Socket Preservation for implant placement

Group 7A-4
Date: October 14th, 2020

Rounds Team

- **Group Leader:** Dr. Rossi
- **Specialty Leader:** Dr. Austen Dodge
- **Project Team Team:**
  - D4: Chelsie Morasko
  - D3: Mackenzie Dederich
  - D2: Kandace Williamson
  - D1: Ibrahim Alwan and Jack Melms

Patient

29 YO Hispanic Female

Chief Complaint: “My tooth broke off and I want to get it fixed”

Medical History

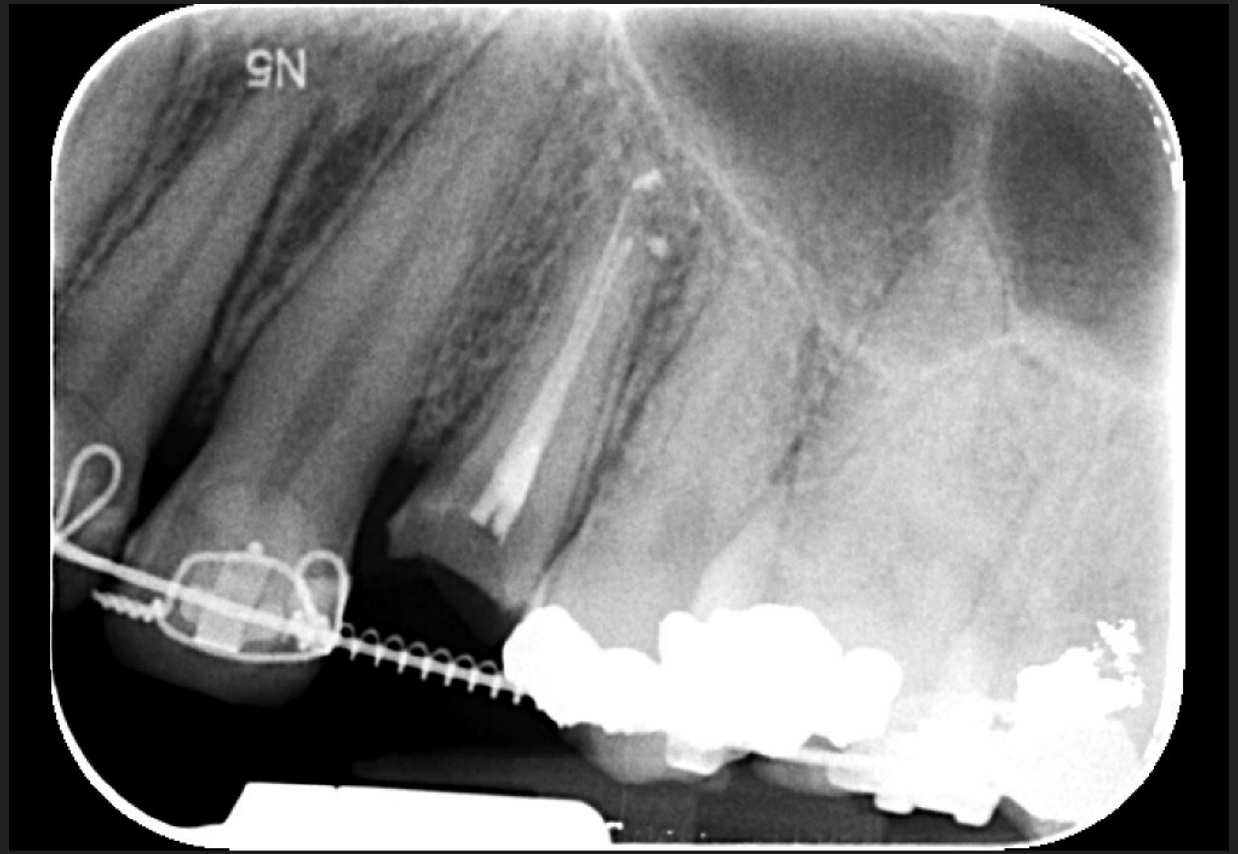
- Non-contributory
  - April 2019 - car accident caused patient to be in physical therapy and take NSAIDs PRN
  - 2018 - patient went to the hospital for gastritis and shortness of breath

Medications: none

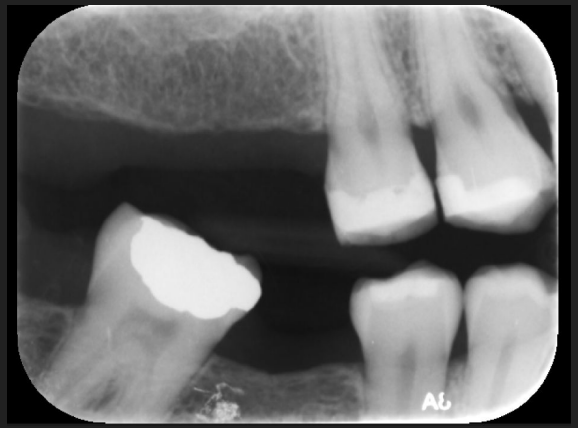
Dental history

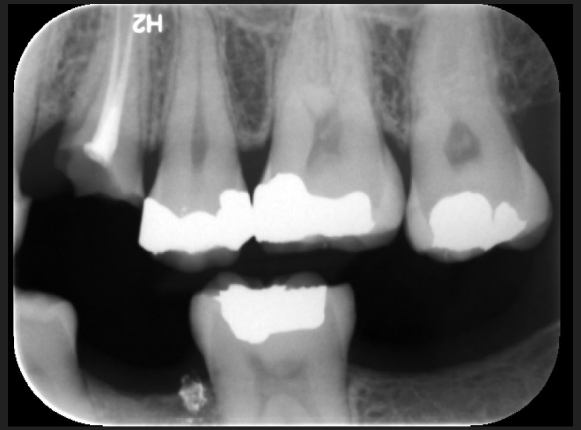
- History of Extractions, Fillings, Endo, and Orthodontics
- Brushes more than twice a day and flosses once a week
- Would like to have the tooth fixed

Radiographs



Radiographs





Radiographic Findings

- Gross Caries #12
  - Tooth broke off at gingival margin
  - Extrusion of sealer material from radiographic apex
  - Occlusal composite

Clinical Findings

- Mesial primary caries #11
- MODB recurrent caries #31

Specific Findings

- Questionable #12
  - Unfavorable diagnosis without intervention

Periodontal Diagnosis

- ASA Class I Periodontal Classification

Problem List

- Primary, Recurrent and Gross Caries
- Orthodontic Therapy
- Fixed Prosthodontics
- Root canal

D1 Basic Science

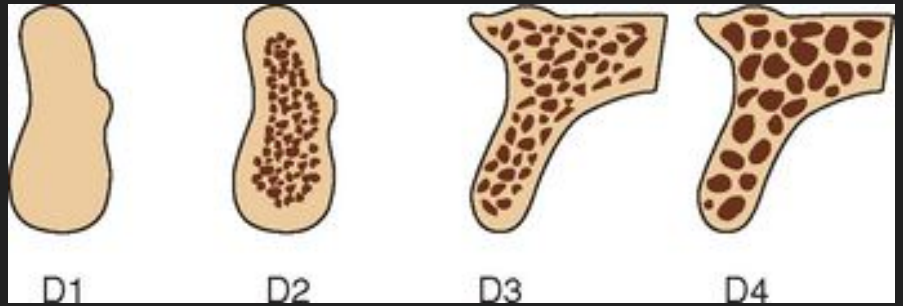
What are the different types of bone found in the dental arch? (Misch Classification)

Ibrahim Alwan

Bone Classifications

- Misch classification of bone is a widely used system
- Classifying bone based on Density
- The bone density may be determined by tactile sensation or using radiographic evidence.

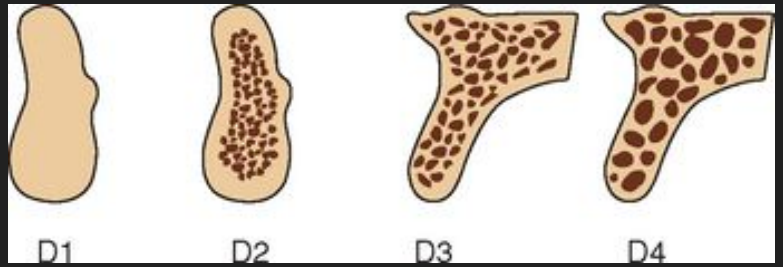
Bone density	Description	Tactile analogue	Typical anatomic location
D1	Dense cortical	Oak / maple wood	Anterior mandible
D2	Porous cortical and coarse trabecular	White pine or spruce wood	Anterior mandible Posterior mandible Anterior maxilla
D3	Porous cortical (thin) and fine	Balsa wood	Anterior maxilla Posterior maxilla Posterior mandible
D4	Fine trabecular	Styrofoam	Posterior maxilla



Misch, C.E.. (2008). Bone density: a key determinant for treatment planning. Contemporary Implant Dentistry. 130-146.
Seriwatanachai D, Kiattavorncharoen S, Suriyan N, Boonsiriseth K, Wongsirichat N (2015) Reference and Techniques used in Alveolar Bone Classification. J Interdiscipl Med Dent Sci 3:172. doi: 10.4172/2376-032X.10001

Type of bone	Hounsfield units
D1	>1250 HU
D2	850 – 1250 HU
D3	350 - 850 HU
D4	150 – 350 HU
D5	<150 HU

https://www.slideshare.net/apurva3011990/bone-density-ppt



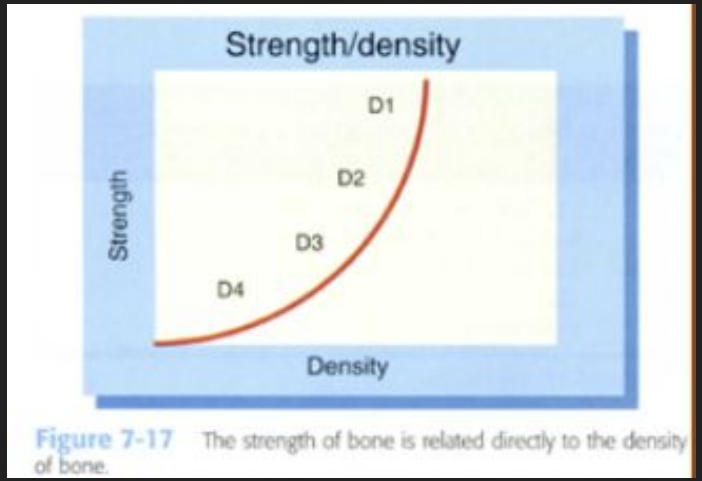


Figure 7-17 The strength of bone is related directly to the density of bone.

https://slideplayer.com/slide/2609441/

"Bone Density: A Key Determinant for Treatment Planning." Contemporary Implant Dentistry, by Carl E. Misch, Mosby Elsevier, 2008, pp. 136–136.

Misch, C.E.. (2008). Bone density: a key determinant for treatment planning. Contemporary Implant Dentistry. 130-146.

D1 Basic Science

What are different bone grafting materials?

Jack Melms

Grafts Using Bone

- Autografts
  - Bone relocated within the body
- Allografts
  - Non-patient human bone
  - Cadavers
- Xenografts
  - Animal bone
  - Bovine, porcine

Effect of alveolar ridge preservation interventions following tooth extraction: A systematic review and meta-analysis, Ortiz et al, J Clin Periodotol. 2019
Comparison of allografts and xenografts used for alveolar ridge preservation,Serrano Mendez et al, Clin Implant Dent Relat Res. 2017
Dental Implant Bone Grafts: Autograft, Allograft, and Xenograft, Nejat, R., DDS 2018

Alloplasts

- Not made of bone
- Biphasic calcium phosphates
  - Osteoconductive
- Hydroxyapatite
  - Preserves structure
- β-tricalcium phosphate
  - Resorbed and replaced
- Scaffolding for bone cells to attach and proliferate

Does Graft Particle Type and Size Affect Ridge Dimensional Changes After Alveolar Ridge Split Procedure?, Kheur et al, J Oral Maxillofac Surg. 2018Hydroxyapatite/beta-tricalcium phosphate biphasic ceramics as regenerative material for the repair of complex bone defects, Owen et al, J Biomed Mater Res B Appl Biomater. 2018

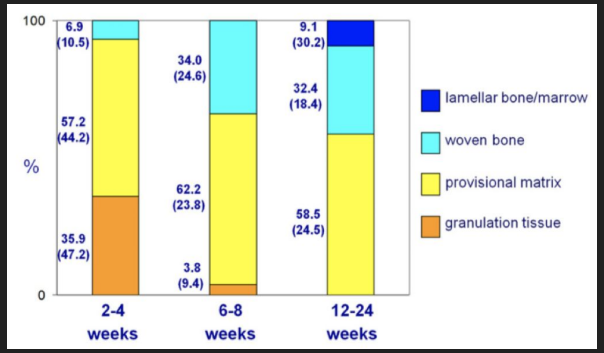
D2 Pathology

Pathological steps in bone formation with and without bone grafting

Kandace Williamson

Natural Bone Healing in Post-Extraction Sockets

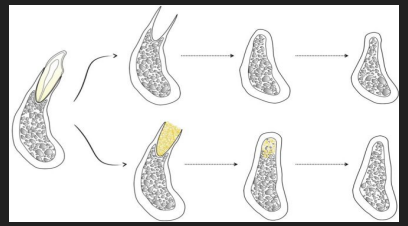
- Wound healing stages:
  - Hemostasis: blood clot formation
  - Inflammation: granulation tissue formation
  - Proliferation: provisional connective tissue matrix formation, woven bone formation
  - Remodeling: lamellar bone formation
- Wound healing stages overlap
- Implants typically placed 6-8 weeks post-extraction
- Bone dimensional changes may prompt bone grafting:
  - Decreased bone volume
  - Alveolar ridge resorption, which is more pronounced in the horizontal direction
  - Hard and soft tissue defects in the alveolus

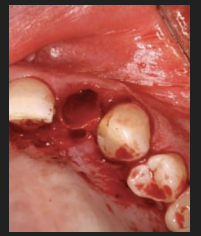


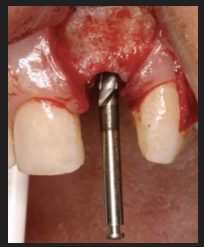
(1) Wound healing of extraction sockets, Farina & Trombelli, Endodontics Topics, 2012
(2) Modeling and remodeling of human extraction sockets, Trombeli et al, J Clin Periodontol, 2008
(3) Rationale for Socket Preservation after Extraction of a Single-Rooted Tooth when Planning for Future Implant Placement, Irinakis, J Can Dent Assoc, 2006

Bone Grafting in Post-Extraction Sockets

- Bone tissue can regenerate completely if provided with the adequate space needed to grow
- Biologic mechanisms of bone grafts:
  - Osteoconduction: Provides porous scaffold to support or direct bone formation
  - Osteoinduction: Induces differentiation of stem cells into osteogenic cells
  - Osteogenesis: Provides stem cells with osteogenic potential, which directly lays down new bone
- As natural bone grows, it replaces the graft material completely
- Bone grafting is effective in limiting alveolar ridge reduction:
  - 1.89 mm buccolingual width, 2.07 mm midbuccal height, 1.18 mm midlingual height, 0.48 mm mesial height, and 0.24 mm distal height preserved in grafted sockets compared to ungrafted sockets







(1) Bone grafts in dentistry, Kumar, Vinitha & Fathima, J Pharm Bioallied Sci, 2013
(2) Effect of alveolar ridge preservation after tooth extraction: a systematic review and meta-analysis, Ortiz et al, J Dent Res, 2014
(3) Rationale for Socket Preservation after Extraction of a Single-Rooted Tooth when Planning for Future Implant Placement, Irinakis, J Can Dent Assoc, 2006

D3 PICO Question

Mackenzie Dederich

- **Clinical Question:**
  - In preparation for an implant, when is a socket preservation bone graft indicated?

PICO Format

P: Extraction socket site for implant

I: Socket preservation grafting

C: Natural bone healing

O: Improve alveolar ridge preservation in preparation for an implant placement

PICO Formatted Question

- For an extraction socket where an implant is being planned, does the use of bone grafting socket preservation techniques improve the alveolar ridge preservation after extraction compared with not using any bone grafting materials and allowing the socket to heal naturally?

Clinical Bottom Line

- When planning to do implant placement where a tooth is to be extracted, having a sufficient volume of bone is critical.
- By having enough bone we have more freedom in implant placement and size selection. This allows us to meet necessary surgical and prosthetic criteria.

Search Background

Date(s) of Search: Sept 29,Oct 2

Database(s) Used: PUBMEDSearch

Strategy/Keywords: Socket Preservation, Alveolar Bone, Bone Loss, Implant Placement

Search Background

MESH terms used:

- **Alveolar Bone Loss**
- **Tooth Extraction**
- **Alveolar Process**
- **Socket Preservation**

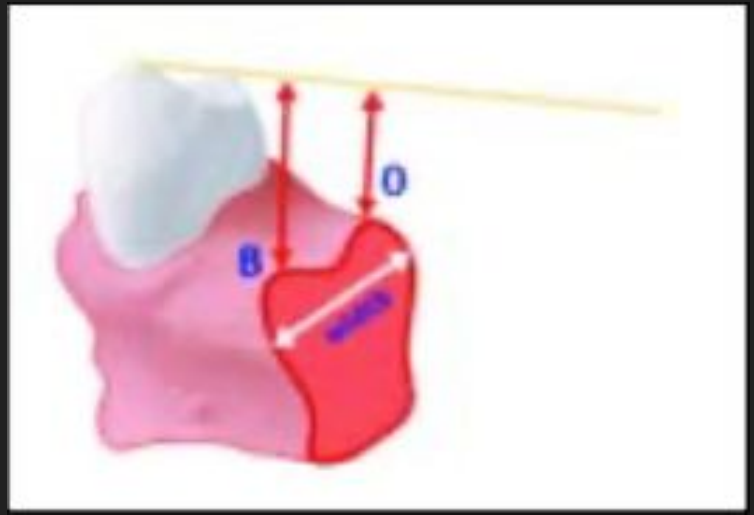
Article 1 Citation, Introduction

Citation: Schropp L, Wenzel A, Kostopoulos L, Karring T. **Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study.** Int J Periodontics Restorative Dent. 2003 Aug;23(4):313-23. PMID: 12956475.

Study Design: Prospective cross-sectional study

Article 1 Synopsis

- Method:
  - 46 patients
    - premolars ext: Max - 11 & Man - 10
    - molars ext: Max - 9 & Man - 16
  - Dimensions of alveolar ridge were measured on clinically via casts and radiographically at 3, 6, and 12 months following tooth extraction



- Results
  - All regions combined:
    - Width: -6.1mm
    - Height (orally/lingually): -0.8mm
    - Height (buccal): 0.4mm
  - Two thirds of this bone loss occurred in the first 3 months post extraction.

Schropp L, Wenzel A, Kostopoulos L, Karring T. **Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study.** Int J Periodontics Restorative Dent. 2003 Aug;23(4):313-23. PMID: 12956475.

Article 1 Selection

- Conclusions:
  - After tooth extraction the greatest boneless occurs in the horizontal dimension with about 50% of loss of ridge width after 12 months.
  - Vertical dimensions were much less affected.
- Limitations:
  - Study does not address bone loss that occurs in the anterior alveolar ridges.

Artic Schropp L, Wenzel A, Kostopoulos L, Karring T. **Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study.** Int J Periodontics Restorative Dent. 2003 Aug;23(4):313-23. PMID: 12956475.

Article 1 Selection

- Reason for selection:
  - Article addresses P & C and was useful in determine a baseline amount of boneless due to natural healing.
- Applicability to your patient:
  - With the goal of placing an implant after tooth extraction, a 50% loss of horizontal width could make implant placement more difficult if not impossible to perform without additional treatments.

Schropp L, Wenzel A, Kostopoulos L, Karring T. **Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study.** Int J Periodontics Restorative Dent. 2003 Aug;23(4):313-23. PMID: 12956475.

Article 2 Citation, Introduction

Citation: Avila-Ortiz G, Elangovan S, Kramer KW, Blanchette D, Dawson DV. **Effect of alveolar ridge preservation after tooth extraction: a systematic review and meta-analysis.** J Dent Res. 2014 Oct;93(10):950-8. doi: 10.1177/0022034514541127. Epub 2014 Jun 25. PMID: 24966231; PMCID: PMC4293706.

Study Design: Systematic Review

Article 2 Synopsis

- Method:
  - Meta analysis of 22 RCTs utilizing 9 total alveolar ridge preservation treatment (ARP) modalities. (ex. bovine bone vs allograft).
  - Outcomes of interest being clinical and radiographic dimensional changes of the alveolar ridge.

- Results
  - ARP in comparison to tooth extraction alone prevented:
    - Horizontal bone loss - 1.99mm
    - Vertical (mid buccal) bone loss - 1.72mm
    - Vertical (mid lingual) bone loss - 1.16mm

Avila-Ortiz G, Elangovan S, Kramer KW, Blanchette D, Dawson DV. Effect of alveolar ridge preservation after tooth extraction: a systematic review and meta-analysis. J Dent Res. 2014 Oct;93(10):950-8. doi: 10.1177/0022034514541127. Epub 2014 Jun 25. PMID: 24966231; PMCID: PMC4293706.

Article 2 Selection

- Conclusions:
  - Socket preservation results in a significant reduction of alveolar bone loss post tooth extraction in all dimension, but primarily in the horizontal (buccal-lingual) dimension.
- Limitations
  - Study doesn't specify if socket preservation leads to different amount of ridge preservation in different regions of the alveolus.

Avila-Ortiz G, Elangovan S, Kramer KW, Blanchette D, Dawson DV. **Effect of alveolar ridge preservation after tooth extraction: a systematic review and meta-analysis.** J Dent Res. 2014 Oct;93(10):950-8. doi: 10.1177/0022034514541127. Epub 2014 Jun 25. PMID: 24966231; PMCID: PMC4293706.

Article 2 Selection

- Reason for selection:
  - Answers P,I,C,O and is a high level of evidence

- Applicability to your patient:
  - By preserving an additional 2mm of horizontal bone, and 1.75mm of vertical bone, there is more freedom when planning implant placement. It allows for better implant positioning with respect to prosthetic criteria, and allows for the potential to use larger implant sizes.

Avila-Ortiz G, Elangovan S, Kramer KW, Blanchette D, Dawson DV. **Effect of alveolar ridge preservation after tooth extraction: a systematic review and meta-analysis.** J Dent Res. 2014 Oct;93(10):950-8. doi: 10.1177/0022034514541127. Epub 2014 Jun 25. PMID: 24966231; PMCID: PMC4293706.

Article 3 Citation, Introduction

Citation: Tabrizi R, Mohajerani H, Ardalani B, Khiabani K. **Does preservation of the socket decrease marginal bone loss in the mandible after extraction of first molars?** Br J Oral Maxillofac Surg. 2019 Nov;57(9):886-890. doi: 10.1016/j.bjoms.2019.07.019. Epub 2019 Aug 9. PMID: 31402193.

Study Design:

prospective cohort study

Article 3 Synopsis

- Method:
  - implants placed in 3 groups (n=30/group):
    - 6mo after socket preservation
    - 8wks after tooth extraction
    - 6mo after tooth extraction
  - Changes in marginal bone level (MBL) measured after loading at 12, 24, & 36 months.
  - Measured radiographically on the mesial & distal sides of the implant using long cone paralleling technique.

- Results
  - No significant difference between the three treatment groups.

Table 3
Marginal bone loss in the three groups. Data are mean (SD).

Variable	Marginal bone loss at 12 months	Marginal bone loss at 24 months	Marginal bone loss at 36 months
Group 1: six months after socket preservation	0.35 (0.15)	0.47 (0.15)	0.58 (0.19)
Group 2: eight weeks after tooth extraction	0.36 (0.13)	0.50 (0.13)	0.57 (0.14)
Group 3: six months after tooth extraction	0.31 (0.16)	0.43 (0.16)	0.52 (0.15)
p value (ANOVA)	0.55	0.22	0.38
F ratio	0.94	1.39	1.03

Tabrizi R, Mohajerani H, Ardalani B, Khiabani K. **Does preservation of the socket decrease marginal bone loss in the mandible after extraction of first molars?** Br J Oral Maxillofac Surg. 2019 Nov;57(9):886-890. doi: 10.1016/j.bjoms.2019.07.019. Epub 2019 Aug 9. PMID: 31402193.

Article 3 Selection

- Conclusions:
  - Socket preservation showed no difference in MBL when compared to implants placed in sites that did not undergo socket preservation.
  - Mandibular posterior bone is mostly comprised of dense D2 bone, and is less susceptible to resorption.
- Limitations:
  - Unable to measure buccal and lingual marginal bone without use of CBCT.
  - Study only focused on mandibular first molars.
  - Maxillary bone (D3&D4) is comparatively less dense than the mandible (D2&D3), therefore more resorption could be expected. It would be useful to perform this study in these areas as well.

Tabrizi R, Mohajerani H, Ardalani B, Khiabani K. **Does preservation of the socket decrease marginal bone loss in the mandible after extraction of first molars?** Br J Oral Maxillofac Surg. 2019 Nov;57(9):886-890. doi: 10.1016/j.bjoms.2019.07.019. Epub 2019 Aug 9. PMID: 31402193.

Article 3 Selection

- Reason for selection:
  - Addresses P, I, & C, at a moderately high level of evidence
- Applicability to your patient:
  - Answers question if socket grafting helps maintain marginal bone around implants after placement has occurred. Although this study shows that its effects are limited in the posterior mandible it may have a a greater effect in other areas.

Tabrizi R, Mohajerani H, Ardalani B, Khiabani K. **Does preservation of the socket decrease marginal bone loss in the mandible after extraction of first molars?** Br J Oral Maxillofac Surg. 2019 Nov;57(9):886-890. doi: 10.1016/j.bjoms.2019.07.019. Epub 2019 Aug 9. PMID: 31402193.

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)

Strength of Recommendation Taxonomy (SORT) For Guidelines and Systematic Reviews

See article **J Evid Base Dent Pract 2007;147-150**

- ☑ **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?
  - Due to the the potential loss of 50% alveolar bone width post-tooth extraction, it would be beneficial to utilize socket preservation to maintain an additional 2mm of width.
  - This would allow for better implant positioning and a larger size which would aid in the
  - As well socket preservation may aid in minimizing MBL post implant placement in the posterior maxilla where the alveolar bone notably the least dense.

QUESTIONS?