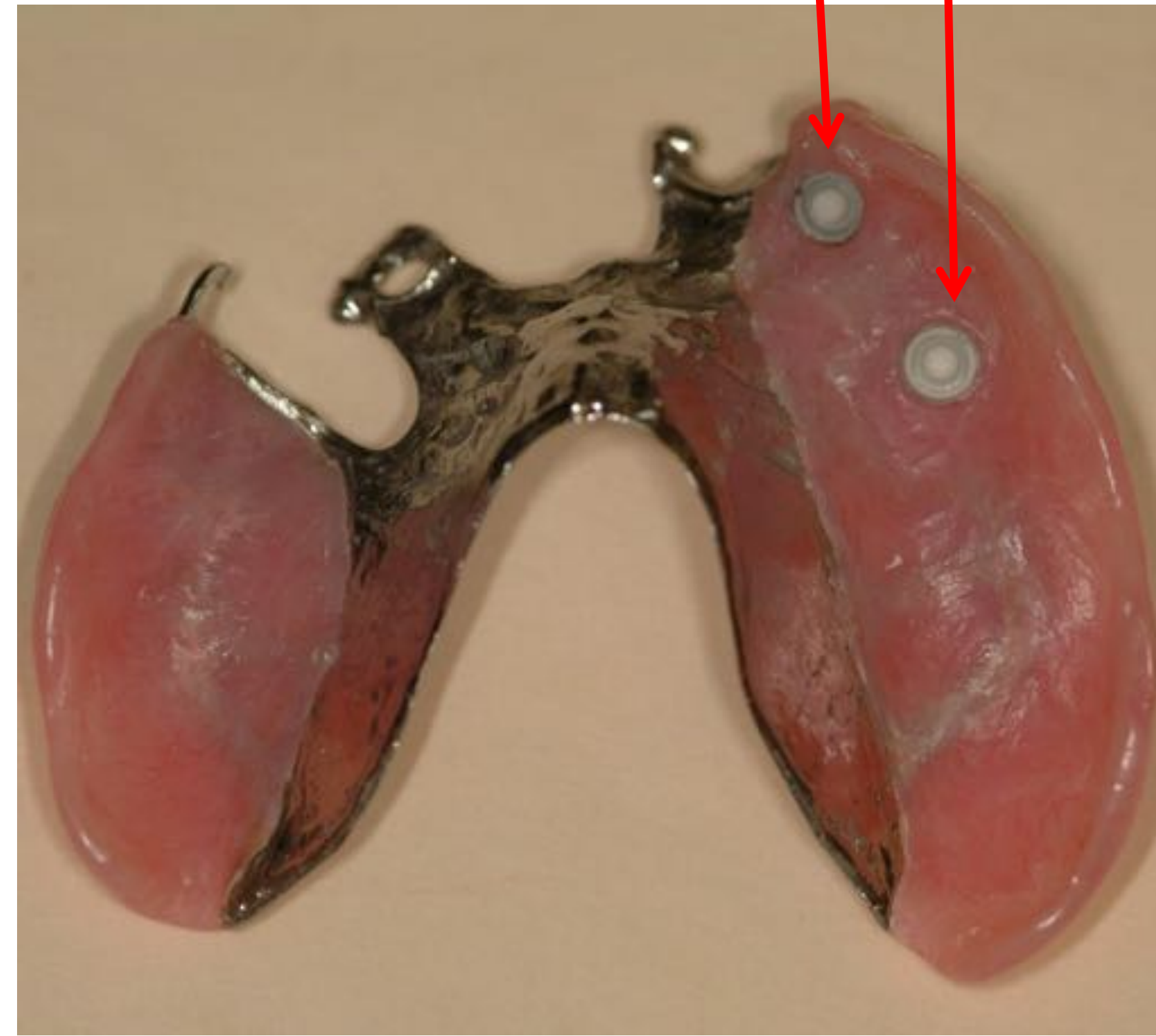
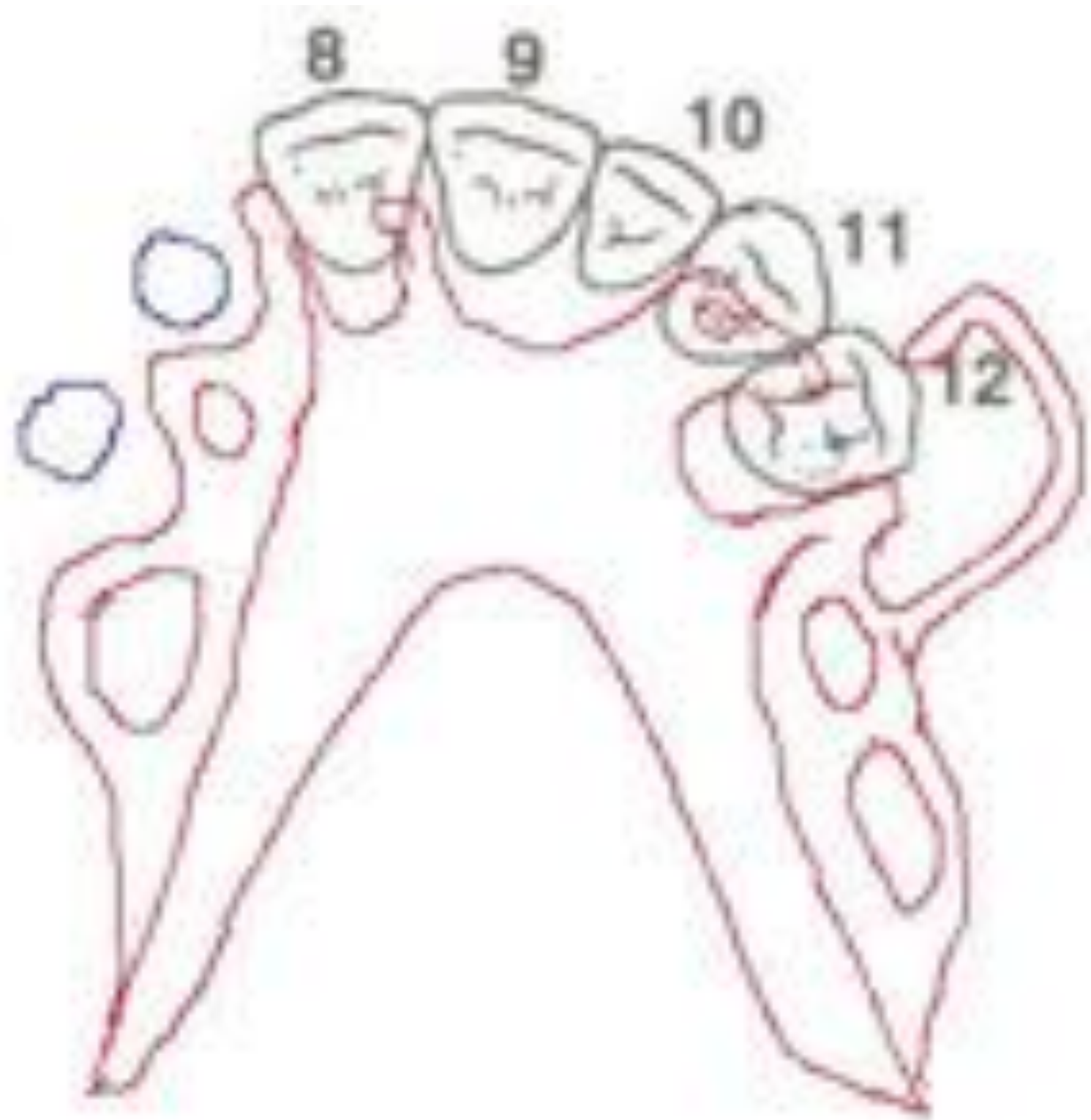
R MAXILLA L

Case 1: Mr. JC



Case 1: Mr. JC

White-colored ERA plastic insert
- the least retentive one



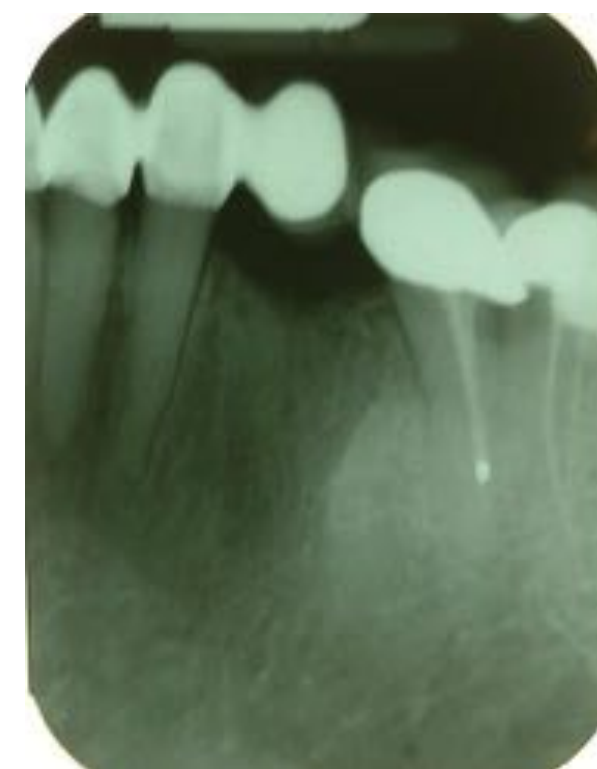
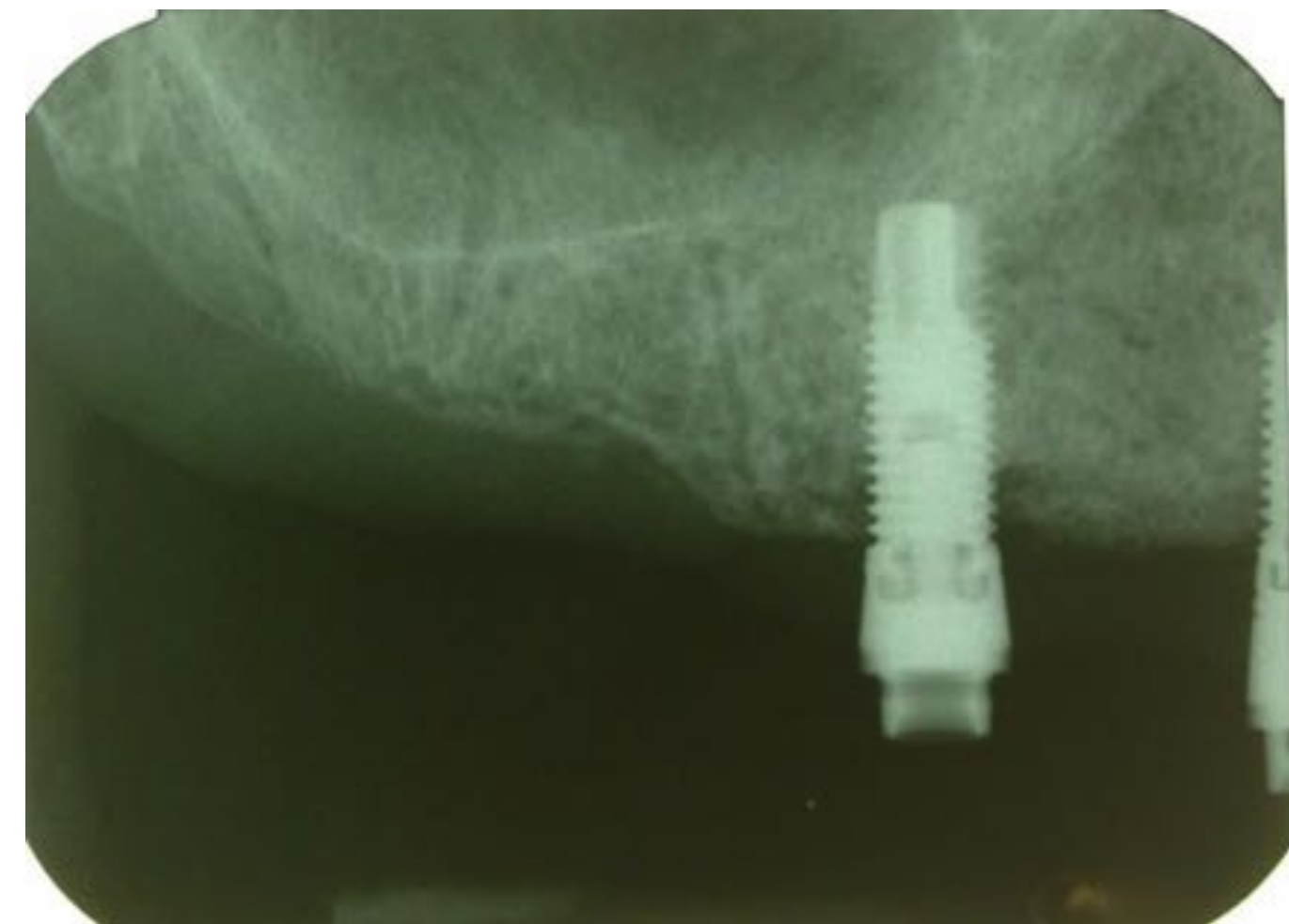
Case 1: Mr. JC



Case 1: Mr. JC



October 2010
(2+ year Follow UP)



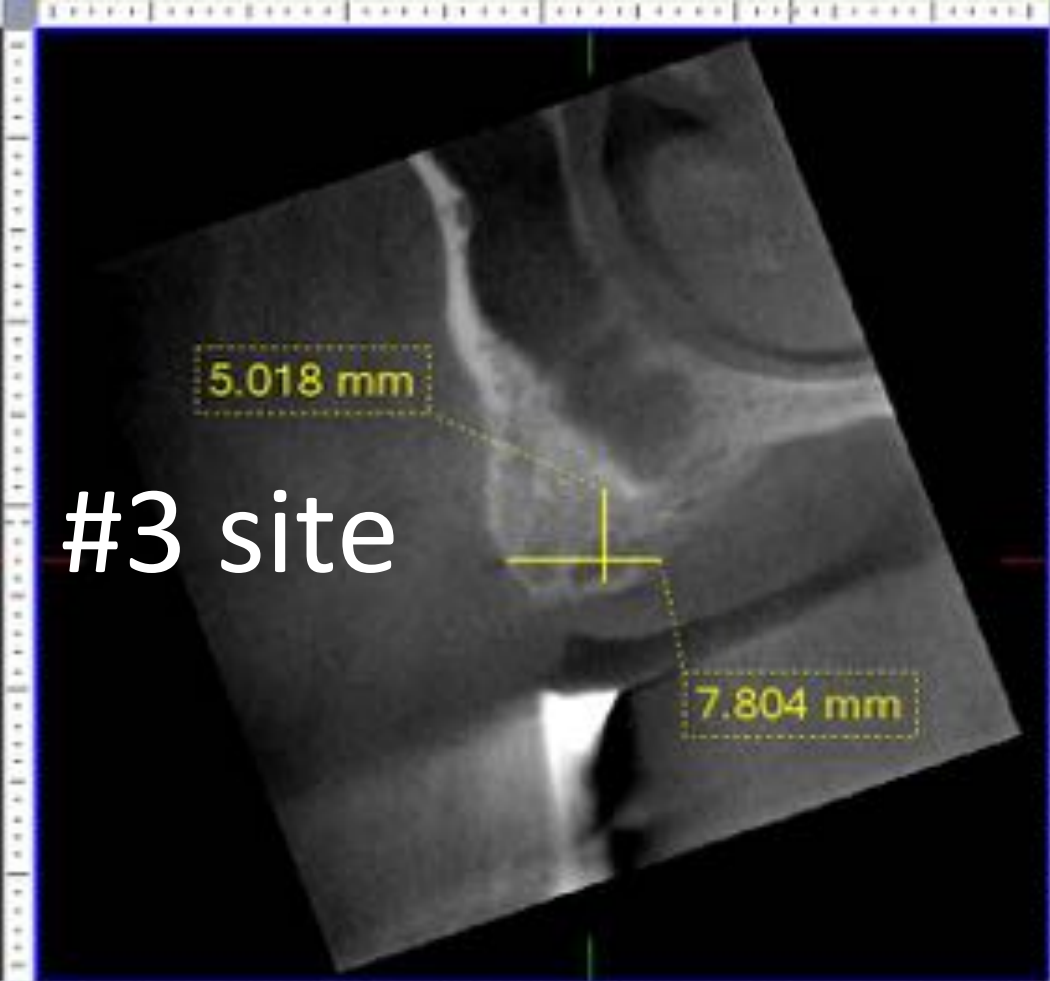
Case 2: JK



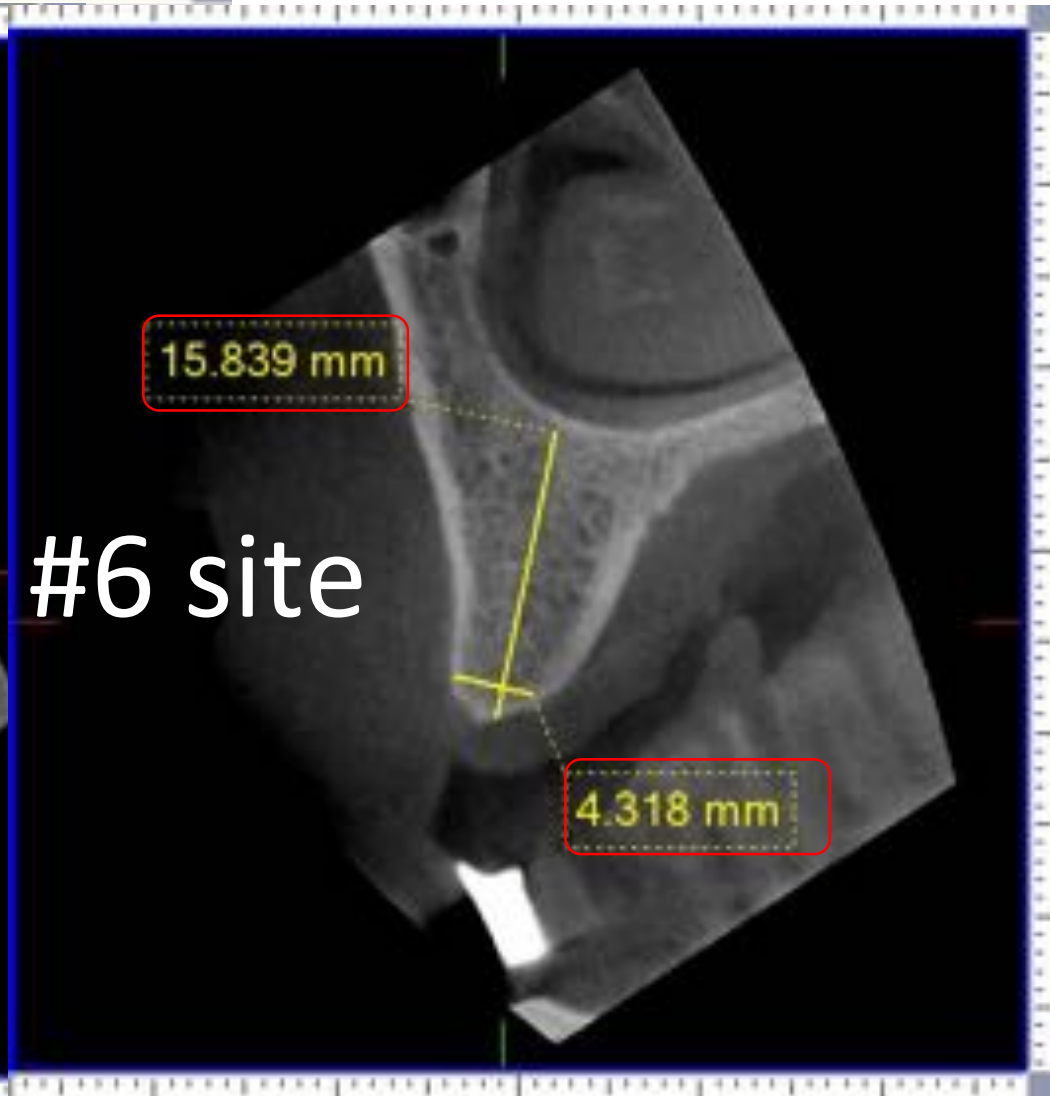
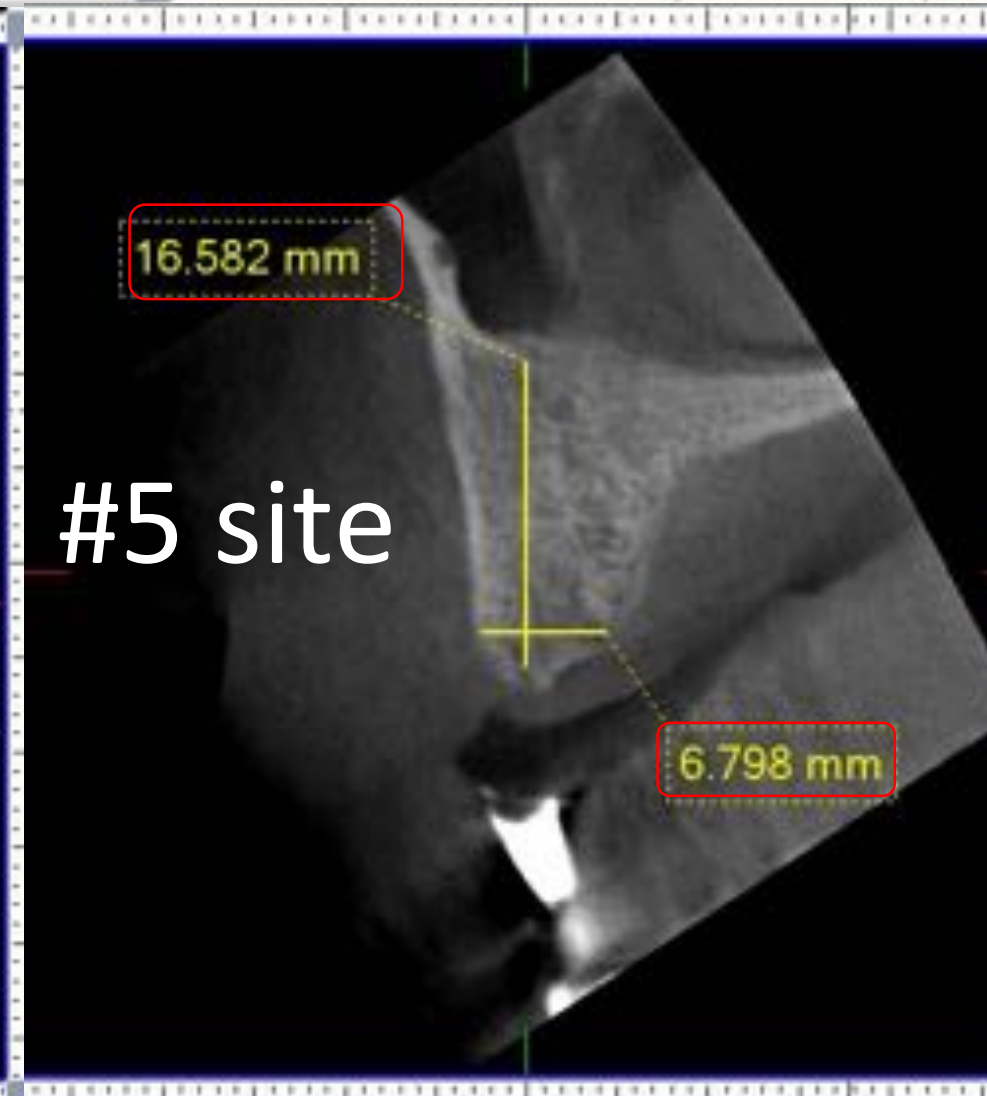
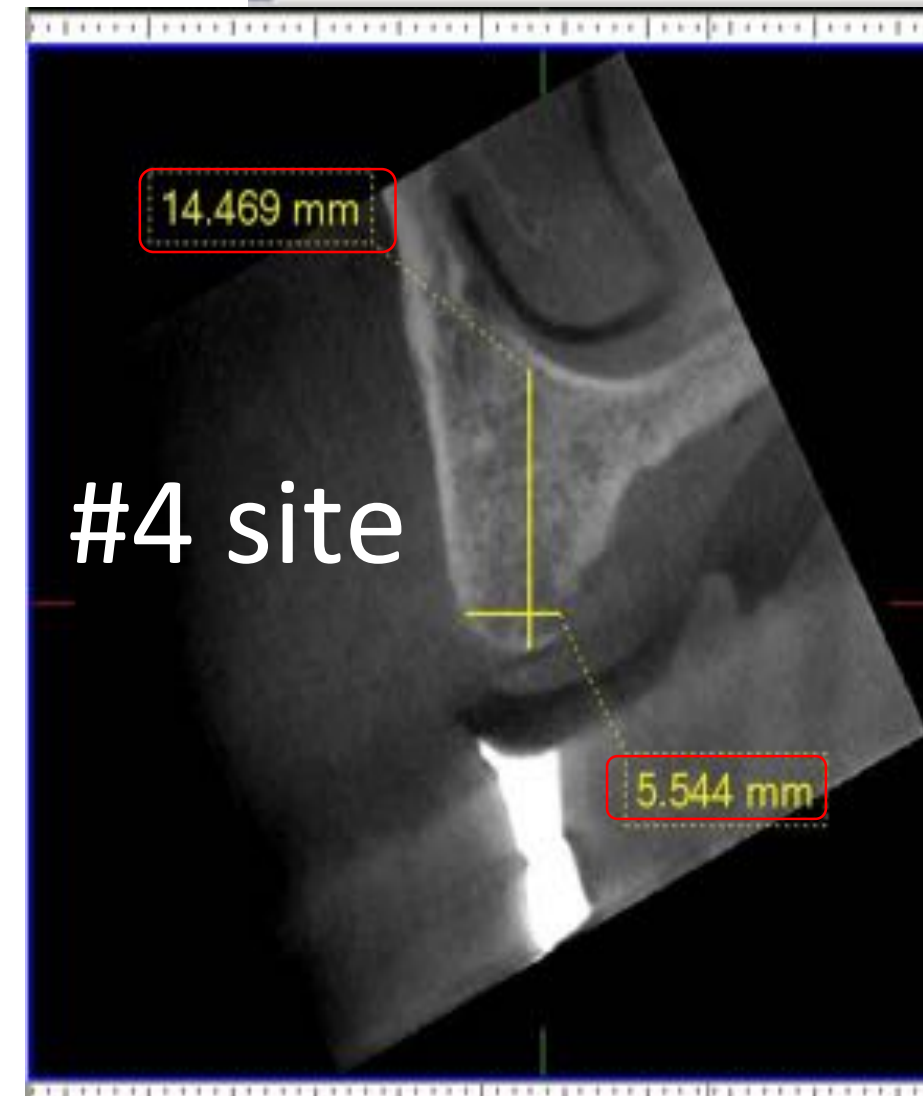
Pt JK, 80 y/o male, presented for implant consultation for implant-supported FPD
Medical history was significant for gout, DM II, CAD, MI, angioplasty/stent placement, CHF and Implantable Cardioverter Defibrillator (ICD) placement

Bilateral sinus lift and graft/implants to replacement 3, 4, 5, 6, 7, 12, 13, 14, and (#2/15)

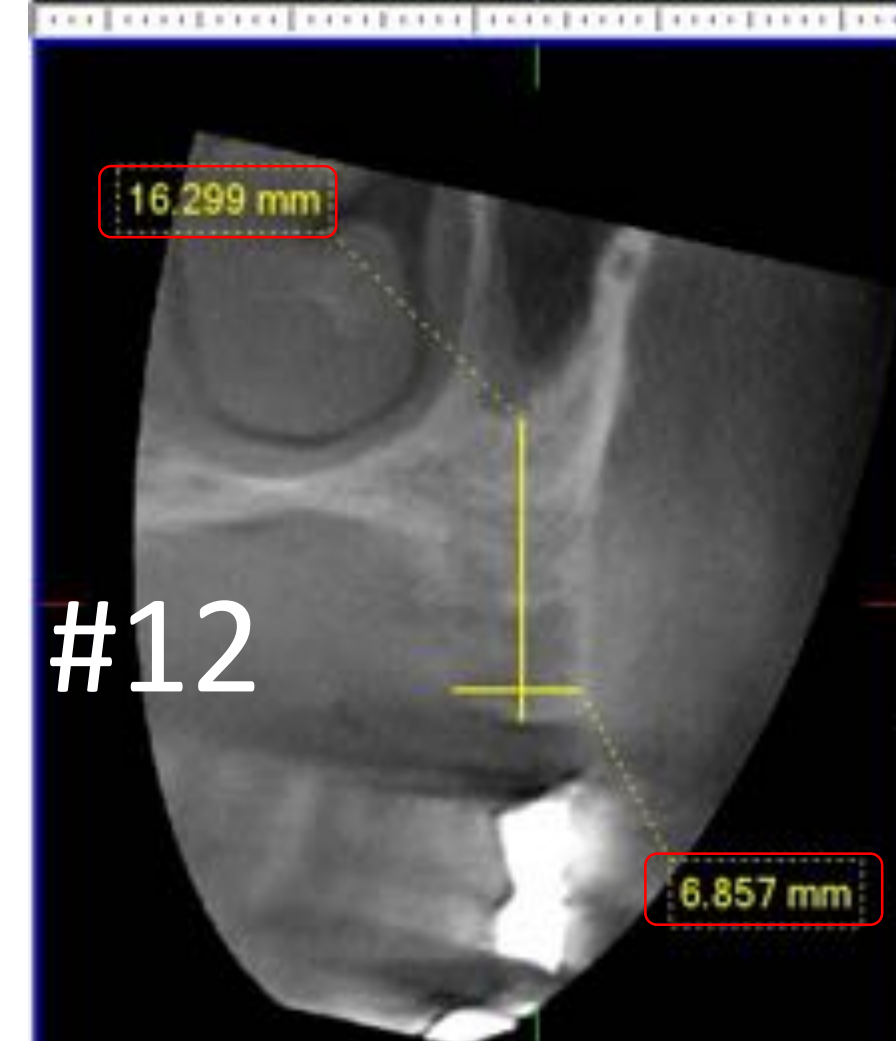
Case 2: JK



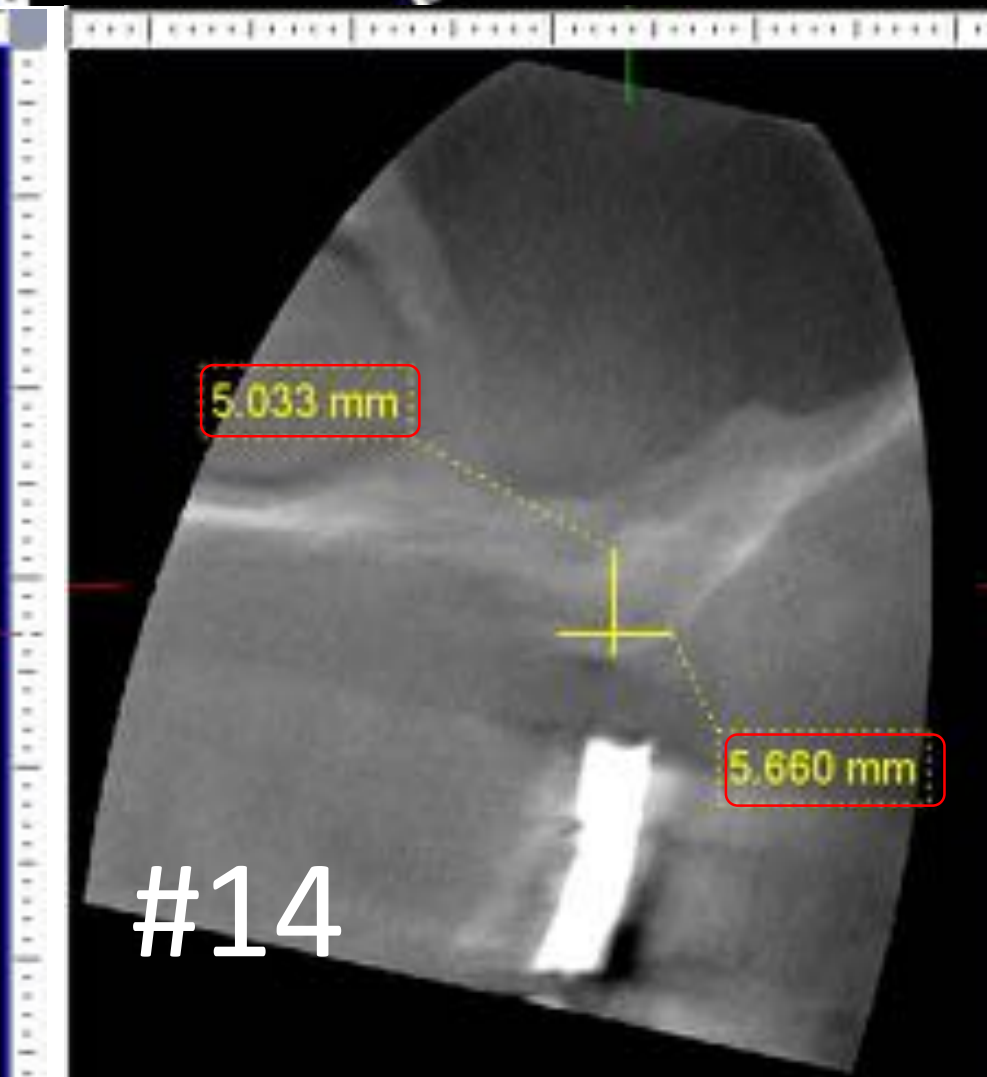
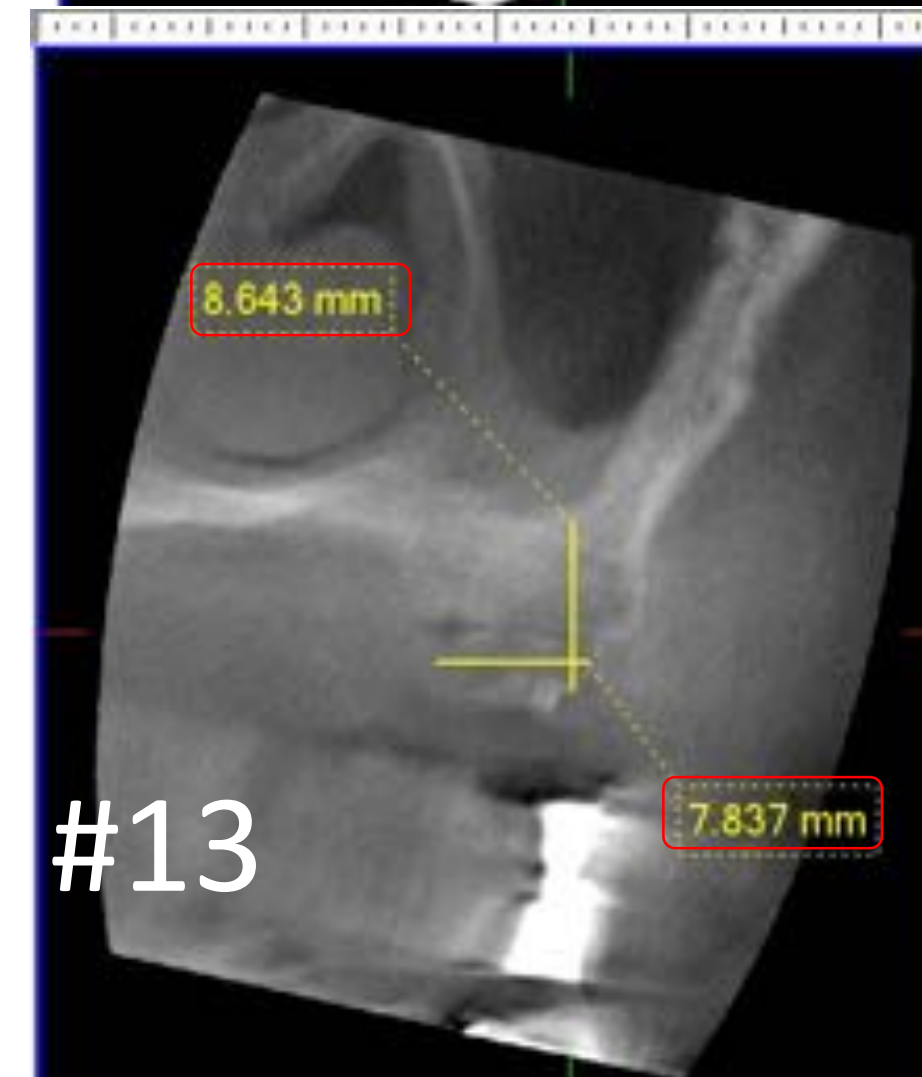
Maxillary
Right posterior
Quadrant
CT Evaluation



Case 2: JK



Maxillary
Left posterior
Quadrant
CT Evaluation

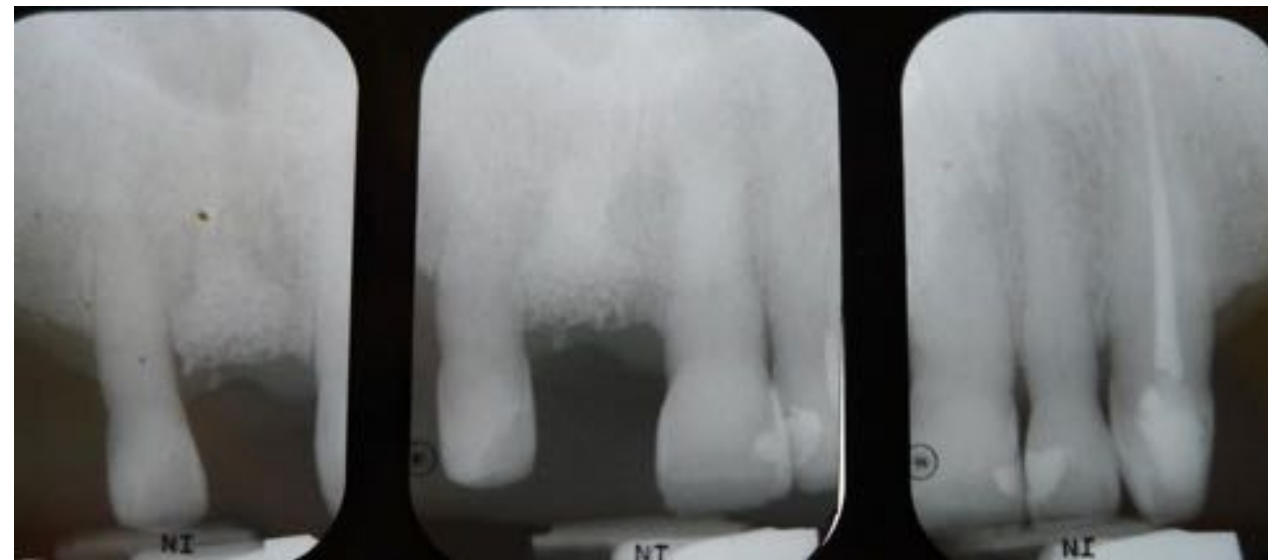


#13 and 14 sites
revealed
inadequate bone
volume and require
sinus graft

Case 2: JK



Due to complex medical history, pt requested to take small steps for each surgery.



#8 was extracted and socket preservation with Bio-Oss.

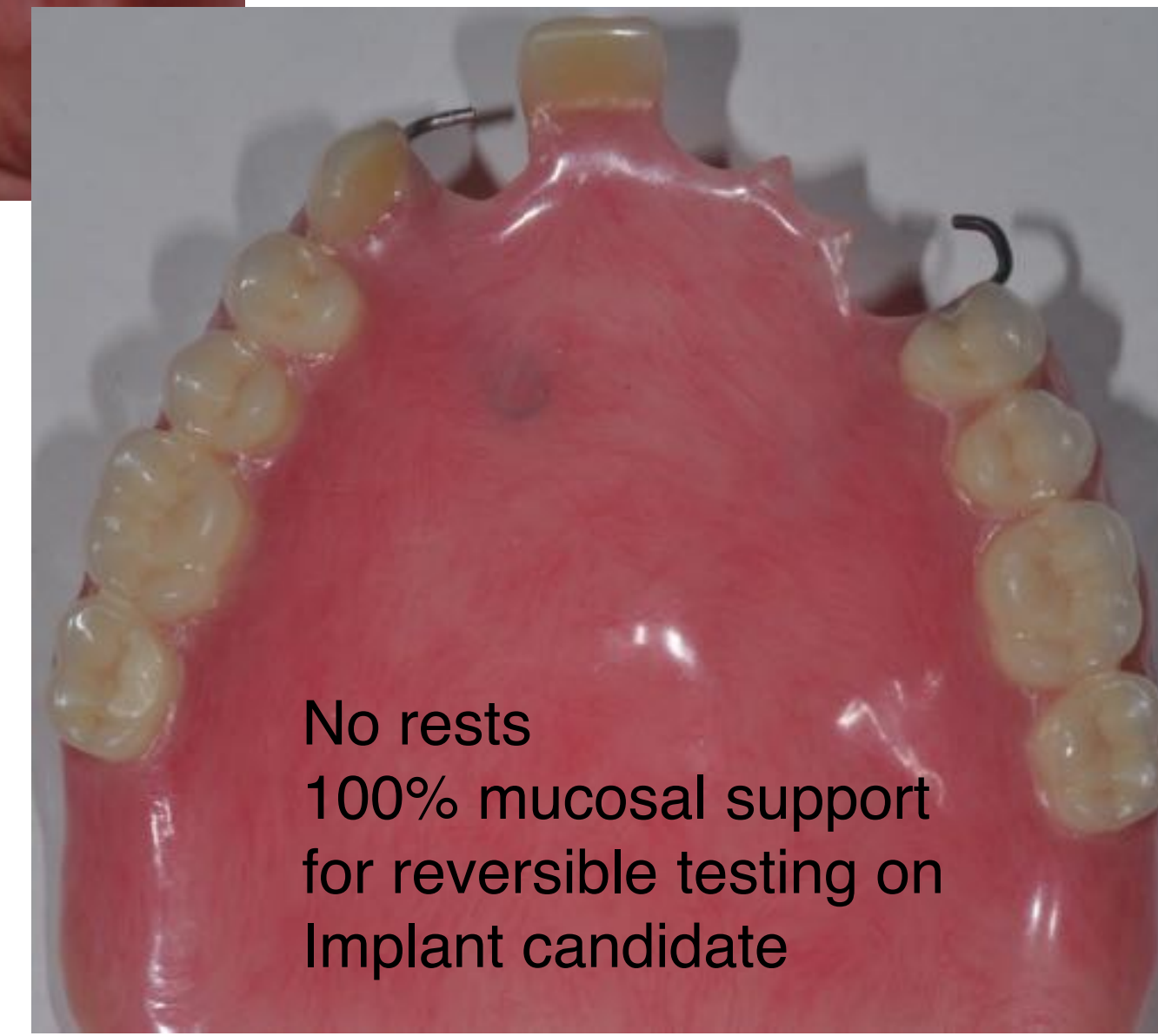


Case 2: JK

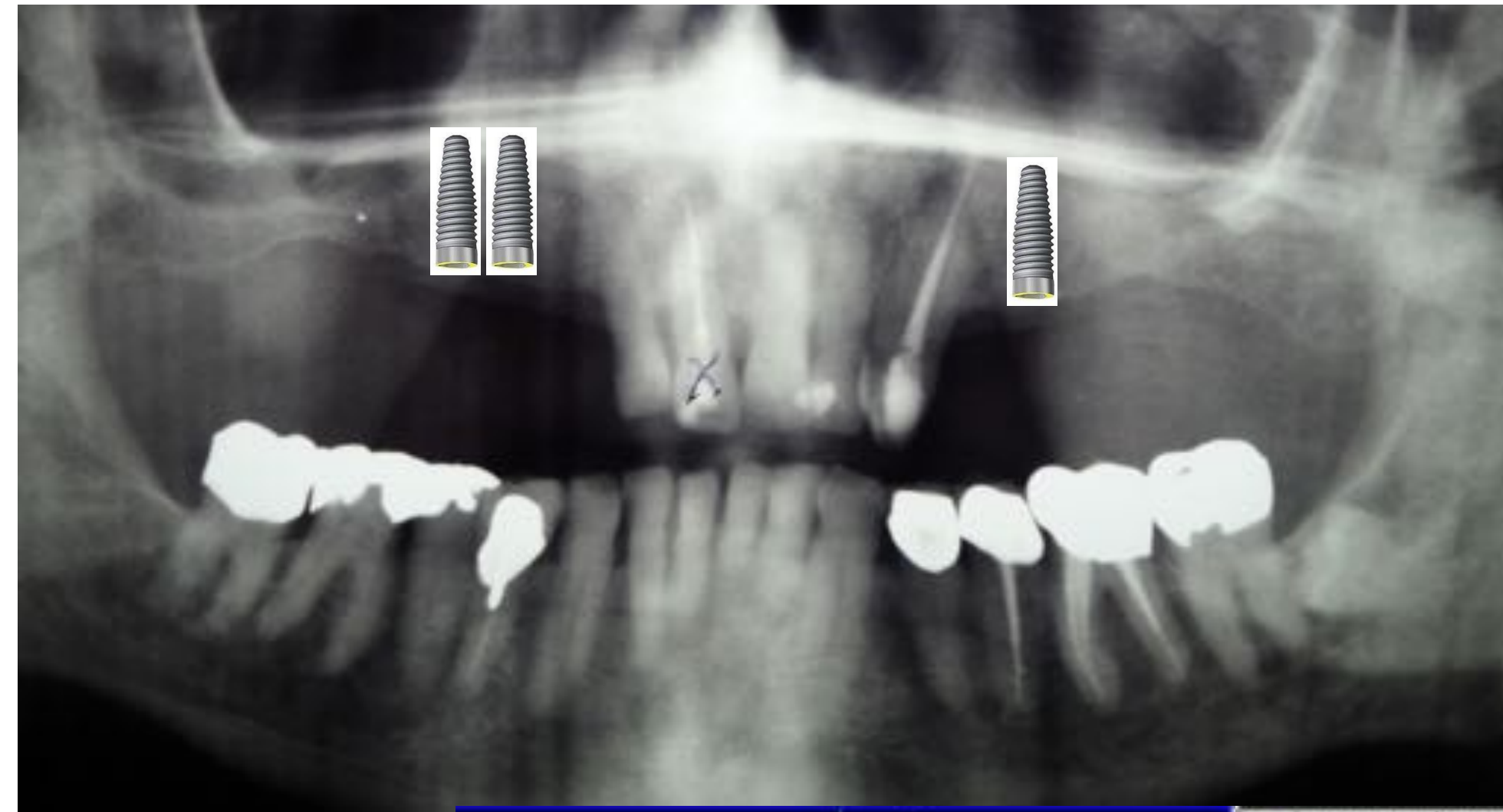


Maxillary Interim Partial
to reevaluate patient's
perceived satisfaction
toward to removable
prosthesis

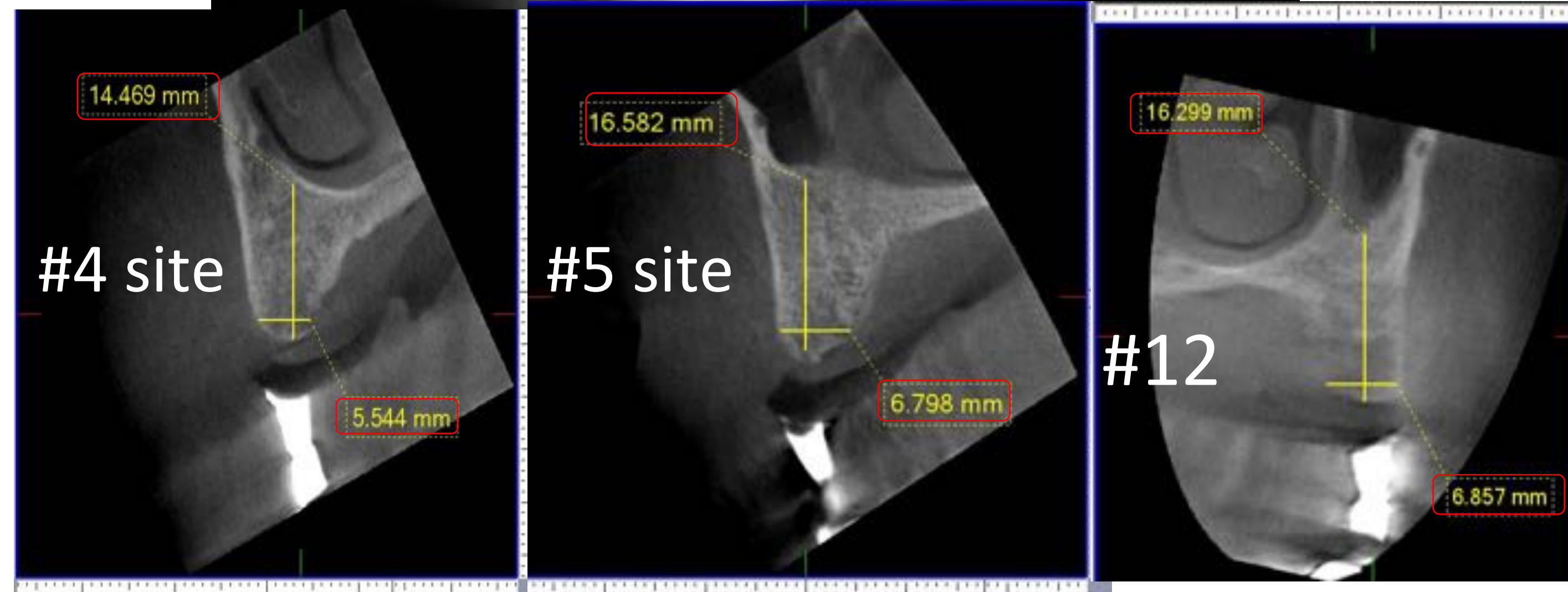
After 6-month pt was satisfied with the interim partial and the definitive pros plan was confirmed for **implant-assisted RPD**



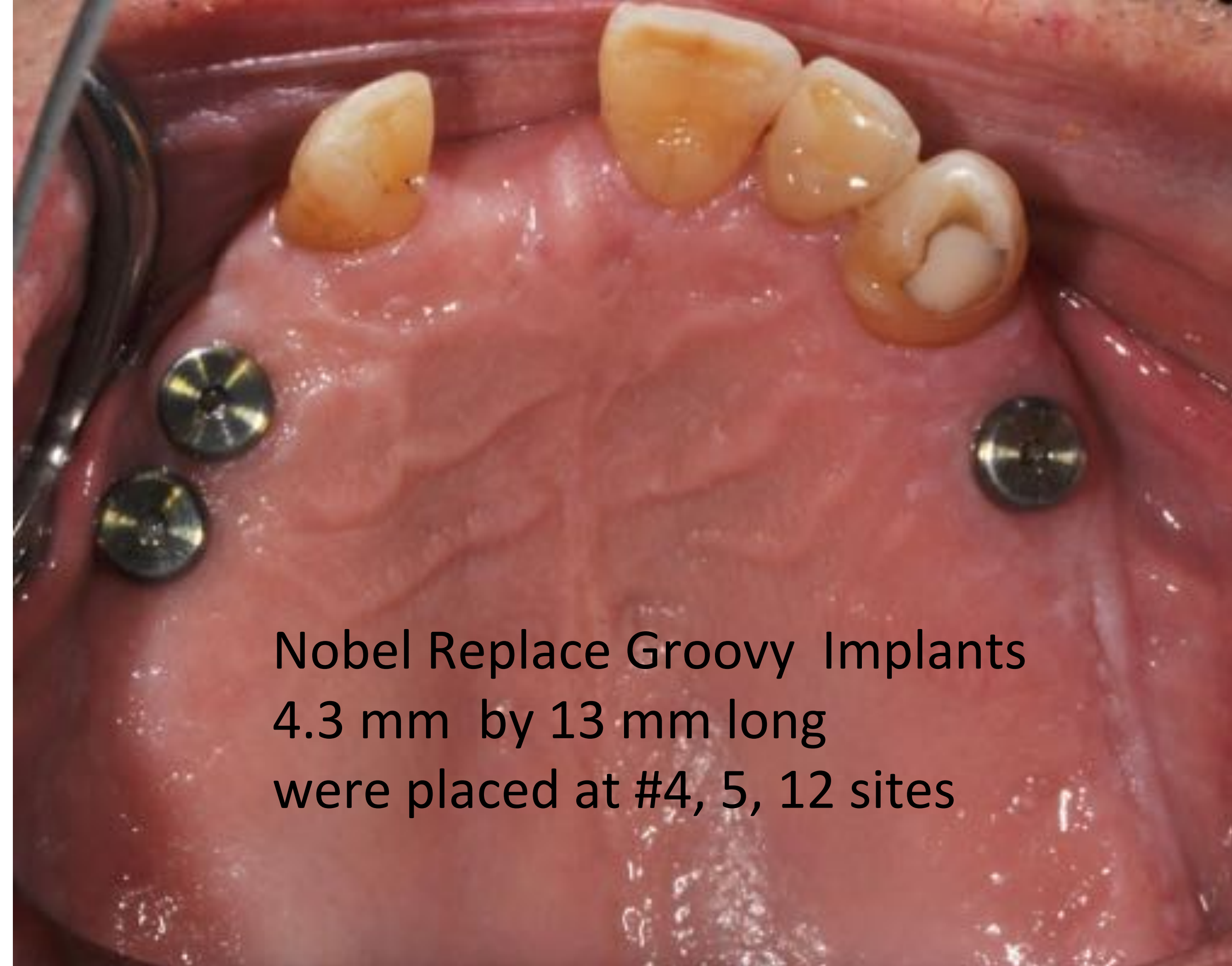
Case 2: JK



NobelReplace
Groovy Implant
4.3 mm by
13 mm long

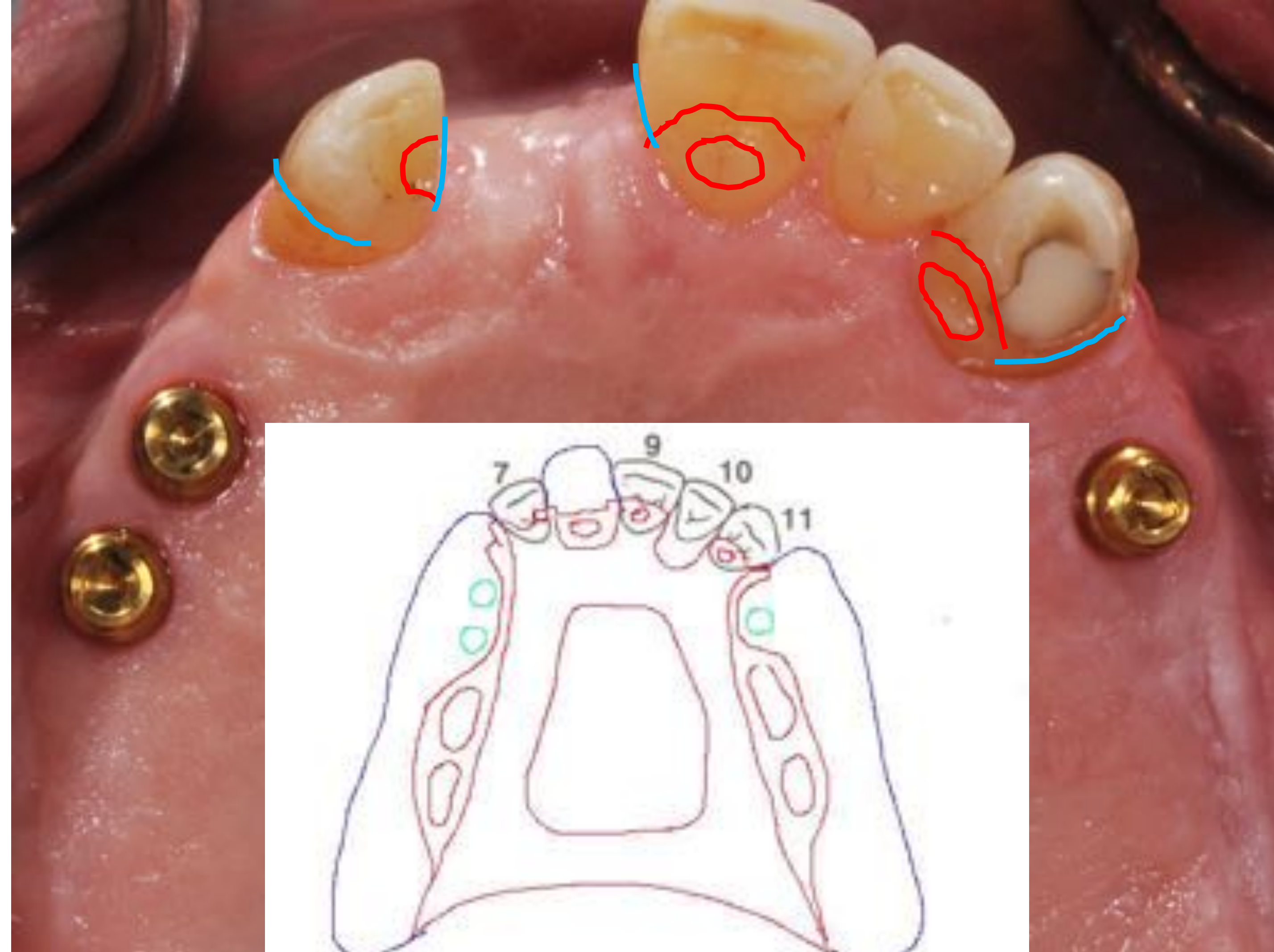


Case 2: JK



Nobel Replace Groovy Implants
4.3 mm by 13 mm long
were placed at #4, 5, 12 sites

Case 2: JK



Case 2: JK



Design Principles for Implant-assisted RPD

Rests

Minor connectors/Proximal plates

Major connectors

Denture connectors

Retainers

Positive rests

#7: mesial circular concave rest

#9: cingulum rest

#11: cingulum rest



Case 2: JK



Locator
abutment

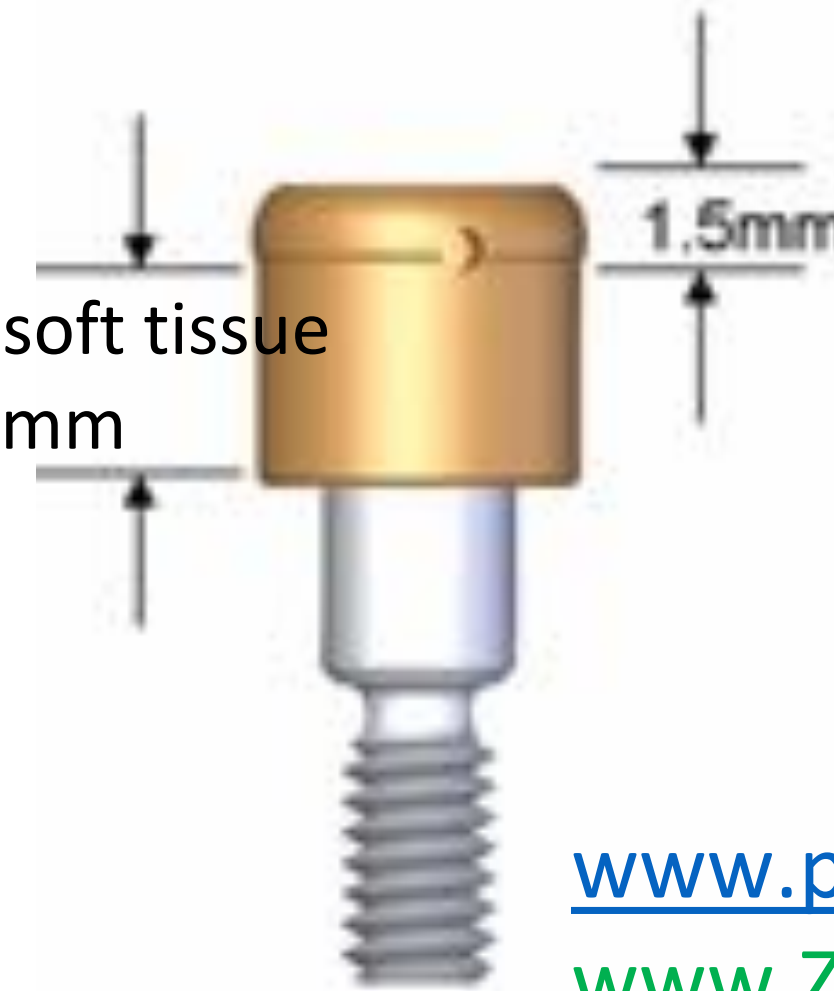


Locator Attachment Implant



0-6 mm

Order by soft tissue height in mm



www.preat.com/locimplant.htm

www.ZestAnchors.com

Case 2: JK

Final Impression for RPD framework

Implant impression can be obtained with open tray impression copings at the implant fixture level during **the RPD framework impression** **OR** **the altered cast impression procedure**



Case 2: JK



Case 2: JK



Interarch Space Consideration



Case 2: JK



Implant positions were obtained at the fixture level during the altered cast impression (open tray impression coping)

Indirect method (lab processing) for Locator attachments to reduce chair time

Black locator pattern for processing

Replace with desirable retention locator pattern (Blue, the least retentive)





Dual Retention 0-10 degrees

(8524) Clear: 5.0 Lbs (2268 Grams)

(8527) Pink: 3.0 Lbs (1361 Grams)

(8529) Blue: 1.5 Lbs (680 Grams)

Implants are relatively
Parallel to each other (up to
20° between implants)



Extended Range

Angle Retention 10-20 degrees

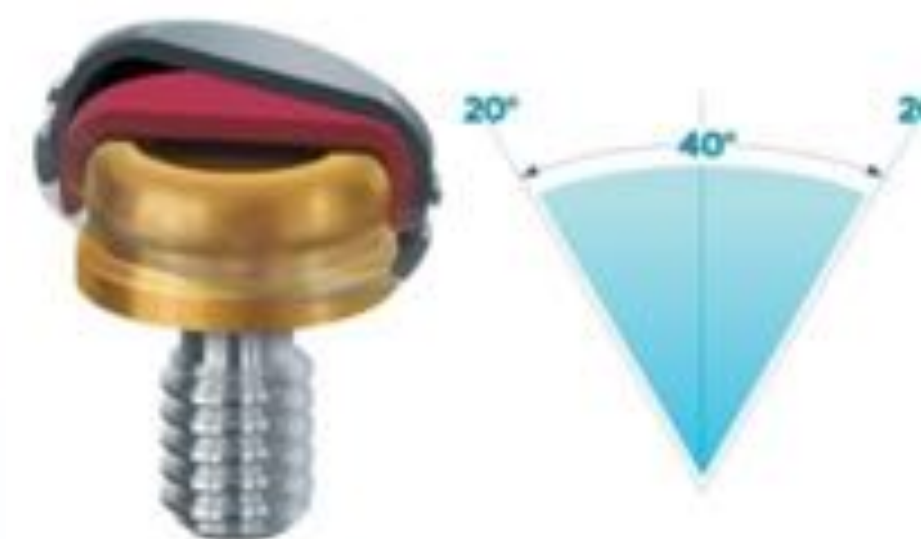
(8547) Green: 3-4 Lbs (1361-1814 Grams)

(8915) Orange: 2.0 Lbs (907 Grams)

(8548) Red: 0.5 - 1.5 Lbs (226-680 Grams)

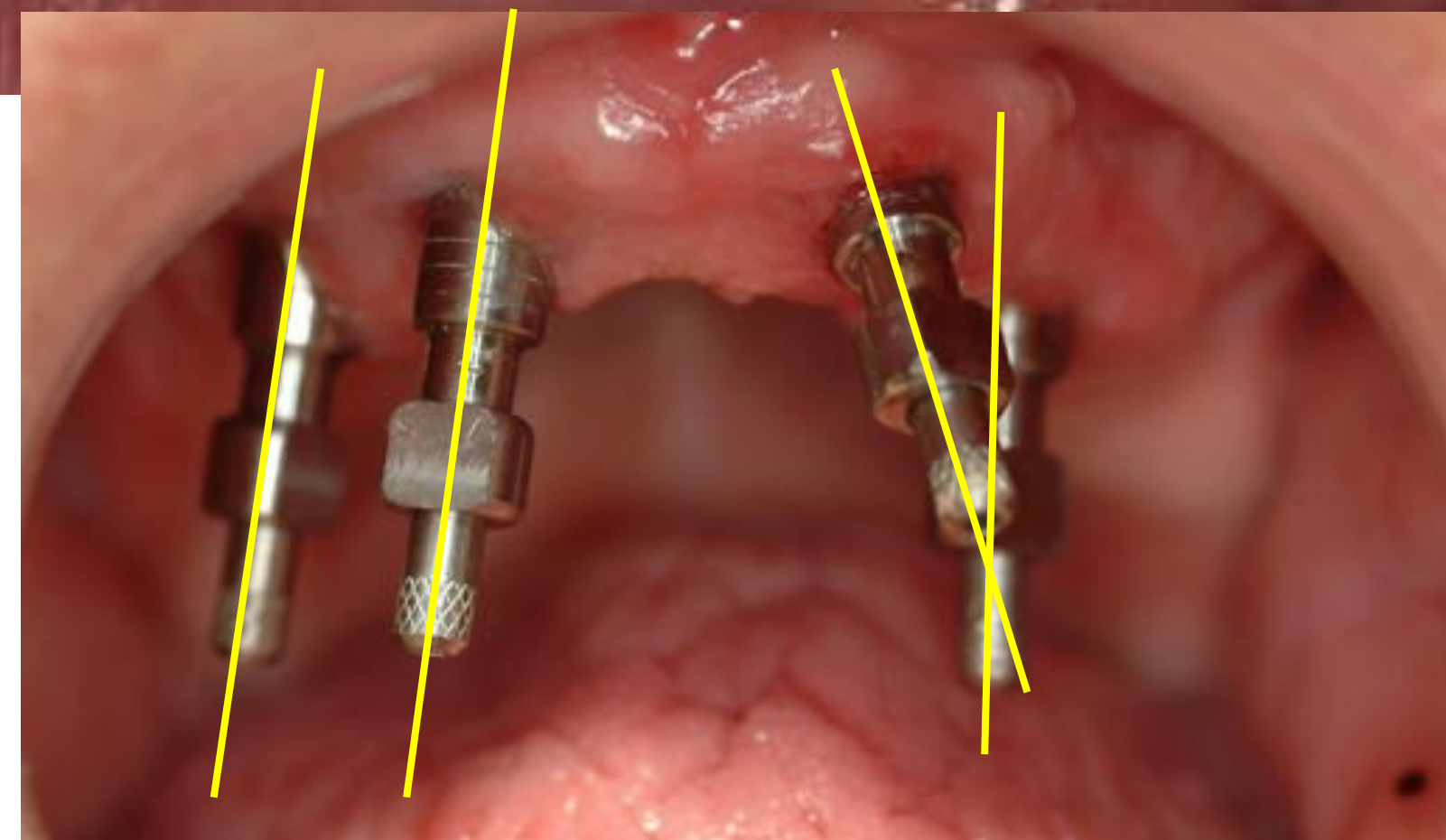
(8558) Gray: 0 (zero) Retention

To overcome implant
angulation issue

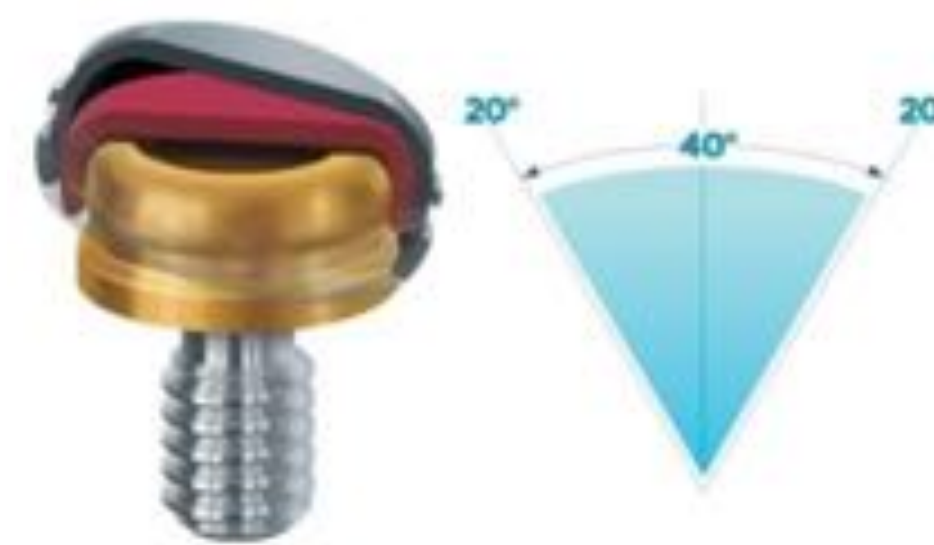


www.preat.com/locimplant.htm

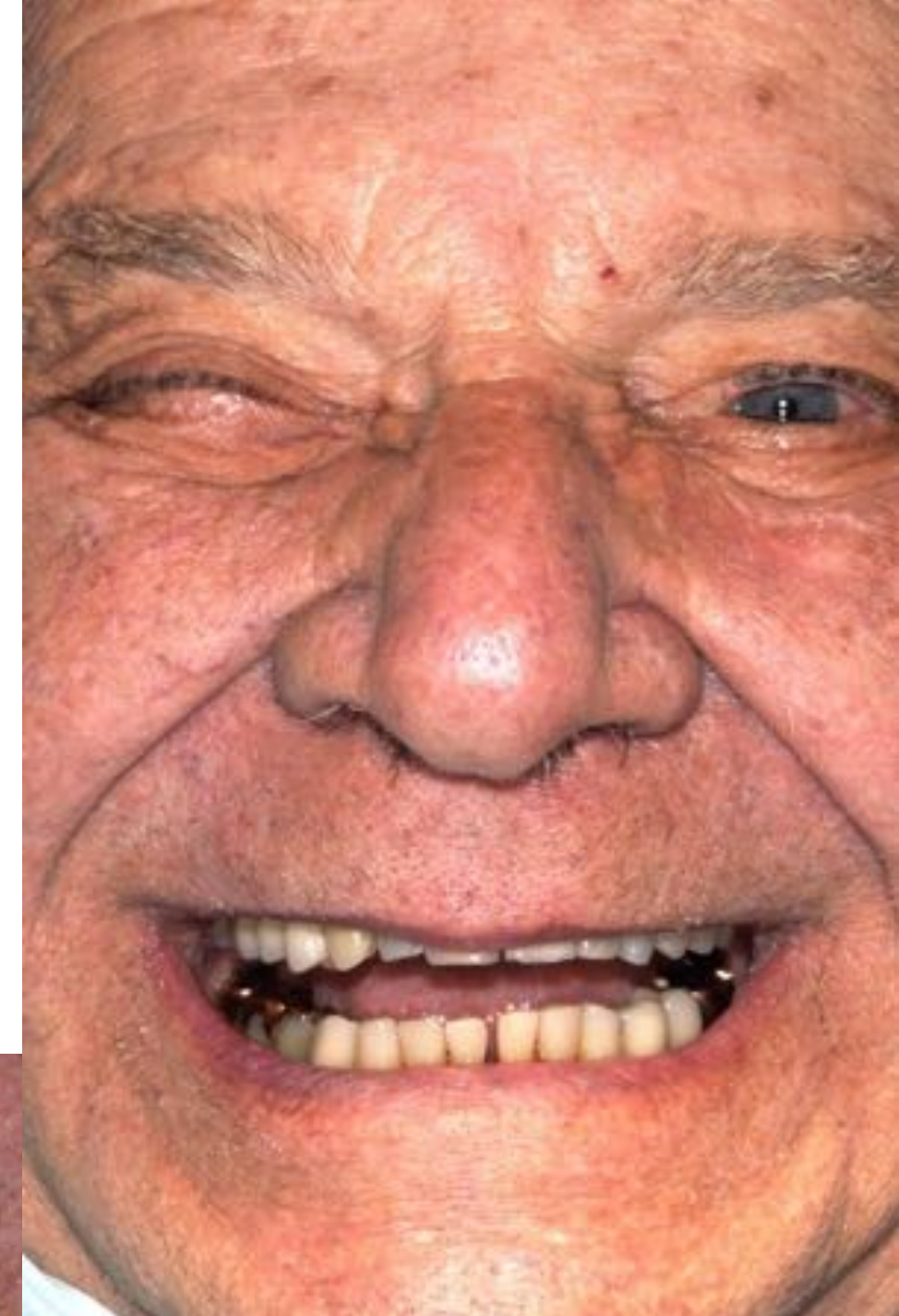
www.ZestAnchors.com



Implants' angulations



Case 2: JK



Implant-enhanced RPD

- Same Design Principles of RPD
- Biomechanical Considerations of Implant(s) and Abutment teeth
- Improve outcomes
- More affordable option than implant fixed option



Case 3: Pt KB



Case 3: Pt KB

Patient presented with fractured #21 and 22 splinted crowns at the subgingival level

#26-27 splinted crowns present no clinical mobility with good margin integrity

Lack of RPD abutment at patient's left quadrant presents challenge for RPD (multiple axis of rotations on two abutments)

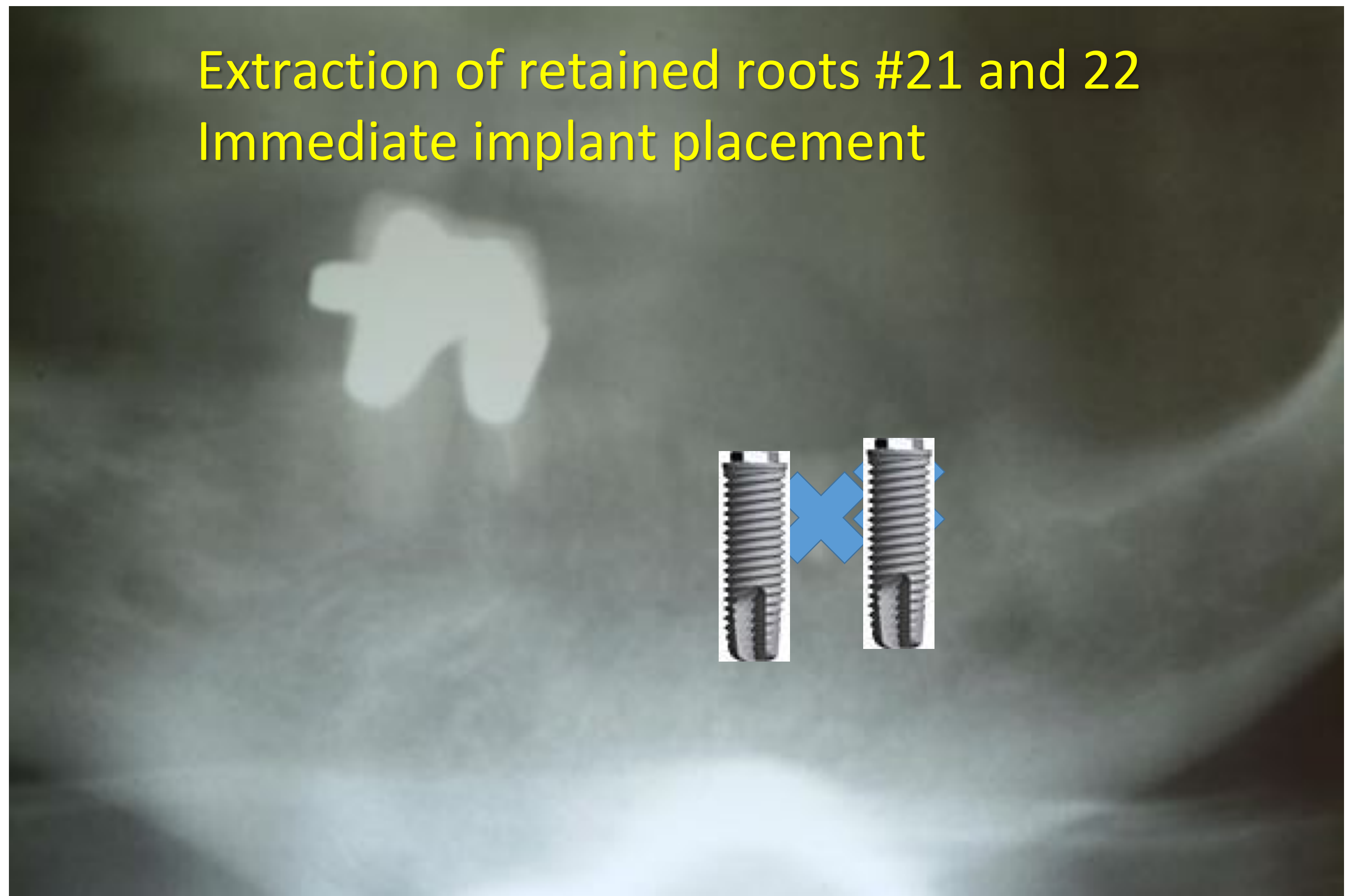
In clinical practice, mandibular distal extension RPDs receive a poor reputation among both dentists and patients. Patients' appreciation is unpredictable and complaints include food retention underneath the saddle and pain, resulting from the **inherited biomechanical disadvantages** and **the rotational movement under mastication**.

Patients discontinue wearing them or insist on replacement by a new one at a high rate.

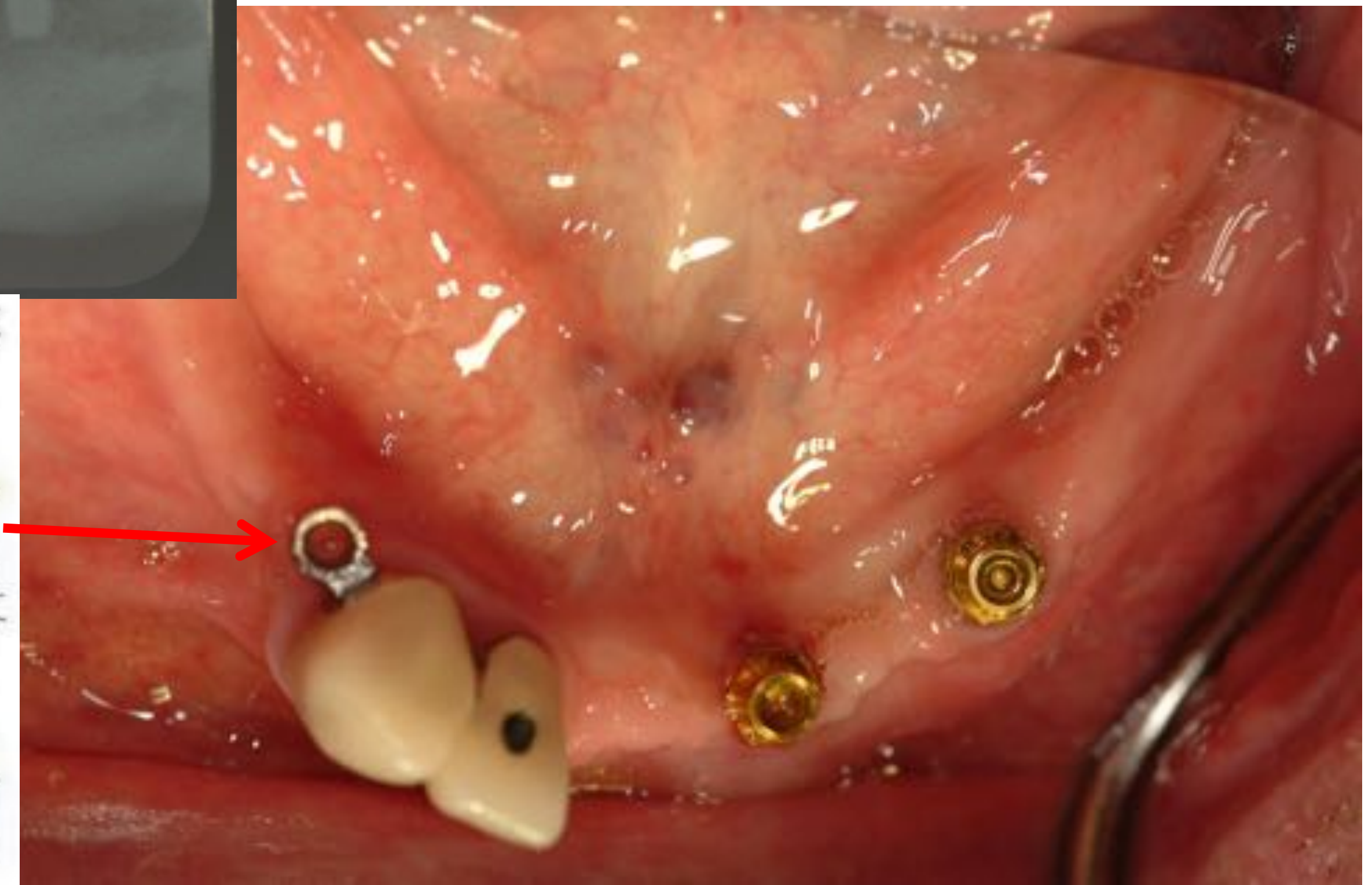
The limitations of the md extension based RPD must be discussed and implant-enhanced RPD for mandibular extension based scenarios should be considered as an alternative option.

Case 3: Pt KB

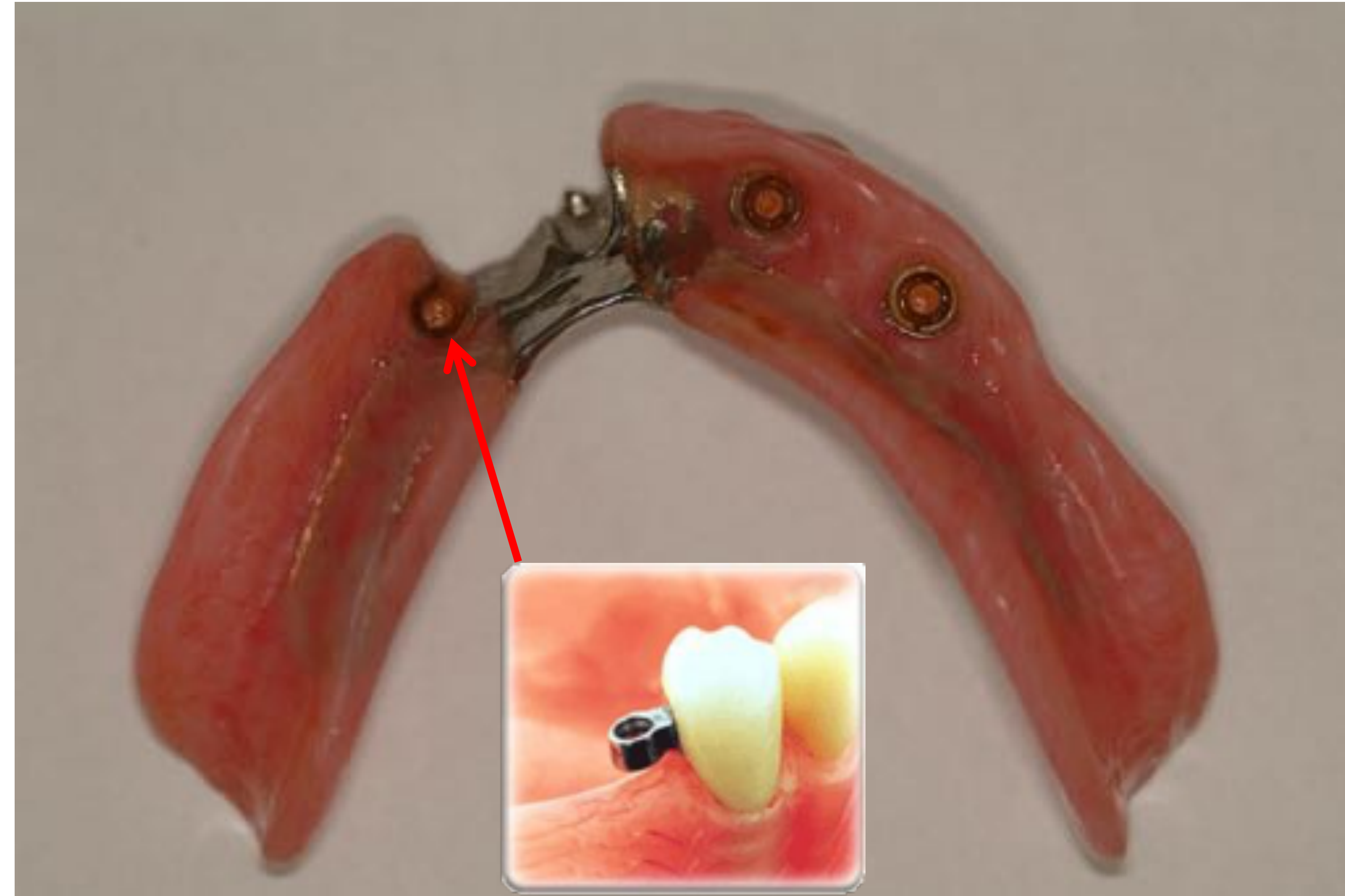
Extraction of retained roots #21 and 22
Immediate implant placement



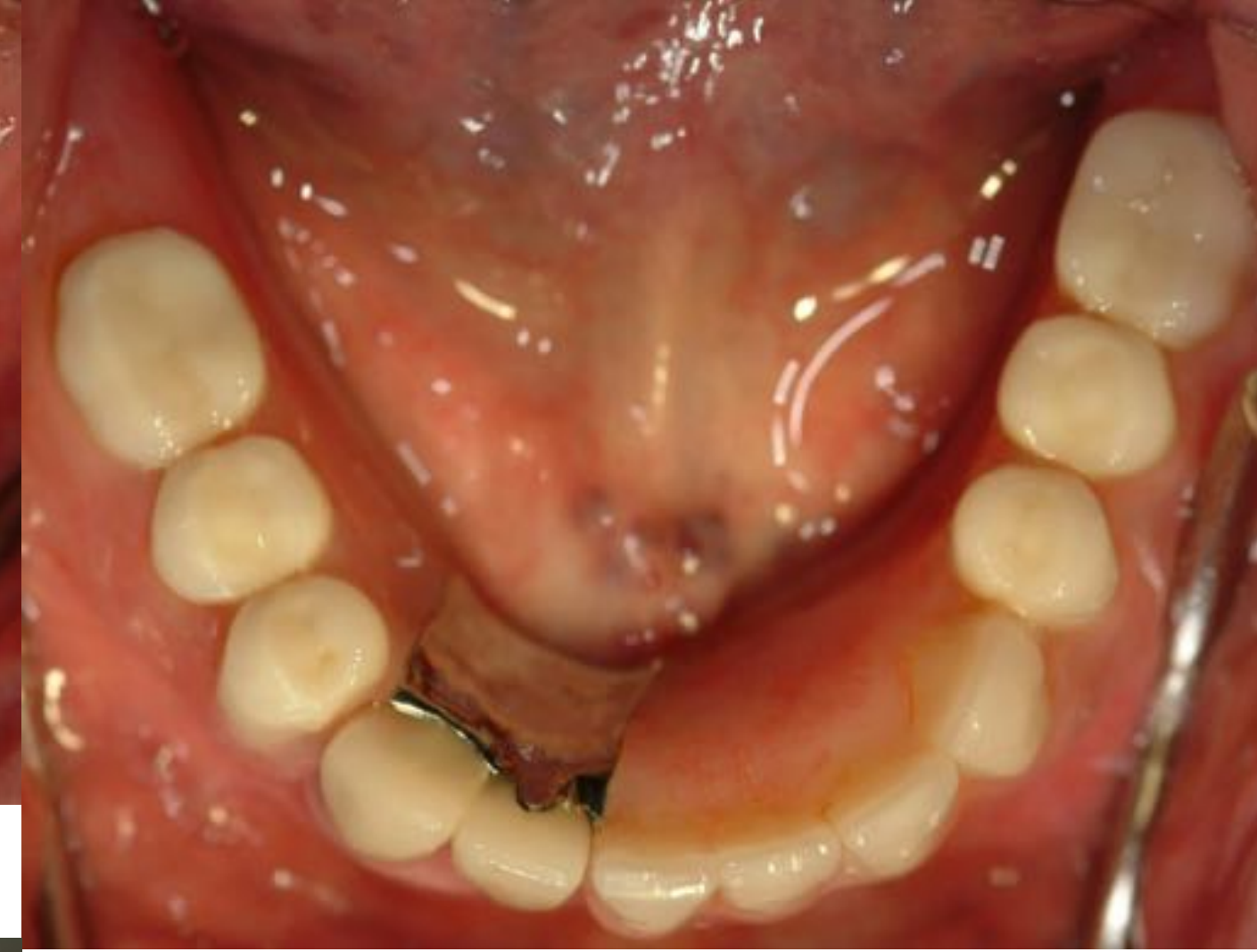
Case 3: Pt KB



Case 3: Pt KB



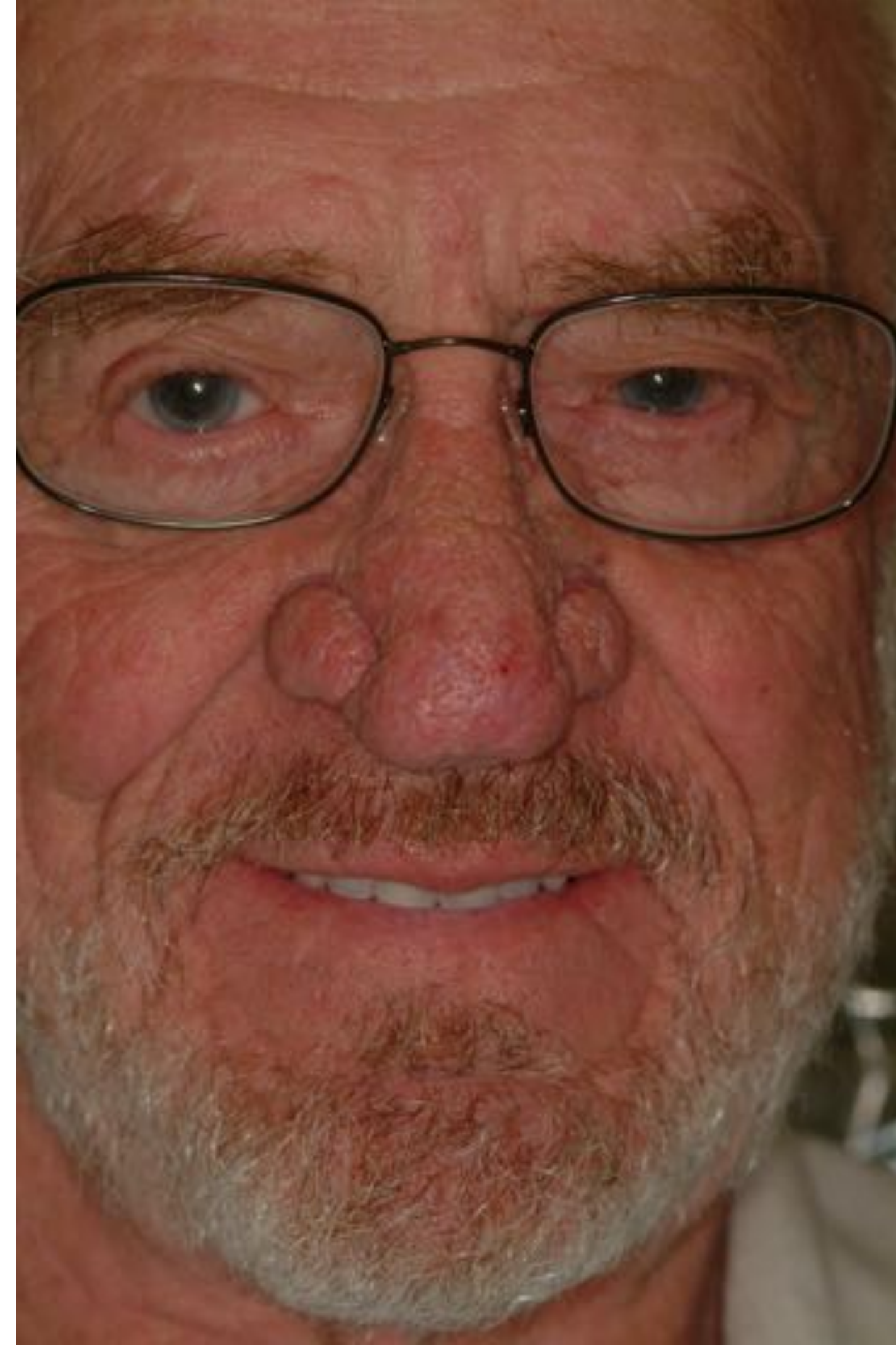
Case 3: Pt KB



Case 3: Pt KB



Case 3: Pt KB



Case 3: Pt KB

Follow up
after 3+ years of
functional loading



Feb 21, 2017
10 years follow up



Candidates for Implant-enhanced RPD Therapy

- Kennedy Class I and II (UCLA extension-based RPD)
- Compromised RPD abutment distribution:
 - Lack of bilaterally positioned RPD abutment
- • Patients with prior unsatisfied RPD experience
- Patients who are interested in less extensive tooth replacement treatment option (surgically and/or financially)

Long-term Implant Survival Rate in Implant-enhanced RPD

- 32 consecutive patients (mean age 56.8 years) with 64 Branemark (Mark III) implants. Follow-up ≥ 8 years
- Satisfaction, implant survival, and prosthetic success were evaluated
- Kennedy classification (Class I = 19, Class II = 10, Class III = 3)
- The implants primarily functioned as retention elements connected to the dentures with a resilient ball attachment

Patient Satisfaction (scale 1-5)

- Before 1 year after treatment
 1.31±0.43 4.59±0.47
- **Caution!!** All patients evaluated in this study presented requesting new prostheses because they were not satisfied with their current RPDs
- Patient satisfaction was improved with RPD/implant treatment but may be overestimated.

Implant and RPD Failure Rate

- The overall implant success was 93.75% (4/64 failures)
- The overall prosthesis success of IR-RPD rehabilitation was 100%.
- Periimplant soft tissues and residual edentulous ridges remain stable over time
- Bone resorption around the implants is within acceptable limits and is comparable to that seen with standard implants.

Bortolini et al.

Journal of Prosthodontics **20** (2011) 168–172

Prosthetic Complications and Maintenance Over 8 Years of F/U

Loose abutment	2 cases in 2 patients
Tooth substitution	29 times in 24 patients
Relining	93 relinings in 32 patients

Resilient components were replaced annually

Other Characteristics of This Study

Implant positions

Implant position	Maxilla	Mandible
Lateral incisor	1	0
Canine	21	10
First premolar	14	9
Second premolar	6	3

Majority of the implants were placed in the more anterior positions (outside the anatomic limitations)

Implant sizes (Branemark MKIII)

Implant size (mm)	Number of implants
3.75 × 10	8
3.75 × 11.5	15
3.75 × 13	22
3.75 × 15	15
5 × 10	2
5 × 11.5	2

All implants were 10 mm or longer

Bortolini et al.

Journal of Prosthodontics **20** (2011) 168–172

Take Home Message

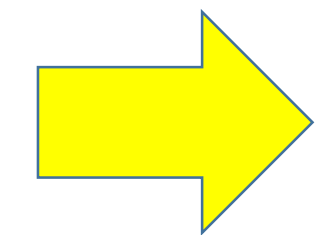
For patients with concerns of traditional RPD treatment, implant-assisted RPD can improve patient's satisfaction and offers comparable high implant survival rate and stable peri-implant condition after 8 years of follow-up.

Bortolini et al.

Journal of Prosthodontics **20** (2011) 168–172

- The keys of a successful RPD design (with or without dental implants)

- Patient selection for implant-enhanced RPD therapy



- The goal of the implant-enhanced RPD treatment option:

esthetics versus comfort

- Treatment planning considerations: number and location of the implants,
selection of the attachment

What do we want to accomplish with implant(s)
to enhance the outcomes of RPD therapy?

Esthetics or Comfort?

Patient expectation and preference?



Implant-supported mandibular removable partial dentures;
patient-based outcome measures in relation to implant position



Charlotte Jensen, DDS^{a,*}, Gerry M. Raghoobar, DMD, PhD^b, Wouter Kerdijk, MSc^c,
Henny J.A. Meijer, DDS, PhD^{a,b}, Marco S. Cune, DDS, PhD^{a,d}

^aUniversity of Groningen, University Medical Center Groningen, Center for Dentistry and Oral Hygiene, Groningen, Department of Fixed and Removable Prosthodontics and Biomaterials, Groningen, The Netherlands

^bUniversity of Groningen, University Medical Center Groningen, Department of Oral and Maxillofacial Surgery, Groningen, The Netherlands

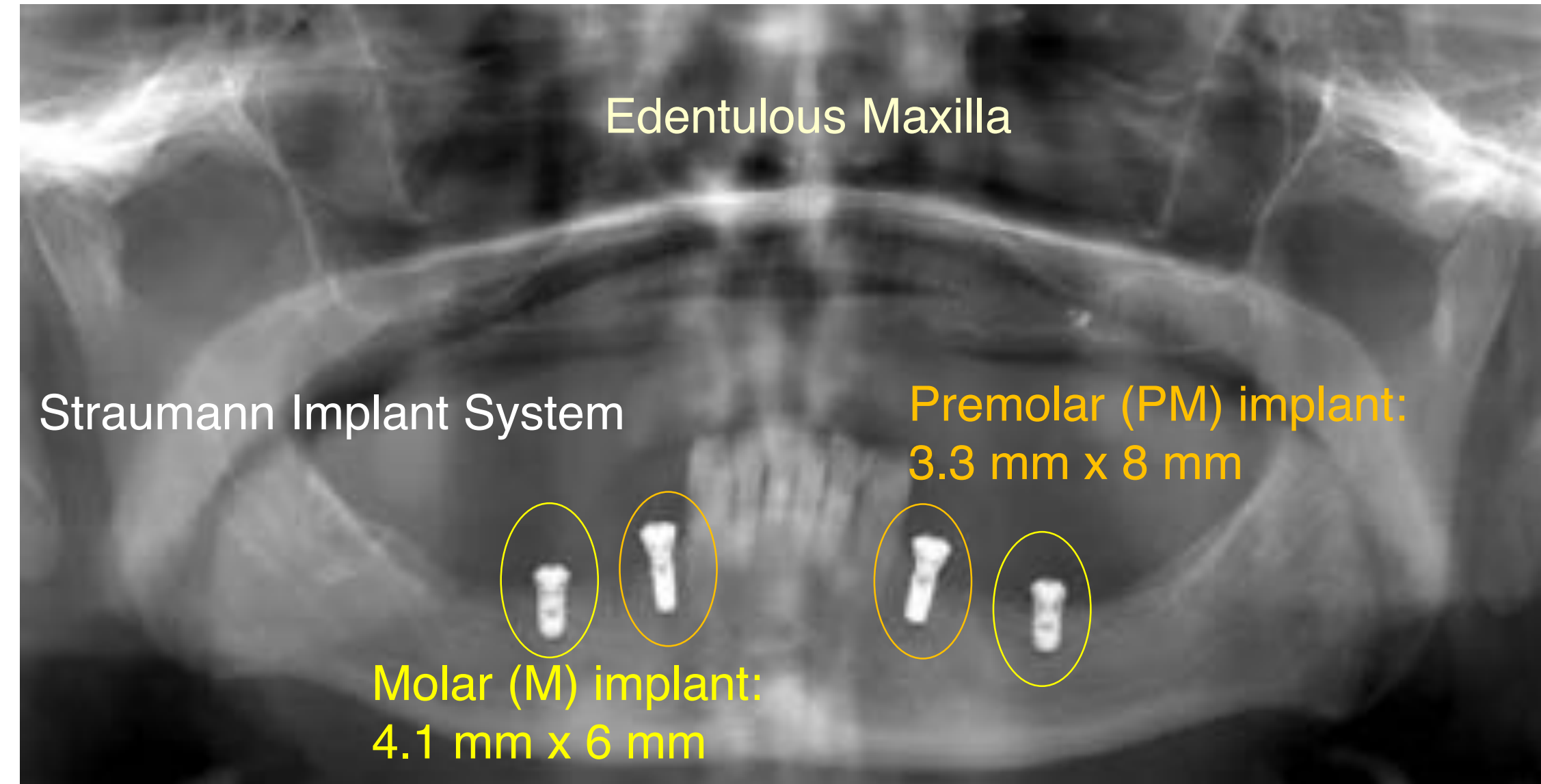
^cUniversity of Groningen, University Medical Center Groningen, Center for Dentistry and Oral Hygiene, Groningen, Department of Public and Individual Oral Health, Groningen, The Netherlands

^dSt. Antonius Hospital Nieuwegein, Department of Oral-Maxillofacial Surgery, Prosthodontics and Special Dental Care, Nieuwegein, The Netherlands

Jensen et al. Clin Implant Dent Relat Res. 2017
Clinical Oral Implant Research 2016
J of Dentistry 2016

Noteworthy

Prospective comparison study, cross-over randomized trial



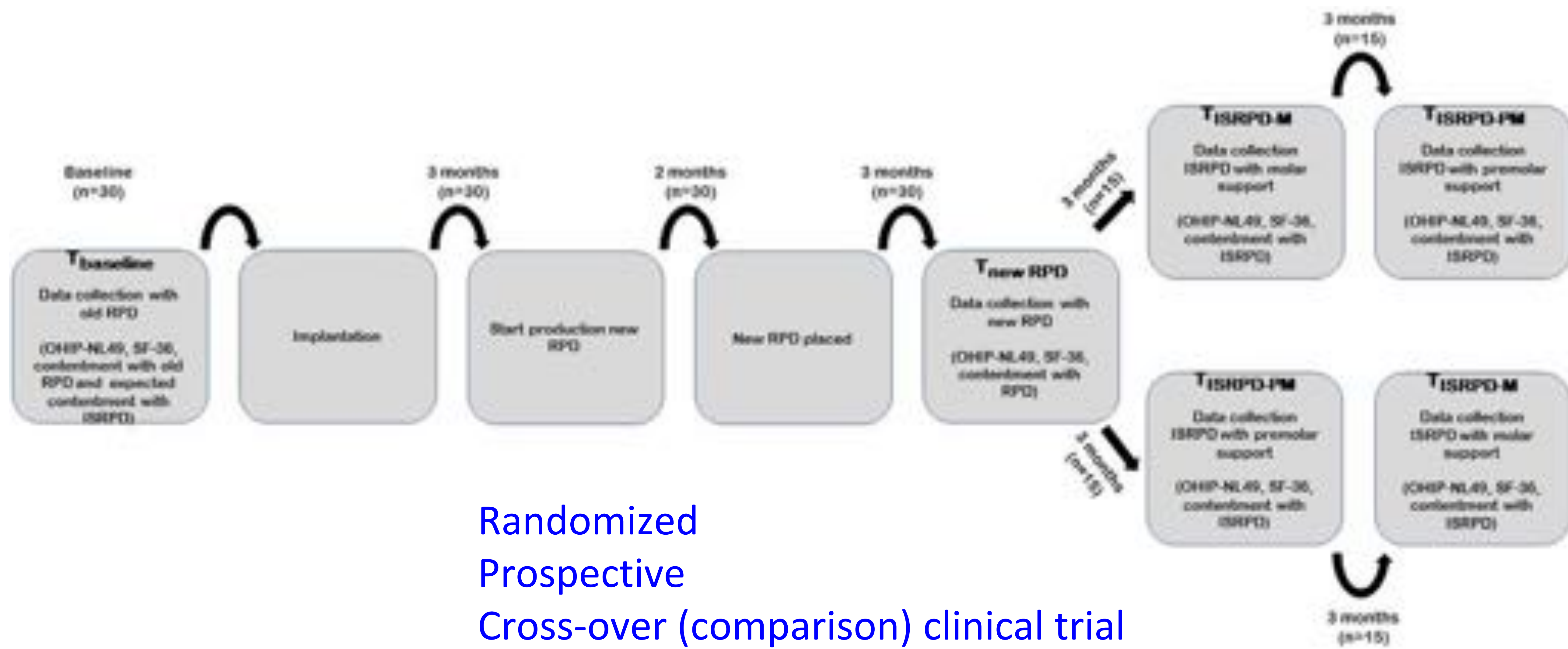
Jensen et al. Clin Implant Dent Relat Res. 2017
Clinical Oral Implant Research 2016
J of Dentistry 2016

Implant RPD

- Prospective comparison study, cross-over randomized trial
- 30 subjects: upper edentulous, lower partial edentulous (Kennedy class I)
- Implants placed at the premolar and molar regions
- Mandibular bilateral distal extension RPD w/o implants, with premolar implants only, and with molar implants only.
3 months to test each implant position.
- Use Locator attachment

Jensen et al. Clin Implant Dent Relat Res. 2017
Clinical Oral Implant Research 2016
J of Dentistry 2016





Randomized
Prospective
Cross-over (comparison) clinical trial

Study Design

- Number of implant(s): one on each quadrant
- How implants used: resilient Locator attachment
- Size/Length: Premolar site 3.3 x 8 mm Molar site 4.1 x 6 mm
- Patient-centered **subjective** outcomes: **OHIP**-NL49 , contentment assessment on a Visual Analogue Scale
- **Objective** outcomes: chewing ability test (Mixing Ability Index, **MAI**), number of hrs wearing the prosthesis
- Pt preferred implant position: premolar or molar site

Jensen et al. Clin Implant Dent Relat Res. 2017
Clinical Oral Implant Research 2016
J of Dentistry 2016

OHIP

Oral Health Impact Profile

The English-language Oral Health Impact Profile (OHIP-E) consists of 49 questions that are conceptually categorized according to Locker's model [1]. This model uses a hierarchy in which different levels of disease-related disruptive impairment are distinguished, resulting in seven domains (see left column in Table 1). The domain 'Functional limitation' (9 questions) concerns the loss of function of parts of the body, like difficulty with chewing. The domains 'Physical discomfort' (9 questions) and 'Psychological discomfort' (5 questions) deal with experiences of pain and discomfort, such as toothache and feeling miserable. The domains 'Physical disability' (9 questions), 'Psychological disability' (6 questions), and 'Social disability' (5 questions) refer to limitations in performing daily life activities, like avoiding certain foods, lack of concentration, and feeling irritable with others, respectively. Finally, the domain 'Handicap' (6 questions) concerns a sense of disadvantage in functioning, like suffering financial loss due to dental problems. Answers to the 49 questions are scored on 5-point ordinal scales ranging from never (0), hardly ever (1), occasionally (2), and fairly often (3), to very often (4). The 49 scale scores are then summed; the total score can thus range from 0 to 196. Similarly, domain scores can be obtained. Higher scores imply a more impaired oral health-related quality of life.

	Mean total score	SD
Total OHIP-NL (49)	44.1	40.2
Functional limitation (9)	10.6	7.8
Physical discomfort (9)	9.2	8.1
Psychological discomfort (5)	6.6	5.9
Physical disability (9)	7.2	8.5
Psychological disability (6)	4.8	6.1
Social disability (5)	2.6	4.9
Handicap (6)	3.2	5.4

The Oral Health Impact Profile (OHIP) questionnaire - a sophisticated and well validated instrument for assessment of OHRQoL .

The lower the OHIP score is, indicate less disease-related disruptive impairment.

Subjective Evaluation: OHIP

	T _{baseline}	T _{newRPD}	T _{RPD-M}	T _{RPD-PM}
Functional limitation (max. score 36)	14.9 (6.9)	11.3 (6.1) [*]	6.5 (3.8) ^{**}	6.9 (4.5) ^{**}
Physical pain (max. score 36)	10.7 (6.6)	11.4 (7.3)	4.2 (4.1) ^{**}	4.5 (5.3) ^{**}
Psychological discomfort (max. score 20)	6.9 (5.8)	4.6 (5.2) [*]	1.8 (2.8) ^{**}	2.3 (4.4) ^{**}
Physical disability (max. score 36)	9.2 (7.6)	8.2 (7.4)	2.6 (3.0) ^{**}	3.1 (4.0) ^{**}
Psychological disability (max. score 24)	3.6 (5.5)	3.0 (4.4)	1.0 (2.3) ^{**}	2.0 (4.1)
Social disability (max. score 20)	1.9 (3.3)	1.5 (2.2)	0.7 (1.5)	1.1 (2.2)
Handicap (max. score 24)	2.5 (5.0)	1.4 (2.4)	0.8 (1.9)	1.3 (3.4)
OHIP (total) (max. score 196)	49.6 (35.2)	40.3 (31.2)	17.6 (16.6) ^{**}	21.2 (26.0) ^{**}

* <T_{baseline} (p < 0.008).

** <T_{baseline} and <T_{newRPD} (p < 0.008).

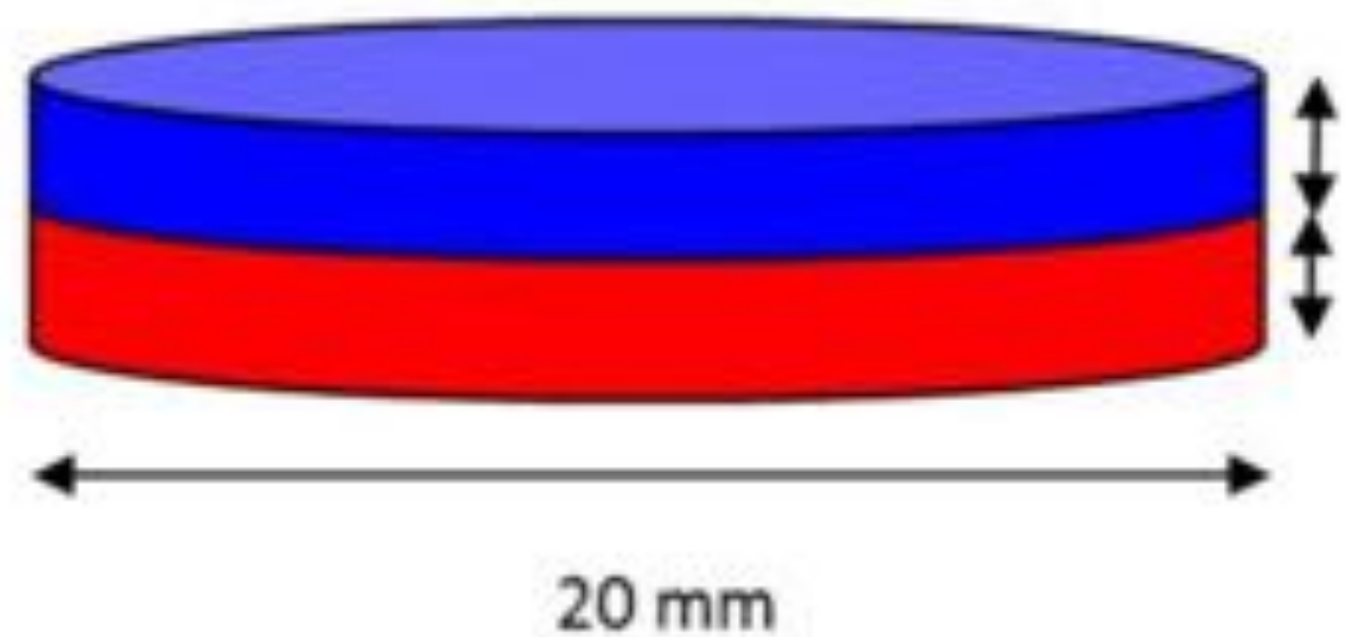
In the present study of patients with a poorly functioning bilateral free-ending mandibular RPD, solely providing a new RPD proved also being effective.

The addition of implant significantly improved overall quality of the RPD and pt satisfaction

Objective Evaluation

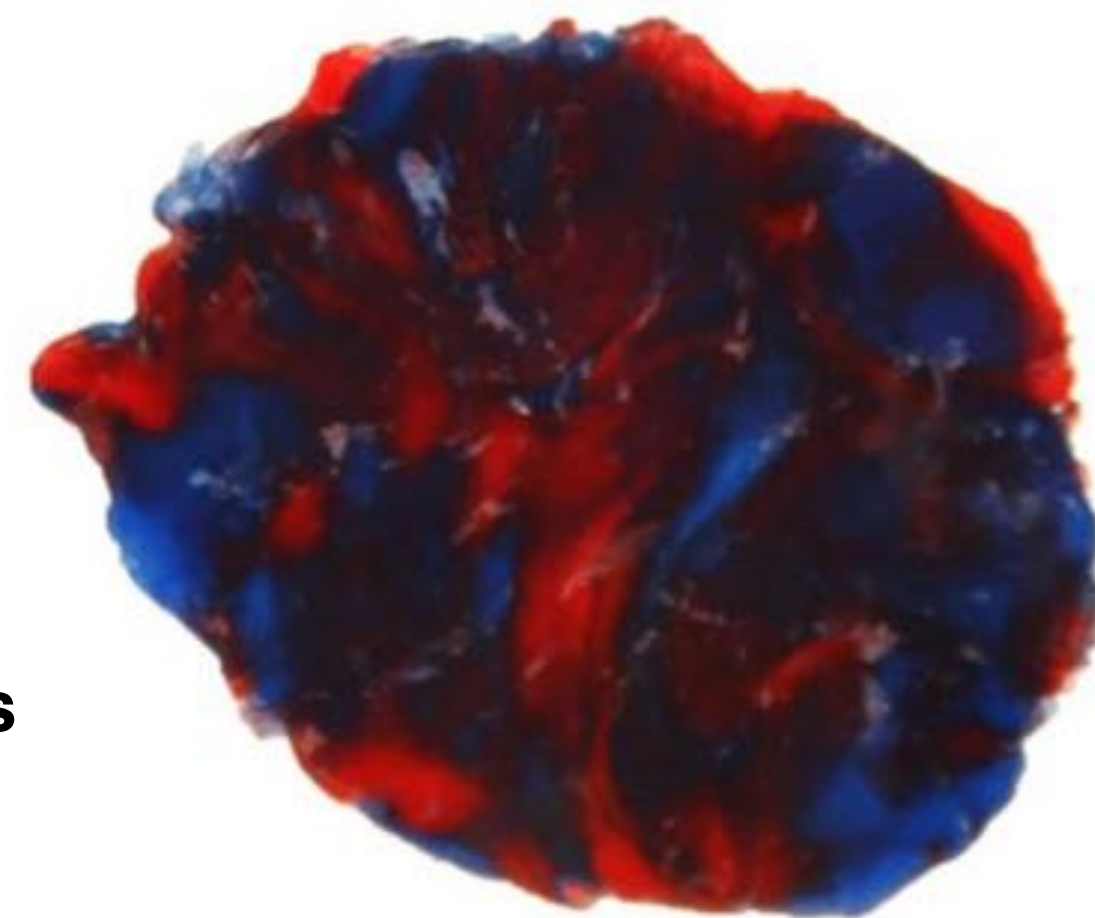
- **Masticatory performance** was studied by means of a mixing ability test.

Pristine wax tablet
for the mixing ability
test



3 mm
3 mm

15 chewing strokes



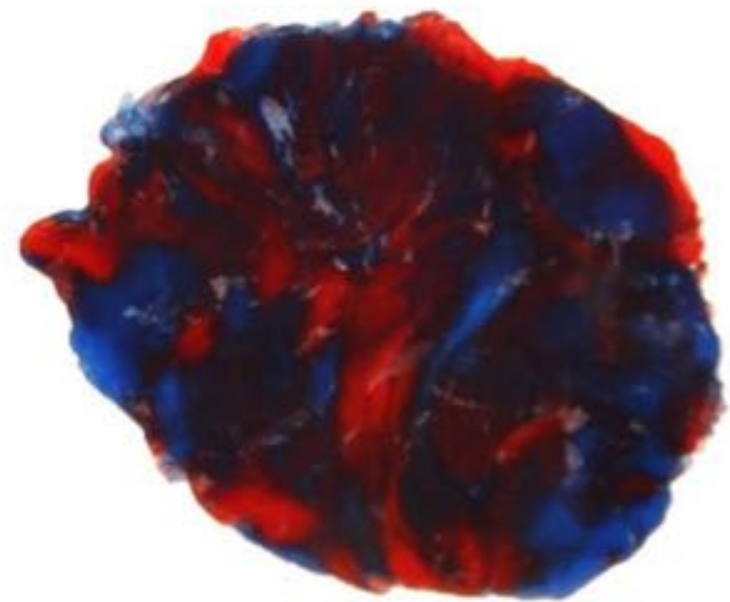
Mixed tablet and flattened
after 15 chewing strokes

Objective Evaluation

- **Masticatory performance** was studied by means of a mixing ability test.

The flattened wax is then photographed and analyzed

A lower Mixing Ability Index (MAI) score implies a better mixed tablet, hence **better** masticatory performance.



Objective Evaluation

- **Masticatory performance** was studied by MAI

TABLE 2 Masticatory performance (mixing ability index) at different stages of treatment: old removable partial denture ($T_{baseline}$), new removable partial denture ($T_{new\ RPD}$), implant supported removable partial denture with support at the molar position ($T_{ISRPD-M}$), implant supported partial denture with support at the premolar position ($T_{ISRPD-PM}$)

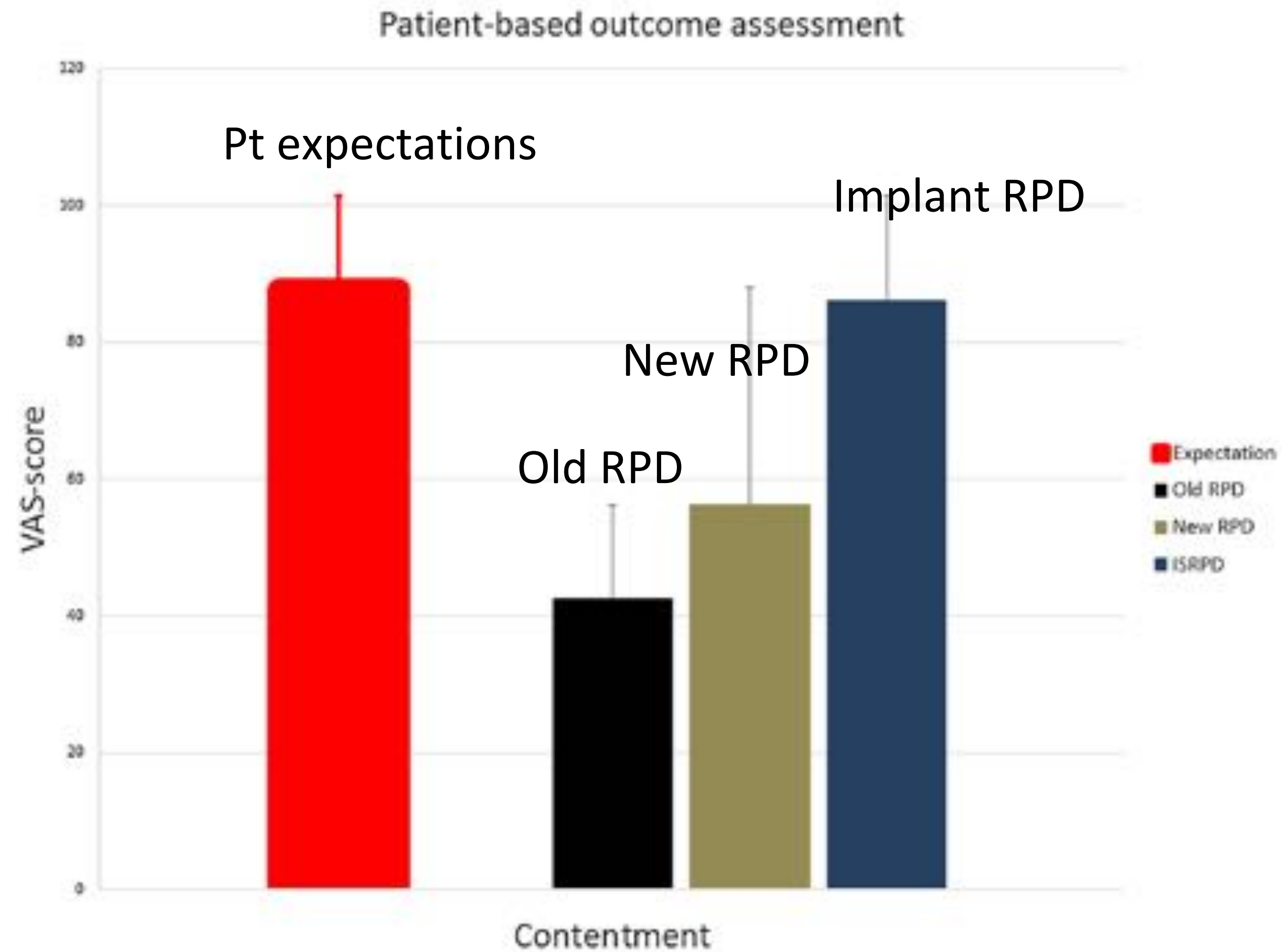
$T_{baseline}$	$T_{new\ RPD}$	$T_{ISRPD-M}$	$T_{ISRPD-PM}$	P value
19.2 (2.2; 15.0-22.9)	20.2 (2.1; 16.5-25.1)	18.0 (1.4; 14.3-20.4)	17.9 (1.5; 15.7-21.3)	$P < .001^*$

Mean values, standard deviations and range between brackets. Lower numbers indicate a better mixed tablet.

*Post hoc tests: $T_{baseline} = T_{new\ RPD} > T_{ISRPD-M} = T_{ISRPD-PM}$.

- Masticatory performance as expressed by the MAI did not change significantly after a new RPD
- Masticatory performance was statistically significant improved with implant support, to a level than prior to treatment and after provision of a new, unsupported RPD. The MAI was comparable to dentate patient group (18.3).
- The implant position, M or PM, had no significant effect on masticatory performance

Implant RPD: Patient Expectations



The data suggest that **patients' expectations of contentment with an ISRPD were met** since no significant difference was seen between expected and actually achieved contentment.

This is seen as an important indicator of the quality of treatment. It enhances the reputation of the health care provider and implant dentistry in general. It transforms new patients into loyal customers and brings new referrals by 'word of mouth'.

Fig. 3. Mean visual analogue scale (VAS) scores and standard deviations of patients' expected contentment with an Implant Supported Removable Partial Denture (ISRPD) assessed prior to treatment, present contentment with their old denture (Old RPD) and the actually achieved level of contentment after having functioned with a newly made Removable Partial Denture without implant support for 3 months (new RPD) or with implant support (ISRPD). Scores for PM and M implant support were averaged. Range 0 (very discontent, major concerns) to 100 (fully content, no concerns at all). Statistical analysis: Expectation=ISRPD>New RPD>Old RPD.

Take Home Message

- Mandibular implant support favorably influences oral health related patient-based outcome measures in patients with a bilateral free-ending situation.
- The majority of patients **prefer** the implant support to be in the **molar** region.

Patient Characteristics:

Upper edentulous, lower partial edentulous (Kenney I)

Mean age : 60.9 y/o

Shorter implants: pm site 3.3x 8 mm, molar site 4.1 x 6 mm

Jensen et al. Clin Implant Dent Relat Res. 2017
Clinical Oral Implant Research 2016
J of Dentistry 2016

Take Home Message

- Implant-retained partial overdentures with resilient attachments are a predictable and cost-effective treatment option for partially edentulous patients.
- When implant is placed to the **more distal position** which is **preferred** position based on the OHIP-NL49, **an anterior clasp/retainer can not be avoided** with esthetic consequences. (**pre-treatment informed consent: esthetics versus comfort**)
- Published literatures reported comparable high implant success rate and increasing patient satisfaction for removable partial denture associated with implants in the extension-based situations.

Long-term success of implants
depends on
biomechanical equilibrium

Implant Biomechanics

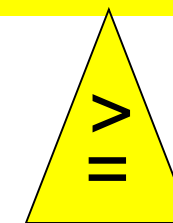
LOAD BEARING CAPACITY

1. Quality of bone site
2. Quality of bone implant interface
3. Implant microsurfaces
 - Machined vs. rough surfaces
4. Implant
 - Number and Arrangement
 - Linear vs. Curvilinear
 - Length and diameter
 - Angulation

ANTICIPATED LOAD

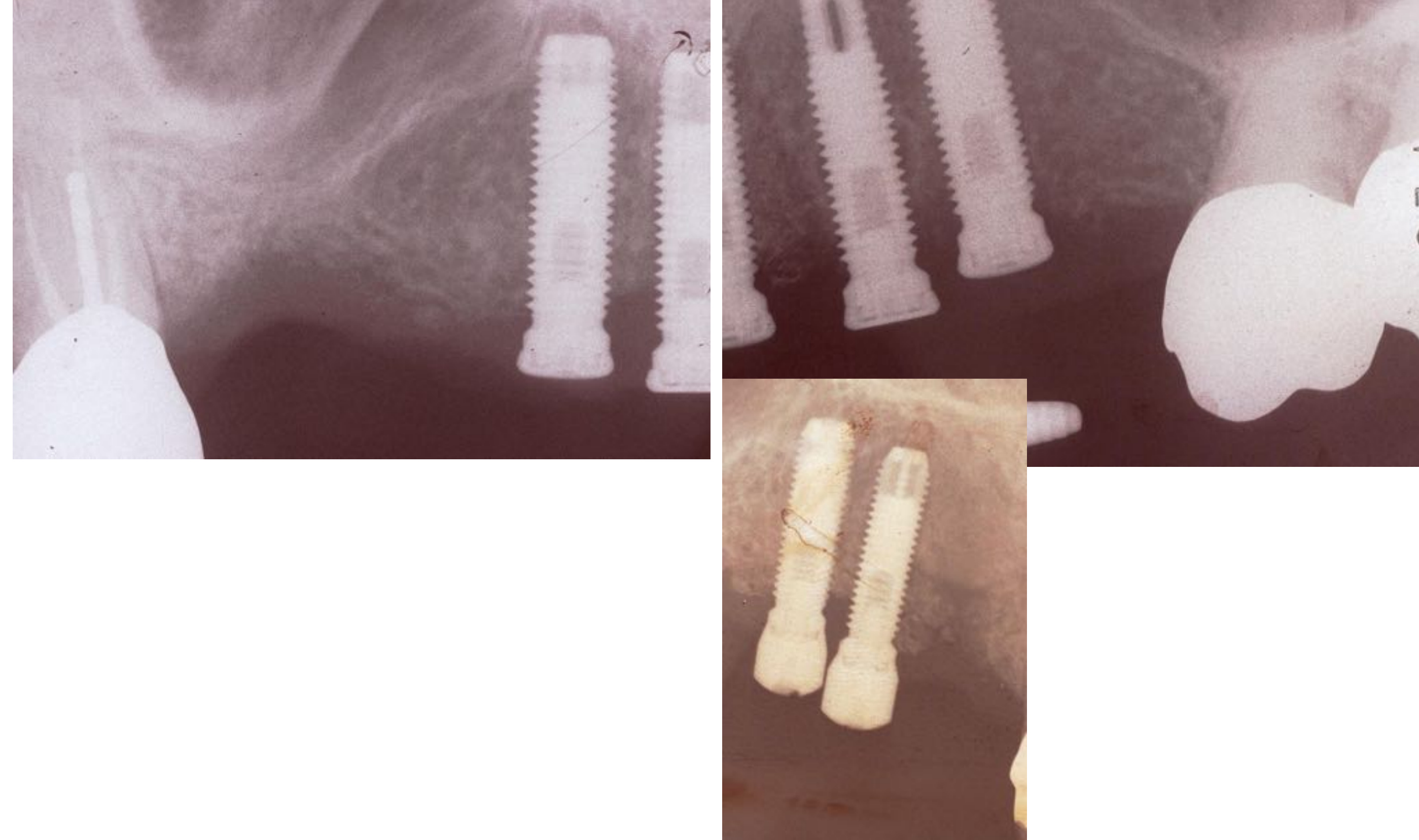
1. Occlusal factors
 - Cusp angles
 - Width of occlusal table
 - Guidance type
 - Anterior guidance
 - Group function
2. Cantilever forces
 - Connection to natural dentition
 - Size of occlusal table
 - Cantilevered prostheses
3. Parafunctional habits (bruxism)
4. Brachycephalics

Biomechanics Equilibrium



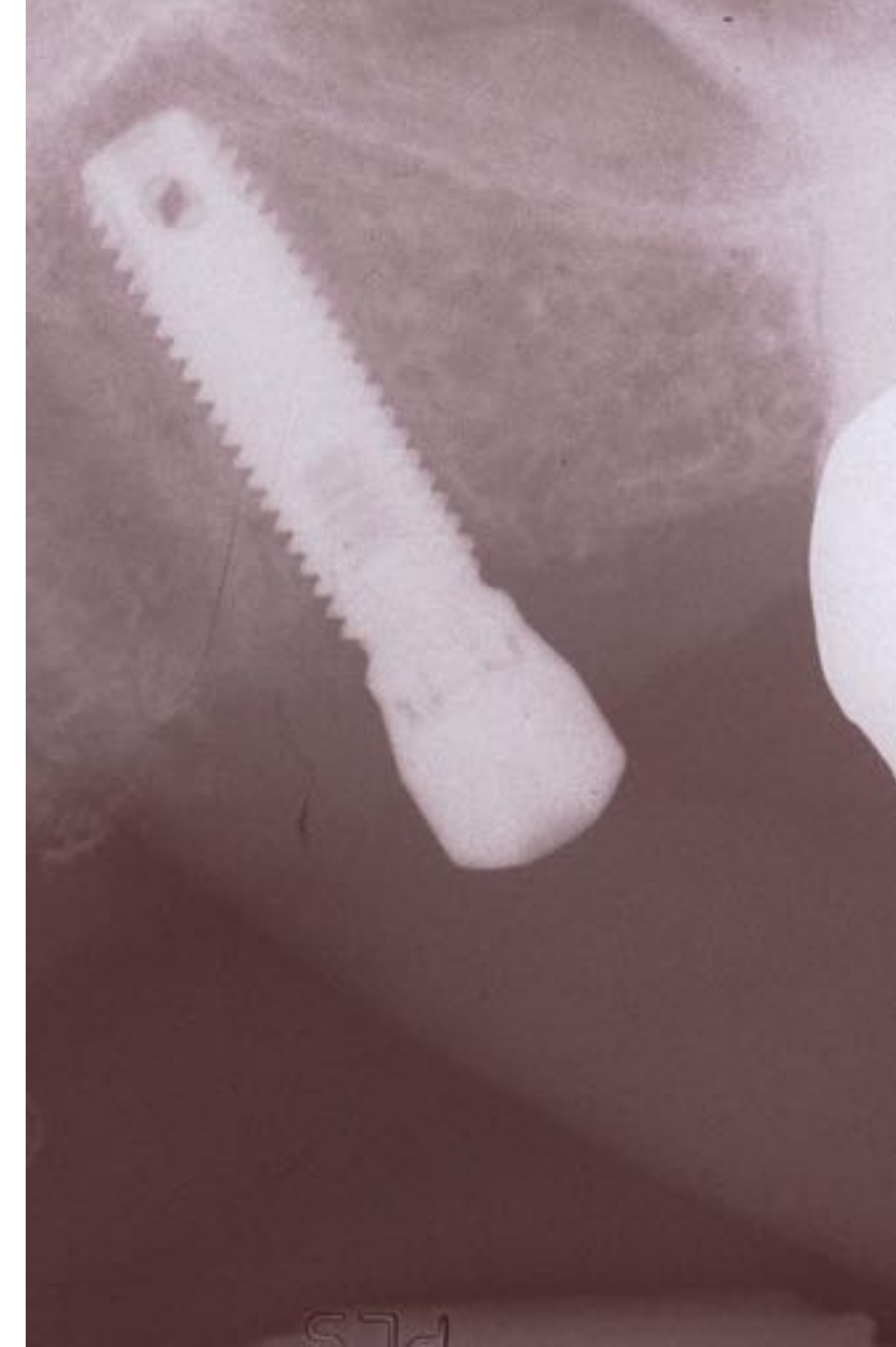
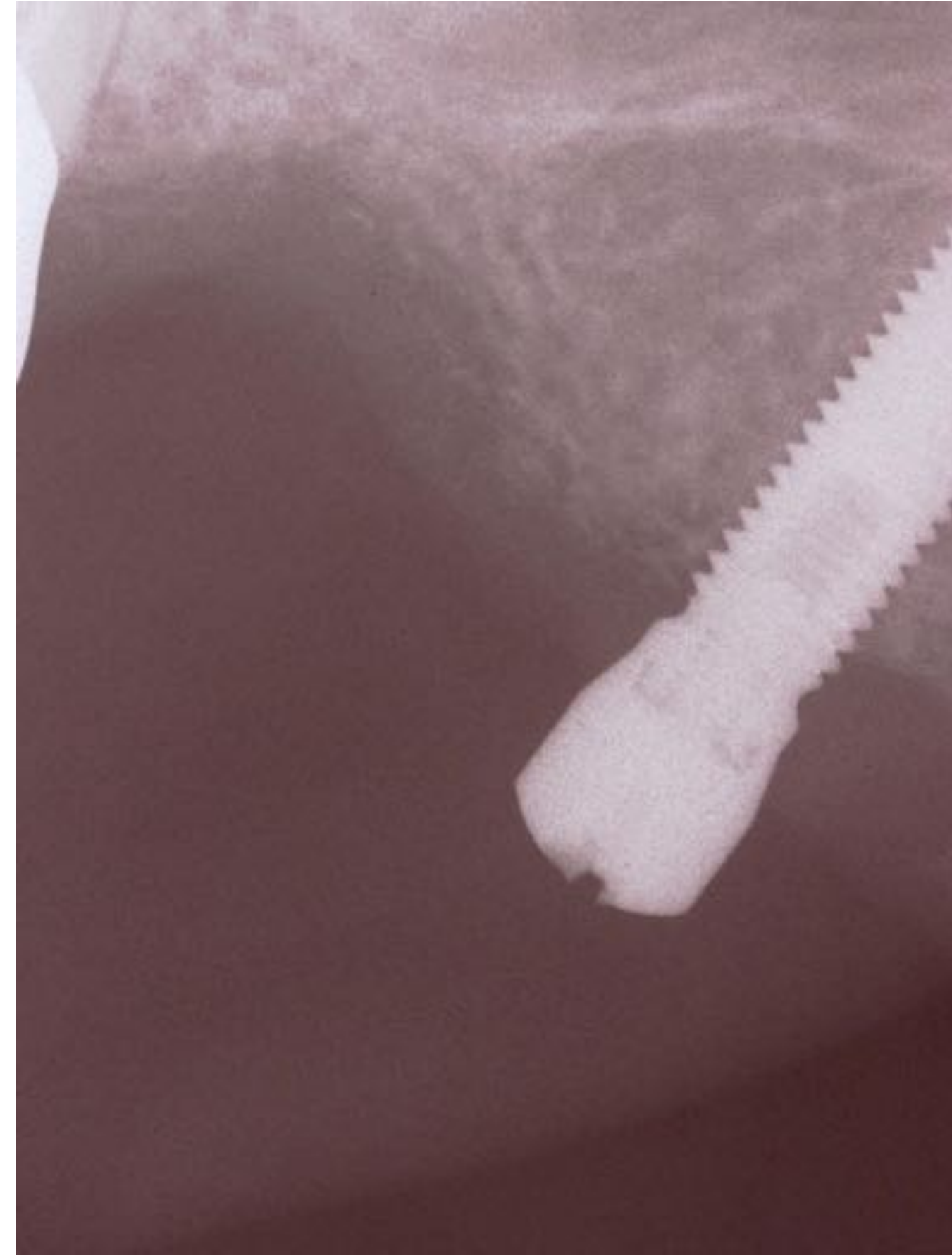
Case 4: AB

Pt AB, 52 y/o male, maxillary partial dentate, 6 implants placed

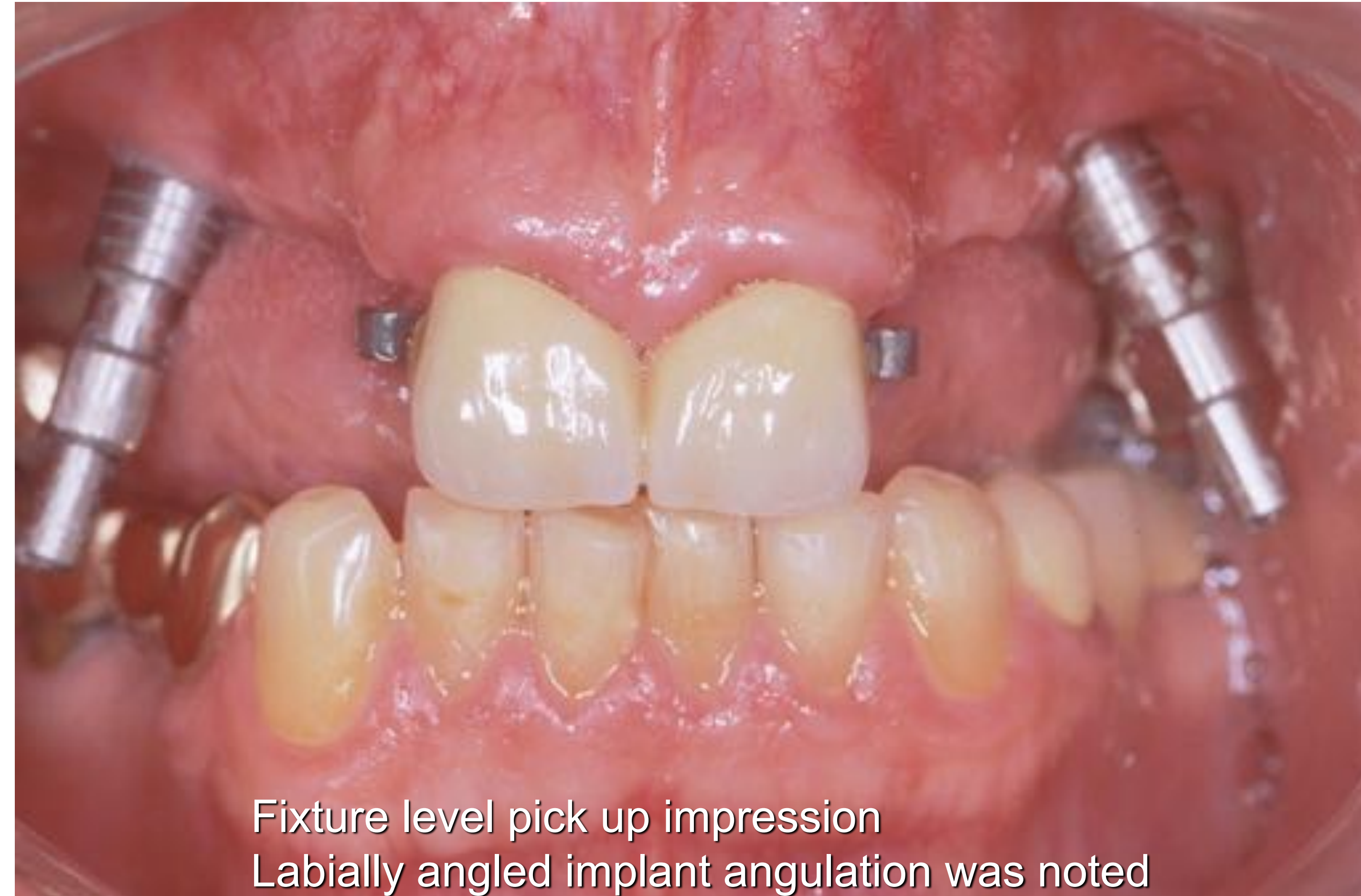


Case 4: AB

Pt AB, 4 out of 6 maxillary implants failed to osseointegrate



Case 4: AB



Fixture level pick up impression
Labially angled implant angulation was noted

Implant Biomechanics

For Pt AB

LOAD BEARING CAPACITY

1. Quality of bone site ?
2. Quality of bone implant interface?
3. Implant microsurfaces
4. **Implant**

Number (fewer than tx plan) and arrangement

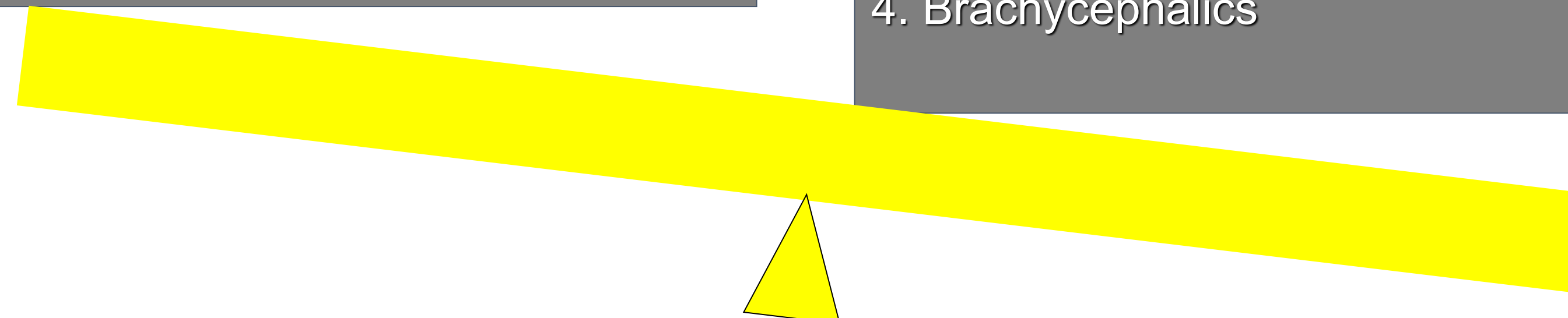
Linear vs. Curvilinear

Length and diameter

Angulation (labial angled)

ANTICIPATED LOAD

1. Occlusal factors
2. Cantilever forces
3. Parafunctional habits (bruxism)
4. Brachycephalics



Implant Biomechanics

For Pt AB

LOAD BEARING CAPACITY

1. Quality of bone site ?
2. Quality of bone implant interface?
3. Implant microsurfaces
4. **Implant**
Number (fewer than tx plan) and arrangement
Linear vs. Curvilinear
Length and diameter
Angulation (labial angled)
5. Tooth support
6. Mucosal support

ANTICIPATED LOAD

1. Occlusal factors
2. Cantilever forces
3. Parafunctional habits
(bruxism)
4. Brachycephalics
5. Use implants mainly for retention

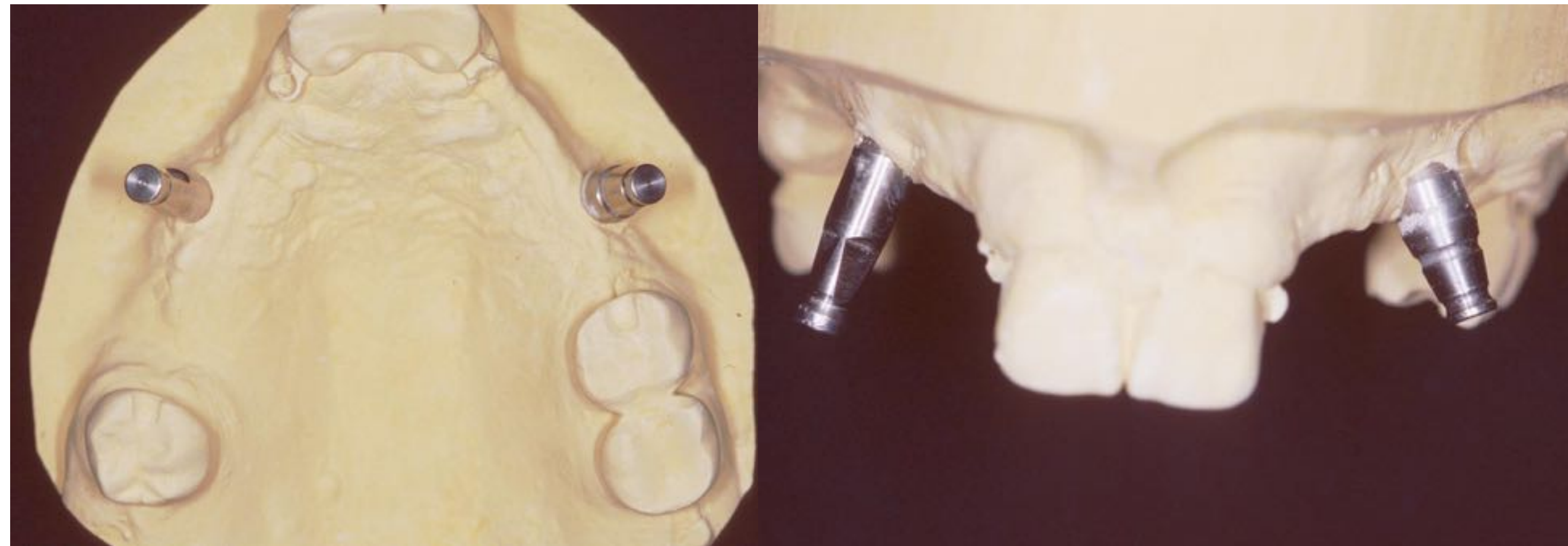
Biomechanics Equilibrium

Case 4: AB



#8 and 9 splinted together with two ERA Attachments

ERA attachment impression housings were picked up at #8 and 9 sites at the same time of implant final impression



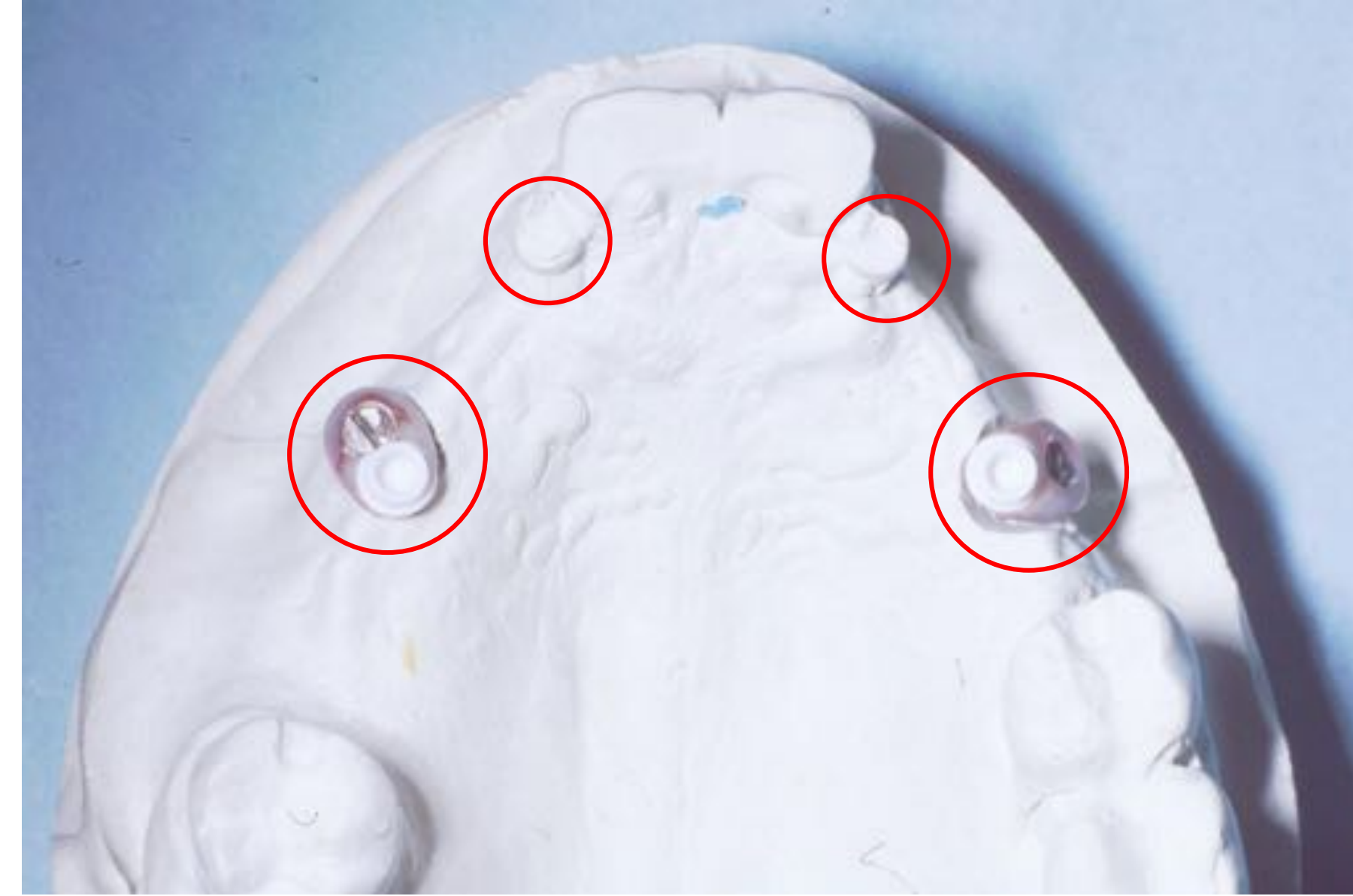
Case 4: AB



Case 4: AB

Two custom ERA Attachments on the implants were made

1. Correct the labial angulation
2. Follow the path of insertion with the two ERAs of #8 & 9



Case 4: AB



Implant Prosthesis Design Concept

1. Implants' labially inclined angulation were corrected by custom abutment with ERA plastic patterns
2. Due to the failure history of the other 4 implants, maximize the support by positive rests on #2, 8, 9, 14 and palatal major connector coverage
3. Implants are mainly designed for retention (from ERAs). Support and stability are mainly from teeth and mucosa
4. #8 and 9 are splinted and ERAs are designed to maximize the esthetics

Case 4: AB



Case 4: AB



Blue-colored (higher retention)
ERA were
used on the teeth #8/9

White-colored (the least amount
of retention) ERA were
used on the implants.



Case 4: AB



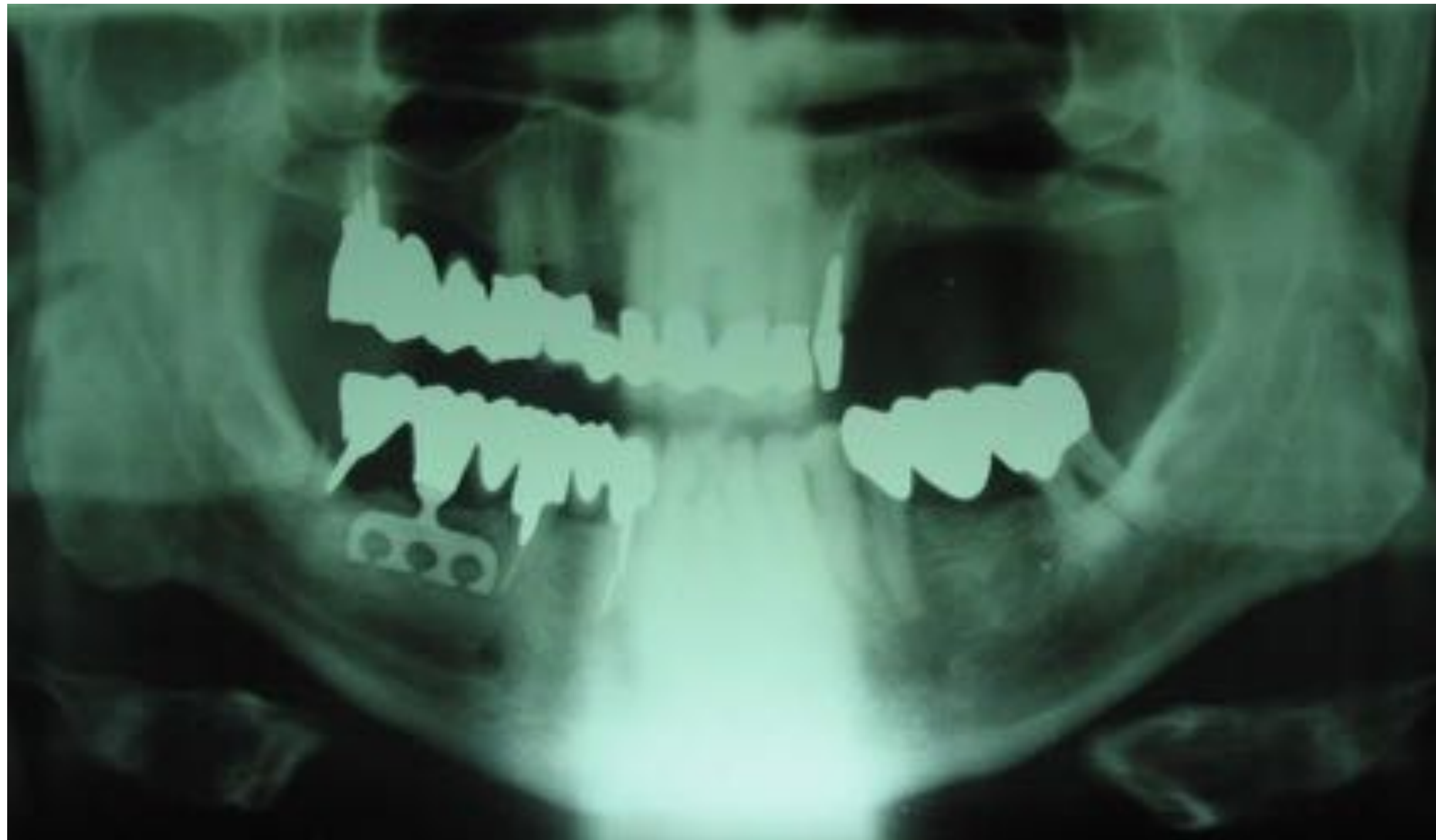
Case 4: AB



Lessons Learned from Pt AB

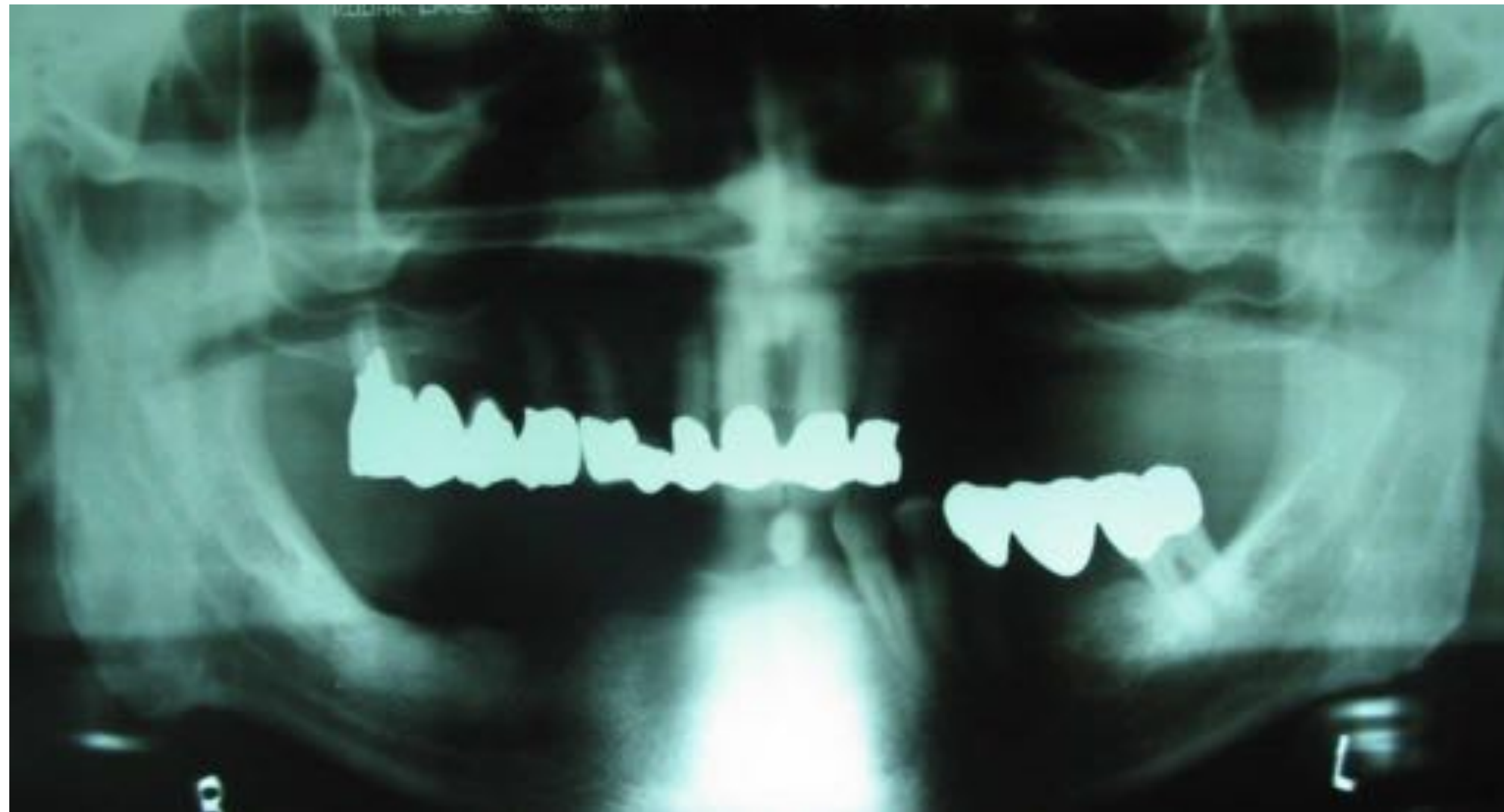
- Despite the best effort implants sometimes still fail. Prosthodontic contingency plan needs to be discussed during the consult.
- Fewer implants with poor angulation
- Support, stability, and retention
- Turn a compromised biomechanics situation around to a esthetic treatment outcome with good long-term prognosis

Pt IR
Panoramic

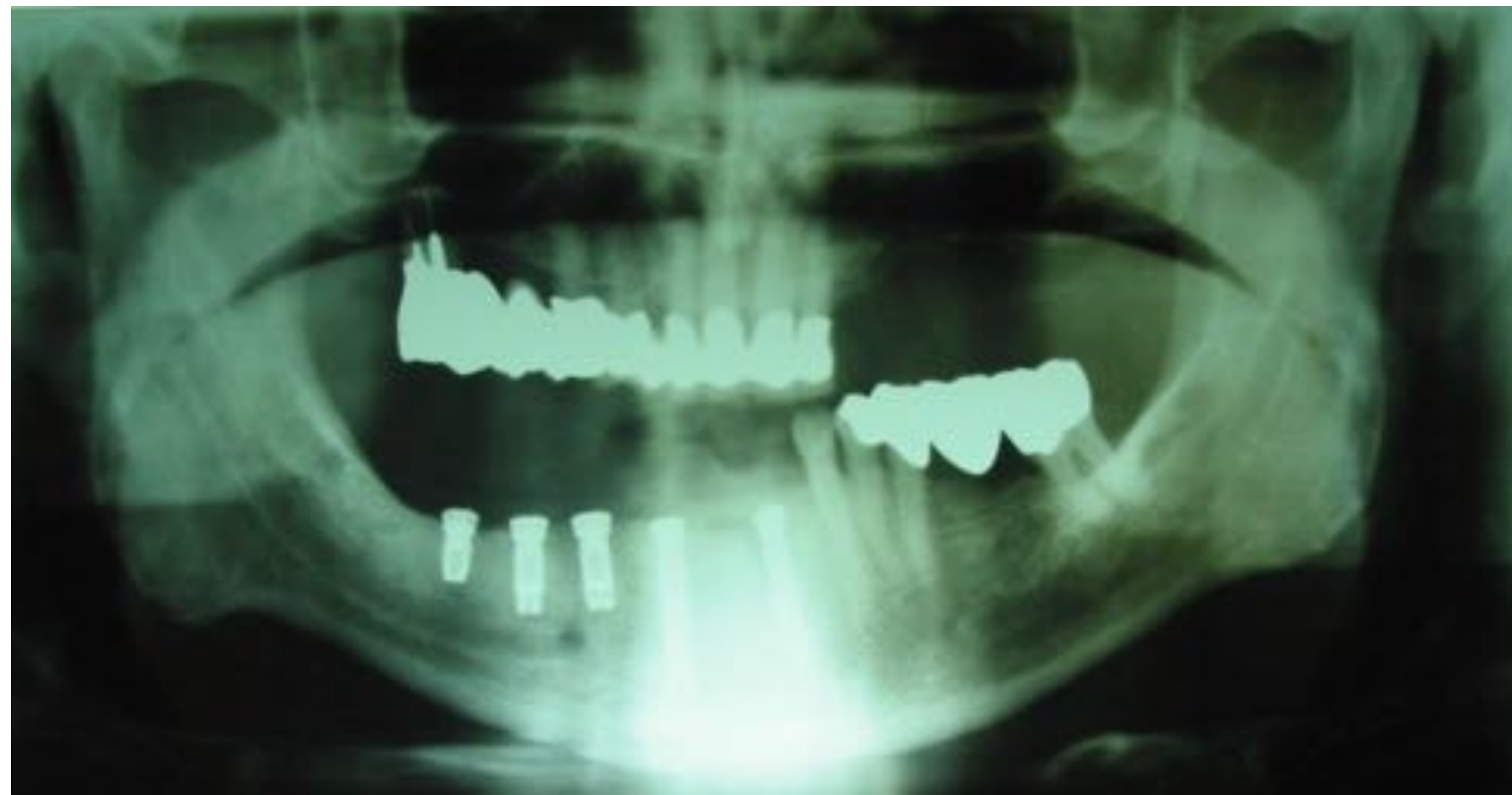


Case 5: IR

Pt IR 1990 Panoramic
after removal of failed blade implant
and hopeless teeth



Case 5: IR



Pt IR

1991 Panoramic after placement of 5 implants to restore the partially dentate mandible

Case 5: IR

Pt IR
1996 Panoramic

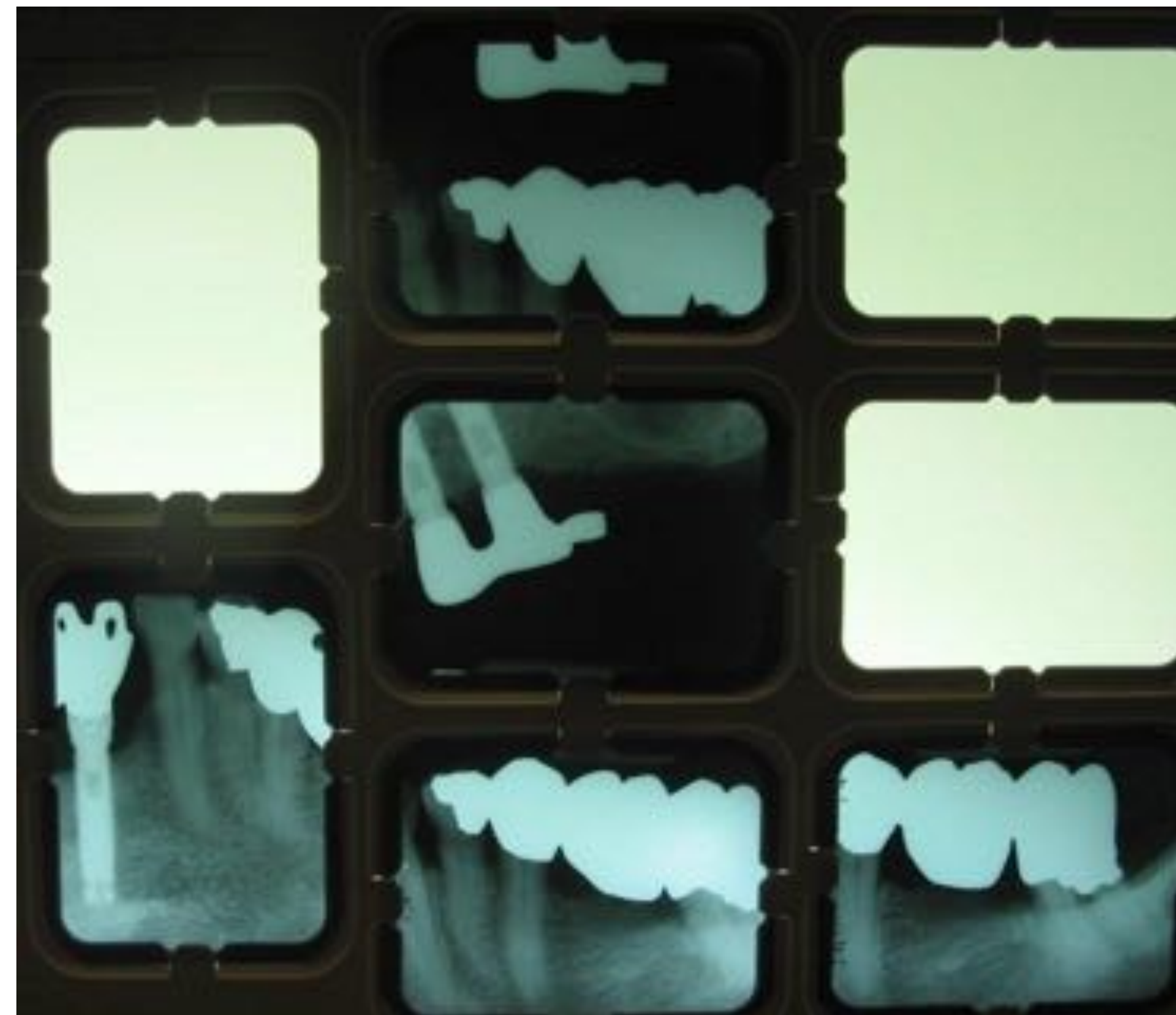
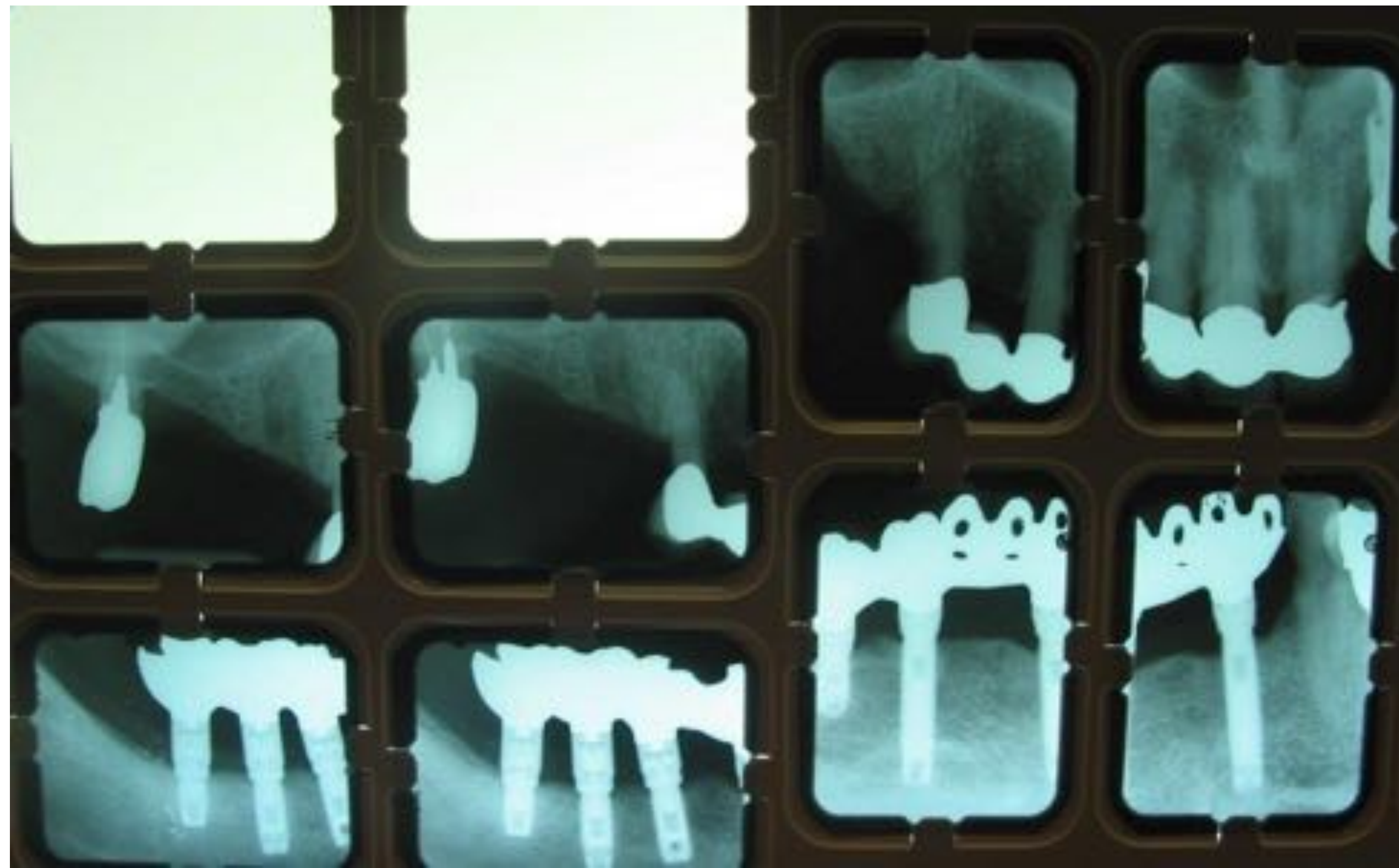


Case 5: IR

Pt IR

2003 FMX

12 y/o functional loading on the mandibular implants



Case 5: IR

Case 5: IR

Long-term Success in Implant-enhanced RPD Therapy: RPD Design Principles and Implant Biomechanical Equilibrium

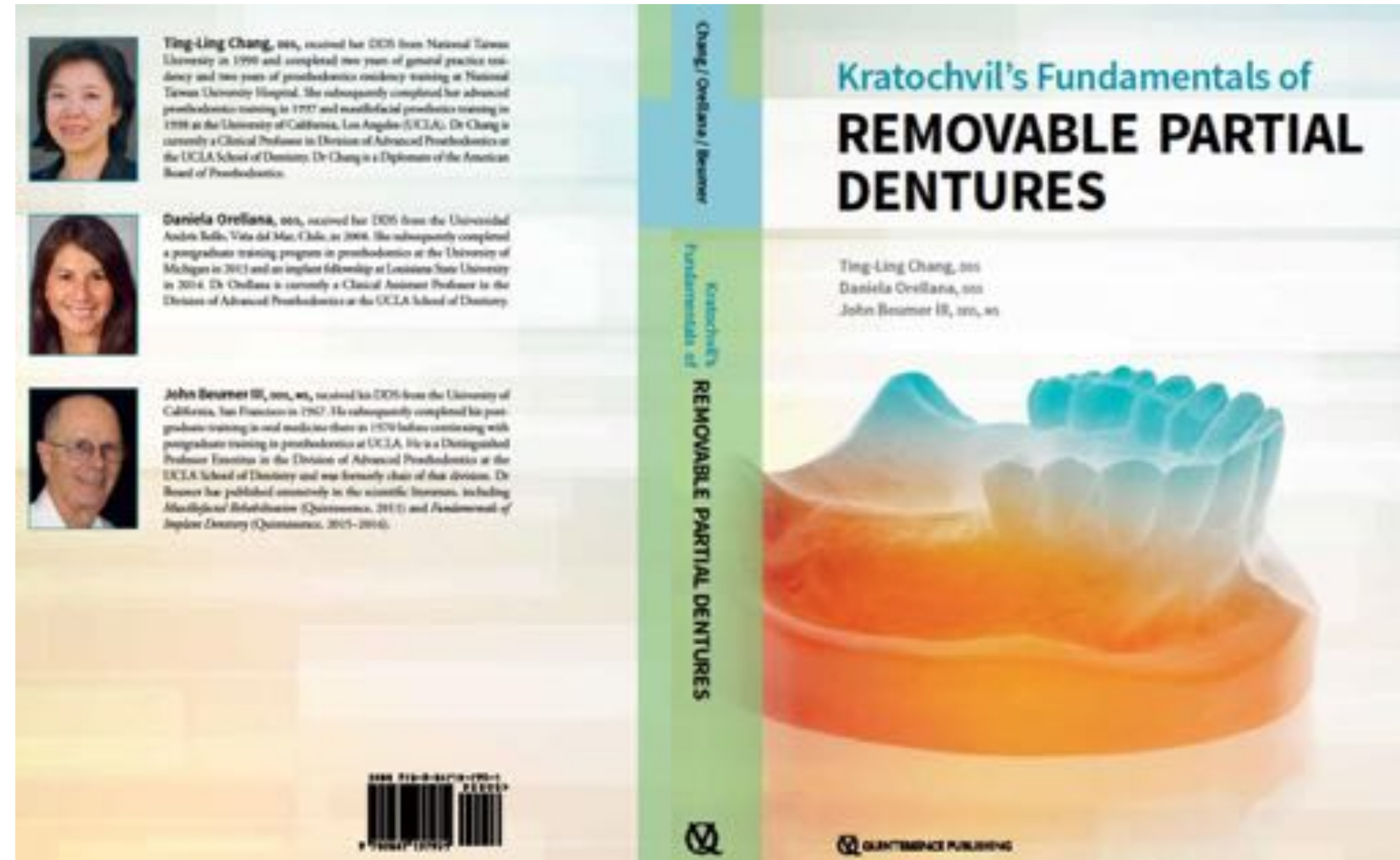
2-implant tissue bar with one ERA attachment to provide retention, improved stability, and improved support for the upper right quadrant

Positive rests on #2 and 5
Active I-bar (0.01" retention) on #2
Passive I-bar on # 5 for bracing/stability



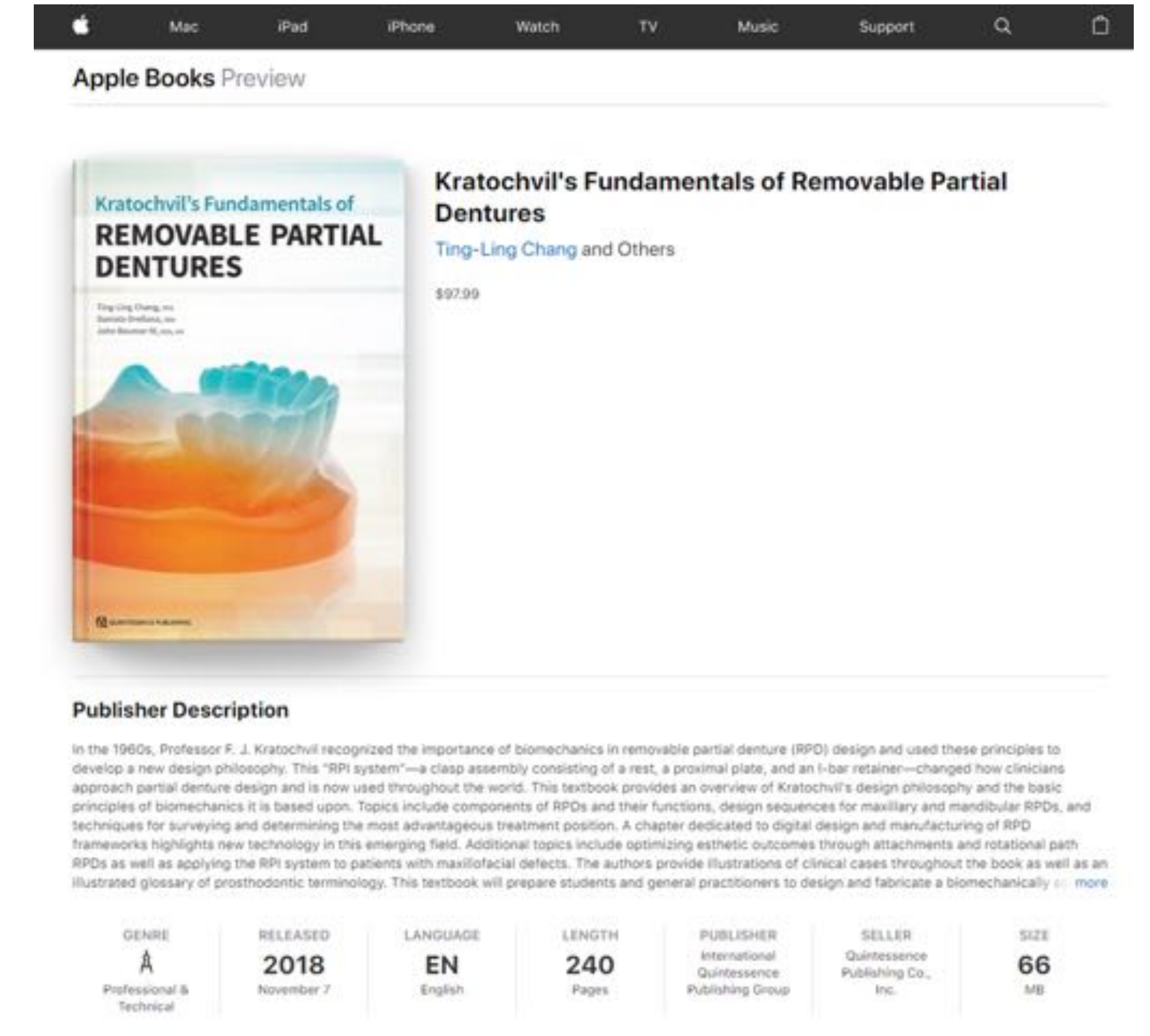
More information about today's content:

Kratochvil's Fundamentals of Removable Partial Dentures 2019 Quintessence Publishing



748 illustrations
Printed version

Also available in
iBooks



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An aerial photograph of a large, modern building complex, possibly a university or government facility. The building is multi-story with a grid-like facade. In the foreground, there is a large, paved parking lot with many spaces. The background shows a body of water and distant hills under a clear sky.

Thank you for your attention!

Any questions?