ROUNDS CASE:
MAXILLARY SINUS AUGMENTATION FOR ENDOSTEAL IMPLANT PLACEMENT
3A-5

OCTOBER 7, 2020

ROUNDS TEAM

Group Leader: Dr. Grady

Specialty Leader: Dr. Guentsch

Project Leader: Nolan Frisch

D3- Jiovannah Campbell

D2- Tyler Grisar

D1- Ine Suh

Patient: A. Hardy

- 64 y/o African American male
- Presented to clinic for Comprehensive Exam
- Chief Complaint: "I've had a partial denture for a few years now and I hate it."
- Works as a social worker in Milwaukee County
- Very adamant on treatment and very flexible

Medical History

- Allergies: Codeine
- Open heart bypass surgery 10+ years ago
- Past tobacco use
- Coronary Heart Disease, High blood pressure, Sinusitis, Type II Diabetic, Vision and Hearing impairment
  - Last reported HbA1c: 6.9
- Medications: Lantis, Humalog, Lisinopril, Coreg, Amlodipine

Dental History

- Seen regularly at an outside office before MUSoD, favored the price at Marquette
- History - Fillings, Crowns, Endo, Extractions, Removable Partial, Gingival Grafting
- Implant - #12 – Peri-Implant Mucositis
- #24 and #25 mobility due to position

Problems

- Failing bridge - #30-32 - recurrent decay
- Abfraction/abrasion
- Missing teeth
- Mobility - #23, 24, 25, 26

Stage I

- Prophy, Diagnostic casts
- Fixed partial denture 30-32 sectioning with caries excavation
- #32 EXT
- #28B and #29B 1 surf. posterior resin
- #8 and #9 MF 2 surf. anterior resin
  - Unesthetic old composite

Stage II

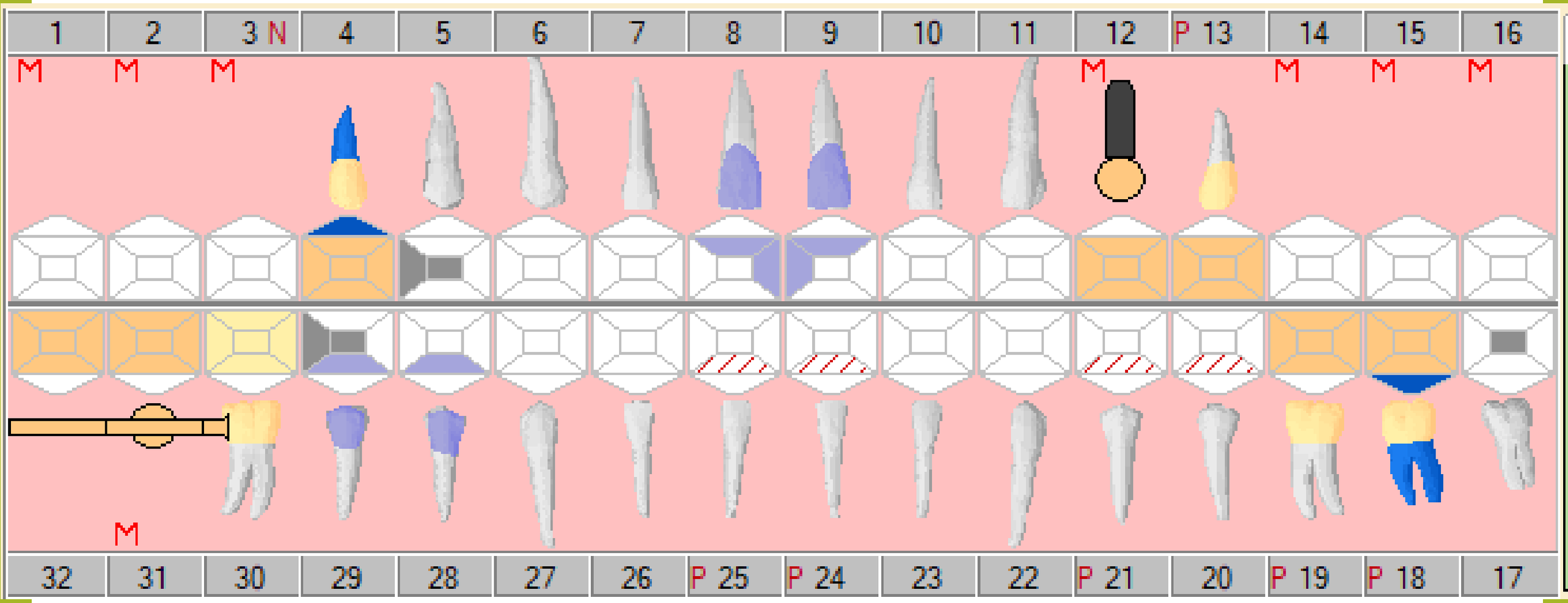
- #30 PFM
- #3 and #14 Endosteal implant placement with custom abutment and PFM crown

Clinical Photos

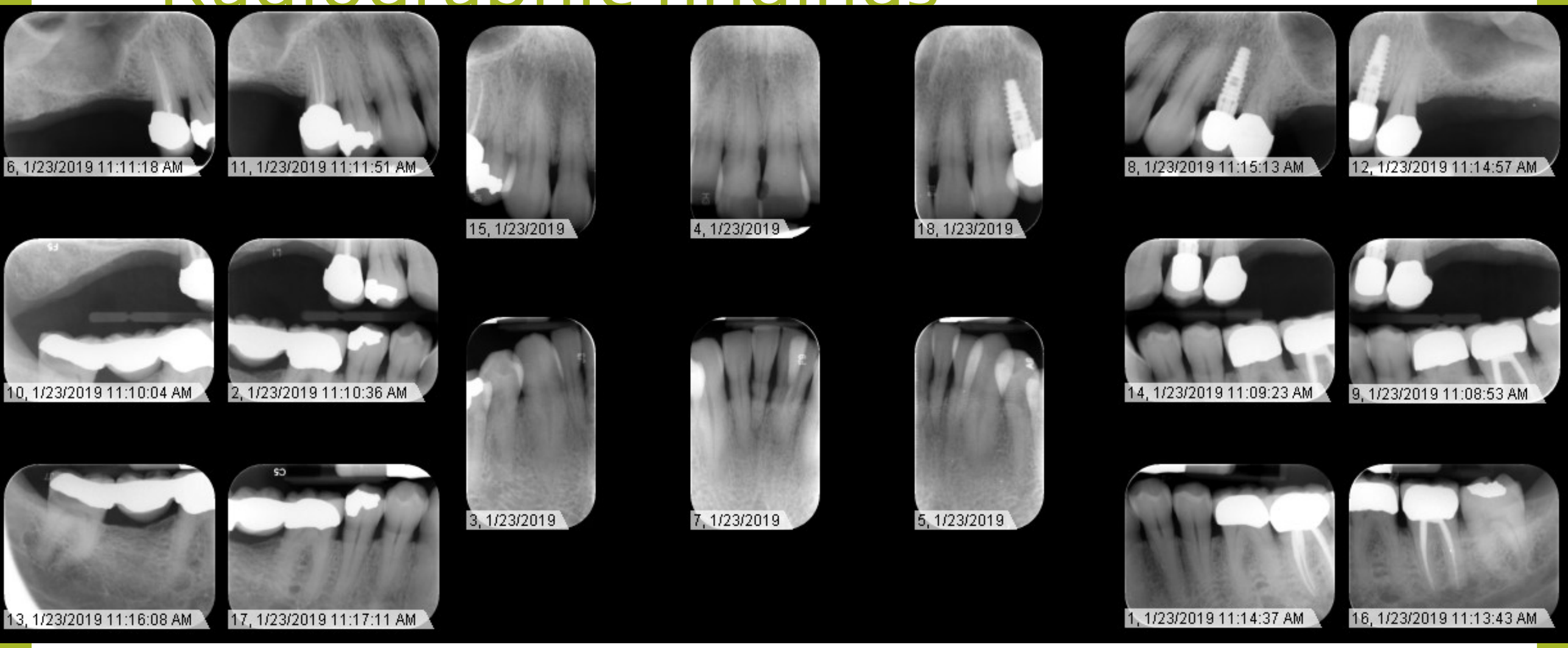
R

L

Odontogram

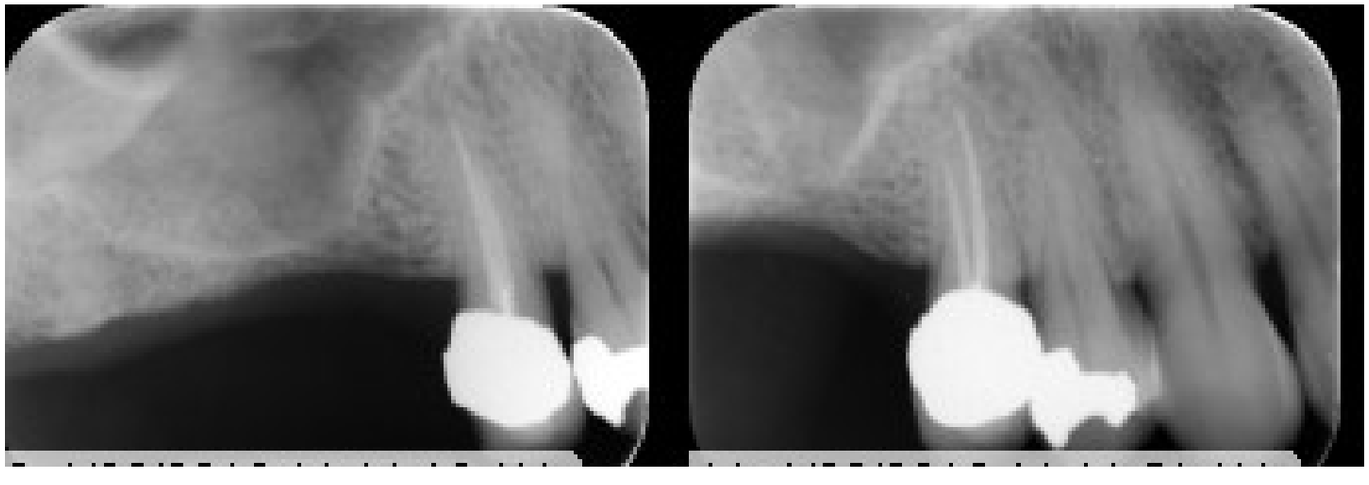

1 2 3 N 4 5 6 7 8 9 10 11 12 P 13 14 15 16
M M M M M M M
M
32 31 30 29 28 27 26 P 25 P 24 23 22 P 21 20 P 19 P 18 17

Radiographic findings

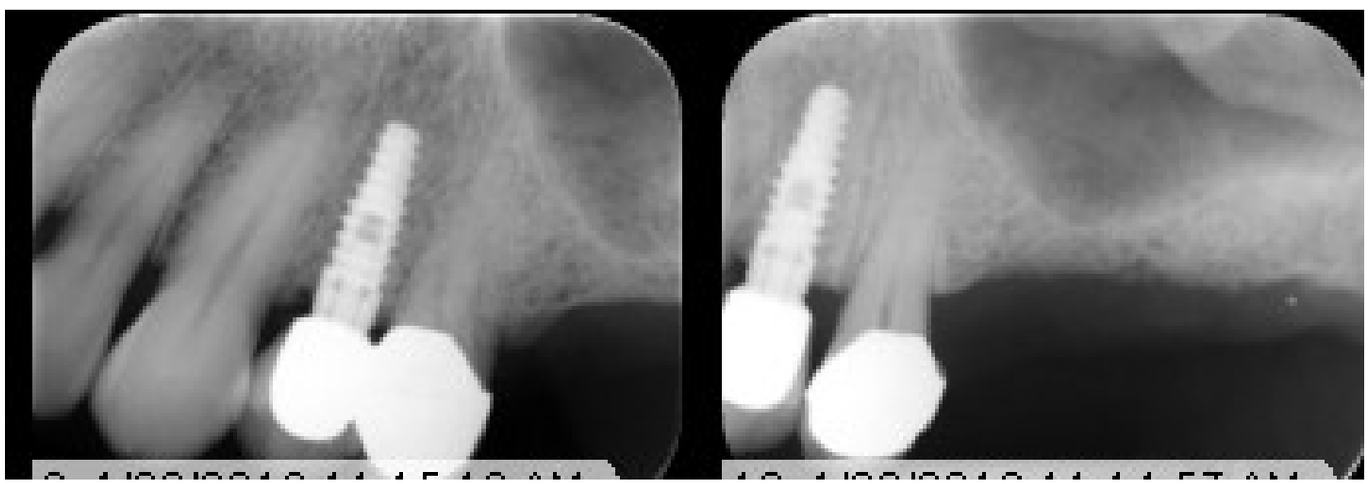


Radiographs

How many mm of bone needed for implant placement?

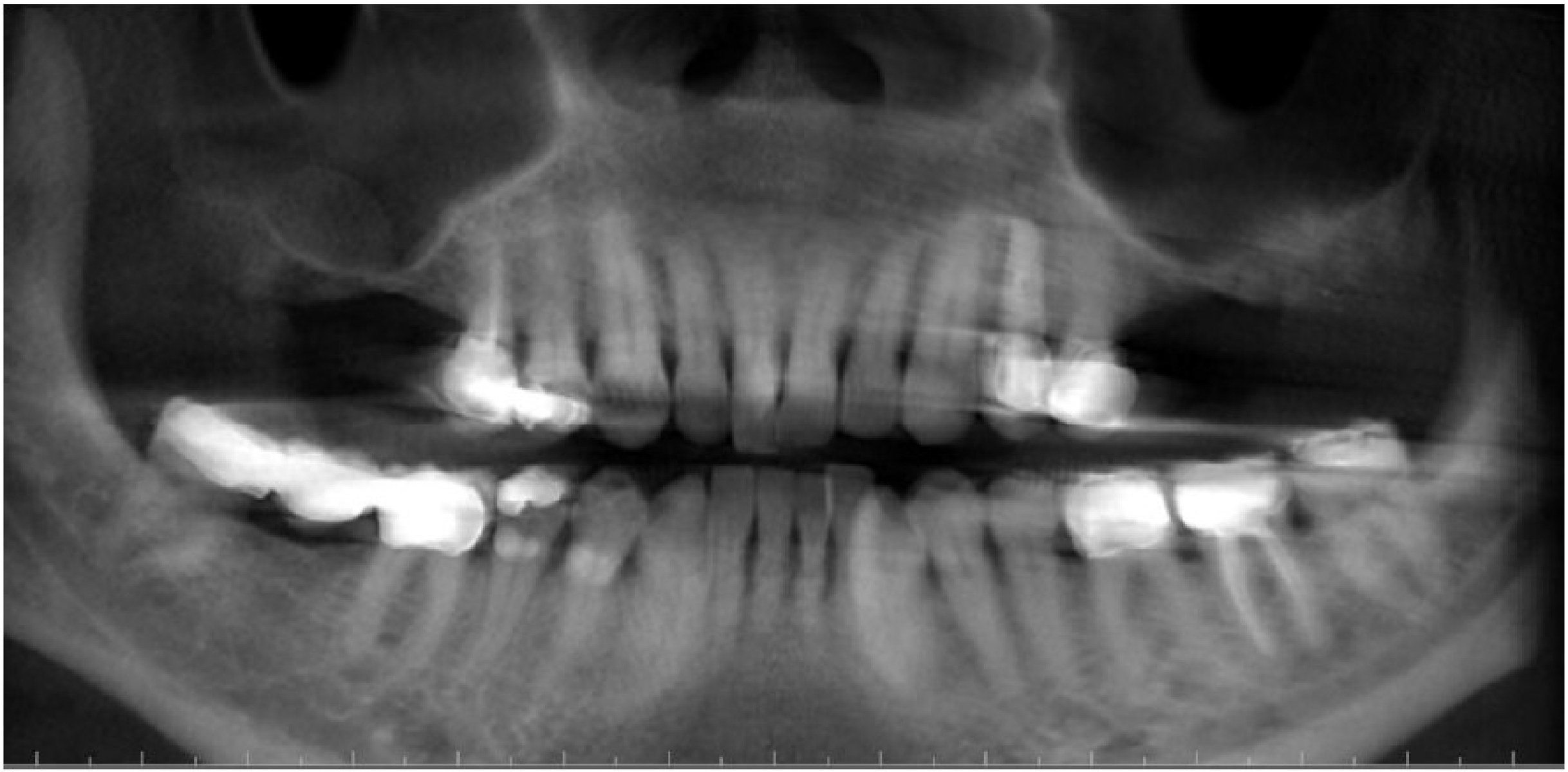


What are other options to view bone quality and quantity?



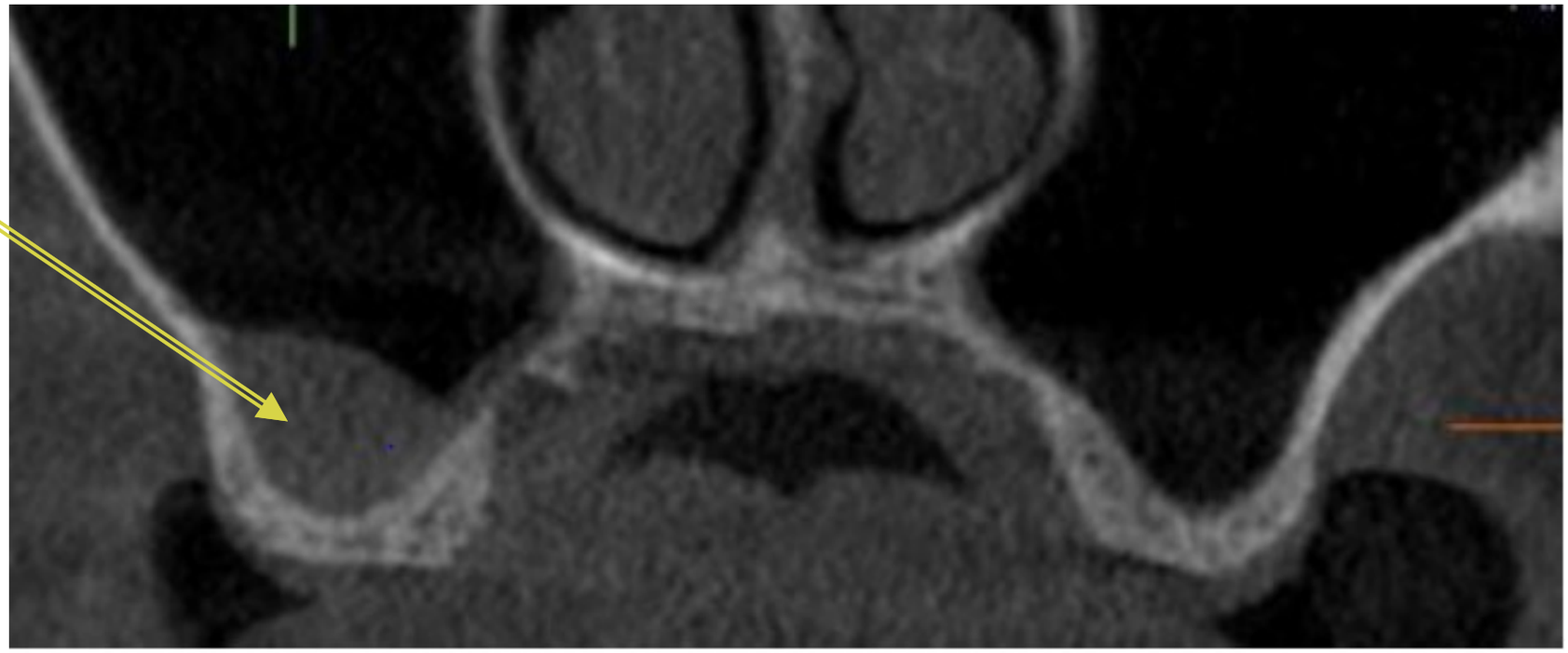
CBCT

CBCT with review from Dr. Demirturk

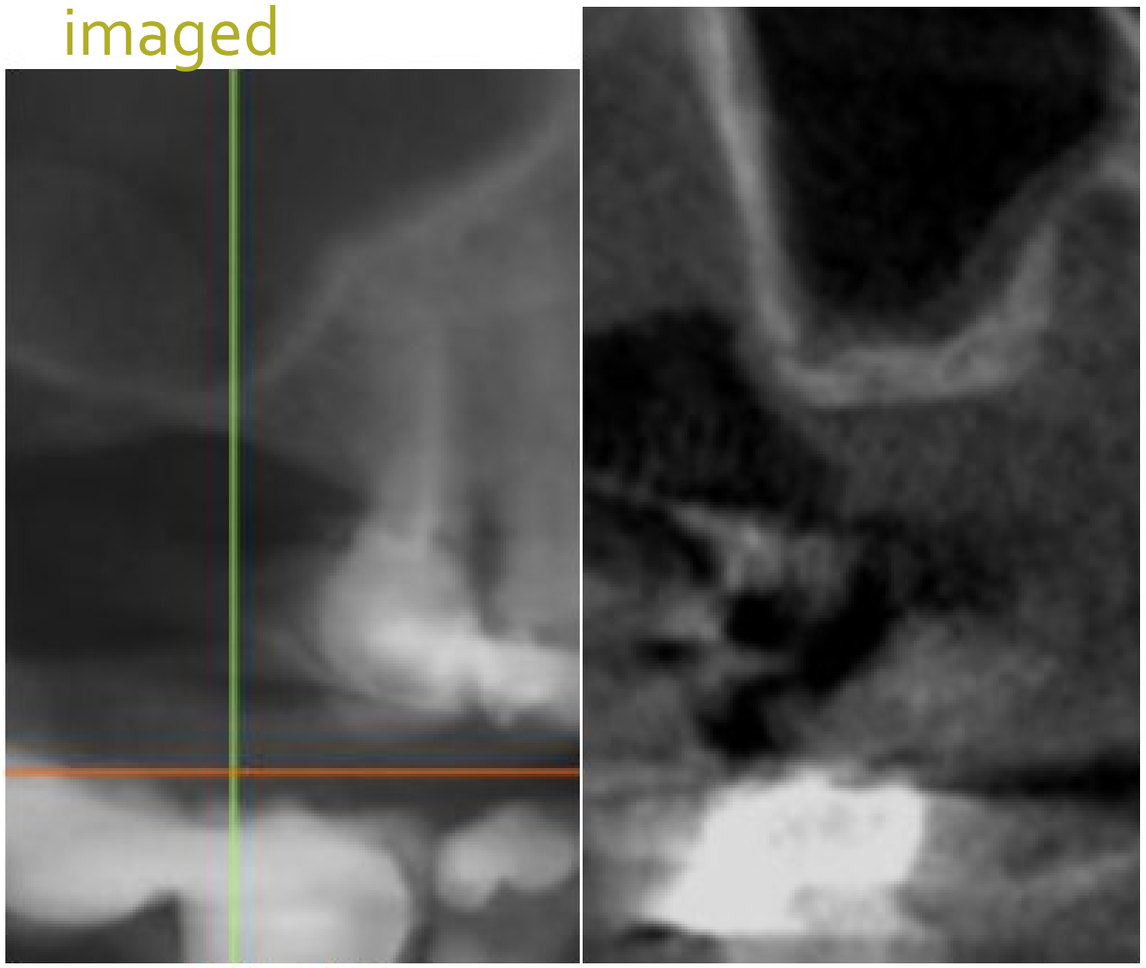


Right maxillary sinus mucous retention cyst

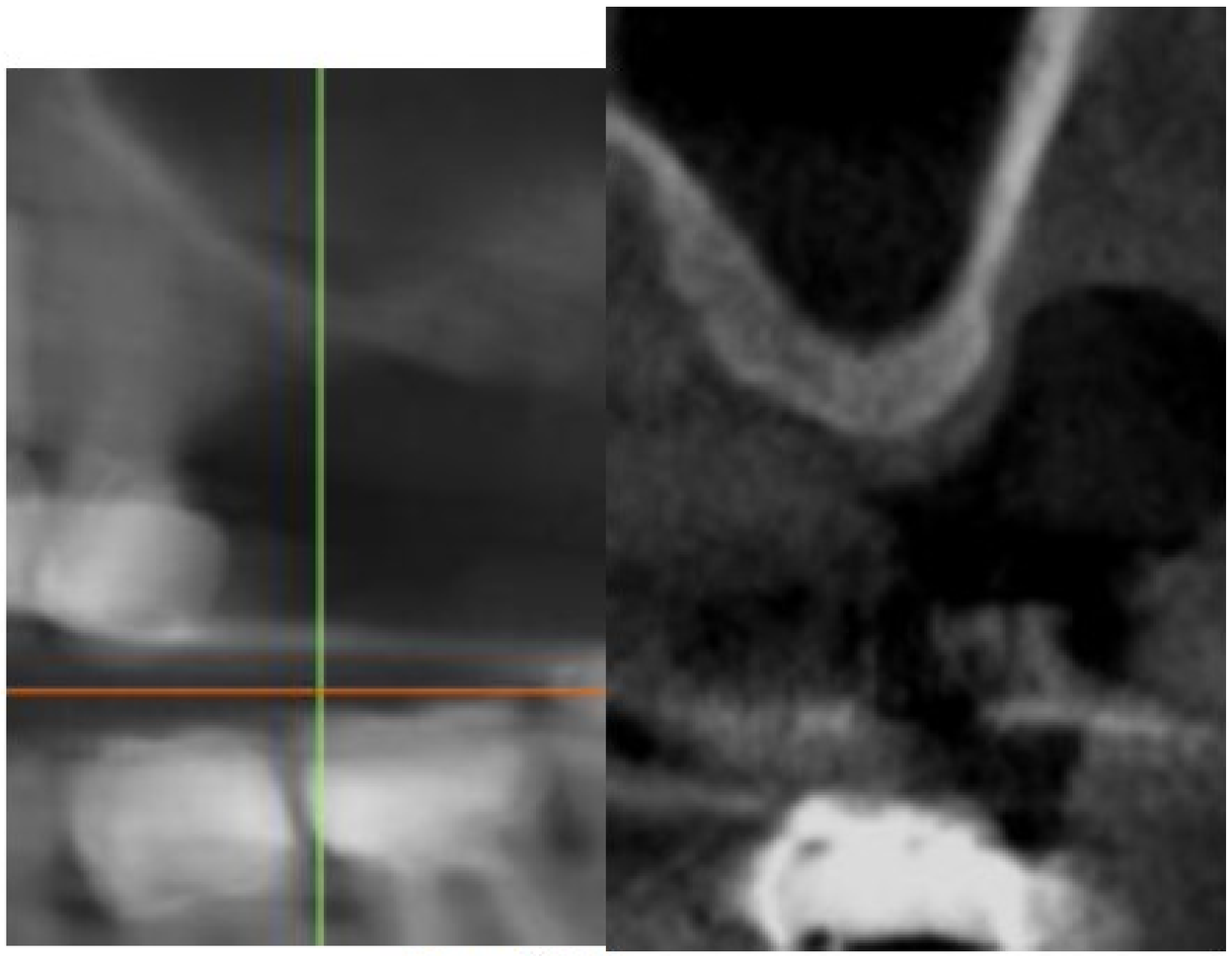
Mucus Retention Cyst



Remember: Responsible for everything that is imaged



Site #3



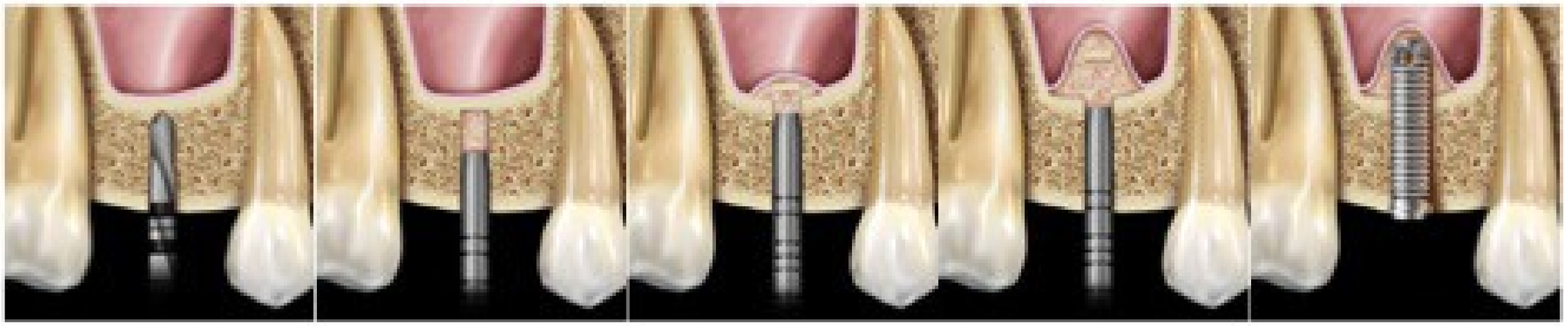
Site #14

What We Know

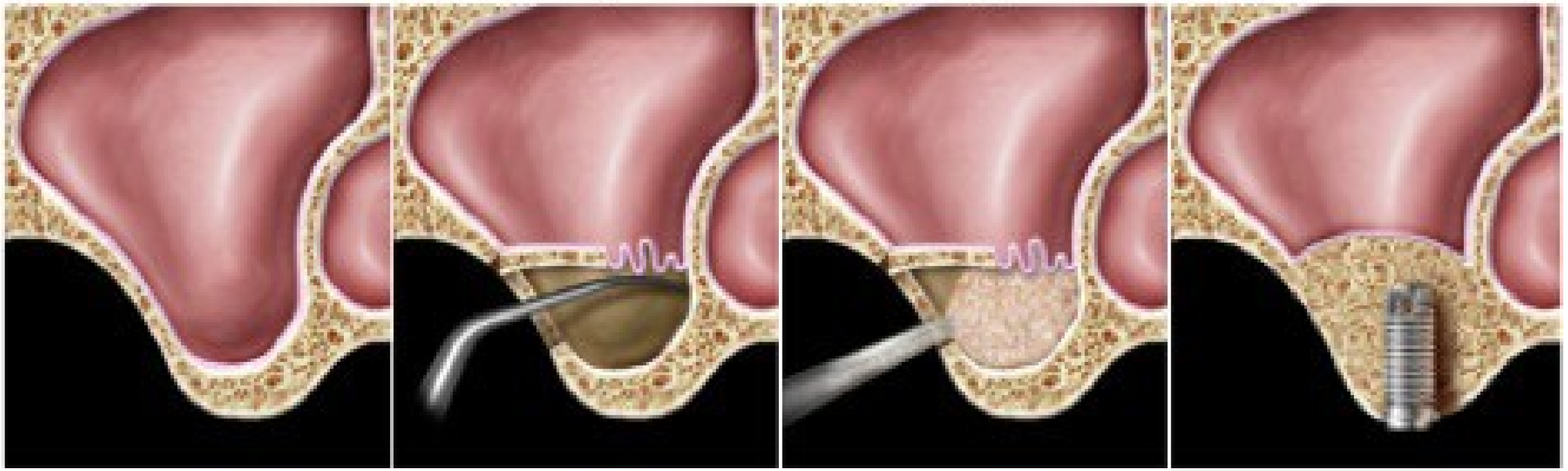
- Patient has stable implant placed 5+ years ago
- Diabetic control necessary for implant survival
- Lack of bone in posterior maxilla
- Poorest bone quality for implant in posterior maxilla
  - Ant. Mand > Post. Mand > Ant. Max > Post. Max

How to gain bone in Posterior Maxilla

Internal (osteotome crestal) approach

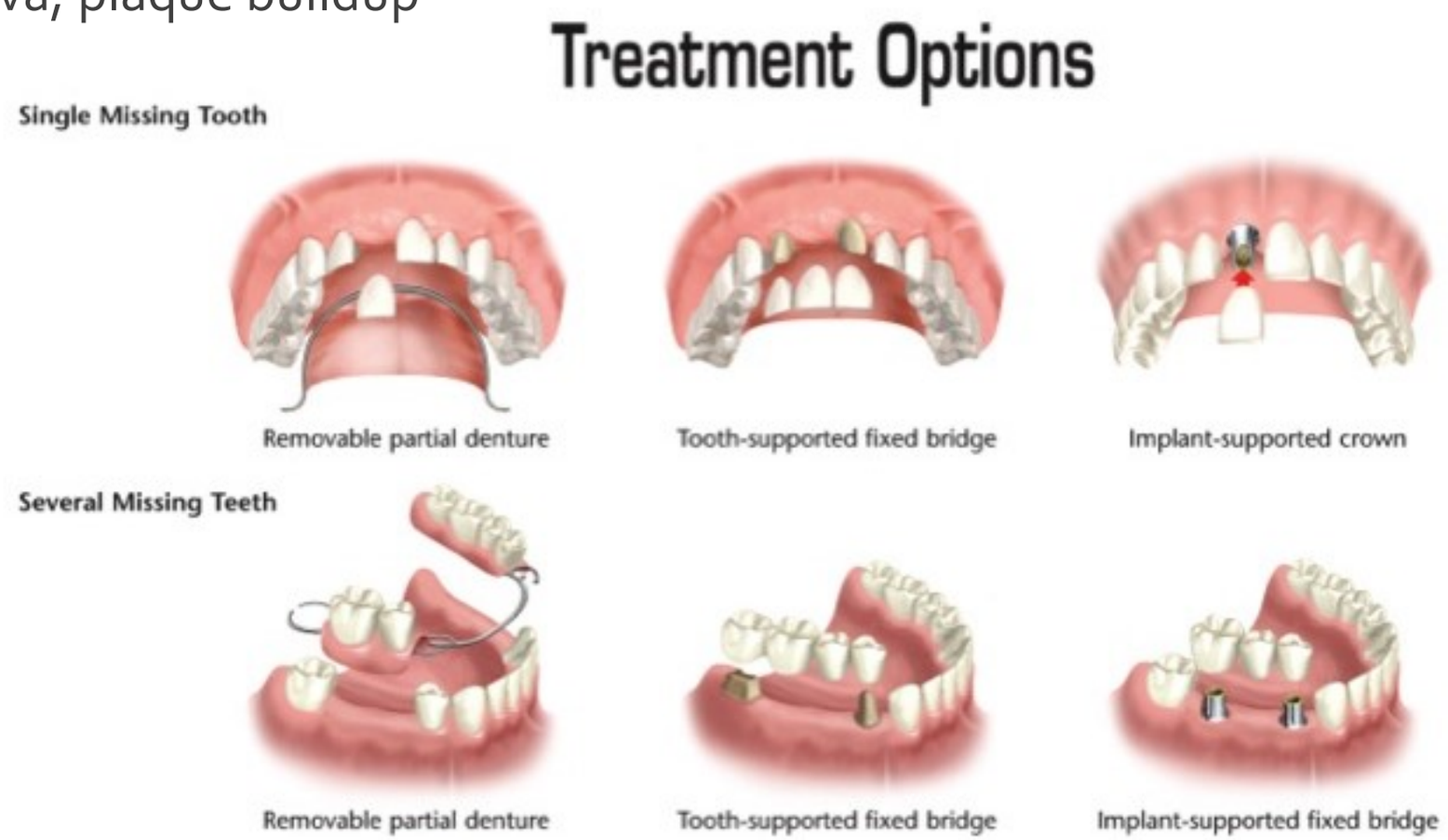


External (lateral window) approach



What are the options to fill an edentulous space?

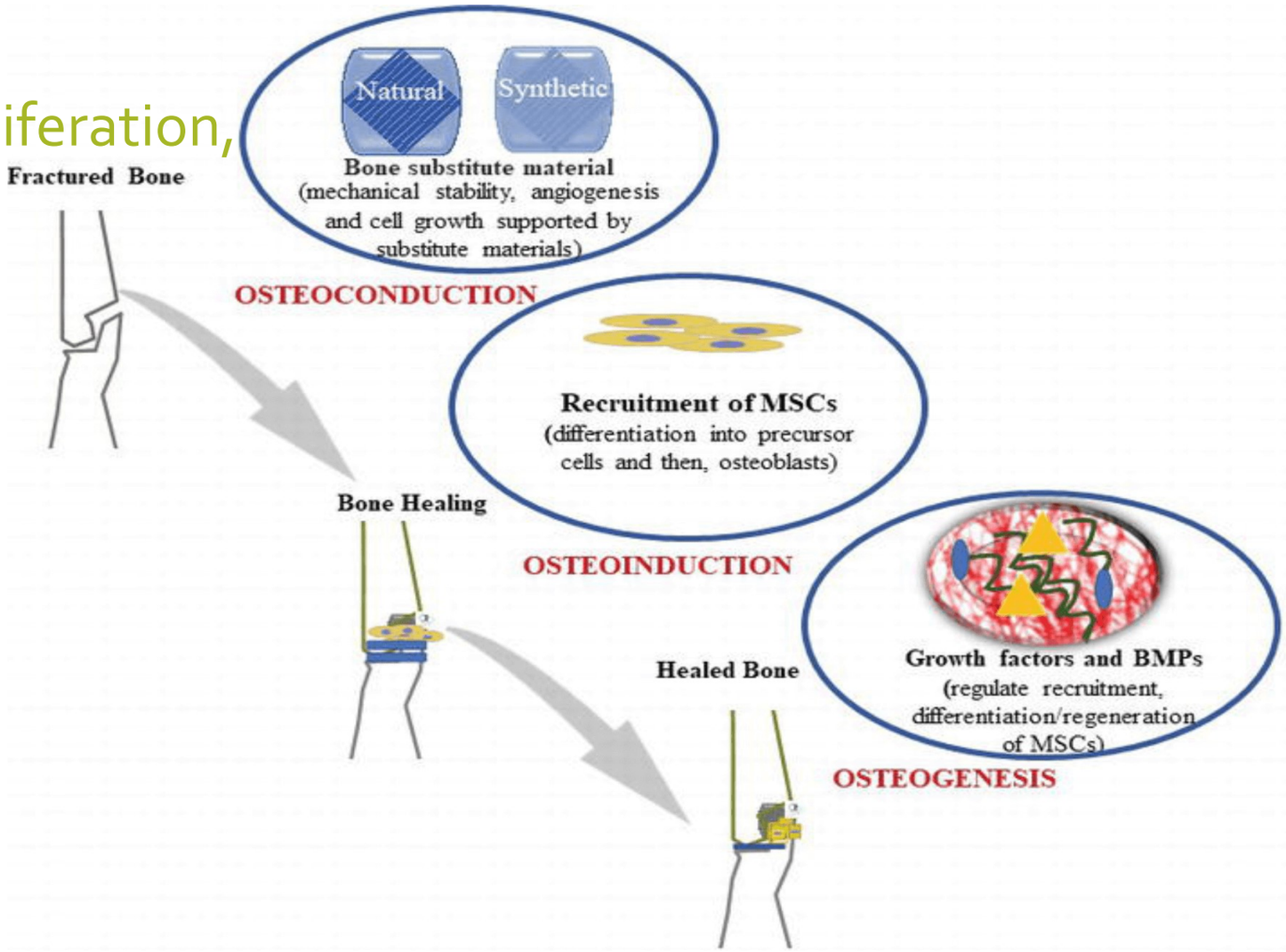
- **Fixed partial denture**
  - For short edentulous span, healthy supportive tissues
  - Requires tooth reduction of abutments
- **Removable partial denture**
  - For multiple edentulous areas, severe periodontitis, excessive bone loss
  - Can lead to trauma to gingiva, plaque buildup
- **Implant-supported crown**
  - Conserves tooth structure
  - May require bone graft



Al-Quran, F. A., Al-Ghalayini, R. F., & Al-Zu'bi, B. N. (2011). Single-tooth replacement: factors affecting different prosthetic treatment modalities. BMC oral health, 11, 34. https://doi.org/10.1186/1472-6831-11-34
Fugazzotto P. A. (2009). Evidence-based decision making: replacement of the single missing tooth. Dental clinics of North America, 53(1), 97–ix. https://doi.org/10.1016/j.cden.2008.10.001

Bone Graft: Mechanisms of Bone Regeneration

- **Osteoconduction**
  - Provides the matrix for bone growth
- **Osteoinduction**
  - Growth factors and BMPs stimulate MSCs to differentiate into osteoblasts
- **Osteogenesis**
  - New bone produced by proliferation, osteoid production and mineralization



Albrektsson, T., & Johansson, C. (2001). Osteoinduction, osteoconduction and osseointegration. *European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society*, *10 Suppl 2*(Suppl 2), S96–S101. https://doi.org/10.1007/s005860100282

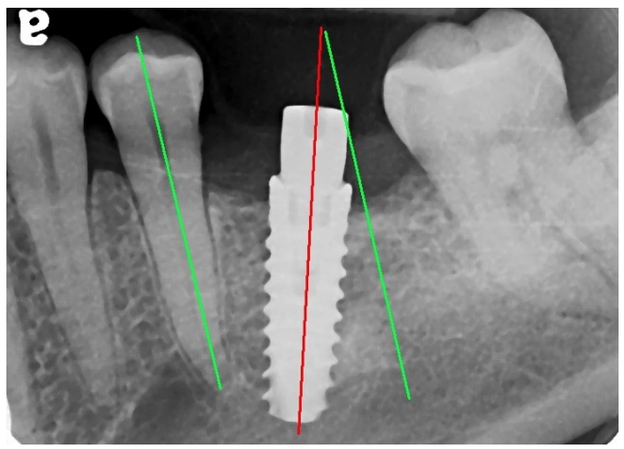
D2 Pathology Question

What are causes of implant failure and how can they be avoided?

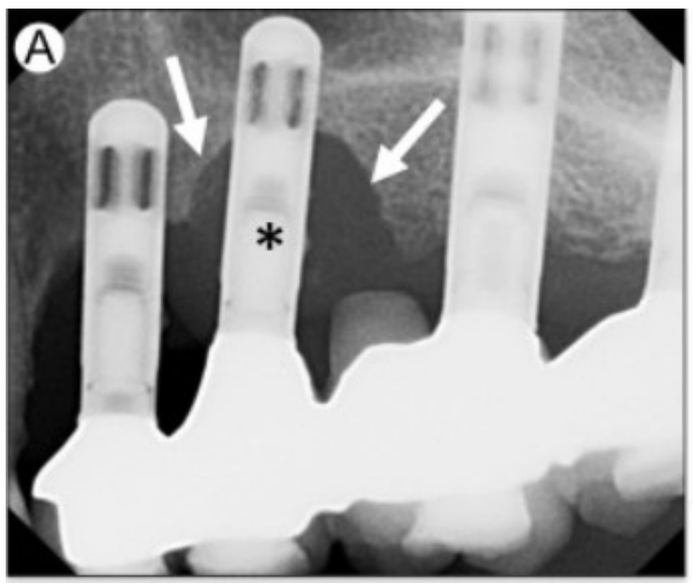
- Biomechanical overload
  - Poor angulation or positioning
  - Parafunctional habits
  - Inadequate posterior support
  - Inadequate amount of bone
- Infection or inflammation
  - Boneloss
- Other
  - Oral hygiene
  - Traumatic injury

D2 Pathology Question

- Biomechanical overload
  - Results in fracture of surrounding bone or implant or loosening due to inadequate retention
  - Bruxers have higher rate of failure than non bruxers
  - Avoid by proper planning and execution



https://www.facialart.com/archived-pages/our-practice/dental-implant-complications/implant-related-problems-complications/

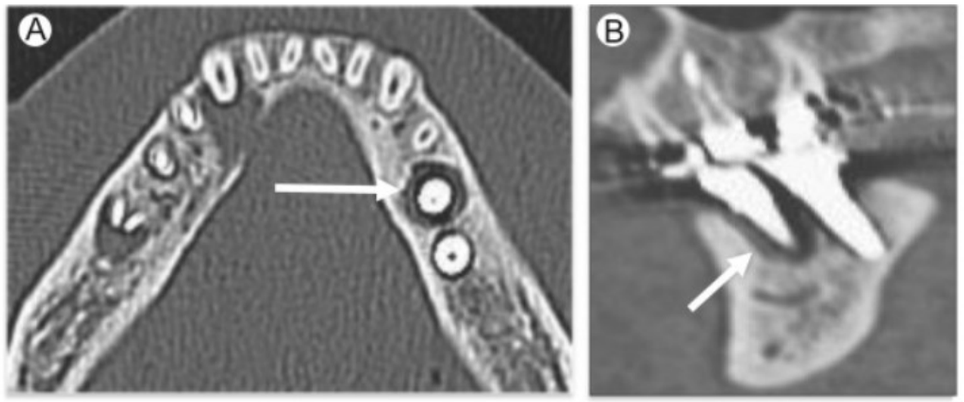


https://0-www-sciencedirect-com.libus.csd.mu.edu/science/article/pii/S0887217115000967?via%3Dihub

http://eximiustheseventh.blogspot.com/2013/12/what-does-bruxism-do-to-implants.html

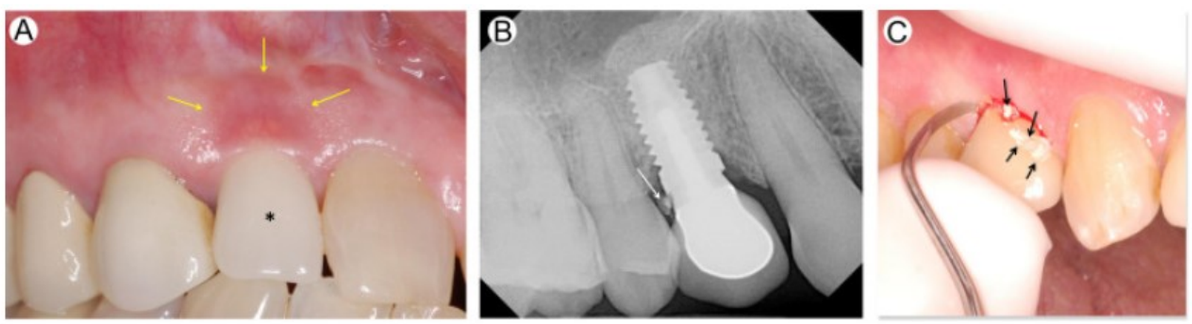
D2 Pathology Question

- Infection and inflammation
  - Poor oral health can result in periodontal disease causing bone loss
  - Proper OHI, prophylaxis appointments every 3-6 months, ensuring no subgingival cement or overhangs present



Download : Download high-res image (292KB) Download : Download full-size image

Figure 3. Axial (A) and oblique sagittal CT (B) shows infection resulting in bone resorption and perihardware radiolucency (arrows).



Download : Download high-res image (486KB) Download : Download full-size image

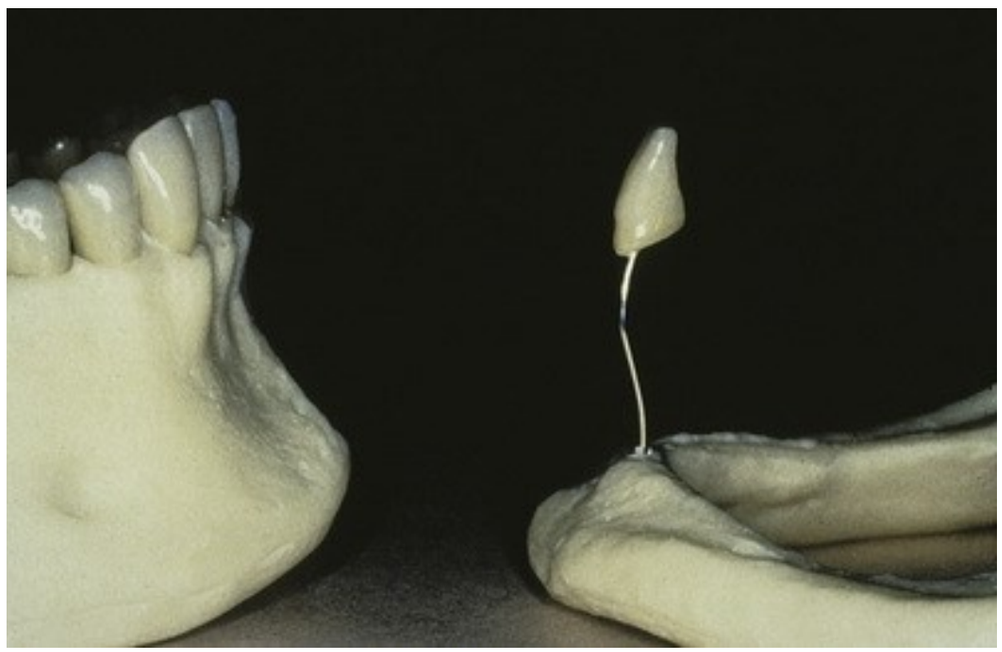
Figure 4. (A) Photo of a patient with subgingival cement causing inflammation (arrows) in area of restored implant (*). (B) Radiograph reveals radiopaque cement on distal aspect of implant (arrow). (C) Photograph demonstrates removal of the cement (arrows).

https://0-www-sciencedirect-com.libus.csd.mu.edu/science/article/pii/S0887217115000967?via%3Dihub

D2 Pathology Question

- Other
  - Natural bone resorption due to lack of vertical pressure
    - Place implants 4-6 months after extraction occurs
  - Traumatic Injury
    - Avoid situations that can result in injury

https://www.researchgate.net/figure/mplants-surrounded-by-thin-mucosa-may-be-more-prone-to-bone-resorption-with-angular-de_fig1_256440184



https://pocketdentistry.com/removable-implant-complications/

D2 Pathology Question

- Liaw, K., Delfini, R. H., & Abrahams, J. J. (2015). Dental Implant Complications. *Seminars in Ultrasound, CT and MRI, 36*(5), 427- 433. doi:10.1053/j.sult.2015.09.007

- Zhou, Y., Gao, J., Luo, L., & Wang, Y. (2015). Does Bruxism Contribute to Dental Implant Failure? A Systematic Review and Meta-Analysis. *Clinical Implant Dentistry and Related Research, 18*(2), 410-420. doi:10.1111/cid.12300

D3 PICO

- **Clinical Question:**

- In patients who require maxillary sinus augmentation, how does the long term prognosis of an endosseous implant placement differ when comparing 1-stage vs. 2-stage procedures?

PICO

P: Patients who require maxillary sinus augmentation before placement of endosseous implant

I: 1-stage sinus floor augmentation

C: 2-stage sinus floor augmentation

O: Long-term prognosis

PICO Question: In patients who require maxillary sinus augmentation before placement of an endosseous implant, does 1-stage or 2-stage sinus floor augmentation provide a better long-term prognosis of the implant?

Clinical Bottom Line

- There is no significant difference regarding implant loss between 1-stage and 2-stage implant surgeries. Both techniques of Maxillary Sinus Augmentation are a reliable treatments to support dental implants in patients with a partial or fully edentulous maxilla and are considered successful in long-term randomized controlled trials (RCTs) and cohort studies.

Search Background

- **Date(s) of Search:** 9/27/2020
- **Database(s) Used:** PubMed
- **Search Strategy/Keywords:** Dental implants, dental implantation, endosseous implant, maxilla/surgery, osseointegration, sinus augmentation, sinus floor augmentation, 1 stage, 2 stage

Search Background

- **MESH terms used:** Sinus augmentation, 1 stage, 2 stage

- ("paranasal sinuses"[MeSH Terms] OR ("paranasal"[All Fields] AND "sinuses"[All Fields]) OR "paranasal sinuses"[All Fields] OR "sinus"[All Fields] OR "sinus s"[All Fields]) AND ("augment"[All Fields] OR "augmentation"[All Fields] OR "augmentations"[All Fields] OR "augmented"[All Fields] OR "augmenting"[All Fields] OR "augments"[All Fields]) AND "1"[All Fields] AND ("stage"[All Fields] OR "staged"[All Fields] OR "stages"[All Fields] OR "staging"[All Fields] OR "stagings"[All Fields]) AND "2"[All Fields] AND ("stage"[All Fields] OR "staged"[All Fields] OR "stages"[All Fields] OR "staging"[All Fields] OR "stagings"[All Fields])

Article 1

- Citation: Felicé P, Pistilli R, Piattelli M, Soardi E, Barausse C, Esposito M. **1-stage versus 2-stage lateral sinus lift procedures: 1-year post-loading results of a multicentre randomized controlled trial.** Eur J Oral Implantol. 2014 Spring;7(1):65-75. PMID: 24892114.

- Study Design: Multicenter, Comparative Randomized Controlled Trial

- Aim of study: Identify whether 1-stage or 2-stage maxillary sinus augmentation by lateral window approach is the more preferable technique? (Goal: five-year follow up)

Article 1 Synopsis

- Methods: Recruitment of 60 patients from three different centers (20 per center), three operators, all using standardized procedures. Study included any patient who was partially edentulous in posterior maxilla with residual bone height of 1-3mm and width of at least 5mm measured by a CT. (Included 14 smokers; 10 being heavy smokers)

- All patients received prophylactic abx therapy of 2g of amoxicillin (or 600mg clindamycin if allergic to penicillin) 1 hour before intervention. Patients rinsed with chlorhexidine for 1 minute prior to intervention. All used Articane with epi 1:100,000. Only 1-stage continued abx therapy (1g amox or 300mg clin) bid for 7 days.

- Sealed envelope containing group allocation code was opened after flap was elevated and sinus lining was assessed (or membrane was placed if lining was perforated/ruptured).

Article 1 Synopsis

- 1-stage patients received one to three 11-15mm long implants. Sites prepared using surgical stents. Neck of implant placed flush to the bone. Residual space in sinus filled with bone substitute granules.

- 2-stage patients received same sinus augmentation, bone substitute and membrane were placed. 4 months to heal before implant placement.

- Patients instructed to use chlorhexidine mouthwash for 1 minute bid for 2 weeks along with other post-op instructions (analgesic).

- Provisional screw-retained acrylic restorations were delivered within 1 month of implant placement. Followed up 1 week (sutures) and 4 months (tightening abutment screws). 6 month recall.

- Dentist not involved in treatment made all clinical assessments of radiographs without knowledge of group allocation (blind).

Article 1 Results

- No statistically significant differences were observed between implants placed according to 1- or 2-stage sinus lift procedures.
- However this study may suggest that in patients having residual bone height between 1 to 3 mm below the maxillary sinus, there might be a slightly higher risk for implant failures when performing a 1-stage lateral sinus lift procedure.

	1-stage	2-stage
Sinus lift proced-ure failures	0 in 30 patients	1 in 30 patients
Prosthesis failures	2	1
Implant failures	3	1
Complications	2 in 30 patients	1 in 30 patients

<u>Implant failures for 1-stage</u>:

-2 implants placed in 1mm residual bone height lacked stability at placement

-1 implant was exposed, painful, purulent. Removed at 1 month.

<u>Implant failures for 2-stage</u>:

-1 implant mobile (#17).

Article 2 Citation

- Citation: Kim HJ, Yea S, Kim KH, Lee YM, Ku Y, Rhyu IC, Seol YJ. **A retrospective study of implants placed following 1-stage or 2-stage maxillary sinus floor augmentation by the lateral window technique performed on residual bone of <4 mm: Results up to 10 years of follow-up.** J Periodontol. 2020 Feb;91(2):183-193. doi: 10.1002/JPER.19-0066. Epub 2019 Aug 2. PMID: 31372997.

- Study Design: Retrospective Cohort Study

- Aim of study: To compare survival rates for up to 10 years of implants placed following 1-stage or 2-stage Sinus Floor Augmentation by Lateral Window technique (SFALW) performed on residual bone of <4 mm.

Article 2 Synopsis

- Methods: Retrospective study conducted by two periodontists based on dental records and radiographic data obtained from patients who received 1-stage and 2-stage SFALW surgery in maxillary posterior area with residual bone height <4mm from March 2006-June 2014. Includes patients who received one or more implants by four providers.
- Mean follow-up period was 5.7 ± 2.4 years (range of 2.1 to 10.8 years).
- Radiographs provided for: Pre-surgical, Post-surgical, Post-Prosthetic, and >2 year follow up after prosthetic loading.
- 156 implants placed with 1-stage SFALW. 239 implants placed with 2-stage SFALW.

Article 2 Synopsis

- 1-stage technique: Half graft material mixed with saline solution placed before implant placement; half placed after. Resorbable collagen membrane placed, flap repositioned and sutured. Patients prescribed abx therapy 5-7 days and chlorhexidine mouth rinse for 2 weeks postoperatively.

- 2-stage technique: Implant placed 5-8 months after sinus surgery.

- Radiographs evaluated by single investigator to rule out interexaminer variation.

Article 2 Results

- There was no statistically significant difference between 1-stage and 2-stage group.

RBH	1-stage	2-stage
<2mm	93.9%	93.2%
2-4mm	98.1%	91.5%
Cumulative survival rate:	**96.8%**	**92.5%**

- 80% of failures occur within the 1st year and that 93.1% of failures within 3 years. All failed after prosthetic loading.
- Influencing factors of implant failure: >13mm implant fixture, window size, primary stability, smoking status.

Article 3 Citation

- Citation: Raghoebar, GM, Onclin, P, Boven, GC, et al. **Long-term effectiveness of maxillary sinus floor augmentation: A systematic review and meta-analysis**. *J Clin Periodontol*. 2019; 46(Suppl. 21): 307– 318. https://doi.org/10.1111/jcpe.13055

- Study Design: Systematic Review and Meta-Analysis of Cohort studies

- Aim of Study: To assess the long-term effectiveness (≥5 years) of maxillary sinus floor augmentation (MSFA) procedures applying the lateral window technique and to determine possible differences in outcome between simultaneous and delayed implant placement, partially and fully edentulous patients, and grafting procedures.

Article 3 Synopsis

- Methods: Systematic review conducted by a biomedical specialist using Medline (via PubMed), Embase, and Cochrane Central Register of Controlled Trials.
- Inclusion criteria: edentulous or dentate, requiring MSFA (lateral window technique) and presented with mean RBH under sinus at site of implant placement <6mm.
- Intervention: Mixture of Autogenous bone (AB) and/or Bone substitute (BS), solely Bone substitute, or no graft material.
- Goal was to pool RCTs with follow up >5 years, but no RCTs directly answered PICO question. Nevertheless, 11 cohort studies with sufficient quality were included.

Article 3 Synopsis

- A variety of studies included MSFA with Autogenous Bone (AB) harvested from maxillary sinus region: chin, tuberosity, ascending mandibular ramus, anterior or posterior iliac crest.

- 2-stage healing period for graft material ranged from 3 to 18 months.

Article 3 Results

- MSFA (lateral window technique) is a safe and predictable procedure as part of oral rehabilitation of severely atrophic maxillae with dental implants. Meta-analysis reveals the survival of implants is high with no difference in simultaneous or delayed implant placement or using AB or BS as augmentation material.

- Overall cumulative weighted average annual implant loss was 0.43 representing a 5-year implant survival rate of 97.8%.

- Annual implant loss was higher when implants placed in mixture of AB and BS compared with placement in AB or BS alone.
- Not possible to draw conclusion about optimal healing time of graft material and implant before loading after MSFA. Prolonged healing period before implant placement is advisable.

Levels of Evidence

☐ **1a** – Clinical Practice Guideline, Meta-Analysis, Systematic Review of Randomized Control Trials (RCTs)

☒ **1b** – Individual RCT

☒ **2a** – Systematic Review of Cohort Studies

☒ **2b** – Individual Cohort Study

☐ **3** – Cross-sectional Studies, Ecologic Studies, "Outcomes" Research

☐ **4a** – Systematic Review of Case Control Studies

☐ **4b** – Individual Case Control Study

☐ **5** – Case Series, Case Reports

☐ **6** – Expert Opinion without explicit critical appraisal, Narrative Review

☐ **7** – Animal Research

☐ **8** – In Vitro Research

Strength of Recommendation Taxonomy (SORT)

☒	**A** – Consistent, good quality patient oriented evidence
☐	**B** – Inconsistent or limited quality patient oriented evidence
☐	**C** – Consensus, disease oriented evidence, usual practice, expert opinion, or case series for studies of diagnosis, treatment, prevention, or screening

Conclusions

How does the evidence apply to this patient?

- 2-stage Sinus Lift
- Implant placement #3, 14
- Advised healing period of 4-6 months before implant placement

Discussion Questions

- Best kind of bone graft to use for sinus augmentation?
- What is the difference between a 1 stage and a 2 stage sinus augmentation?
- What is the average healing time of sinus augmentation?
- What are the complications of sinus augmentation?
- How much does a sinus augmentation cost?
- Time required for healing after sinus augmentation before implant placement?
- Any type of specific implant that is bested used in an area that has had a sinus augmentation?
- What alternatives are there if maxillary sinus augmentation fails?