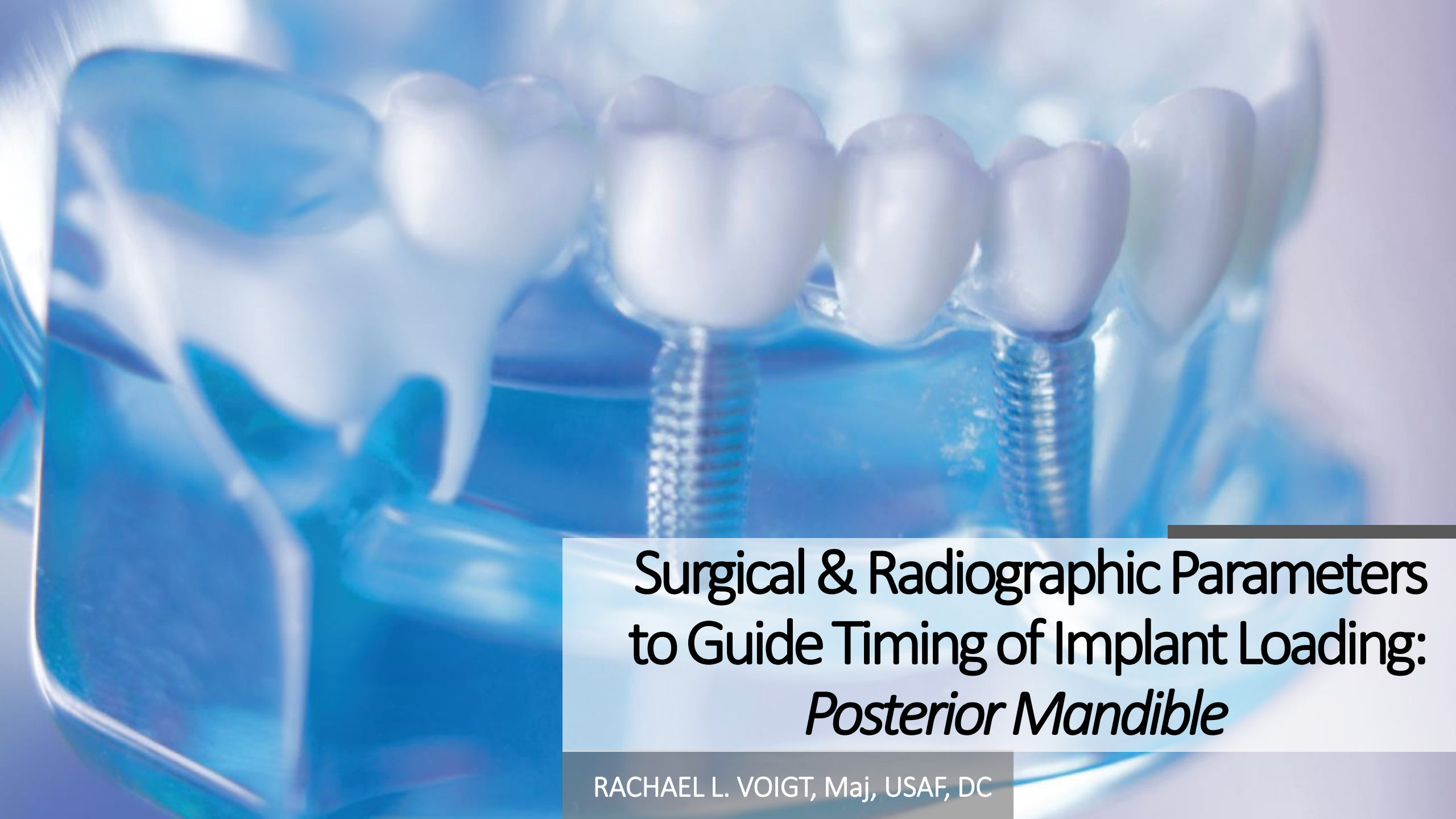

Surgical & Radiographic Parameters to Guide Timing of Implant Loading: *Posterior Mandible*

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Disclosure

The views expressed are those of the author and do not reflect the official views or policy of the Department of Defense or its Components. The voluntary, fully informed consent of the subjects used in this research was obtained as required by 32 CFR 219 and DODI 3216.02_AFI 40-402.

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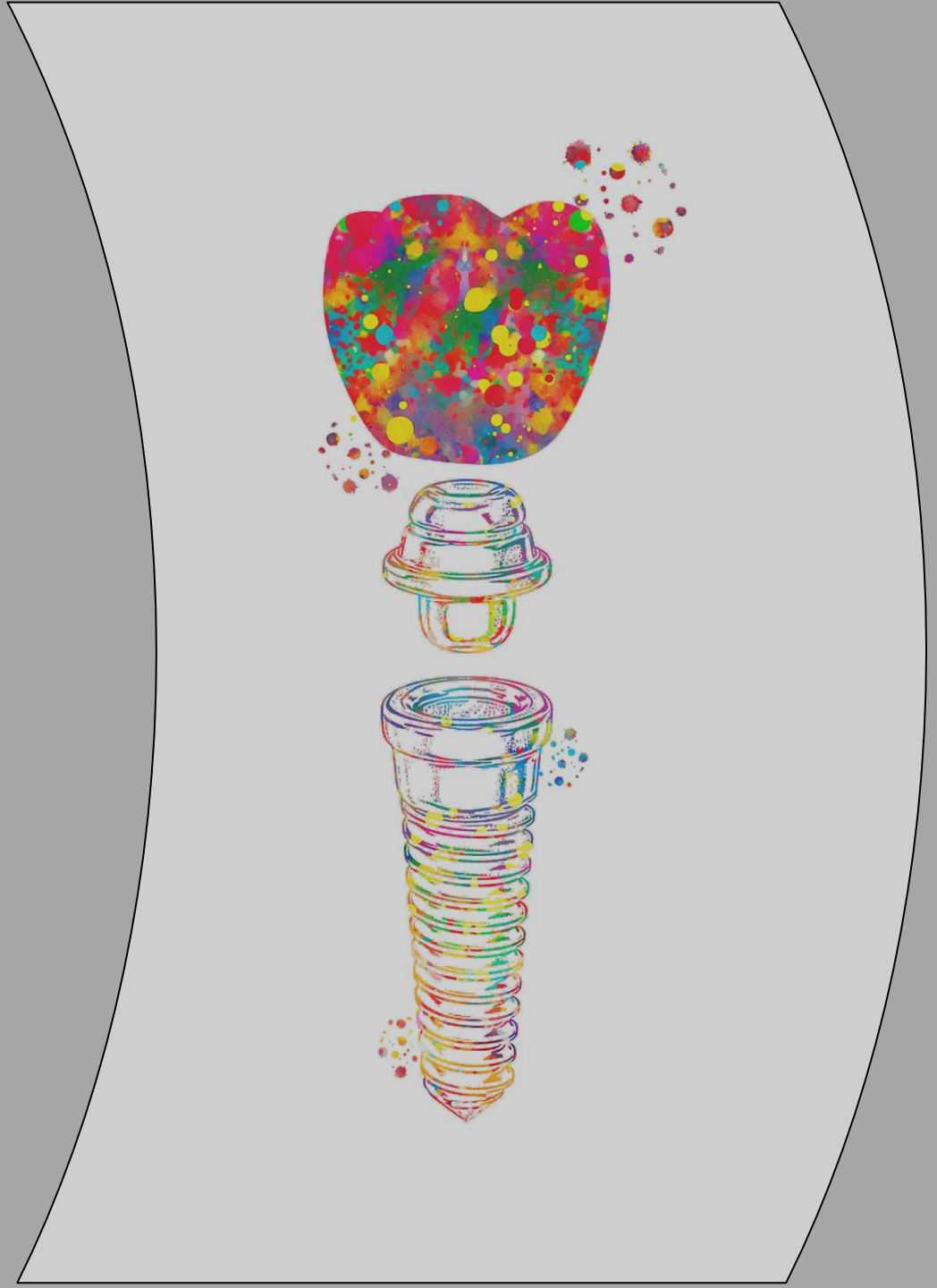
Introduction



What is Edentulism?

"The TERMINAL OUTCOME of a MULTIFACTORIAL oral disease process"

The **WHO** classifies **EDENTULOUS PATIENTS** as:

1) Physically impaired
2) Disabled
3) Handicapped

Partial Edentulism

Complete Edentulism

Mouth - Body Connection

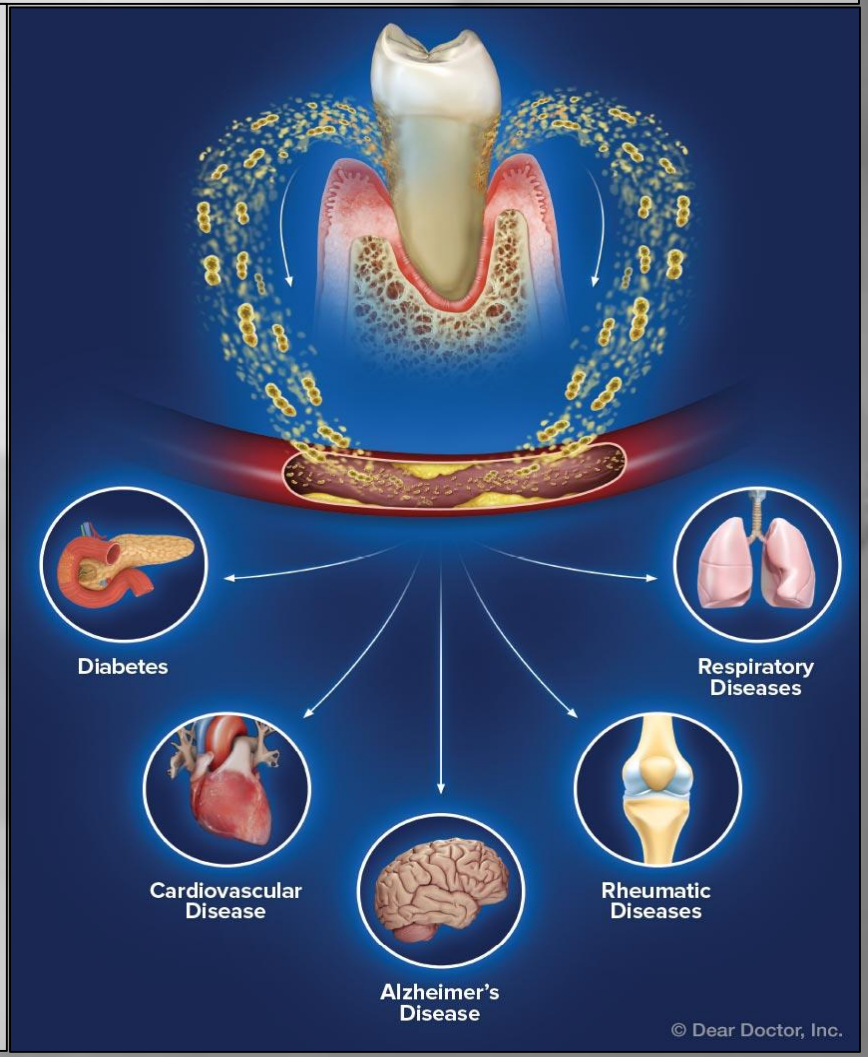
Systemic:

-Obesity
-Type 2 Diabetes
-Coronary Artery Disease
-Ischemic Heart Disease
-COPD
-Cognitive Impairment/ Depression

Intraoral:

-Atrophy of Hard/soft tissues
-Migration of teeth
-↑ risk for Periodontal disease & caries
-↑ rate for further tooth loss

Pauni

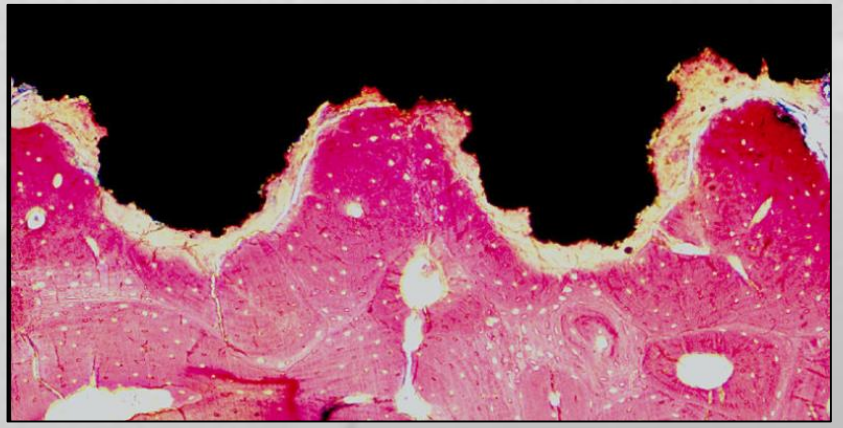


History of Osseointegration

The direct structural and functional connection between living bone and the surface of a load-bearing artificial implant. Histologically, an osseointegrated implant resembles a functional ankylosis.

- Described by Per-Ingvar Branemark in 1970's

- Conventional Loading Protocol (**3 months**)
  - Emphasis on submerged Healing



The Problem

1. Conventional loading:

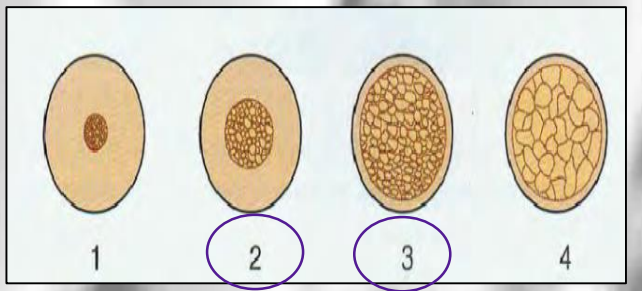
- Uniform loading protocol
- Machined surface/External hex prototype implant
- Based on empiric evidence in canine model
- Deficient in defining bone quality in precise & measurable way
- Relies only on primary stability/Insertion torque

2. Physiologic host response & biological variability in tissues:

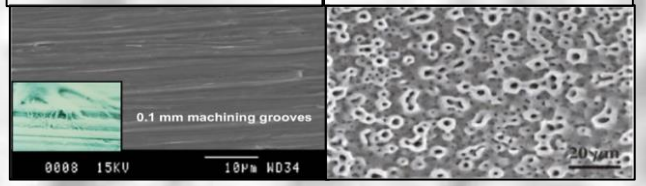
- Surgical Site, Surgical Technique, Wound Healing

3. Evolution of implantology:

- Improvements in biomechanical properties/ implant topography
- Direct marketing to consumers



Machined Titanium (1970's)	Anodized Titanium (Today)



An Alternative EARLY Loading Protocol

Early loading: Prosthesis connected to the dental implant between 1 week and 2 months following surgical placement.

Supported by clinical practice

BUT

A lack of well-structed research, early implant loading is controversial

Objectives

1. Is the success of early implant loading equal to conventional loading in the posterior mandible?

2. Can early osseointegration be predicted, based on a patient's clinical presentation?

Hypotheses

1. There is a subset of patients for whom early implant loading can be achieved with success equal to that of conventional loading.

2. Early osseointegration can be predicted, and all clinical & radiographic parameters will be equally prognostic.

Materials & Methods

Inclusion Criteria

- **>21** years old; Male & Female
- ASA **I and II**
- Planned for implant in **posterior mandible** (Nobel Replace Conical Connection)
- Single or multiple implants
  - Independent of restoration (crown, FDP)
- Adequate bone volume & OH

  -Assessed via clinical eval + CBCT
- Provide documentation of a restorative provider

Exclusion Criteria

- History of IV bisphosphonates/ Head & Neck Radiation
- Uncontrolled Diabetes HBA1C **>7.0**
- Pregnant women
- Bone augmentation/ extraction at surgical site within the **past 6 months**
- Heavy smokers (**>10** cigarettes per day)
- Require hard/soft tissue grafting at the time of placement to augment stability

Clinical & Radiographic Parameters of Interest

Study Design:

- Posterior Mandible prospective cohort study
- 21 subjects; 22 tapered Ti-Unite implants
  *Requirement: IT ≥ 35 N/cm and ISQ ≥ 55

Methods:

1. CBCT/ custom surgical guide
2. 2x4mm bone core harvested; Implant placed; Periapical x-ray
3. Initial: IT and ISQ measured
4. Bone core sent for histological & micro-CT analysis
5. 2 months: RTT, ISQ, PT; Periapical x-ray; Implant loaded
6. 3, 6 months: ISQ, PT; Periapical x-ray

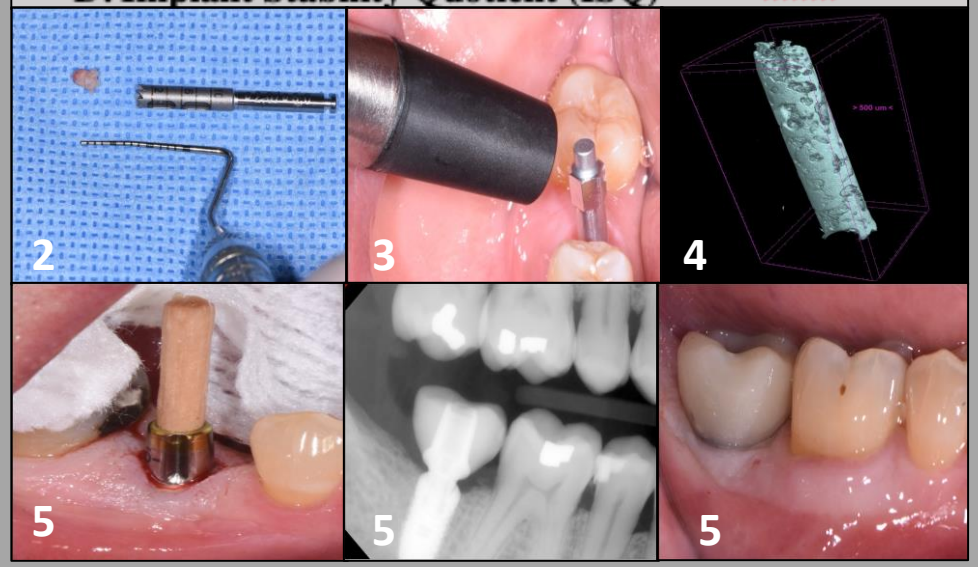
Criteria for Osseointegration:

1. (-) RTT, PT, symptoms; crestal bone loss <0.2mm

Methods for Evaluating Implant Stability Explored:

Cutting Torque Resistance Analysis
A. Insertion Torque (IT)
Reverse Torque Analysis
B. Reverse Torque Test of 20 N/cm (RTT)
Modal Analysis
C. Percussion Test (PT)
D. Implant Stability Quotient (ISQ)

Atsumi et al (2007)



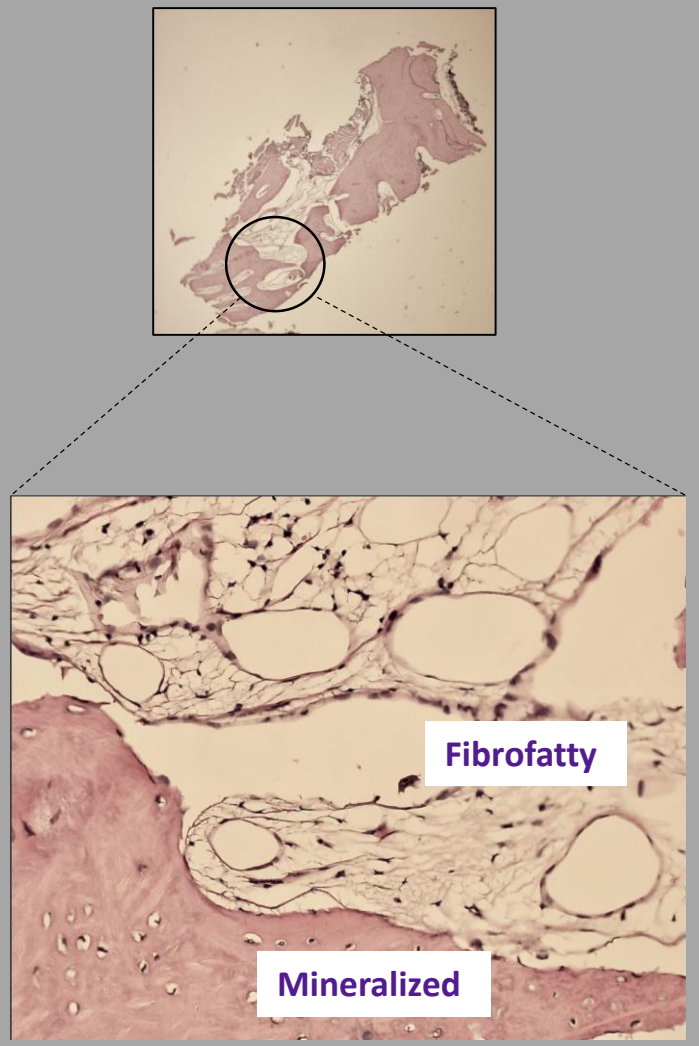
Statistical Analysis

- Incidence of successfully osseointegrated, functional implants at 6 months
- Correlations between IT, ISQ, %BV using descriptive statistics
- ANOVA test with repeated measurements to determine statistical significance of timeframes

Results

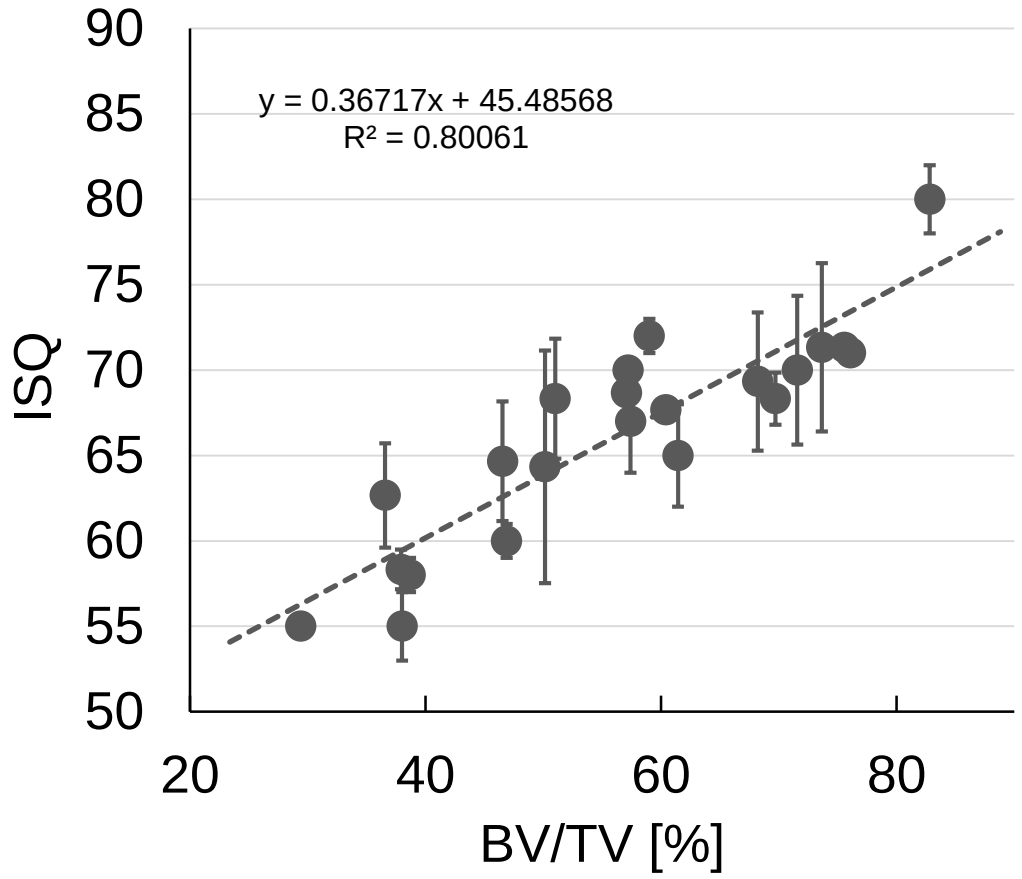
Results

- Mean age of subjects: **62** years old
- **62%** Male, **38%** Female
- Incidence of Early Osseointegration: **95%**
- Marginal Bone loss over study: **0.7 ± 0.2 mm**
- **1:1** relationship between Bone Volume (%BV/TV) from Micro-CT & Histological Analysis
- %BV/TV: **29-82%**

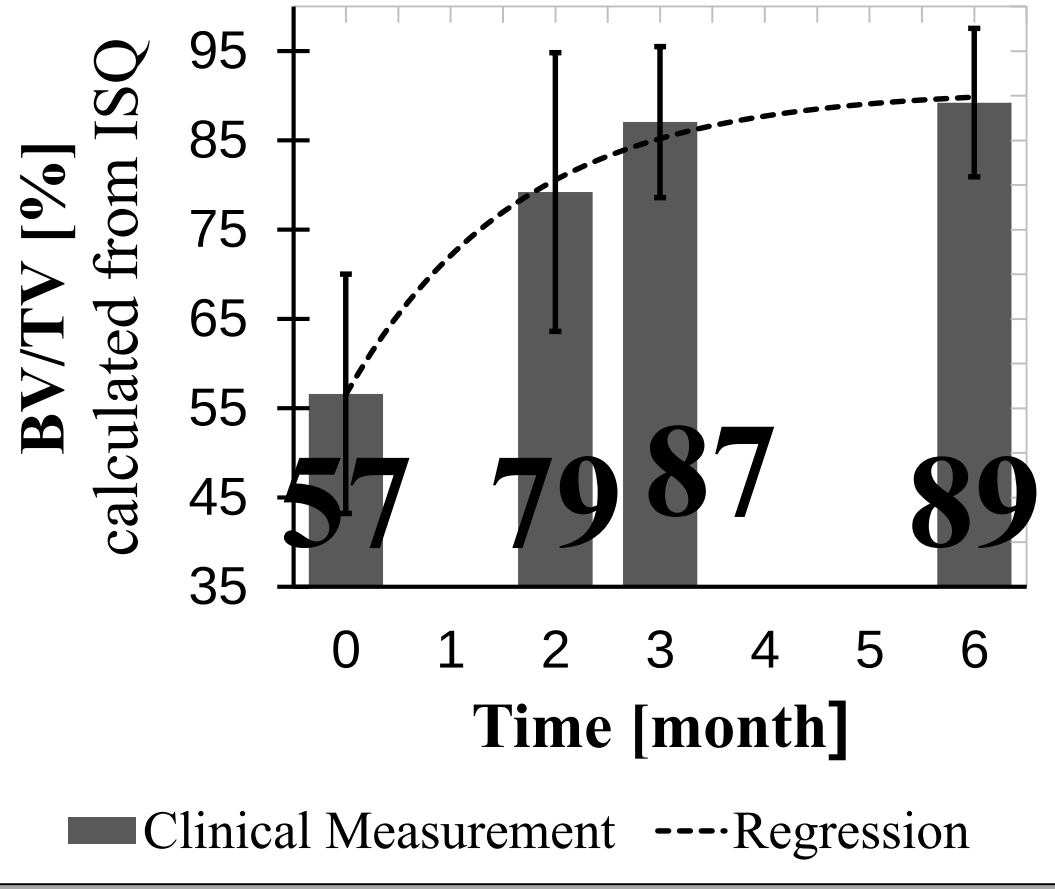


Results

The Relationship Between Bone Volume & ISQ



Bone Volume Over Time



Results

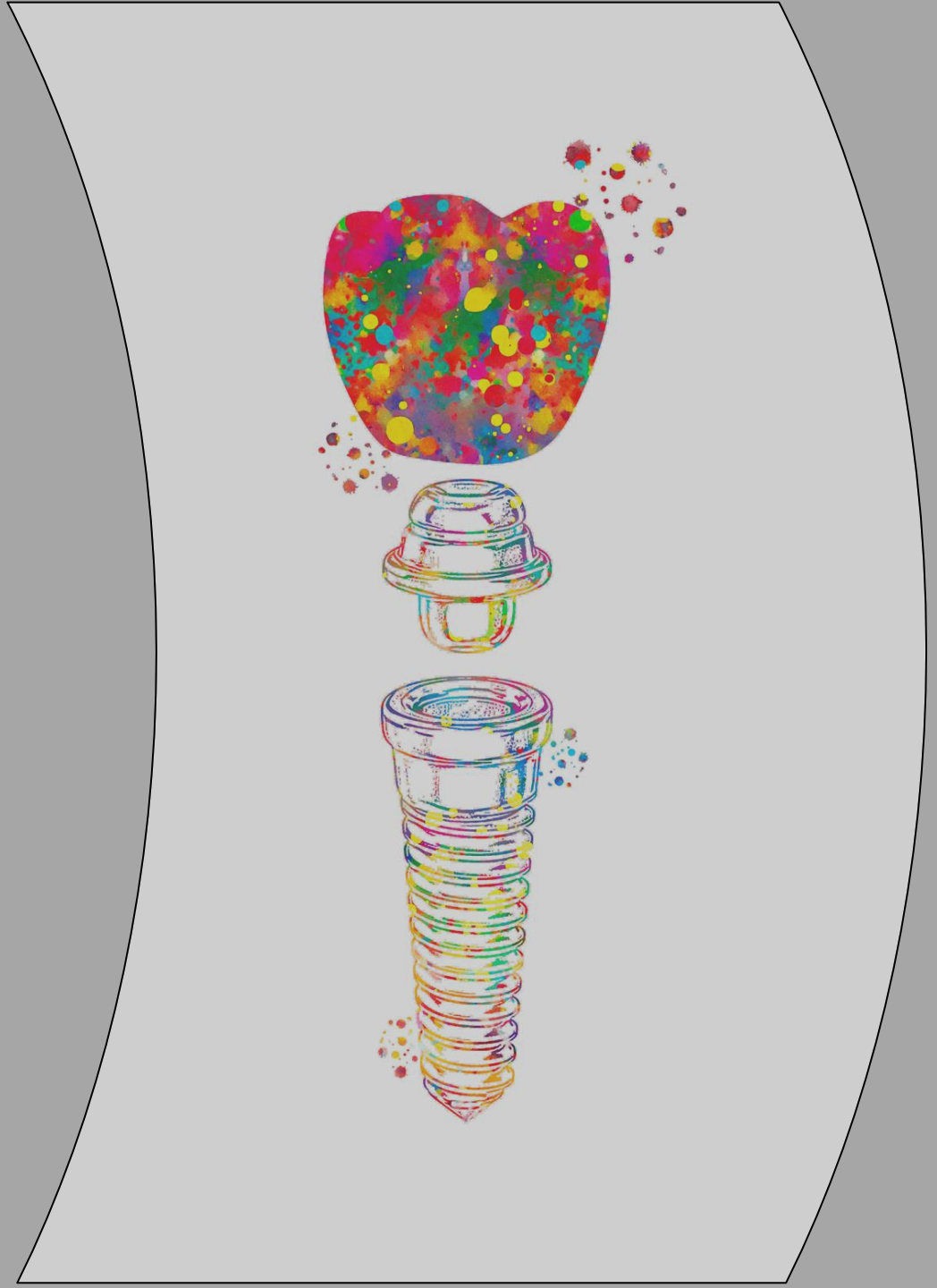
- IT as predictor of early osseointegration:
  - -Sensitivity: **64.3%**
  - -Specificity: **50%**
  - -PPV: **69%**
  - -NPV: **44%**

- PT & RTT correctly identified early osseointegration **100%** of the time
  - -**4.7%** of implants had abnormal response to RTT and PT

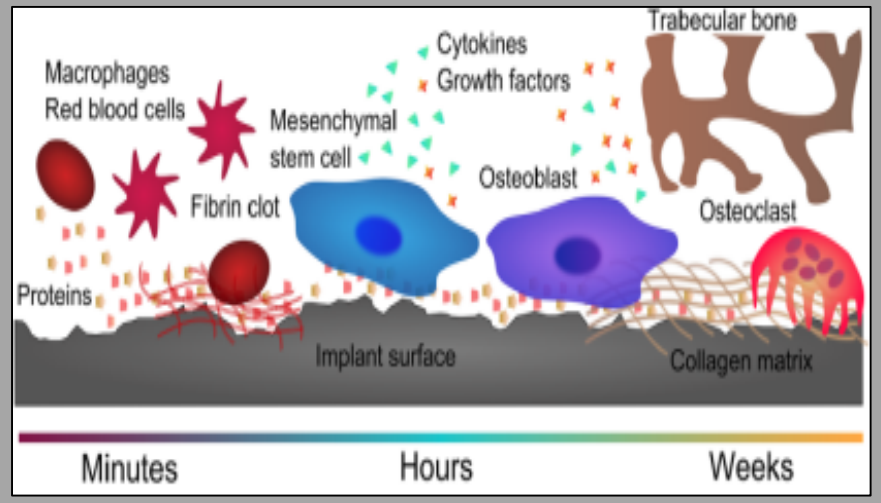
	High BV BV/TV ≥ 56% Or ISQ ≥ 66	**Low BV** BV/TV < 56% Or ISQ <66
High Initial Torque (40 or 50 N cm)	**9** True Positive	**4** False Positive
Low Initial Torque (35 N cm)	**5** False Negative	**4** True Negative

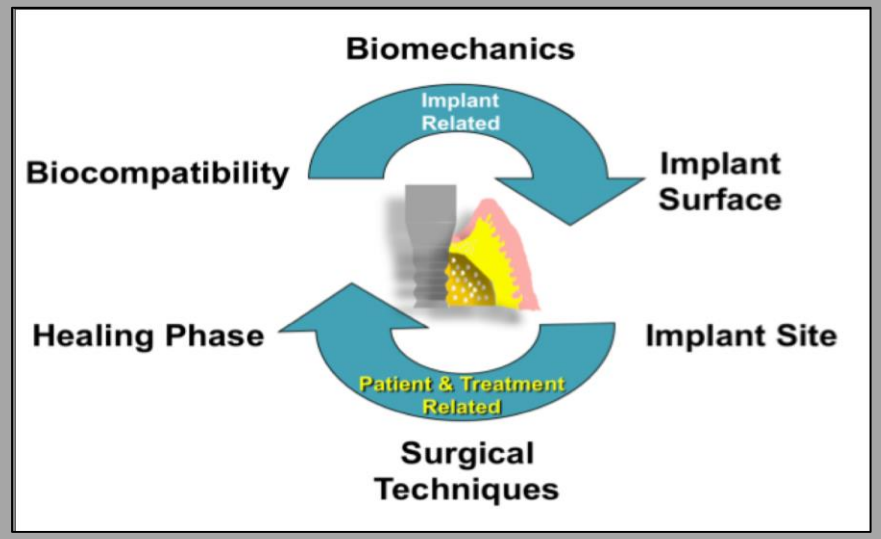
	-- Response (Normal)	**+ Response (Abnormal)**
Percussion	21	1
Reverse Torque	21	1

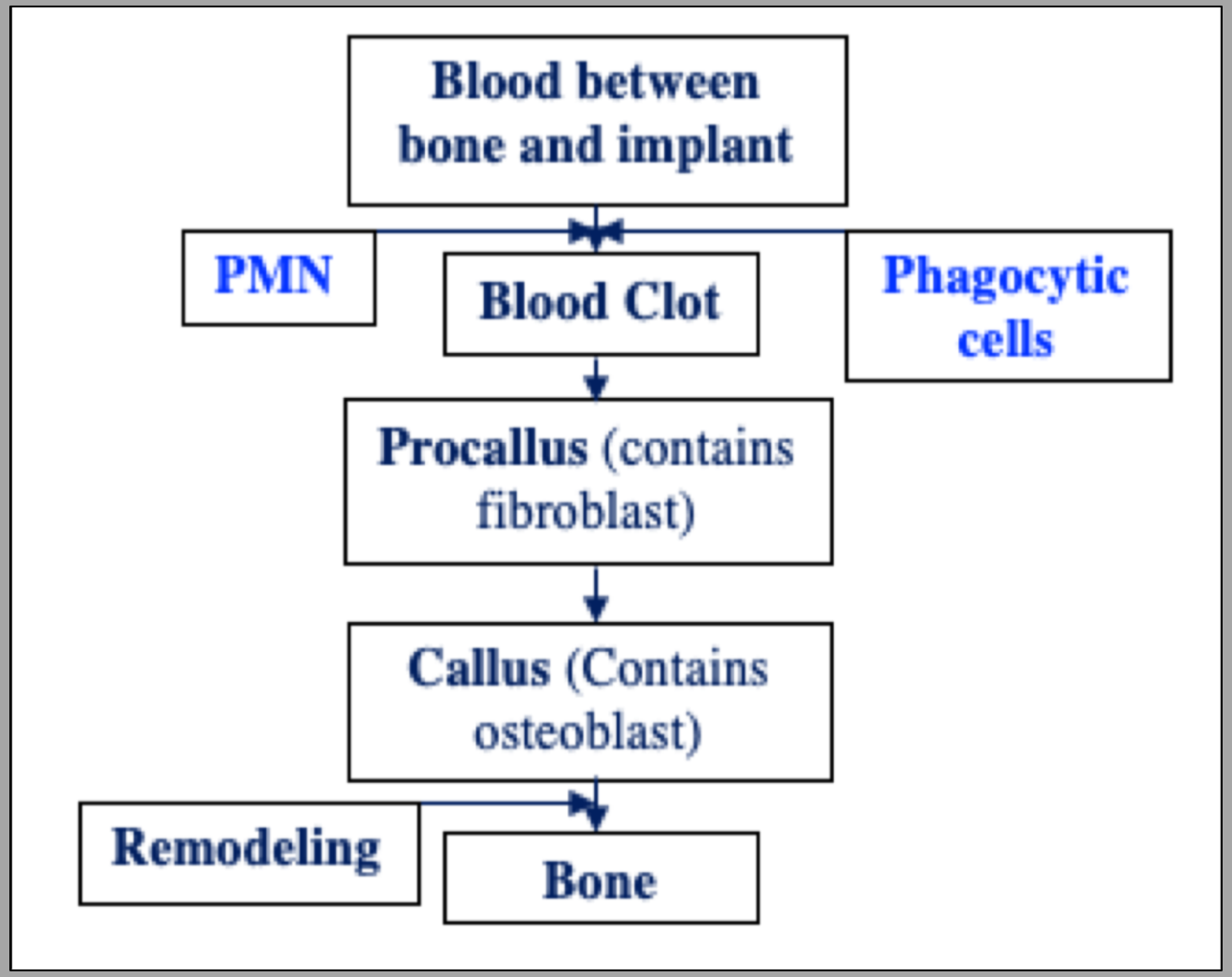
Discussion



Effects of Wound Healing on Osseointegration

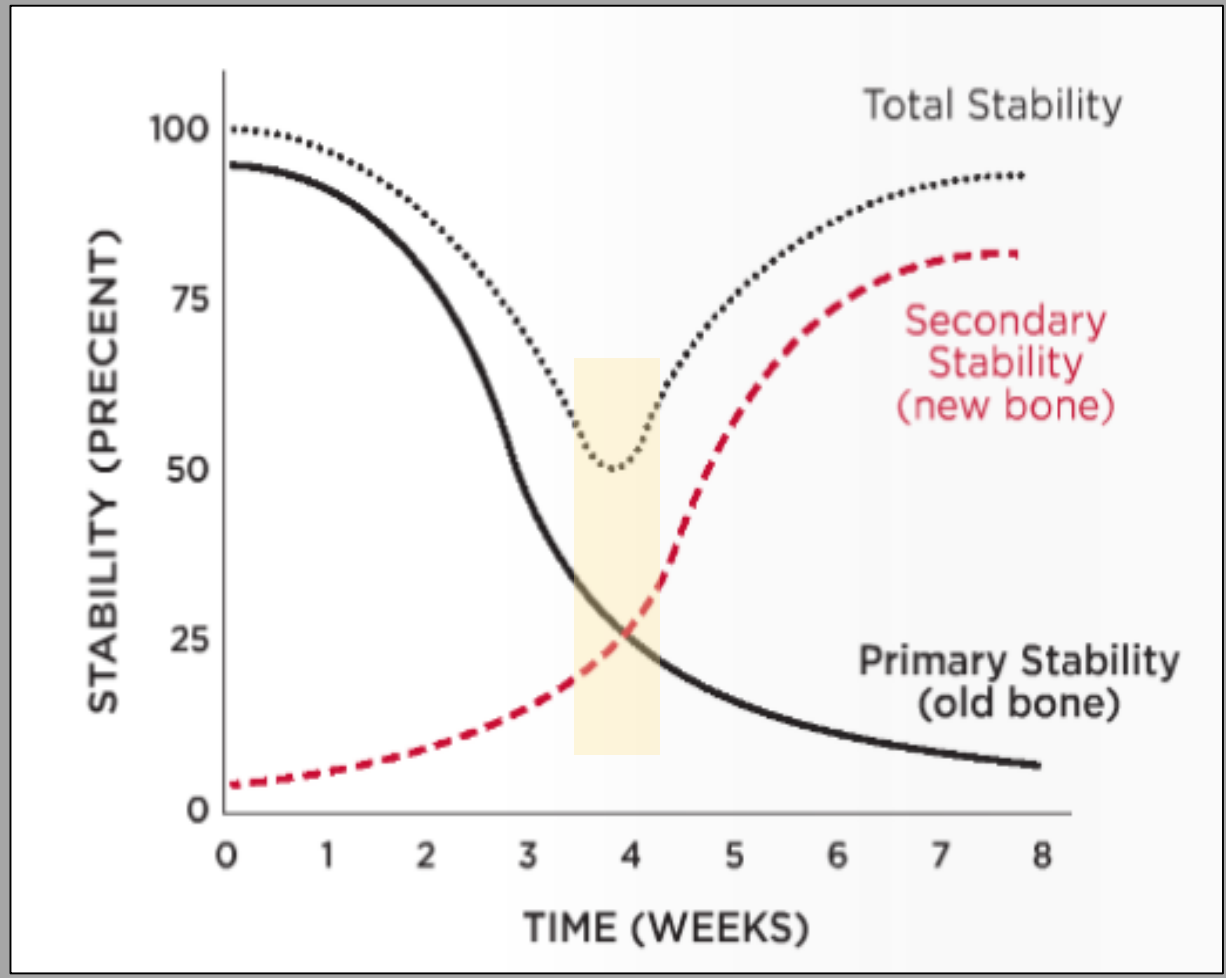






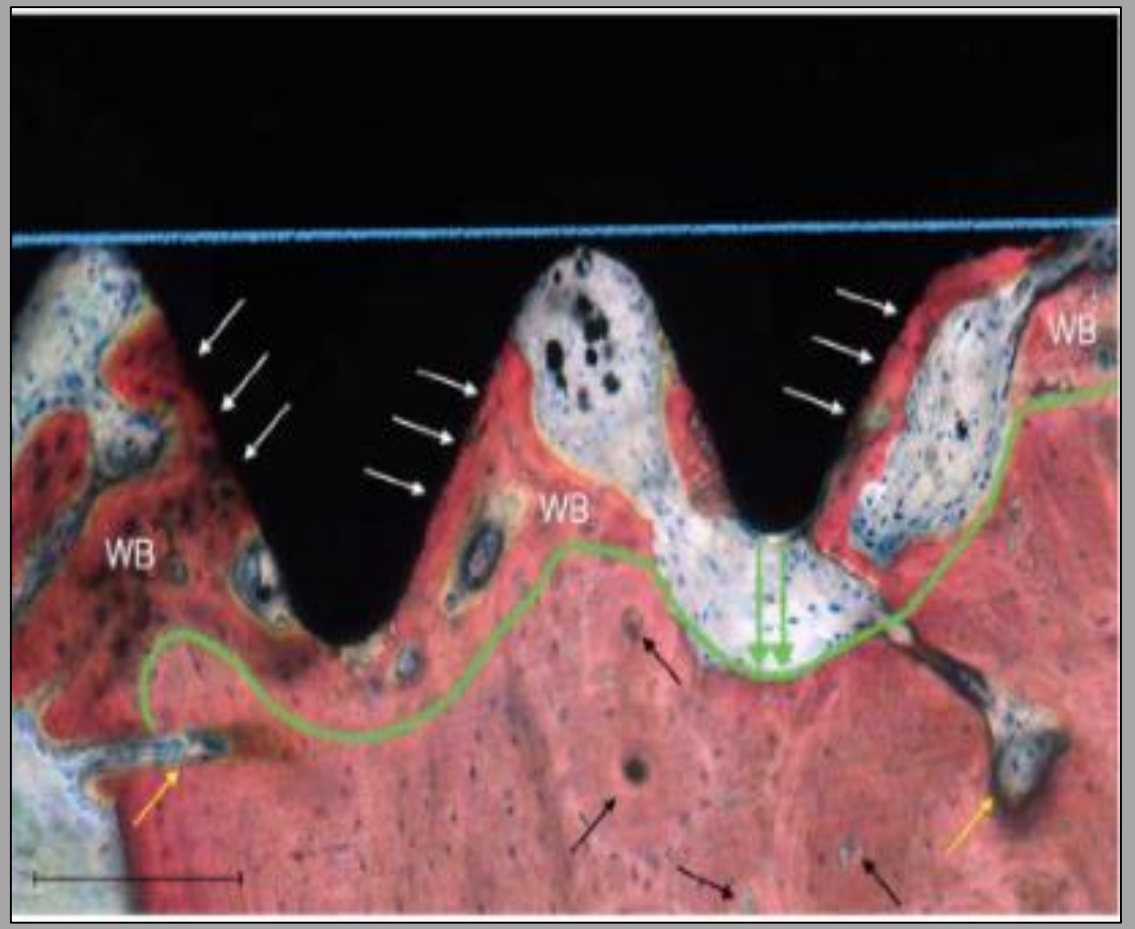
Implant Stability

- Pre-requisite for osseointegration
- **Primary Stability** :absence of mobility in the bone bed after placement
- **Secondary Stability**: related to biologic events at the bone-to-implant interface and is a direct result of healing
- Primary stability changes to secondary stability once osseointegration is complete
  -Implant at highest risk of failure
- **Downward** trajectory of ISQ values at 2 months = problematic



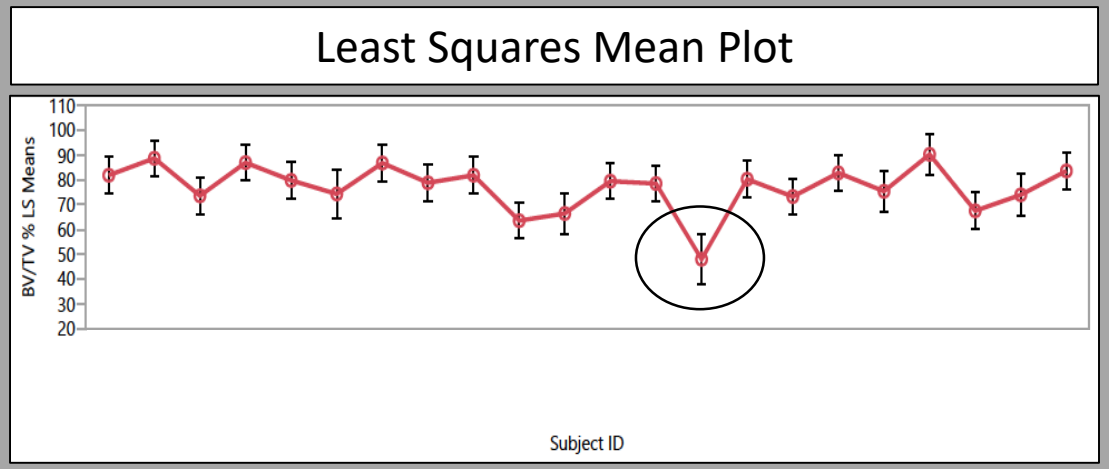
Additional Diagnostics

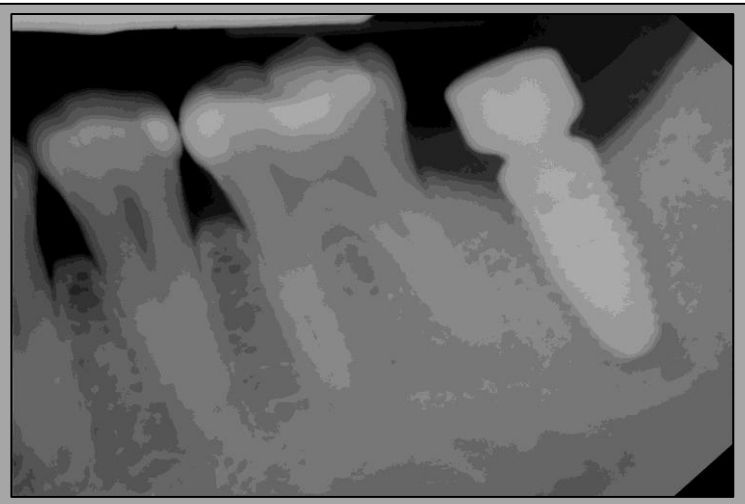
- IT has no meaningful predictive value as sole tool
  - -If IT ≥ 35 N cm
- PT and RTT provide only qualitative information



The One That Failed To Osseointegrate

- Distal most tooth in arch
- Had similar primary stability as successful implants
- IT: **35 N cm**
- Mean ISQ: **55**



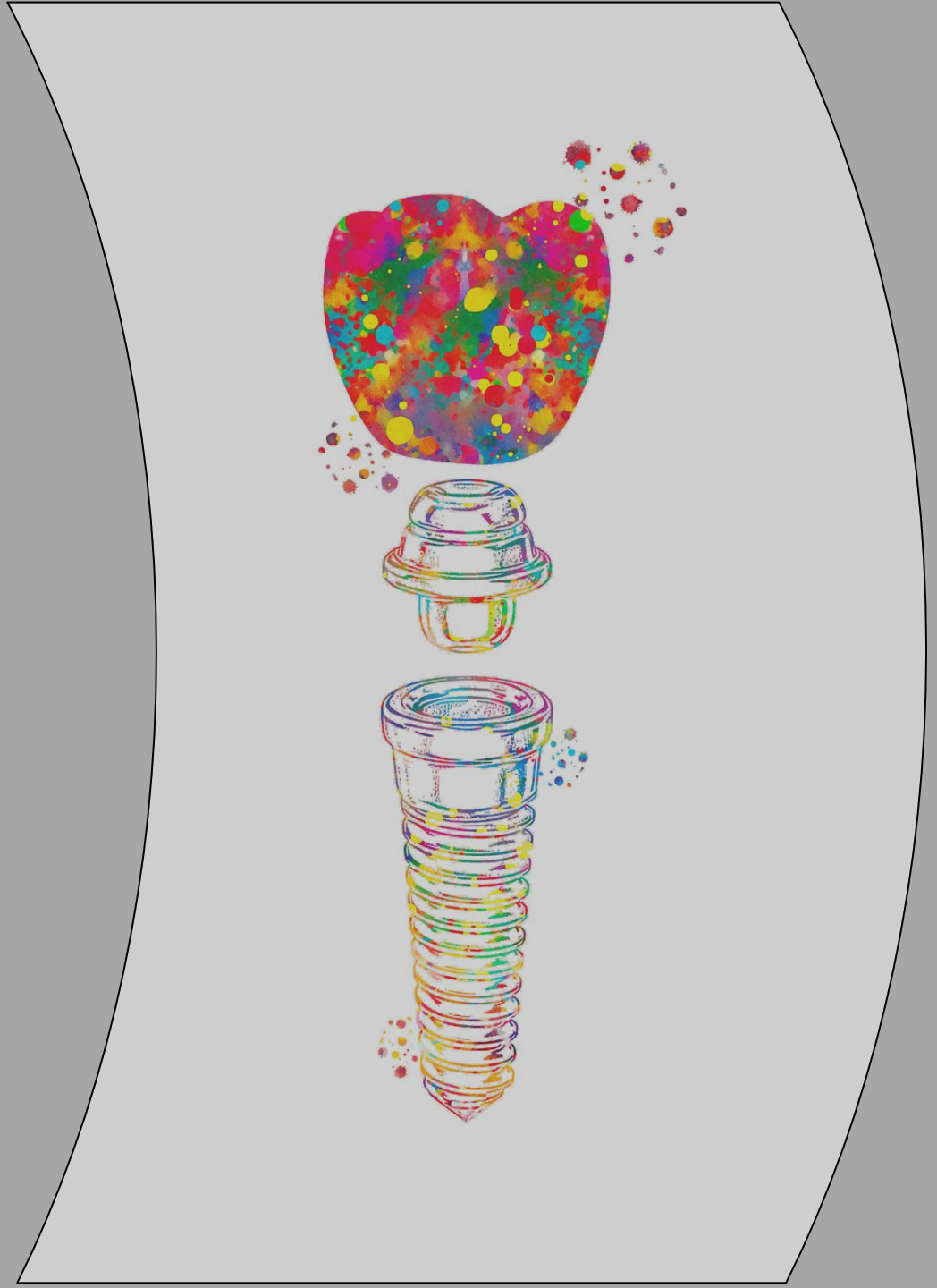


Early Loading Recommendations

4 Factors that could cause loss of osseointegration after loading:

1. Cuspal inclination
2. Implant inclination
3. Horizontal offset of implant
4. Vertical offset of implant

Conclusions



Summary of Results

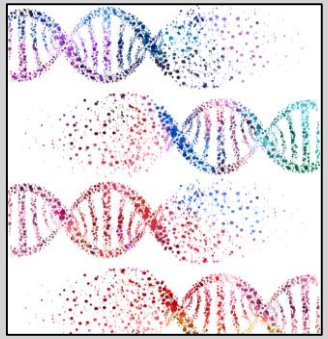
1. The incidence of osseointegration at 6 months was 95%.
2. Patients with an initial ISQ > 80 showed the least amount of ISQ increase over time.
3. ISQ & Bone Volume showed a direct, linear relationship.
4. The majority of patients showed the most healing within the first 2 months.
5. Bone growth is initially exponential & reaches a state of quiescence at 2 months.

Take Away Messages

Loading at 2 months CAN be as successful as conventional loading.

A personalized approach, accounting for patient, site, and implant-related factors should be used.

ISQ is the most prognostic predictor of %BV/TV and in turn, implant stability

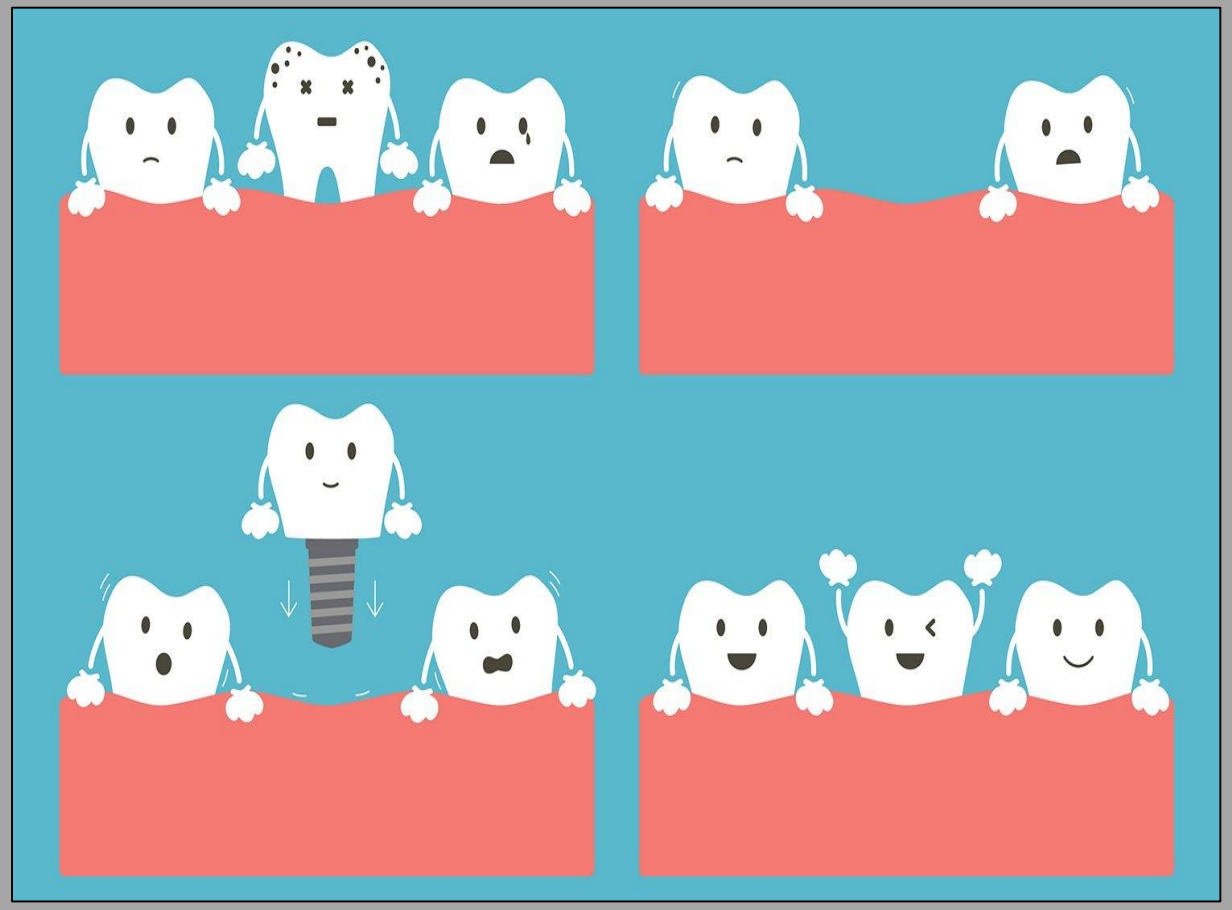


IT should be used to evaluate stability only in conjunction with ISQ.

Osseointegration at 2 months can be predicted if either of the following present:

1. ISQ $\geq 66 \pm$ IT $\geq$ 35 N/cm; (-) Percussion
2. (-) RTT; (-) Percussion

Future Directions for Research



- Asses outcomes of patient's with initial ISQ <55 and IT <35
- Repeat study in different areas of the mouth

Special Thanks

Col Wen Lien

Dr. Concepcion Barboza- Arguello

Dr. Petrina Gerogianni

Lt Col Michael Gardner

Lt Col Demitri Villarreal


QUESTIONS?