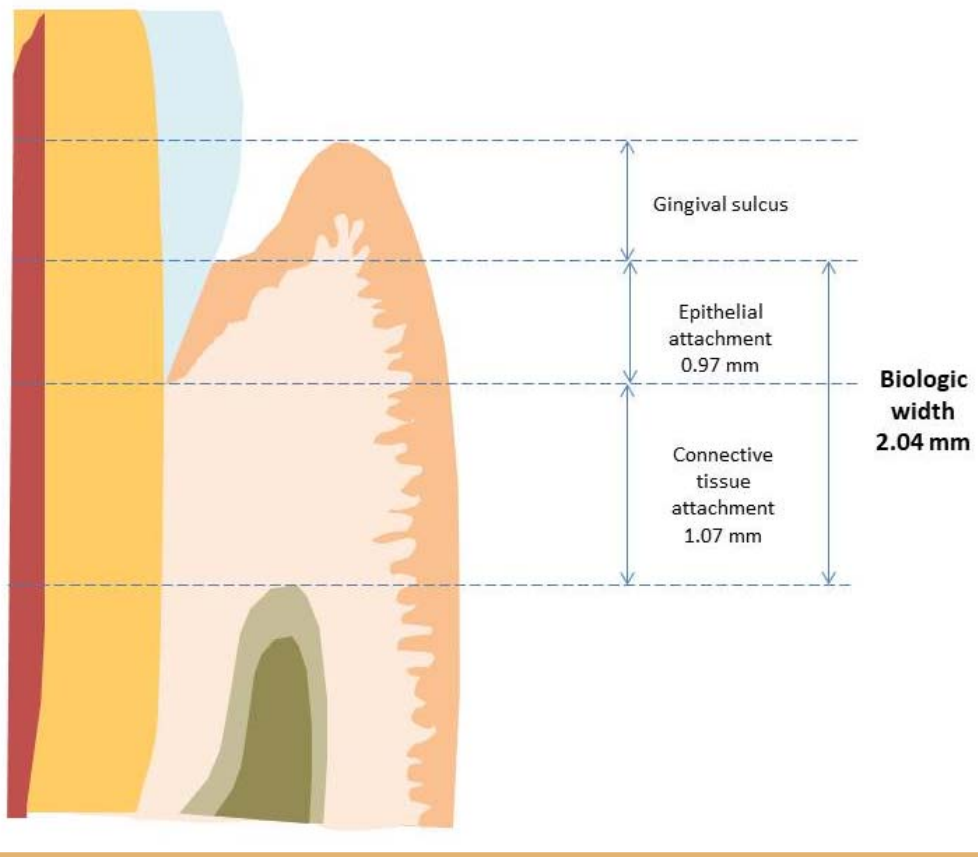
Biologic Width and Crown Lengthening

Dr. Saif Sehaam Saliem

Contents

Biological Width



Super-crestal Tissue Attachment

2017 world workshop

Nature barrier prevent entry of microorganism

Gargiulo etal 1961

Gargiulo, Wentz, and Orban. Dimensions and Relations of the Dentogingival Junction in Humans. J Periodontol. July 1961s .

- Determined mean values for CT (1.07mm), EA (0.97mm), sulcus (0.69mm)

. Human autpsy, 19-50 years .

Passive Eruption	Phase I		Phase II		Phase III		Phase IV	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Sulcus depth	0.00- 2.62	.80	0.00-5.36	.61	0.00-0.94	.61	0.00-2.25	1.76
Attached epithelium	0.28- 3.72	1.35	0.34-2.90	1.10	0.16-1.04	.74	0.08-2.65	0.71
Deepest point of attached epithelium to alveolar bone (CT attachment)	0.04- 3.36	1.08	0.02-4.38	1.07	0.16-2.37	1.06	0.00-6.52	1.05

sulcus depth 0.69 mm **junctional epithelium 0.97 mm** **connective tissue 1.07 mm**

gingival complex dimension 2.73 mm

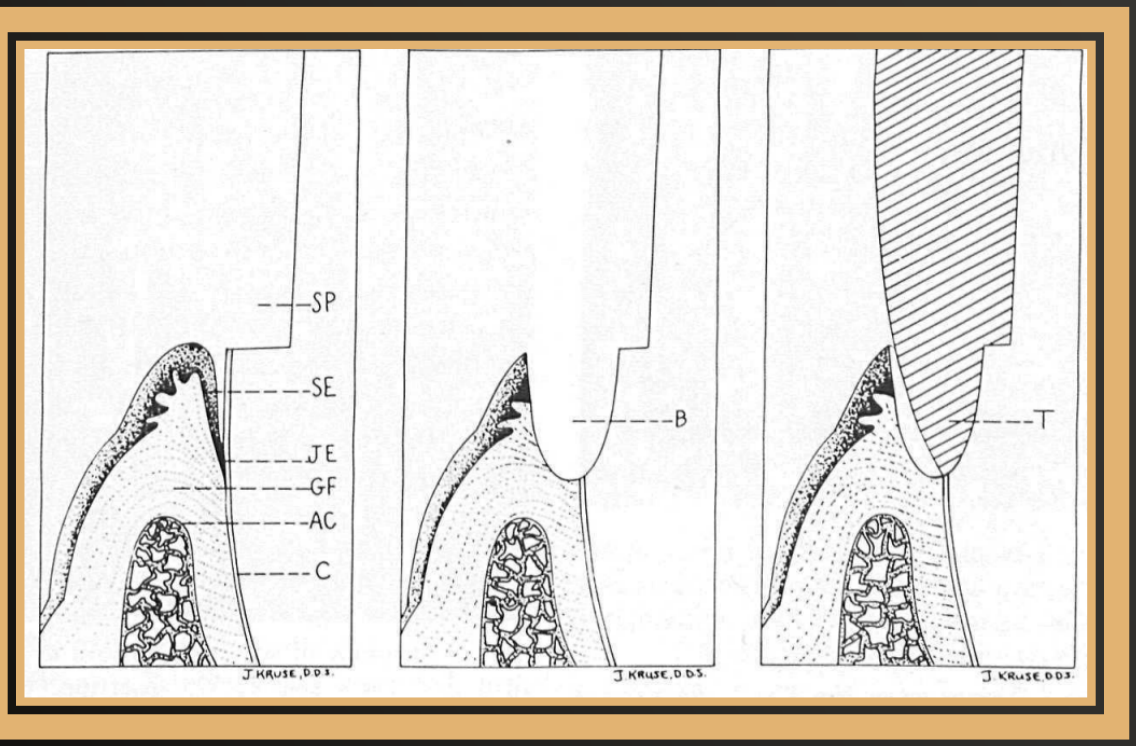
Vacek et al. The Dimension of the Human Dentogingival Junction. Int J Periodont Rest Dent. 1994.

- Noted variability of dentogingival complex between anterior and posterior teeth
- Found no difference in dentogingival complex between M, D, B, L surfaces

Table 3. Biologic width (epithelial attachment plus connective tissue attachment) (mm) for teeth grouped by arch position

Arch position	Measurement (mean ± SD)	Range
Anterior	1.75 ± 0.56	0.75 - 3.29
Premolar	1.97 ± 0.67	0.78 - 4.33
Molar	2.08 ± 0.55	0.84 - 3.29

Biological Width violation



Why it is important? Tarnow 1986

- At 1 and 2 weeks post-treatment the margin showed a mild to moderate inflammation.
- Within 1 week post crown placement, apical migration of the junctional epithelium presented.
- Following this migration, resorption of crestal portions of the facial plate occurred

Biological Width

Clinical features of violating BW

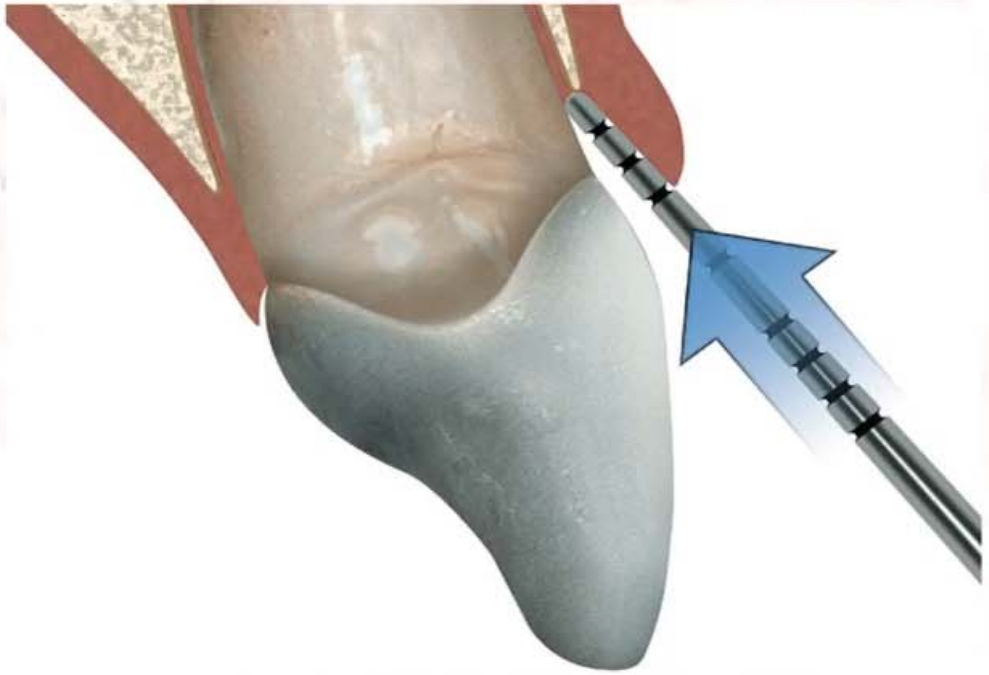
- ❑ Chronic pain after crown insertion.
- ❑ Linear gingival inflammation only around the restoration.
- ❑ Localized gingival hyperplasia.
- ❑ Bleeding on probing.
- ❑ Gingival recession.
- ❑ Pocket formation.
- ❑ Bone loss.

Biological Width

How to measure the Biologic Width?

Bone sounding

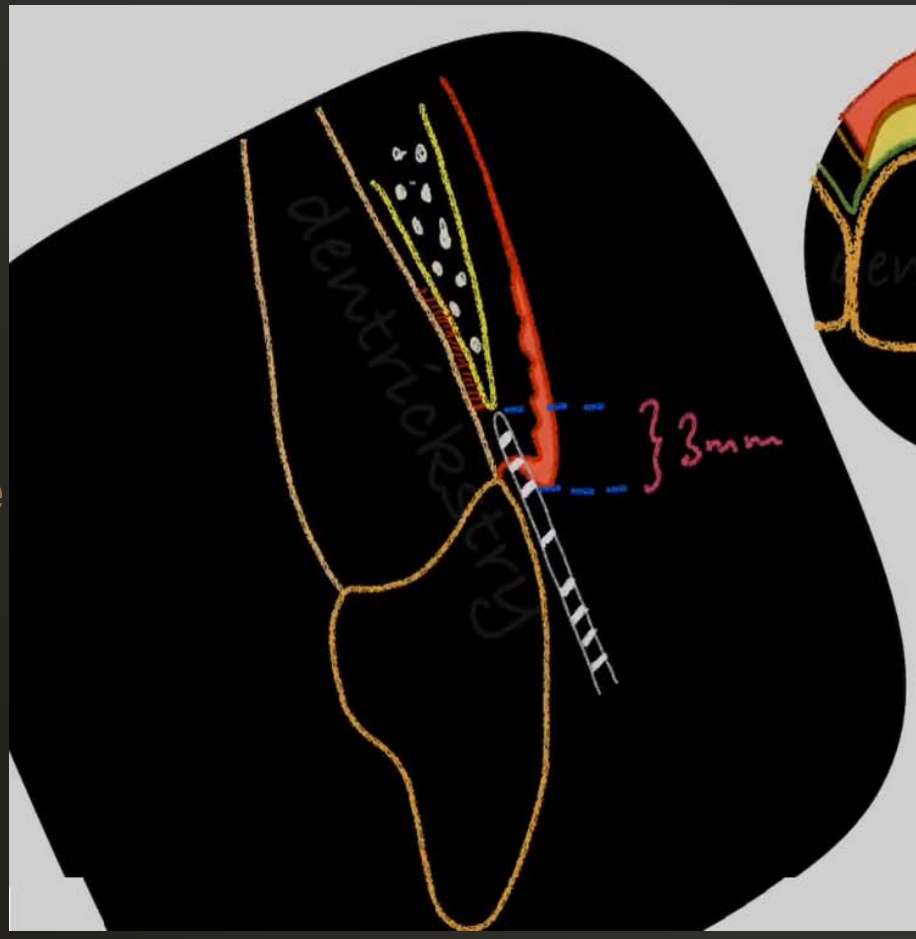
The biologic width can be identified by probing under local anesthesia to the bone level (referred to as "sounding to bone") and subtracting the sulcus depth from the resulting measurement. If this distance is less than 2 mm at one or more locations, a diagnosis of biologic width violation can be confirmed.



Crest Positions

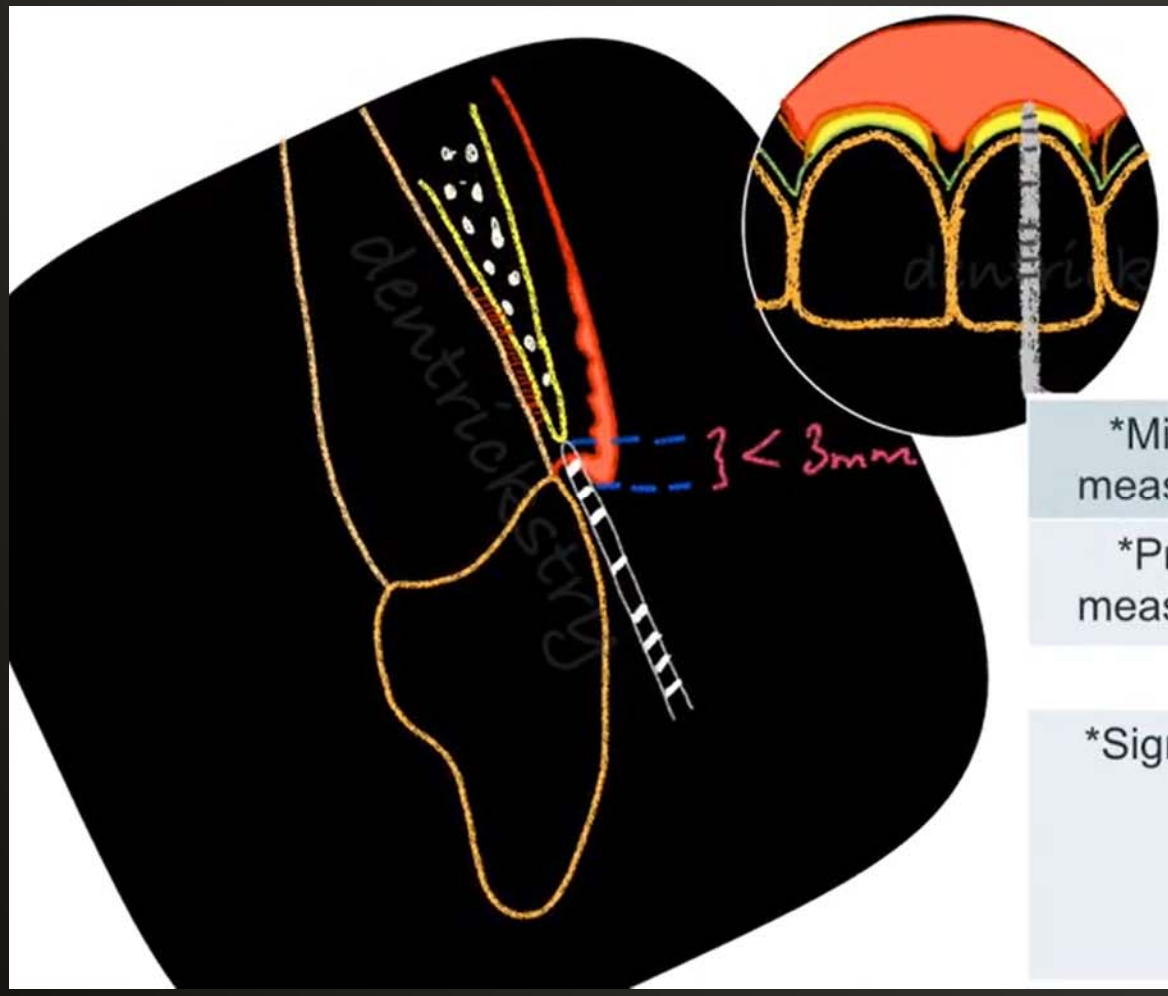
There are three categories of biological width based on the total dimension of attachment and the sulcus depth .

Kois 2000



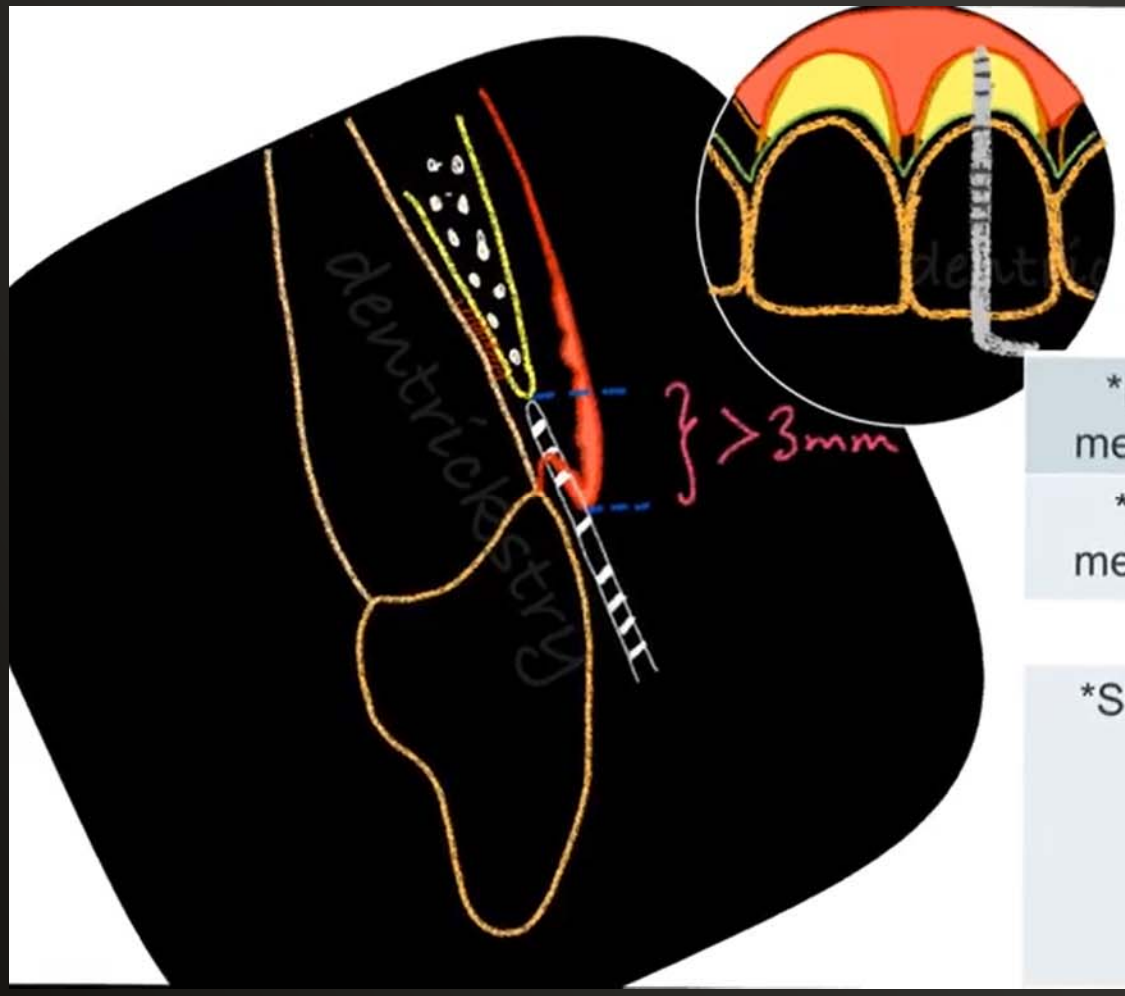
	Normal crest
*Mid-facial measurement	3 mm
*Proximal measurement	3 to 4.5 mm
* Significance	Stable gingiva

Crest Positions



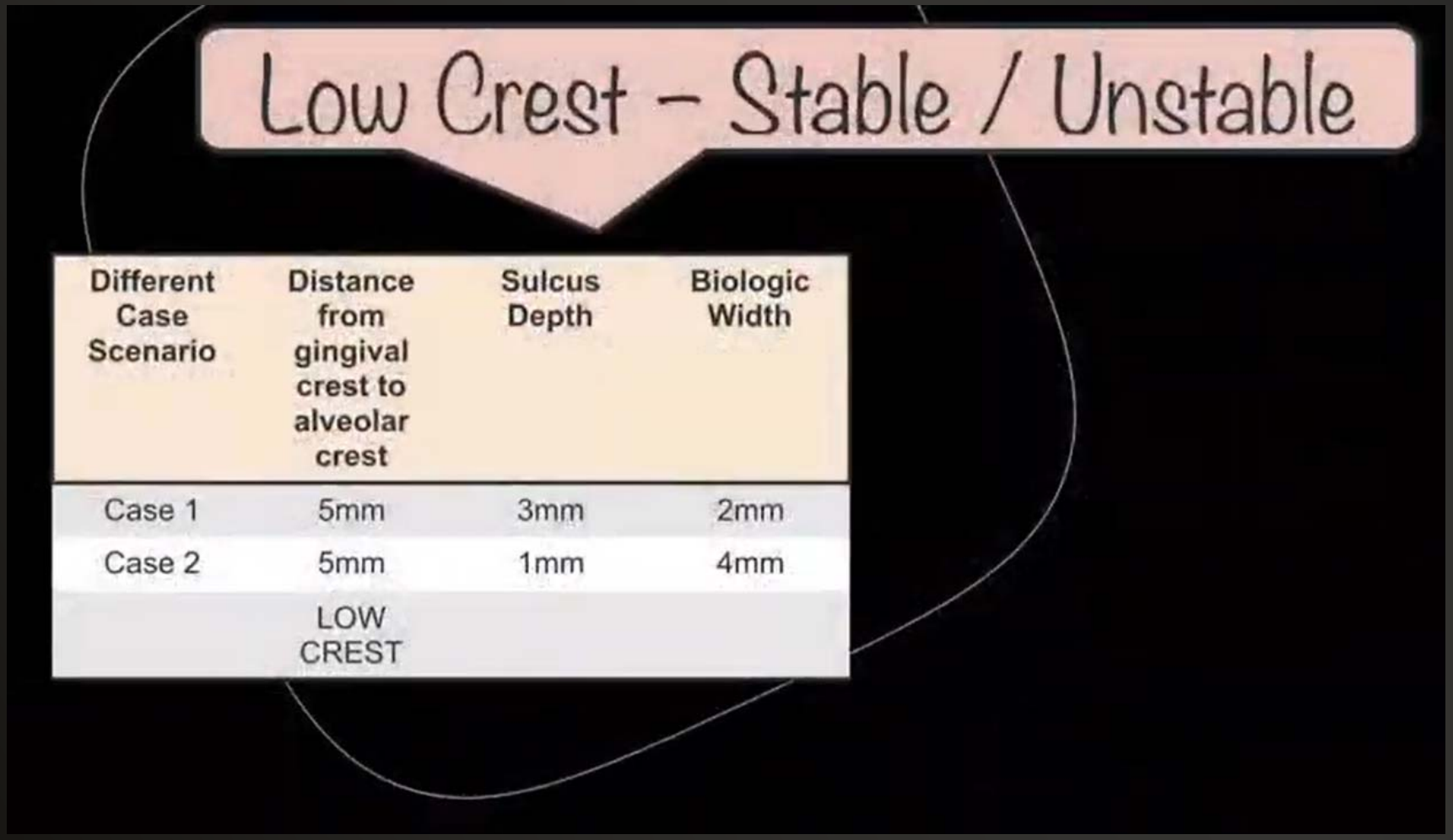
	High crest
*Mid-facial measurement	<3mm
*Proximal measurement	<3mm
	2%
*Significance	seen on a proximal surface adjacent to an edentulous site

Crest Positions



	Low crest
*Mid-facial measurement	>3 mm
*Proximal measurement	>4.5 mm
	13%
*Significance	more susceptible to recession secondary to the intracrevicular margin placement

Crest Positions



Different Case Scenario	Distance from gingival crest to alveolar crest	Sulcus Depth	Biologic Width
Case 1	5mm	3mm	2mm
Case 2	5mm	1mm	4mm
	LOW CREST		

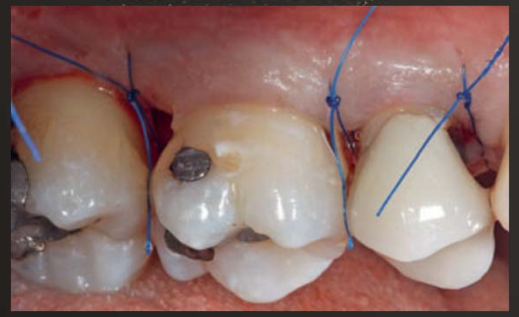
Crown Lengthening

Crown Lengthening

It is a surgical procedure used to expose a greater tooth structure while maintaining the biological width.(simple, compound, complex)

Insufficient abutment (no ferrule)

Deep cavity



Esthetic

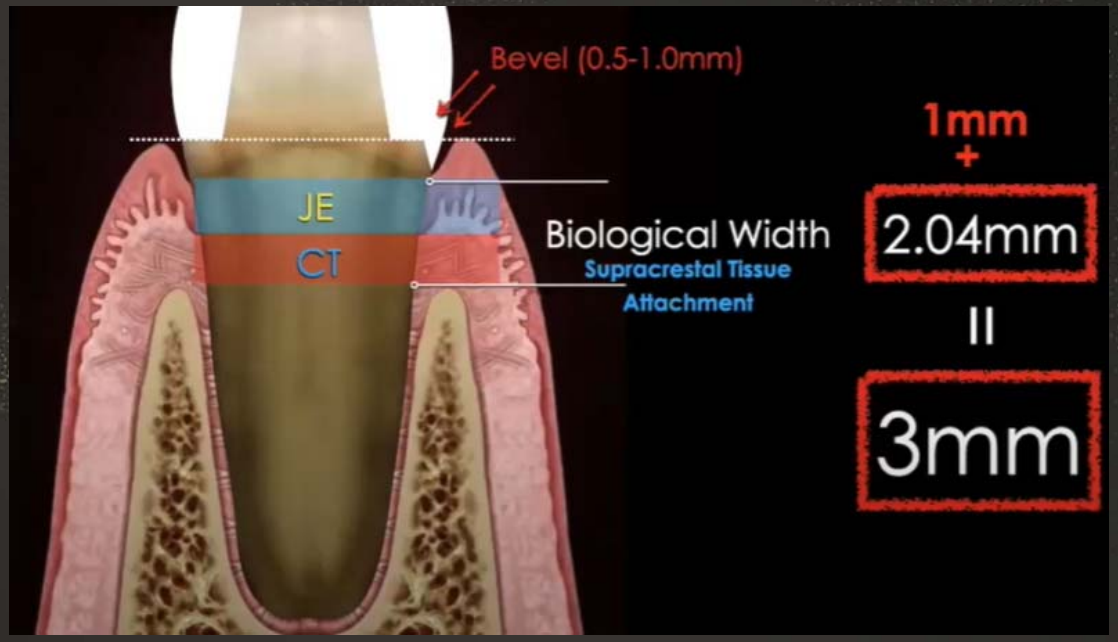
Subgingival fracture

How much mm is enough?

Biological width
2.04 mm

0.5 – 1 mm for bevel of finish line

No violation of biological width
3 mm of Ingber 1977



How many months are enough?

Epithelium attachment: 1-2 weeks

Connective tissue formation: 4-8 weeks

2 Months

Periosteum: 3-6 months

Connective tissue maturation: 6-9 months

Bone stabilization: >6 months

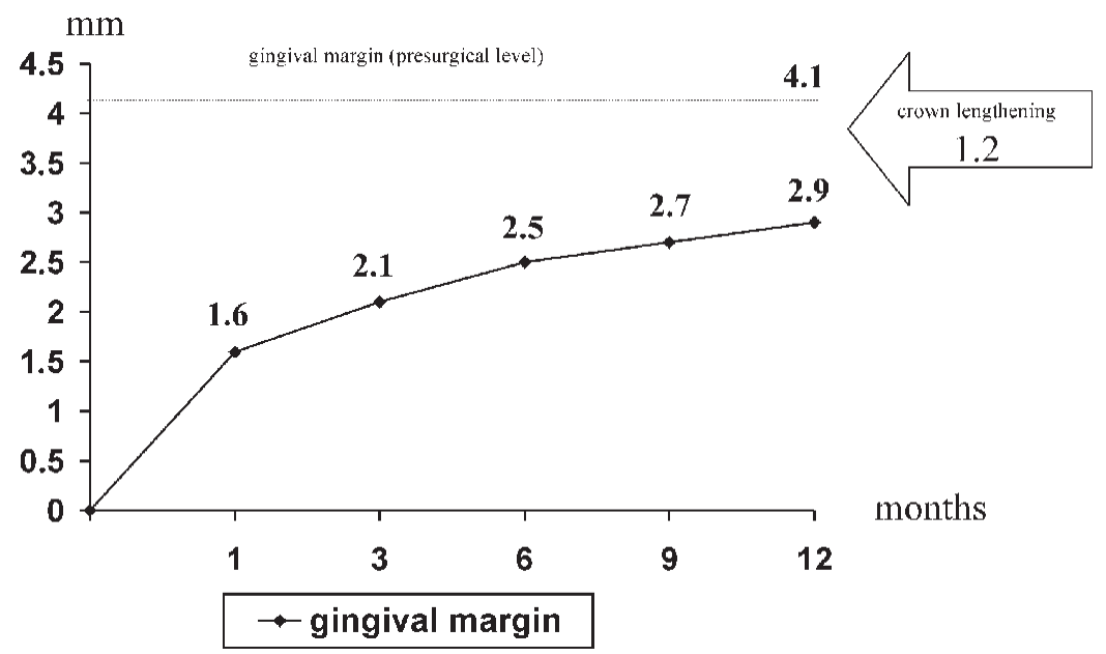
3-6 Months

Ramjfordb& Engler 1966
Wilderman 1970
Biagini 1988

How many months are enough?

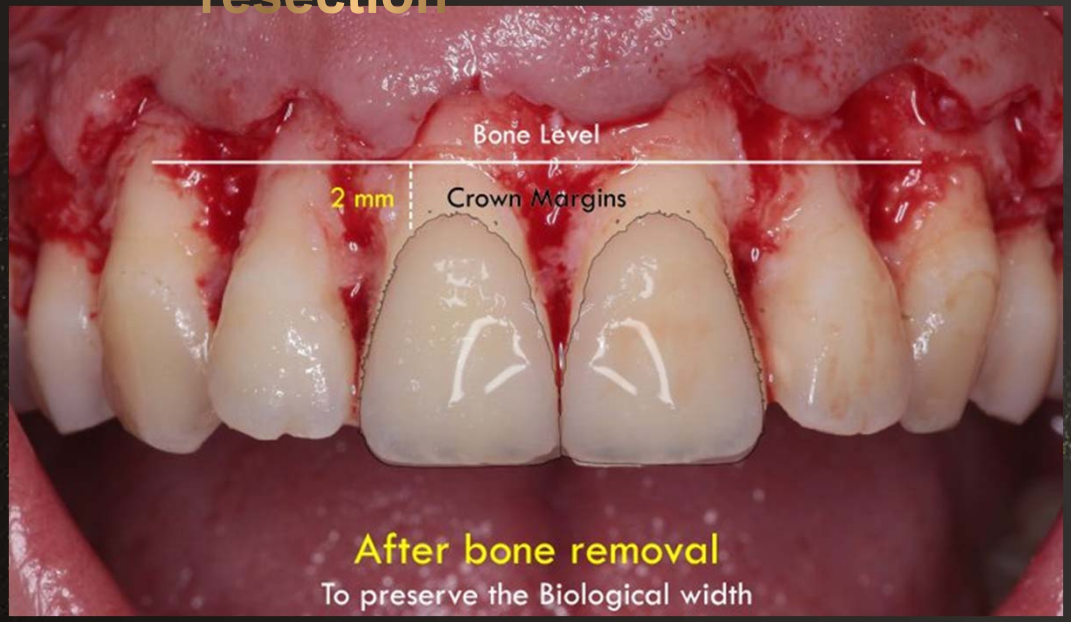
Tissue rebound 0.26-3mm

Pontoriero 2001



- During healing period marginal tissue kept coronally shifting.
- The first month showed the greatest coronal growth.
- The coronal growth decreased and maintained after 6 months.

Osseous resection



Pontoriero 2001

- Tissue rebound 2.9mm.
- Mean osseous reduction was 1mm, bone resection more than 2 mm only at 8% of sites.

Lanning 2003

- Tissue rebound 0.26 mm.
- At 90% of treated sites, when 3 mm or more of bone was removed.

Sufficient bone removal is important

(3mm from gingival margin in normal but we take 3mm from CEJ or restorative margin to decrease rebound)

Case 1

Case 1

Immediate post op

2 months post op

Case 1

Initial

2 months post op

However 3 years later

Initial

2 months post op

3 years post op

Insufficient bone reduction <2 mm

Treatment Options for Crown Lengthening Procedures

Surgical

A Gingivectomy

B Internal Bevel Gingivectomy with or without ostectomy (also referred as flap surgery with or without osseous surgery)

C Apical positioning flap with or without ostectomy

Combined (SURGICAL & NON SURGICAL) - Orthodontic Treatment

Message No. 1

Factors

- Flap management
- Periodontal phenotype
- Sufficient bone reduction

Bone reduction

- 3 mm for thin phenotype
- >3 mm for flat thick phenotype

Healing time

- Non esthetic zone 2-3 months
- Esthetic zone 3-6 months

Esthetic Crown Lengthening



- Gummy smile .Short teeth

"**Excessive Gingival Display**"

Esthetic evaluation and periodontal evaluation



Esthetic evaluation

Incisal edge

The maxillary central incisal edge is key to esthetic and functional treatment planning

3 mm. at rest
female more than male

Case 2

Initial

Crown lengthening

Incisal display

Change treatment plan from **crown lengthening** into **root coverage + new restoration**

Esthetic evaluation

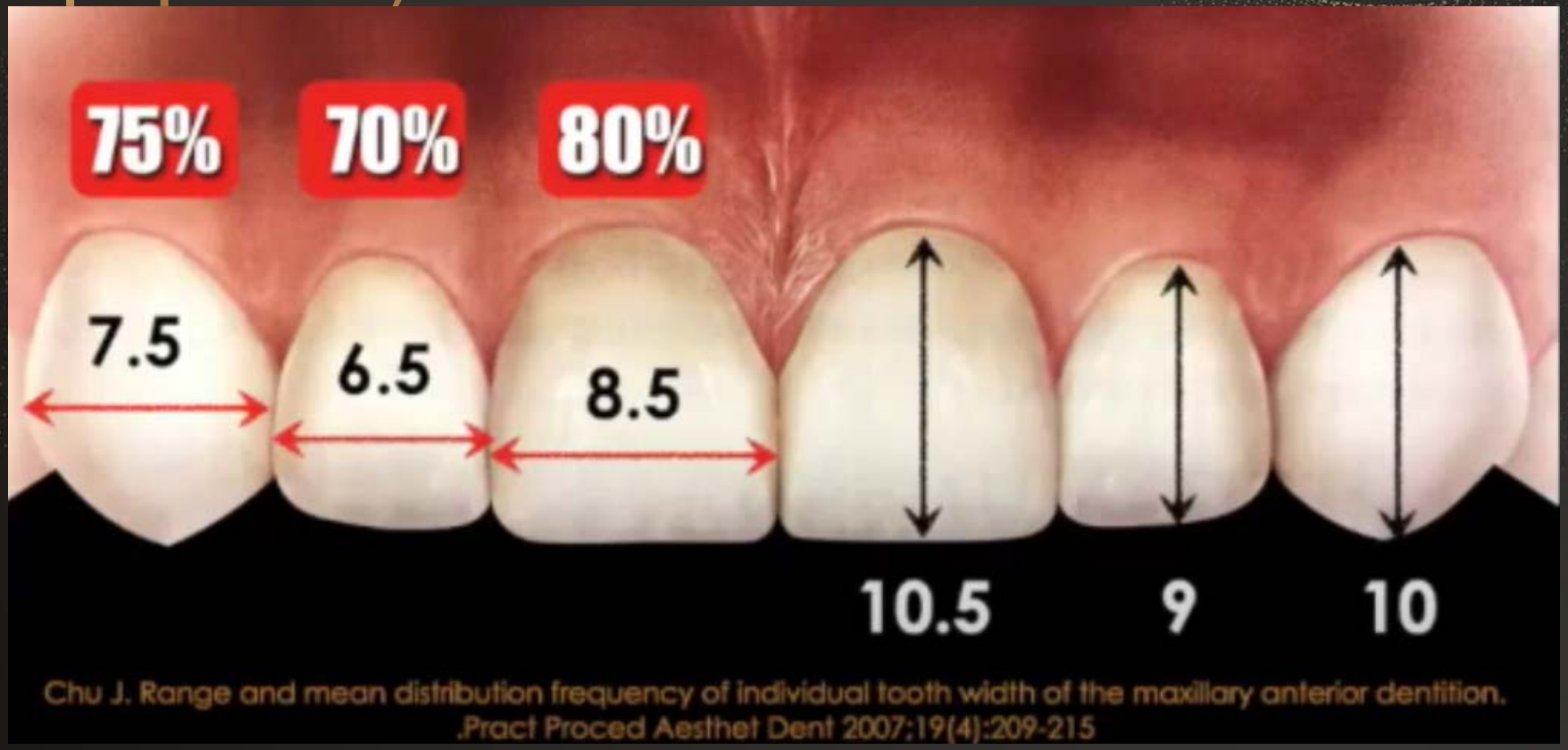
Tooth proportions

Width/Length ratio

Esthetic evaluation (tooth proportions)

Asian 70%

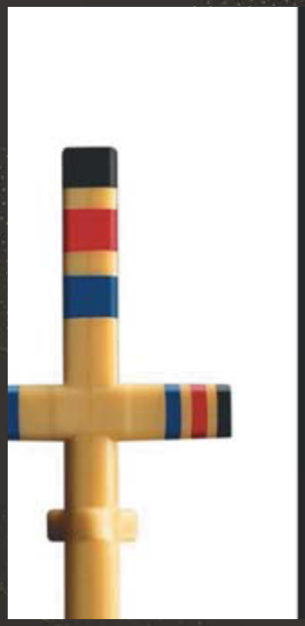
Esthetic evaluation (tooth proportions)

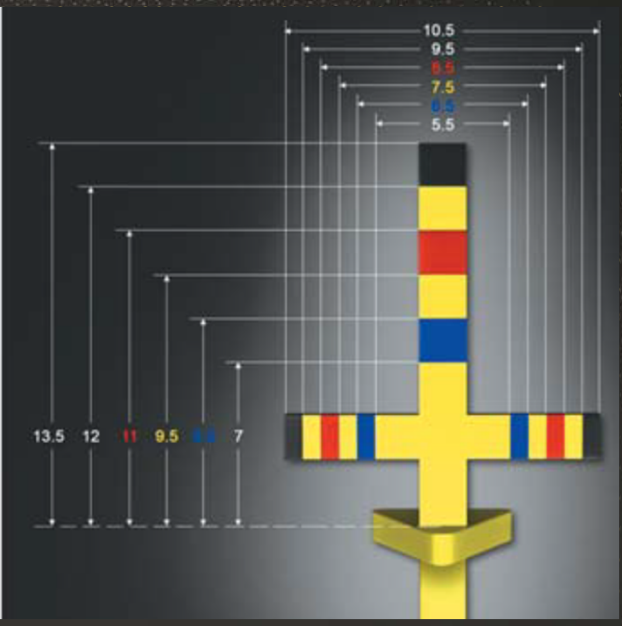


Chu J. Range and mean distribution frequency of individual tooth width of the maxillary anterior dentition. .Pract Proced Aesthet Dent 2007;19(4):209-215

T-Bar gauge

Blue lateral yellow canine red central





Periodontal evaluation

Differential diagnosis for excessive gingival display

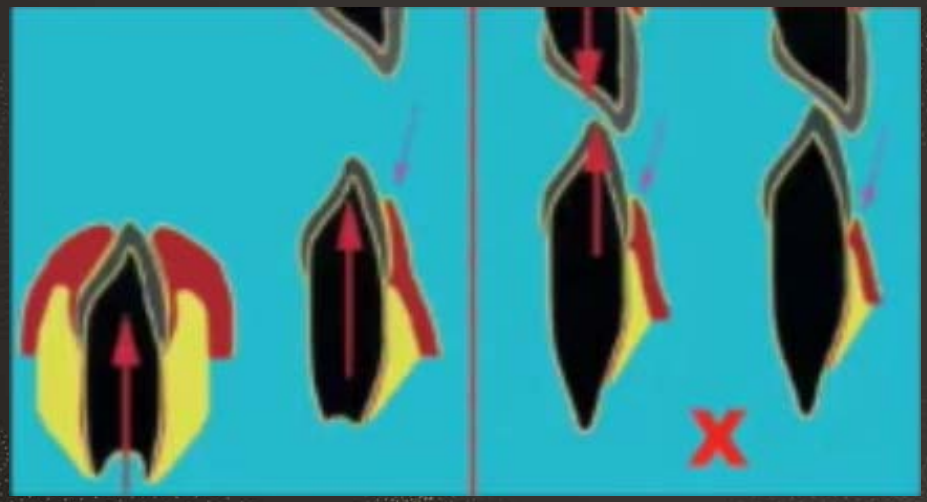
- ❑ Pathologic gingival hyperplasia.
- ❑ Vertical maxillary excess.
- ❑ Dentoalveolar extrusion.
- ❑ Short or hyperactive upper lip.
- ❑ Altered passive eruption .

Robbins 1999

Altered (retarded) passive eruption 35%

- Active phase

Tooth emergence into oral cavity



- Passive phase

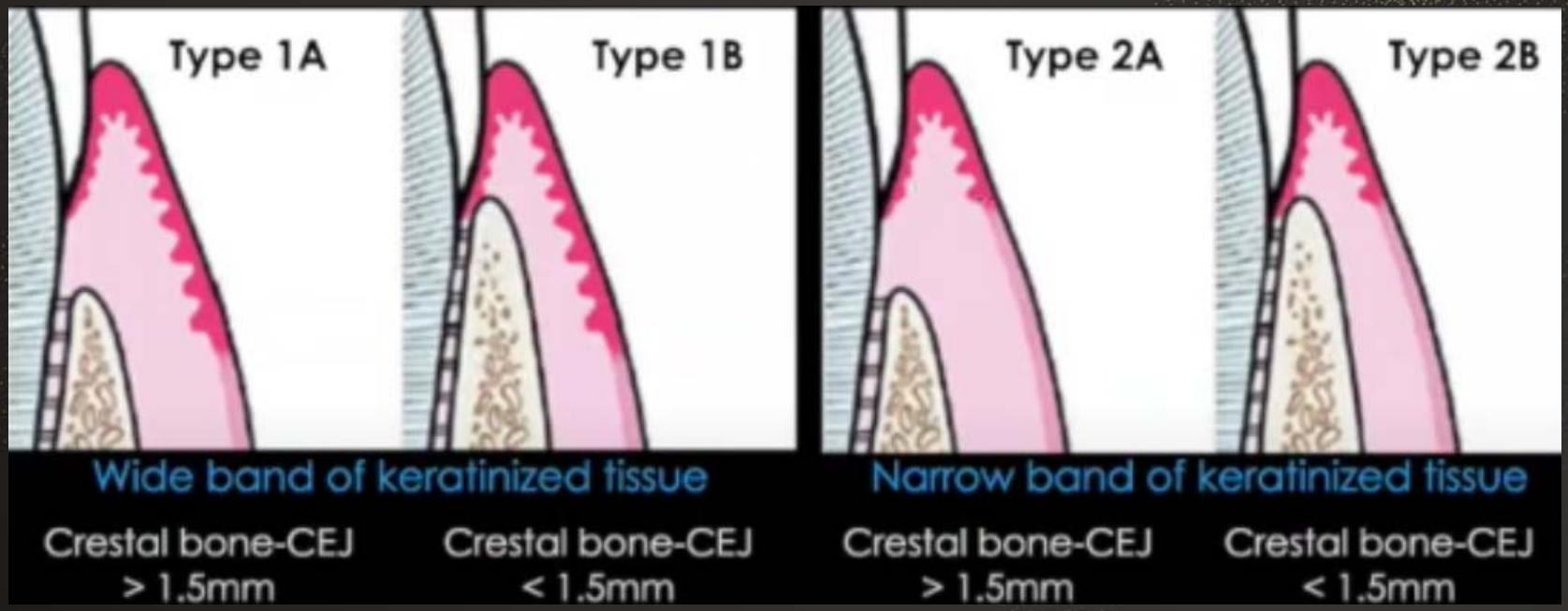
Apical migration of soft tissue.

- Definition

The gingival margin in the adult is located incisal to the cervical convexity of the crown.
(Goldman and Cohen 1968)

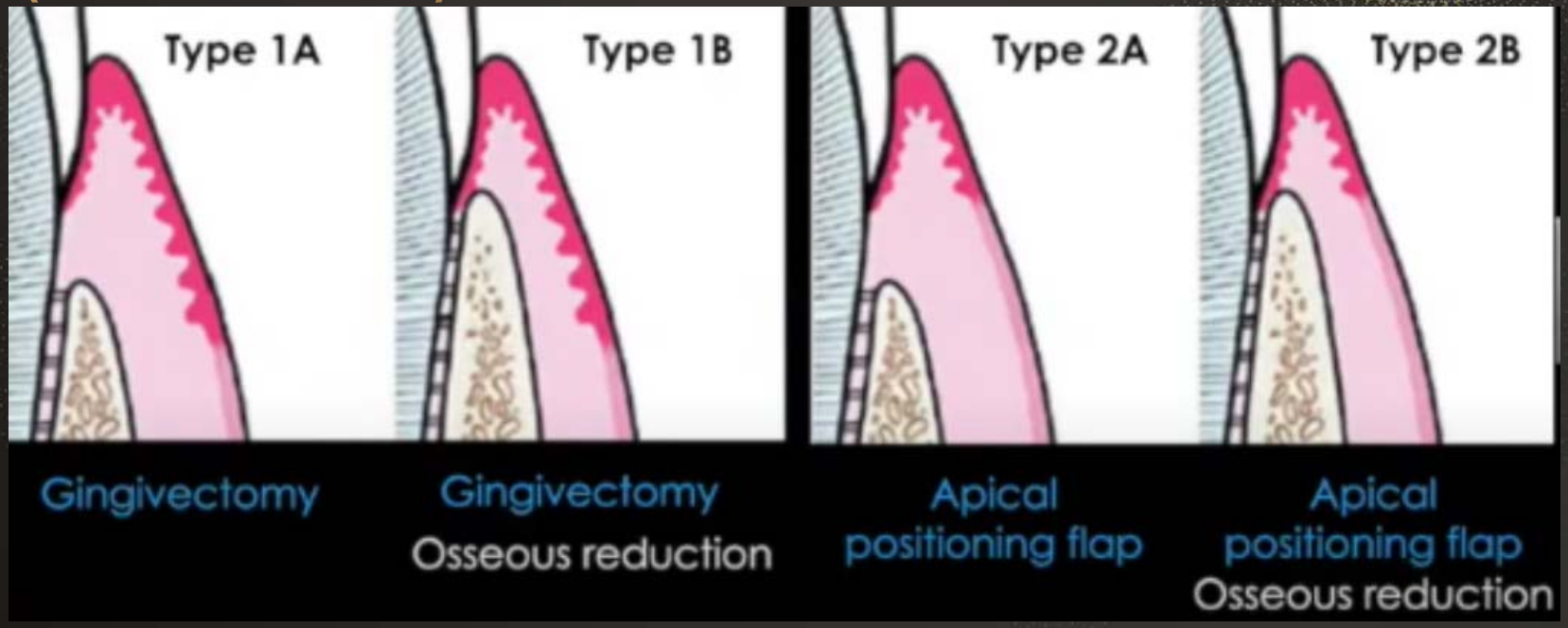
Delayed passive eruption (Volchansky 1974)

Altered passive eruption (classification)



Coslet et al. 1977

Altered passive eruption (classification)



If K tissue ≤ 3 don't make G

If K tissue > 3 do

White, green, blue colored probe

Altered passive eruption continue to 18-20 years

Causes are
Thick fibrotic gingiva
Genetic
Ortho trauma
Endocrine condition hypopituitarism and hypogonadism

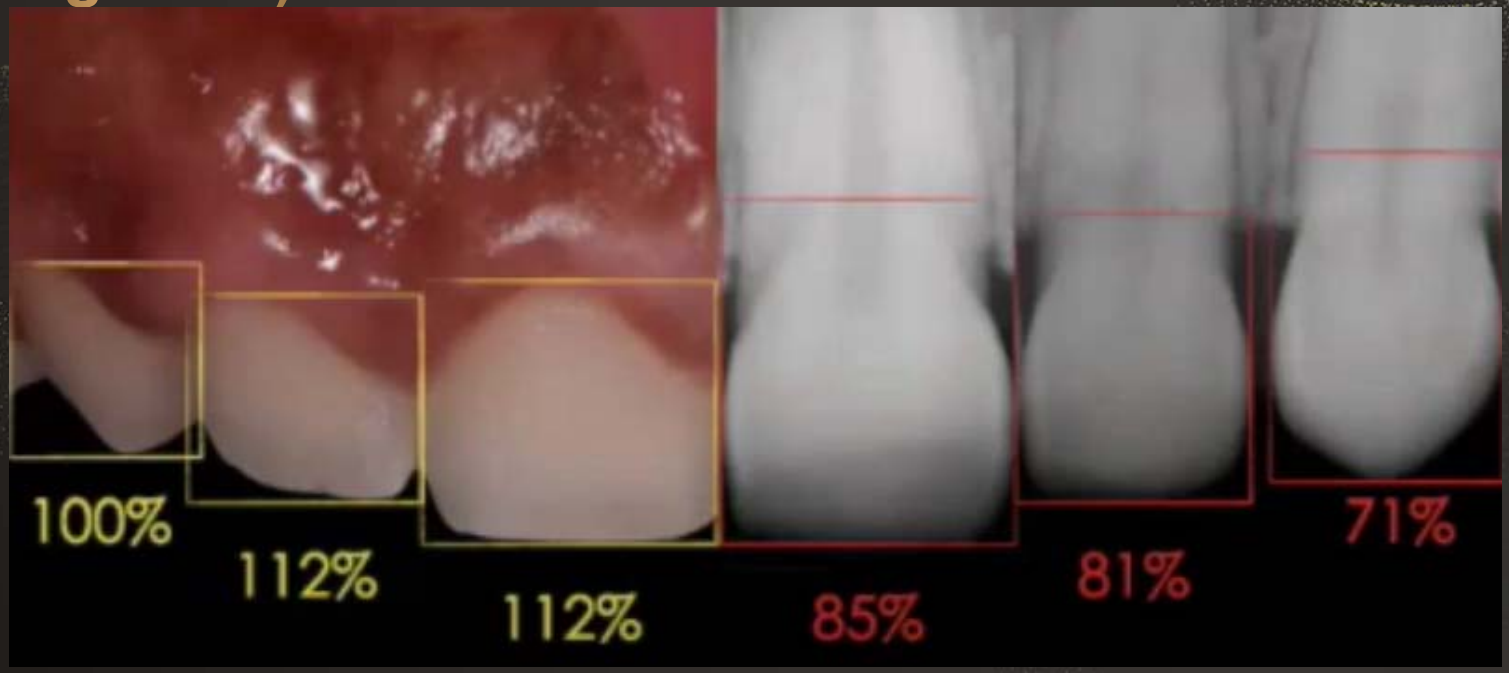
Altered passive eruption (diagnosis)

Clinical appearance

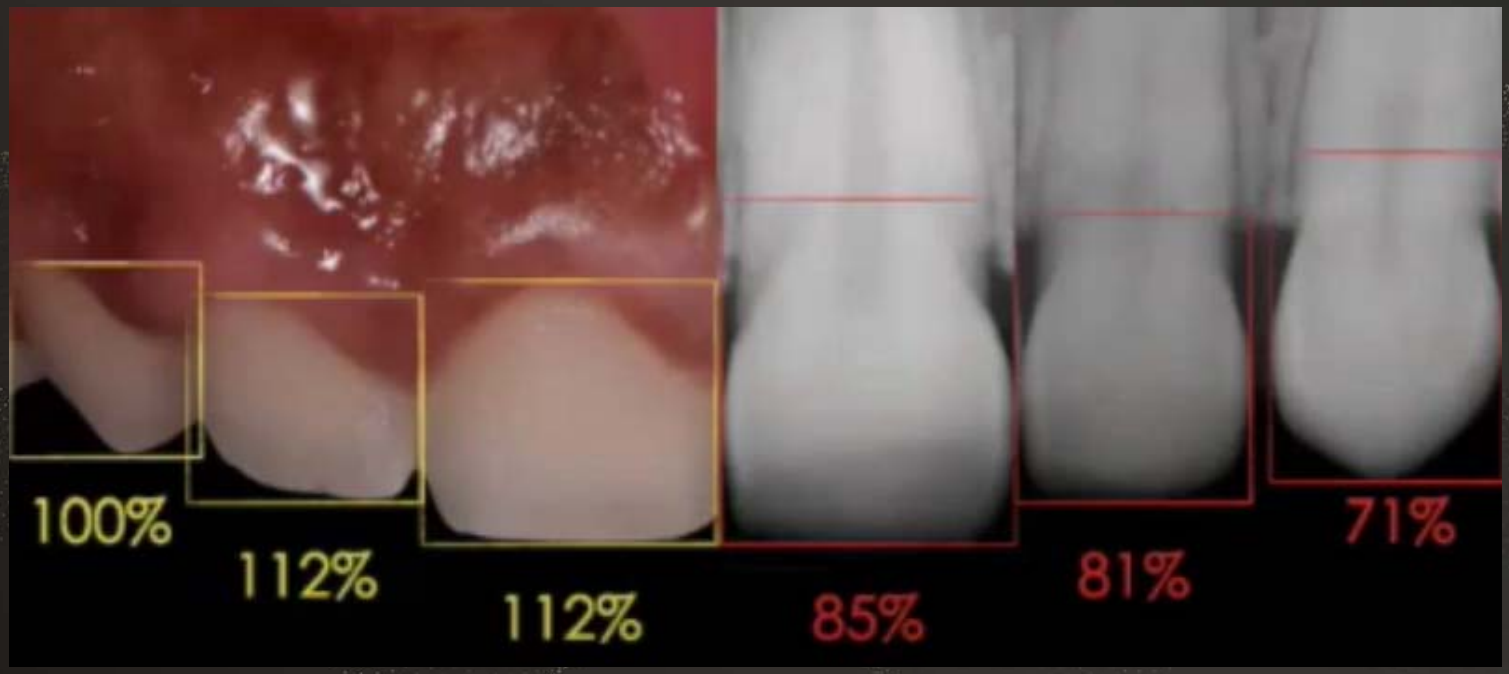
- Short/square clinical crown.
- All 6 anterior teeth are affected.
- Gingival display > 2mm.
- Thick-flat phenotype.

Alpiste-Illueca F. 2011

Altered passive eruption (diagnosis)



Case 9



Altered passive eruption type 1B
Gingivectomy + osseous reduction

Case 9

Gingivectomy

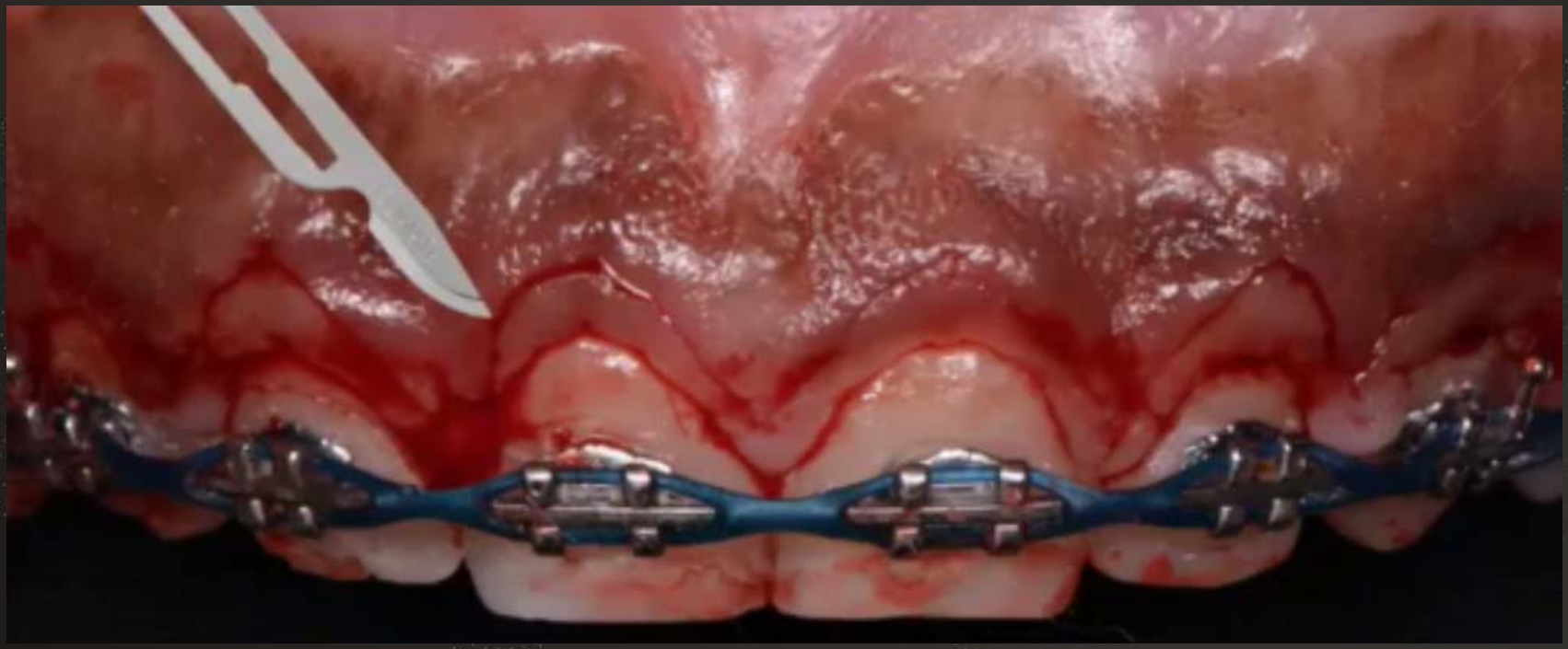
Patient refused to remove bone

Case 9

Case 9

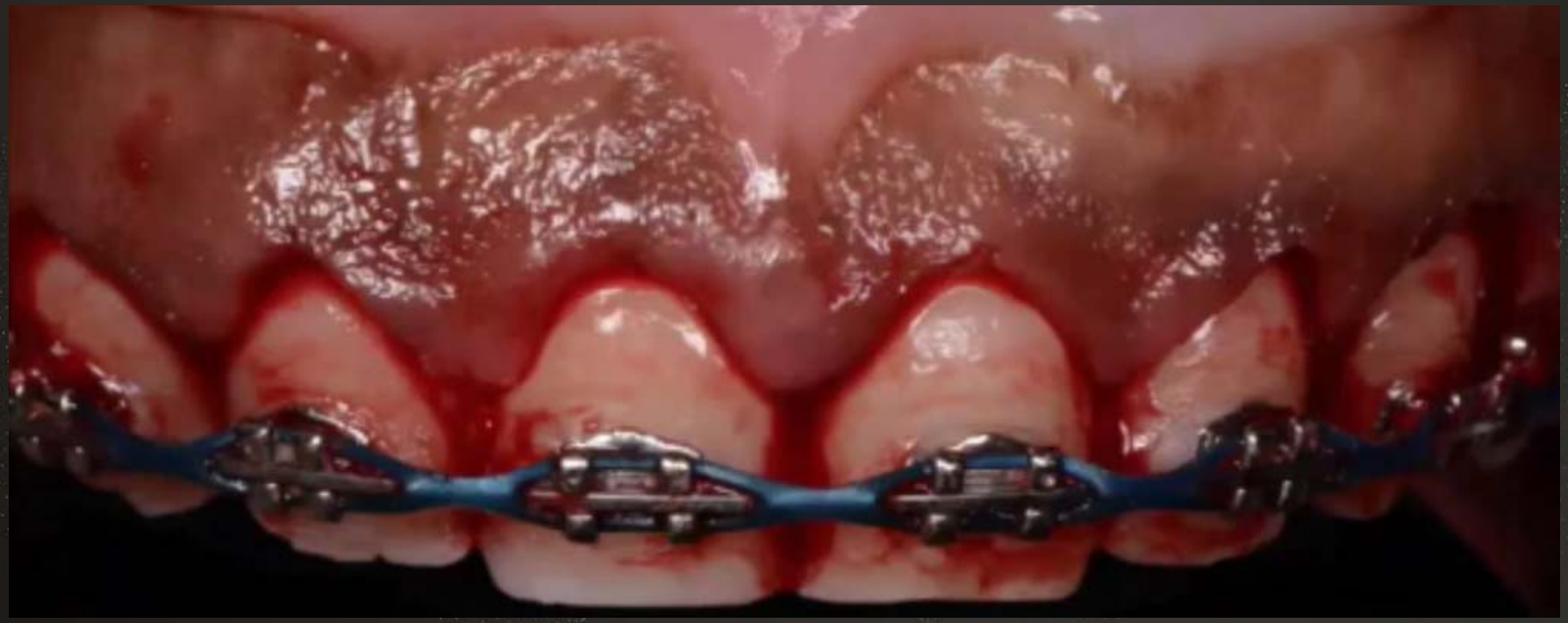
1 year later
Gingivectomy + osseous reduction

Case 9



Gingivectomy with no. 15C

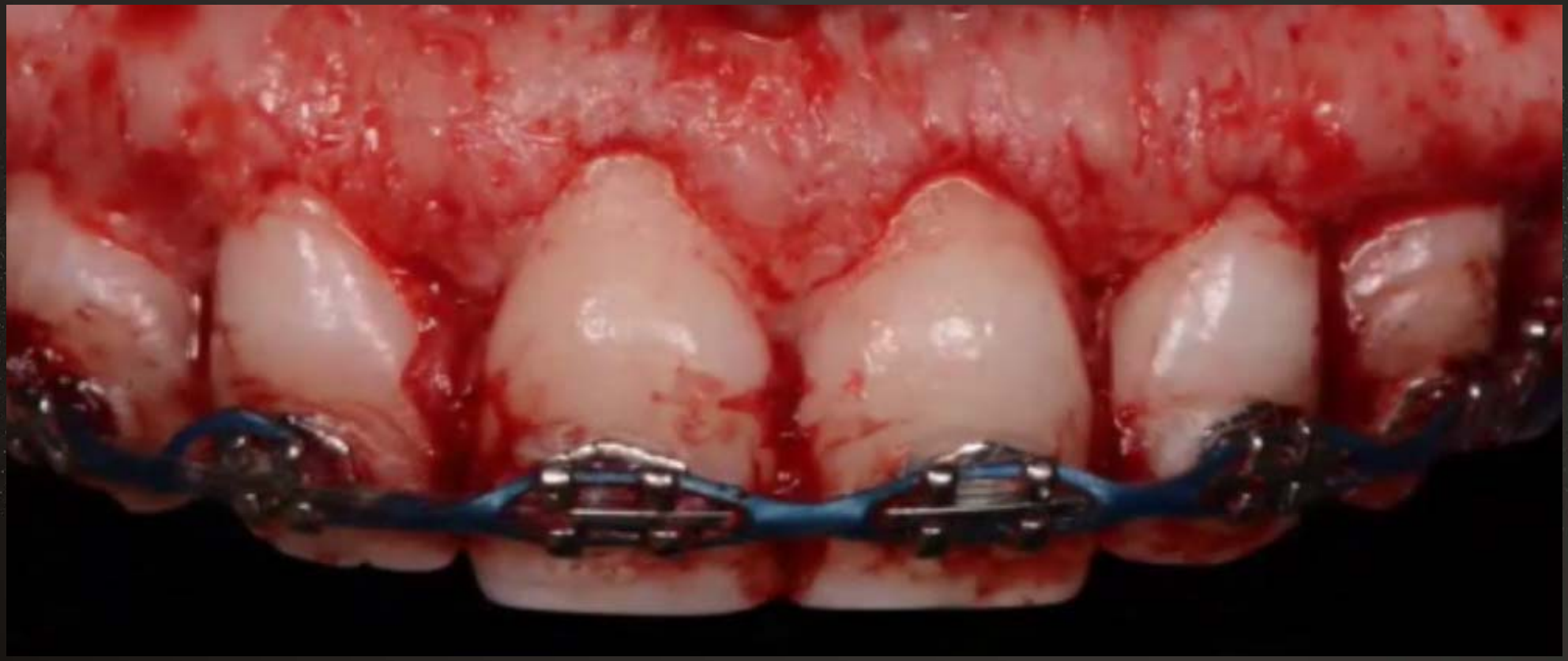
Case 9



Flap: full thickness

Case 9

Coverd CEJ

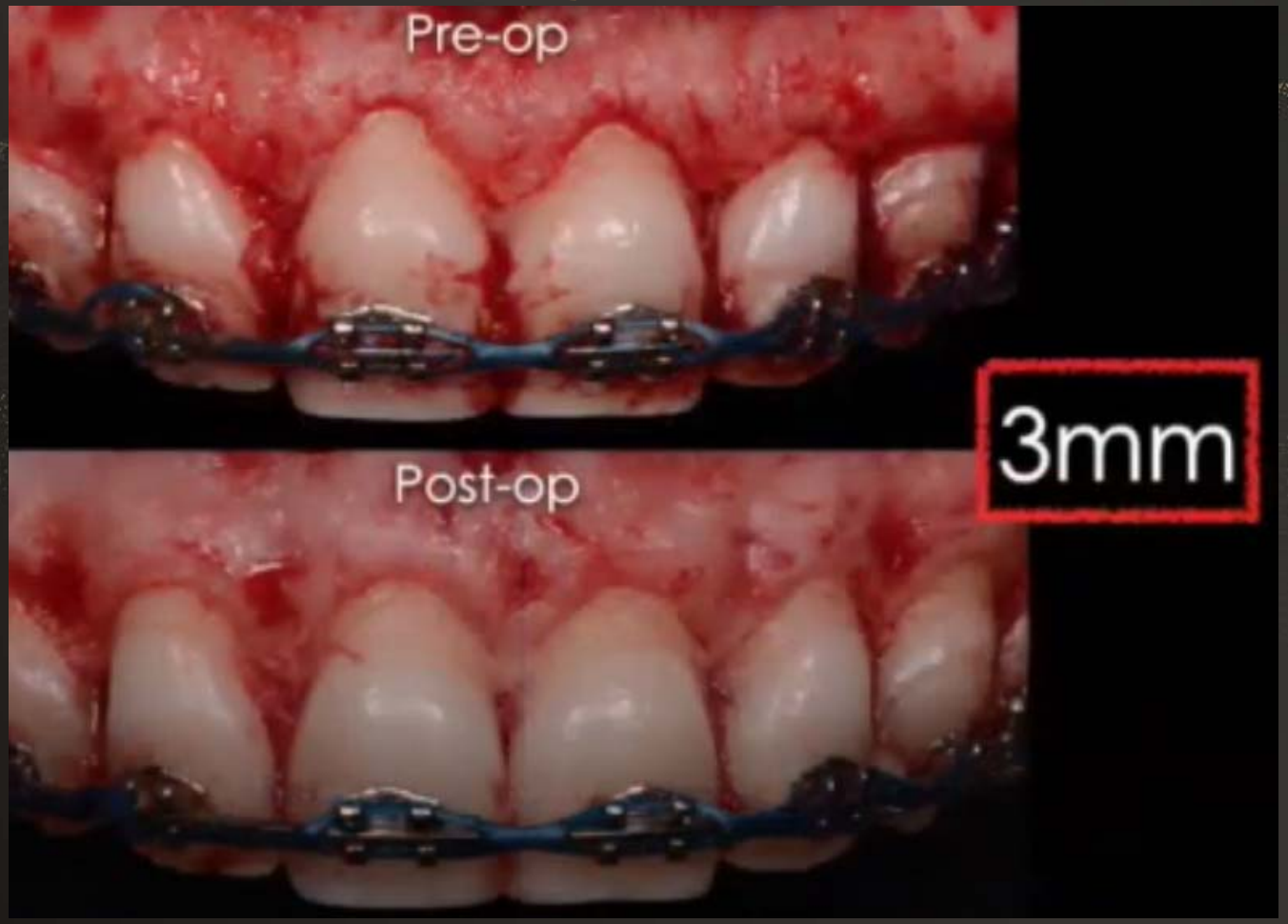


Case 9

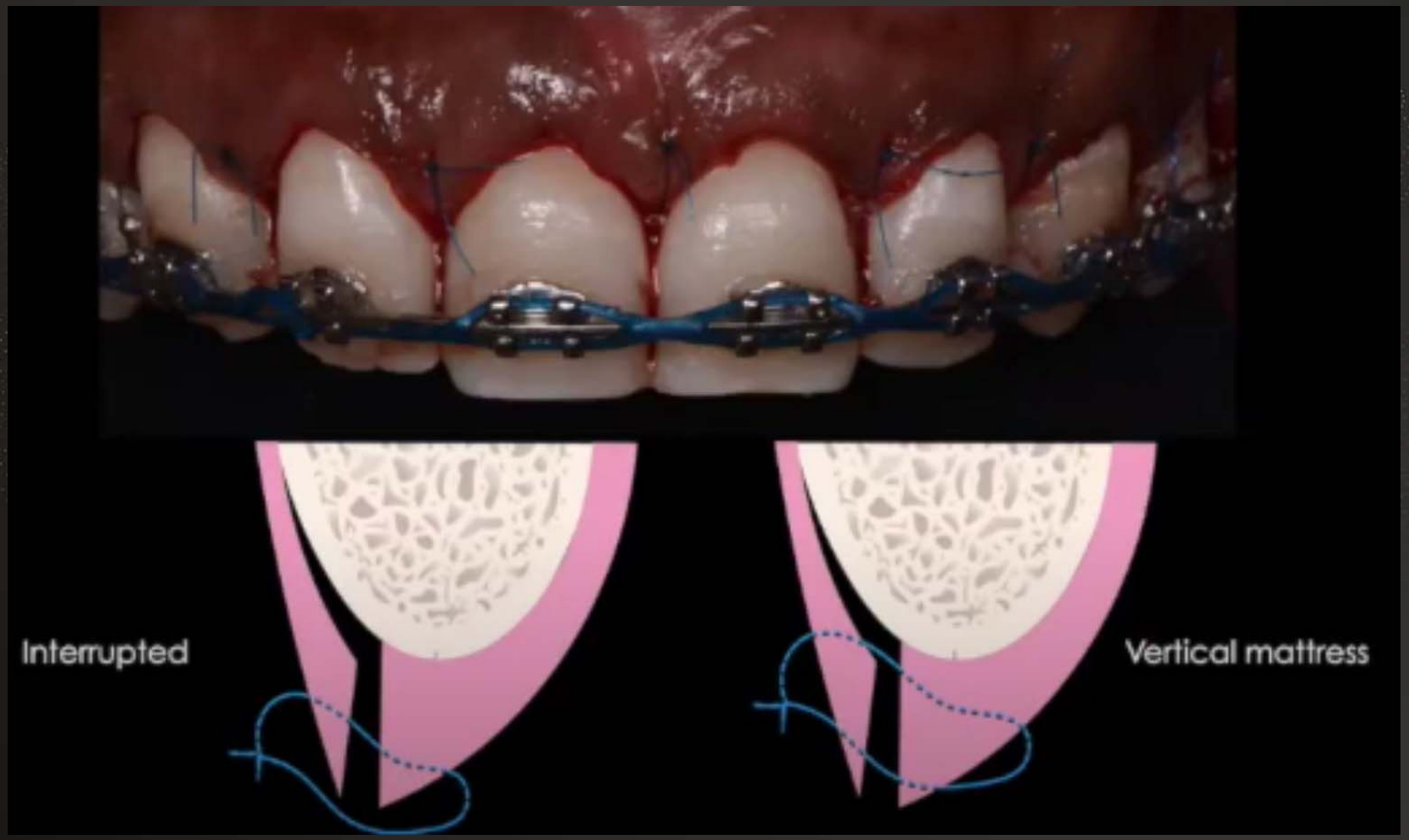
Removal of ledge

Case 9

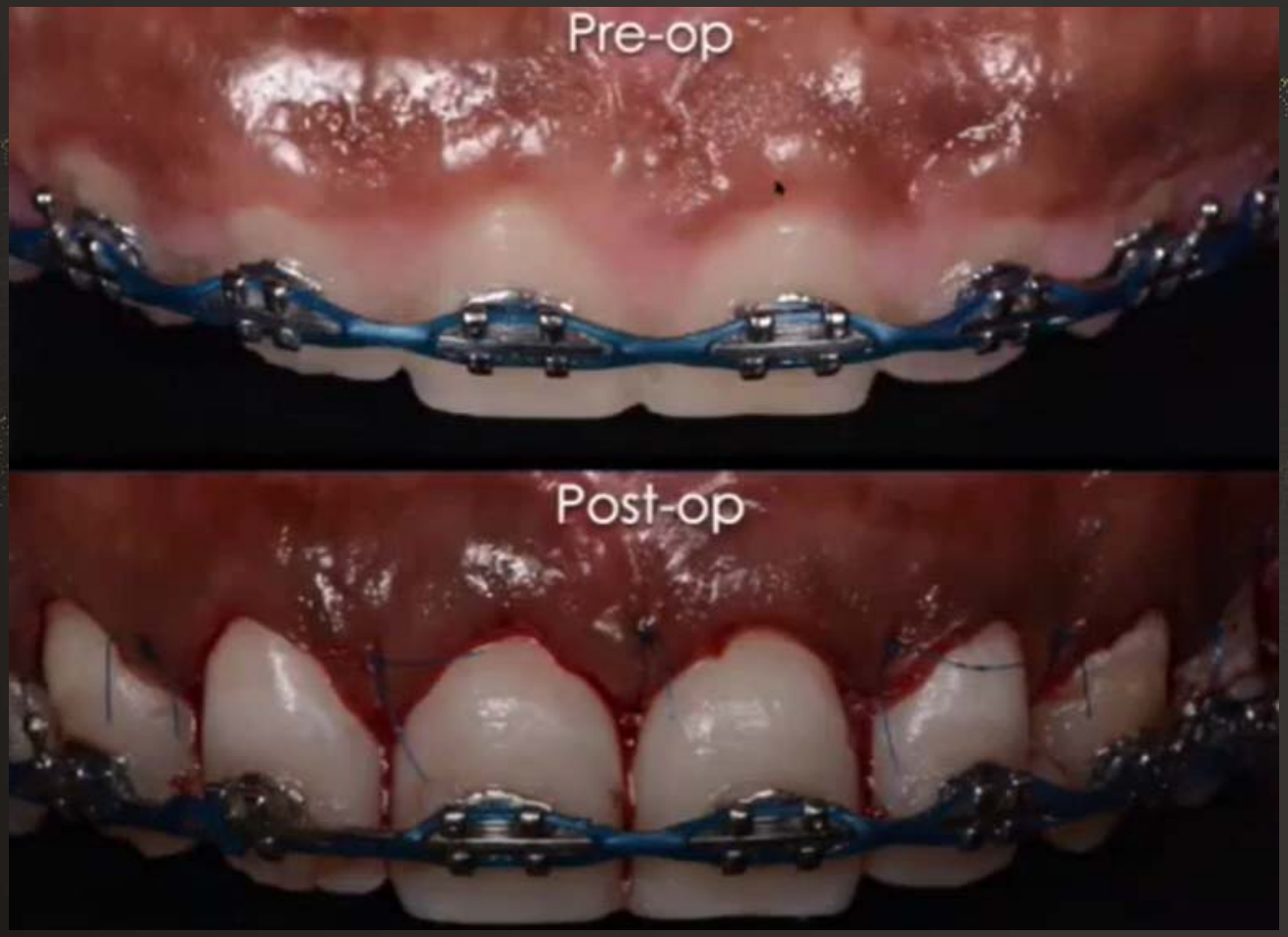
Carving interproximal



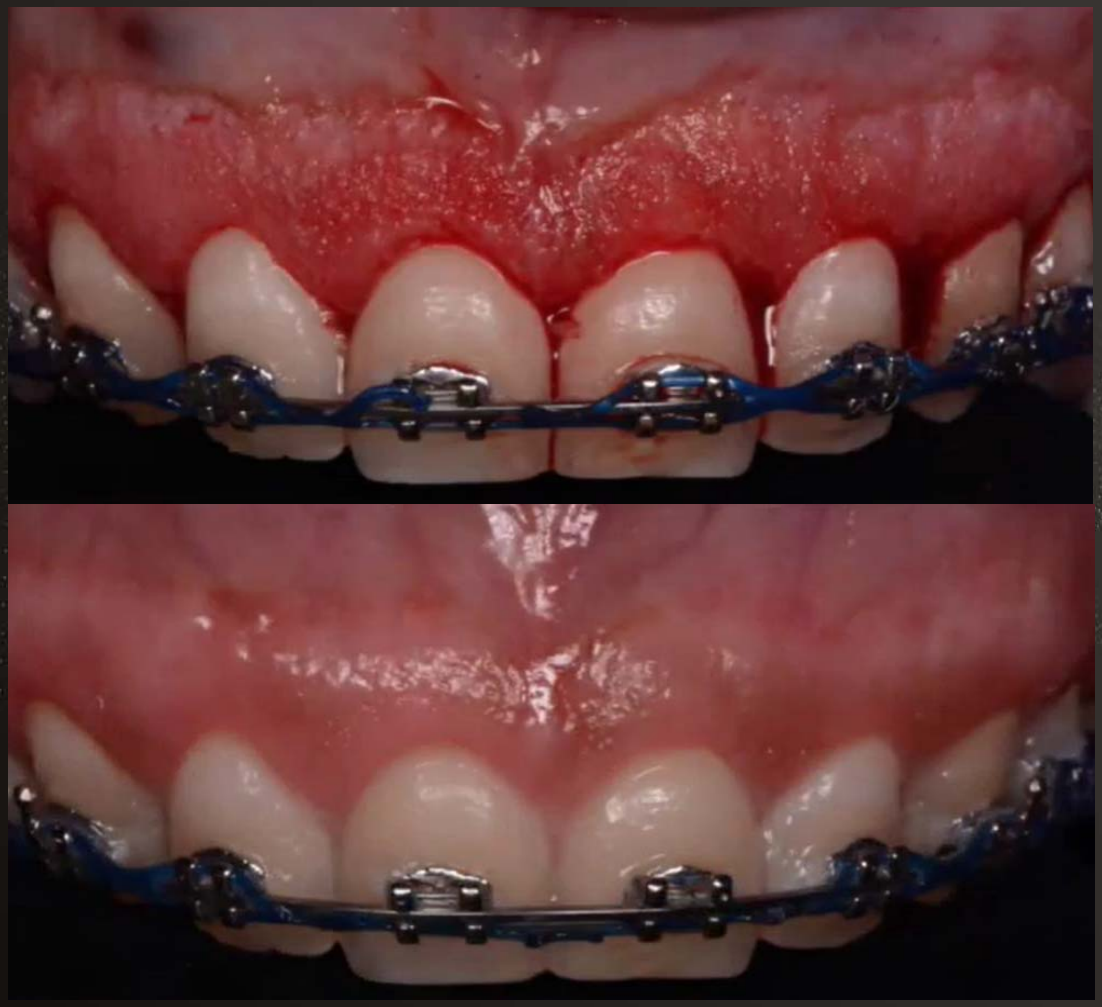
Case 9



Case 9



Case 9



Depigmentation

After depigmentation

Message No. 3

Altered passive eruption

No restoration needed

Surgery without guide

Thin and thick scallop biotype 3 mm.
Thick flat biotype >3 mm.

Case complete

Functional Crown Lengthening

Functional crown lengthening

Uses

- ✓ To expose more abutment tooth structure.
- ✓ To expose fracture line.
- ✓ To expose restoration margin.
- ✓ 360 degree circumferential bone reduction.

Functional crown lengthening

Indications

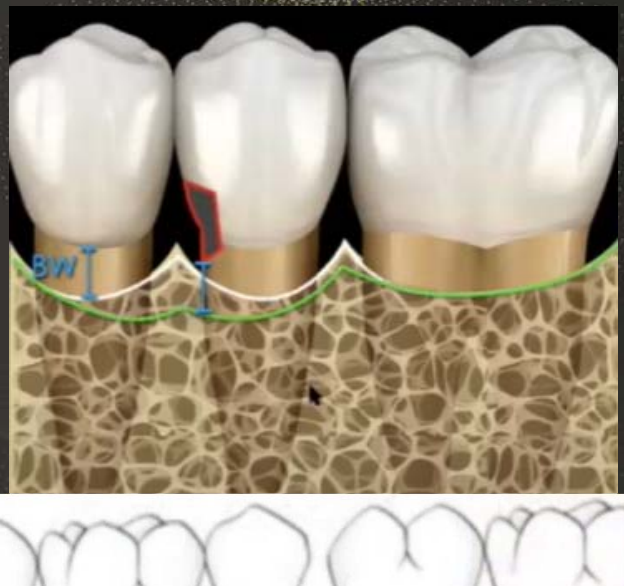
- ✓ Insufficient tooth structure.
- ✓ Subgingival fracture.
- ✓ Deep caries.
- ✓ Cervical root desorption.

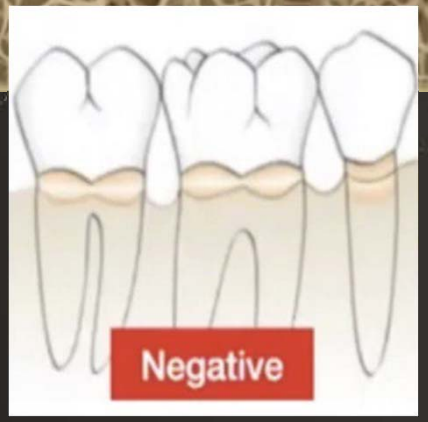
Functional crown lengthening

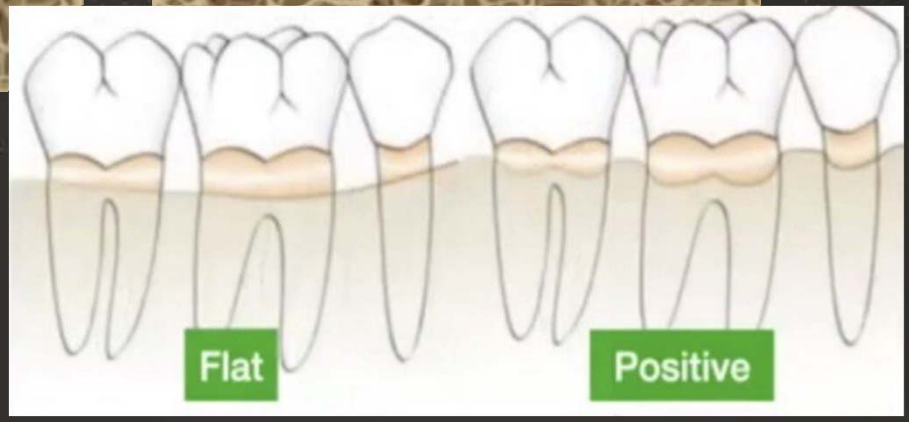
Contraindications

- ✓ Poor crown root ratio (less than 1:1).
- ✓ Furcation exposure.
- ✓ Root proximity.
- ✓ Compromising of adjacent tooth.

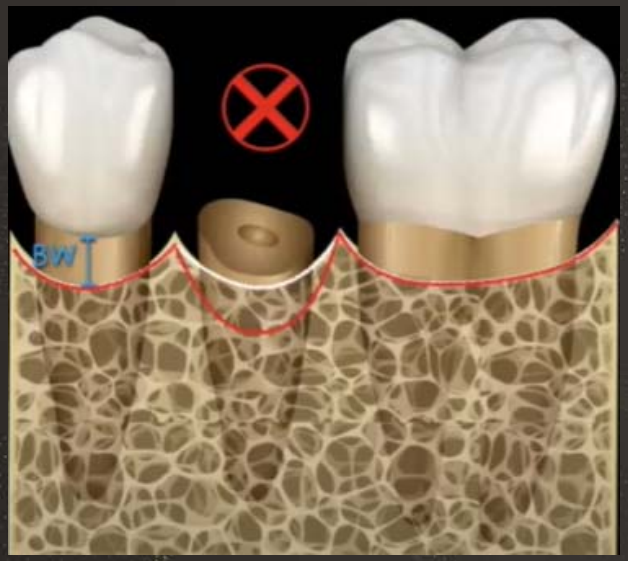
Ingber technique 1977 (3mm)

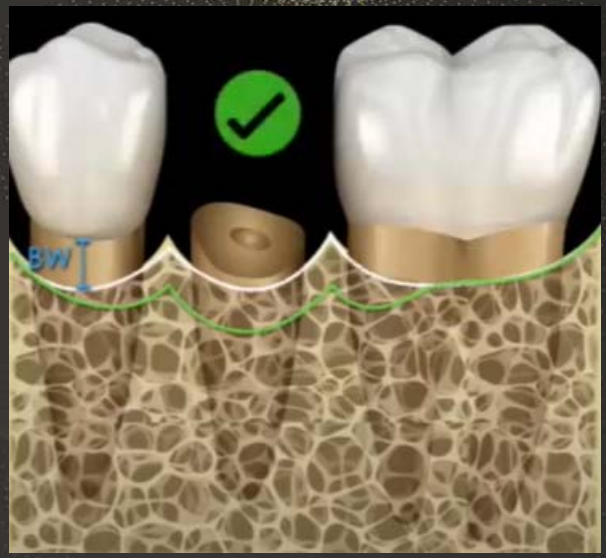






Ingber technique 1977 (3mm)





To avoid tissue rebound

Lanning 2003- 0.26mm rebound because
Take bone from non adjacent site

Ingber technique 1977 (3mm)

- ✓ Established restorative margin/finish line.
- ✓ Sufficient bone reduction for treated tooth and adjacent teeth.
- ✓ Maintain positive/flat architecture.
- ✓ Furcation management(critical distance from the furcation).

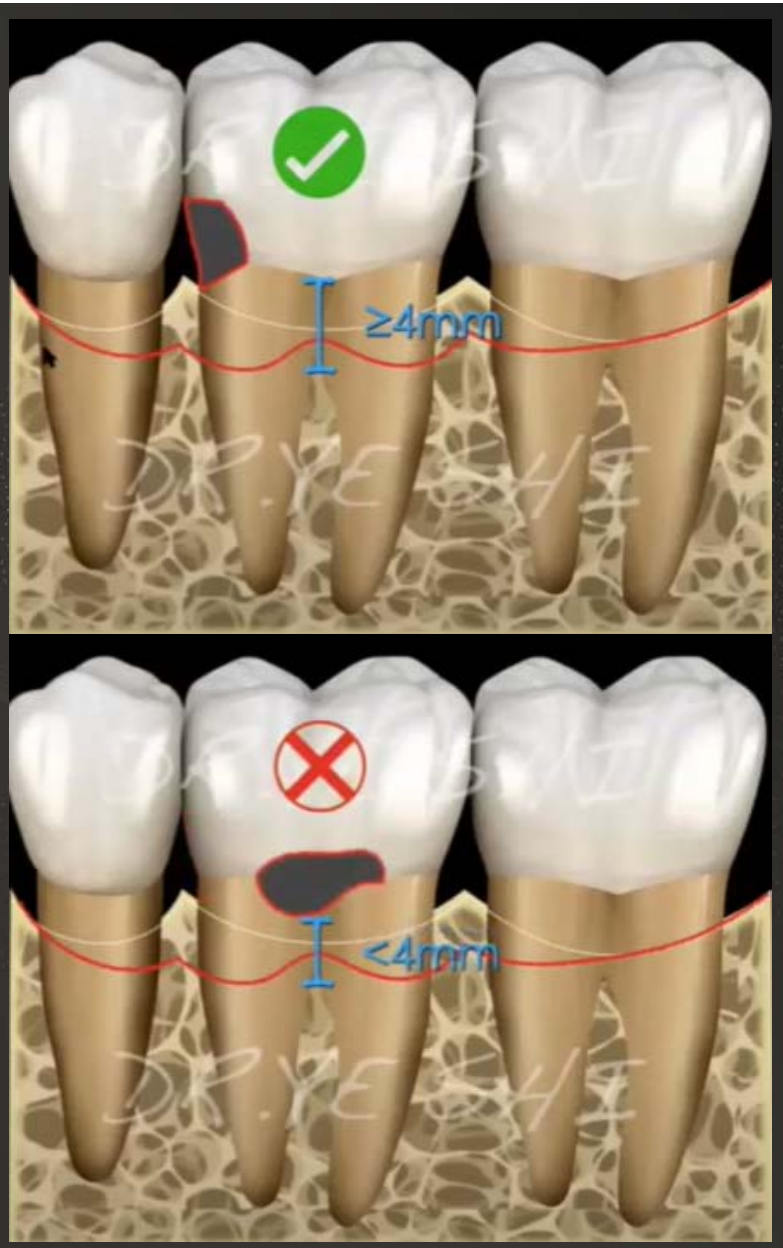
Ingber technique 1977 (3mm)

Critical distance from the furcation CDF

✓ The distance from the furcation entrance to the margin of the temporary crown.

4mm

Dibart et al. 2003



Ingber technique 1977 (3mm)

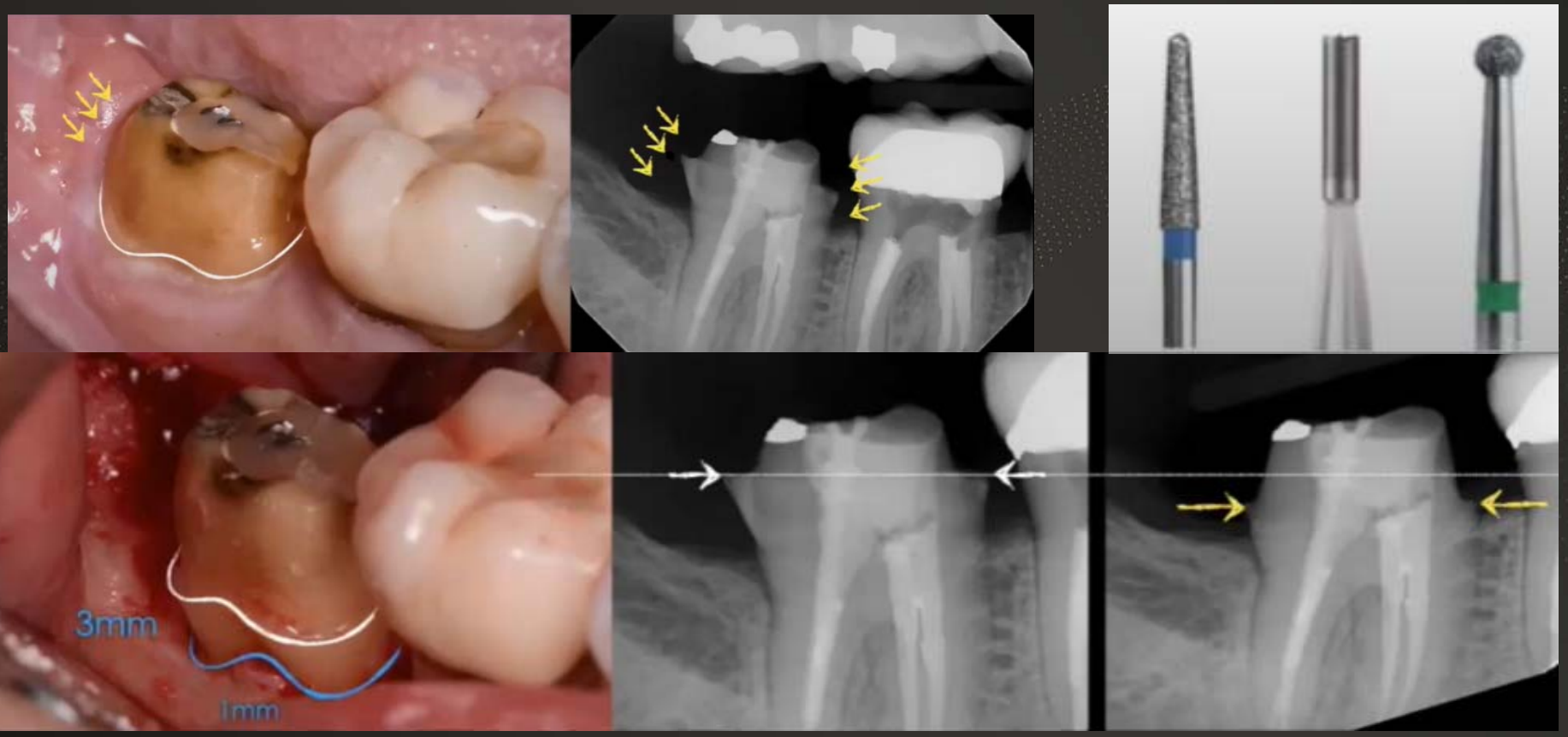
Step 1: restorative evaluation

- ✓ Crown root ratio(≥1:1).
- ✓ Abutment height(4-5).
- ✓ Ferrule(2mm).

Step 2: periodontal evaluation

- ✓ Periodontal health.
- ✓ Furcation (cdf >4mm).
- ✓ Adjacent teeth (mobility).

Case 15



Initial prep

Re-prep

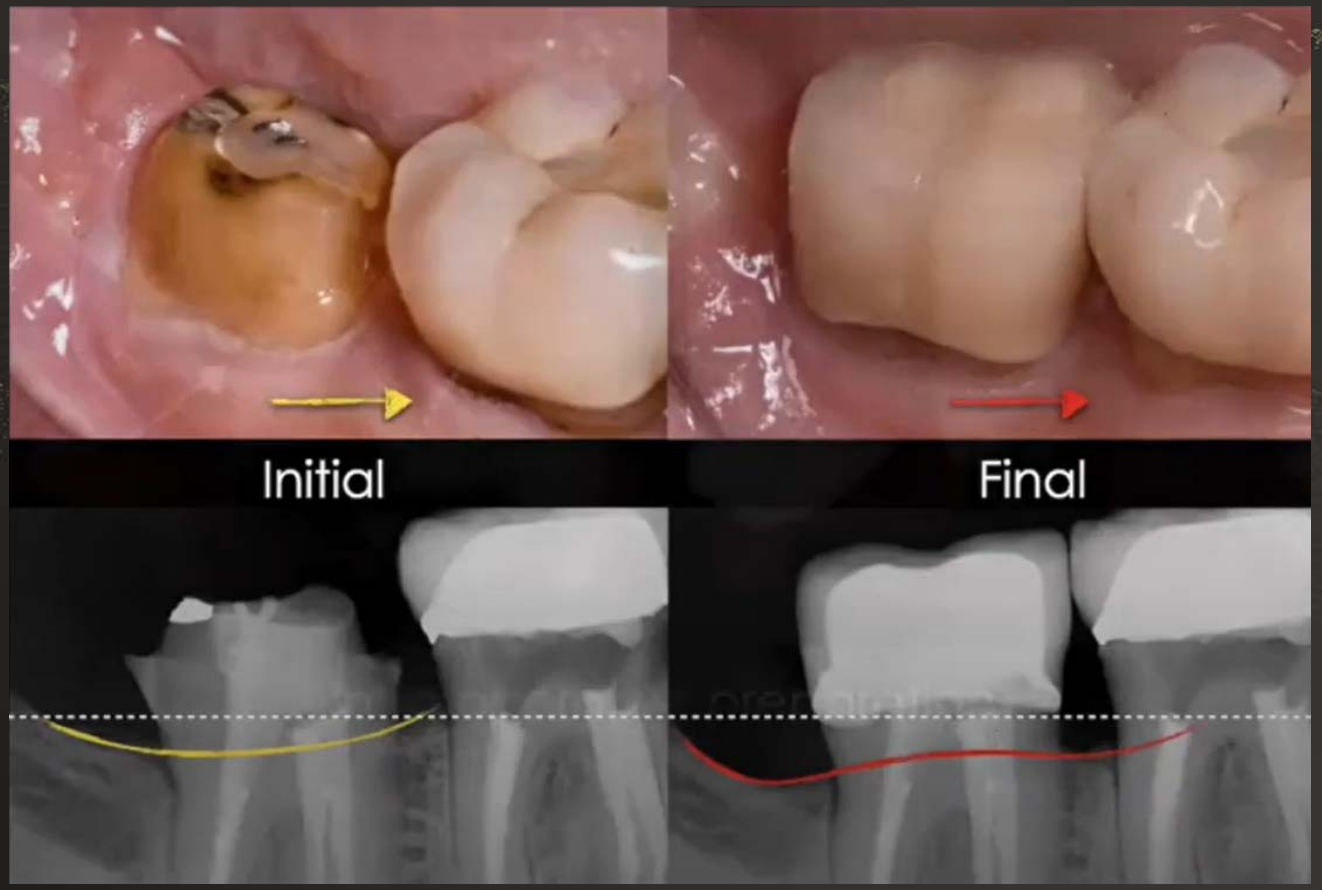
Dr. shi

Case 15

Surgery Immediate post-op 3weeks post-op Final

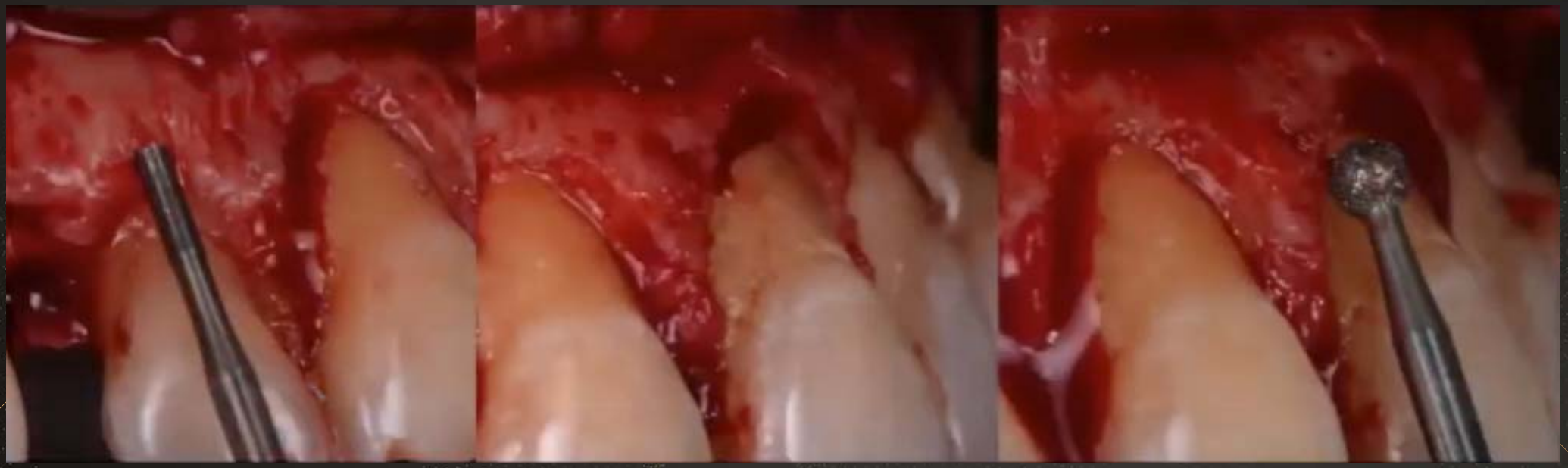
Case 15

Why rescission on adjacent teeth



Case 16

3mm burs



Case 17

Intra operative preparation

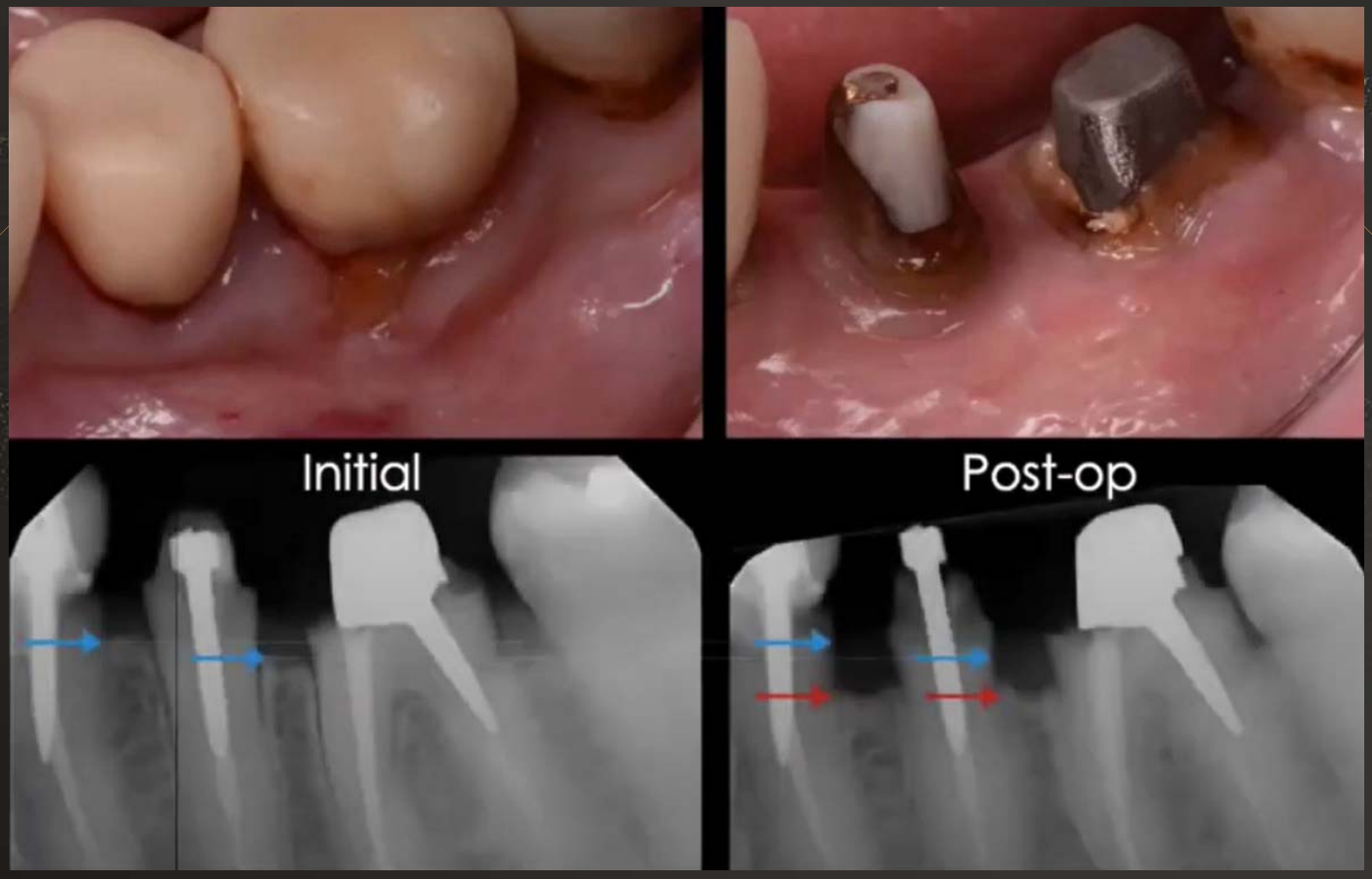
Case 18

Case 19

Odontoplasty

CTG

Case 19



How will you treat this case?

Case 25

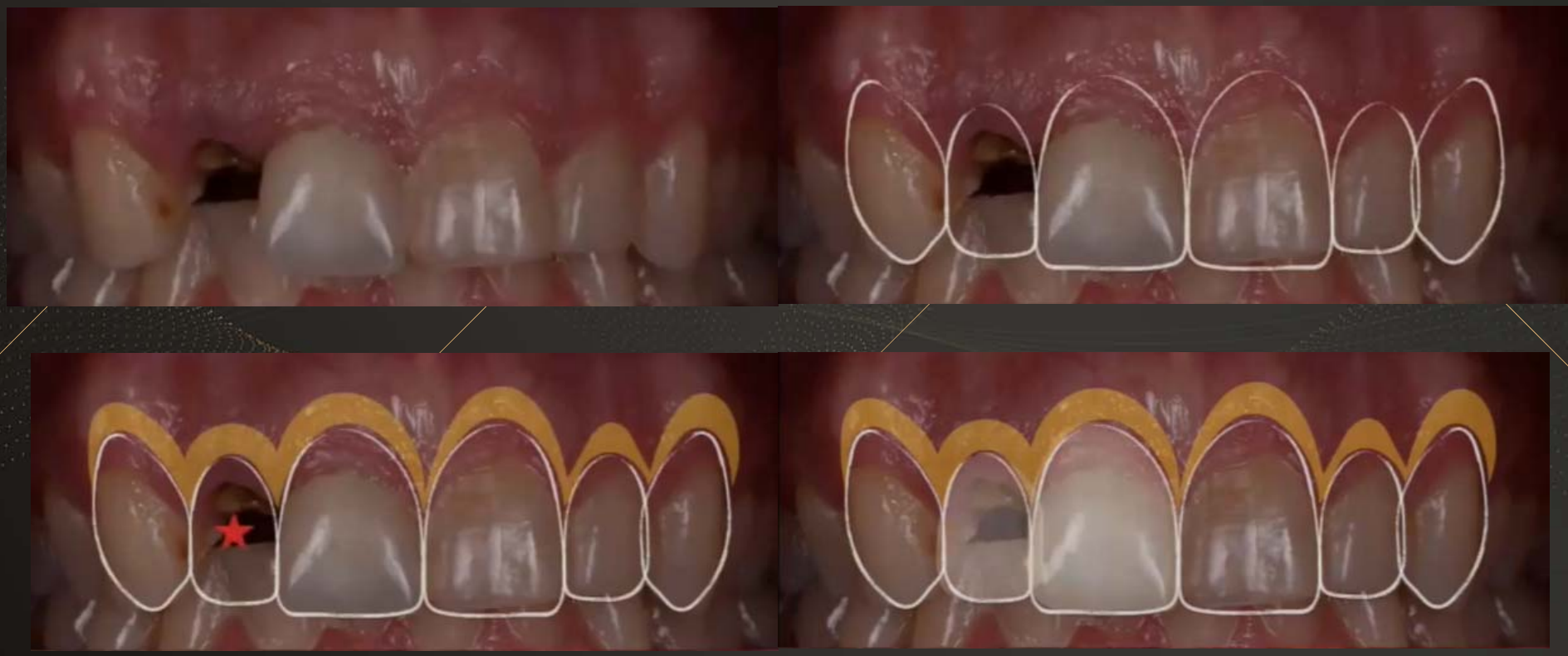
1.5 years later, after 6 surgeries…

Case 25

Altered passive eruption type 1B

Case 25

Esthetic CL with FCL to lateral



Ortho or crown lengthening ?

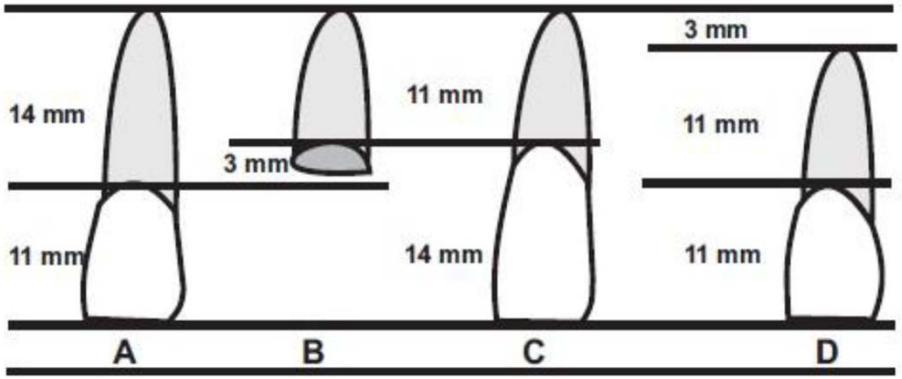
High smile line

Ortho or crown lengthening ?

High smile line

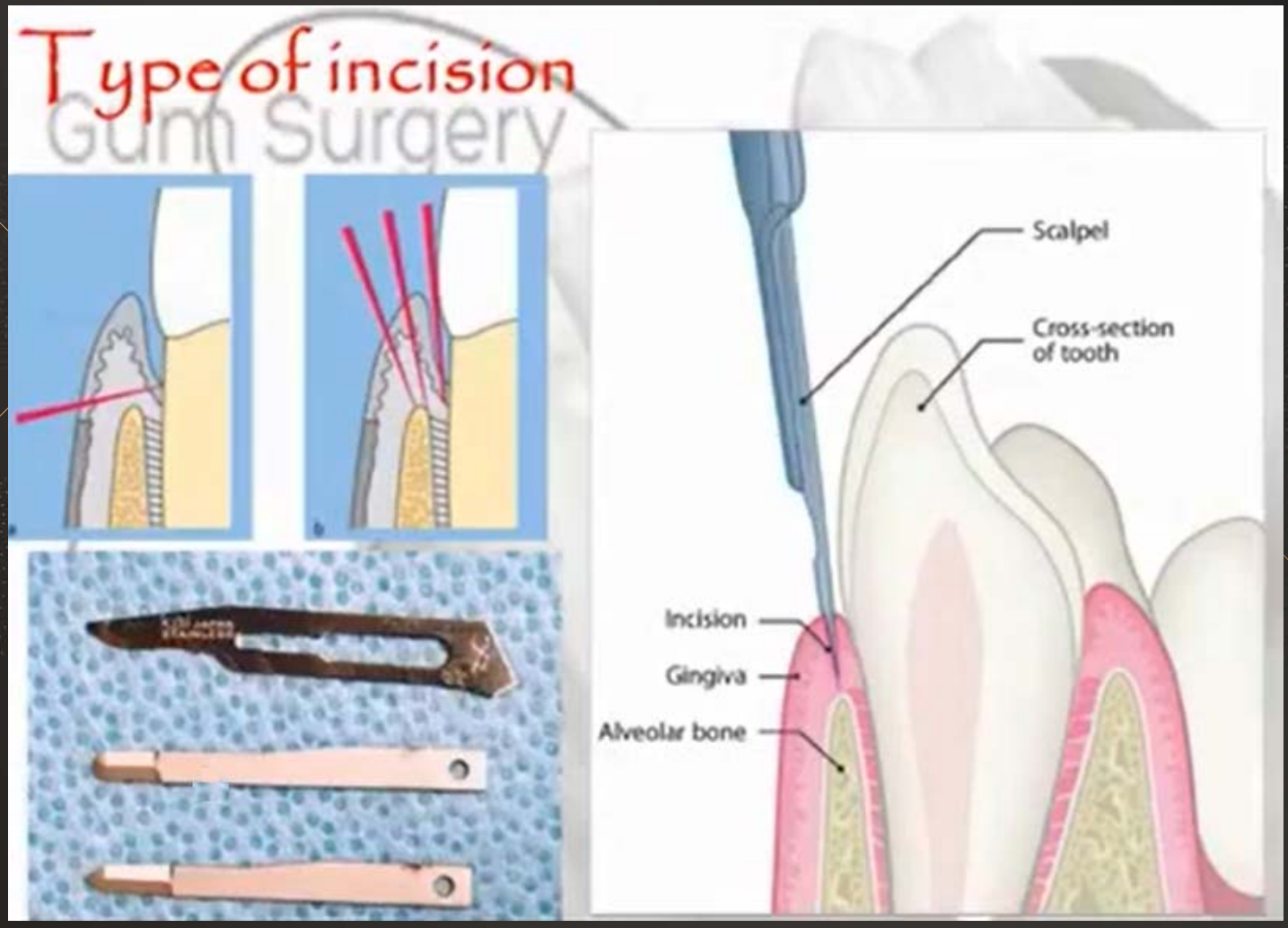
-LOW ORTHODONTIC FORCE, the tooth can be extruded slowly, bringing the al veolar bone and gingival tissue with it

-RAPID ORTHODONTIC EXTRUSION, where the tooth is extruded rapidly. Durin g this period, a supercrestal fibrotomy is performed weekly in an effort to preve nt the tissue and bone from following the tooth. Occasionally, especially with ra pid orthodontic extrusion, there is no need for osseous reduction and the soft t issue may be removed by simple excision.



Surgical steps

1. Internal or external bevel incision
   - Apically displaced flap or gingivectomy
2. Osteotomy
   - Reduction of bone height
3. Osteoplasty
   - Reduction of bone thickness


Type of incision
Gum Surgery
Scalpel
Cross-section of tooth
Incision
Gingiva
Alveolar bone

Sulcular Incisions

"Incision that maintains the entire marginal gingival tissue. It is made from the base of the gingival sulcus, parallel to the root surface, reaching the alveolar bone crest."

Indicated for buccal side with less keratinized gingiva and esthetic concerns

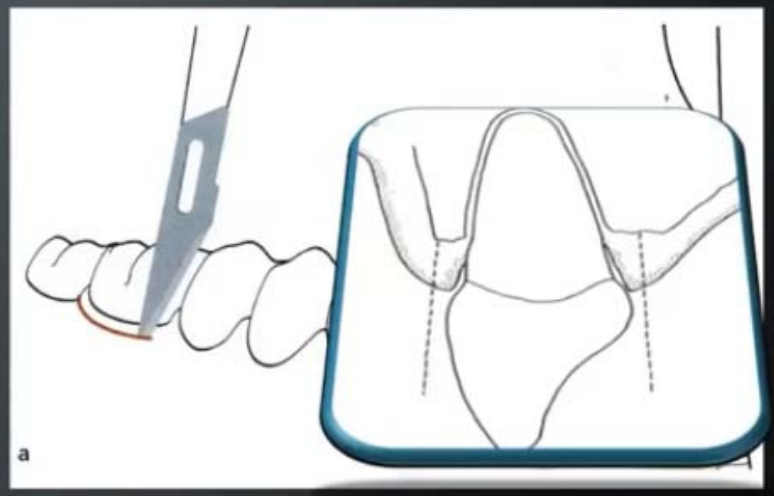
Submarginal Incision

Inverse bevel incision starts apical to marginal gingiva and down to osseous.

Indicated on buccal area with min. 3-4mm keratinized tissue and on palatal/lingual area based on desired amount of exposure and final margin positioning.

Submarginal Incision Technique

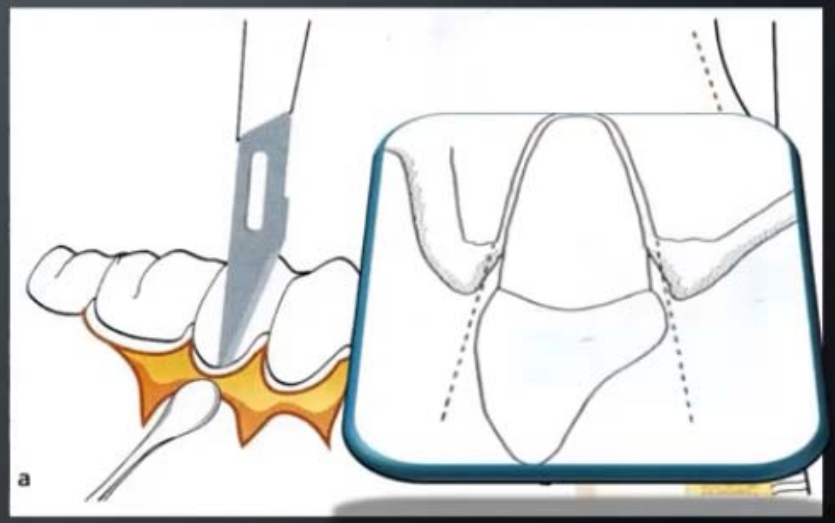
- Initial incision parallel to the long axis of the tooth
- Apical margin depends on extent of flap



Ramfjord SP., 1974, The modified widman flap, J of Periodontology
Lindhe J., 2003, Clinical periodontology and implant dentistry 4th ed.

Submarginal Incision Technique

- Following flap elevation, a second intracrevicular incision is made to separate the tissue collar from the root surface.



Ramfjord SP., 1974, The modified widman flap, J of Periodontology
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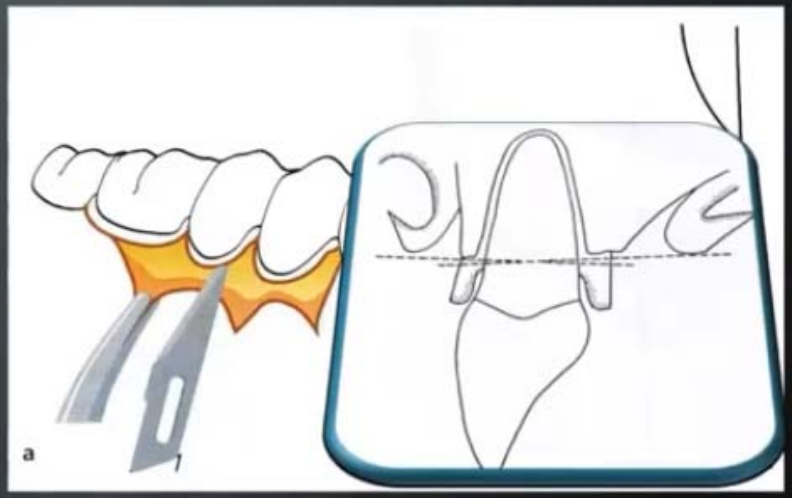
Submarginal Incision Technique

- A third incision is made perpendicular to the root surface and as close as possible to the bone crest, separating the tissue collar from the alveolar bone.



Ramfjord SP., 1974, The modified widman flap, J of Periodontology
Lindhe J., 2003, Clinical periodontology and implant dentistry 4th ed.

-Extend flap at least 1 tooth mesial and distal from the involved tooth

-Full to partial thickness flap

Marking at 4mm

Potential Complications

- Furcation + recession creation (due to excessive bone removal)
- Mobility of tooth
- Formation of periodontal pocket
- Creation of black triangles and long final crown
- Phonetic impairment
- Hypersensitivity
- Relapse (due to inadequate bone removal)

Rules of Margin Placement

RULE 1 : If the sulcus probes 1.5 mm or less, place the restoration margin 0.5 mm below the gingival tissue crest.

RULE 2 : If the sulcus probes more than 1.5 mm, place the margin one half the depth of the sulcus below the tissue crest. This places the margin far enough below the tissue so that it still is covered if the patient is at higher risk of recession

RULE 3 : If a sulcus greater than 2 mm is found, then evaluate to see whether a gingivectomy could be performed to lengthen the teeth and create a 1.5 mm sulcus.

Steps in preparation without traumatizing the attachment

Step 1
- Prep the tooth completely to the level of gingival crest, leaving only the subgingival margin preparation to be completed.

Step 2:
- Place a thin retraction cord in the sulcus (000, 00)

Step 3
- Final Prep subgingivally just on top of the cord

Step 4:
- Impression – Double cord technique

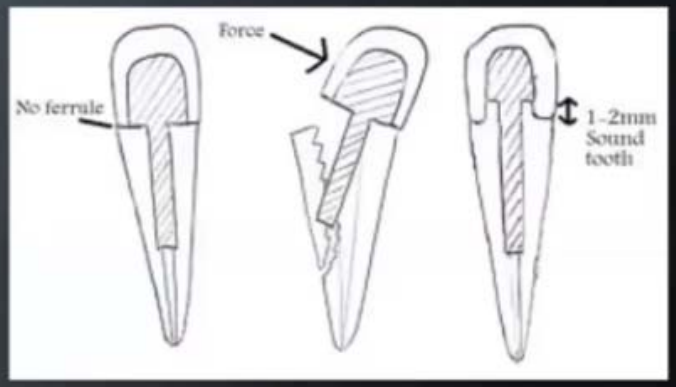
Advantage – the 1st retraction cord acts as a buffer an prevents any violation of biologic width.


Any
Questions?

Ferrule

As defined by "The Glossary of Prosthodontic Terms" ...

- fer_rule \fe˘ r#al\ n (15c) l: *a metal band or ring used to fit the root or crown of a tooth. One way to visualize this effect is when observing a wine barrel. The metal bands or hoops, which encompass the wooden barrel, give support when the barrel is full.*



*A minimal height of **1.5 mm to 2 mm** of intact tooth structure above the crown margin for 360 degrees around the circumference of the tooth preparation appears to be a rational guideline for this ferrule effect*

Therefore...

Biologic width + Ferrule = Approximately

4.5-5mm minimum healthy tooth structure!

Furcation Morphology Relative to Periodontal Treatment

Furcation Root Surface Anatomy

Bower R. *J Periodontol*, 1979; 50:23.

Size of furcation entrance varies from 0.5 to 2.0 mm.

81% of all furcation entrance diameters measure <1mm
58% of all furcation entrance diameters measure <0.75mm
Most curret blade face widths range from **0.75-1.1mm**

Therefore, 60% of the molars studied had furcation entrance diameters smaller than the average curette tip!