Taming the Old Dragons of Dental Implant Prosthetics

June 1, 2019

Implant Prosthetics, Mechanical and Biological Complications, Mucositis, Peri-implantitis, Oral Pathogens, Reverse Margin, Making Implant Treatment Safer

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HONORED FELLOW, AMERICAN ACADEMY OF IMPLANT DENTISTRY

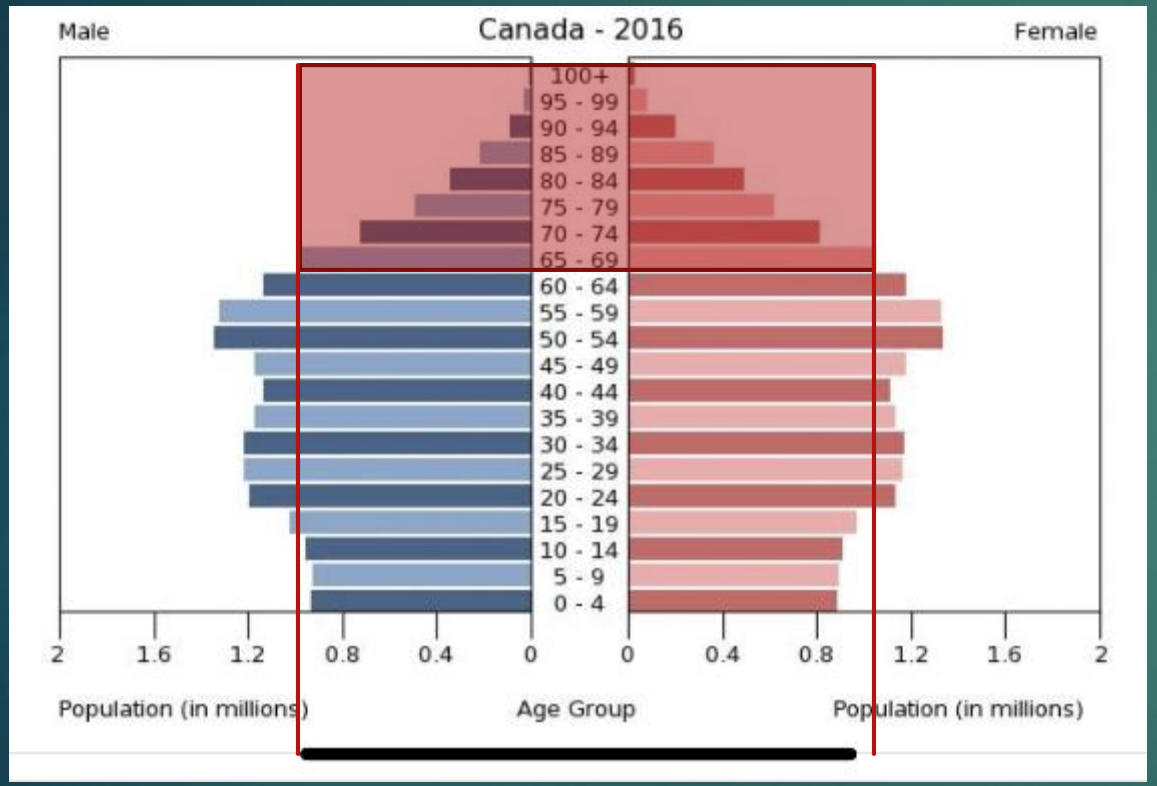
DIPLOMATE, AMERICAN BOARD OR ORAL IMPLANTOLOGY / IMPLANT DENTISTRY

Award Winning ePoster

AAID, Sept 28, 2018

Dr. David G. Hochberg, President of American Academy of Implant Dentistry congratulates Dr. Emil Svoboda at the 67th Annual Meeting in Dallas

Our Treatment Needs to Last a Long Time!



Statistics Canada Census 2016

Your 65 year old Patient is expected to live another 19 years

2018 Population 37 Million

65+ 6.4 M

80+ 1.6 M

10,000 Centenarians

Why Are Teeth Lost?

Infection: Caries & Periodontal Disease

Mechanical Problems

Why Are Teeth Lost?

Infection Weakens Teeth

Mechanical Problems

Dental Implants

Let Us Put

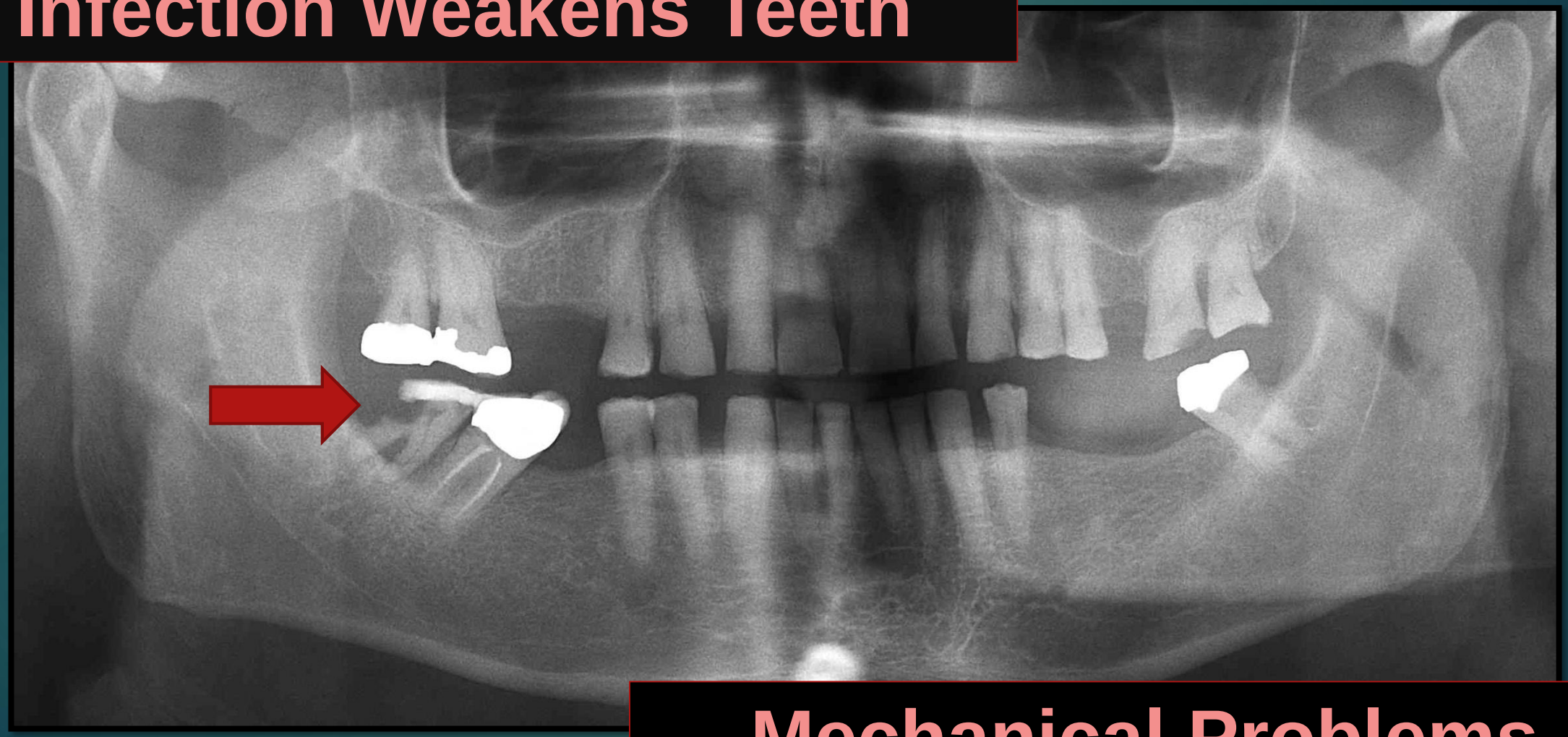
Humpty Together Again

After All Else Has Failed

1. Increase load bearing units
2. Preserve existing tissues
3. Reduce collateral damage
4. Resistance to caries
5. Improve function & Esthetics

Sore Back Tooth – Procrastinator!

Infection Weakens Teeth



Mechanical Problems

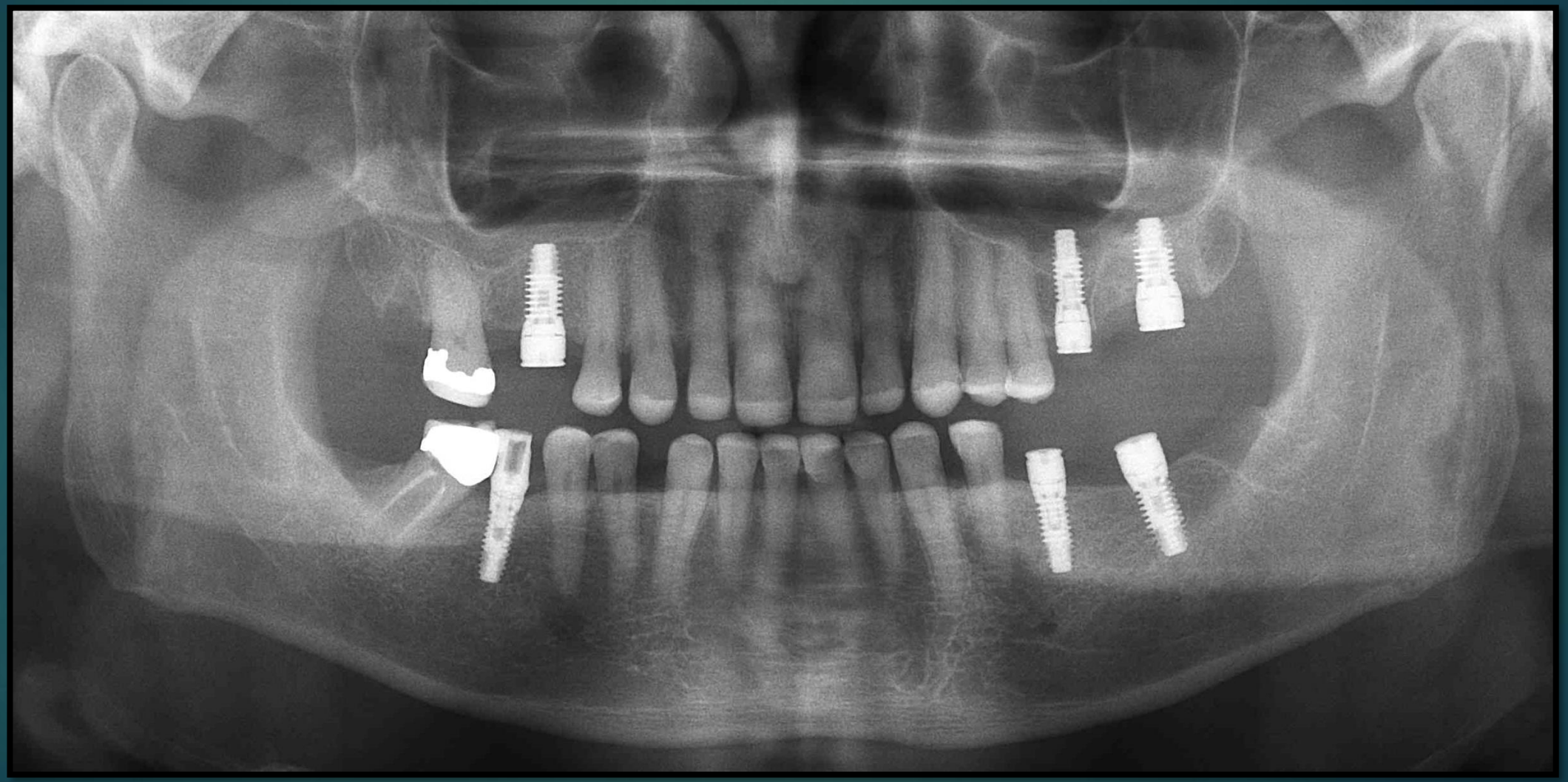
Missing Teeth, Heavy Wear

PF12

I want Natural Teeth
"Not Horse Teeth"

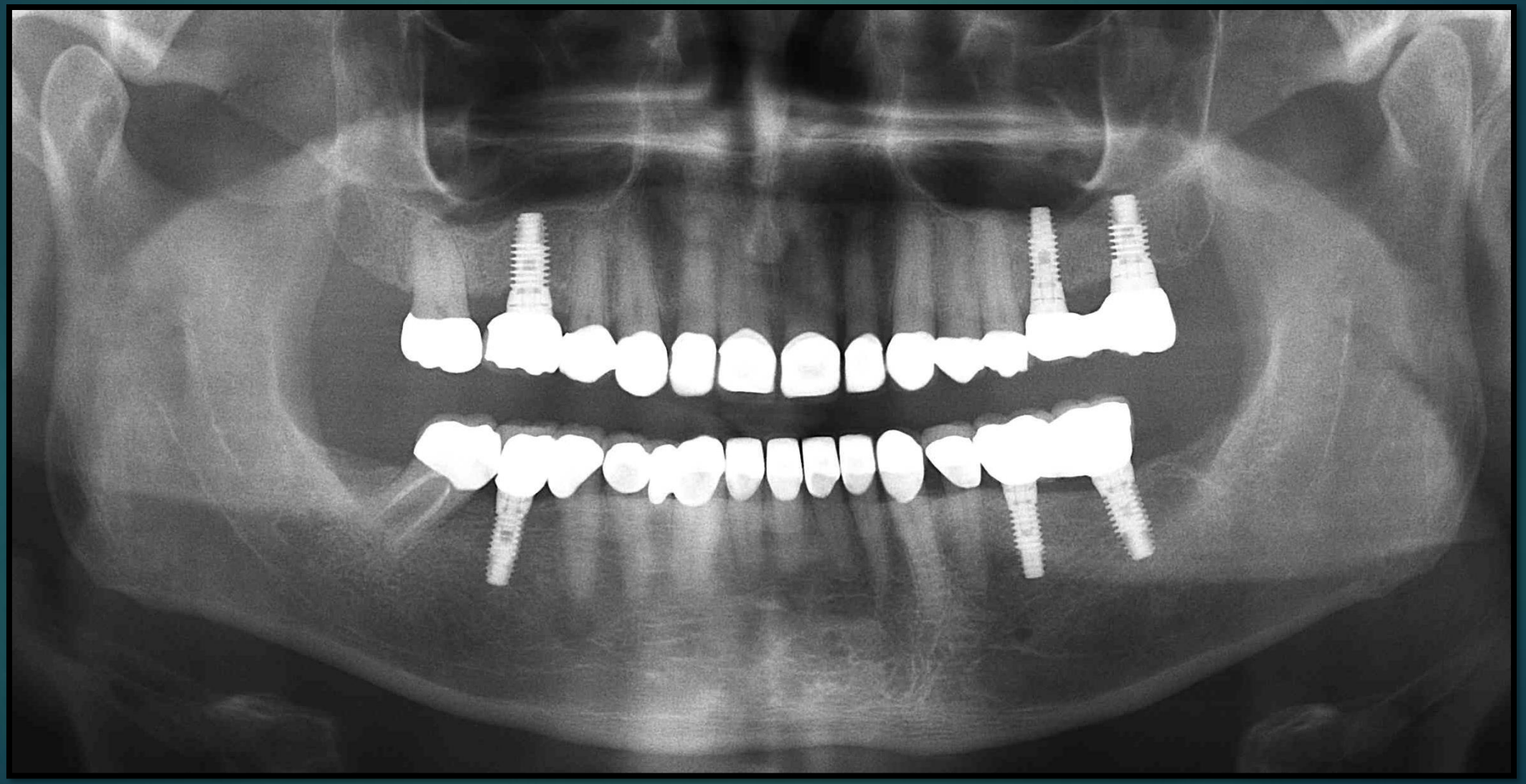
Dr. E. Svoboda PhD,DDS

Immediate Implants



PF12

Improved Mechanical Stability



PF12

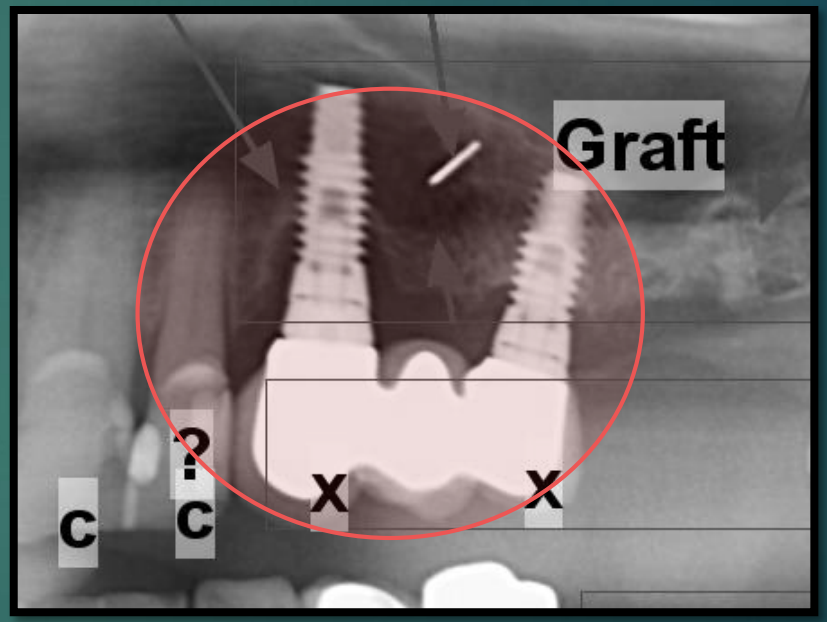
Hygiene and Mechanics Better

Can He Now Prevent Infection By Maintenance?

PF12

Why Are Dental Implants Lost Lost?

Infection & Mechanical Failure



Treatment Complications are Bad for Business

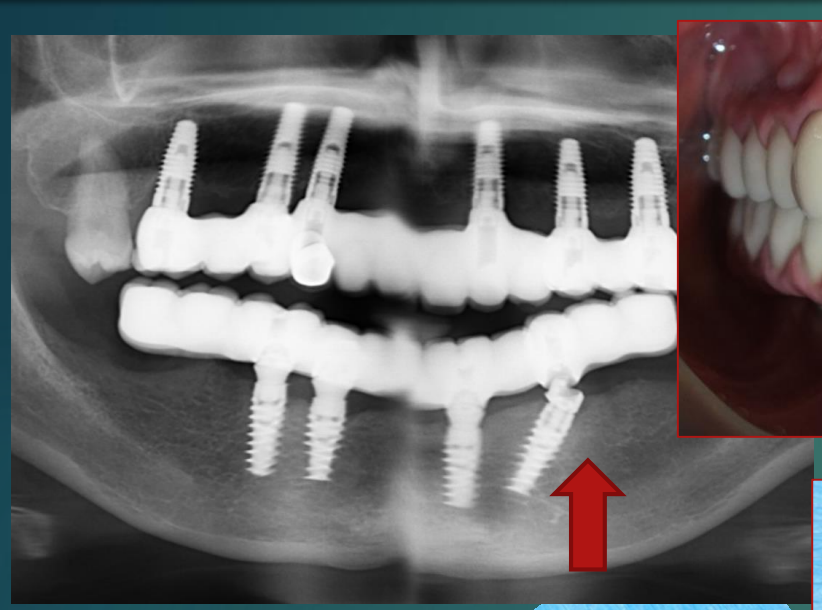
If We Could Make Implant Treatment Better, Why Wouldn't WE?

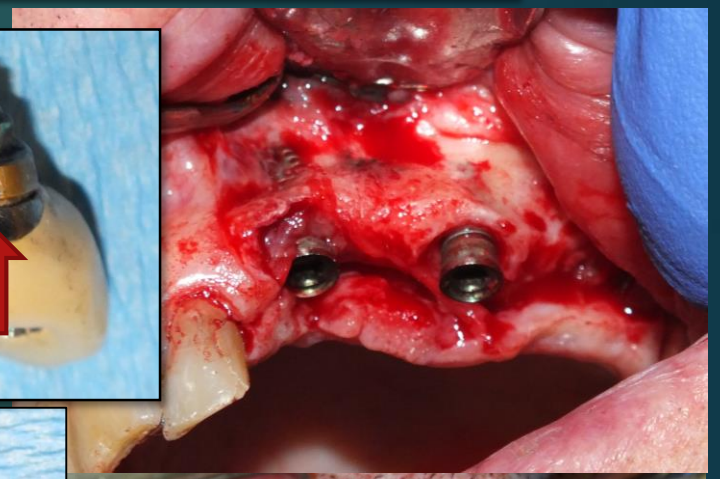
- **Safer** – Reducing Risk Factors that are known to cause Complications for Patients
- **Faster** – Reducing the number of appointments required to complete and maintain treatment
- **Easier** – Reducing complexity of the treatment process for achieving predictable excellent results

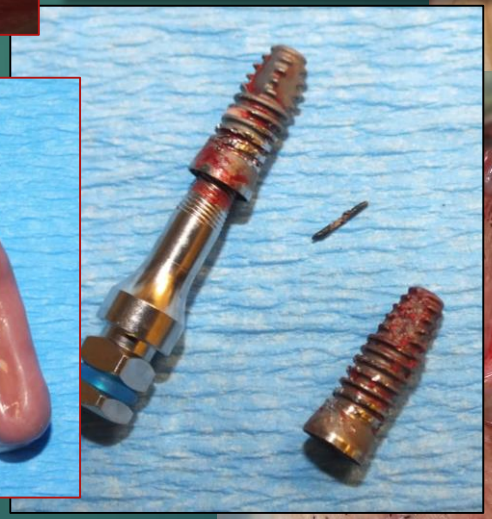
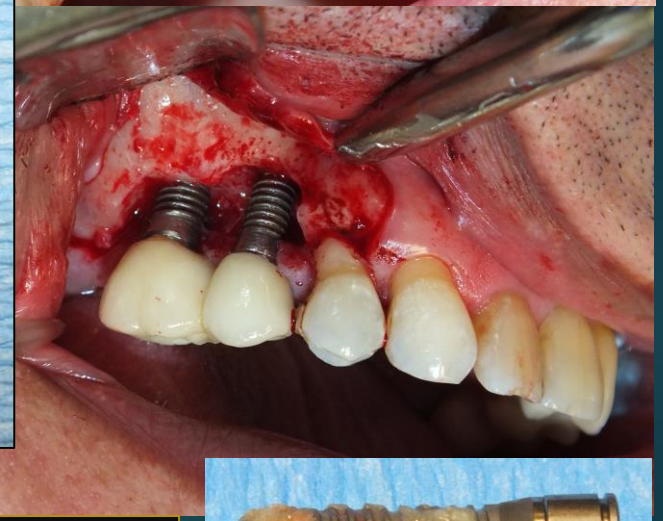
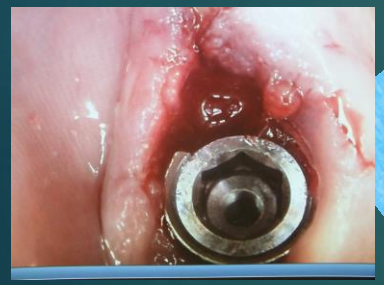
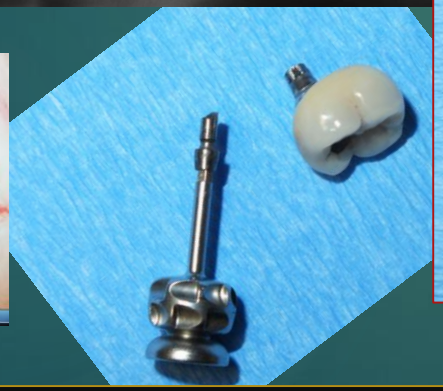
Increase Treatment Durability & Efficiency

More Happy Patients = Great For Business!

What Do Complications Look Like?
How are Mechanical Issues Related to Infection?



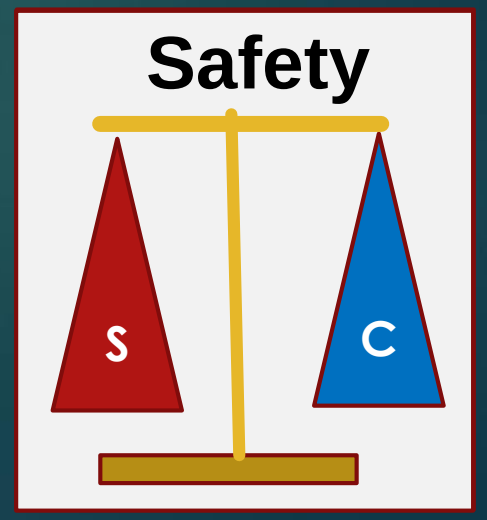
Treatment Complications are Bad for Patients

4 Large Reviews

Mucositis	30% of **Implants**
Peri-implantitis	15% of **Implants**
Peri-implant Disease	**45% of Implants****
Failures	**4% 5 years, 8% 10 years**

Same for Cement or Screw Installation

This includes Residual Cement and Master Cast Techniques
**** Requires Additional Treatment!**



Atieh MA et al. The Frequency of Peri-implant diseases: A systemic review and meta-analyses. J Periodontol **2013**:84(11):1586-1598

Daubert DM et al. Prevalence and predictive factors for peri-implant disease and implant failure: a cross-sectional analyses. J Periodontol **2015**:86(3): 337

Sherif S et al. A Systematic Review of Screw- versus Cement-Retained Implant Supported Fixed Restorations. J of Prosthodontics **2014** (23)1-9

Whittneben JG et al. Clinical Performance of Screw- Versus Cement Retained Fixed Implant-Supported Reconstructions: A Systemic Review. The Int J Oral Maxillofac Implants; **2014**:29(Suppl):84-98.

Why Do Some Key Opinion Leaders only Focus on Complications Related to the Cement-in Installation Technique?

Complication Rates For Both Systems Are Similar!

What is Causing Them??

Review 2016

8989 Implants – 2139 Participants
average 5 years

Cement-in Better than Screw-in

1. Less marginal bone loss
2. Higher implant survival rates
3. Fewer prosthetic complications

Lemos CAA et al. Evaluation of cement-retained versus screw-retained implant-supported restorations for marginal bone loss: A systematic review and meta-analysis. J Prosthet Dent **2016**; 115(4):419-27.

Cement-in Can be Safer than Screw-in Prosthesis Installation

Nissan et al. Long-Term Outcome of Cemented Versus Screw-Retained Implant-Supported Partial Restorations. Int J Maxillofac Implants 2011; 26:1102-1107

Table 1 Comparison of Complications and Clinical Parameters of Screw-Retained and Cemented Implant-Supported Partial Restorations

Complications/clinical parameters	Screw-retained restoration		Cemented restoration	*P*
Ceramic fracture	38% ± 0.3%	10X	4% ± 0.1%	< .001
Abutment screw loosening	32% ± 0.3%	4X	9% ± 0.2%	.001
Metal frame fracture	0		0	NS
Mean Gingival Index	0.48 ± 0.5	5X	0.09 ± 0.3	< .001
Mean marginal bone loss (mm)	1.4 ± 0.6	2X	0.69 ± 0.5	< .001

Split Mouth Design, 38 patients, 221 Implants, mean follow up 5 years to 15 years

Should We Install Implant Prosthetics by Screw or Cement?

Insanity … Doing the same thing over and over and expecting different results.

Albert Einstein

Is it Pick your Poison?
Is the 45% Peri-Implant Disease Rate OK?
Can We Do Better?

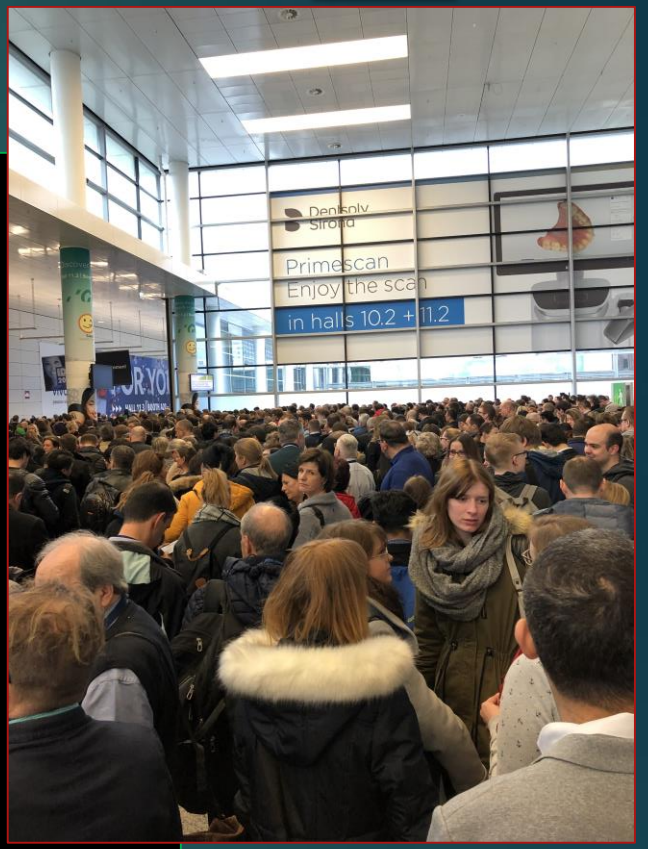
Why are the Large Implant Companies Pushing the Screw-in Installation Technique? More Parts, More Control?

Dentists are Chasing Expensive Technology that is Changing Rapidly & Only Half-Baked

Do Implant Companies Suffer from our Complications???

Making Treatment Better for Whom?

IDS Cologne Germany 2019



- **PATIENTS!**
- Dentists
- Dental Specialists
- Dental Laboratories
- **Implant Manufacturers ******
- **Implant Product Distributers & Services ****

We Are All in the Health Care Industry!

Who is Responsible for Complications??

1. **Patients?**
2. Educators?
3. Implant manufacturers?
4. Governing bodies?

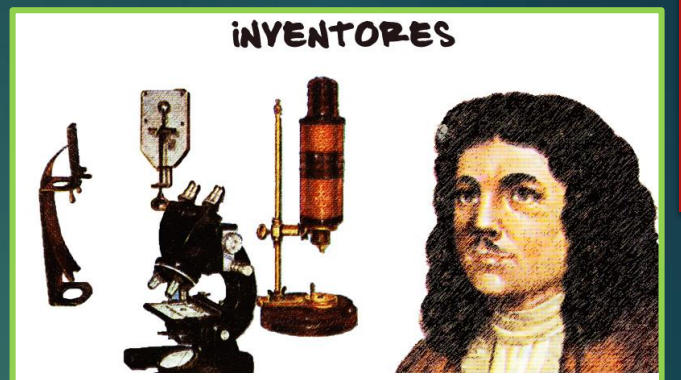
5. **You the DR** appear to be alone & …

Directly
Responsible

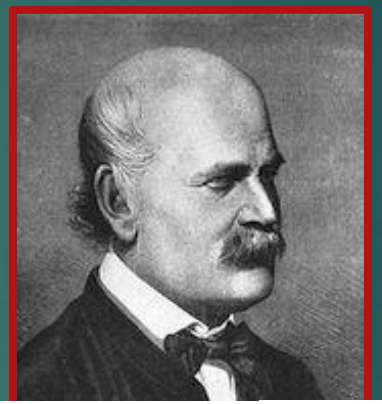
Are We Really Incompetent?
Or Are Our Systems <u>FLAWED</u>?

To Prevent Problems

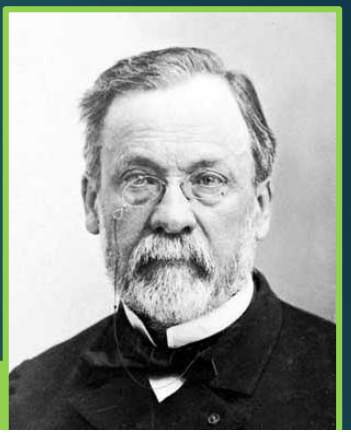
We Must First Discover Their Root Causes



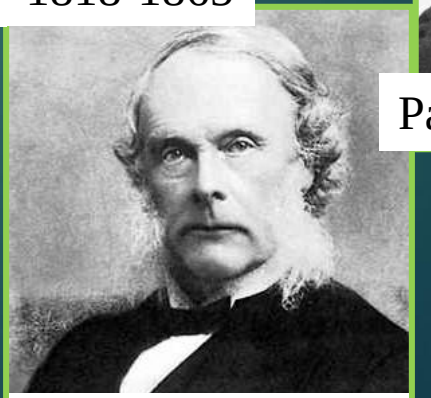
Van Leeuvwenhoek 1632-1723



Semmelweis 1818-1865



Pasteur 1822-1895



Lister 1827-1912

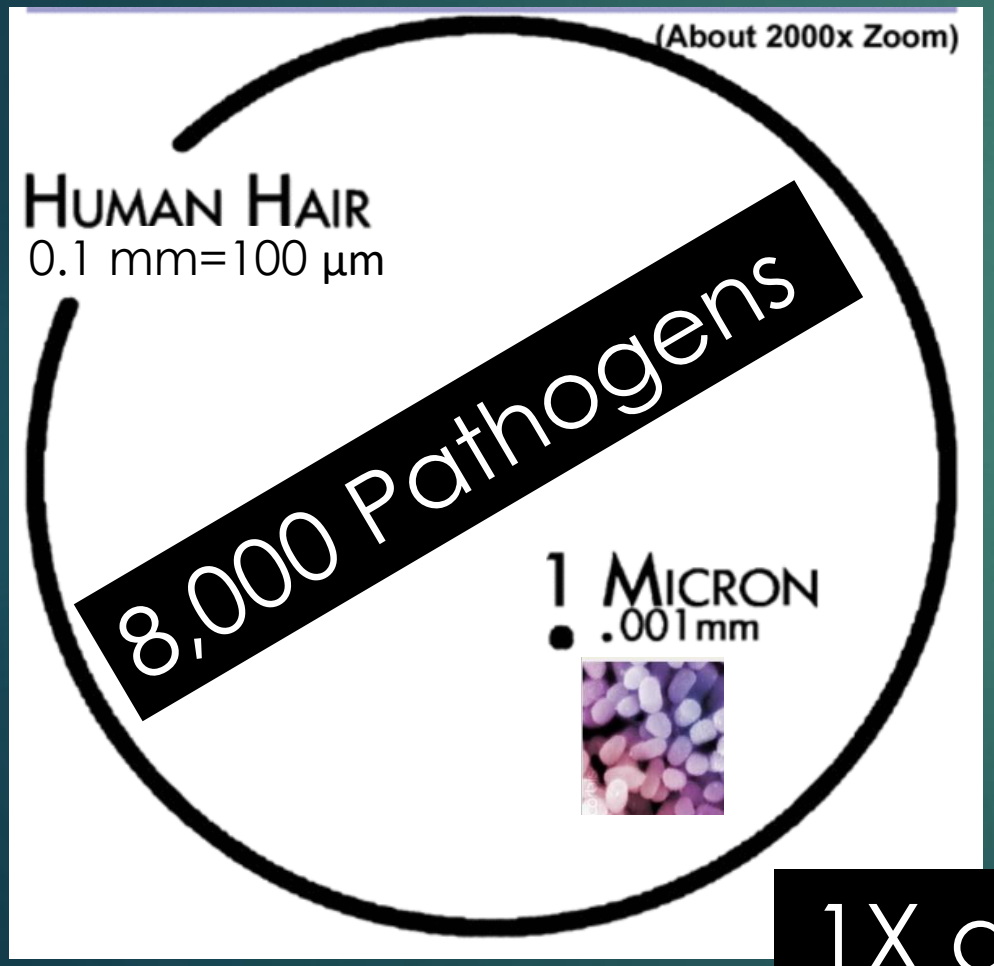
Oral Pathogens are a Root Cause of Peri-implant Disease

Shouldn't We Be Investigating Our Work At The Micron Level

Peri-Implant Mucositis and Peri-Implantitis: A Current Understanding of Their Diagnoses and Clinical Implications. American Academy of Periodontology (AAP). J Periodontol: April 2013; Vol 84, No 4, 436 - 443

Svoboda ELA. Safer Implant Treatment. OralHealth; Oct 2018, 58-60.

SIZE MATTERS!



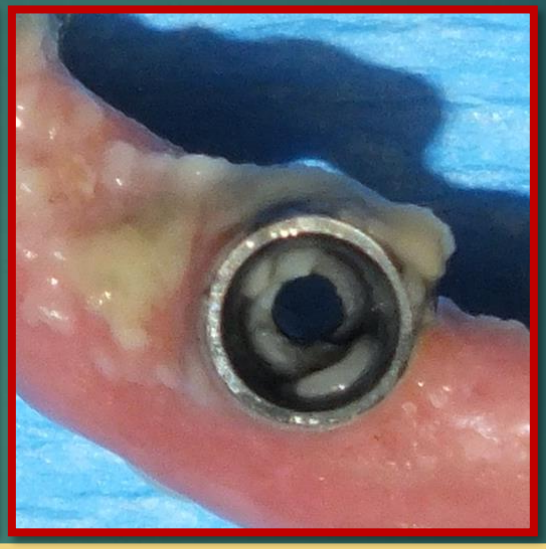
8,000 Pathogens

8 Million/mm

32 mm perimeter

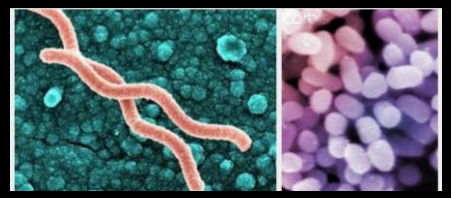
1X around = 250 Million Pathogens

In Microbiology
SIZE MATTERS!



Are We Relying too Much on Host Resistance ????

Size of Inoculum



Host Resistance ⟷ **Pathogen Virility**

Oral Pathogens That Cause Biological Complications Live

on gingiva, teeth & dental prosthetics
under overhanging, overextended & in open margins,
on subgingival cement, in voids under crowns
under cantilevered prosthetics & between implant parts,
(implant-abutment & abutment-prosthesis misfits)
in & on dental implants

Oral Disease is Difficult to Treat & Much Better to Prevent

Can We Reduce Some of the Difficult to Access Breeding Places for Oral Pathogens?

YES BUT

First, We Must Understand How We Continue to Create Them

The OLD Dragons of Dentistry

They Are The Root Causes of Treatment Complications Related to Both Prostheses Installation Techniques

1) Prosthesis Dimensional Error
2) Tissue Effects

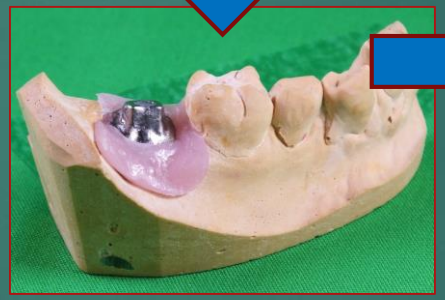
Prosthesis Dimensional Error

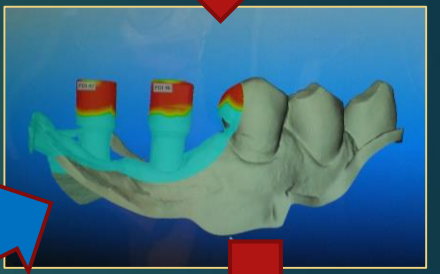
1

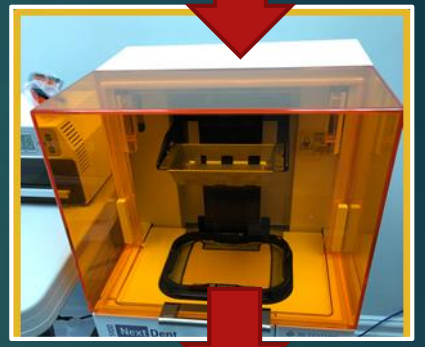
Is a Well Known
Root Cause
Of
Treatment
Complications

How are Prosthetics Made?

The Dentist Makes an Impression of the Mouth







Lab Makes the Prosthesis To Fit the Dental Model

Model System Evolved For Cement-in Prosthetics

It Allows the Lab to Work Outside the Mouth to Make the Prosthesis

The Cement Space is the Tolerance For Error Between Model & Mouth

Physical Model Based Construction has Many Parts that Contribute to Error

2019

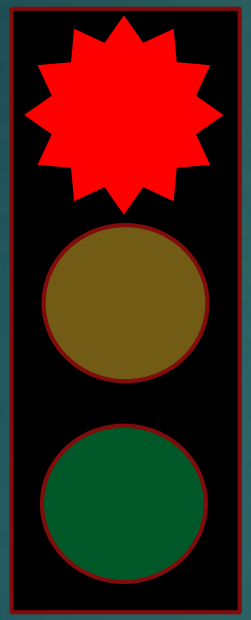
***Acceptable Levels**
Model Error ±150 µm
AKA 300 µm spread

Inaccurate

Comparison of the Accuracy of Different Transfer Impression Techniques for Osseointegrated Implants. Zen BM et al. JOI Vol 41 No 6 2015: 662-667.

BUT

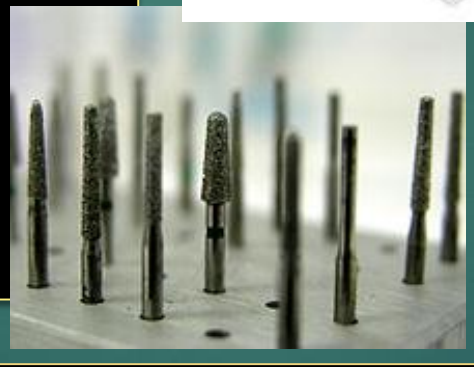
Does Anyone Really Know How Accurate a Specific Model/Prosthesis Is?



Is Accuracy a Game of Chance?

The Prosthesis is Inaccurate

That is Why We Need to Adjust
Contacts, Fit & Occlusion
to Install it into the MOUTH



We have Good and Bad Days
Fit is Variable & Technology is Complex

Mass Produced Machined Construction

30X More Accurate than Models

***Acceptable Levels**
Error ± 5 µm
AKA 10 µm spread

Little Tolerance for Error!

Health Canada & FDA in the USA Regulate the Sale of Abutments

Manufacturers Must Demonstrate Implant-Abutment Connection Stability According to ISO 14801:2016 Standards

For Testing, the Implant & Abutment are connected to create an Optimized Fit according to Manufacturer's Specifications

What is an Optimized Fit?

2019

Microgap
Related to Parts Manufacturing Errors

(±5 µm)

Macrogap (30X Bigger)
Prosthesis Manufacturing Errors
Plus Microgap

(± 150 µm)

Optimized Fit
Macrogap = Microgap

(±5 µm)

A BIG Problem for Screwed-in Prosthetics Components have Little Tolerance for Error!

Its Like a Shell Game – Where is the PDE?

3 Joint Systems

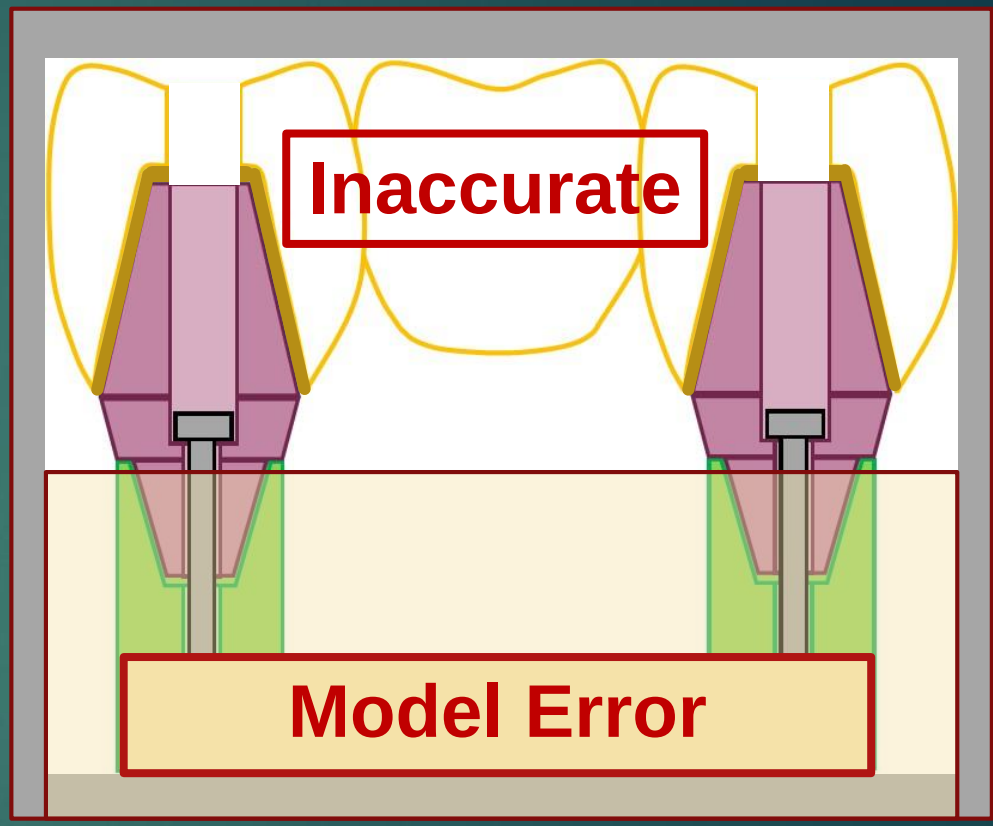
1. Implant-Abutment
2. Abutment-Prosthetic Part *
3. Prosthetic Part-Prosthesis

2 Joint Systems

1. Implant-Abutment *
2. Abutment-Prosthesis **

The Lab Adjusts & Joins the Inaccurate Prosthesis to its Abutments On the Inaccurate Model

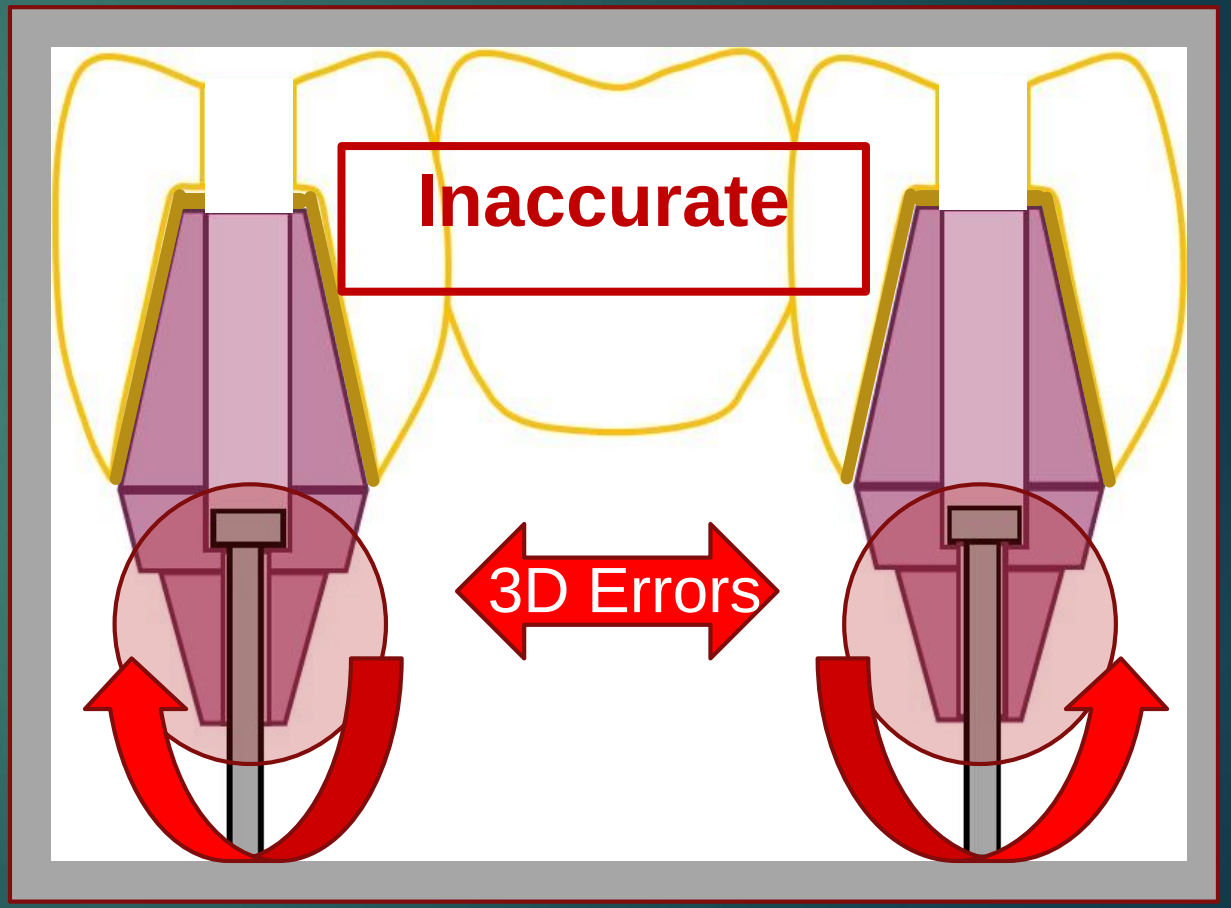
Prosthesis Dimensional Error (PDE)



This is Now a Rigid Complex with Built-in 3-D Model/Prosthesis Error

The Inaccurate Prosthesis Now Constrains the Abutments

Abutment Connectors Are Fixed and Mispositioned!



NOT So Good! Implant Companies are Aware!

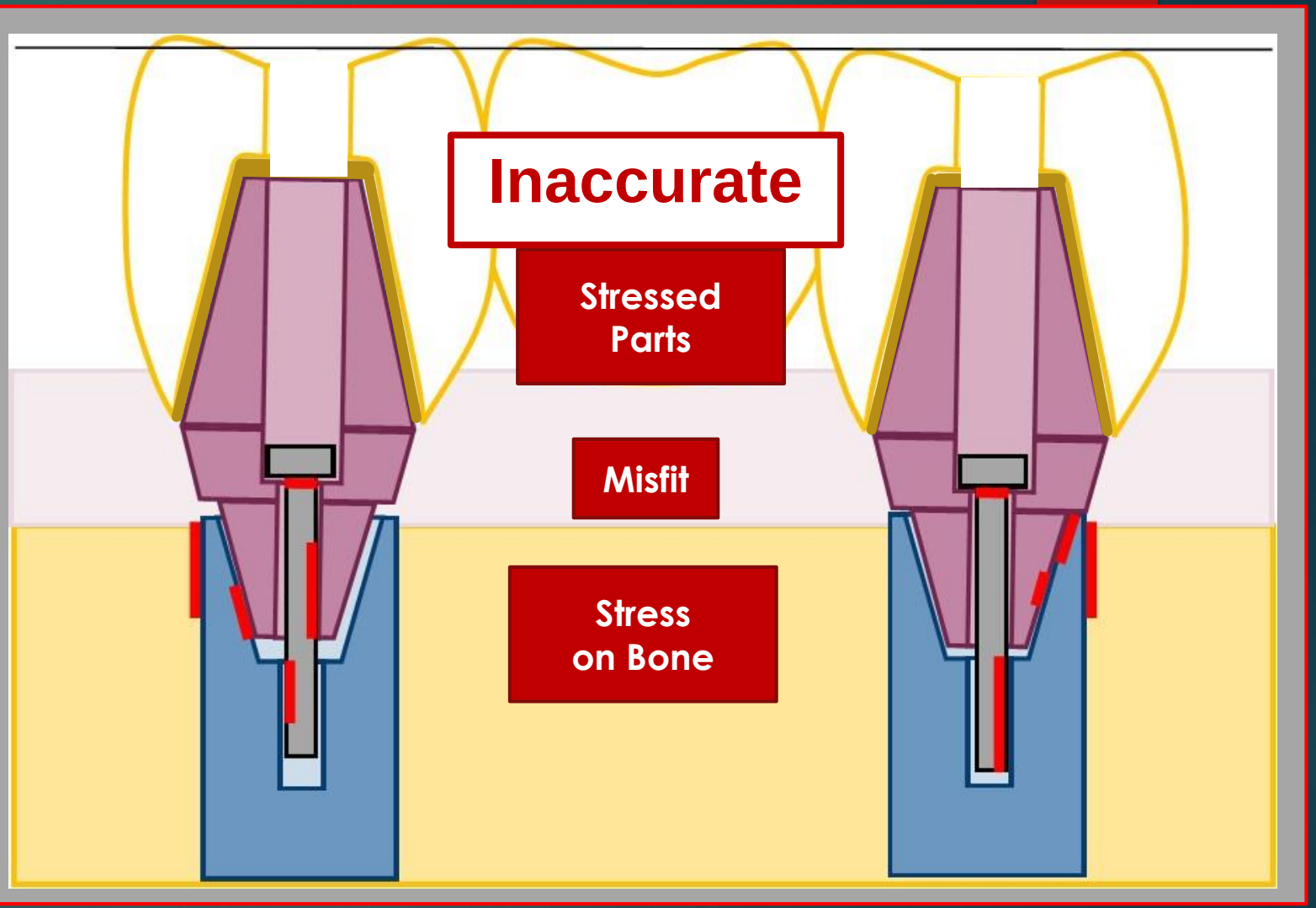
Implant-Abutment Misfit in the Mouth

Mechanical Problems

- Misfit of Components
- Deformation of Parts
- Broken Retaining Screws
- Movement of Parts
  - Micropump (Zipprich,YouTube 1,2)

Biological Problems

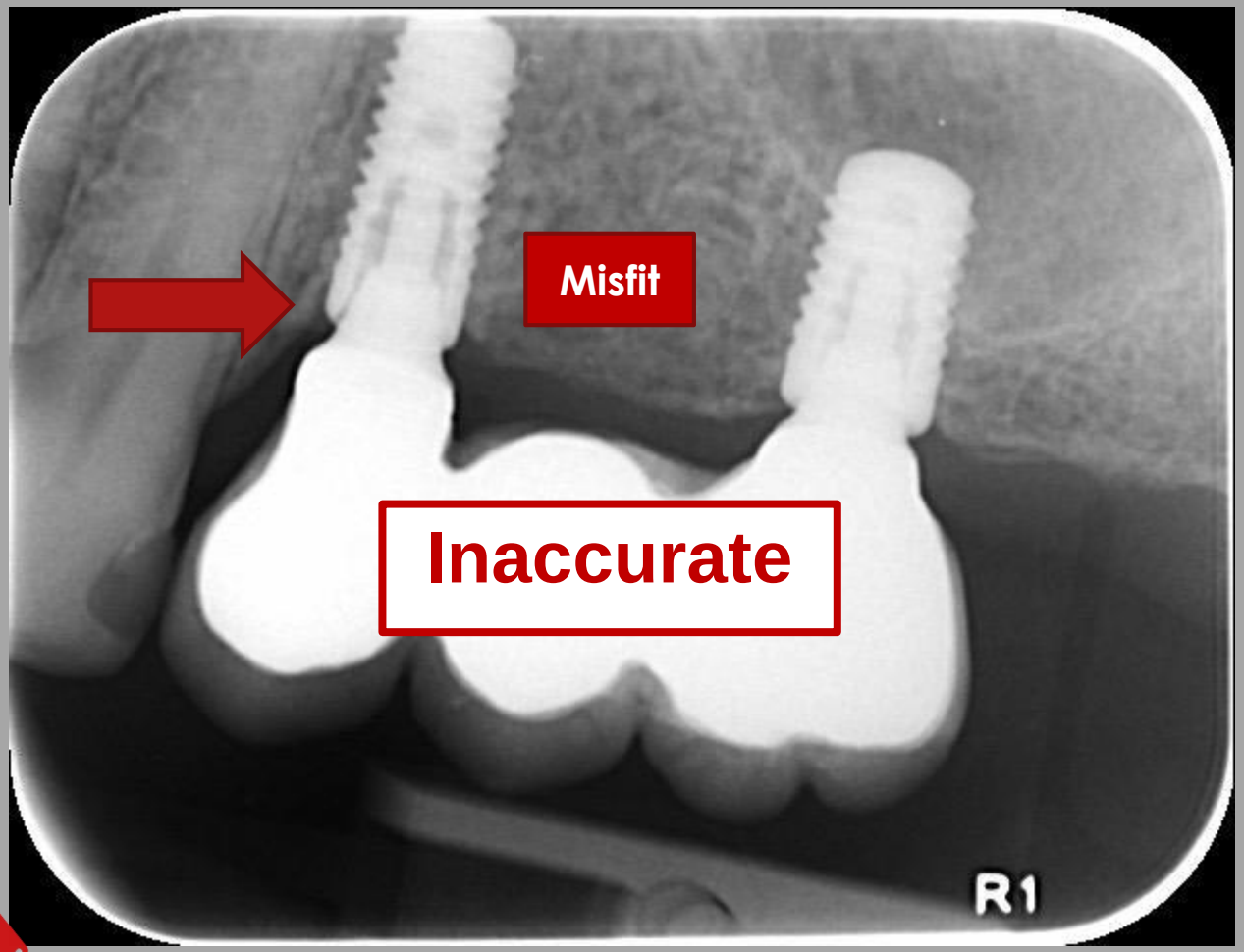
- Stress on Bone
- Voids at Connection and Microbial Invasion



NOT So Good, and Preventable!

The Screw-in Technique

Can Dentists Optimize the Implant-Abutment Fit with Multiple Units?



NO, NOT Consistently!

Implant-Abutment Connection

What is Better Mechanically & Biologically? Fit or Misfit???

If We Could Optimize the Fit Why Wouldn't We?

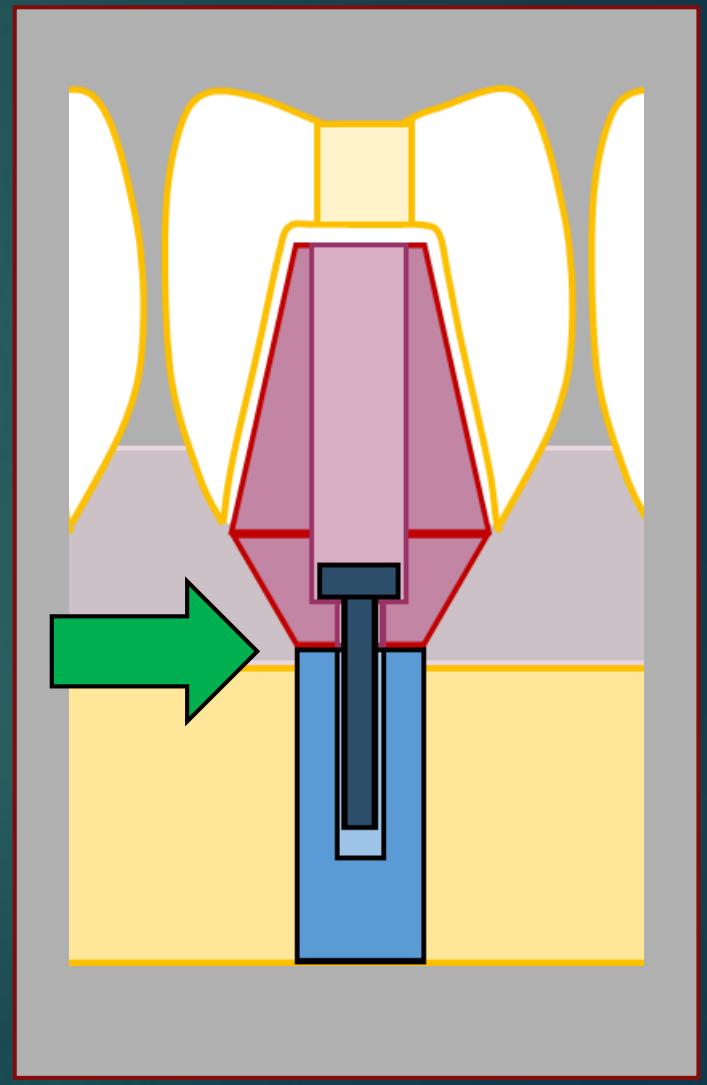
Single Implant - Crown Restoration
The Screw-in System Challenge!

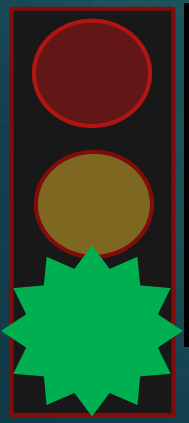
Can Dentists Consistently Optimize BOTH?

1. Implant-Abutment Connection
2. Path of Insertion

Optimizing the Implant-Abutment Connection

Can Dentists consistently line up the
path of crown insertion
with the implant-abutment screw channel
to achieve the optimal fit of parts
as per manufacturer and
Government regulators?

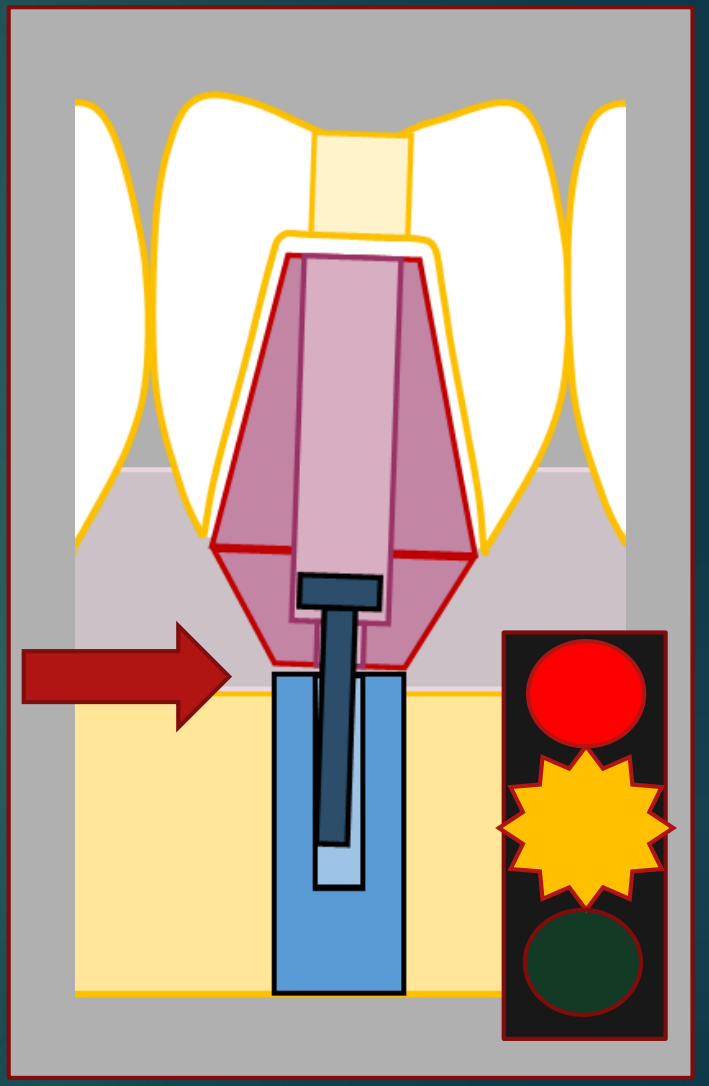




Yes! It Can be Predictable
when there are
NO Contacts with Adjacent Teeth!

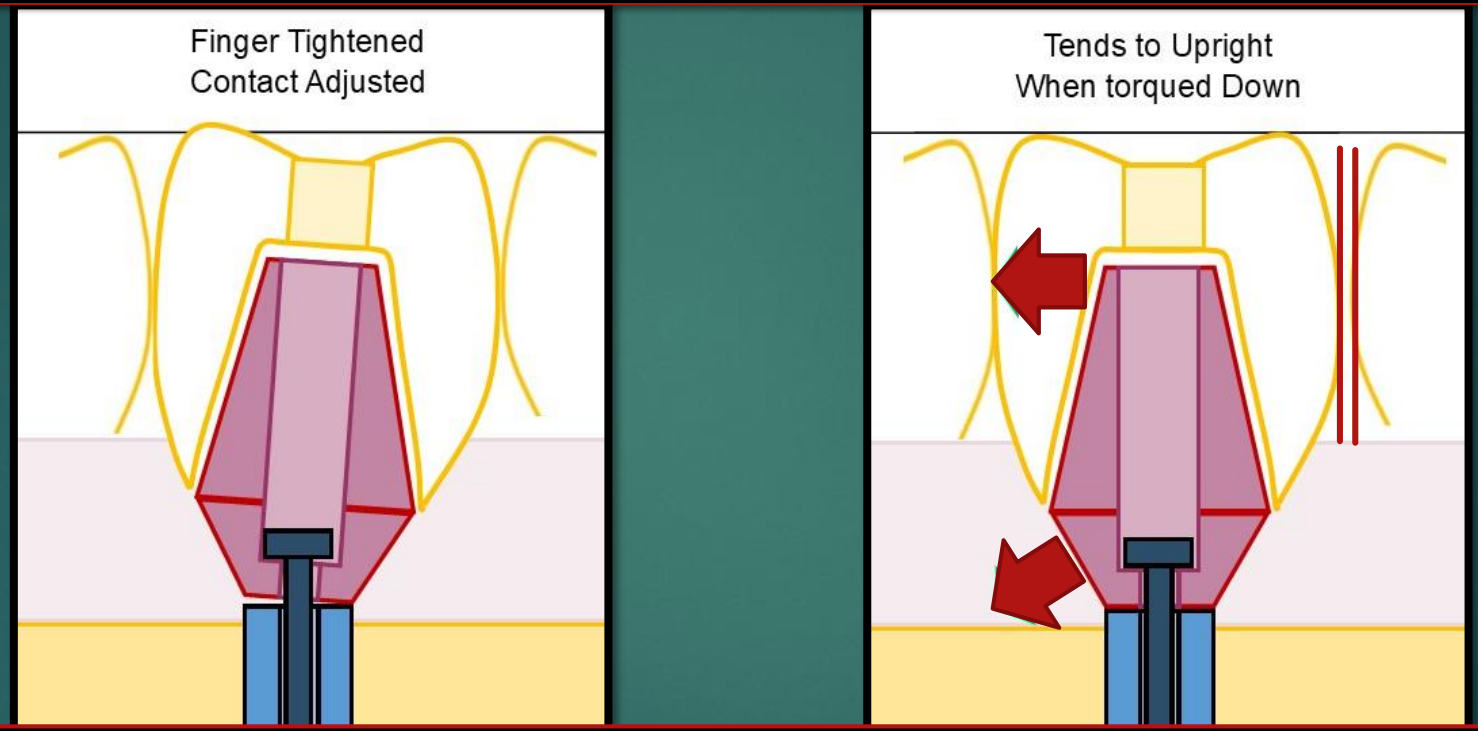
What if there are Contacts with Adjacent Teeth?

Path of Insertion May Take Precedence over Implant-Abutment Fit



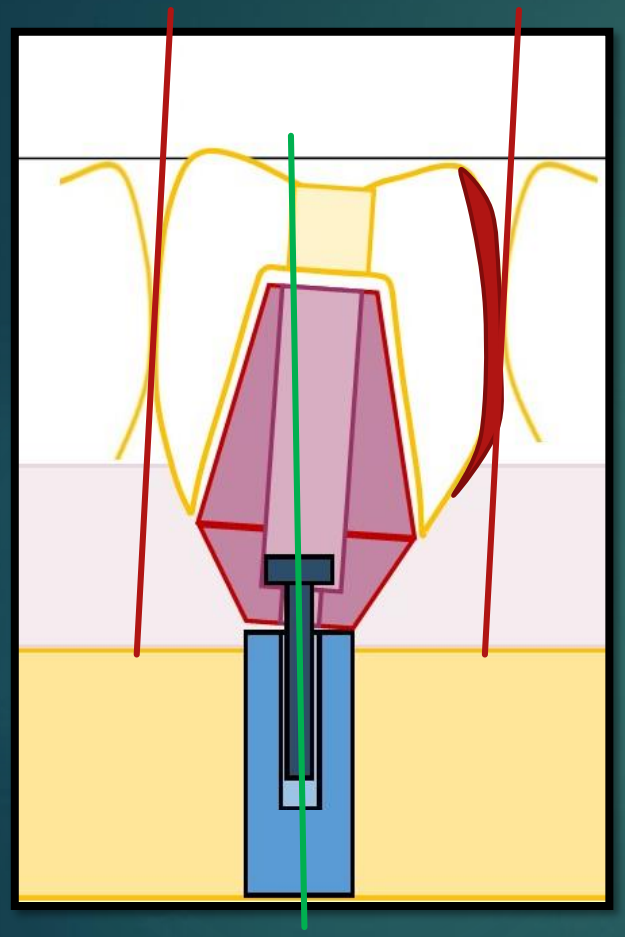
Optimizing the Implant-Abutment Connection is Not Predictable

After Hand Tightening the Abutment Screw and Adjusting the Prosthesis Contacts Final Torqueing of Abutment Screw May Upright the Abutment-Crown Complex



This Can Cause a Tight and Open Contact Problem and/or Implant-Abutment Misfit

Open Contact – Transport to Lab



Lab - Put in Oven to Disassemble,
Add Porcelain to Contact (overbuild),
Reassemble on the Inaccurate Model?
Transport back to Dentist

Dentist Reappoints Patient, Adjusts Contacts to Seat Abutment-Crown Complex onto Implant, Screws into Place and **Hopes for the Best**

Implant Alignment ≠ Path of Insertion

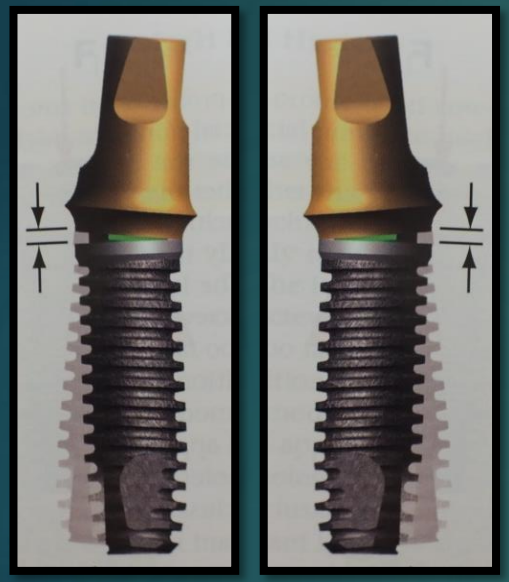
The Dreaded Macrogap
AKA – Implant-Abutment Misfit

1. Inaccurate impressions/Models
2. Tight Contacts
3. Tissue Interferences
4. Cheaper Inaccurate Parts
5. Use of Engaging Abutments
6. Trying to Re-insert an Abutment that has been Previously Misfit Deformation?

"When **bacteria** are able to colonize a **Macrogap**, implant failure can result due to **biologic failure** such as **peri-implantitis**. (4)
In addition, **misfit** can lead to **mechanical failure** of the implant system because of factors such as **screw fracture** and/or implant fracture. (5)" **Movement?**

Top factors leading to dental implant abutment/implant fixture misfit: The dreaded microgap. **Scott Froum**, Perio-Implant Advisory, Feb 6, 2017. Clinical Associate Professor – Periodontist NYU

*Passive Fit could not be achieved with Screwed-in Prosthetics!



Figures of implants from "Dental Implant Prosthetics, Carl E. Misch, Elseier Mosby, 2005 & 2015

That Includes Using The "Master Model Technique" (Expensive)

*Review: Passive Fit in Screw Retained Multi-unit Implant Prosthesis Understanding and Achieving: A Review of the Literature. MM Buzaya, NB Yunus. J Indian Prosthodont Soc. **2014**, Mar;14(1):16-23 Comparison of the Accuracy of Different Transfer Impression Techniques for Osseointegrated Implants. Zen BM et al. JOI Vol 41 No 6 2015: 662-667. Tissue -integrated prostheses. Branemark PI, Zarb GA, Albrektsson T. Chicago: Quintessence; 1985. p. 253

Comparing the accuracy of master models based on digital intra-oral scanners with conventional plaster casts. C Vogtlin et al. Physics in Medicine. June 2016. Volume 1, 20–26

Risk Factors and Risk Stratification Using a Risk Score for Peri-implant Pathology

1. History of Periodontitis
2. Is there Bacterial Plaque Present
3. Implant Close to other Teeth or Implants
4. Prosthetic Materials
5. Lack of Passive Fit or Prosthetic Loosening
6. Existing Bone Level
7. Smoking Patient

Attributable fractions, modifiable risk factors and risk stratification using a risk score for peri-implant pathology. M Nobre …..
Paulo Malo … Jan 2017 Journal of Prosthodontic Research, Vol 61, Issue 1, 43-53.
https://www.for.org/en/treat/peri-implant-pathology-risk-assessment/take

How Did They Detect Macro-gaps?
Their X-rays are Insufficient!

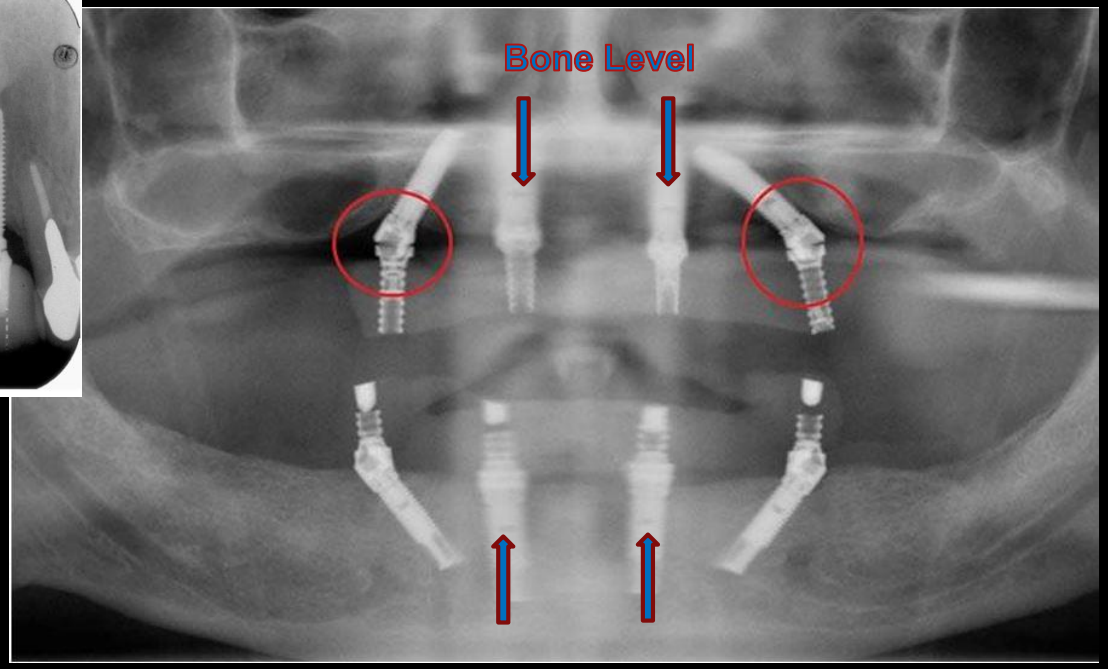


Table 3
Attributable Percent of **Peri-implant Pathology**

History of Periodontitis	74%
Non-Optimal Screw Joint	5%

The Example is assembled in the mouth!

How Can We Detect Macro-gaps?

Attributable fractions, modifiable risk factors and risk stratification using a risk score for peri-implant pathology.
M Nobre ….. **Paulo Malo** … **Jan 2017** Journal of Prosthodontic Research, Vol 61, Issue 1, 43-53.

Risk Factors and Risk Stratification using a Risk Score for Peri-implant Pathology

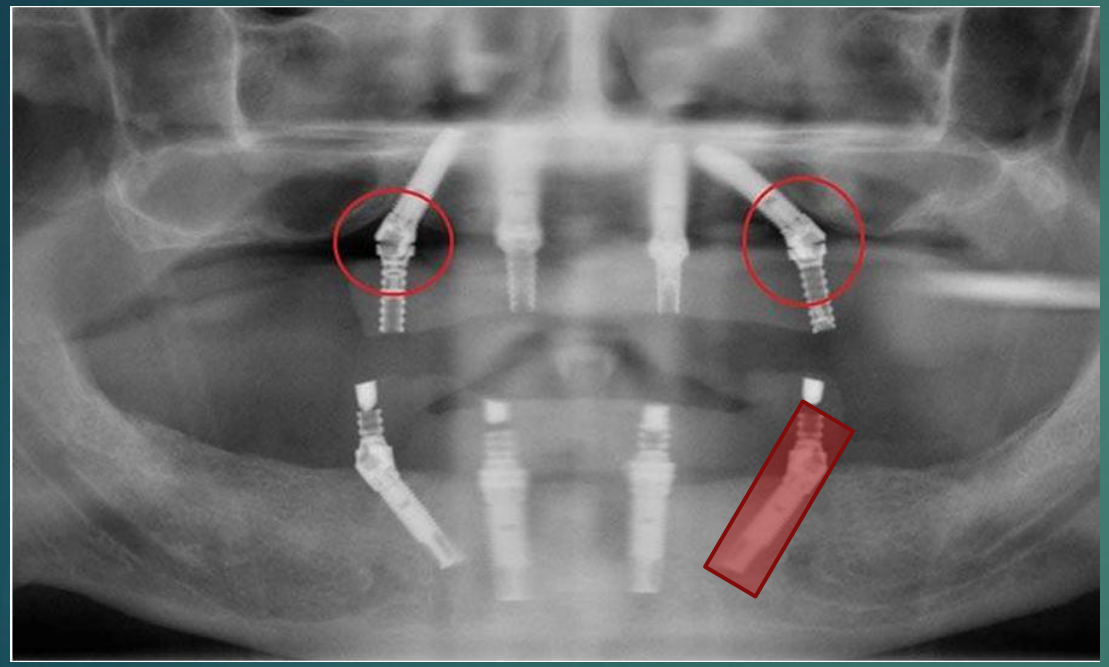
History of Periodontitis	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Bacterial Plaque Present				X			X	X
Bleeding on Probing					X	X	X	X
Lack of Passive Prosthesis Fit		**X**	**X**	**X**	**X**	**X**	**X**	**X**
Patient Smokes			X			X		X
Negative Points	**4**	**7**	**7**	**9**	**9**	**11**	**11**	**11**
Risk Level	**M**	**H**	**H**	**VH**	**VH**	**VH**	**VH**	**VH**

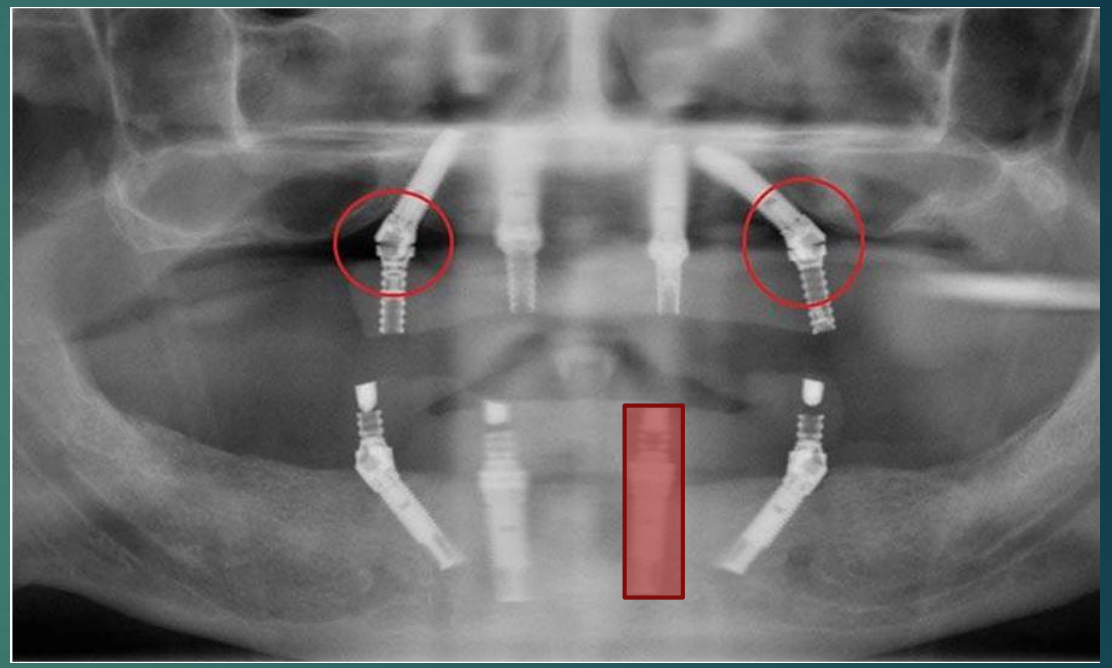
Low Risk (**L**)	<10%	6 Months
Moderate Risk (**M**)	10-20%	4 Months
High Risk (**H**)	**20-40%**	**3 Months**
Very High Risk (**VH**)	**>40%**	**2 Months**

How Does One Diagnose, Maintain or Treat An Implant-Abutment Misfit?

Attributable fractions, modifiable risk factors and risk stratification using a risk score for peri-implant pathology. M Nobre ….. **Paulo Malo … Jan 2017** Journal of Prosthodontic Research, Vol 61, Issue 1, 43-53.
https://www.for.org/en/treat/peri-implant-pathology-risk-assessment/take

What Are the Dentist-Patient Consequences of a Single Failed Implant?





Who Suffers?

Attributable fractions, modifiable risk factors and risk stratification using a risk score for peri-implant pathology.
M Nobre ….. **Paulo Malo** … **Jan 2017** Journal of Prosthodontic Research, Vol 61, Issue 1, 43-53.

How Big Is this Problem?

Katsoulis J et al., Misfit of implant prostheses and its impact on clinical outcomes.
Eur J Oral Implantol **2017**;10(Suppl 1):121-138

Vertical Misfit Values 95 to 232 µm

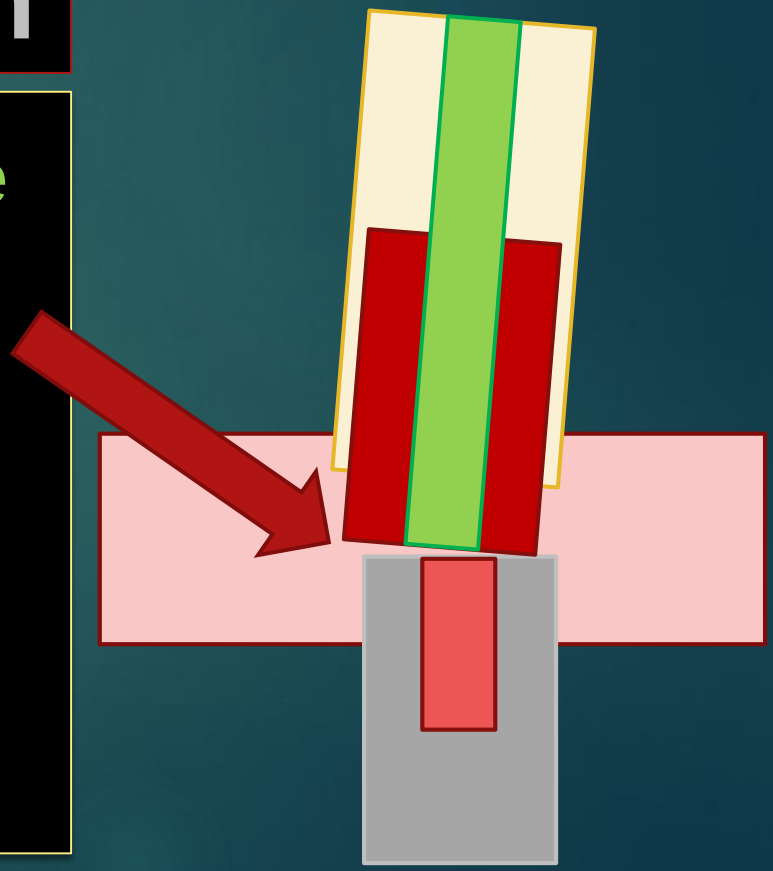
The current literature provides insufficient evidence as to the effect of misfit at the

Prosthesis-Implant Interface

on clinical outcomes of screw-retained implant-supported fixed dentures.

The present data do not imply that clinicians neglect good fit, but aim to achieve the least misfit possible.

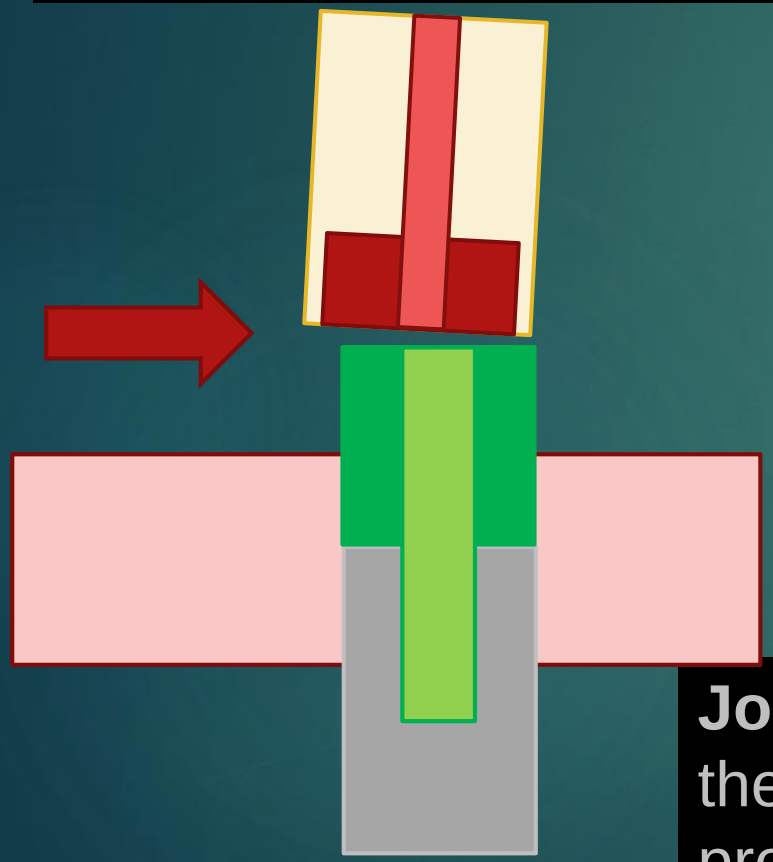
Screwed-in Crown & Bridge



Prosthesis Dimensional Error

Screw-Screw

Abutment-Prothesis Misfit



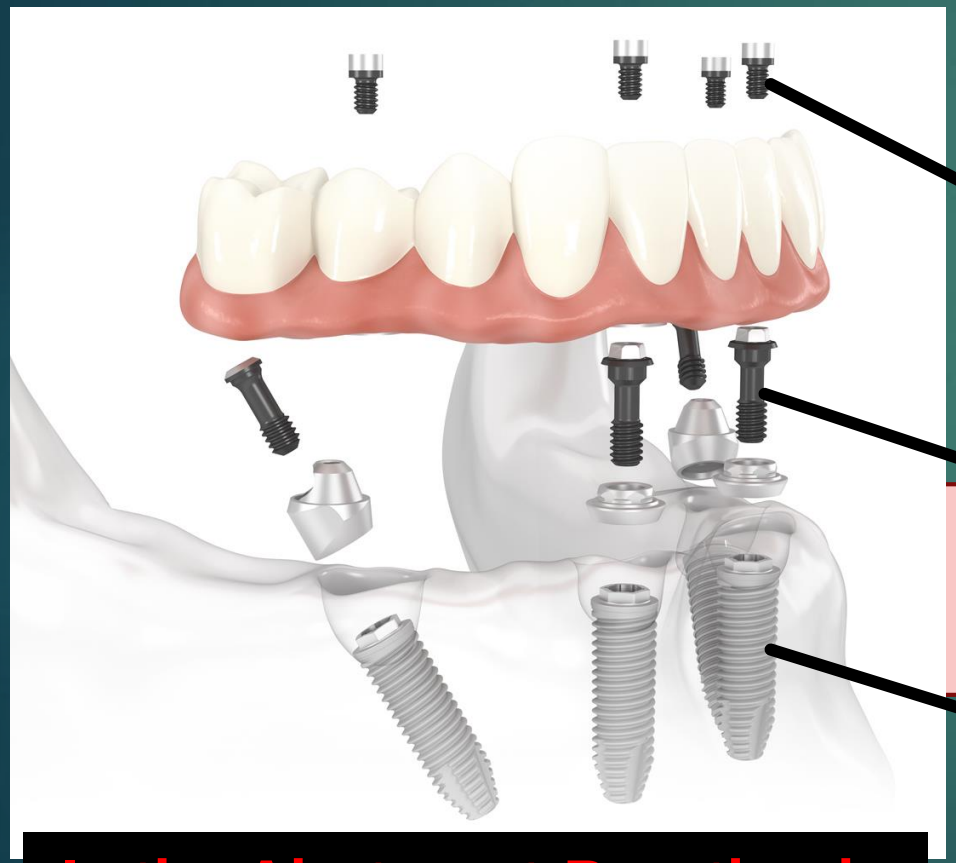
All-on-4

Conclusion: The effect of misfit between the superstructures on its supporting implants up to ~230 µm on the long-term clinical outcomes appears to be MINOR, apart from a slightly higher risk of screw-related adverse events.

Jokstad A, Shokati B. New 3D technologies applied to assess the long-term clinical effects of misfit of the full jaw fixed prosthesis on dental implants. **2015**; Clinicl Oral Implants Research 26(10):1129-1134

Prosthesis Dimensional Error

Jokstad A, Shokati B.



Is the Abutment-Prosthesis Misfit going Subgingival?

Screw-Screw

All-on-4

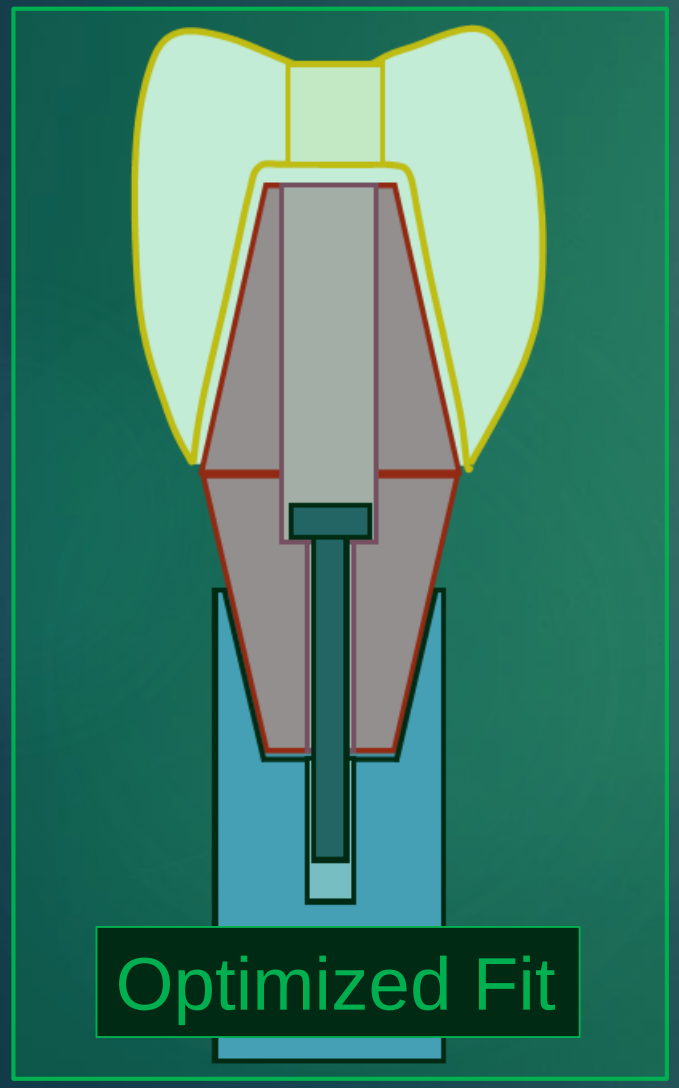
Abutment-Prosthesis Misfit

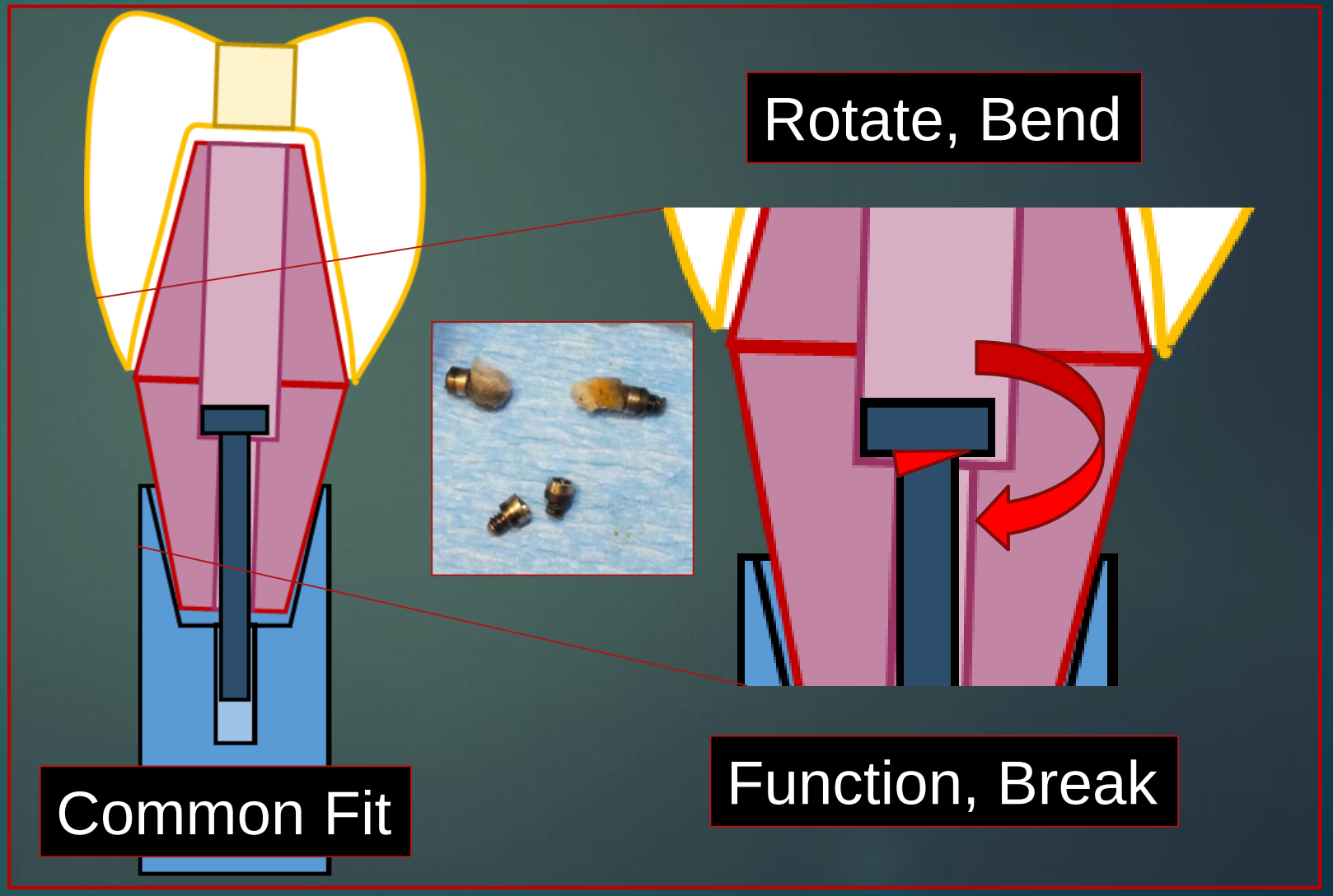
Screw

Crown & Bridge

Implant-Abutment Misfit

Failed/Broken Screws: When Components Don't Line Up



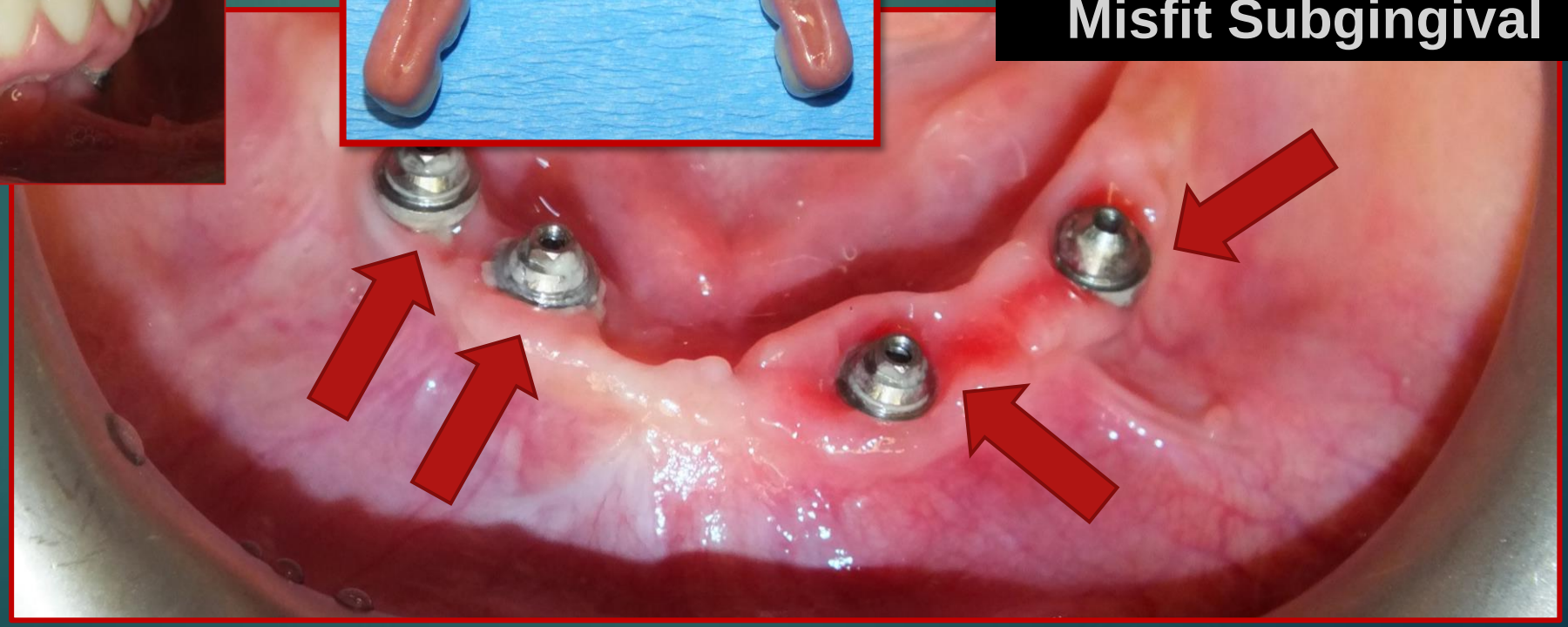


In Addition to A) Misfit: What Else is Causing Problems?

B) Stress Amplifiers on Components

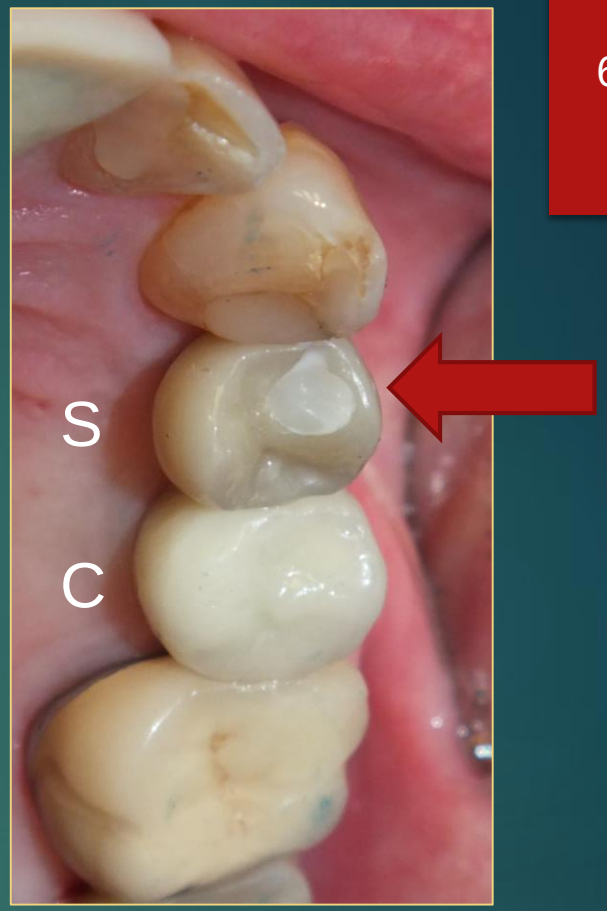
- Cantilevering to for Additional Teeth
- Cantilevering for Screw Access
- Heavy Functioning Patient

C) Does Blocking Access to Maintenance Matter?



Abutment-Prosthesis Misfit Subgingival

D) Like Dealing With Screw-Access-Holes?



- Access-Hole Maintenance
- Esthetics
- Occlusion

Patients with 4 or more implants were 15X more likely to have Peri-implantitis

77% of their Prosthetics were installed by the Screw-in Technique

Effectiveness of Implant Therapy Analyzed in a Swedish Population: Prevalence of Peri-implantitis. Derks et al. J Dental Research, **2016** Vol 95(1):43-49 **(588 patients with 2,277 implants)**

"NO Predictable Treatment of Peri-Implantitis"

Primary Prevention of peri-implantitis:
Managing of peri-implant mucositis

Jepsen S et al. J Clin Periodontol **2015**;42 (Suppl. 16) S152

Is Managing Mucositis Primary Prevention?
How Should We Do That?

Effective Implant Decontamination May Be the First Treatment Step …

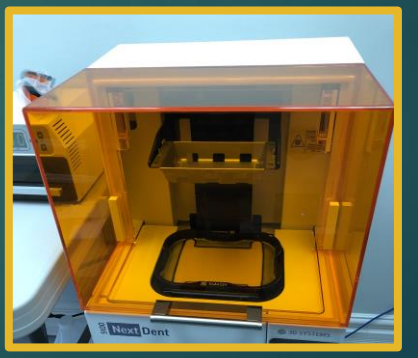
But … How Do We Fix Macrogaps?

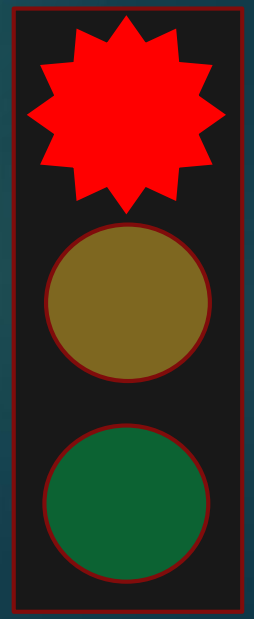
Has this Inaccuracy Problem Already Solved by Digital Technology?

Rutkūnas V et al., Accuracy of digital implant impressions with intraoral scanners. A systematic review. Eur J Oral Implantol. **2017**;10(Suppl1):101–120

In TOTAL: 1 *in vivo* and 15 *in vitro* studies.
The clinical study concluded that angular and distance errors were too large to be acceptable clinically.

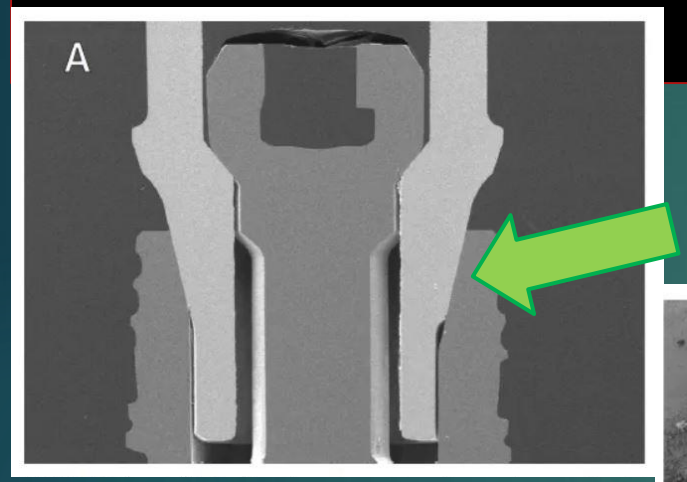
Conclusions: Data on accuracy of digital records, as well as accuracy of printed or milled models are of high relevance and are still lacking.

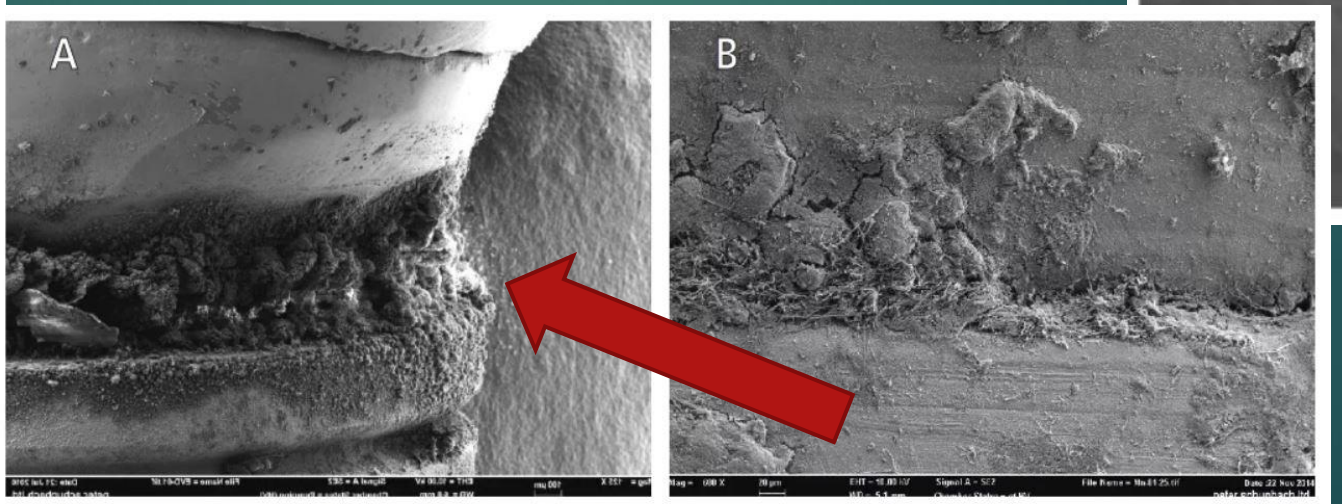




NO - Not Yet!

Implant Company: "Our Parts Are Made to Fit Great. Dentists Do Not Assemble Units Properly!"





FIGURES 6A and 6B. Microscopic views show a poorly adapted implant abutment connection interface on a failed implant (A). Poor adaptation allowed microbial growth (B), which had a negative impact on the implant treatment outcome.

Understanding Implant Abutment Connection Interfaces. *C Wadhwani,* April 11,2018 Implant Dentistry, Latest Features, Oral Surgery, Periodontics, Prosthodontics

Fatal Assumption
Model = Mouth

≠

Following their Installation Instructions
Will NOT consistently result in an Optimized Fit!

What Good are Great Parts When Dentists are Unable Optimize their Fit in the Mouth?

External Hex, Internal Hex
*** Conical with Platform Switch

Many Implant Companies make Great Conical Connections

Optimizing the Fit, Optimizes Mechanical & Biological Stability

Government Regulators Believe Joint Stability is Important

Manufacturers Research Predicts Performance of Optimized Connections Tested According to ISO 14801:2016 Standards

Shouldn't Dentists be able to Install Abutments According to Manufacturer's Specifications and Government Regulations?

A Solution Begins with

Understanding

Model ≠ Mouth

and

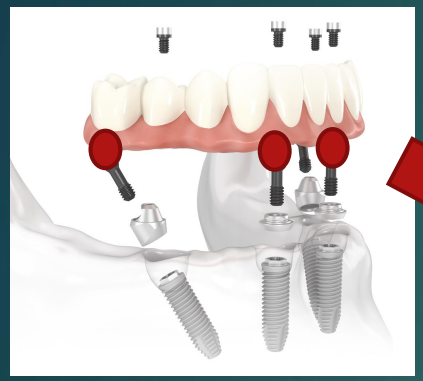
Building Tolerance for Error

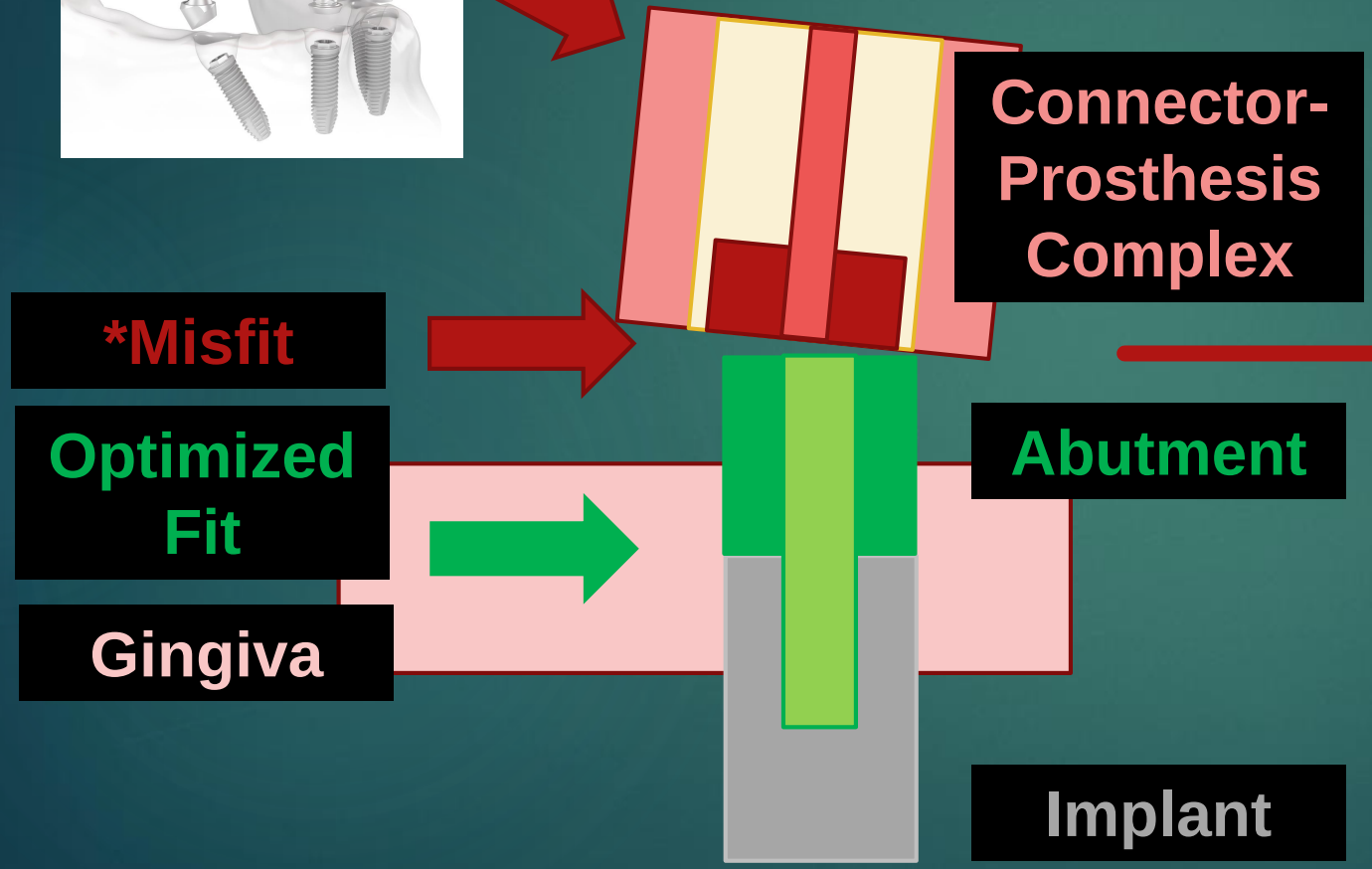
Today We Can Mitigate PDE …

To Prevent the Abutment-Prosthesis and Implant-Abutment Misfits

By a Simple Change!

Current Abutment-Prosthesis Misfit





Lab Model Dependent Fit Inaccurate

***Misfit may be Subgingival!**

Machined Parts 30X More Accurate

A Simple Change

Screw-in All Machined Components

Step 1

Prosthetic Connector

No Model Involved

Lute Prosthesis Intra-Orally

Step 2

Cemented Connector-Prosthesis Complex

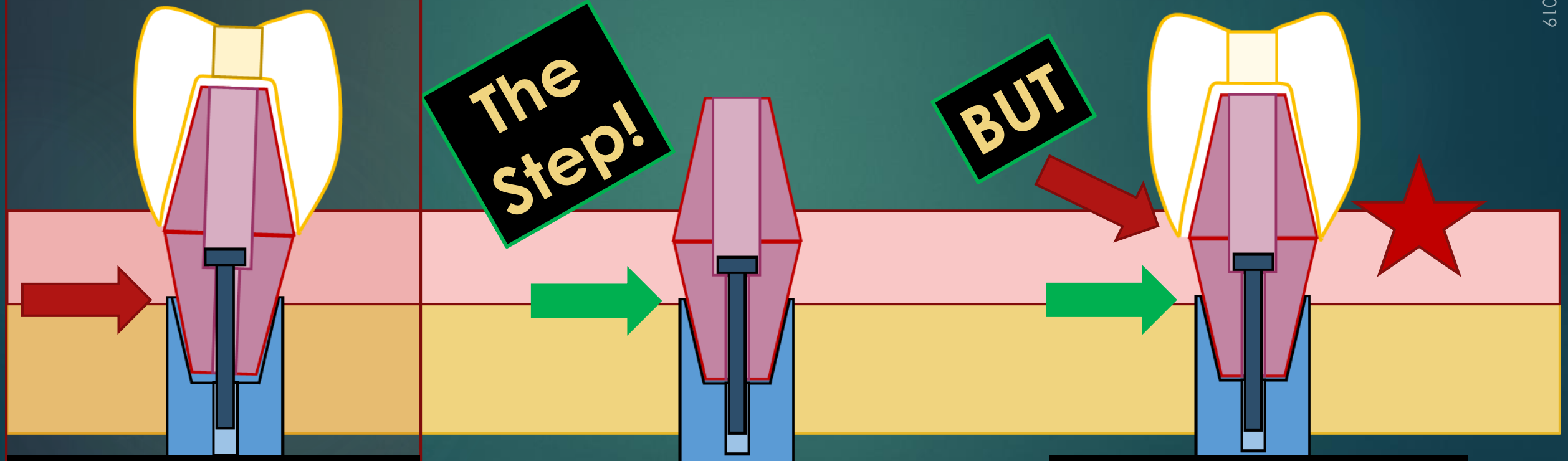
Pick it Up, Pick it Up The Svoboda Way

Optimized Implant-Abutment Fit

Current Screw-in Crown & Bridge

Screw-in Abutments Individually

Now Like Current Cement-in Crown & Bridge



Implant-Abutment Misfit

No Model Involved Optimized Fit

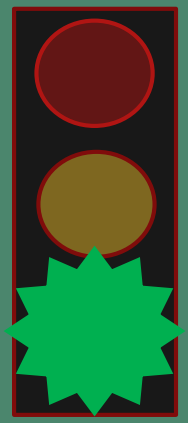
Margin & Cement Problems

Screw-in Misfits

Can Be Prevented By Installing Accurately Machined Components Into the Mouth With No Prosthesis Attached!

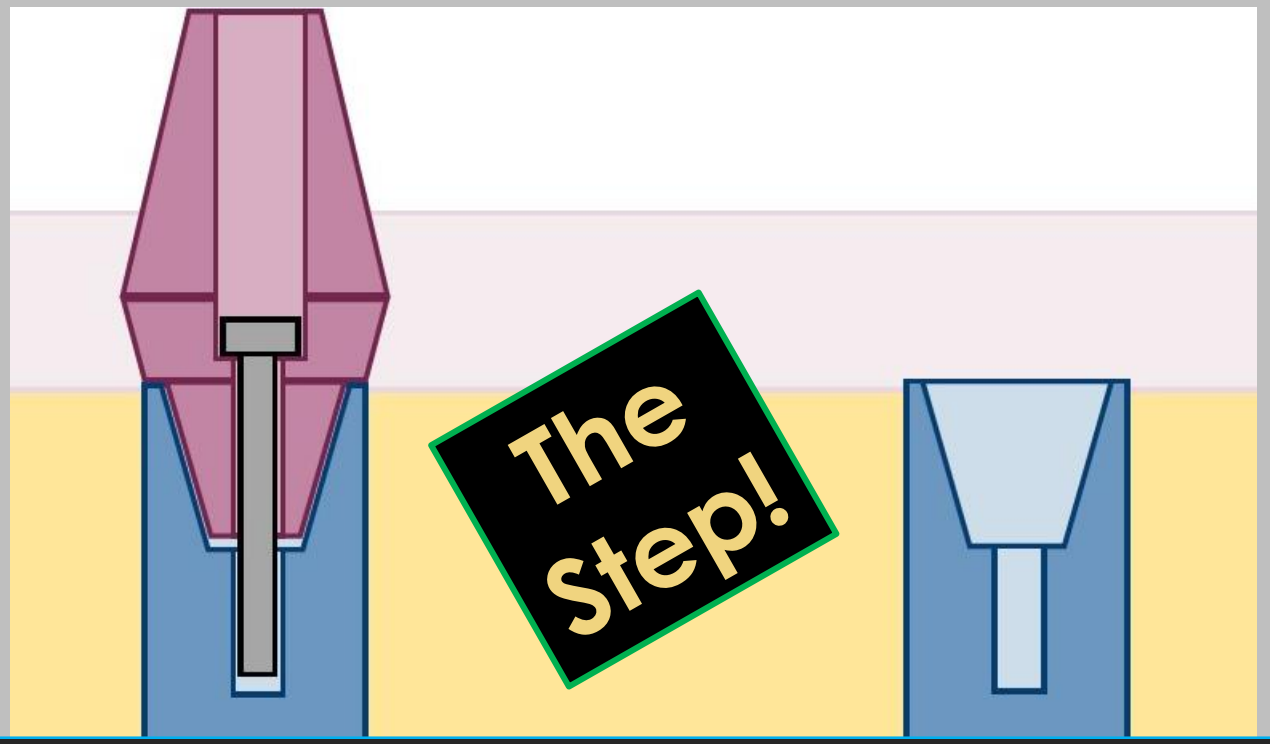
1

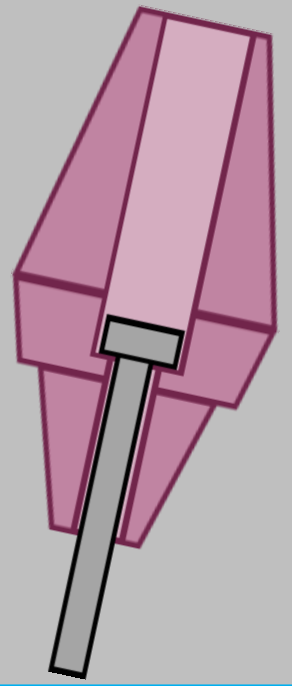
Now "The Steps" Make the Screw-in Prosthesis Installation Process Like the Cement-in Installation Technique



Optimized Machined Component Fits Can Be Achieved Routinely!

Protocol for Intra-Oral Cementation
Abutments Installed First!



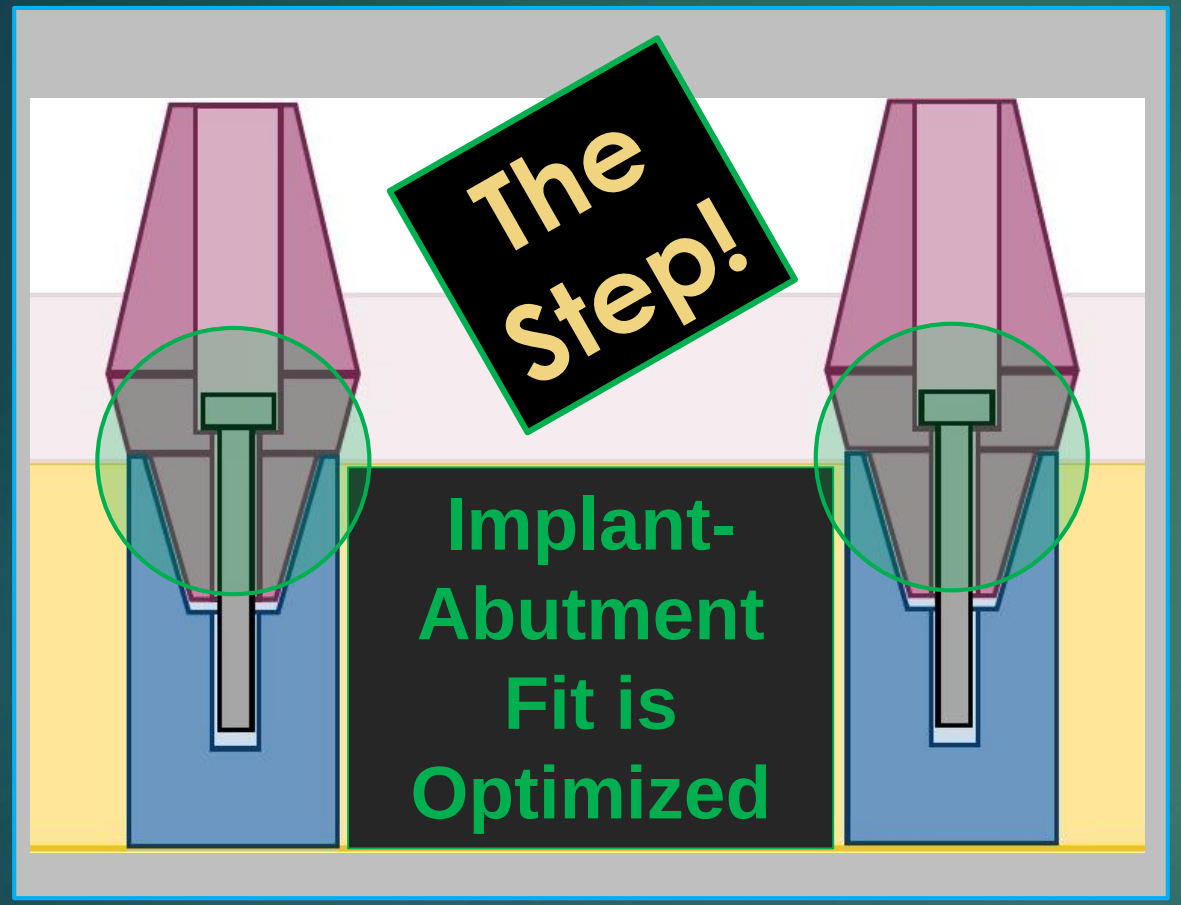


Parts Manufacturing Accuracy (±5 µm)

30X More Accurate

than Model Accuracy (±150 µm)

Current Cement-in Technique



The Behavior of these Connections Can be Predicted According to Manufacturer's Research Results

BUT, How Do We Safely

Attach the Prosthesis
to the Retainers Inside the Mouth
Preventing Poor Margins, Subgingival Cement & Cement VOIDS that can be Inhabited by Oral Pathogens?

These are Old Problems that Have Never Been Solved For Teeth or Dental Implants

Is Intra-oral Cementation Just A Big Can of Worms?

Did You Know that Prosthodontists in a University Setting Restoring Implants Left Subgingival Cement 60% of the Time?

Why Does this Happen? Is Our Understanding of this Common Dental Process Deficient and/or Flawed?

Korsch M, Obst U, Walther W. Cement-associated peri-implantitis: a retrospective clinical observational study of fixed implant-supported restorations using a methacrylate cement. Volume 25, Issue 7, July 2014, pgs 797-802

Let's Find the Root Causes of Residual Subgingival Cement

What do we understand about intra-oral cementation? It is a hydraulic event.*

Excess cement can be:

1. difficult to control**
2. deep in the subgingival spaces*,**
3. difficult to detect and remove**
4. a risk factor for periodontitis & peri-implant disease***
5. removed by endoscopic or surgical means***

*Cementation in Dental Implantology. An Evidence Based Guide. Edited by Chandur P.K. Wadhwani. Published by Springer 2015.

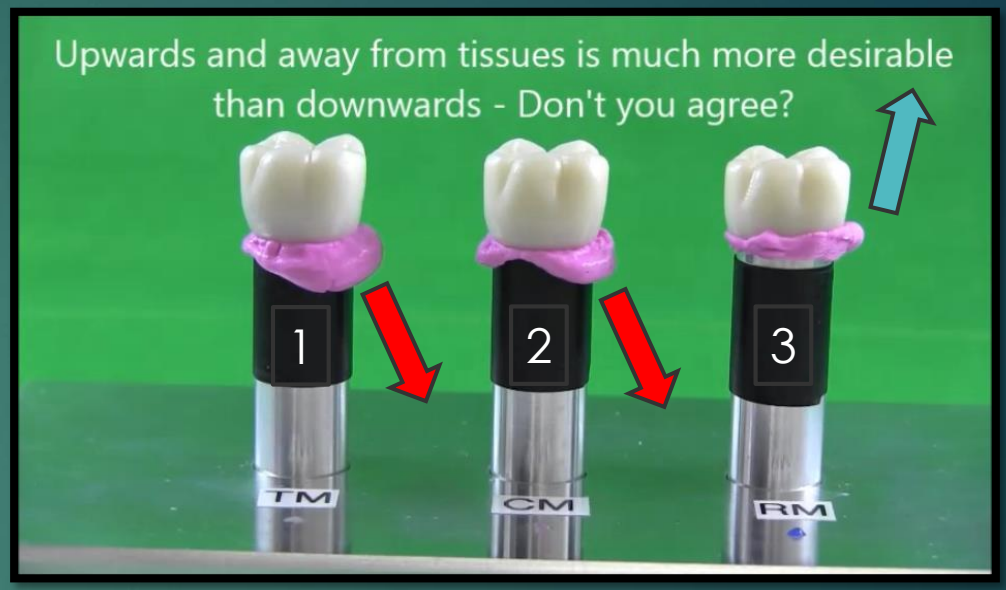
**The Influence of the cementation margin position on the amount of undetected cement. A prospective clinical study. Tomas Linkevicius et al. Clinical Oral Implants Research. Vol 24,Issue 1, 71-76, Jan 2013.

***Thomas G Wilson Jr. The Positive Relationship Between Excess Cement and Peri-implant Disease: A Prospective Clinical Endoscopic Study. J. Periodont 2009;1388-1392

Effects of Margin Design on Flow of Excess Cement

Watch the Video at www.ReverseMargin.com

Effects of Margin Design on Flow of Excess Cement



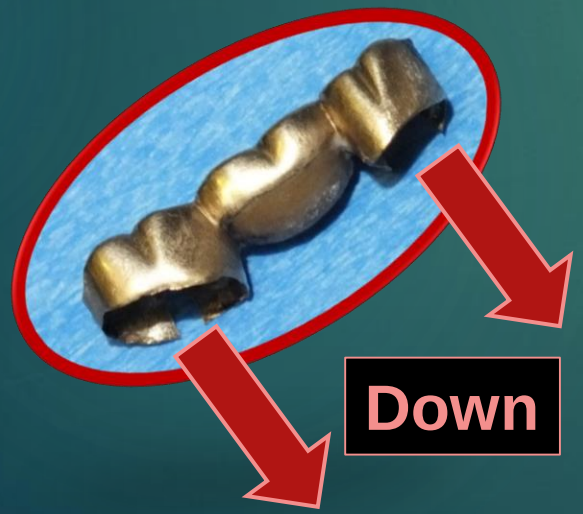
Arrows Indicate Margin Slope
1) Tapered
2) Chamfer
3) Reverse Margin

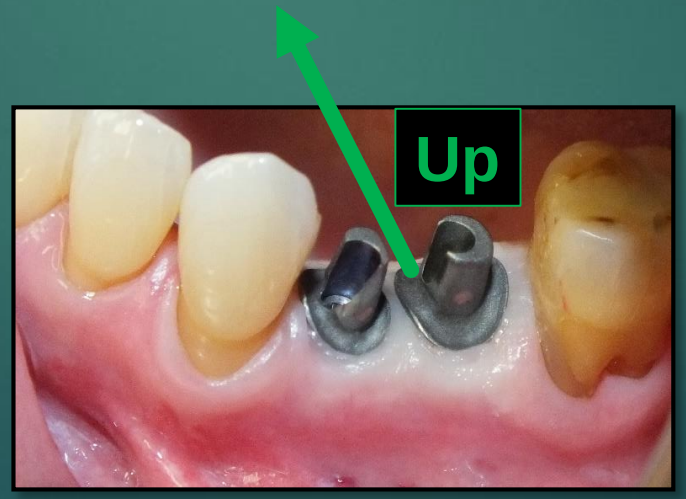
Arrows Indicate Cement Flow
1) Tapered - Down
2) Chamfer - Down
3) Reverse Margin - Up

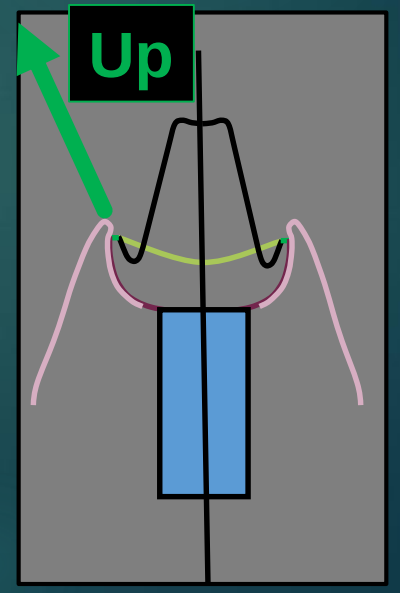
Watch the Video at www.ReverseMargin.com

Margin Design Effects the Direction of Cement Flow!

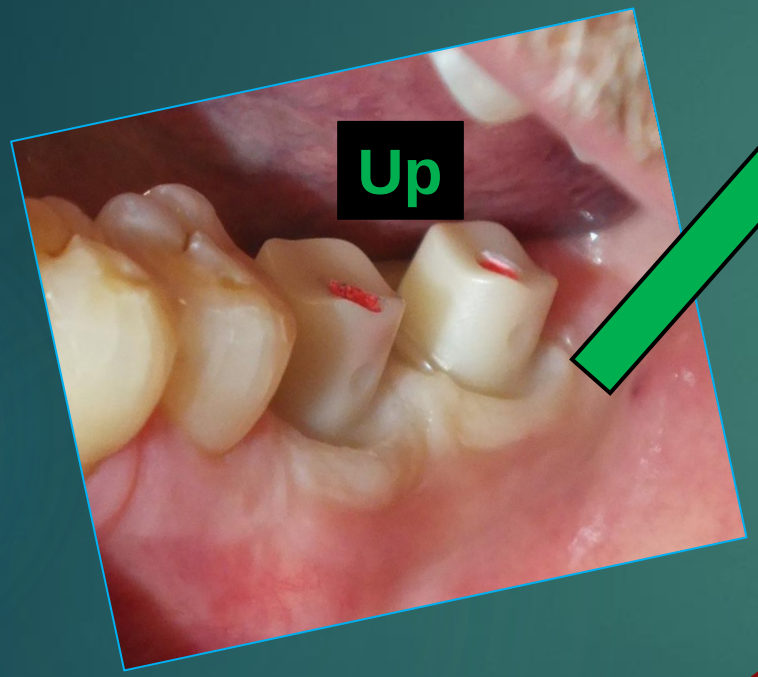
Why Choose Margin Designs that Direct Excess Cement into Tissues??



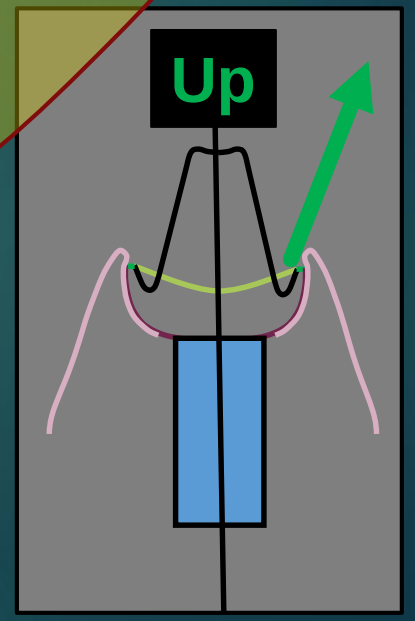




This Super Margin Design Can Move Excess Cement …



Up Up & Away!



“Gingival Effects” Discovered

When “Gingiva” was Present, Excess Cement was Projected Under the Gingiva, Regardless of Margin Design!

Svoboda ELA. Controlling Excess cement During the Process of Intra-oral Prosthesis Cementation: Overcoming the Gingival Effects. OralHealth, Oct 2015; 52-66.

The “Gingival Effects” can Increase the Problem of Subgingival Cement

Watch the Video at www.ReverseMargin.com

The "Gingival Effects" can Increase the Problem of Subgingival Cement

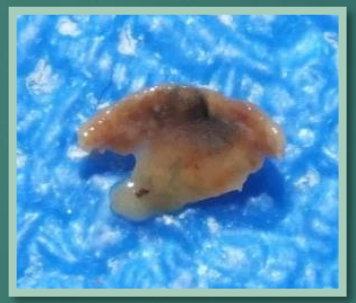
Three Margin Designs
1) Tapered
2) Chamfer
3) Reverse Margin
Clear Tygon Tubing Simulates Gingiva

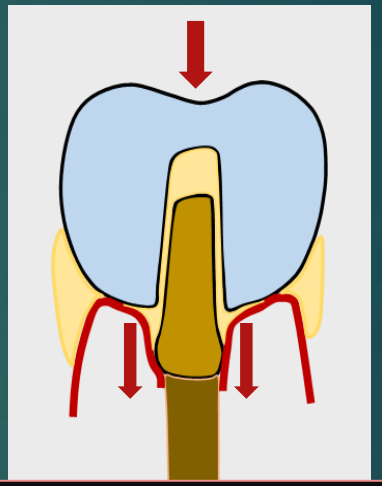
Regardless of Margin Design, excess cement became trapped by a gingiva-crown seal during installation and was forced DEEP into the Subgingival Environment

Watch the Video at www.ReverseMargin.com

The Gingival Effects on Cement Flow Can Be HUGE

They include the 1) Deflection Effect, 2) Eddy Effect, 3) Plunger Effect, 4) Bellows Effect 5) …

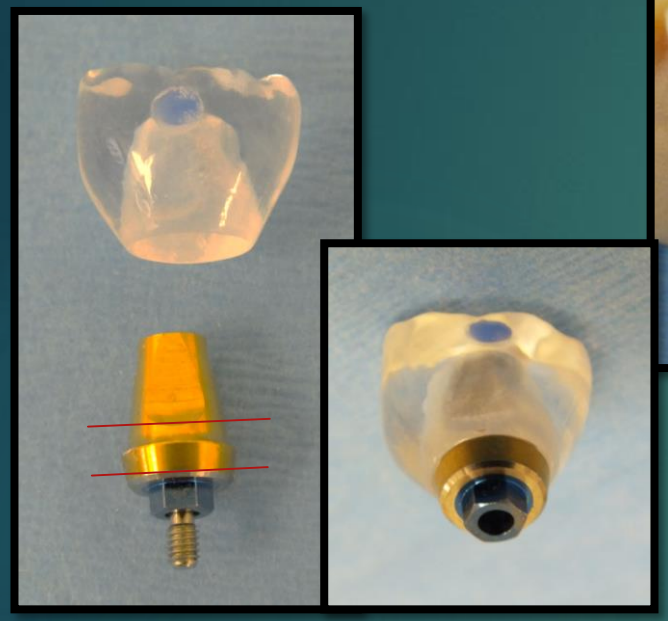


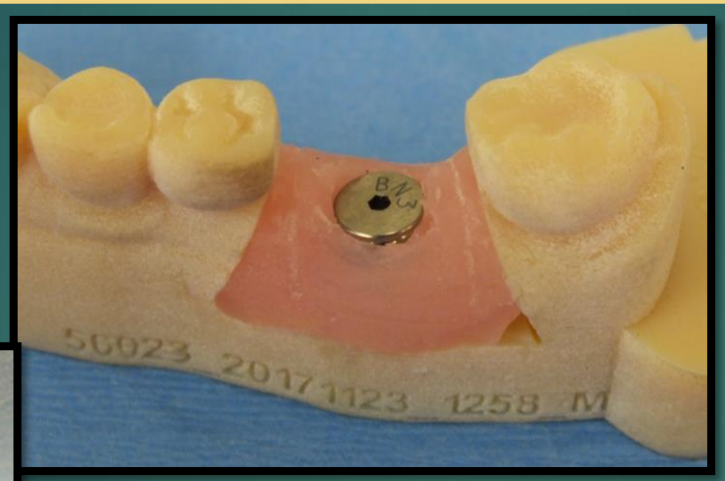


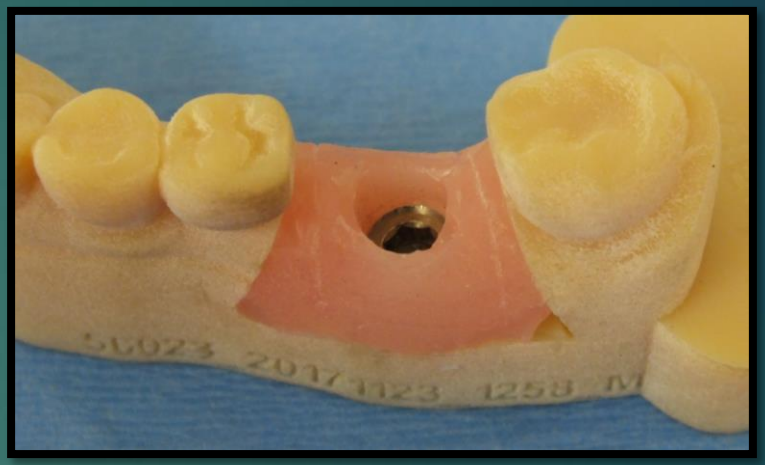
Narrow Abutments with Wider Profile Crowns are the Worst! We All Need to Understand Why!

ELA Svoboda. Controlling Excess Cement During The Process of Intra-oral Prosthesis Cementation: Overcoming the Gingival Effects. OralHealth Oct 2015;52-66 and at www.ReverseMargin.com.

Lab Experiment
Stock Abutment & the Gingival Effects

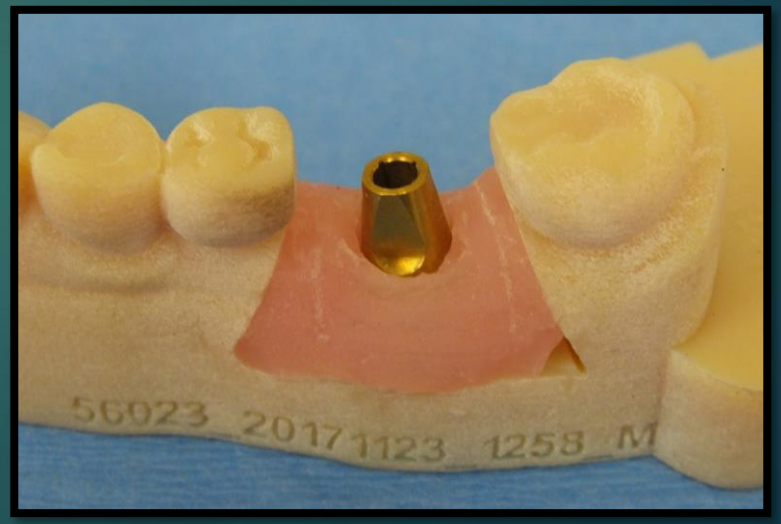






Excellent Fit of Solid Crown on Abutment

3 mm Cover

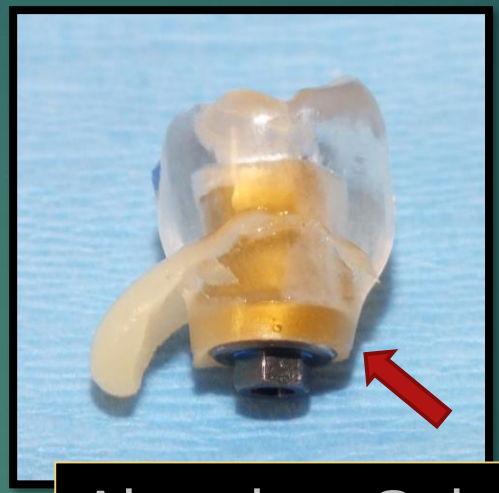


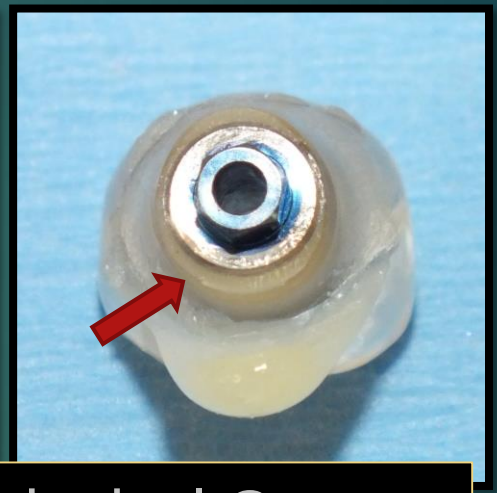
This and other experiments shown are easy to reproduce and were done many times with consistent Results

Gingival Effects Can Cause Abundant Subgingival Cement

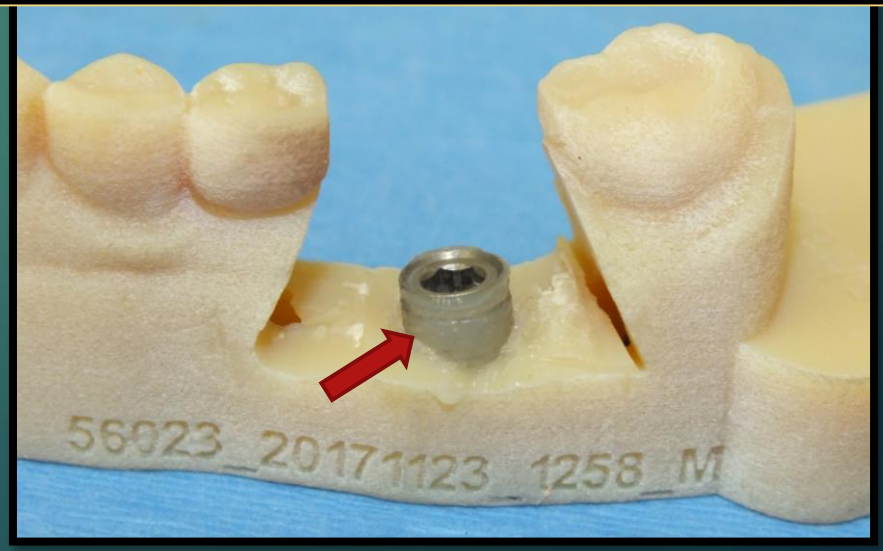
Cemented

Access Hole Drilled For Crown Removal



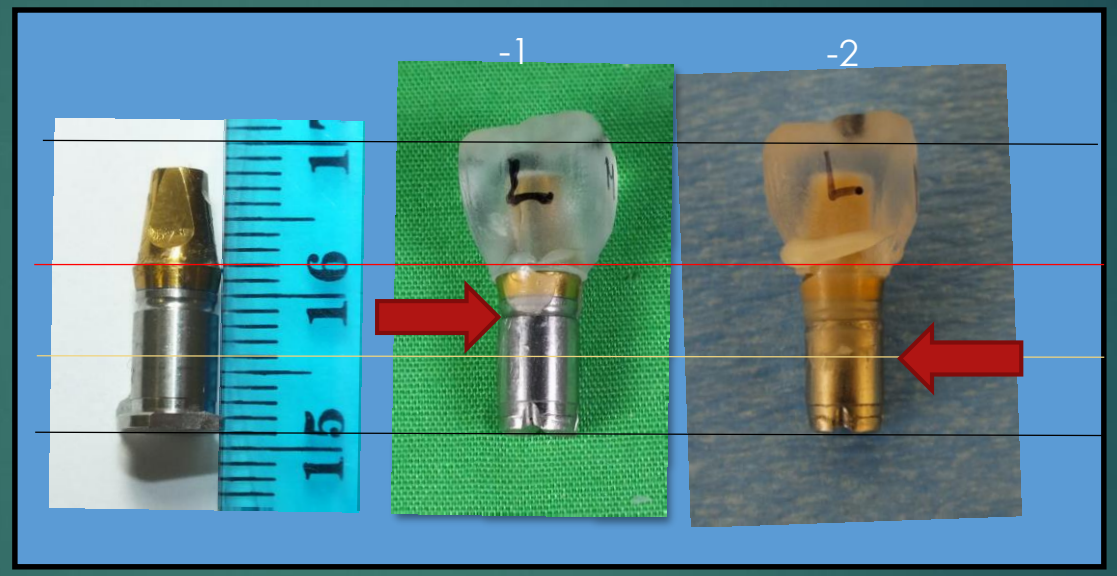


Abundant Subgingival Cement



100% of 20 Trials
Abundant Sub-Marginal Cement
& Open Margins*

Lingual Abutment Margin



Distance of Cement from Gingival Margin

-1 mm **average 4.5 mm**, range 3.6-5.2 mm

-2 mm **average 6.3 mm**, range 5.2-8.0 mm

T-1≠T-2, P 0.01, Mann Whitney U Test

Clinical Experiment #1: Stimulating the Gingival Effects

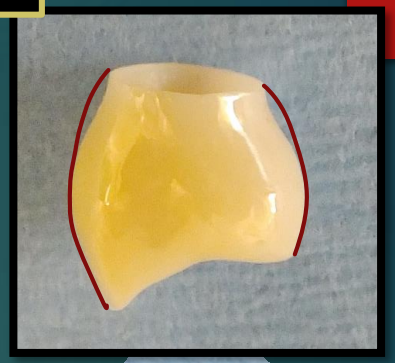
Biting Force to Seat Crown

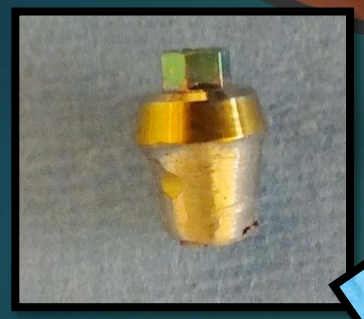
Excellent Fit of Crown on Abutment

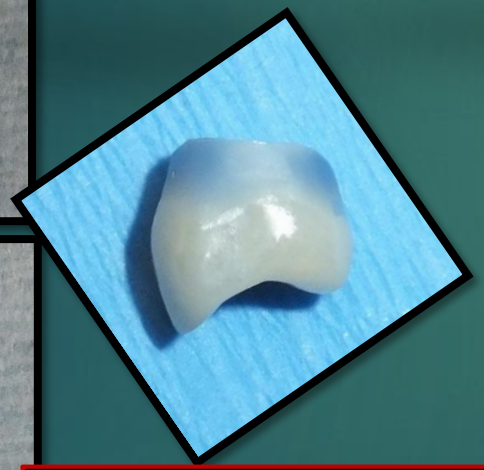
Abundant Residual Subgingival Cement

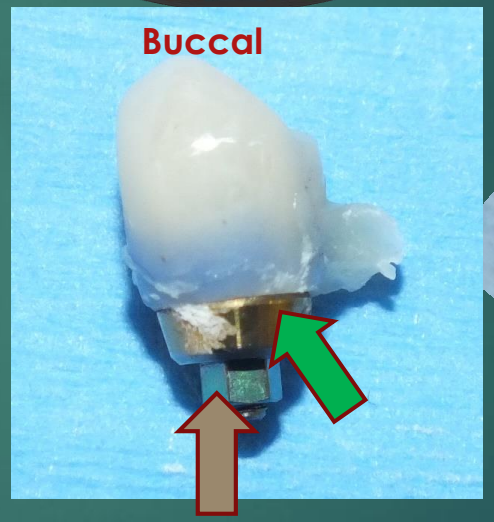
Wide Crown and High Seating Force Can Cause Subgingival Cement

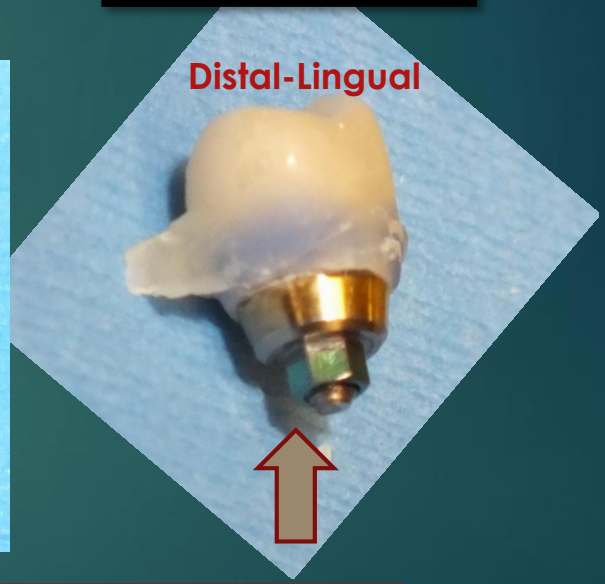
Clinical Experiment #2











Gingival Effects Can Cause:

1) **Open Margins**
2) **Residual Subgingival Cement**

Residual Subgingival Cement & Open Margins

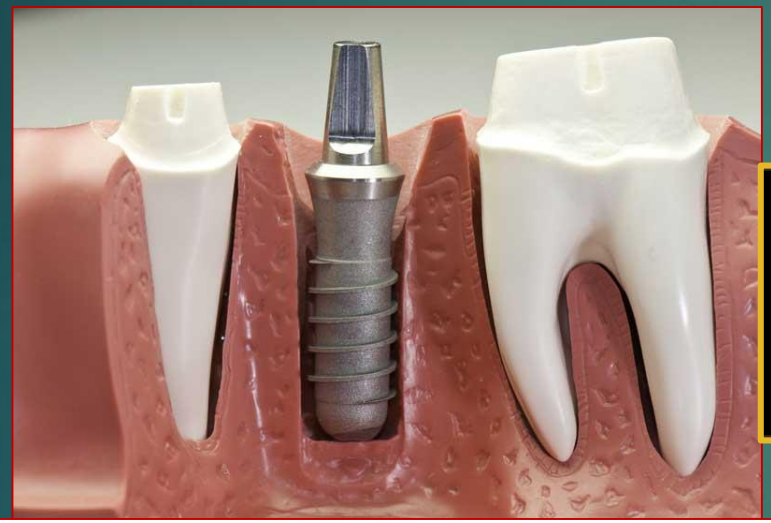
(Gingival Resistance to Displacement by Crown?)

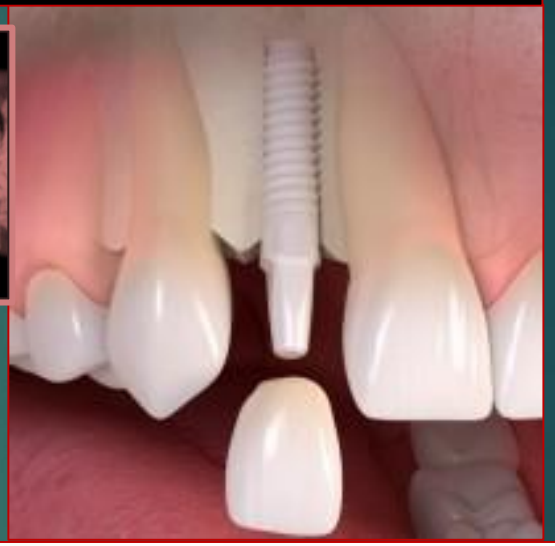
Do subgingival tissue fluids displace cement from margins?

Are Stock Abutments Safe for Intra-oral Cementation? Not With Subgingival Margins!

Every Implant Company Sells Stock Abutments Because Dentists Still Buy Them

Product Use Depicted in these Cartoons Are Not Designed for Safe Intra-oral Cementation!





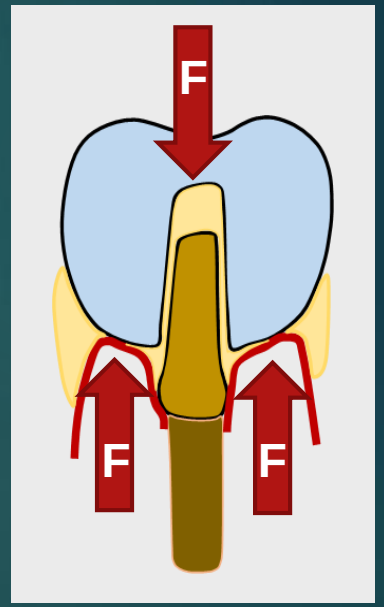
Replacement of multiple teeth with an implant-supported bridge – Adjacent natural teeth remain intact, and bone is preserved over time.

New

Gingival Effect #5
"Resistance to Displacement Effect"

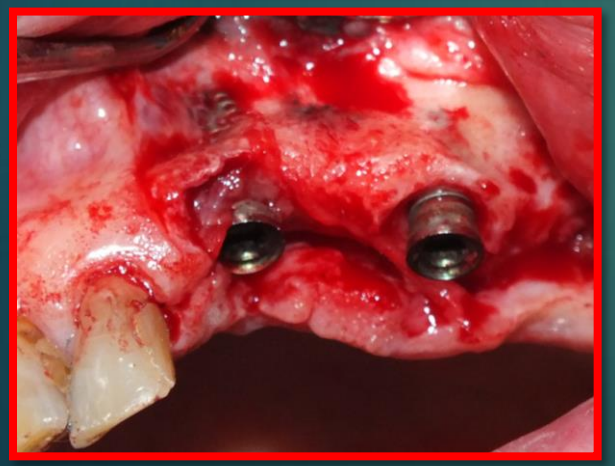
Can Cause the "Dreaded Open Margin"

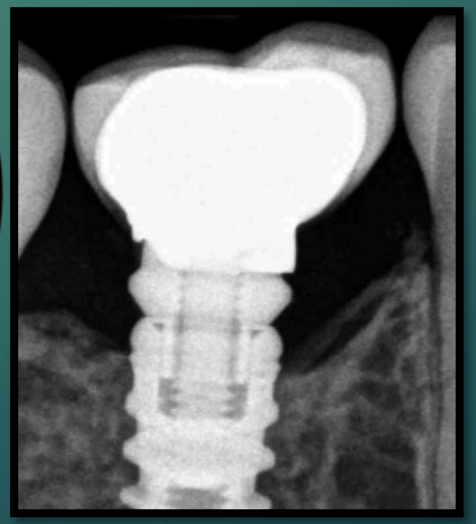
Stiffer Gingiva Can Further Increase Subgingival Cement

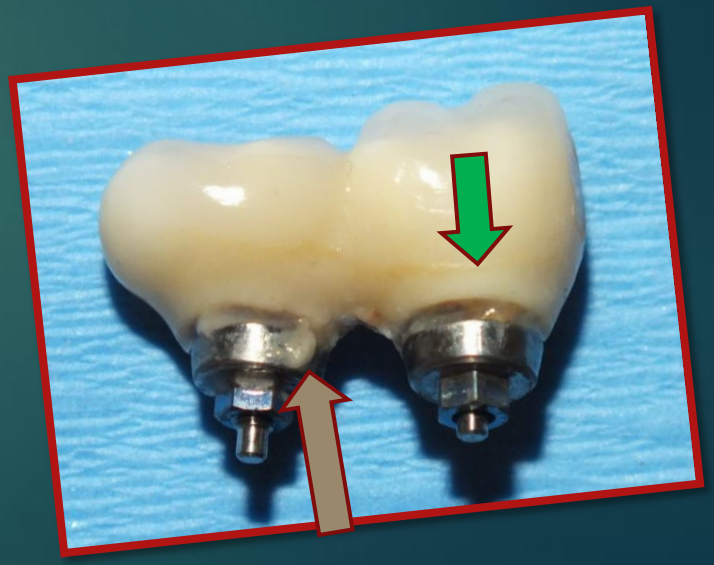


ELA Svoboda. Controlling Excess Cement During The Process of Intra-oral Prosthesis Cementation: Overcoming the Gingival Effects. OralHealth Oct 2015;52-66 and at www.ReverseMargin.com.

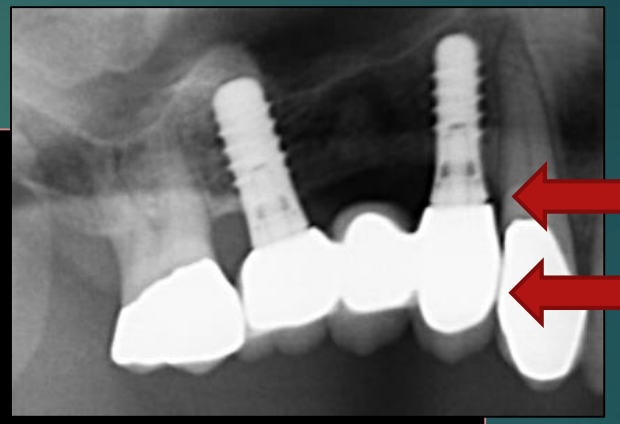
Residual Subgingival Cement & Open Margins Are Common Complications







Causing Open Margins



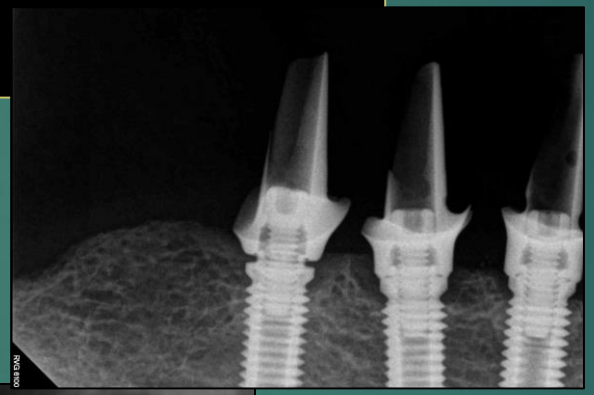
Prosthesis Dimensional Error

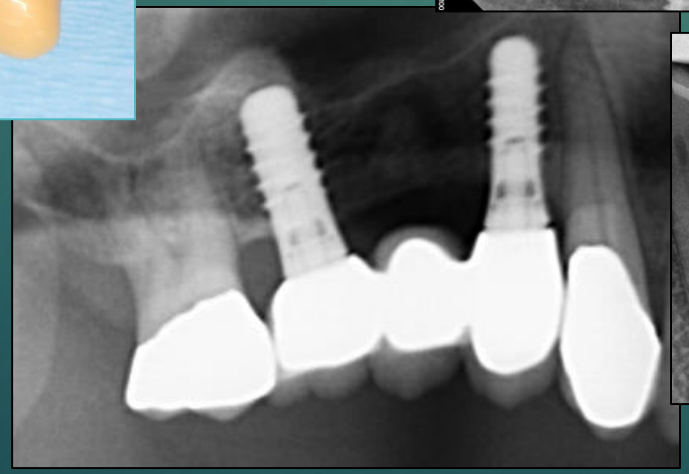
a) Tight Contacts
   i. Adjacent dental units
   ii. Adjacent retainers
b) Inadequate Cement Space
   i. Cause binding of prosthesis on retainer
   ii. Allow excess cement to exit prosthesis

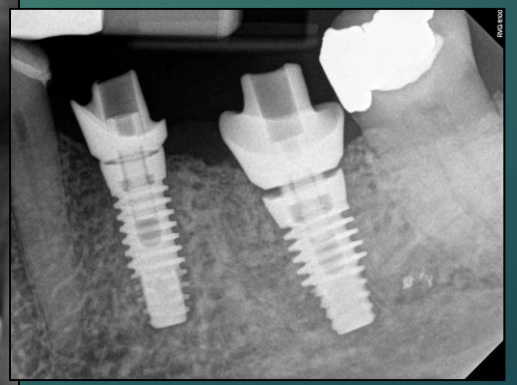
Causing Open Margins

Tissue Effects (Hard & Soft)

a) Resistance to displacement
b) Tissue impingement

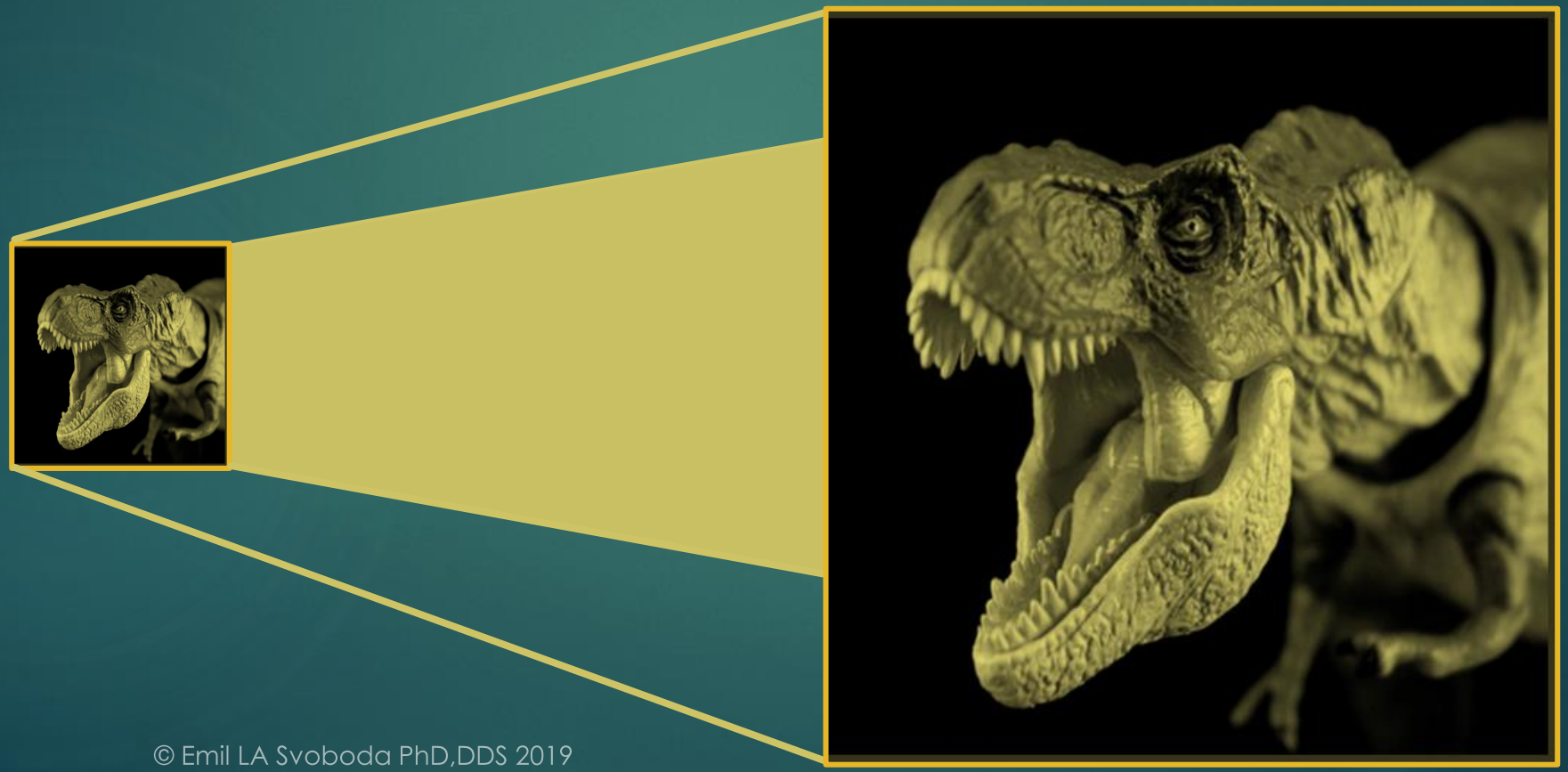






Gingiva
Tissue Fluids
Bone
Tooth

Gingival Resistance to Displacement Increases as it Approaches Bone and Adjacent Teeth



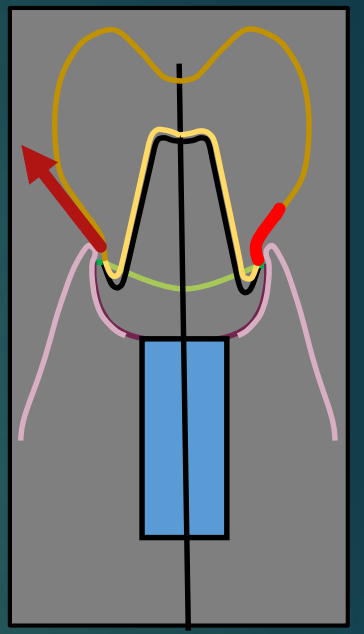
The Gingival Effects

2

Are a Root Cause of Complications (Subgingival Cement, Open Margins) Common to the Cement-in Technique

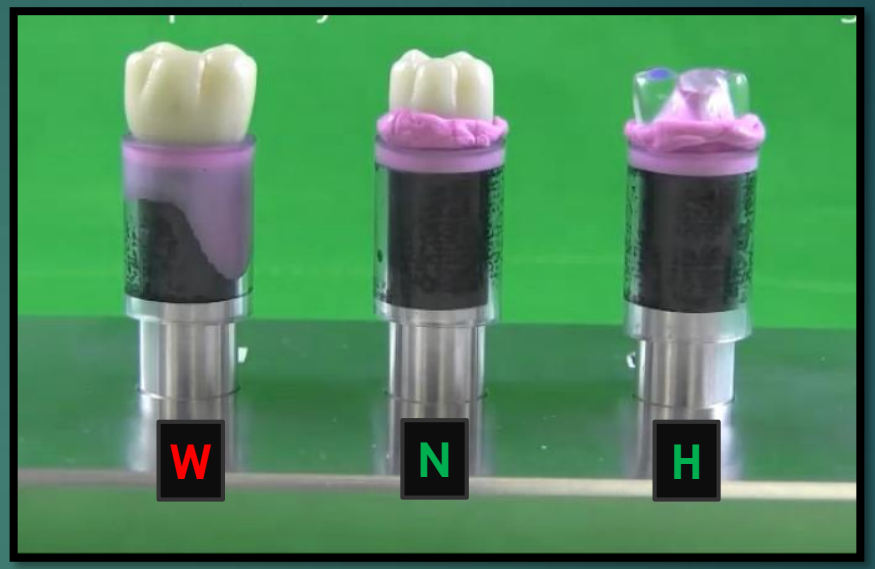
New

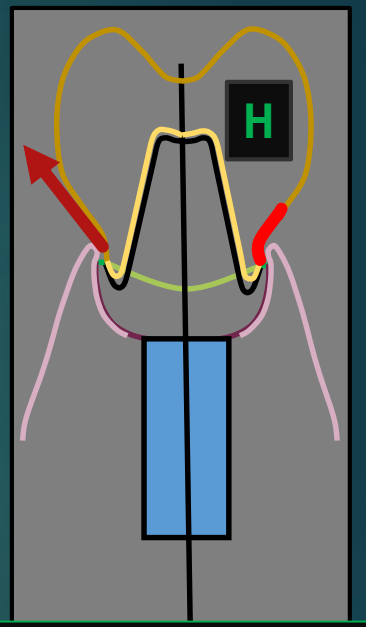
Overcoming the “Gingival Effects” by Prosthesis Design



Watch the Video at www.ReverseMargin.com

New Overcoming the "Gingival Effects" by Prosthesis Design

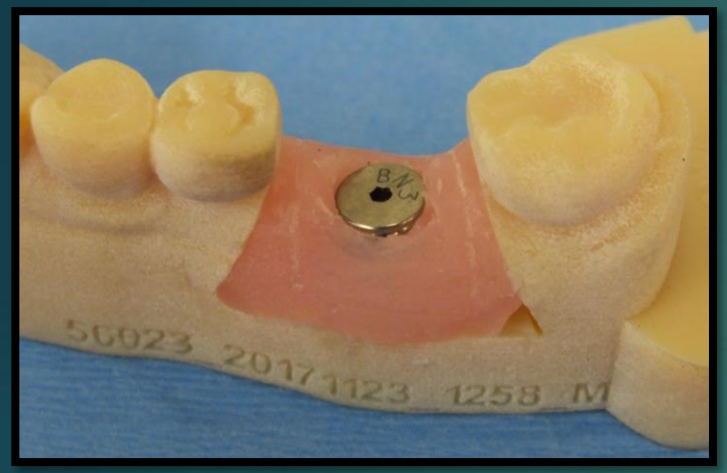




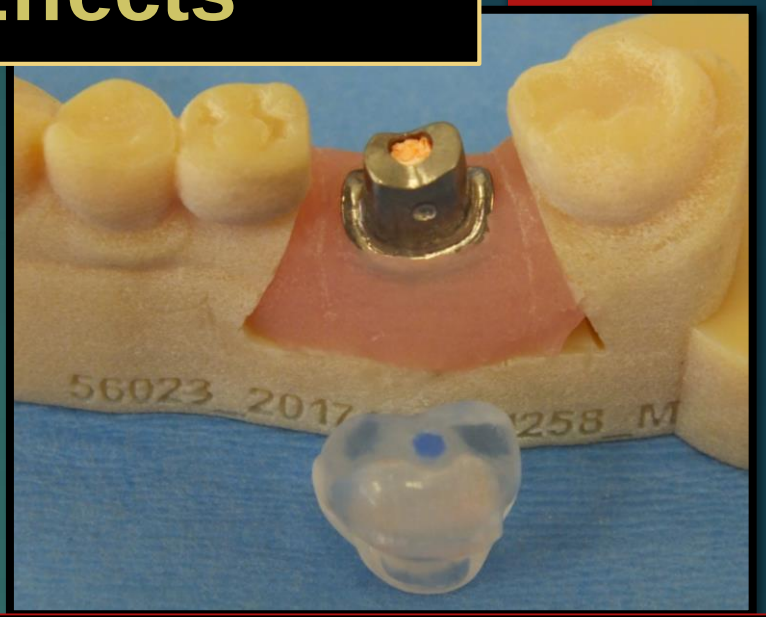
All Rods have Reverse Margins, Crowns Shapes are Wide, Narrow and Hybrid
The W is wider than the adjacent gingiva. N has a space between the gingiva and crown, and the H is like N but transitions to a W shape above the gingiva
W Causes SubMarginal Cement but N and H do not!

Watch the Video at www.ReverseMargin.com

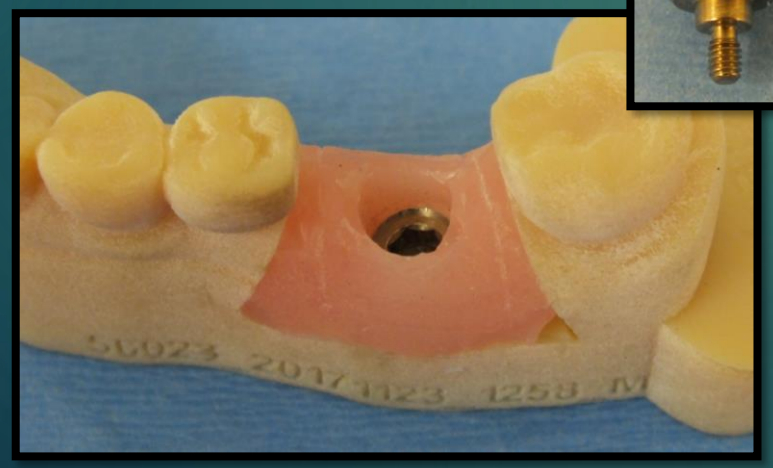
Lab Experiment #2: Custom Abutment & Crown Designed to Mitigate the Gingival Effects



3 mm Cover



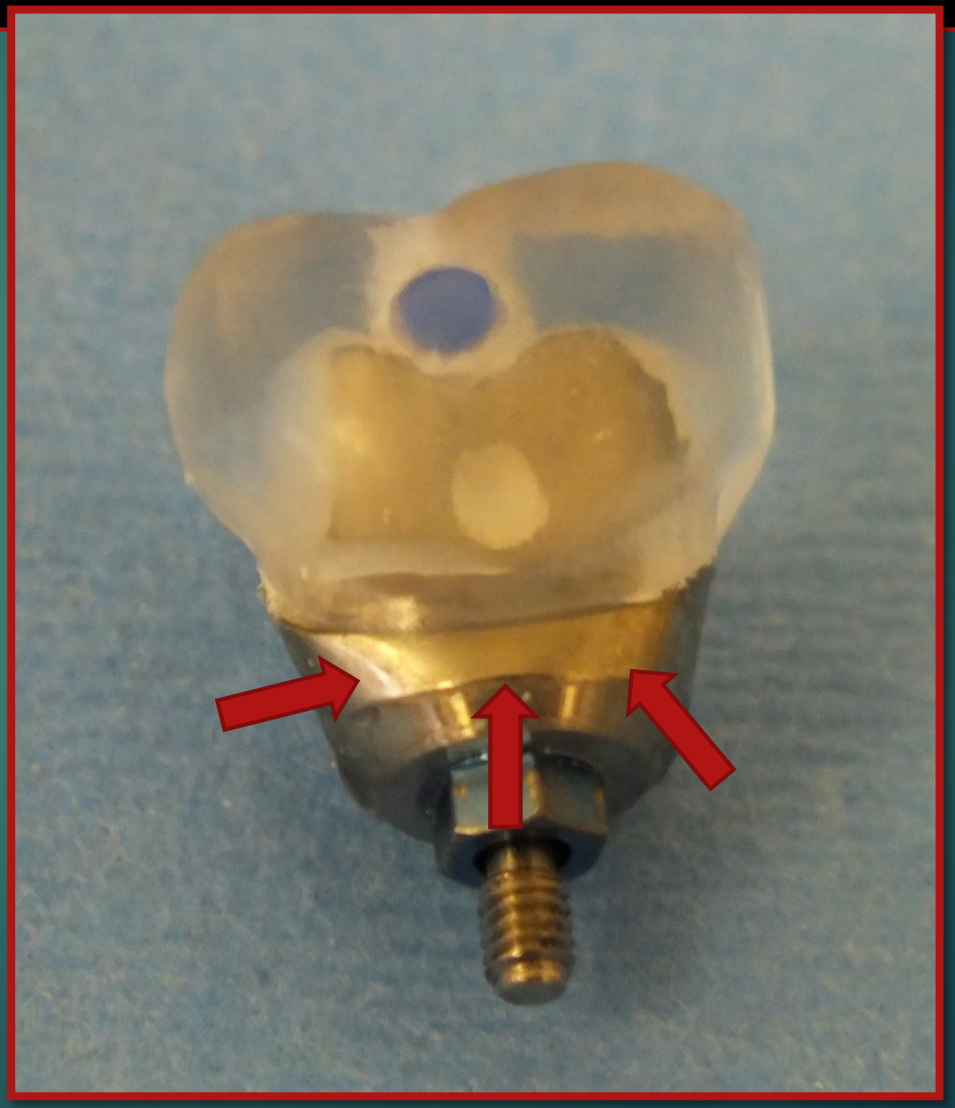
Margin 1 mm Subgingival



Crown in Place

Taut Gingiva Stretched Over Top of Abutment Margin Interacted with Crown Base

Some Cement Went Beyond Abutment Margin in Spite of Margin Design!



170112

Buccal Margin 1 mm Under Gingiva

All Reverse Margin Abutments - No Open Margins

Not Trimmed
All Have
Sub-Marginal Cement

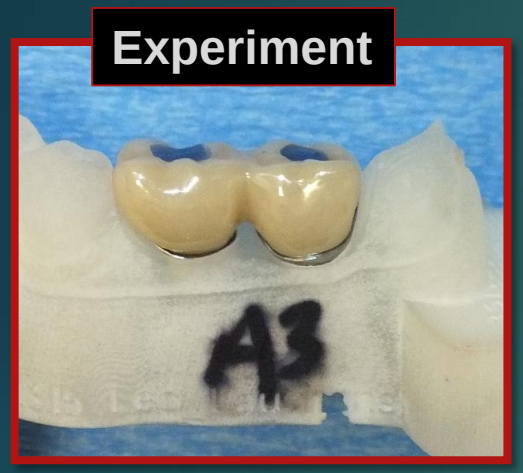
Trimmed
None Have
Sub-Marginal Cement

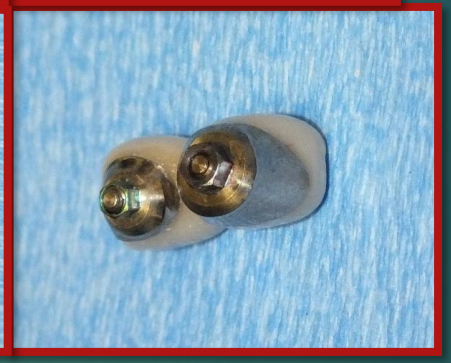
"With External Cement Vent" – No Sub-Marginal Cement

Experiment #5 – Two Splinted Crowns

Margins Subgingival on Buccal

Clinical Experiments

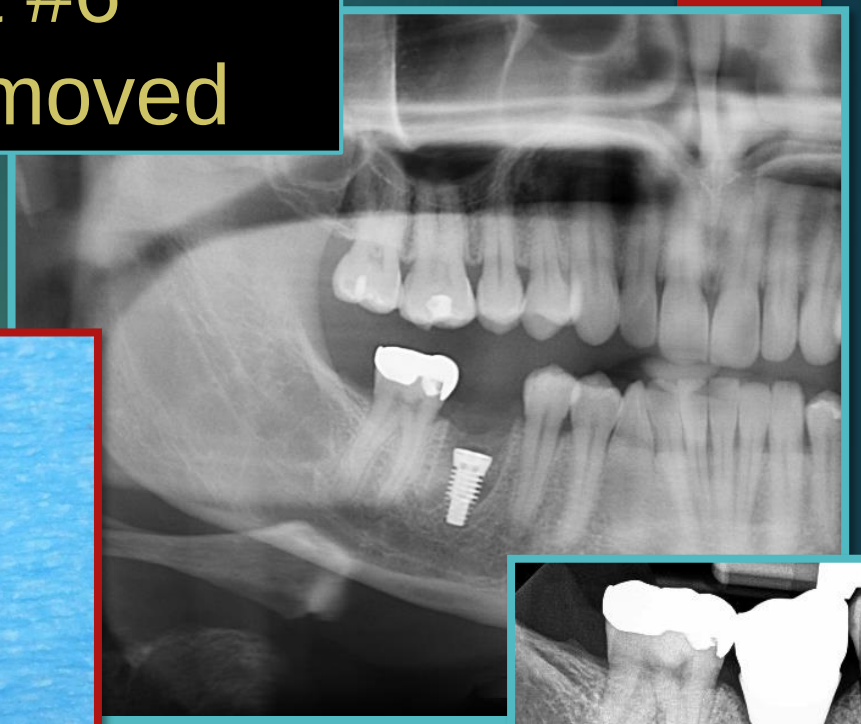




Gingiva Does Not Interact with the Prosthesis – By Design

Mitigating the Gingival Effects
No Sub-Marginal Cement, No Open Margins

New Version Experiment #6
Expressed Cement Not Removed



Gingiva Does Not Interact with the Prosthesis – By Design

1) No Cement Beyond Margins
2) Optimized Implant-Abutment Connection
3) The Cemented Crown was Retrievable

These Safer Designs are Not Limited to Particular Materials

We Can Now Prevent

The Gingival Effects By Moving the Gingiva Out of the Way By Abutment-Prosthesis Design

2

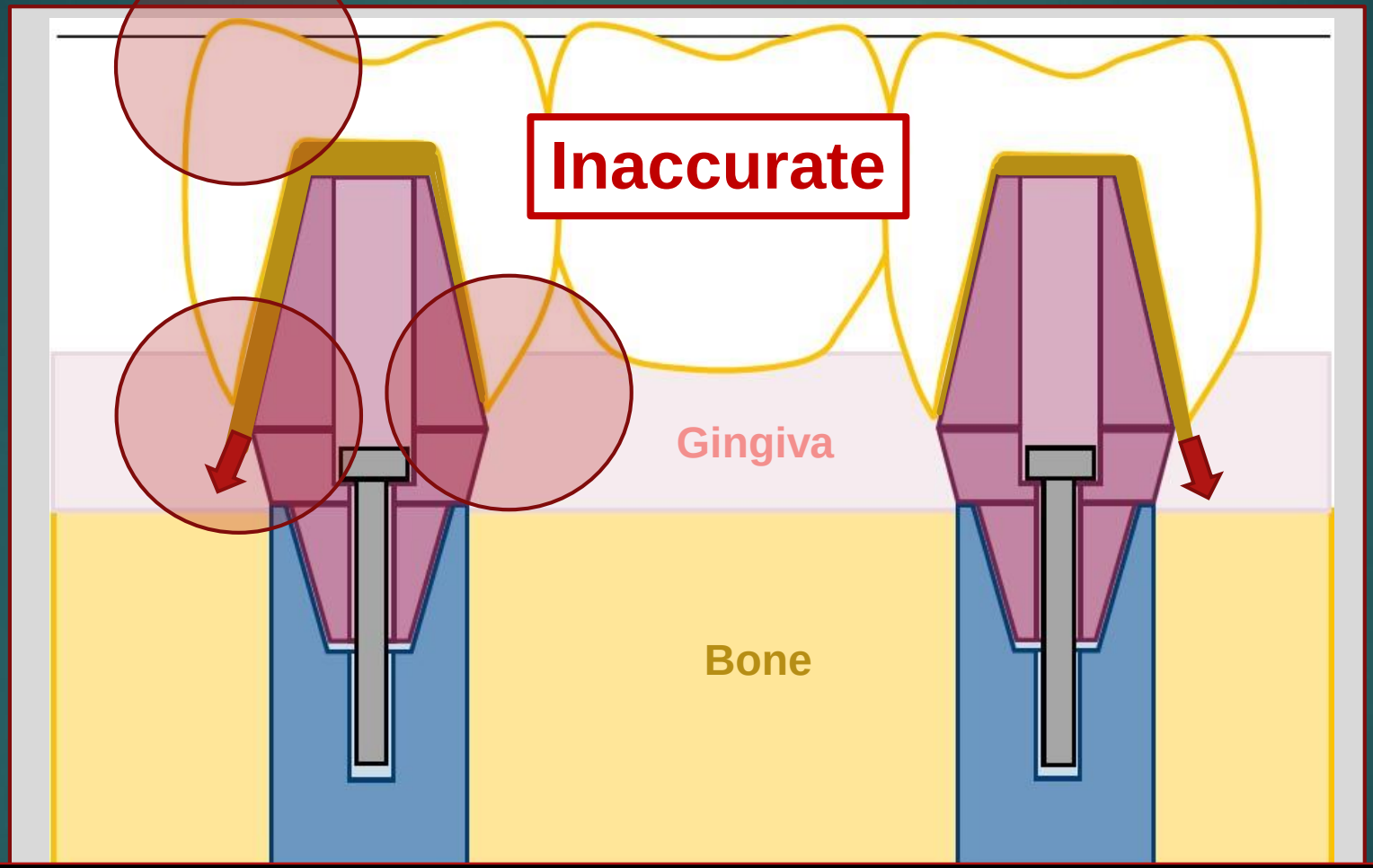
BUT!

Prosthesis Dimensional Error

3

Is also a Root Cause of Multiple Risk Factors Common to the Cement-in Technique

Prosthesis Dimensional Error Can Cause:



Poor Contacts, Hyperocclusion, Submarginal Cement, Overhanging, Overextended, Open Margins

Relationship of Residual Excess Cement to Peri-implant Disease

34 / 42 diseased implants (81%) had subgingival cement

After cement removal 25 of 33 (74%) no longer had signs of peri-implant disease "after 30 days"

Thomas G Wilson Jr. The Positive Relationship Between Excess Cement and Peri-implant Disease: A Prospective Clinical Endoscopic Study. J. Periodont **2009**;1388

Still No Effective Treatment of Peri-implant Disease!

Decontamination of Implant Surfaces and Removal of Subgingival Cement May Be Great First Treatment Steps …

But … How Do We Fix Overextended, Overhanging and Open Margins?

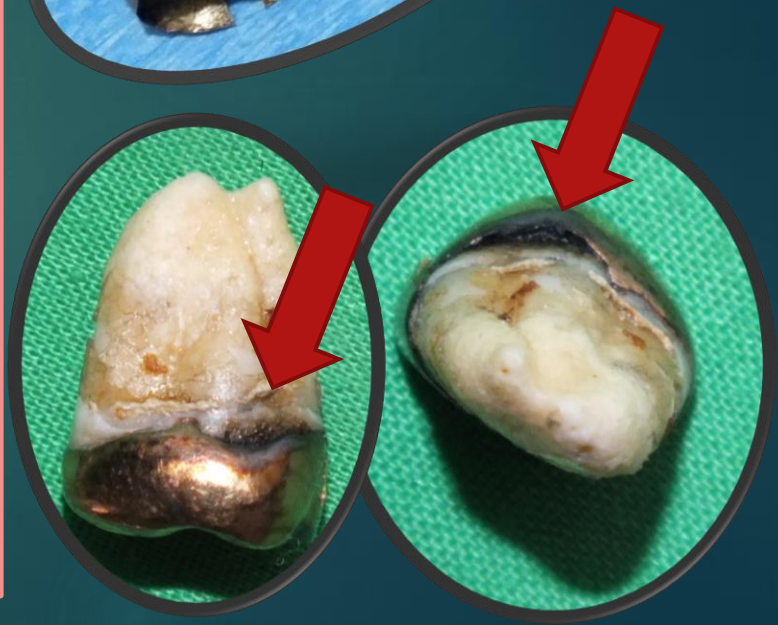
How Do We Fix Misfit Implant Parts?

These Problems Need to be Prevented For Treatment to be More Successful!

Do you think Peri-Implant Disease Stayed Away after 30 days???

Let's Investigate

This BIG 100 Year Old Problem

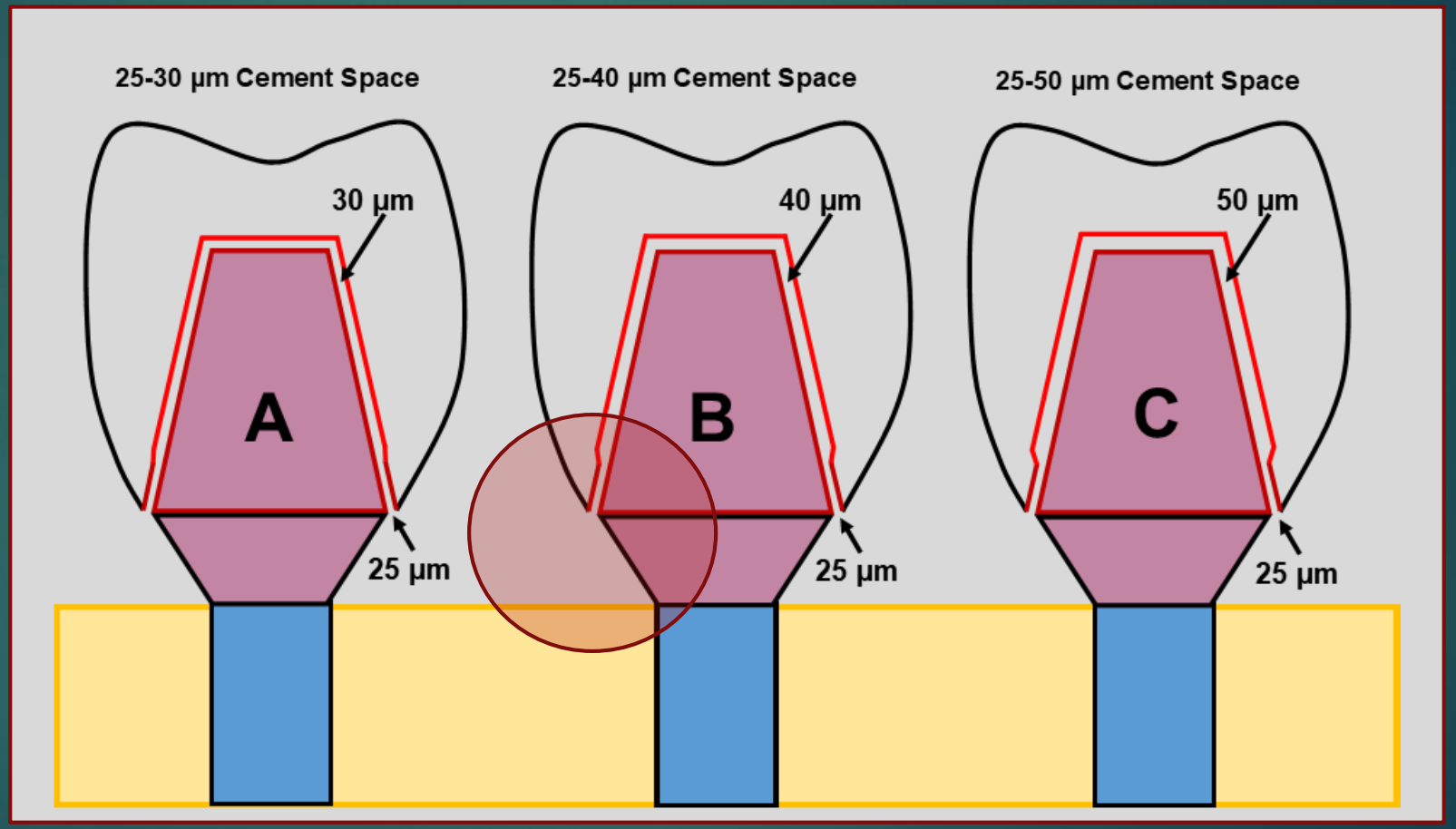


Did you know?

Dental Labs & Milling Companies Increase Cement Space at the Margins to make Prosthesis Installations Easier?

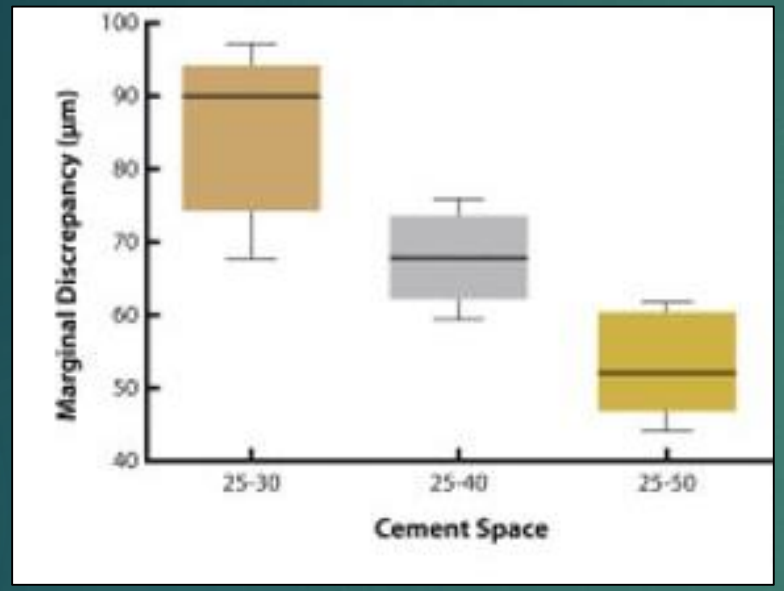
What happens to the Vertical Misfit when Cement Space is Increased?

The Design



Kale E et al. Effect of cement space on the marginal fit of CAD-CAM-fabricated monolithic zirconia crowns. J. Periodont 2009;1388

With Increased Cement Space under Crown
The Vertical Misfit Decreases



Vertical Dimension Misfit

A (25 – 30) Ave 85 µm

B (25 – 40) Ave 68 µm

C (25 – 50) Ave 53 µm

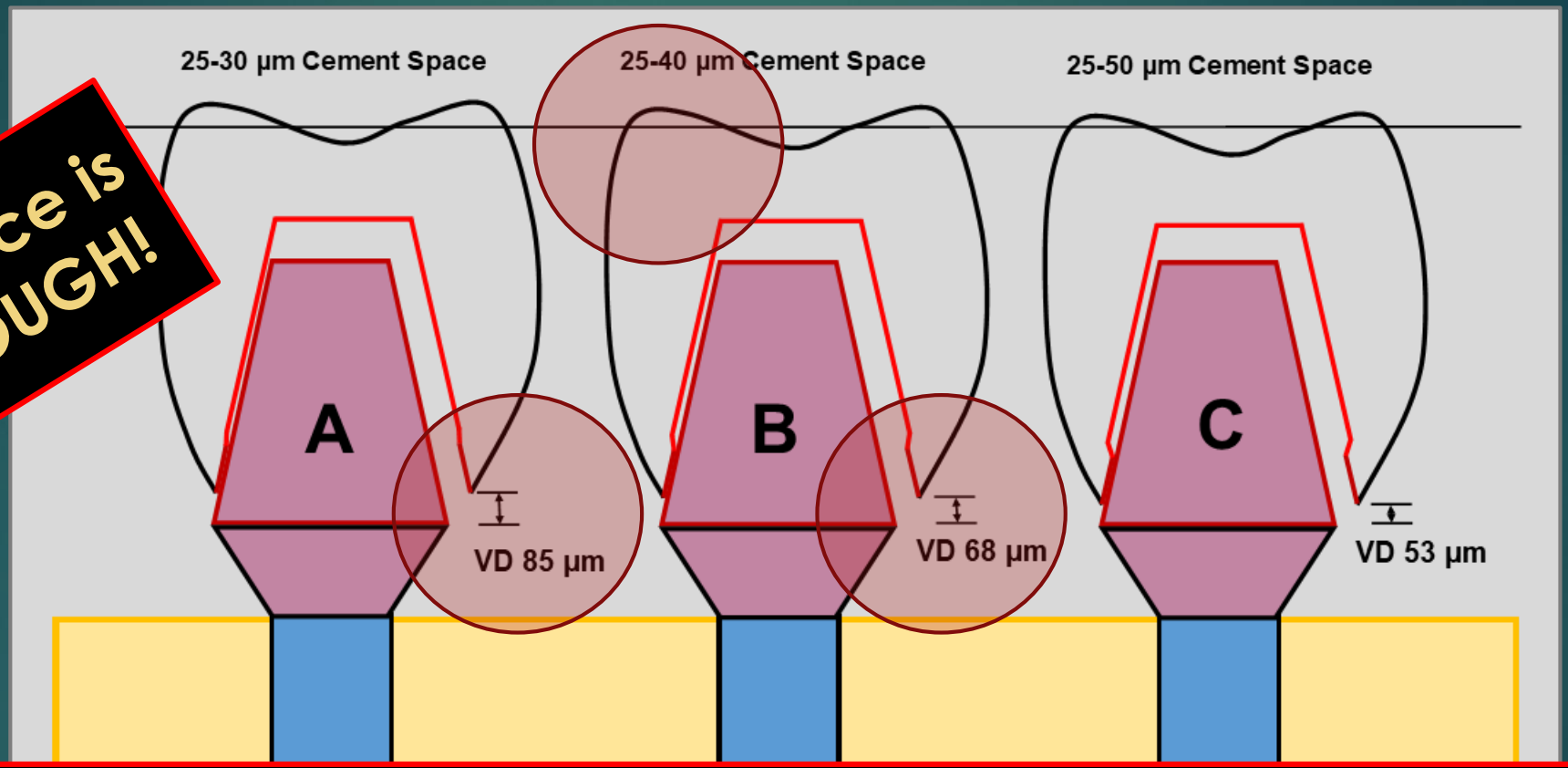
To about Double the 25 µm
Default Overhang at the Margin

Single Tooth Cemented Restorations in vitro

Kale E et al. Effect of cement space on the marginal fit of CAD-CAM-fabricated monolithic zirconia crowns. J. Periodont 2009;1388-1392

A Lateral Crown Shift during Installation Increases the Overhang

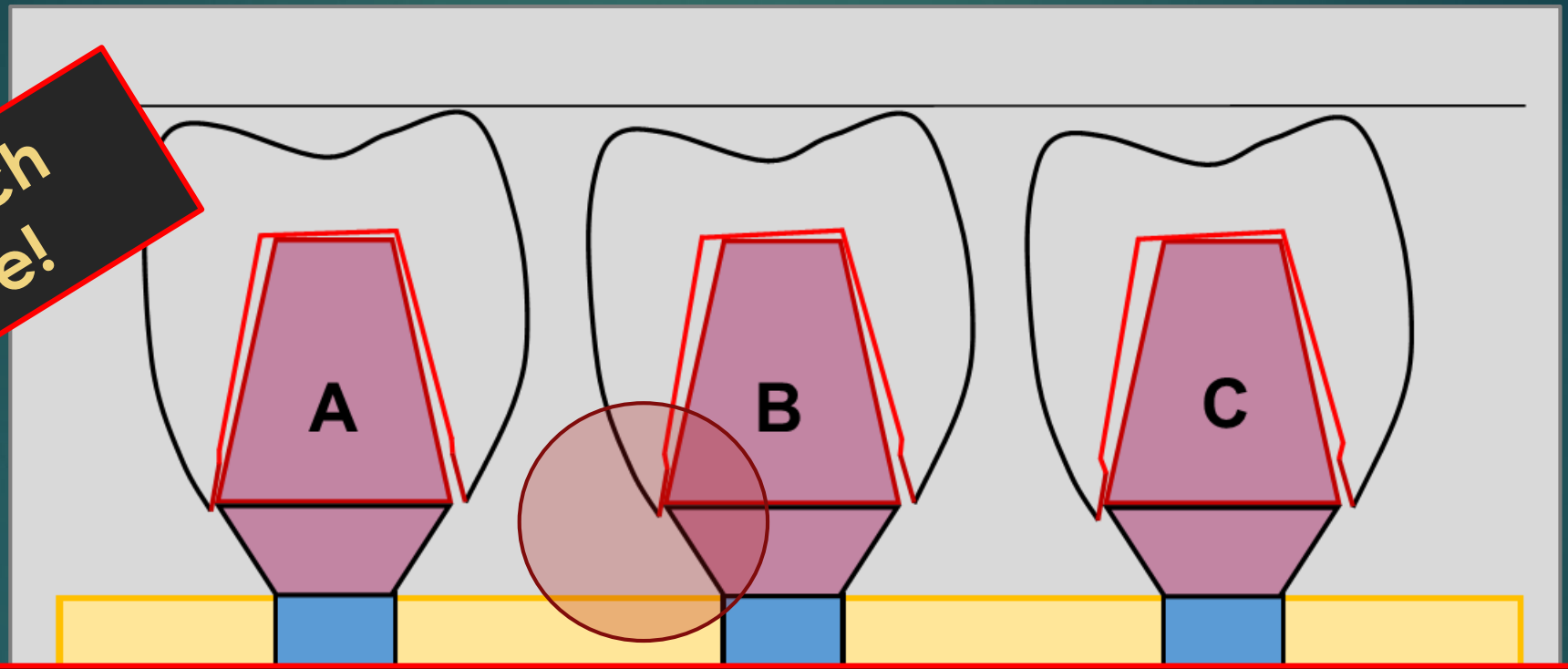
25 µm space is NOT ENOUGH!



Increased Overhanging and Open Margins

Hyperocclusion and Subgingival Cement

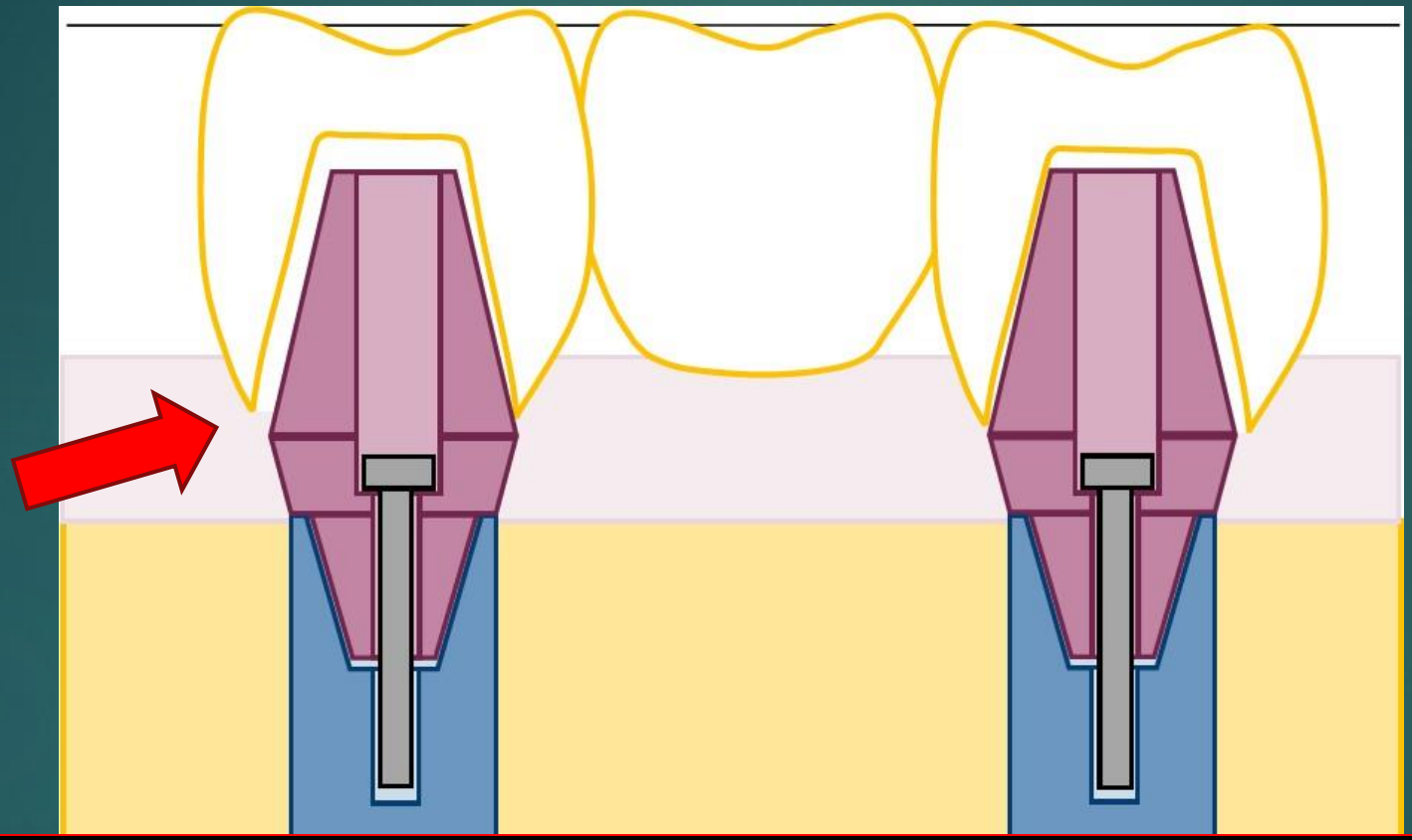
What About Overextended Margins?



Wider Crowns were found in 86-97% of Cases
Overextended Margins 57-72% of Cases
Precise Fit of Crown Margin is Very Rare!

Kissov HK, Popova EV, Katsarov SG. **Position of crown margin in relation to the tooth preparation line.** Folia Med (Plovdiv). 2008 Apr-Jun;50(2)57-62.

Can We Safely Increase Cement Space to Compensate for Prosthesis Dimensional Error?

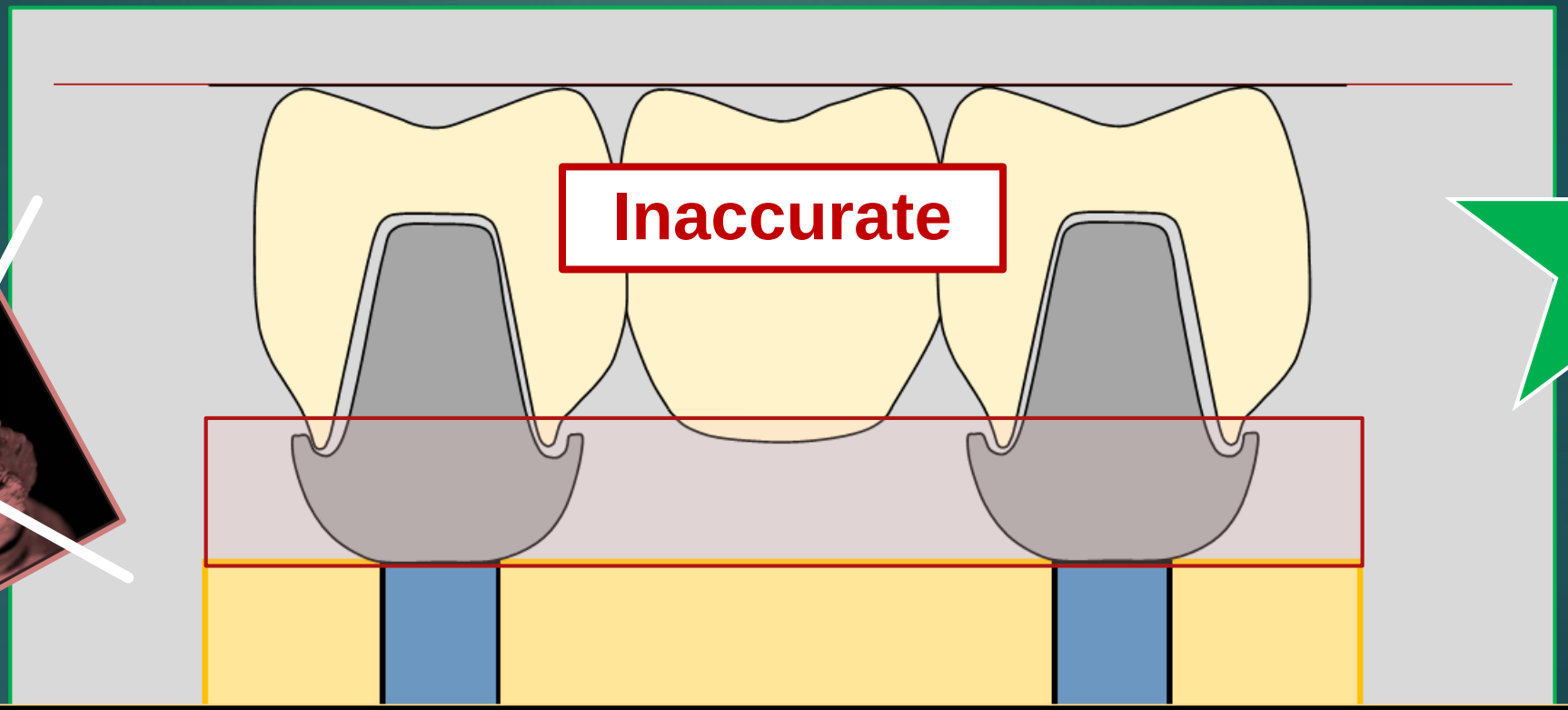


NOT With Downward (Tissue) Facing Margins

Overhanging and Overextended Margins Get Worse

Can We Safely Increase Cement Space to Compensate for Prosthesis Dimensional Error with Upward Facing Margins?

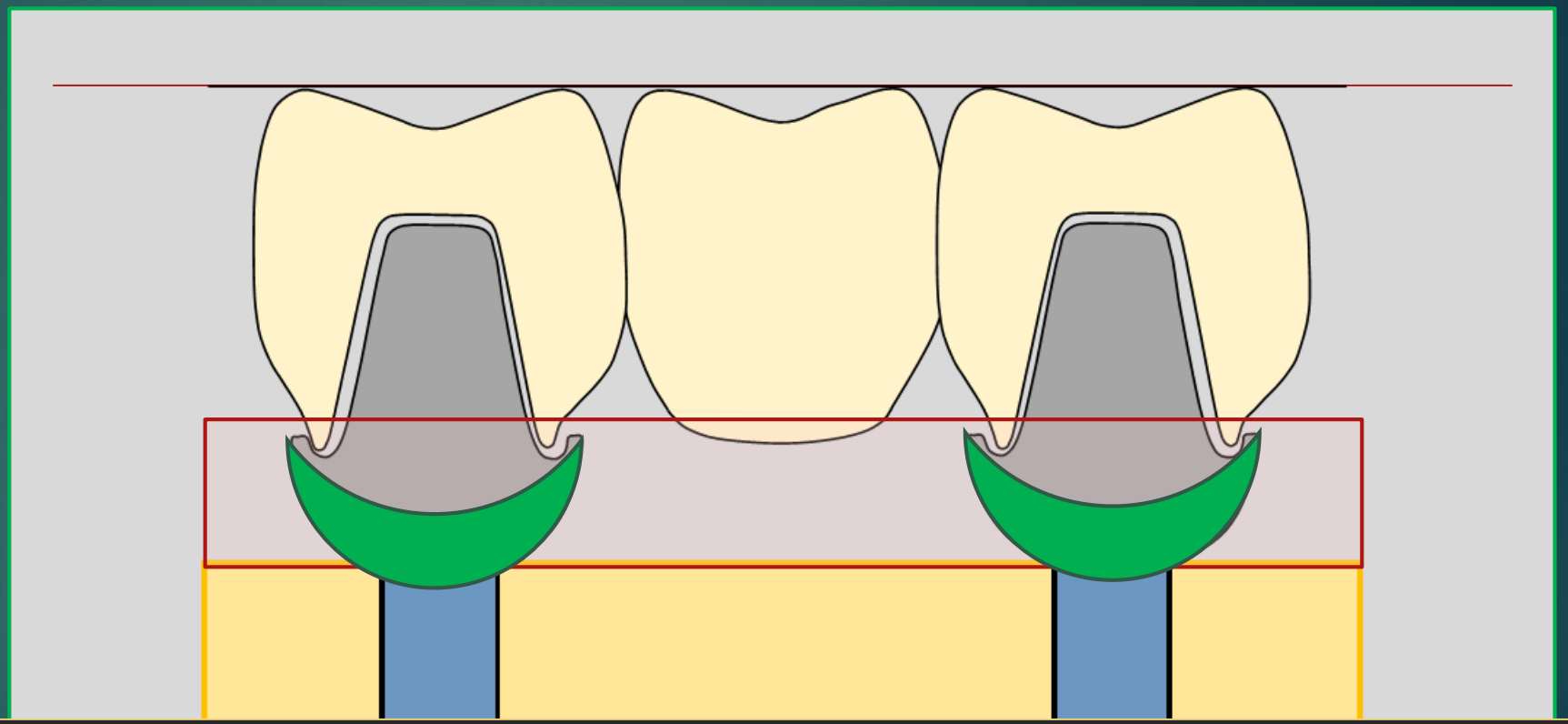
YES!



3

Cement Fills Space Between Upwards Facing Margins
No More Overhanging, Overextended and Open Margins

The Abutments Act like SHIELDS
Protecting Gingival from Interacting with the Base of the Prosthesis

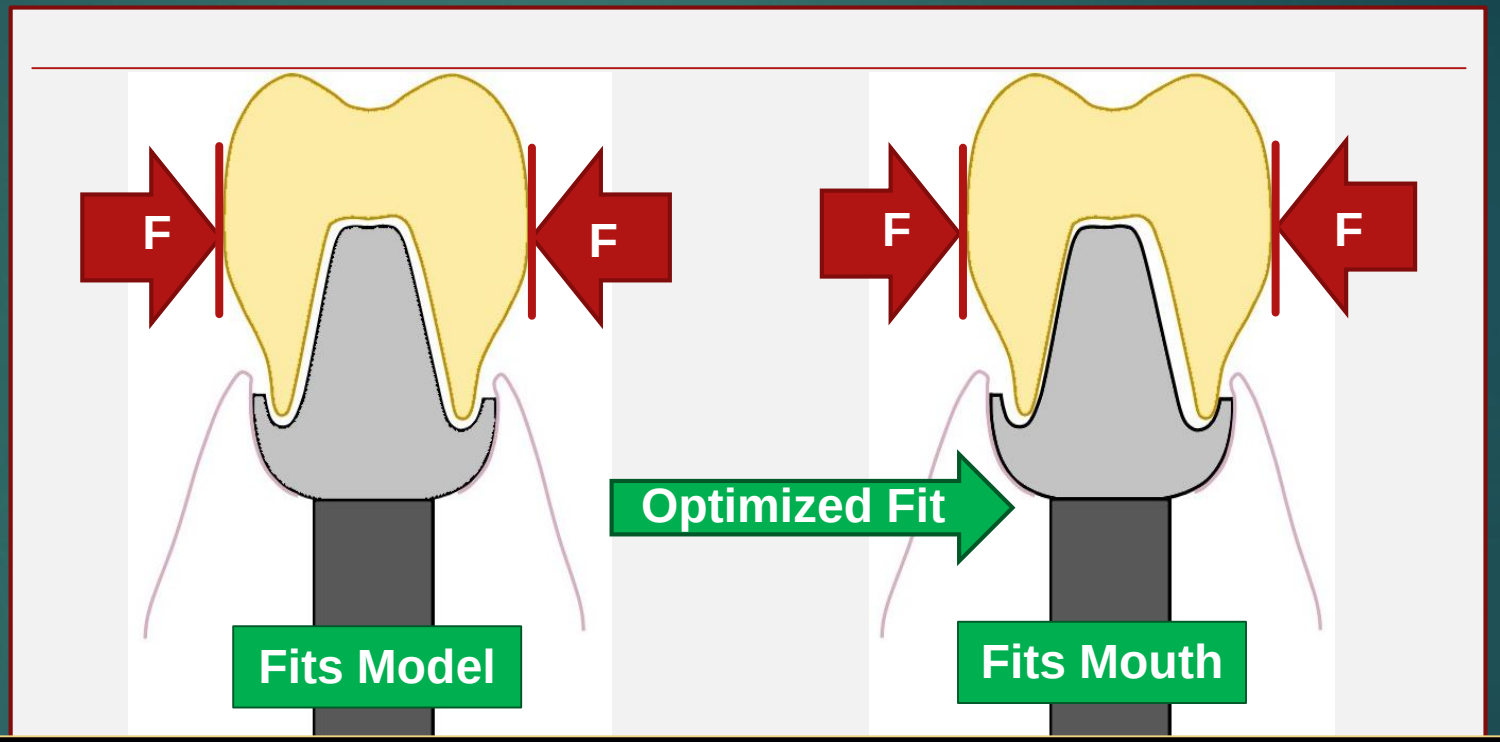


Upward facing margins are accessible for maintenance

Cement Fills the Gap

What About Tight Contacts?
This System Assumes & Tolerates Error

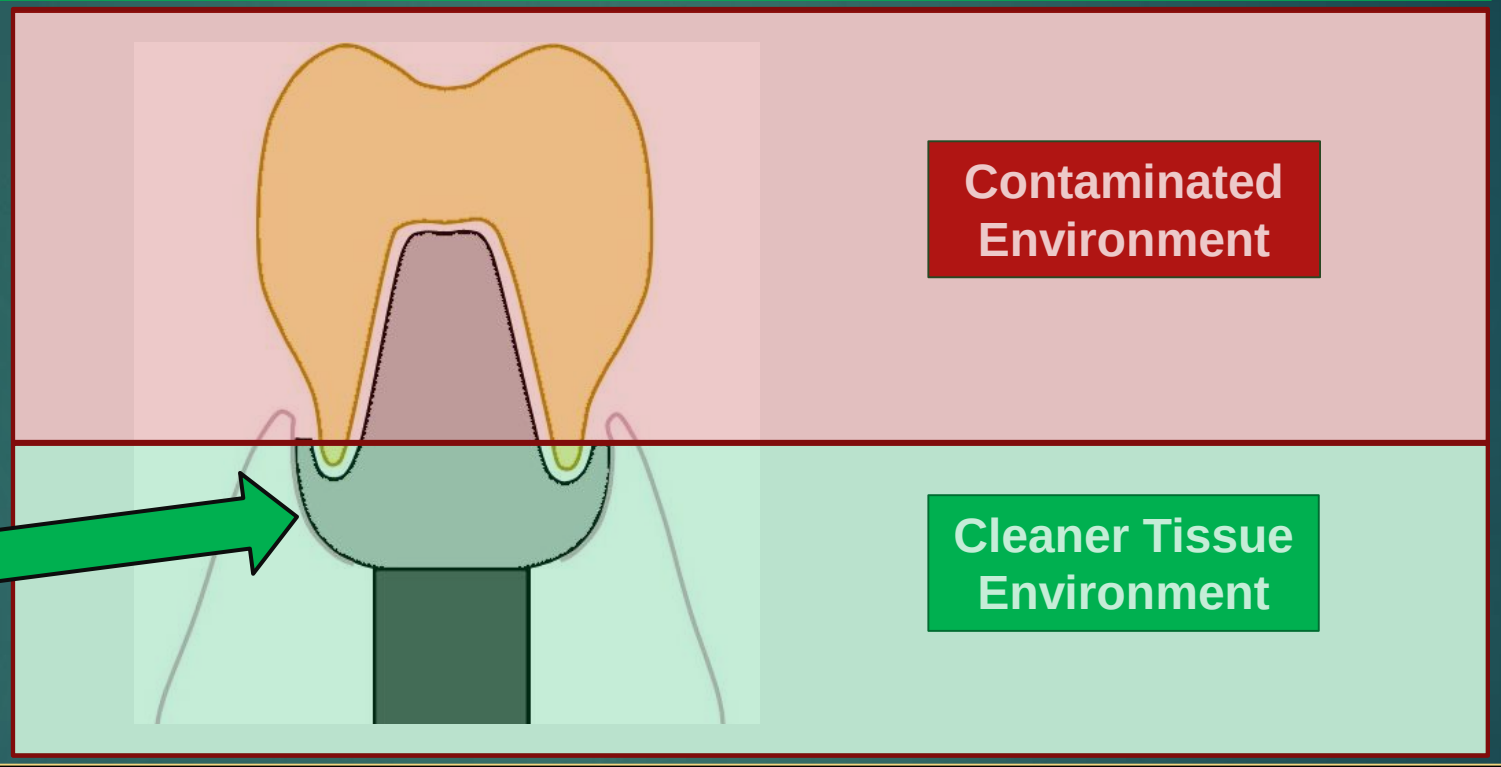
Bonus!



Self Centering, Less Hyperocclusion
= Easier Installation

Abutment Undersurface allows for Epithelial Attachment to Create a Tissue Barrier Against Noxious Materials and Pathogens

Optimized Biological Barrier with Titanium or Zirconia



More Resistant to Disease

Tomas Linkevicius 2019 shows epithelial attachment remnants on Zirconia & Titanium

The Safer Cementation Puzzle has a Number of Interdependent Pieces

Choice of Cement is Important

Temporary Cement

Temporary Cement + Petroleum Jelly

Zinc Phosphate Based

Resin Based

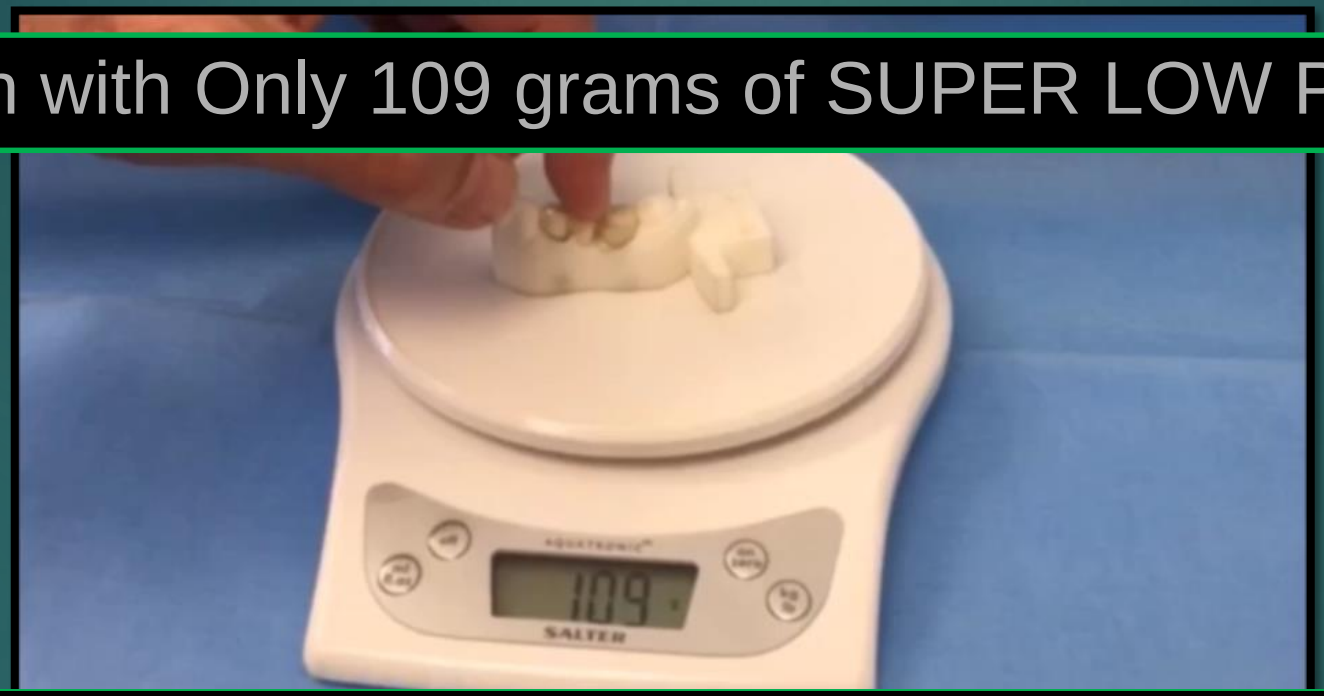
For Safer Cementation We Can Use An Appropriate Cement, Cement Space and Cementation Pressure

	Solubility	Compressive Strength	Cement Space	Cementation Pressure
Zinc Phosphate Cement	High	Low (90 -100 Mpa)	30-40 microns	40 NCm
Resin Cement	**Very Low**	**High (262 Mpa Rely X Unicem, 3M)**	**30-300 microns**	**1 NCm**

Resin Cements Have High Compressive Strength over a Wide Range of Thicknesses and Don't Wash out at Margins

Increased Cement Space allows for Super Lower Pressure Cementation and Increased Excess Cement Control

Tapped in with Only 109 grams of SUPER LOW PRESSURE



Bridge loaded with Rely X Ultimate Cement (3M) and tapped into place. Once seated, the bridge is held with higher pressure while setting cement with light.

Watch the Video at www.ReverseMargin.com

Identifying the Dragons Makes Treatment Decisions Easier

& Prosthesis Installation Safer

The Root Causes of Treatment Complications Related to Prostheses Installation Techniques

1) Prosthesis Dimensional Error
2) Tissue Effects

We Can Make Implant Treatment Better
Let's Do it! It's Our Job!

- **Safer** – Mitigating **PDE** and **GE** by **Design** to prevent multiple risk factors for treatment complications
- **Faster** – Less clinical steps and less lab interventions
- **Easier** – Installations are more controlled, less stressful and easier to adjust.

Increase Treatment Efficiency & Stability
More Happy Patients = Great For Business!

1. **Installing abutments individually without a Prosthesis attached,** allows screw connections to be optimized, more predictably.
2. **The Reverse Margin™ Design** mitigates the Gingival Effects and thus prevents residual submarginal cement & open margins ...
3. **… AND allows for the Safe Use of Adequate Cement Space** to compensate for Prosthesis Dimensional Error, without causing open, overhanging & overextended margins ...
4. **… AND increases cement control by super low-pressure cementation.**

= Safer Prosthesis Installation

A New Way to Install Implant Prosthetics That Safely Compensates for Prosthesis Dimensional Error

	Prothesis Dimensional Error	Current Screw-in Installation	Current Cement-in Installation	The Svoboda Way
1	**Implant-Abutment Misfit**	+++++	-	-
	Contact Management	+++	++	+
	Hyperocclusion Adjustment	+++	++	+
2	**Abutment-Prosthesis Misfit**	-	+++++	-
	Open Margins	-	++++	-
	Overextended Margins	-	+++++	-
	Overhanging Margins	-	+++++	-
3	**Submarginal Cement**	-	+++++	-

"-" No or Very Little Difficulty

More "+'s" Designate More Difficulty
The Svoboda Way involves the Reverse Margin System

A New Way to Install Implant Prosthetics That Safely Mitigates The Tissue Effects

	The Tissue Effects	Current Screw-in Installation	Current Cement-in Installation	The Svoboda Way
1	**Implant-Abutment Misfit**	++++	+	+
	Contact Management	++++	++	+
	Hyperocclusion Adjustment	+++	++	+
2	**Abutment-Prosthesis Misfit**	-	+++++	-
	Open Margins	-	++++	-
	Overextended Margins	-	+++++	-
	Overhanging Margins	-	+++++	-
3	**Submarginal Cement**	-	+++++	-

"-" No or Very Little Difficulty

More "+'s" Designate More Difficulty
The Svoboda Way involves the Reverse Margin System

The Svoboda Way Is Has Been Specifically Designed to

Mitigate Both Root Causes of Prosthesis Installation Related Complications

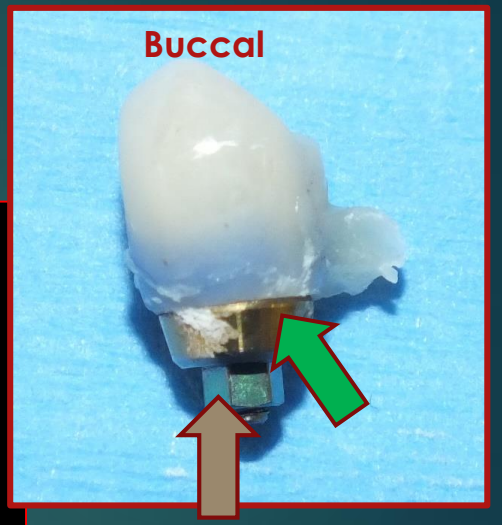
Use its Designs and Protocols to Keep More of Your Patients Smiling Year After Year

Who is Responsible for Complications?

After A Lot of Bad Press
McDonald's Now Offers
Healthier Meal Choices
To their Customers!

Isn't it Time
For Dentists to Offer
Healthier Treatment Choices
to Patients?

The Inconvenient Implications of My Work



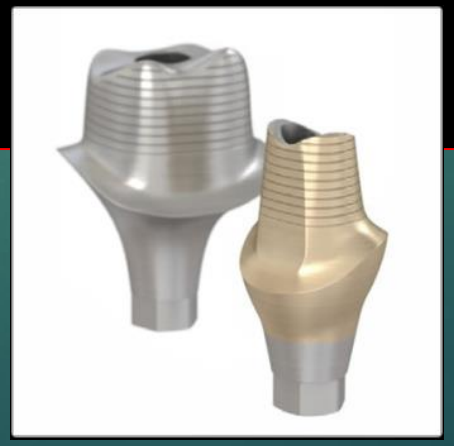
1. **Stock Abutments with Subgingival Margins** are not sensitive to the **Gingival Effects** and are not able to compensate for **Prosthesis Dimensional Error** and are thus **NOT Safe** to use as Retainers for Prosthetics that are to be cemented into the mouth.

Tissue Effects such as the Gingival Effects Can Cause:

1) **Open Margins**
2) **Residual Subgingival Cement**

Another Inconvenient Implications of my Work

2. **Many expensive custom abutments and prostheses with Subgingival Margins** are not usually sensitive to the **Gingival Effects** and are not able to compensate for **Prosthesis Dimensional Error**. They **Are NOT Safe** to use as Retainers for Prosthetics that are to be cemented into the mouth



& Another Inconvenient Implication of my Work

3

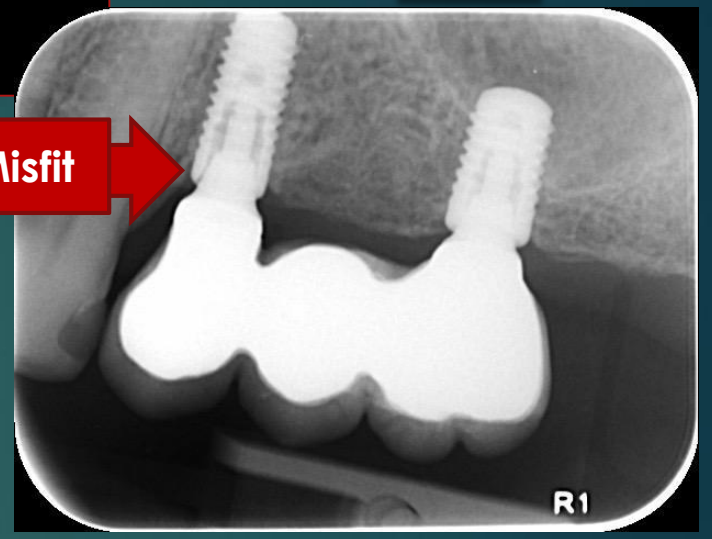
Current Screw-in installation techniques do not usually accommodate Prosthesis Dimensional Error.

This system cannot consistently prevent implant-abutment misfits and could not comply with the spirit of Government ISO Standards regarding the stability of the implant-abutment connection.

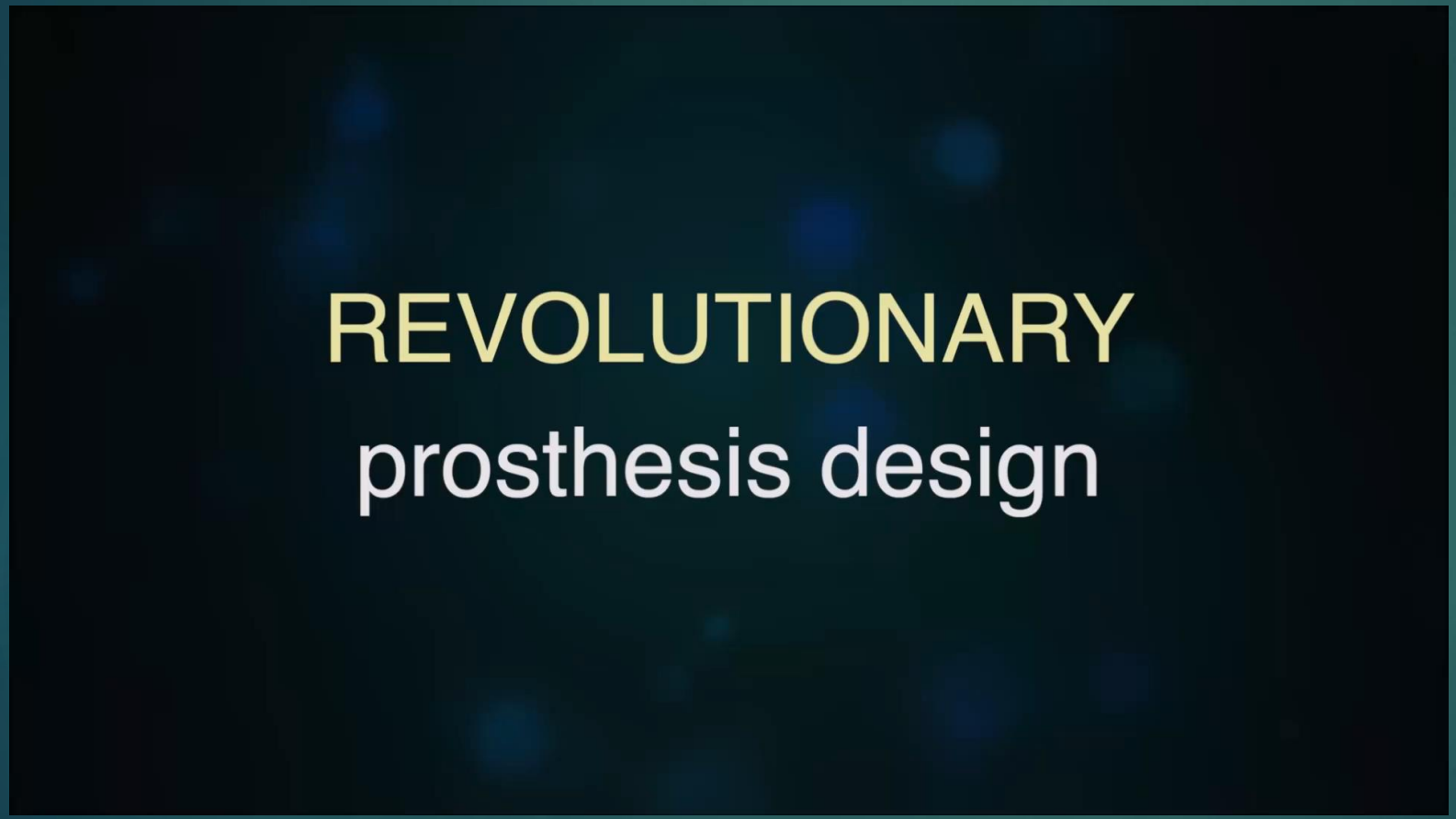
When used to install “All-on type cases”, current systems often shift the misfit to other component joints and thus expose patients to complications related to those misfit connections.

Thus current Systems are Not Safe to use as is.

This Problem is Easy to Fix!



My Solution: The RM Hybrid Fits Almost All Major Implant Systems



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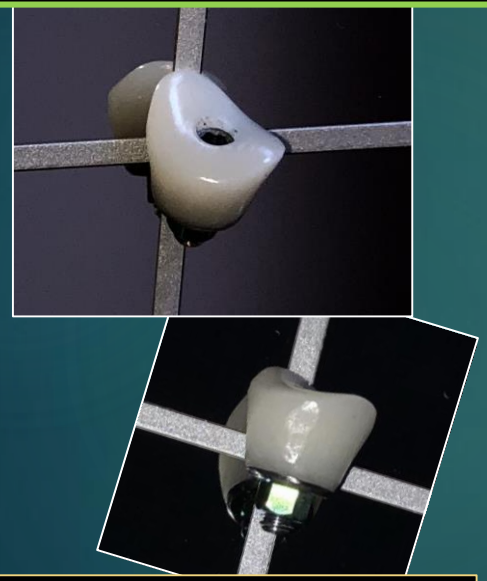

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& Make
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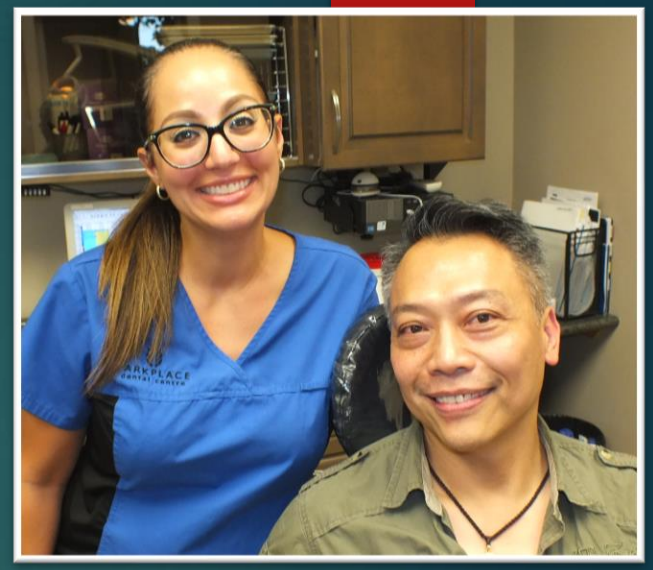
More Predictable



PREVENTION IS BEST!

Thank You for Your Attention

I Look Forward to Your Questions

www.ReverseMargin.com

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