Material Selection for Long-span Fixed Partial Dentures

Evidence Based Dentistry Rounds
Dental Materials

Group 5A-3
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11/11/2020

Rounds Team

- **Group Leader:** Dr. Dix
- **Specialty Leader:** Dr. Berzins
- **Project Team Leader:** D4 – Maisie Tolzmann
- **Project Team Participants:**
  - D1: Greta Hevesi
  - D2: Nadiya Choi
  - D3: Kimberly Kaiser

Patient

- Age: 74
- Gender: Female
- Ethnicity: White
- Chief Complaint
  - "I want to get these front teeth replaced."

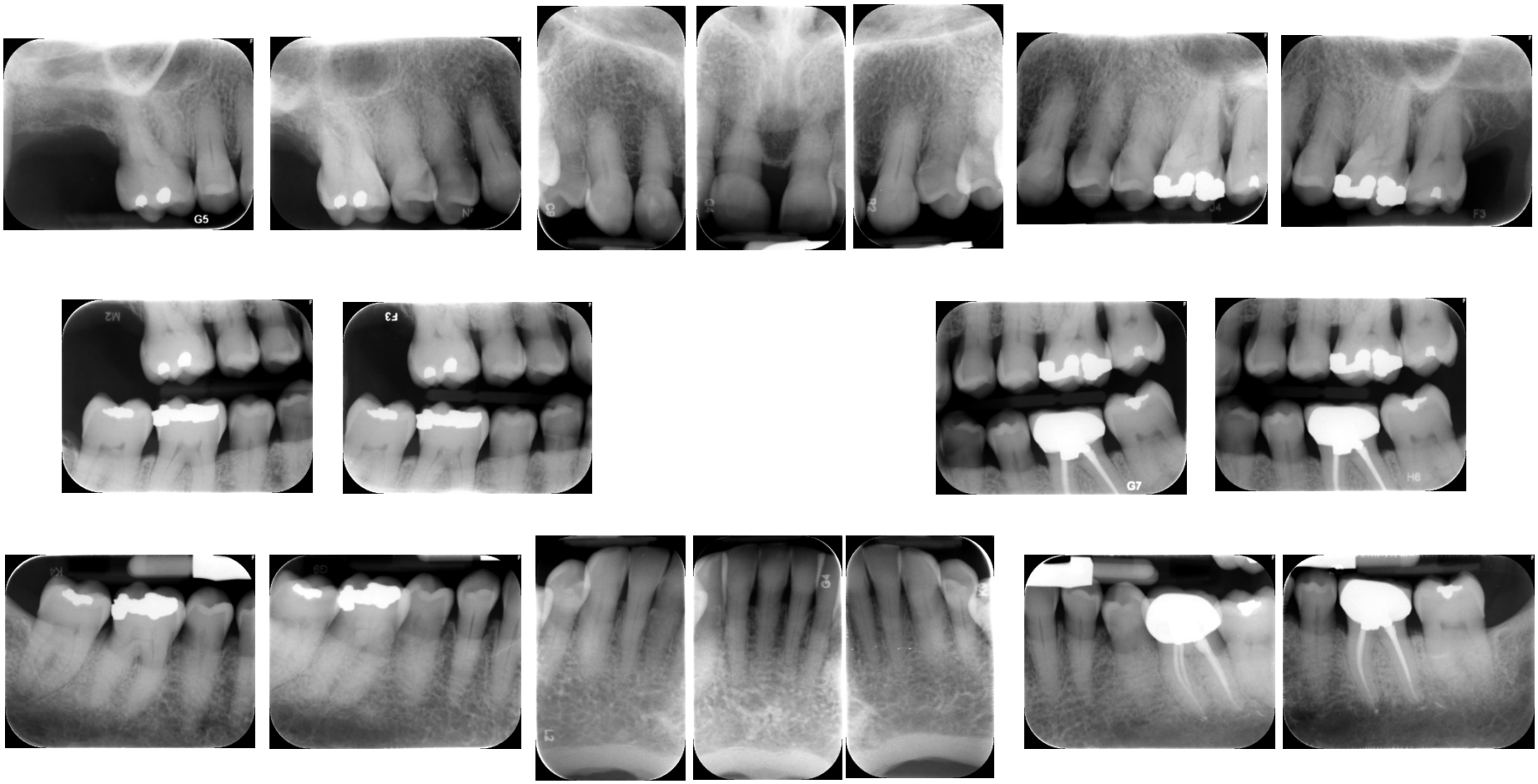
Medical History

- **Medical Conditions**: Hypertension, atrial fibrillation, hypothyroidism, stage 3 renal insufficiency
- **Medications:** Amlodipine, amiodarone, aspirin, levothyroxine, zinc, vitamin D3, refresh ophthalmic solution
- Left hip replacement in 2015
  - Medical consult to orthopedic surgeon stated no antibiotic premedication required for dental treatment
- Treatment considerations
  - Avoid NSAIDs due to poor kidney function

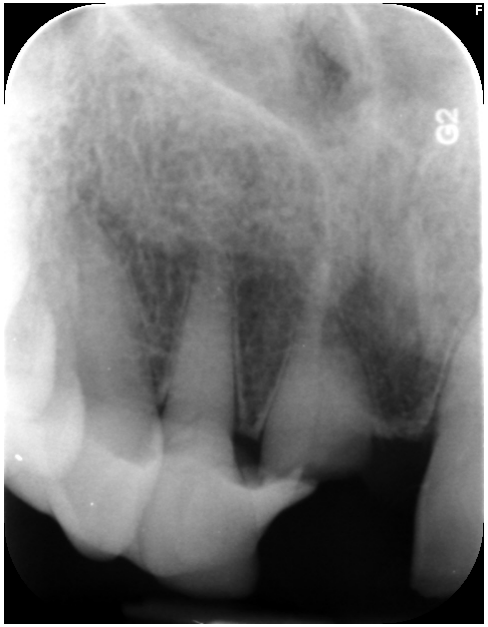
Dental History

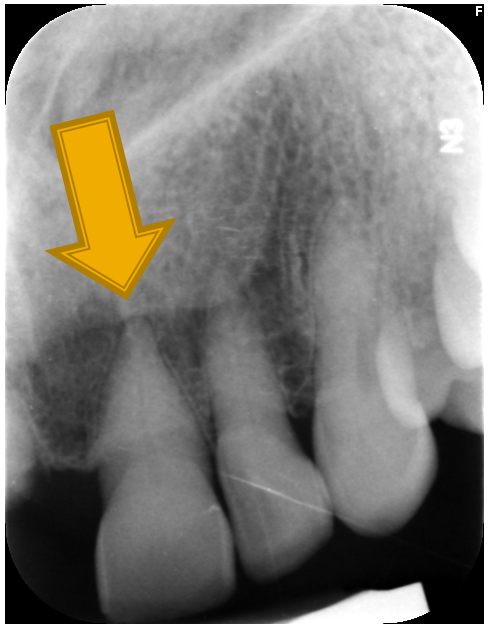
- **SRP in UL, LL, LR, in November of 2019**
  - 4-month periodontal maintenance
- **Pt. fell in December of 2019**
  - **#7** deemed non-restorable after splint was removed due to level of fracture
  - **#8** fractured when pt. fell, deemed non-restorable
  - **#9** necrotic pulp with symptomatic apical periodontitis. Pt. chose to proceed with extraction rather than RCT
  - Tx partial delivered after extractions

Radiographs – Spring 2019



Radiographs – taken after injury

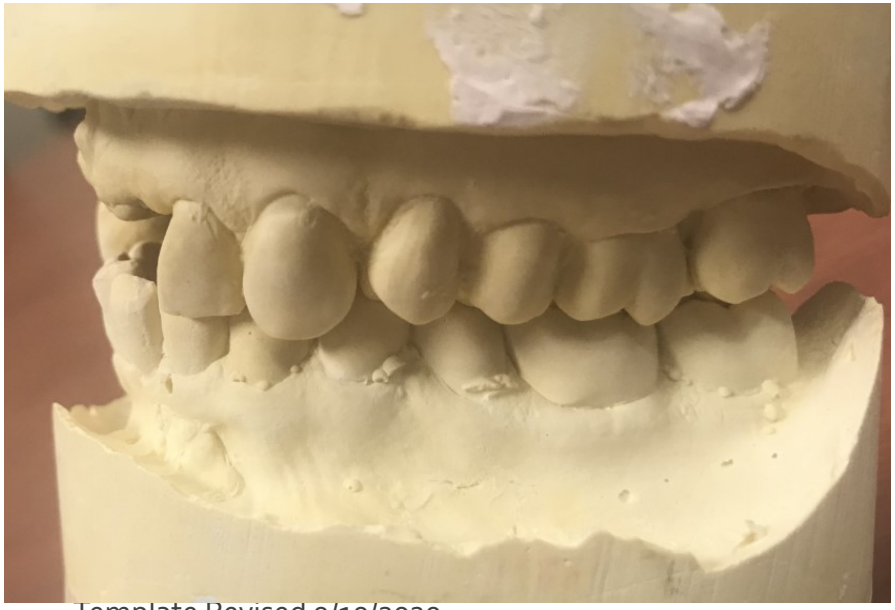


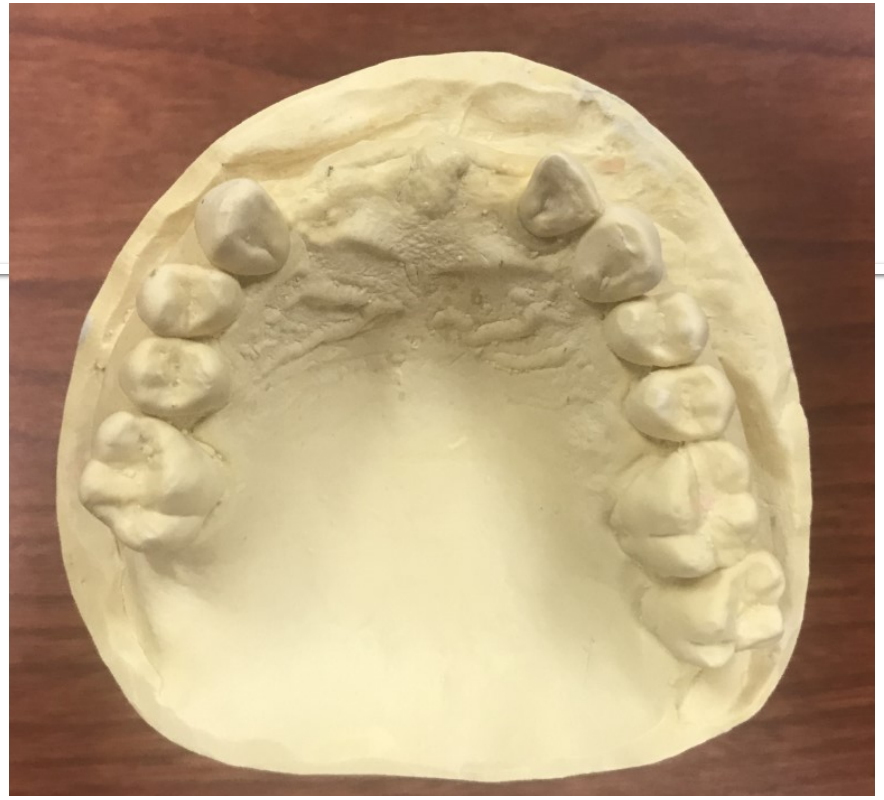


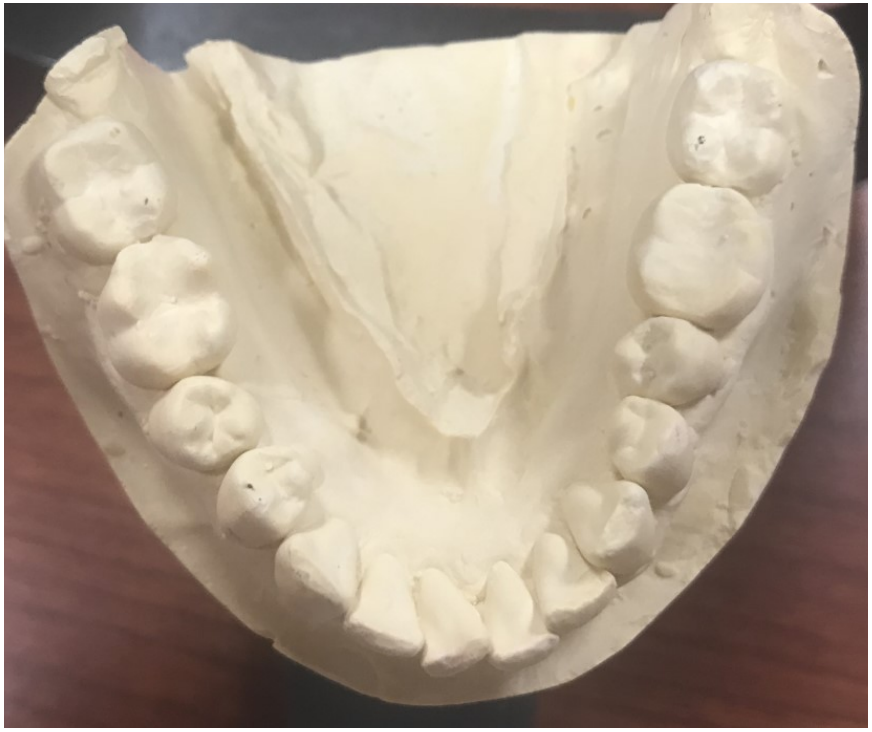
Radiographic Findings

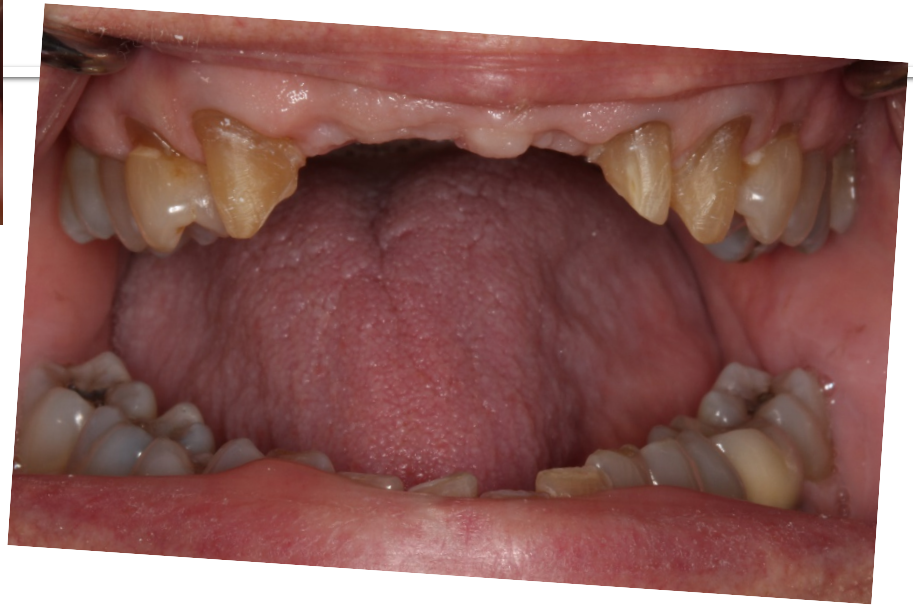
- Splint on maxillary teeth after injury
- Fractured #7 (noted with splint in place)
- Fractured #8
- #9 widened PDL

August 2019 - After extractions





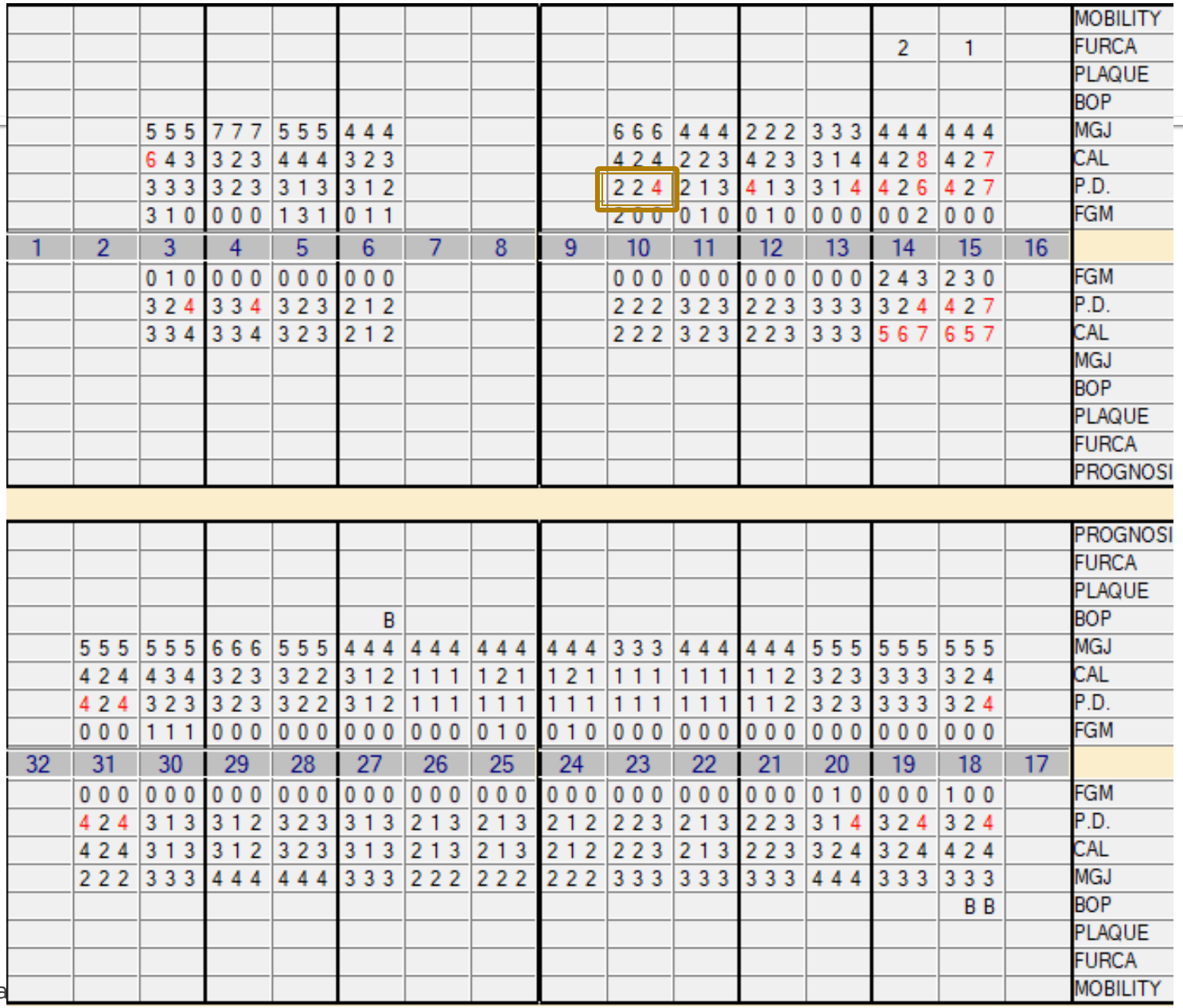




Clinical Findings

- Localized periodontitis
- Fractured #7 and #8
- #9: necrotic pulp, symptomatic apical periodontitis
- #30 fracture line found on the distal
  - Need full coverage restoration

Periodontal Charting



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Diagnosis

- Stage III Grade B periodontitis
  - Localized chronic
- #7: non-restorable due to fracture
- #8: non-restorable due to fracture
- #9: necrotic pulp with symptomatic apical periodontitis

Problem List

- Dental trauma
- Multiple missing teeth
- Periodontal disease

D1 Basic Science
FPD Components

Pontics:

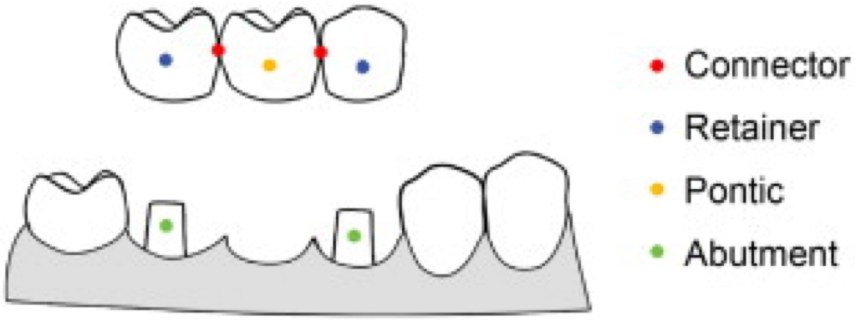
-Artificial tooth

-Restores function and esthetics

-Prevents tilting or drifting of adjacent teeth into edentulous space

Classifications:

1. Sanitary/Hygiene Pontic:
   a. Poor esthetics, best for hygiene
2. Saddle-ridge-lap Pontic:
   a. Esthetic, not amenable to hygiene
3. Conical Pontic:
   a. Poor esthetics, amenable hygiene
4. Modified-ridge-lap Pontic:
   a. Esthetic, somewhat amenable to hygiene
5. Ovate Pontic:
   a. Optimal esthetics, amenable to hygiene



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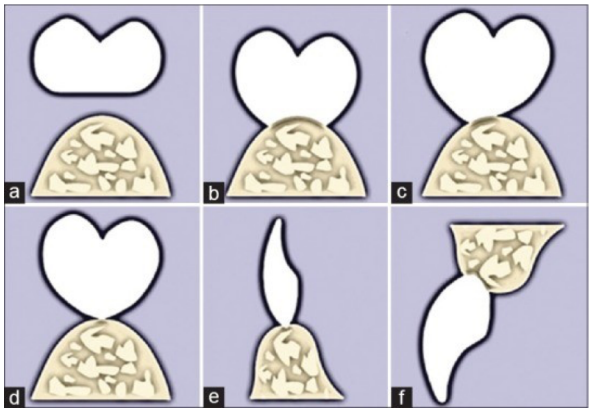

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2. Connectors:

Function: Establishes union between pontics and retainer, as well as provides stress relief of prosthetic

Two types of Connectors:

1. **Rigid:** Locked connector
- Metal connector made by: Casting, Soldering , Welding
- Different advantages/disadvantages to each process
2. **Non Rigid:** Provides limited movement
- Dovetail
- Split-pontic
- Cross pin and wing
- Loop Connector

3. Retainer:

Function:

- Directly attaches to abutment in order to provide stability
- Connects abutment with bridge
- Prevents dislodgement of prosthetic

Ante's Law:

"The total periodontal membrane area of the abutment teeth must equal or exceed that of the teeth to be replaced" (Balevi)

Rosenstiel, S. F., Land, M. F., Fujimoto, J., & Baima, R. F. (2016). *Contemporary Fixed Prosthodontics*.

Zhao, J., & Wang, X. (2014). Dental Prostheses. *Advanced Ceramics for Dentistry,* 23-49. doi:10.1016/b978-0-12-394619-5.00003-1

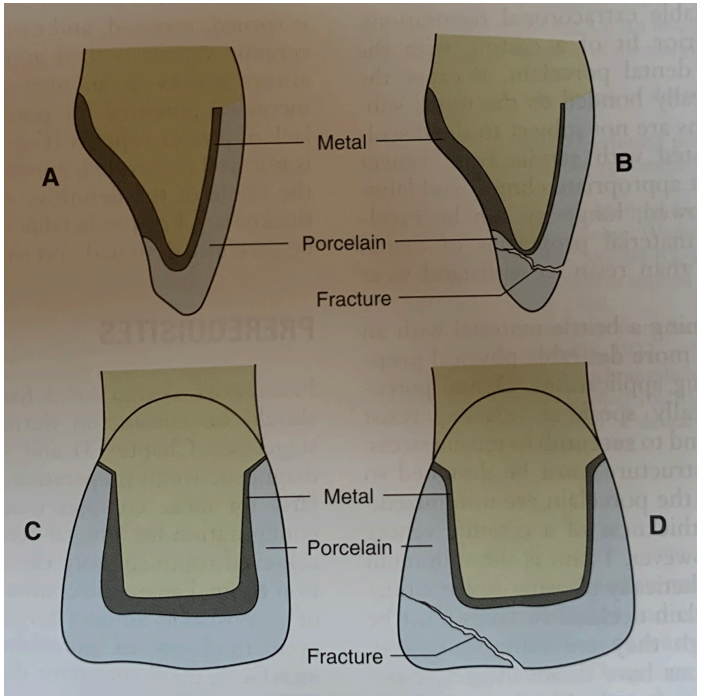
Balevi, B. (2012, September 1). Ante's law is not evidence based. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/22942148

D2 Pathology
FPD Failure : Biological

D2 Pathology Question:

What are some reasons why fixed partial dentures fail?

1. **Biological Complications**
   - **Secondary caries** – poor FPD design and oral hygiene
   - **Loss of vitality** – endodontic treatment needed
   - **Abutment tooth fracture** – lack of support
   - **Periodontal disease** – invasion of biologic width

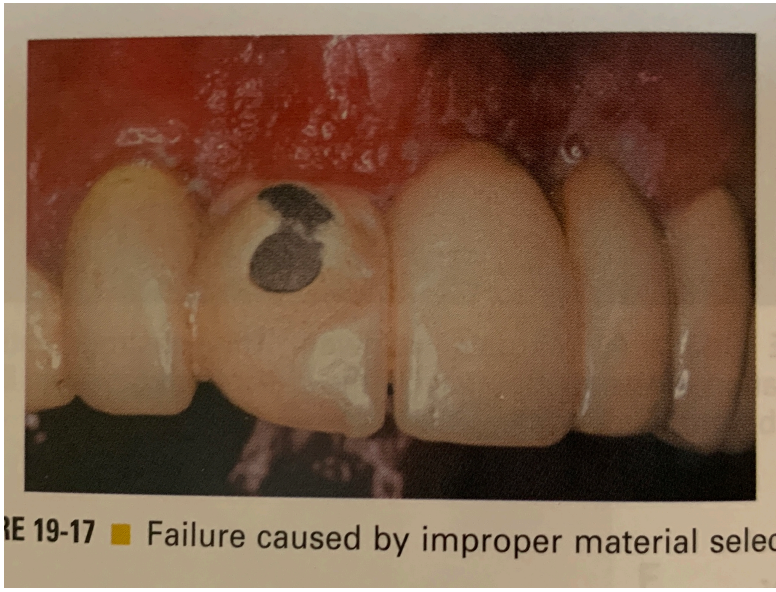


Rosenstiel, S. F., Land, M. F., & Fujimoto, J. (2006). *Contemporary fixed prosthodontics*. St. Louis, Mo: Mosby Elsevier.

D2 Pathology
FPD Failure : Technical

2. Technical Complications

- **Material** – framework fracture and ceramic chipping
  - Alloy and/or porcelain should be compatible
  - Dental porcelain susceptible to tensile strength
- **Loss of retention** – insufficient crown length
- **Marginal discoloration** – manufacturing technique
  - CAD/CAM reconstruction?



RE 19-17 ■ Failure caused by improper material selec

Rosenstiel, S. F., Land, M. F., & Fujimoto, J. (2006). *Contemporary fixed prosthodontics*. St. Louis, Mo: Mosby Elsevier.

D3 PICO

- **Clinical Question:**
  - Which material is better for a long span fixed partial denture, porcelain-fused to metal or all-ceramic?

PICO Format

P: Patients replacing multiple teeth with long span fixed partial denture

I: All-ceramic crowns

C: Metal-ceramic crowns

O: More successful restoration

PICO Formatted Question

- In patients replacing multiple teeth with a long span fixed partial denture, which material will make a more successful restoration: porcelain-fused to metal or all-ceramic?

Clinical Bottom Line

- **Porcelain-fused to metal restorations should be first treatment option when considering which material to use for a multiple-unit FDP restoration.**

Search Background

- **Date(s) of Search:** 11/4/2020
- **Database(s) Used:** PubMed
- **Search Strategy/Keywords:**
  - Fixed Partial Dentures
  - All-ceramic
  - Metal-ceramic
  - Survival
  - Systematic review

Search Background

- **MESH terms used:**
  - Fixed partial denture
  - Fixed dental prosthesis
  - Metal ceramic restorations
  - All-ceramic
  - Porcelain-fused
  - Survival rate

Article 1 Citation, Introduction

- **Citation:** Pjetursson, Bjarni Elvar, et al. "All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part II: Mutliple-unit FDPs." *Dental Materials*, vol. 31, no. 6, 2015, pp. 624-639., doi: https://doi.org/10.1016/j.dental.2015.02.013

- **Study Design**: Systematic Review

- **Study Need / Purpose:** "What are the survival and complication rates of tooth supported FDPs after a mean observation period of at least 3 years? "Are the survival and complications rates of metal-ceramic and all-ceramic tooth-supported FDPs similar after a mean observation period of at least 3 years?"

Article 1 Synopsis

- **Method**
  - Systematic search of literature published from December 1st, 2006 – December 31, 2013 from the following databases: Medline (PubMed), Embase, and Cochrane Central Register of Controlled Trials (CENTRAL).
  - 40 studies fulfilled inclusion criteria of this systematic review
  - All-ceramic FDPs were further broken down into different compositions:
    - Densely sintered zirconia ceramic FDPs
    - Reinforced glass ceramic FDPs
    - Glass-infiltrated alumina FDPs

- **Results after 3 years:**
  - Lowest failure rate observed for metal-ceramic FDPs (5.6%)
  - All-ceramic FDP failure rates:
    - Densely sintered zirconia ceramic FDPs: 9.6%
    - Reinforced glass ceramic FDPs: 10.9%
    - Glass-infiltrated alumina FDPs: 13.8%
  - Higher failure rates in all-ceramic FDPs due to parafunctional habits /malocclusion, technical complications , marginal discoloration

Article 1 Synopsis

- **Conclusions**
  - Metal- ceramic FDPs had lower failure rates than all-ceramic FDPs after a mean observation period of at least 3 years
  - Drawbacks of all-ceramic compared to metal-ceramic:
    - Framework fractures were commonly reported in reinforced glass ceramic and glass-infiltrated alumina FDPs
    - Densely sintered zirconia is a more stable framework material, but its misfit leads to complications such as marginal discoloration, secondary caries and loss of retention
    - Chipping of ceramics
- **Limitations**
  - Mean observation period was on average 7 years for metal-ceramic FDPs and only 4.7 years for all ceramic FDPs
  - Mainly based on studies conducted in university or specialized implant clinics; therefore, long-term outcomes observed cannot be generalized to services provided in private practice

Article 1 Selection

- **Reason for selection**
  - Directly applied to PICO
  - High level of evidence
- **Applicability to your patient**
  - Suggests metal-ceramic FDP
- **Implications**
  - A metal-ceramic FDP may be indicated for this patient due to the span of the FDP as well as the location

Article 2 Citation, Introduction

- **Citation**: Sailer I, Strasding M, Valente NA, Zwahlen M, Liu S, Pjetursson BE. "A systematic review of the survival and complication rates of zirconia-ceramic and metal-ceramic multiple-unit fixed dental prostheses." *Clinical Oral Implants Research*, vol. 29, no. S16, 2018, pp. 184-198., doi: 10.1111/clr.13277

- **Study design**: Systematic Review and Meta-analysis

- **Study Need / Purpose**: "aim of present review was to compare the outcomes, that is, survival and complication rates of zirconia-ceramic and/or monolithic zirconia implant-supported fixed dental prostheses (FDPs) with metal-ceramic FDPs."

https://o-onlinelibrary-wiley-com.libus.csd.mu.edu/doi/full/10.1111/clr.13277

Article 2 Synopsis

- **Method**
  - Electronic MEDLINE search complemented by manual searching to identify randomized controlled clinical trials, cohort studies and retrospective case series on implant-supported FDPs with mean follow-up of 3 years
  - Patients clinically examined at follow-up visit
  - Assessment and data extraction performed independently by two reviewers
  - Failure and complication rates analyzed using robust Poisson regression models to obtain summary estimates of 5-year proportions
- **Results after 3 years:**
  - 19 studies on implant FDPs met inclusion criteria
  - Estimated 5-year survival rates:
    - Metal-ceramic: 98.7%
    - Zirconia-ceramic : 93.0%
  - Estimated 5-year complication rates:
    - Metal-ceramic: 11.6%
    - Zirconia-ceramic: 50.0%

Article 2 Synopsis

- **Conclusions**
  - For implant-supported FDPs, conventionally veneered zirconia should not be considered material of first priority due to risk of fractures of framework and chipping of zirconia veneering ceramic
  - Monolithic zirconia may be considered as an alternative, but there is not much long-term data to support this

- **Limitations**
  - More information is available on metal-ceramic FDPs, leading to the numbers of metal-ceramic and zirconia-ceramic FDPs included on this metal-analysis to be highly differing
  - No randomized control trials (RCTs) comparing the two treatment options were available for this review
  - No studies on monolithic zirconia could be included; interpretation of the results is limited to veneered zirconia

Article 2 Selection

- **Reason for selection**
  - Directly applied to PICO question – metal-ceramic vs. all-ceramic (zirconia) multiple-unit FPDs
  - Recent data of high evidence emphasizing consistency in results from previous meta-analysis
- **Applicability to your patient**
  - Survival and success rate of metal-ceramic vs. all-ceramic FDPs
- **Implications**
  - Metal-ceramic shows higher survival rate and less complication rate when compared to all-ceramic/zirconia multiple-unit FDPs

Article 3 Citation, Introduction

- **Citation**: Sailer I, Balmer M, Hüsler J, Hämmerle CHF, Känel S, Thoma DS. 10-year randomized trial (RCT) of zirconia-ceramic and metal-ceramic fixed dental prostheses. J Dent. 2018 Sep;76:32-39. doi: 10.1016/j.jdent.2018.05.015. Epub 2018 May 25. PMID: 29807060
- **Study Design**: Randomized controlled trial (RCT)
- **Study Need / Purpose**: to monitor zirconia-ceramic and metal-ceramic posterior FDPs with respect to survival and technical/biological complication rates

https://o-onlinelibrary-wiley-com.libus.csd.mu.edu/doi/full/10.1111/jerd.12389

Article 3 Synopsis

- **Method**
  - 44 patients with 53, 3-5 unit posterior FDPs
    - 29 zirconia-based
    - 24 metal-based
  - Examined at 6 months, 1 year and annually up to 10 years
  - Statistical analysis performed by using Kaplan-Meier estimation, log-rank, Mann-Whitney and Fisher exact test
- **Results after 10 years**
  - Zirconia-based survival rate: 91.3%
  - Metal-based survival rate: 100%
  - Zirconia-based FDPs demonstrated a significantly higher rate of framework fracture, debonding, major fractures of veneering ceramic and poor marginal adaption
  - Biological outcomes and minor chipping of veneering ceramic and occlusal wear were similar in both groups

Article 3 Synopsis

- **Conclusions**
  - At 10 years, zirconia-based and metal-based posterior FDPs resulted in similar outcomes for the majority of outcome measures
  - Metal-based restorations had better survival rates compared to zirconia-based
- **Limitations**
  - Focus was on the posterior region
  - Small sample size (<53 patients)

Article 3 Selection

- **Reason for selection**
  - Directly compares metal-based and zirconia-based FDPs
- **Applicability to your patient**
  - Can be used to weigh which material to use for multiple-unit FPD
- **Implications**
  - While biological and minor complication rates were similar, metal-ceramic has a higher survival rate in comparison to all-ceramic and should be used in this case

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: D3

How does the evidence apply to this patient?

- Literature suggests that metal-ceramic restorations have reduced complication rates and increased survival rates for multiple-unit FDPs
- Discussion with Dr. Berzins about his clinical experience further provided evidence that metal-ceramic FDPs provide increase survival rate as compared to all-ceramic
- All-ceramic could provide reduced cost/fewer visits with CAD/CAM technology as well as improved esthetics

Based on the above considerations, how will you advise your D4?

- Recommend offering porcelain-fused to metal FDP for their multiple-unit restoration form

Conclusions: D4

Based on your D3's bottom line recommendations, how will you ***advise*** your patient?

- I will advise my patient to select a porcelain fused to metal FPD

How will you ***help*** your patient?

- I will help my patient by explaining the evidence-based reasons for selecting PFM over all ceramic.

Questions??

- How will a patient's homecare need to be modified when receiving a longspan FPD in order to maintain periodontal health?
- Do you expect the answer to the clinical question to change as dental materials, especially ceramics, continue to develop in the future?
- Are there any specific measures that can be taken to ensure that an FPD will not fail?
- What are the contraindications for a long span FPD?

Thank you!