Ridge splitting
Ridge Expansion
Osseo-densification

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Lecture Outline

- Bone Characteristics
- Ridge Splitting;
  - *Indications, Techniques, complications, cases and Evidence*
- Ridge Expansion
  - *Indications, Techniques, complications, cases and Evidence*
- Osseo-densification
  - *Concept, advantages, disadvantages, indications, Kits, Case selection*
- Platelet concentrates, PRP, PRF and sticky bone
  - *History, Origin, applications*

Concept

Characteristics of Bone:

1. Bone is flexible & can absorb energy
2. Bone can deform & change shape without cracking as in dental extraction
3. Bone is able to widen with compression
4. Bone is able to lengthen with tension
5. Bone is viscoelastic

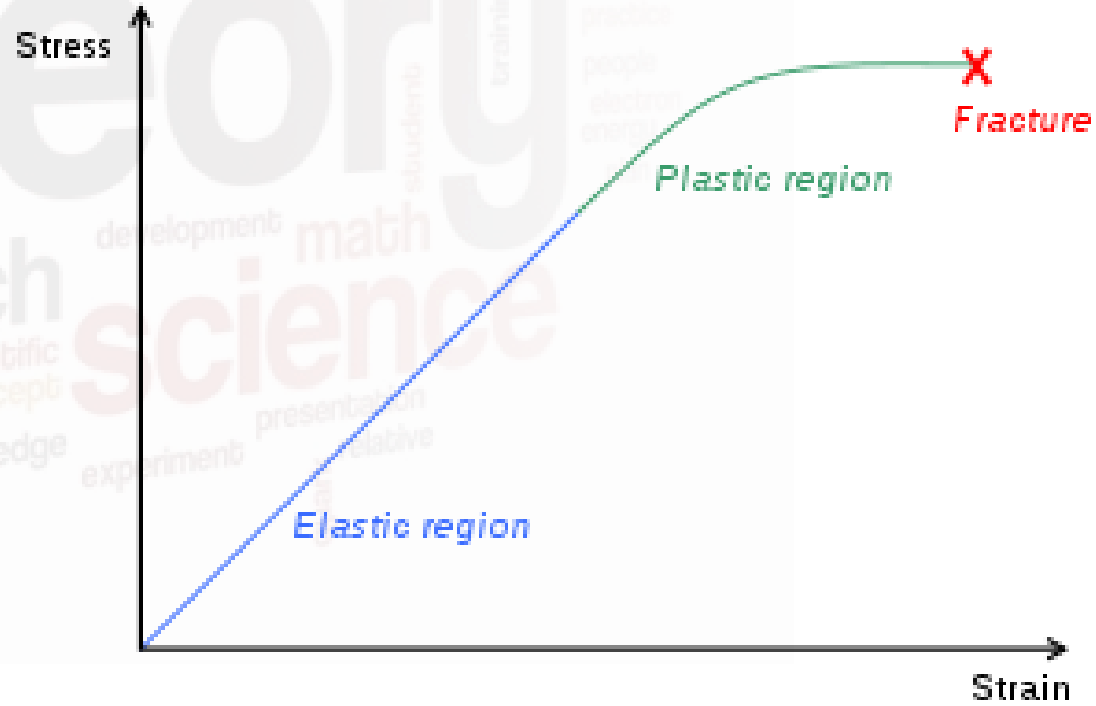
Bone compaction and autografting in an outward expanding direction to form the osteotomy

Concept

- Viscoelasticity of bone allows it to change its shape with time example dental extraction
- Luxation during dental extraction is time dependent stress leading to time dependent strain in the form of expansion of the alveolus

Stress is force

Strain is change by force



Plasticity of Bone

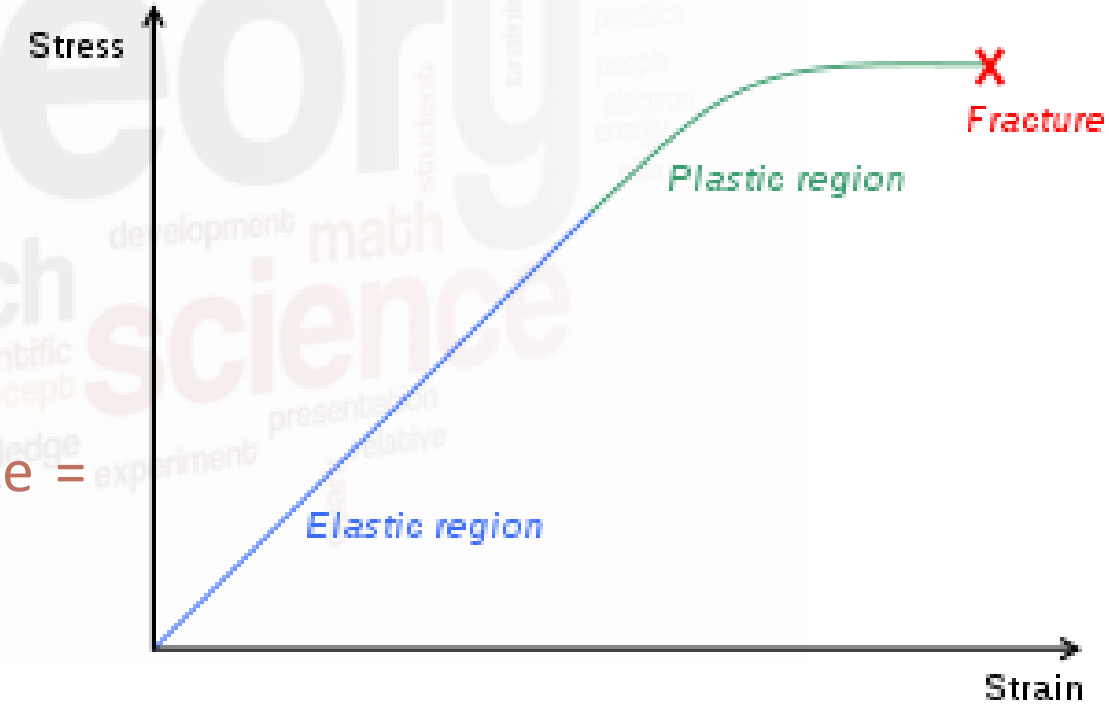
Bone Collagen

Fracture Risk

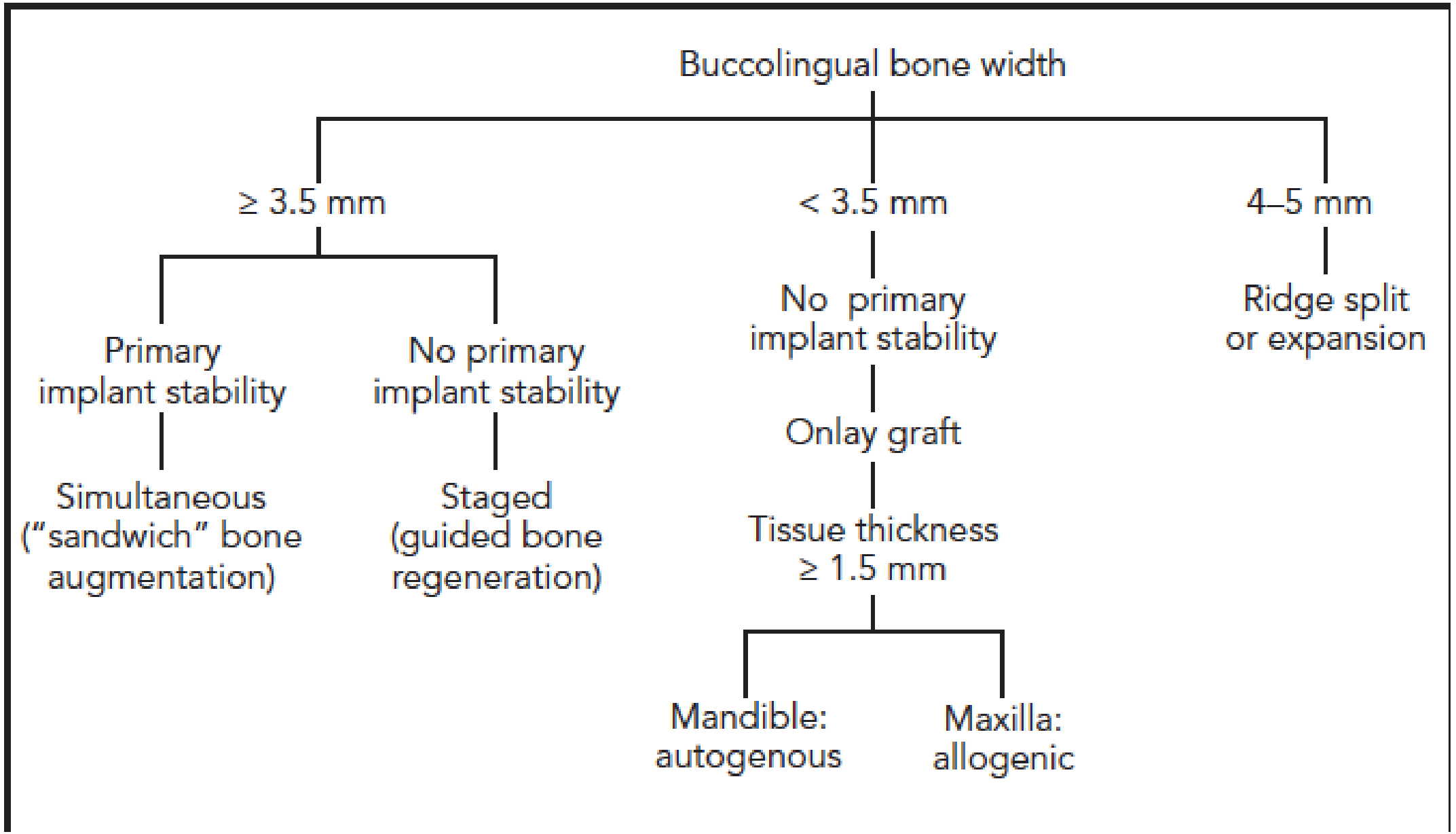
Water

Viscoelasticity

When the weaker bonds break and polymeric chains remain intact expansion occur.



With age, More cross linking = less ground substance = less ability for plastic deformation


Buccolingual bone width
≥ 3.5 mm
< 3.5 mm
4–5 mm
Primary implant stability
No primary implant stability
No primary implant stability
Ridge split or expansion
Simultaneous ("sandwich" bone augmentation)
Staged (guided bone regeneration)
Onlay graft
Tissue thickness ≥ 1.5 mm
Mandible: autogenous
Maxilla: allogenic

Bone Quantity

TABLE 1

Classification of alveolar ridge width

Alveolar ridge width (mm), based on CBCT* scan	>10	8–10	6–8	4–6
Alveolar ridge deficiency	No deficiency	Minimal	Mild	Moderate
Class	0	I	II	III
Schematic diagram				
Comments				
Indications for surgery	Hard tissue surgery is not indicated. Occasionally, alveolar width (buccal convexity) can be improved for esthetic reasons with a soft tissue graft.	Hard tissue surgery is rarely indicated. Occasionally, alveolar width can be improved by particulate bone graft or palatal soft tissue graft for esthetic and prosthetic reasons.	Particulate (GBR) grafting or ridge-split is often needed to improve labial bone projection and proper occlusal implant position.	An ideal width for the ridge-split procedure that can be done in a single- or two-stage approach (see Figure 3). Block graft or GBR can also be done.
Immediate insertion	Yes	Yes	Yes/no, depends on presence of apical bone for primary implant stability	Yes/no, depends on presence of apical bone for primary implant stability (see Figure 4)
Operator experience	Basic	Basic	Basic	Basic to advanced

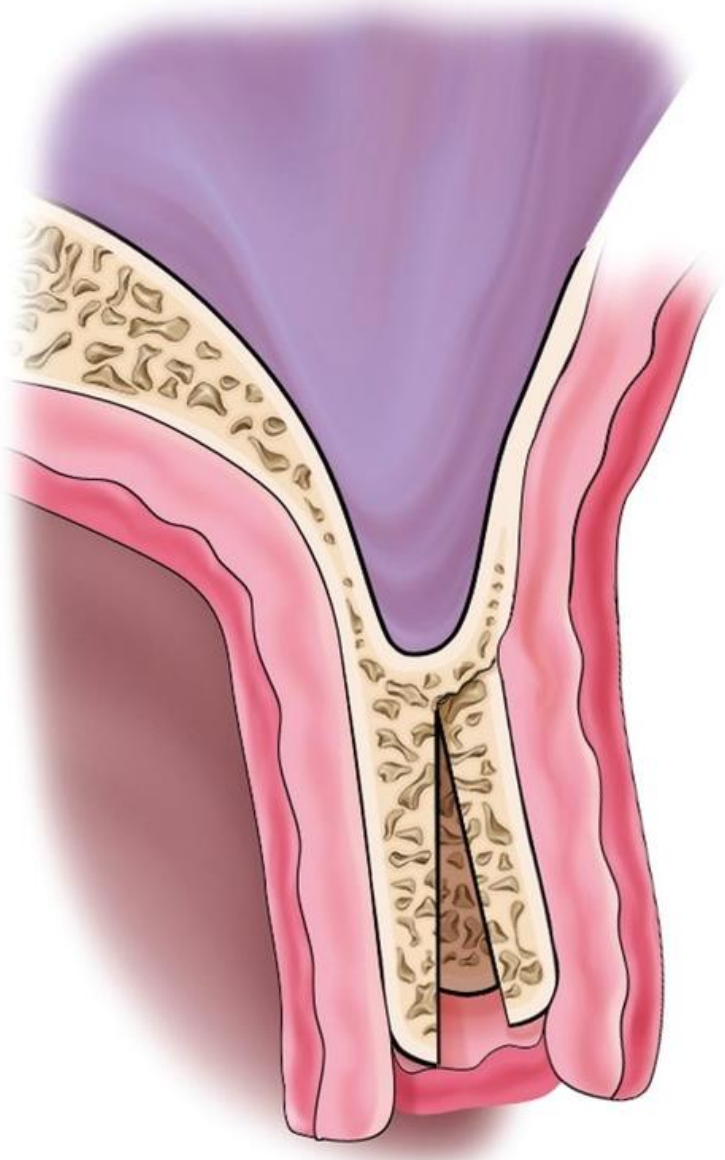
Bone Quantity

TABLE 1

Extended

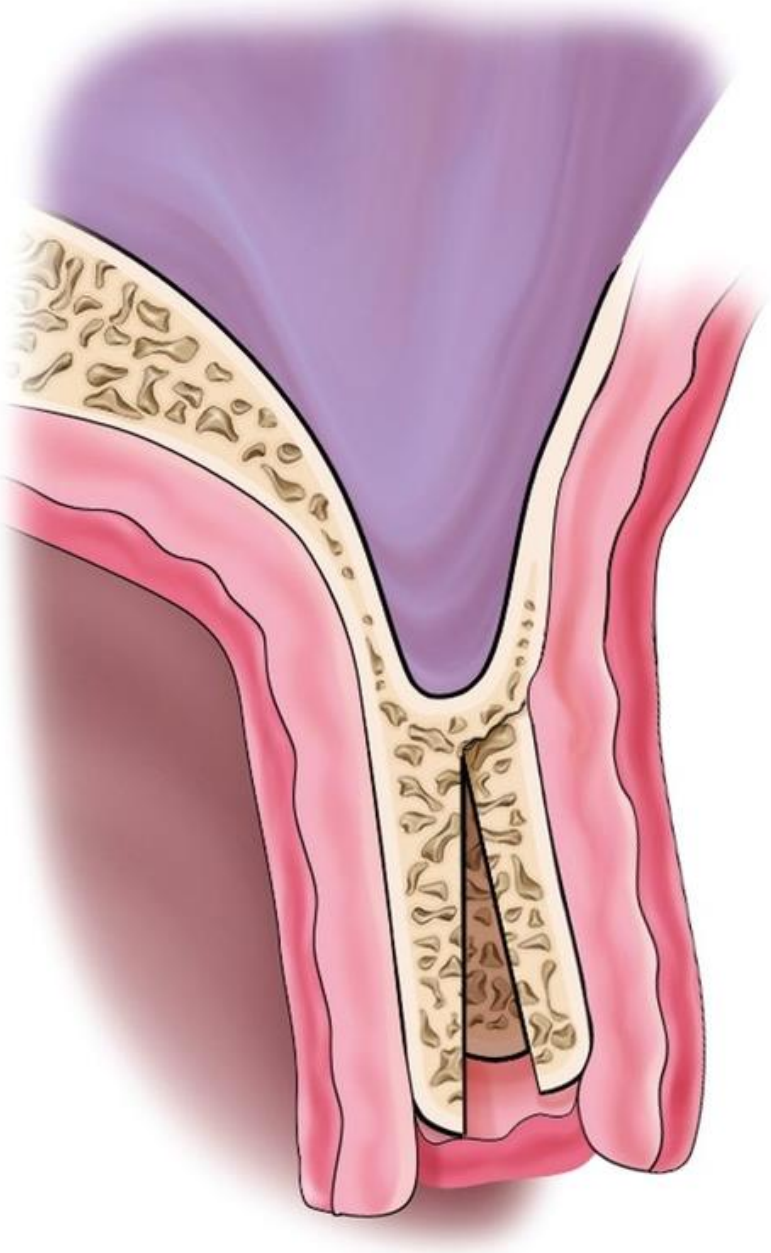
2–4	<2	6–10/2–4	2–4/6–10
Severe	Extreme	"Hourglass" (undercut) (buccal or lingual)	"Bottleneck"
IV	V	VI	VII
			
		GBR† at the mid ridge level can be done	Ridge reshaping or GBR at the top of the ridge can be done
Ridge-split or block bone graft is a graft of choice (surgeon's experience).	Large extraoral block graft is a preferable surgical choice. Alternative is multiple and sequential augmentation procedures.		
Not recommended	No	Yes/no, depends on the severity of the undercut	Usually yes, can depend on the morphology of the top portion of the ridge
Advanced	Advanced	Basic	Basic

Ridge Splitting



Ridge deficiencies could require the need for GBR, but this also has its drawbacks, such as:

1. Invasive procedure
2. Donor site morbitity and the need for second surgery
3. Resporption of grafting material
4. Risk of membrane collapse(Resorbable membranes)
5. Risk of exposure and infection(Non resorbable membranes)

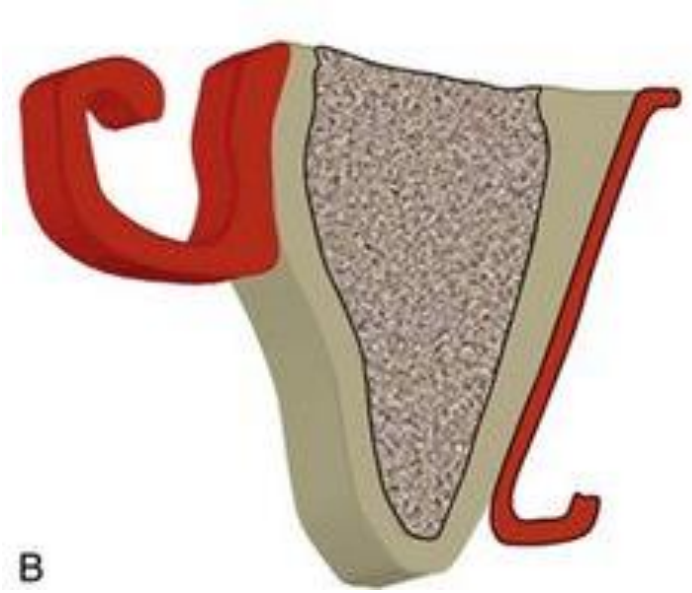


Ridge Splitting

Manipulation of the horizontally deficient alveolar ridge to form a receptor site for an implant without the removal of any bone from the patient

(Borgner Et.al 1999)

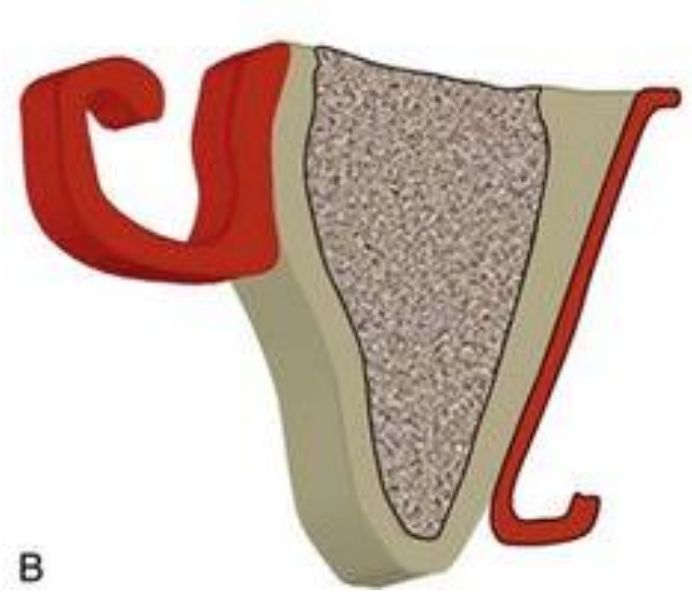
Indications



- Minimal horizontal bone width of **3 mm.**
- Minimal vertical bone height of **10 mm.**
- Triangular shaped alveolar ridge
- **No concavity** in alveolar bone profile.
- Horizontal osteotomies have to end at least **1 mm** before the neighboring teeth.
- Presence of at least **1 mm cancellous bone** between the two cortices which ensures a good blood supply.

(*Holtz-claw et al. 2010; Bassetti et al. 2013).*

Contraindications



- Ridge with less than 3mm.
- Vertical ridge deficiency .
- Over angulated maxillary edentulous ridge.
- Single site in the mandible.

(*Holtz-claw et al. 2010; Bassetti et al. 2013).*

Different approaches available for Ridge splitting

- Surgical Blades
- Laser
- Micro-saw devices
- Piezo-electric devices

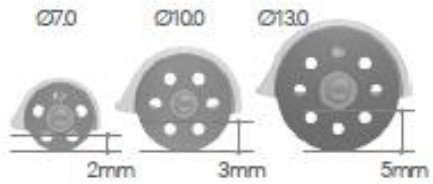
Different approaches available for Ridge splitting

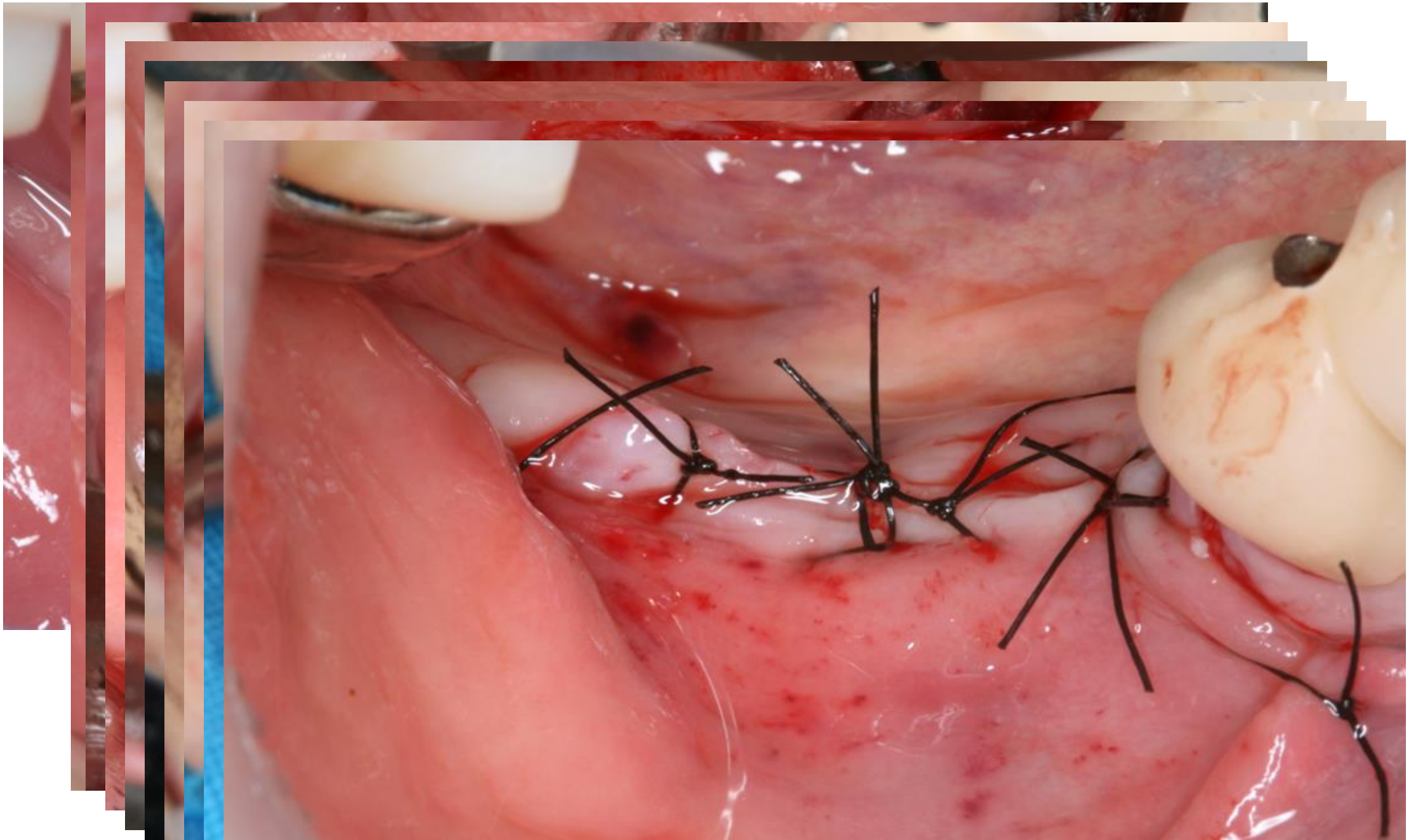
Surgical Blades

Indicated only in cases of soft bone (D4)

Different approaches available for Ridge splitting

Micro-saw devices





Surgical Protocol

Figures 1A and 1B

Figure 2

Figure 3

Figure 4

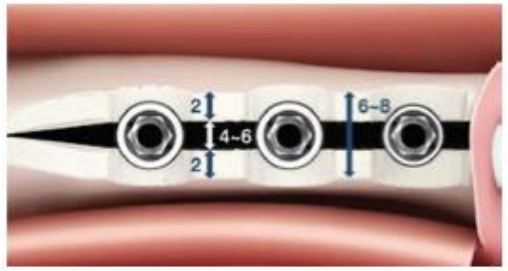


Figure 5

Figure 6

- Flap Design
- Crestal osteotomy
- Ridge widening
- Implant placement

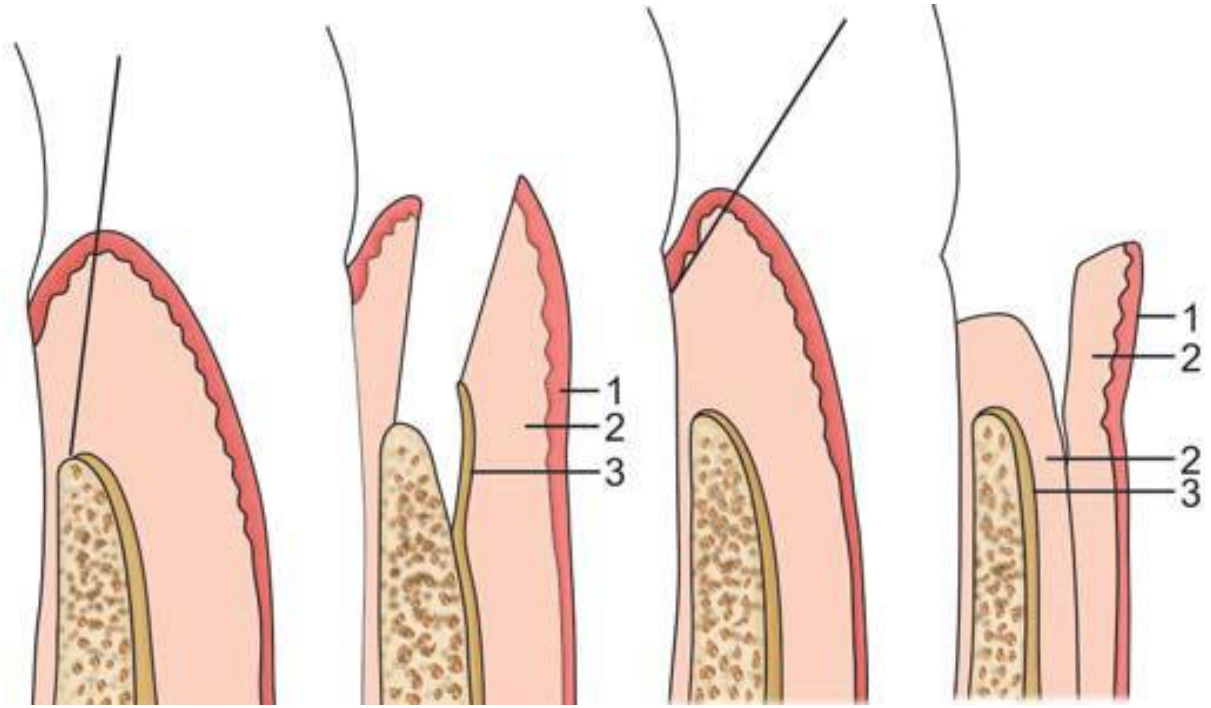
Surgical Protocol

Flap Design

Partial or split thickness Flap Design

Vs

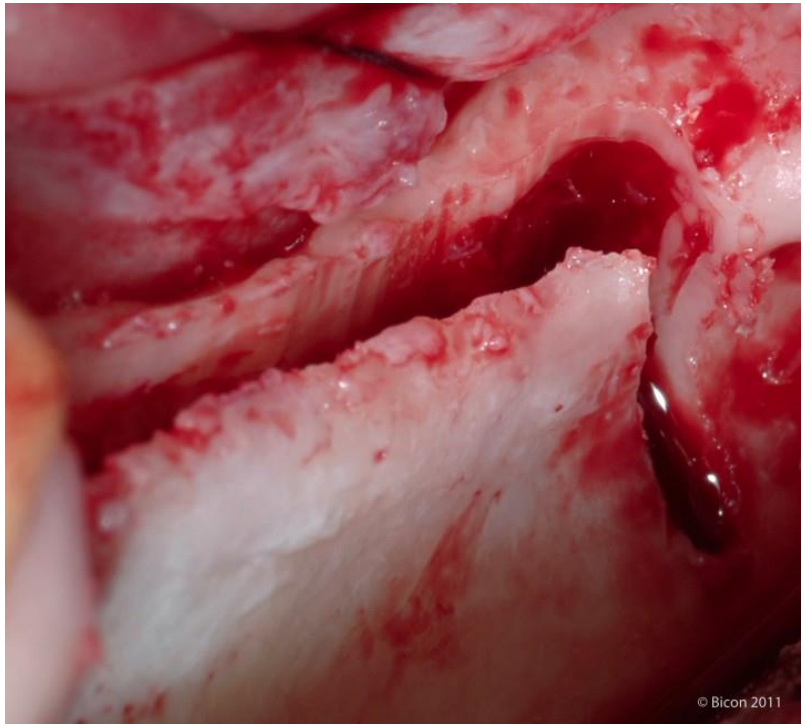
Full thickness Flap Design



Surgical Protocol

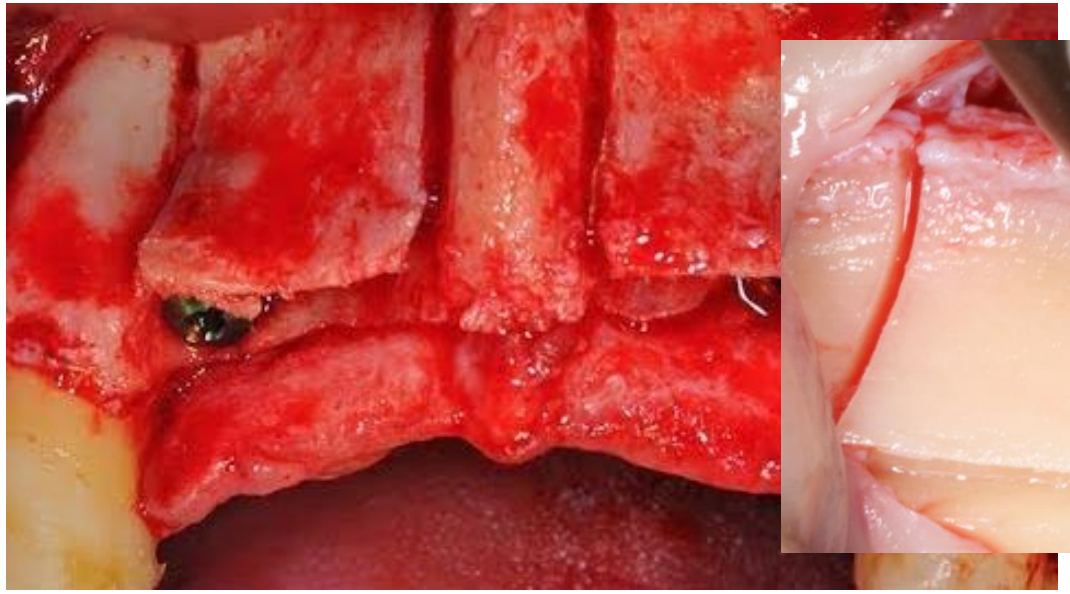
Flap Design

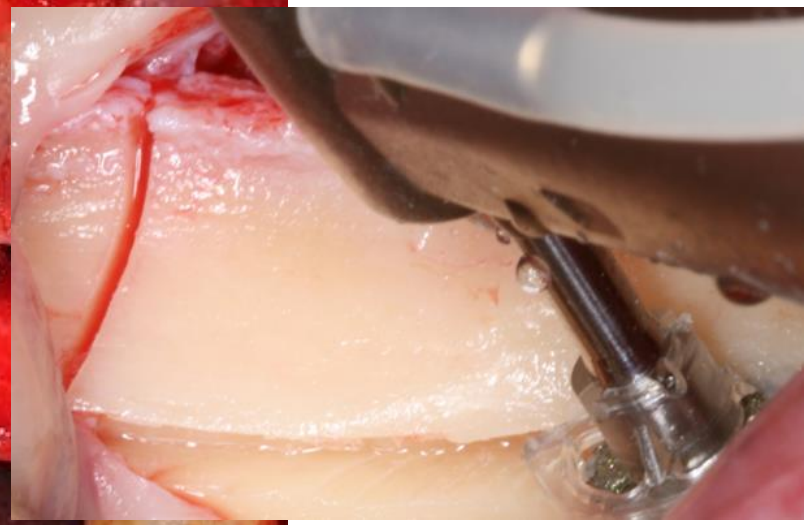
Buccal Reflection Vs No Buccal Reflection



Number of bone cuts

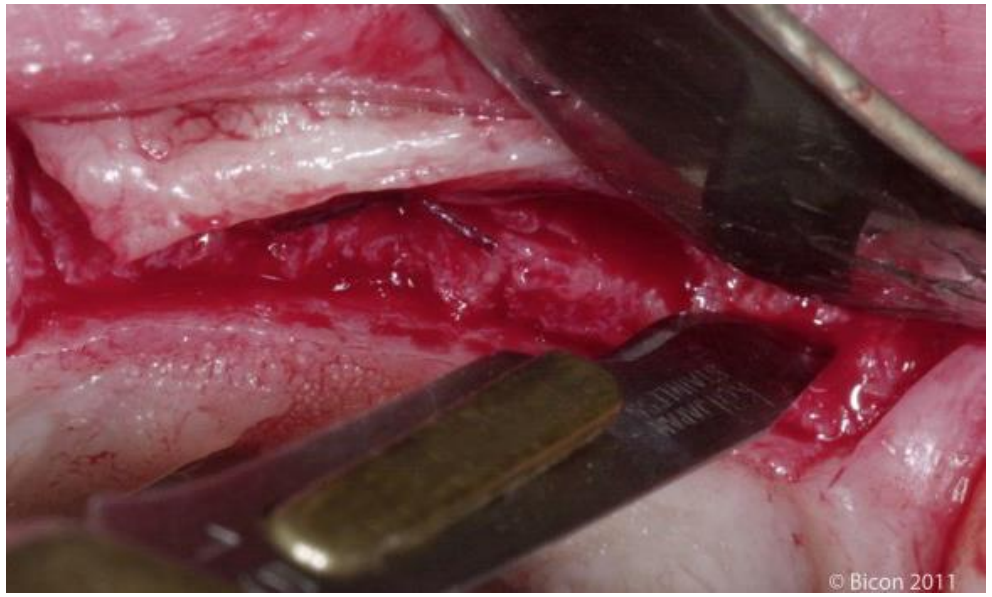
Crestal osteotomy
Crestal + vertical osteotomy
Crestal + vertical + apical osteotomy





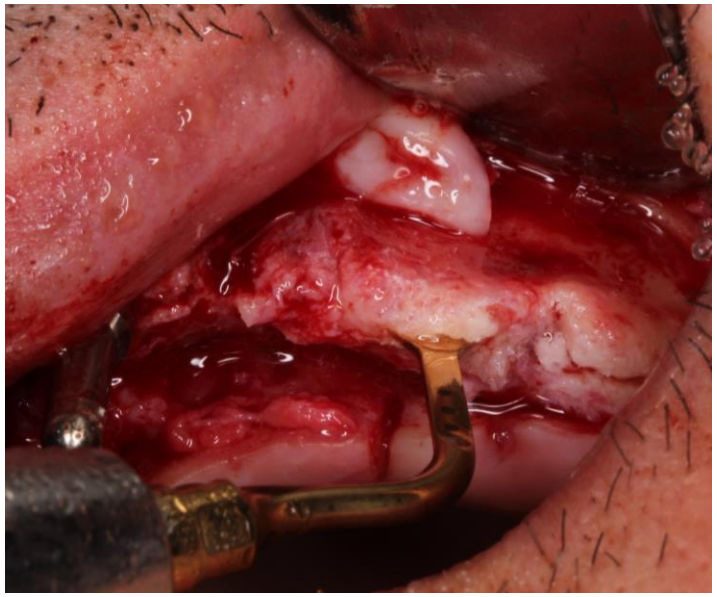
Surgical Protocol

Crestal osteotomy



Surgical Blade

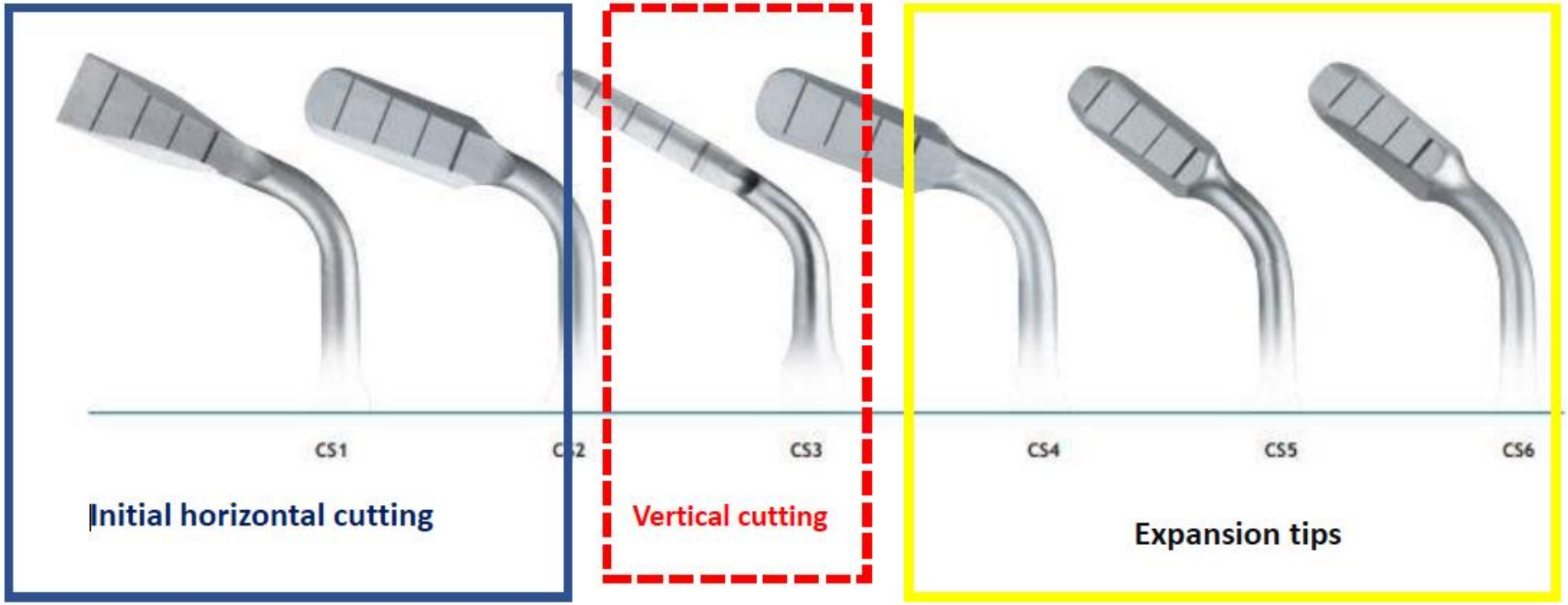
Micro saw



Piezo

Surgical Protocol

Crestal osteotomy

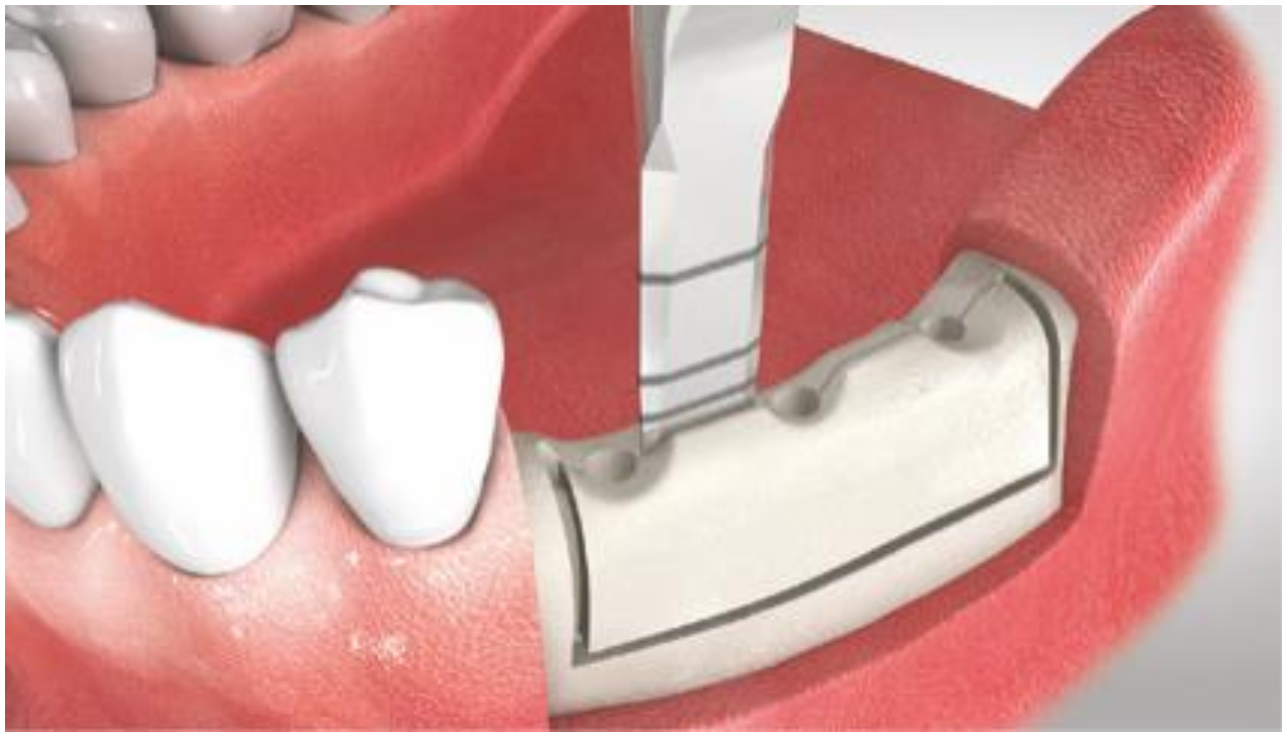


Piezo

Surgical Protocol

Ridge widening

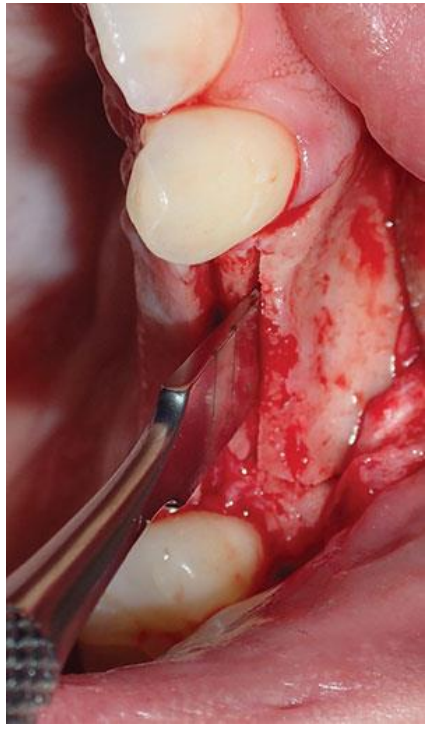
- Chisel
- Blade
- Spatula
- Piezo

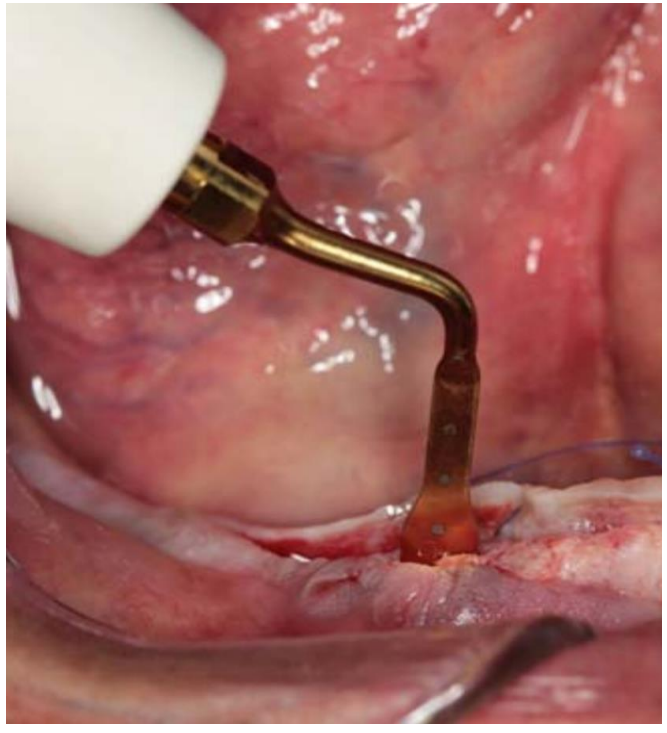


Surgical Protocol

Ridge widening

Chisel → Piezo → Blade → Spatula





Surgical Protocol

Implant placement

Tapered implant

Simultaneous implant placement

- Morbidity
- No second surgery site
- Low invasiveness
- Treatment costs
- Less treatment time

Staged implant placement

- Severe atrophy
- Risk of fracturing the resorbed buccal plate
- The first stage is for bone augmentation
- The second procedure is for the implant placement.
- They are 6 month apart

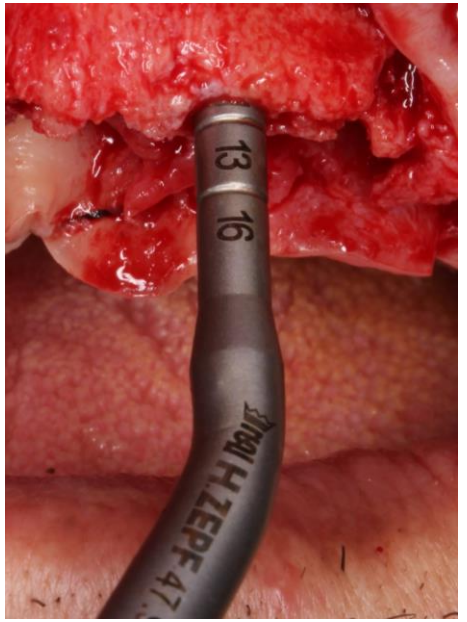
Surgical Protocol

Implant placement

Osteotomy preparation

Manual

- Osteotomes
- Expanders



Disadvantages:

1. Time consuming
2. Requires technical skills and a long learning curve.

Surgical Protocol

Implant placement

Osteotomy preparation

- Motorized
  - Drills
  - Motorized Expanders
  - Osseo densification burs

Advantages:

It is more rapid

Disadvantages:

1.Soft tissues and delicate anatomical structures can be damaged
2.Close access to adjacent teeth can be difficult
3.High risk of losing control over the cutting device.

motorized bone expanders indicated for :

Extremely resorbed ridges with minimum tissue damage.
Quick precise movements for the clinician

Types of devices used in ridge split procedure for alveolar bone expansion: A systematic review

Nayansi Jha[1], Eun Ha Choi[2], Nagendra Kumar Kaushik[2]*, Jae Jun Ryu[1]*

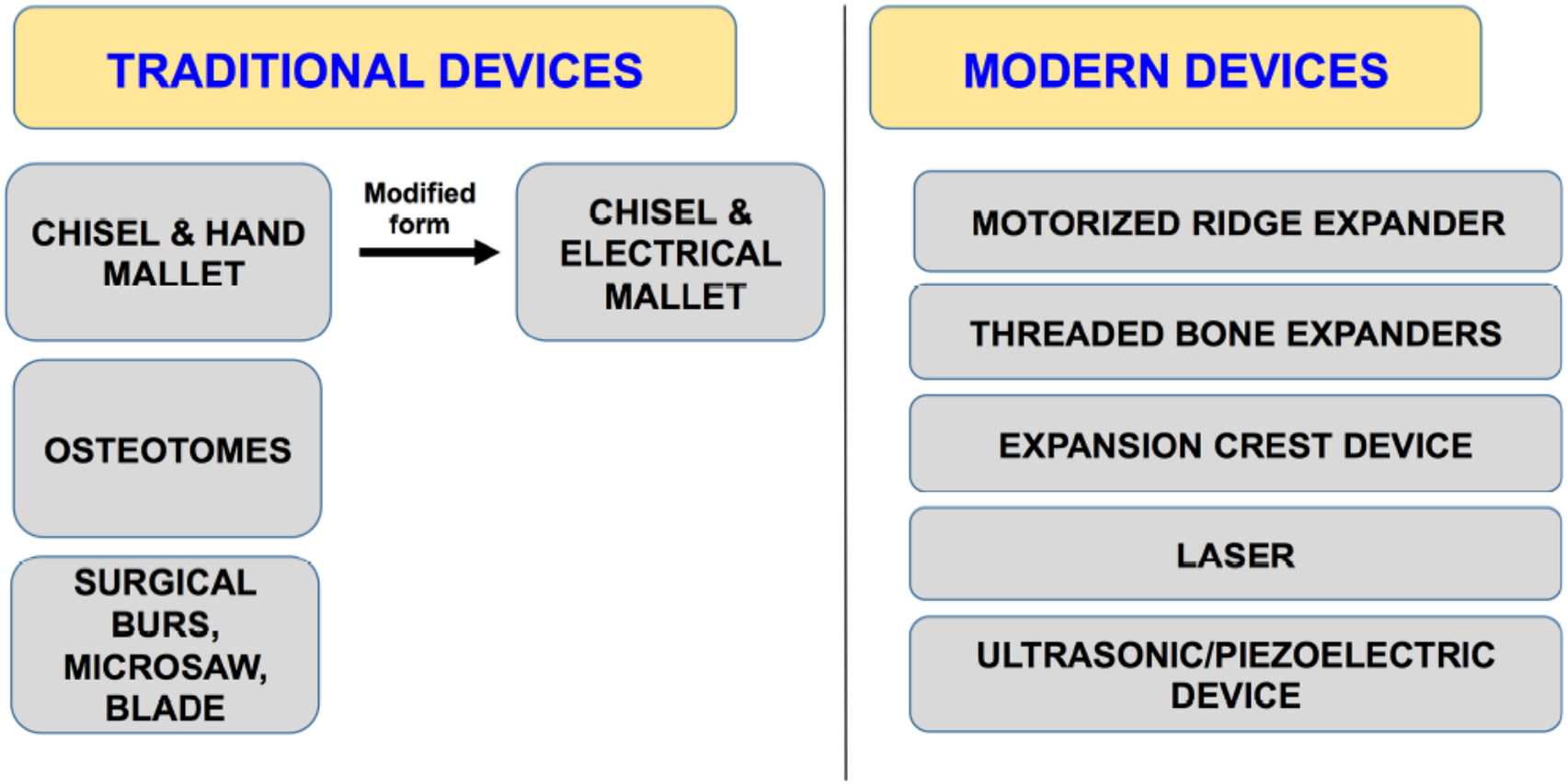
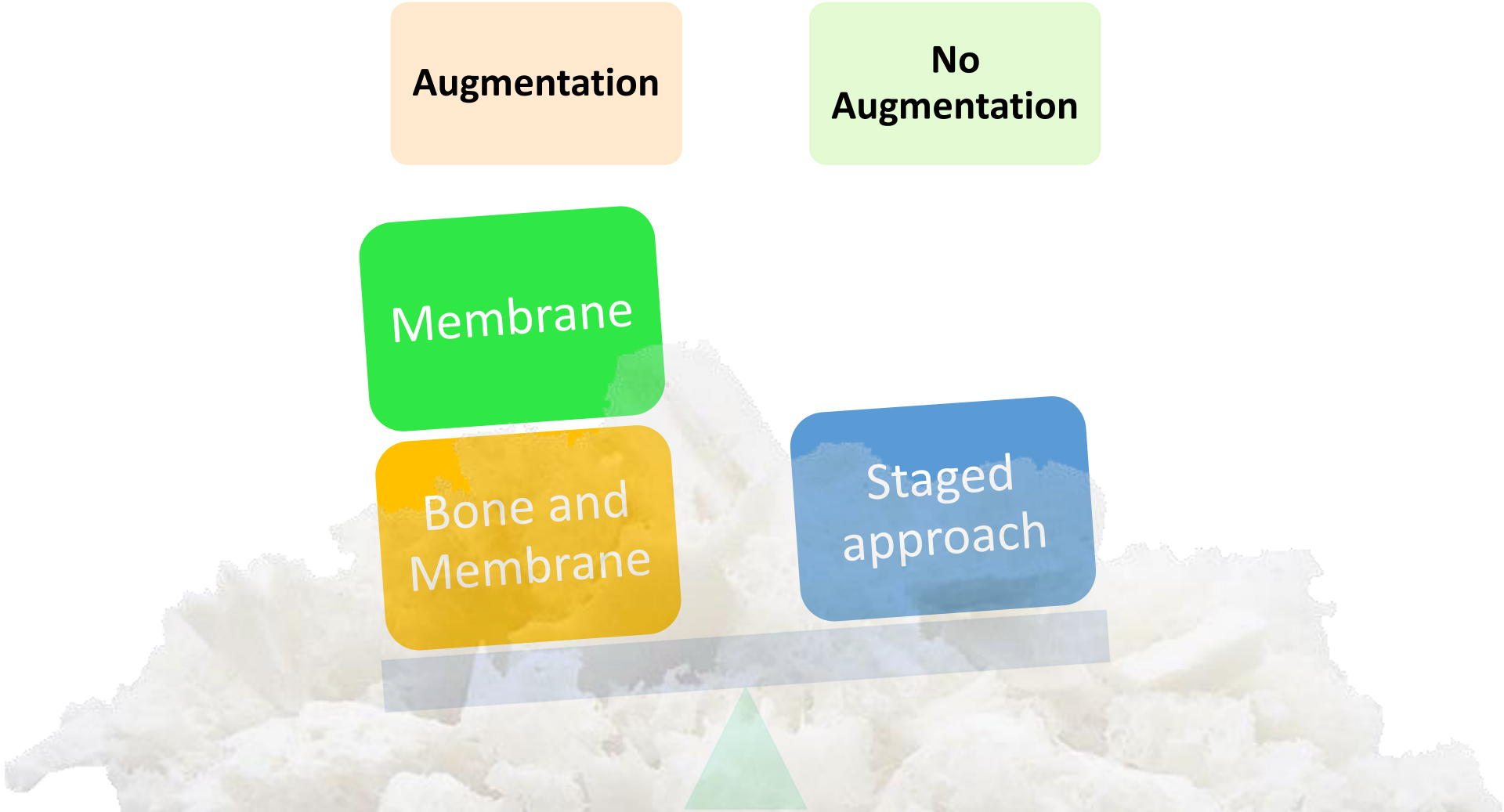


Fig 2. Devices used for ridge expansion.

- **osteotomes** increase in bone width of about **± 3mm**
- **piezo surgery** devices and motorized expanders were used with an average bone width increase of **± 3.44mm**
- **motorized bone expanders** were used, the mean bone width gain for ridges **4 mm** was **2.93 mm**
- expansion obtained for ridges **<4 mm** was **3.95 mm**; this indicates that ***motorized bone expanders*** provide the ***best results***



The **use of a membrane** with or without a bone filler in the gap **resulted in less bone loss** compared with sites treated **with- out a membrane after 12 weeks of healing (Han et al. 2011)**

GENTLE REMINDER

Ridge splitting SHOULD achieve **PASS** principle:

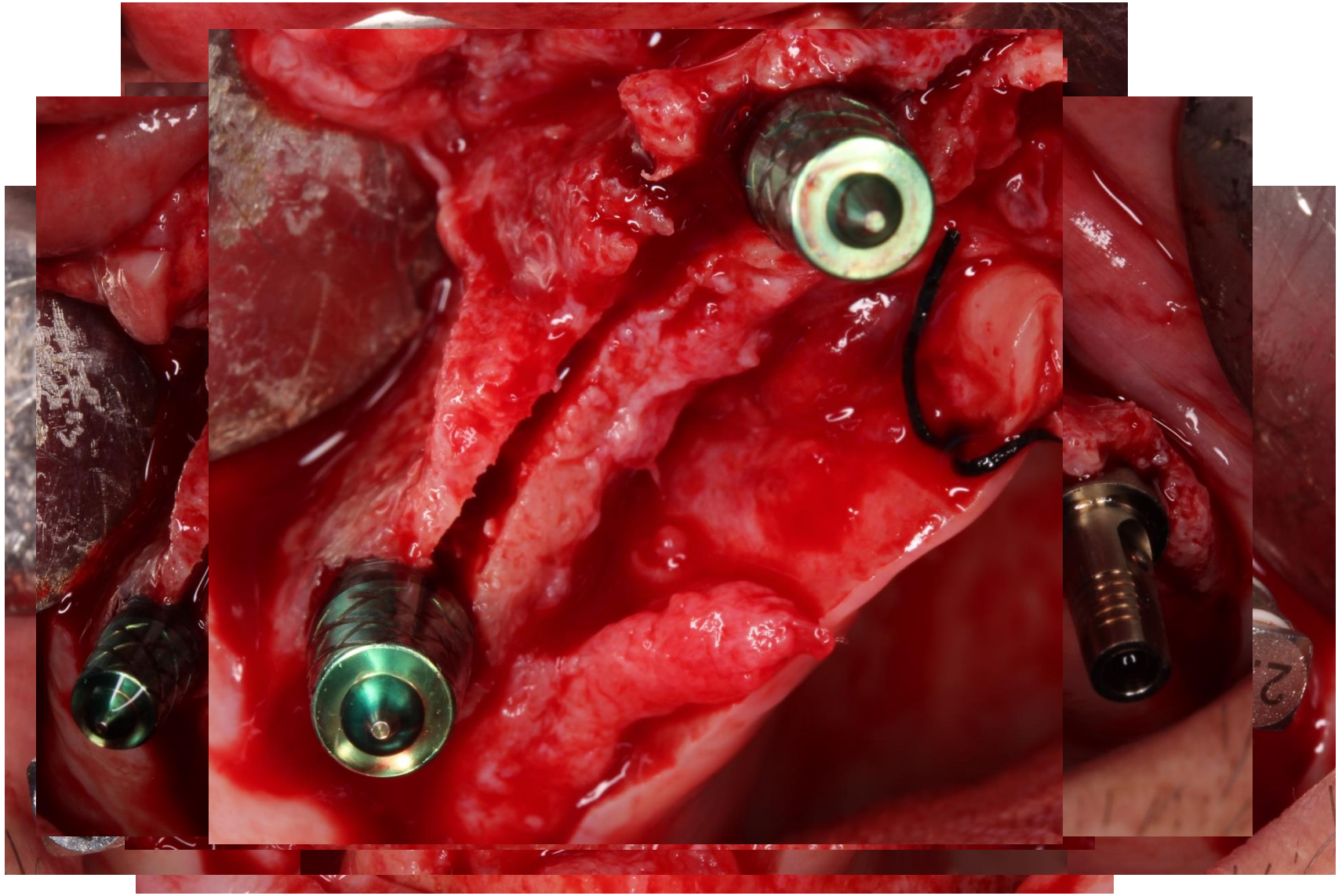
1. - Primary wound closure.
2. - Angiogenisis.
3. - Space maintainance.
4. - Graft stability.

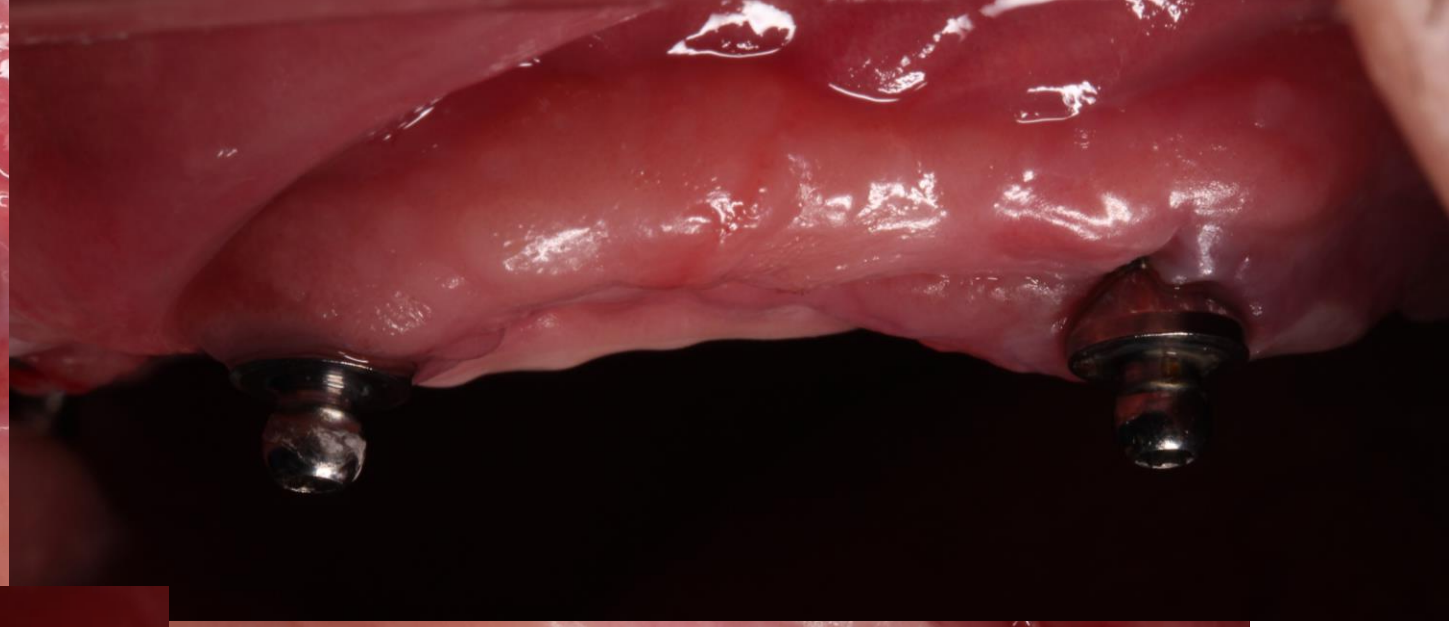
Complications

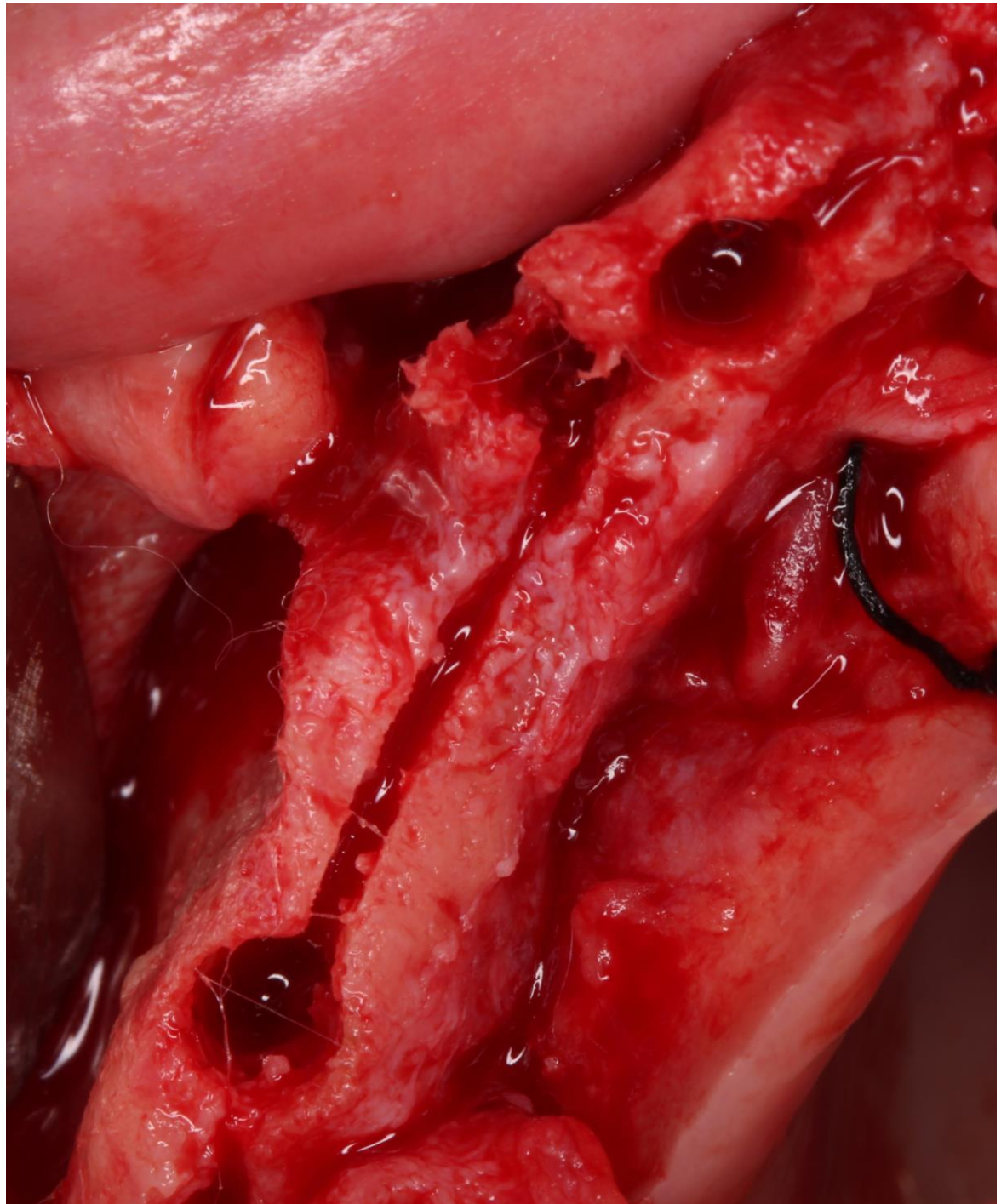
1. The possibility of fracture during displacement of the buccal bone wall
2. Crestal bone loss should be considered.
3. Unfavorable implant angulation.

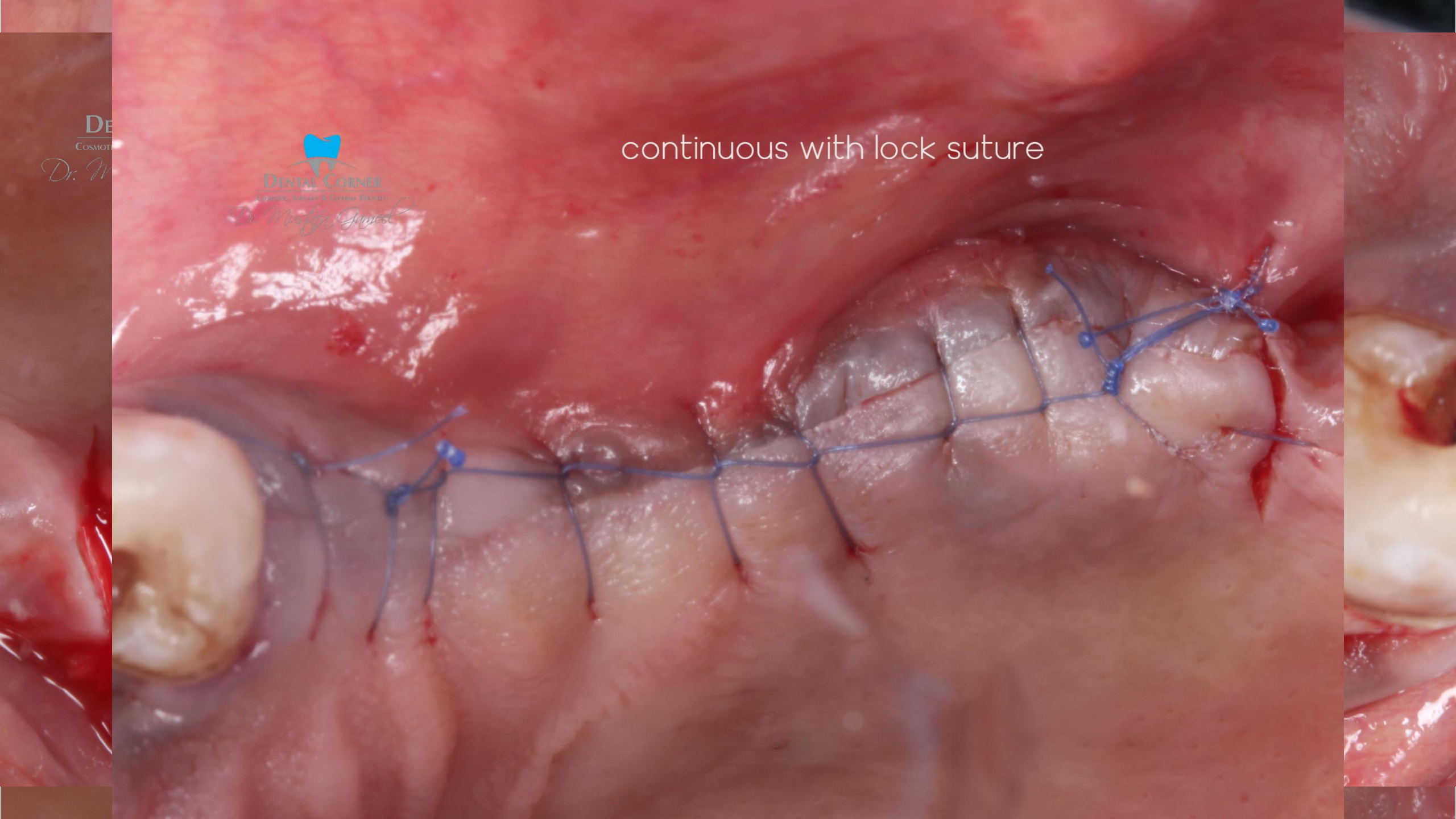
(Holtzclaw et al. 2010; Bassetti et al. 2013).

Ridge splitting using piezoelectric







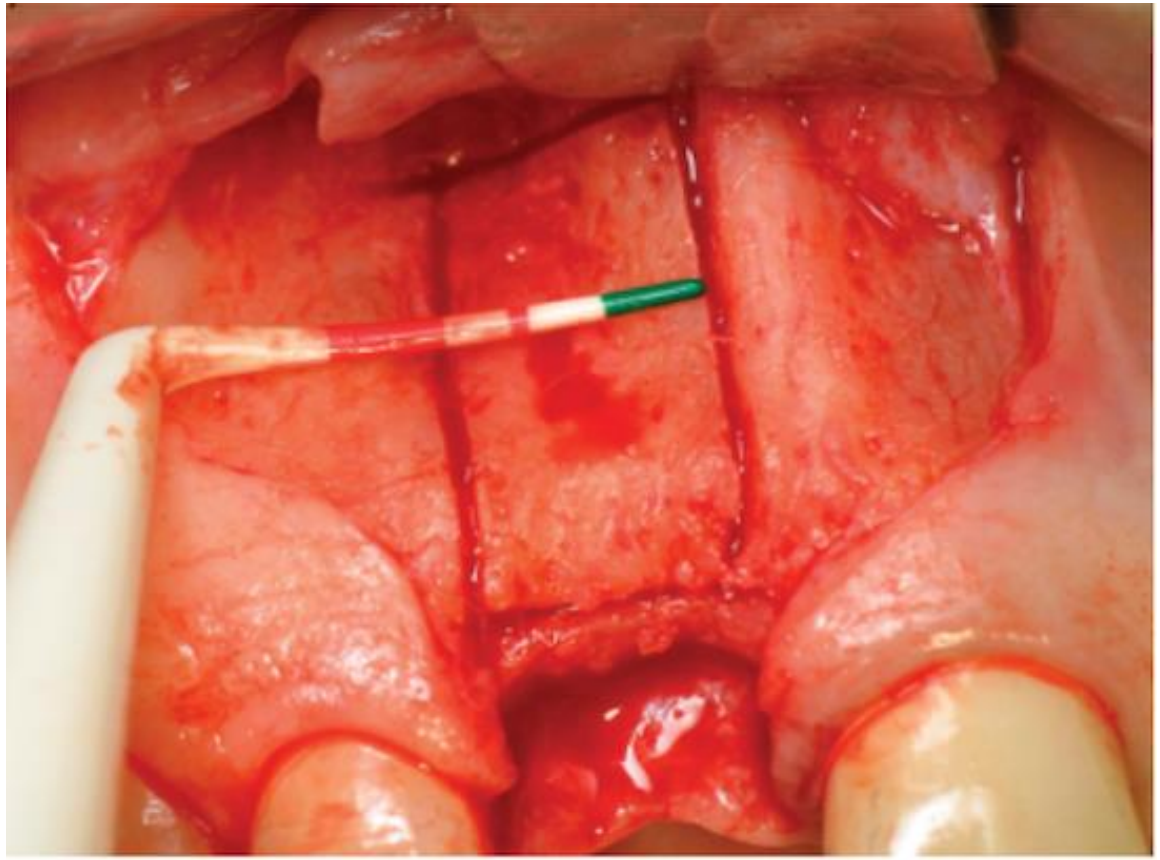

continuous with lock suture

Different approaches

- Single-stage split crest technique
- Two- staged split crest technique
- Three –staged/modified split crest technique

Single-stage split crest technique

- The technique involves splitting with simultaneous implant placement .
- This means shortened time between the first surgery and prosthetic treatment.
- Immediate implant installation requires lower amounts of biomaterials, reduces costs, and also prevents the collapse of the expanded cortical walls. Finally, it also results in less discomfort for the patient, who will undergo only one surgical procedure.



Length-height cortectomy proportions can be remembered as **7-8-9-10 rule**, meaning:

- A minimum of 7-8 of bone length space between vertical cuts
- A minimum of 9-10 of bone height distance between horizontal ones(for a single implant average dimension replacement)

(Tolstunov,L et al., 2016)

Two-stage split crest technique

It involves two stages: First surgery is crest split technique, and then reopening to place implants. Theory was to prevent unplanned fracturing of the vestibular wall, reducing complications and obstacles to treatment.

Two-stage ridge-split at narrow alveolar mandibular bone ridges.

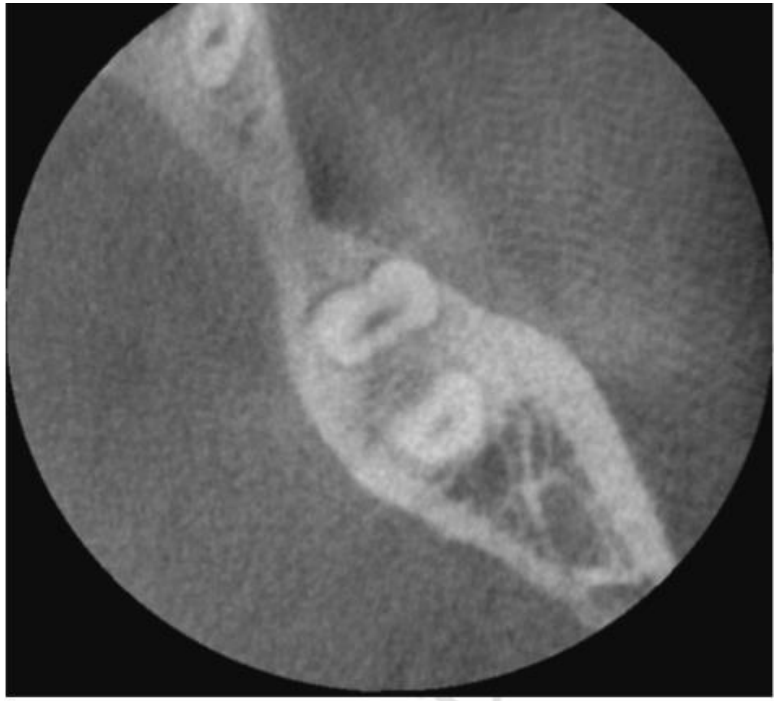
Ivo Agabiti[1], DDS, Private Practice, Pesaro, (PU), Italy
Visiting Professor at Post Graduate in Advanced Implantology, School of Dentistry - University of Modena and Reggio Emilia, Italy

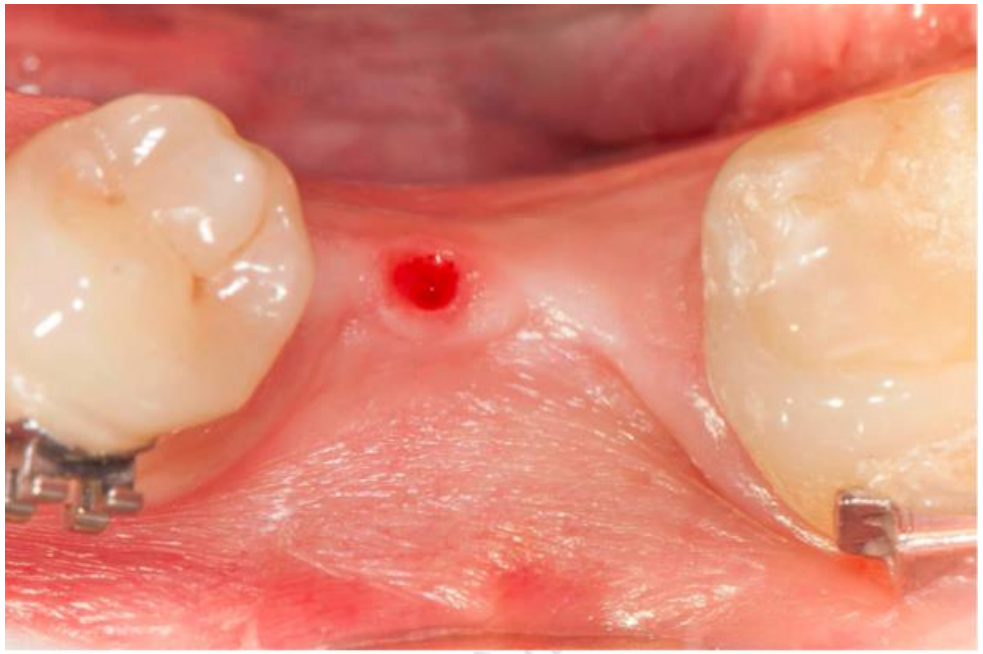
Daniele Botticelli[2], MD, PhD, ARDEC Academy, Rimini, (RN) Italy

Please cite this article as: Agabiti I, Botticelli D, Two-stage ridge-split at narrow alveolar mandibular bone ridges, *Journal of Oral and Maxillofacial Surgery* (2017), doi: 10.1016/j.joms.2017.05.015.

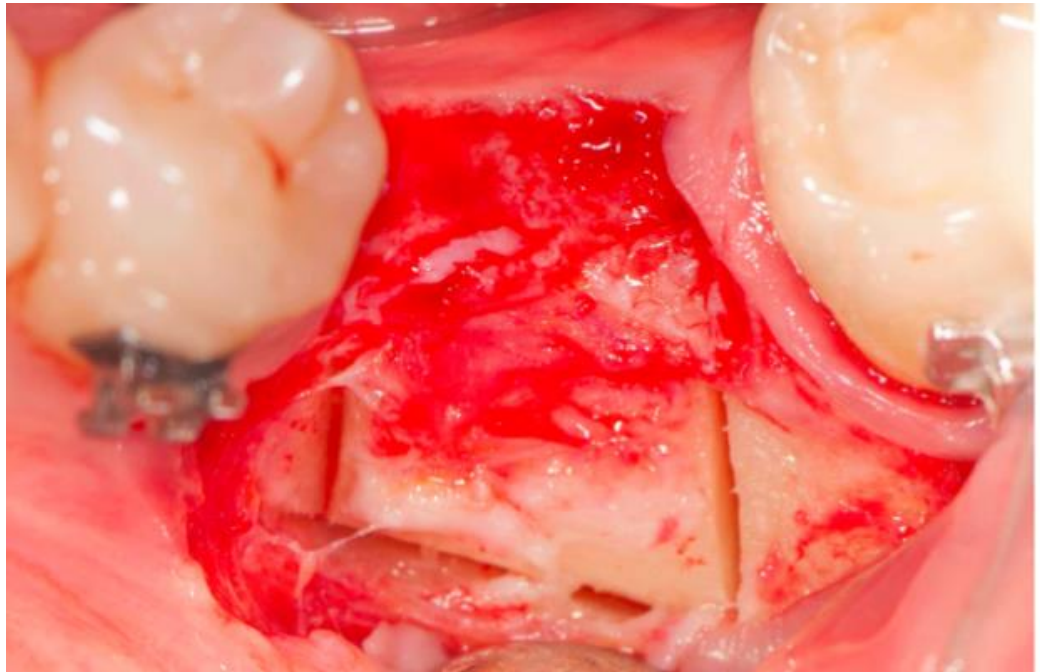
Conclusion : The use of a modified edentulous ridge expansion (ERE) in two stages allowed the installation of implants in narrow and corticalized alveolar ridges.

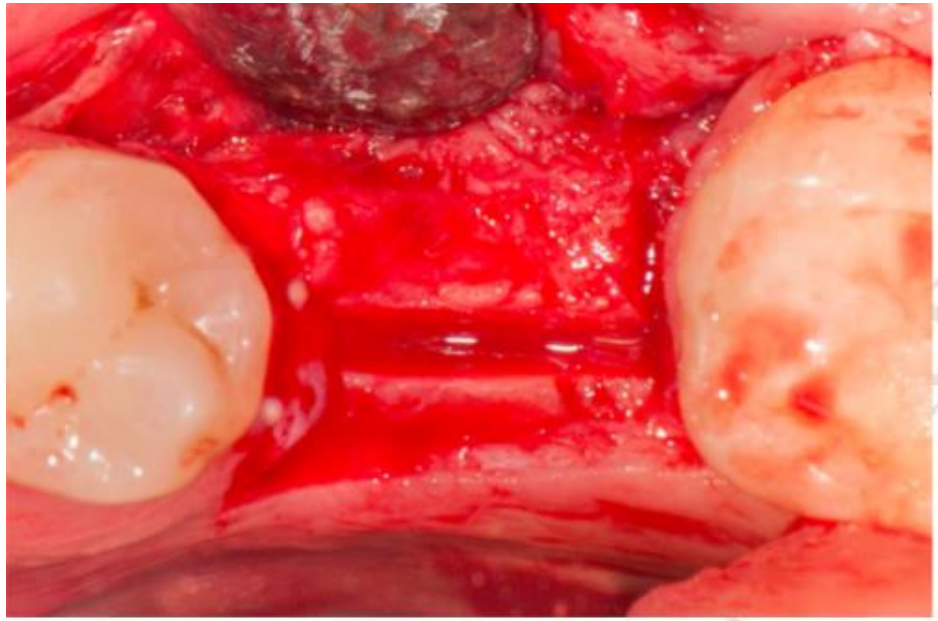
We suggest that the present technique is especially applicable in the distal segments of the mandible because of the low invasiveness, low risk of buccal plate fractures, reduced morbidity, and reduced costs.

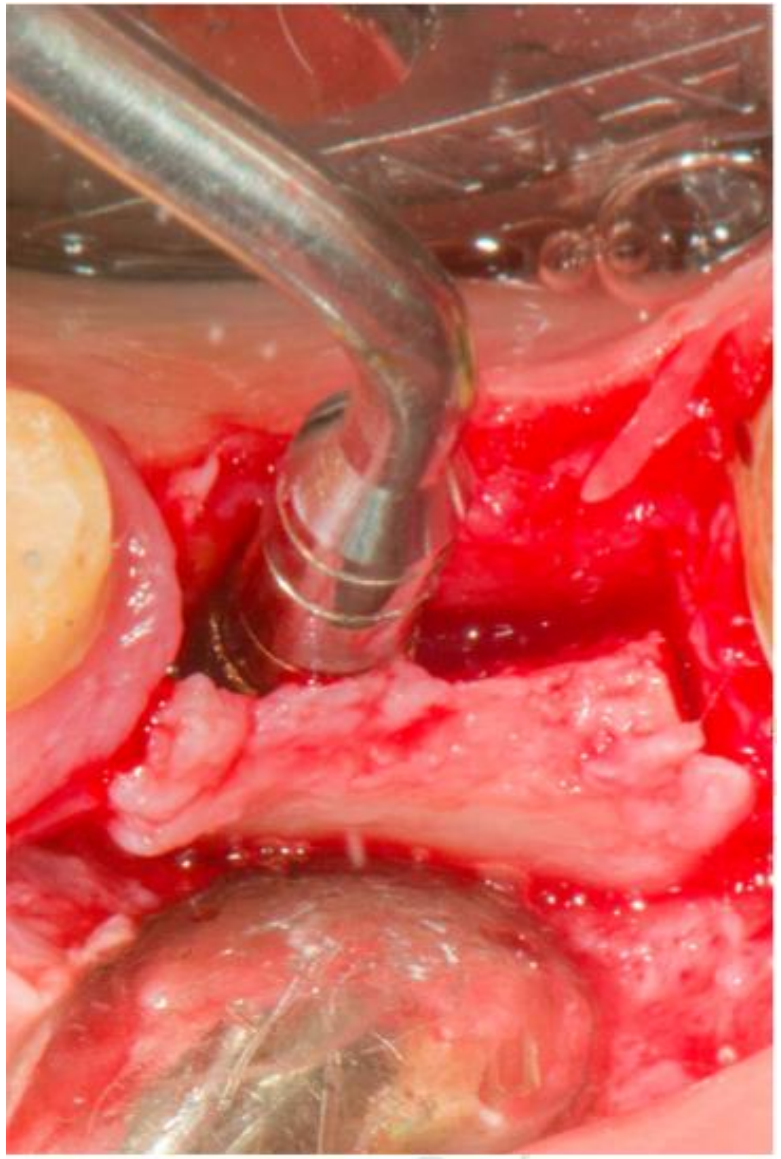




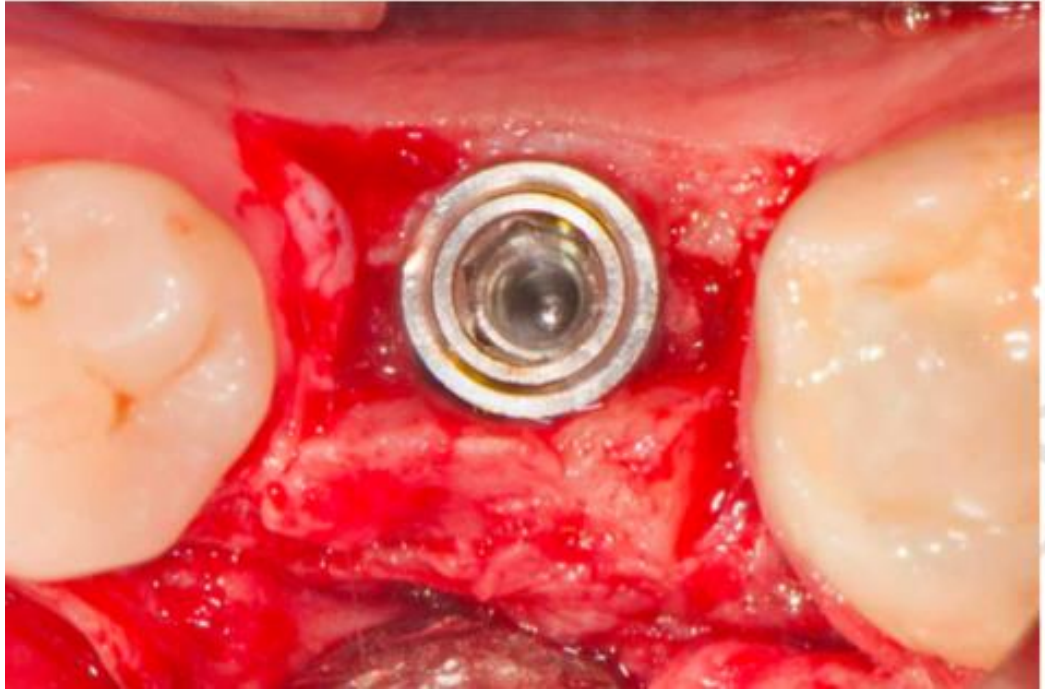
First surgery







Second surgery after 40 days



After implant placement and final prosthesis.

Three-stage/modified split crest technique

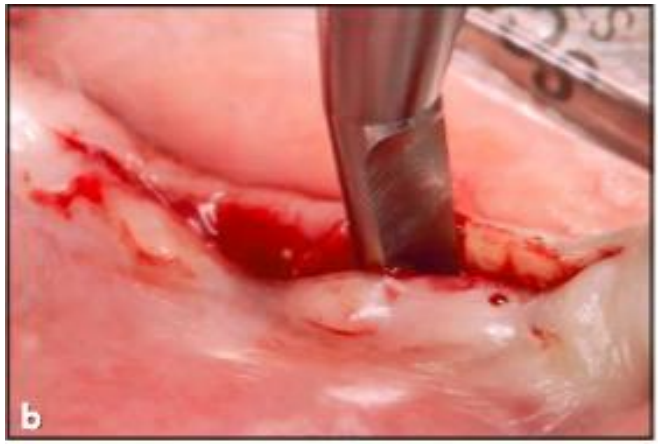
A Three-Stage Split-Crest Technique: Case Series of Horizontal Ridge Augmentation in the Atrophic Posterior Mandible

Int J Periodontics Restorative Dent 2018;38:565–573. doi: 10.11607/prd.2907

First Stage → Splitting the ridge

Second stage → After 3-4 week healing time, expansion of the cortical plate (without elevating the periosteum) and Placement of a bone replacement graft material

Third stage → After 3 to 4 months of healing, the implants are placed.

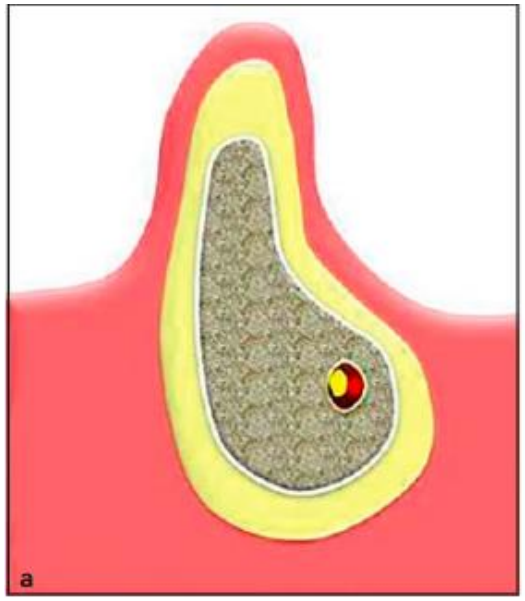


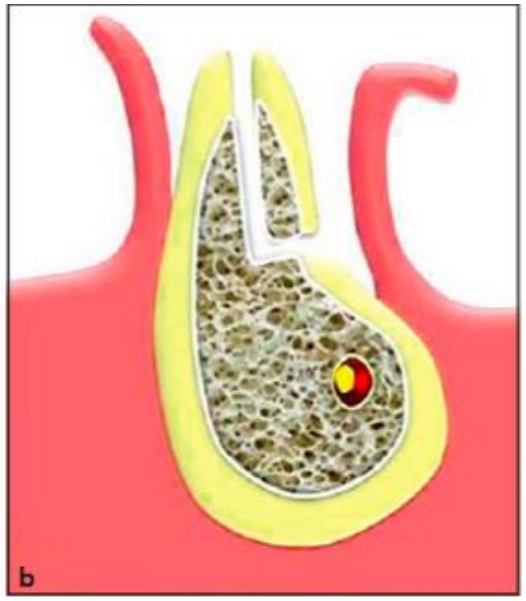
The advantages of this three-stage technique are :

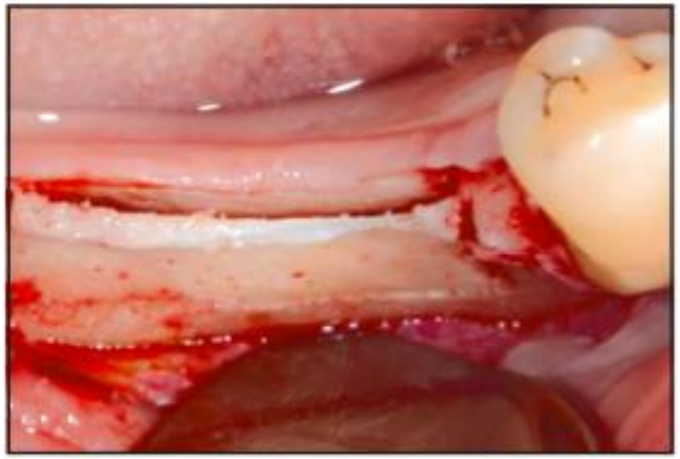
1. Increased vascularization to the surgical area,
2. Decrease in procedure complications
3. Improved implant survival rates.

However, the extended treatment time is the main disadvantage.

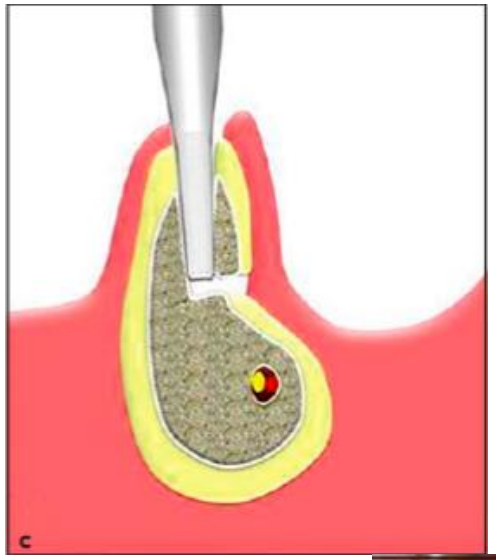
First stage: The atrophic posterior mandibular ridge is shown and rectangular osteotomies are made using the piezoelectric saw, provoking a greenstick fracture

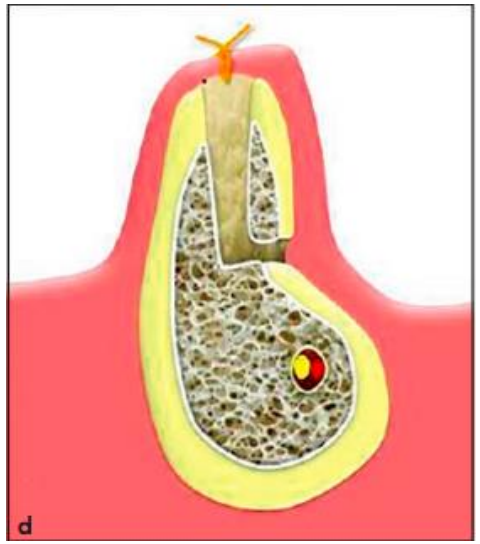


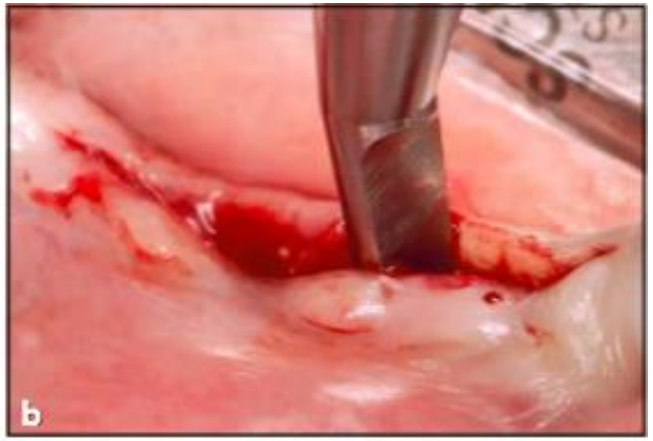




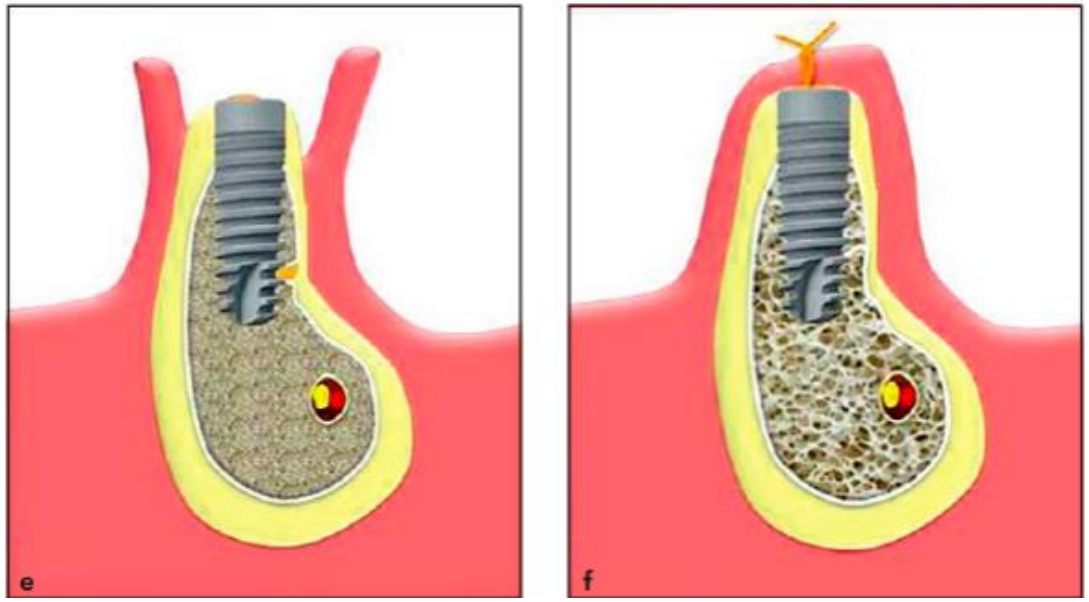
Second stage: Using a 3.3-mm-diameter chisel to separate the buccal fractured segment, then suturing following placement of the bone substitute graft.

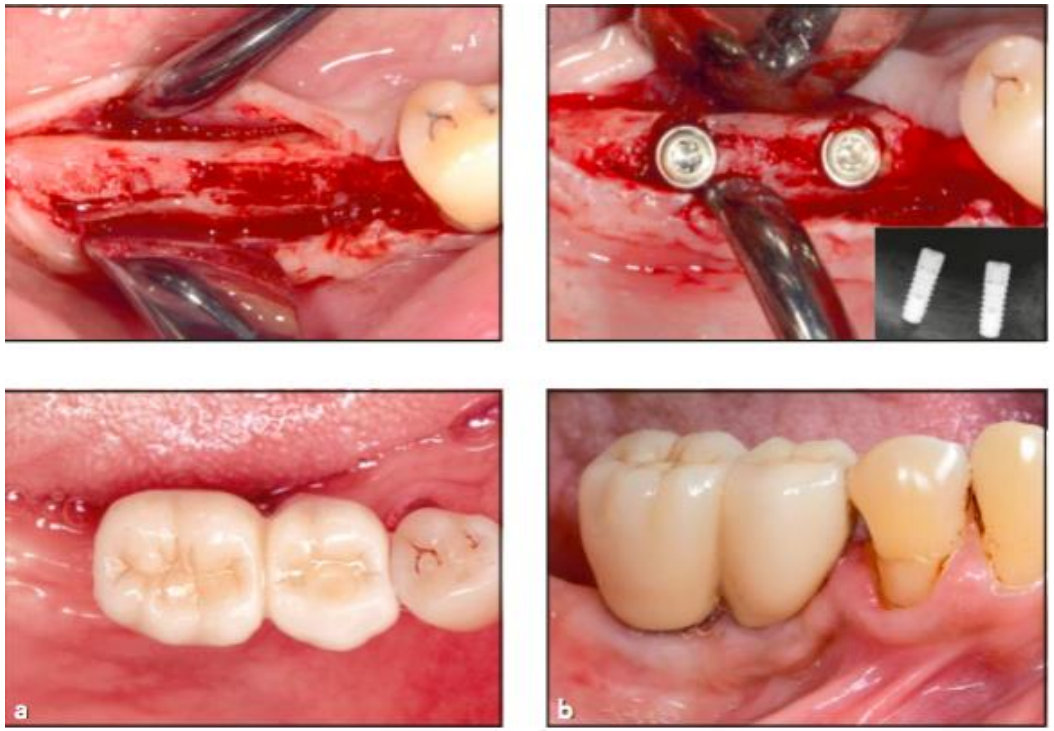






<u>Third stage</u>: Placement of implants in the augmented ridge and finally flap suturing following implant placement.

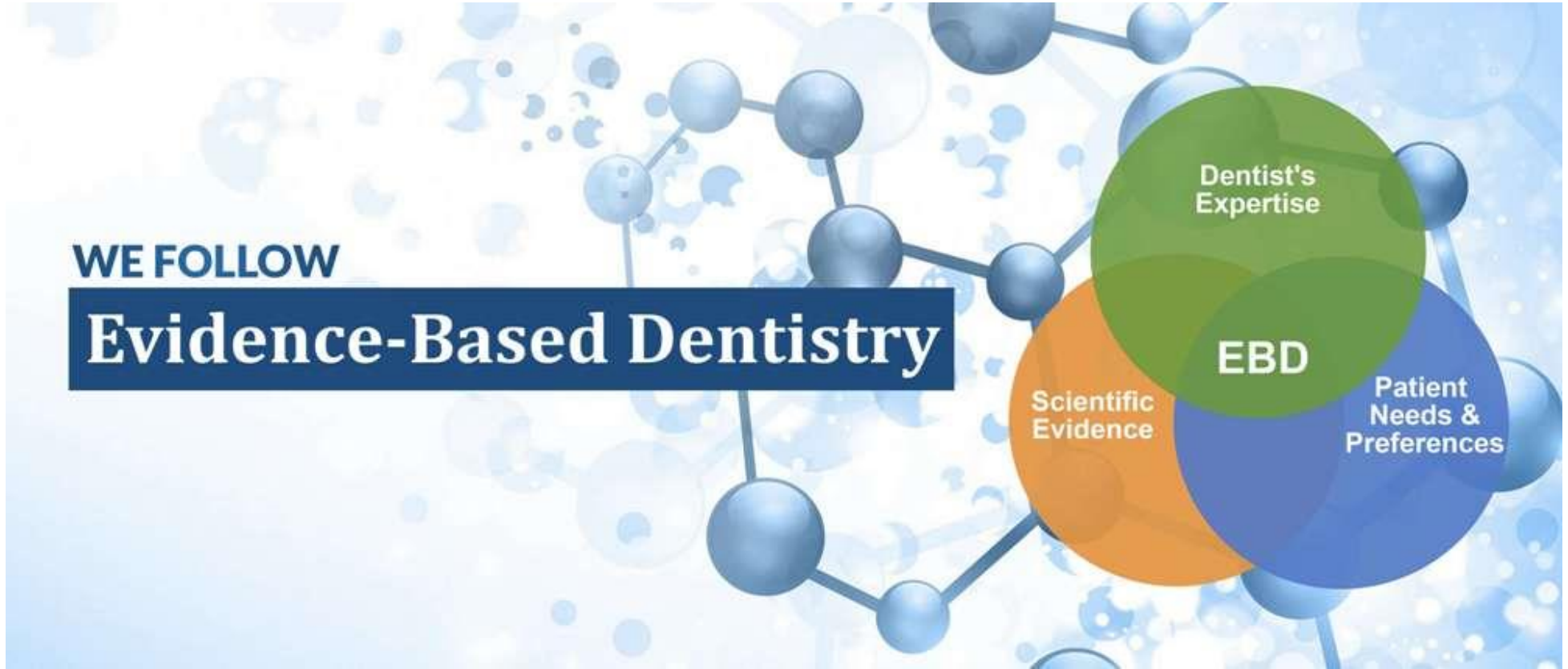




The TSSC technique is **indicated** in severely buccolingually atrophied posterior mandibular edentulous regions , where there is risk of fracture of the osteomized segment. Due to the fact that mandibular bone has a more rigid cortical bone and a thicker cortical plate.

To sum up

- Different split crest techniques were introduced aiming to increase width of the atrophied ridges, with sufficient alveolar height.
- These require proper case selection, instrumentation and require skilled surgeons.
- Complications such as accidental fracture of the coronal portion of the buccal cortical plate during the ridge expansion can occur.
- Management could be by **free buccal bone fragment to be fixated to the alveolar ridge with screws.**


WE FOLLOW
Evidence-Based Dentistry
Dentist's Expertise
EBD
Scientific Evidence
Patient Needs & Preferences

The split crest technique and dental implants: a systematic review and meta-analysis

J. Waechter, F. R. Leite, G. G. Nascimento, L. C. Carmo Filho, F. Faot: The split crest technique and dental implants: a systematic review and meta-analysis. Int. J. Oral Maxillofac. Surg. 2016; xxx: xxx–xxx.

This systematic review focused on two aspects:

1. the expected bone volume **gain** with the split crest technique, and
2. how the use of **surgical instruments** affected the performance of this technique .

This systematic review showed the following:

1. An average gain of 3.8 mm in thickness of the alveolar ridge can be expected following SCT.
2. Edentulous ridge with a thickness of <3 mm requires bone augmentation procedures before implant placement (two-stage technique)

3. The smallest change in bone thickness was found in a study that included only data from the mandible.

4. Even though maxillary bone crest is obtained with relative ease due to bone characteristics (D3,D4) and due to the higher vascularization of the maxilla.

5. The posterior mandible is the most difficult region for reconstruction and early implant placement, especially in cases of severe alveolar resorption.

Radiographic Evaluation of Crestal Bone Level in Split-Crest and Immediate Implant Placement: Minimum 5-Year Follow-up

Giovanni B. Bruschi, MD, DDS[1]/Paolo Capparé, MD, MFS[2]/Fabrizio Bravi, DDS[1]/Nicola Grande, DDS[1]/
Enrico Gherlone, MD, DMD[3]/Giorgio Gastaldi, MD, DMD[4]/Roberto Crespi, MD, MS[5]

Int J Oral Maxillofac Implants 2017;32:114–120. doi: 10.11607/jomi.4203

Aim of this study was to evaluate the radiographic bone level changes of implants positioned via the split-crest procedure both in the maxilla and mandible at a long-term follow-up.

Conclusion: These results showed that marginal bone stability is influenced by blood supply on different flap approaches and suggests that a full-thickness flap should not be reflected when ridge splitting is done.

CLINICAL ORAL IMPLANTS RESEARCH

*Mario A. Bassetti**
*Renzo G. Bassetti**
Dieter D. Bosshardt

The alveolar ridge splitting/expansion technique: a systematic review

Table 3 **Initial crestal ridge width and width gain in self-tapping implant group and cylinder-type implant group**

	Initial crestal ridge width (mm)	After implant insertion (mm)	Width gain (mm)
Self-tapping implant group (NobelActive)	2.79 ± 0.49	4.76 ± 0.75	1.97 ± 0.66
Cylinder-type implant group (Straumann Bone Level)	2.98 ± 0.53	4.61 ± 0.43	1.62 ± 0.58

Conclusion

If an increase in width in ridges more than 3 mm wide is desired, other techniques must be used.

Implant success rate with split crest technique

- The success rate was variable 97% ~100% which are similar to those placed in pristine bone without ARST and with or without aGBR procedure

(Oetterli et al. 2001;Buser et al. 2012)

- All the studies, which reported the success rate of implants, osteotomes were used.

- 100% success rates using motorized expanders piezoelectric device

(Anitua et al. 2013)

The annual bone loss after the first year of loading for ARST seems to be very limited and comparable to that of implants placed in pristine bone without ARST **(Laurell & Lundgren 2011; Bassetti et al. 2013)**

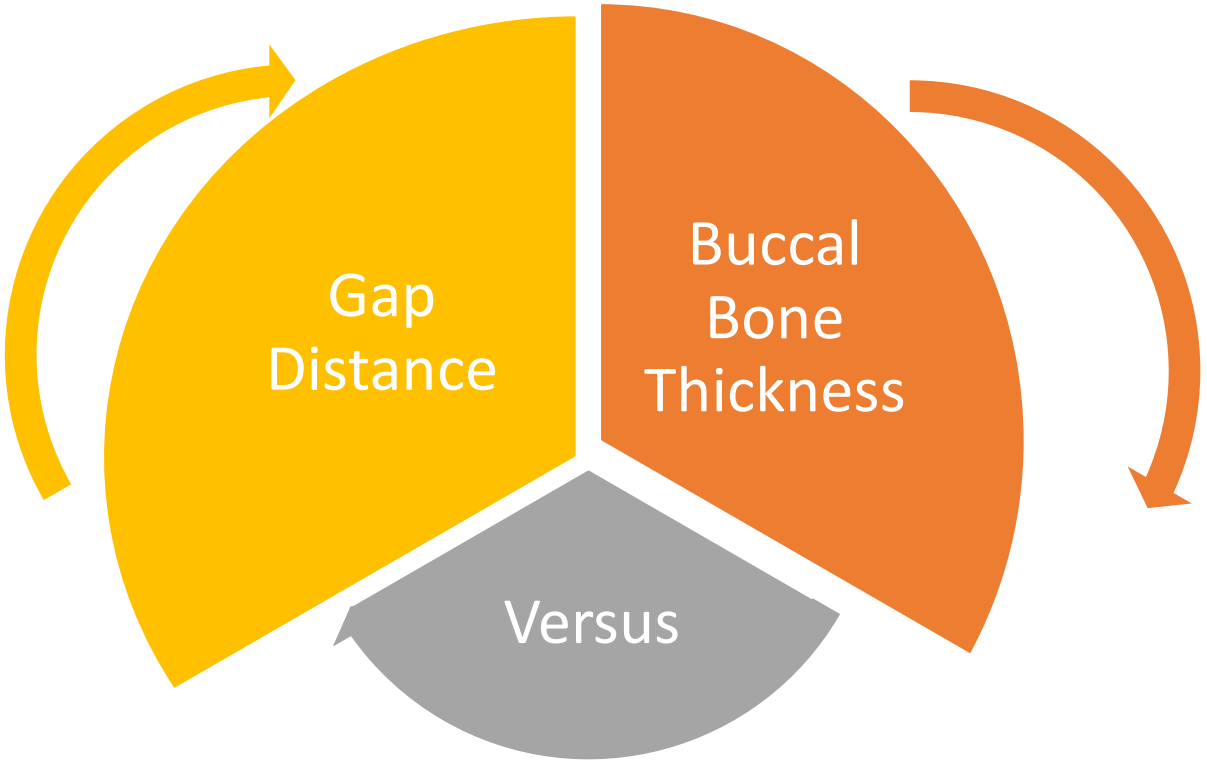
Bone loss was observed during the healing phase ;
However it ranges from **1.61 ~ 0.91** mm for **ARST without GBR** &
1.19 ~ 1.01 mm for **ARST** in combination **with GBR** **(Bassetti et al. 2013) (Tang et al. 2013)**

Effect of flap design : partial-split-flap design results in reduction in buccal bone resorption (Chiapasco et al. 2006)

The **use of a membrane** with or without a bone filler in the gap **resulted in less bone loss** compared with sites treated **with- out a membrane after 12 weeks of healing** **(Han et al. 2011)**

No differences in **gap healing** with and without filling of the bone gap with **especially in cases with gap less than 3mm . (Stricker et al. 2013).**

ARST combined with horizontal augmentation **with a barrier membrane and a bone substitute resulted in better preservation of buccal bone** height and width when compared to ARST alone (Strickeret al. 2013)

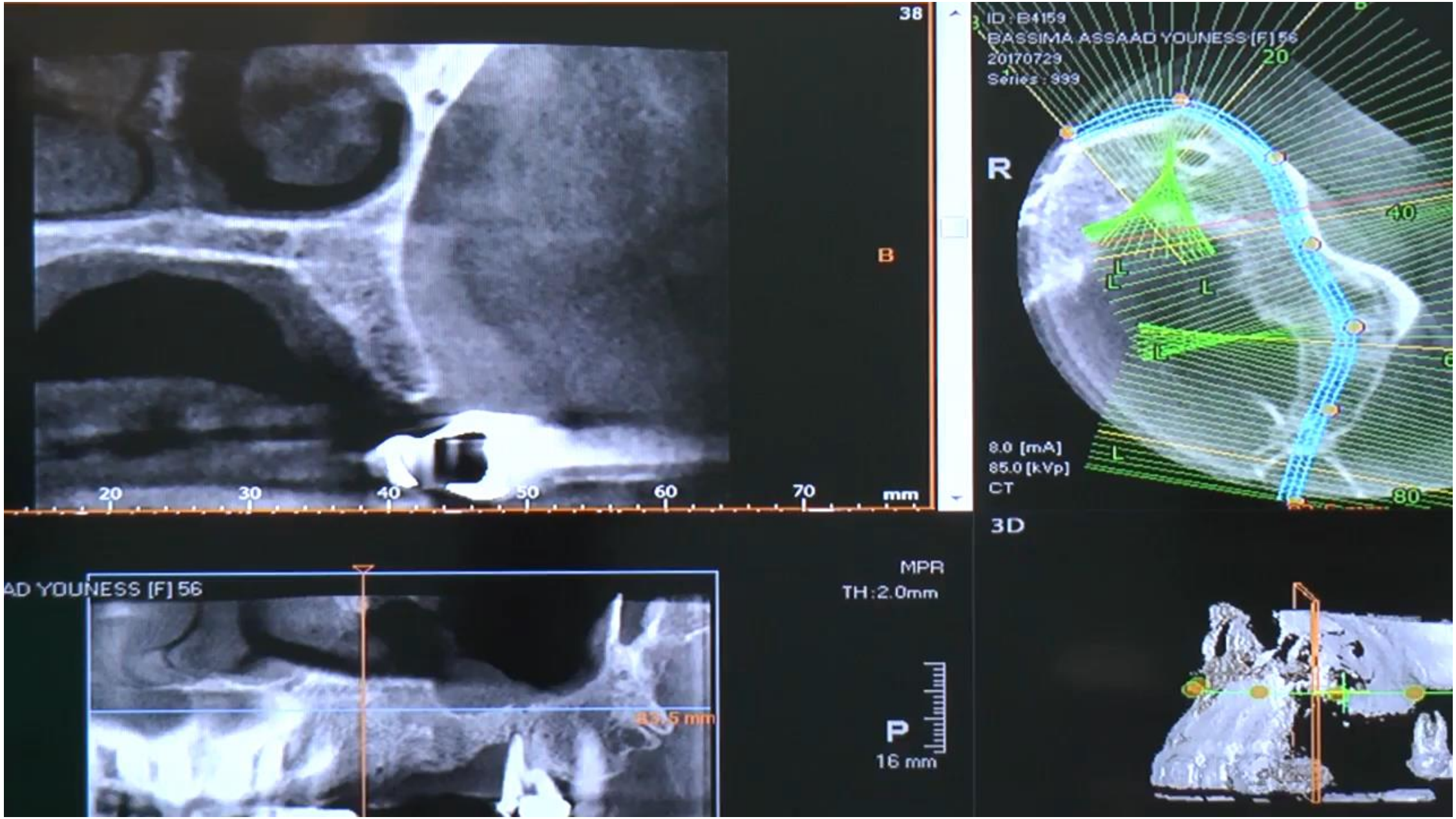


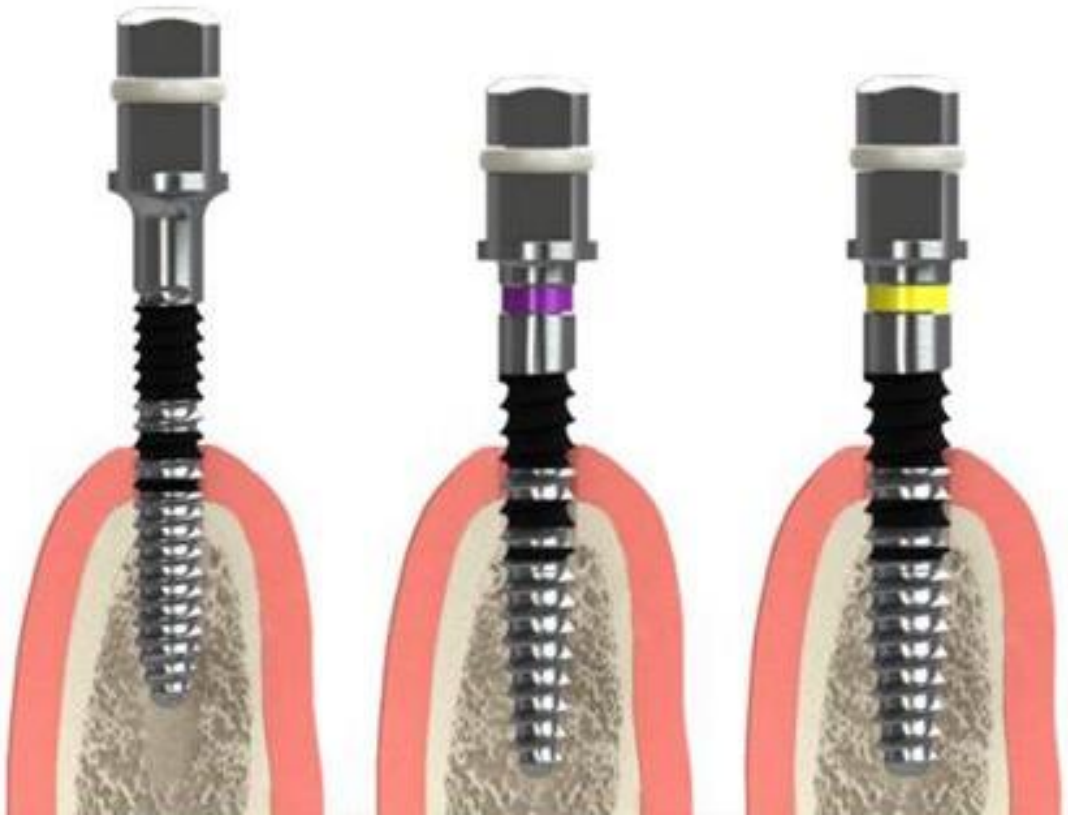
Comparative Study of Immediate and Delayed Lateral Ridge Expansion Technique in the Atrophic Posterior Mandibular Ridge

Viswambaran M [α], Verma Kamal [σ], Desai A P [ρ] & Yadav Rajesh Kumar [ω]

2019

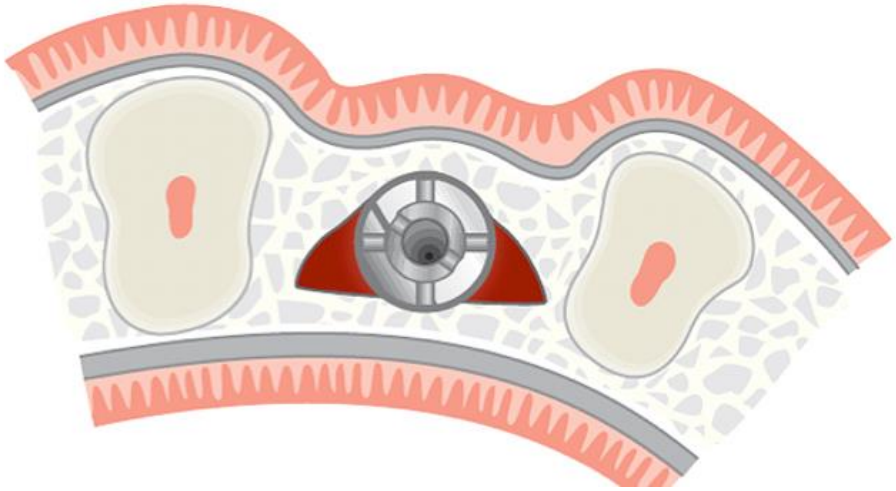
- Both the techniques found to be successful and comparable without any major complications.
- Hard as well as soft tissue structures revealed favorable and stable results with a follow-up period of one year.
- The **delayed** lateral ridge expansion technique can be used more safely and predictably in patients with high bone quality and thick cortex and a narrower ridge in the mandible.


38
B
20
30
40
50
60
70
mm
ID : B4159
BASSIMA ASSAAD YOUNESS [F] 56
20170729
Series : 999
20
R
40
L
L
L
L
8.0 [mA]
85.0 [kVp]
CT
80
3D
AD YOUNESS [F] 56
MPR
TH : 2.0mm
P
16 mm



Ridge Expansion

Indications



- Minimal horizontal bone width of **4 mm.**
- Minimal vertical bone height of **10 mm.**
- Triangular shaped alveolar ridge
- **No concavity** in alveolar bone profile.
- Presence of at least **1 mm cancellous bone** between the two cortices which ensures a good blood supply.

(*Holtz-claw et al. 2010; Bassetti et al. 2013).*

Different approaches available for Ridge expansion

Motorized Expanders

Indicated in:

- Extremely resorbed maxilla with multiple missing teeth.
- Minimum tissue damage.
- Quick precise movements for the clinician.
- Can be placed in apical and occlusal alveolar ridge areas

Different approaches available for Ridge expansion

Manual Expanders

Motorized Expanders

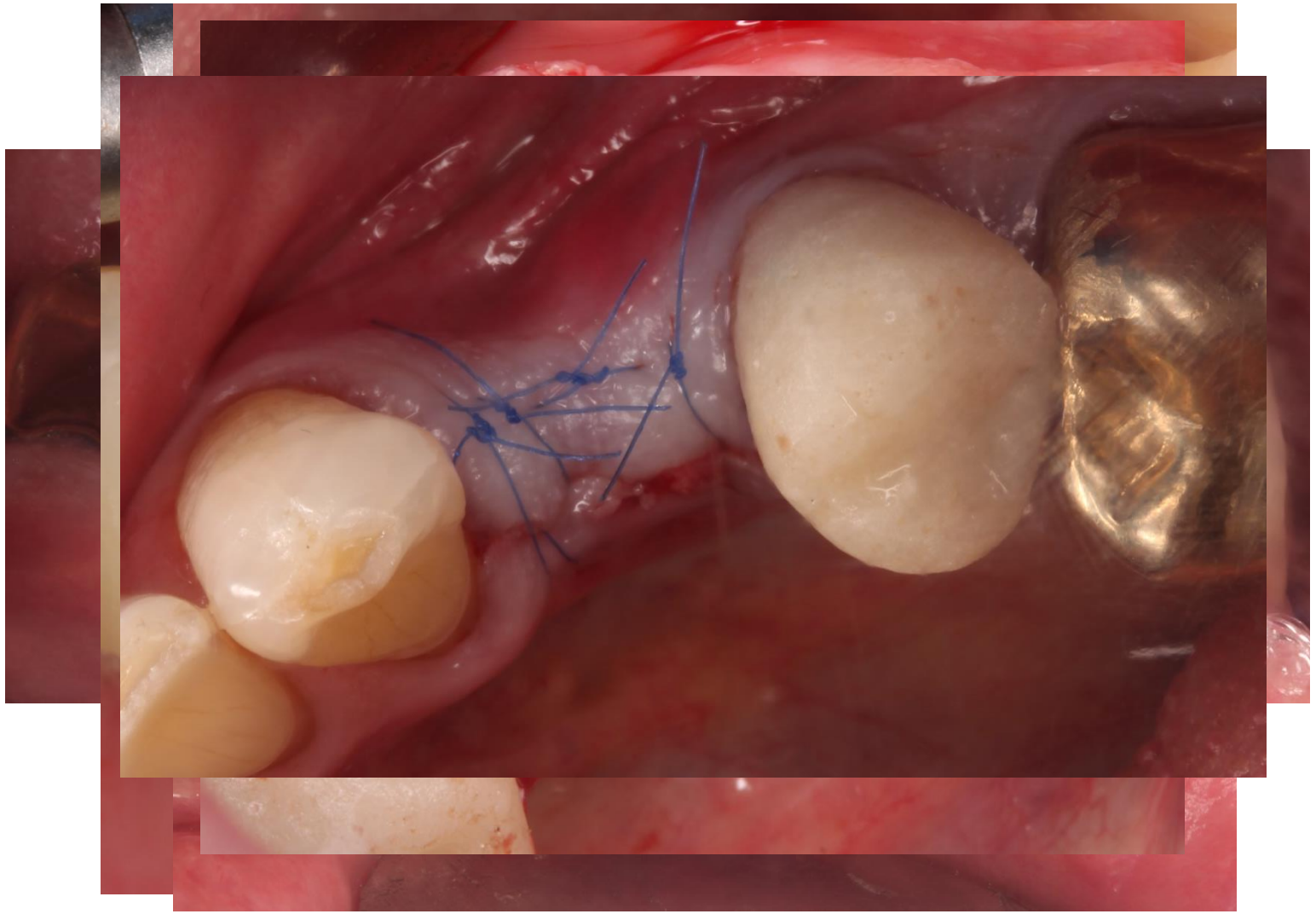
Osteotomes

Complications

1. Fracture of alveolar bone in some cases
2. Uncontrolled force in case of hammering
3. Microcracks in some cases
4. Limited to 1-2 mm increase in ridge width

(Holtzclaw et al. 2010; Bassetti et al. 2013).

Ridge expansion using Expanders



Osseo-densification

Concept

Osseo-densification Salah Huwais 2014

Osseo-densification is a time dependent low plastic deformation of trabecular bone

↓

Keep the bone bulk = Shorten the healing time

↓

Bone Characteristics Allow for This Theory

Concept

Characteristics of Bone:

1. Bone is flexible & can absorb energy
2. Bone can deform & change shape without cracking as in dental extraction
3. Bone is able to widen with compression
4. Bone is able to lengthen with tension
5. Bone is viscoelastic

Bone compaction and autografting in an outward expanding direction to form the osteotomy

Bur design

Non-subtractive drills

Osseodensification

Do not Remove Bone

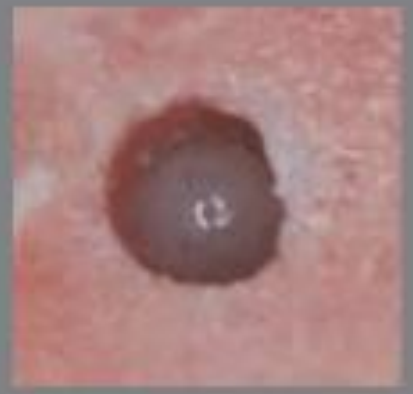
Just

Move it

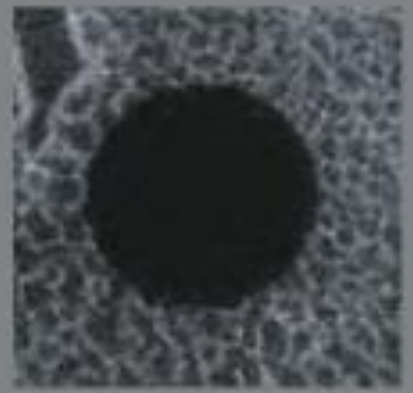
Autografting

Standard Drills Vs Densah Bur Clockwise cutting Vs Densah Bur anticlockwise osseodensification

Osteotomies Created With Standard Drills

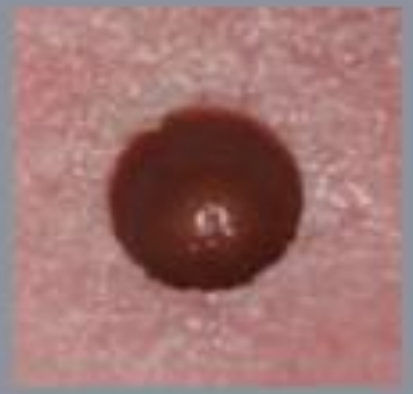


1. Osteotomy prepared in porcine Tibia with standard fluted drills

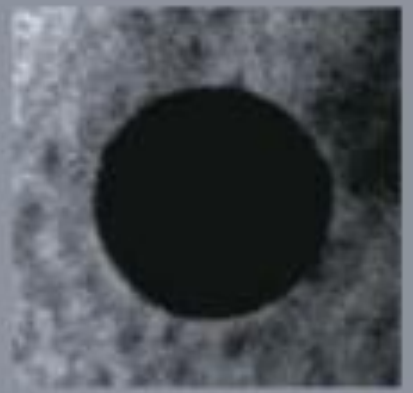


2. uCT radiograph

Osteotomies Created With Densah™ Bur Clockwise Cutting

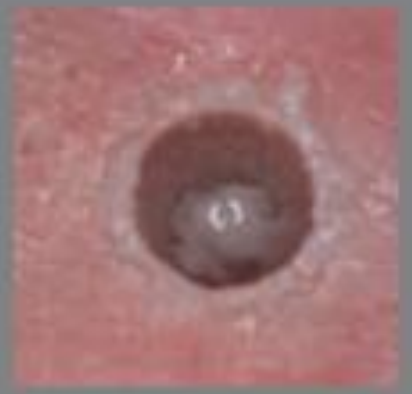


1. Osteotomy prepared in porcine with Densah Bur rotating clockwise (cutting)

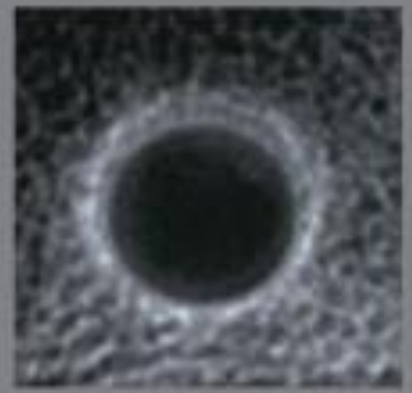


2. uCT radiograph

Osteotomies Created With Densah Bur Counterclockwise Osseodensification



1. Osteotomy prepared in porcine with Densah Burs rotating counterclockwise (Osseodensification)



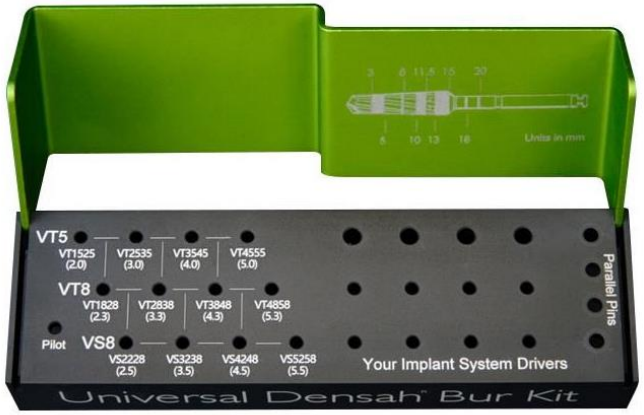
2. uCT radiograph

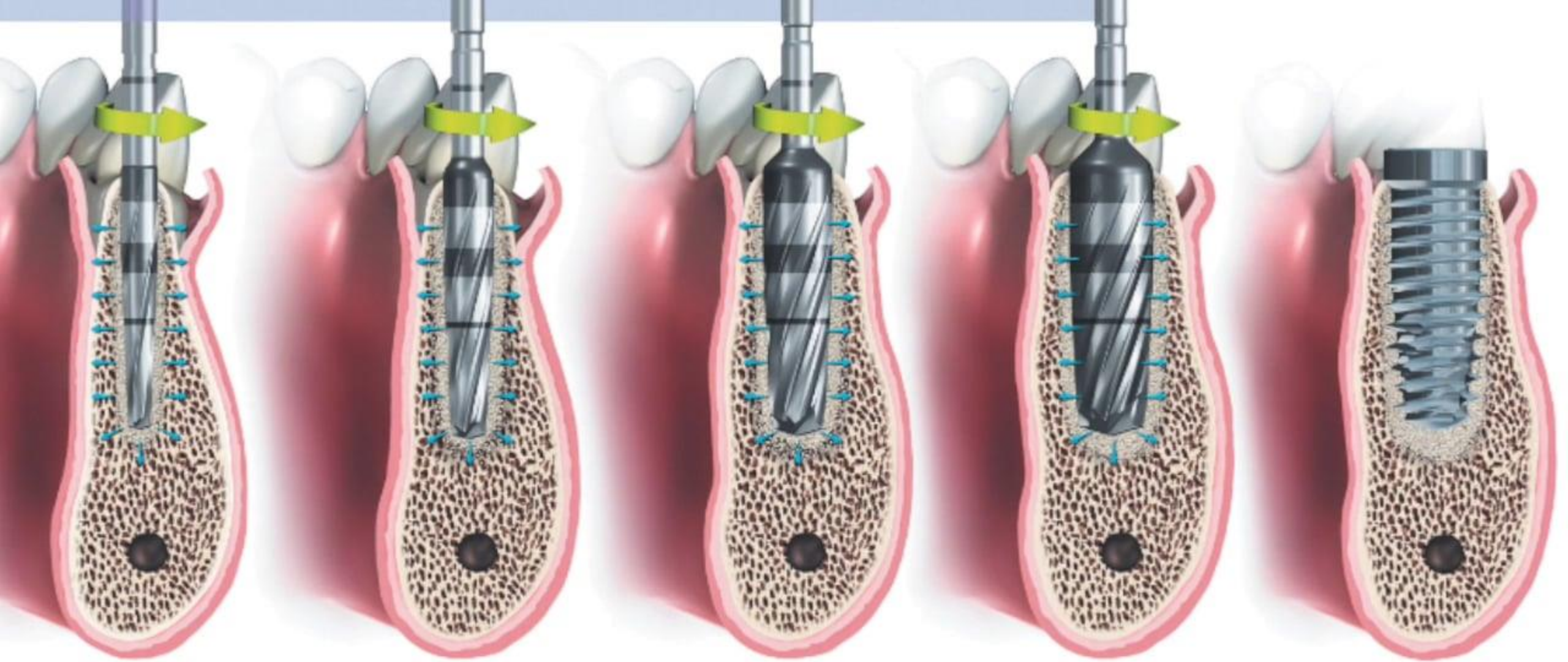
Bur design

Non-subtractive drills

1 Kit is 12 drills + pilot

“straight and taper designs”





Speed 800-1500 RPM
Pumping action

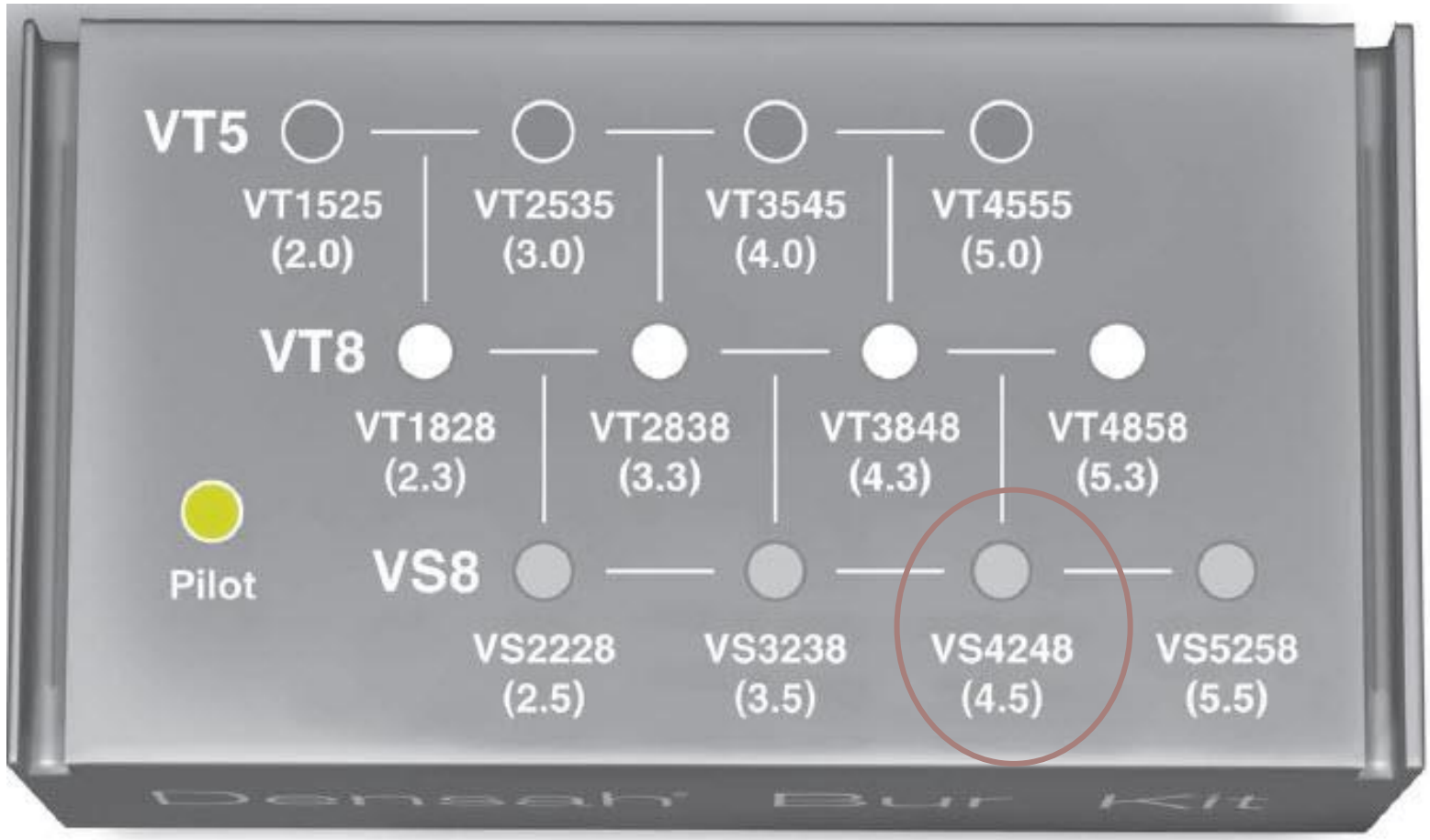
Osseodensification Technique

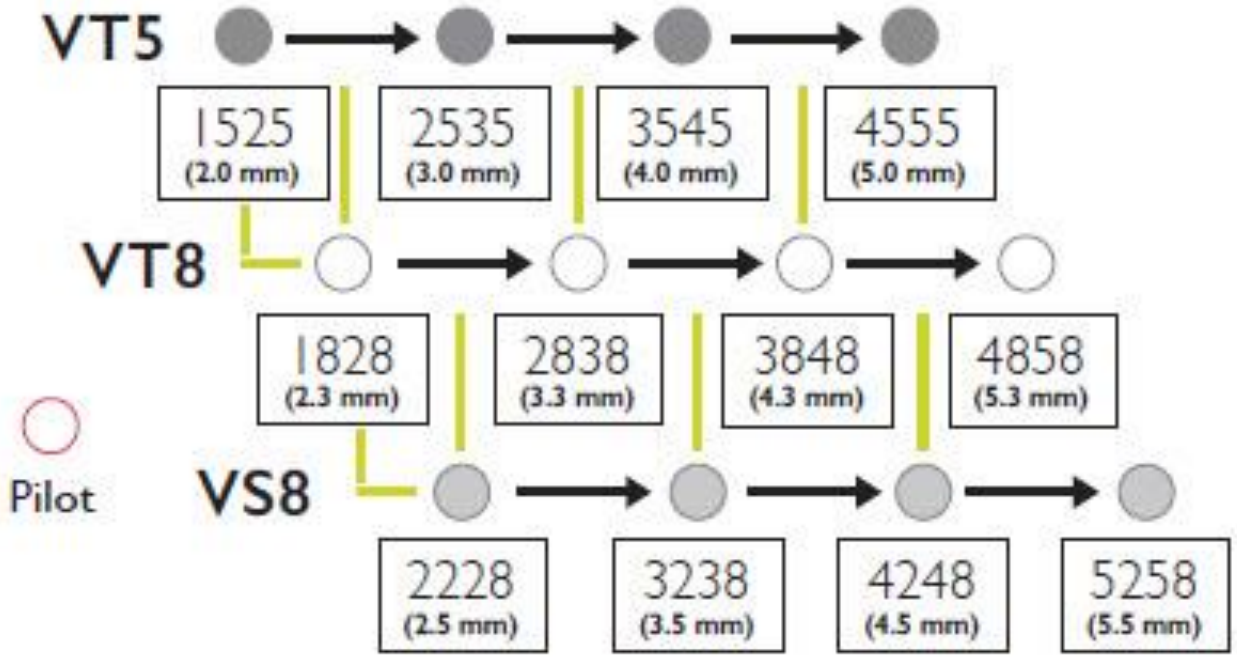
Tapered Model “Versa Taper”

- 38 is 3.8 mm smallest diameter at the tip
- 48 is 4.8 mm largest diameter at the shank
- 4.3 is the average diameter

Straight Model “Versa Straight”

- 42 is 4.2 mm smallest diameter at the tip
- 48 is 4.8 mm largest diameter at the shank
- 4.5 is the average diameter





Preparation Steps for Hard Bone Osteotomy

Preparation Steps for Soft Bone Osteotomy

VT5 For Tapered Implants Placement with Diameters of X.5, X.7, X.8

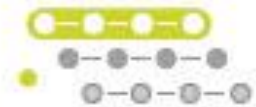
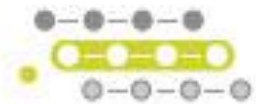
VT8 For Tapered Implants Placement with Diameters of X.0, X.2, X.3

VS8 Last Step Finishers for Parallel Wall Implants

II. Decision Tree for Osseodensification Protocol

● VT5 Set ○ VT8 Set ○ VS8 Set

Soft Bone — Tapered Implants

Implant Diameter		Bur 1	Bur 2	Bur 3	Bur 4	
3.5, 3.7, 3.8	Pilot	**VT** 1525 (2.0)	**VT** 2535* (3.0)	—	—	
4.0, 4.2, 4.3	Pilot	**VT** 1828 (2.3)	**VT** 2838* (3.3)	—	—	
4.5, 4.7, 4.8	Pilot	**VT** 1525 (2.0)	**VT** 2535 (3.0)	**VT** 3545* (4.0)	—	
5.0, 5.2, 5.3	Pilot	**VT** 1828 (2.3)	**VT** 2838 (3.3)	**VT** 3848* (4.3)	—	
5.5, 5.7, 5.8	Pilot	**VT** 1525 (2.0)	**VT** 2535 (3.0)	**VT** 3545 (4.0)	**VT** 4555* (5.0)	
6.0, 6.2	Pilot	**VT** 1828 (2.3)	**VT** 2838 (3.3)	**VT** 3848 (4.3)	**VT** 4858* (5.3)	

II. Decision Tree for Osseodensification Protocol

● VT5 Set ○ VT8 Set ○ VS8 Set

Hard Bone — Tapered Implants

Implant Diameter		Bur 1	Bur 2	Bur 3	Bur 4	Bur 5	Bur 6	Bur 7	
3.5, 3.8	Pilot	**VT** 1525 (2.0)	**VT** 1828 (2.3)	**VT** 2535* (3.0)	—	—	—	—	
4.0, 4.2, 4.3	Pilot	**VT** 1525 (2.0)	**VT** 1828 (2.3)	**VT** 2535 (3.0)	**VT** 2838 (3.3)	**VS** 3238* (3.5)	—	—	
4.5, 4.7, 4.8	Pilot	**VT** 1525 (2.0)	**VT** 2535 (3.0)	**VT** 2838 (3.3)	**VT** 3545* (4.0)	—	—	—	
5.0, 5.2, 5.3	Pilot	**VT** 1828 (2.3)	**VT** 2535 (3.0)	**VT** 2838 (3.3)	**VT** 3545 (4.0)	**VT** 3848 (4.3)	**VS** 4248* (4.5)	—	
5.5, 5.7, 5.8	Pilot	**VT** 1525 (2.0)	**VT** 2535 (3.0)	**VT** 2838 (3.3)	**VT** 3545 (4.0)	**VT** 3848 (4.3)	**VT** 4555* (5.0)	—	
6.0, 6.2	Pilot	**VT** 1828 (2.3)	**VT** 2838 (3.3)	**VT** 3545 (4.0)	**VT** 3848 (4.3)	**VT** 4555 (5.0)	**VT** 4858 (5.3)	**VS** 5258* (5.5)	

*Denotes implant placement.

NOTE: Surgeon preference overrules this suggestive protocol

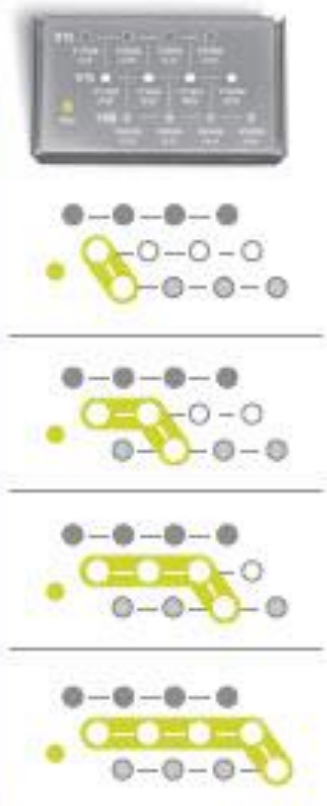
Continued on next page

II. Decision Tree for Osseodensification Protocol

● VT5 Set ○ VT8 Set ○ VS8 Set

Soft Bone — Straight Implants

Implant Diameter		Bur 1	Bur 2	Bur 3	Bur 4	Bur 5
3.0	Pilot	**VT** 1828 (2.3)	**VS** 2228* (2.5)	—	—	—
4.0	Pilot	**VT** 1828 (2.3)	**VT** 2838 (3.3)	**VS** 3238* (3.5)	—	—
5.0	Pilot	**VT** 1828 (2.3)	**VT** 2838 (3.3)	**VT** 3848 (4.3)	**VS** 4248* (4.5)	—
6.0	Pilot	**VT** 1828 (2.3)	**VT** 2838 (3.3)	**VT** 3848 (4.3)	**VT** 4858 (5.3)	**VS** 5258* (5.5)

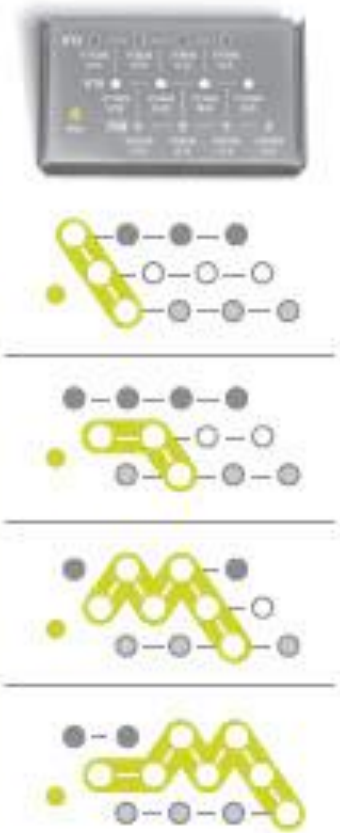


II. Decision Tree for Osseodensification Protocol

● VT5 Set ○ VT8 Set ○ VS8 Set

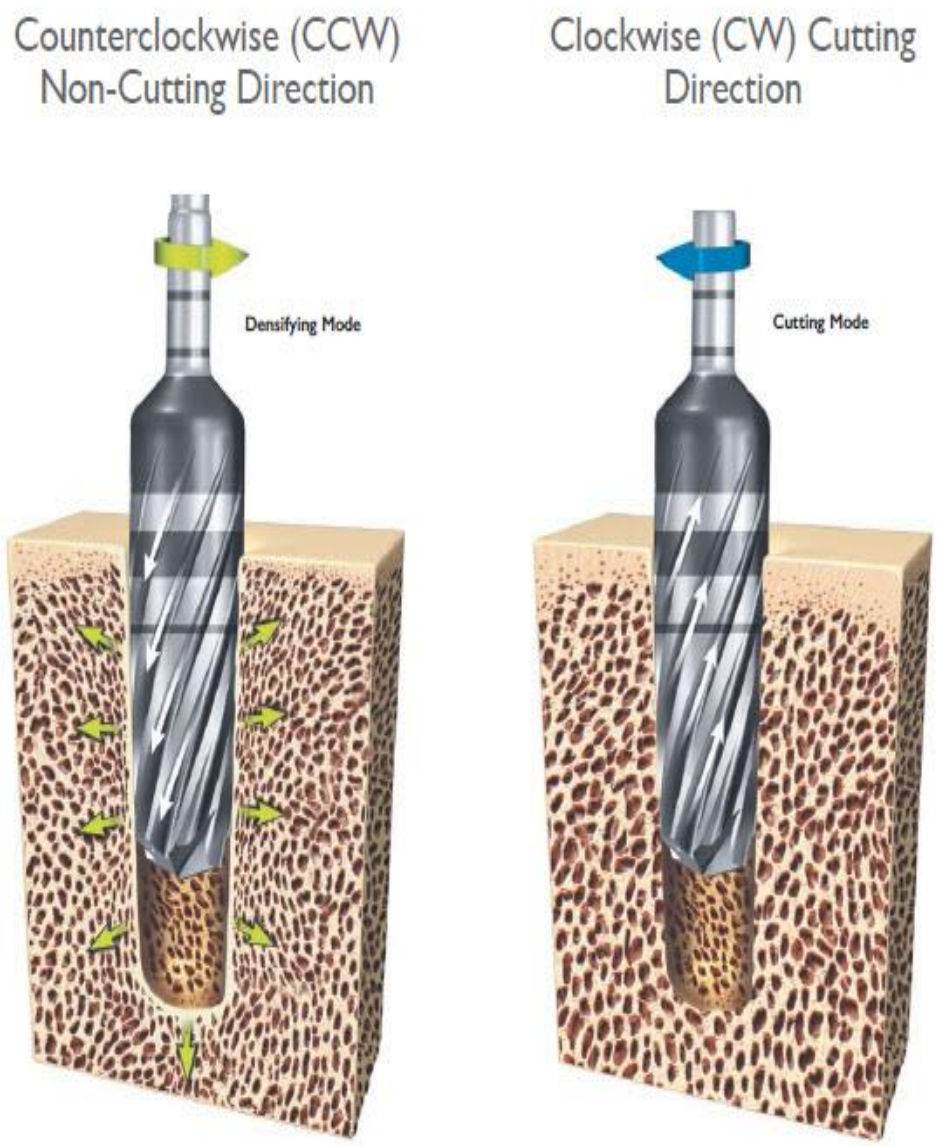
Hard Bone — Straight Implants

Implant Diameter		Bur 1	Bur 2	Bur 3	Bur 4	Bur 5	Bur 6	Bur 7
3.0	Pilot	VT 1525 (2.0)	VT 1828 (2.3)	VS 2228* (2.5)	—	—	—	—
4.0	Pilot	VT 1828 (2.3)	VT 2838 (3.3)	VS 3238* (3.5)	—	—	—	—
5.0	Pilot	VT 1828 (2.3)	VT 2535 (3.0)	VT 2838 (3.3)	VT 3545 (4.0)	VT 3848 (4.3)	VS 4248* (4.5)	—
6.0	Pilot	VT 1828 (2.3)	VT 2838 (3.3)	VT 3545 (4.0)	VT 3848 (4.3)	VT 4555 (5.0)	VT 4858 (5.3)	VS 5258* (5.5)



Indications

1. Soft bone to enhance quality
2. Expansion of bone in narrow ridges
3. Sinus lifting
4. Accompanied by ridge splitting in hard bone
5. In immediate implant (especially molars “inter-septal bone”)



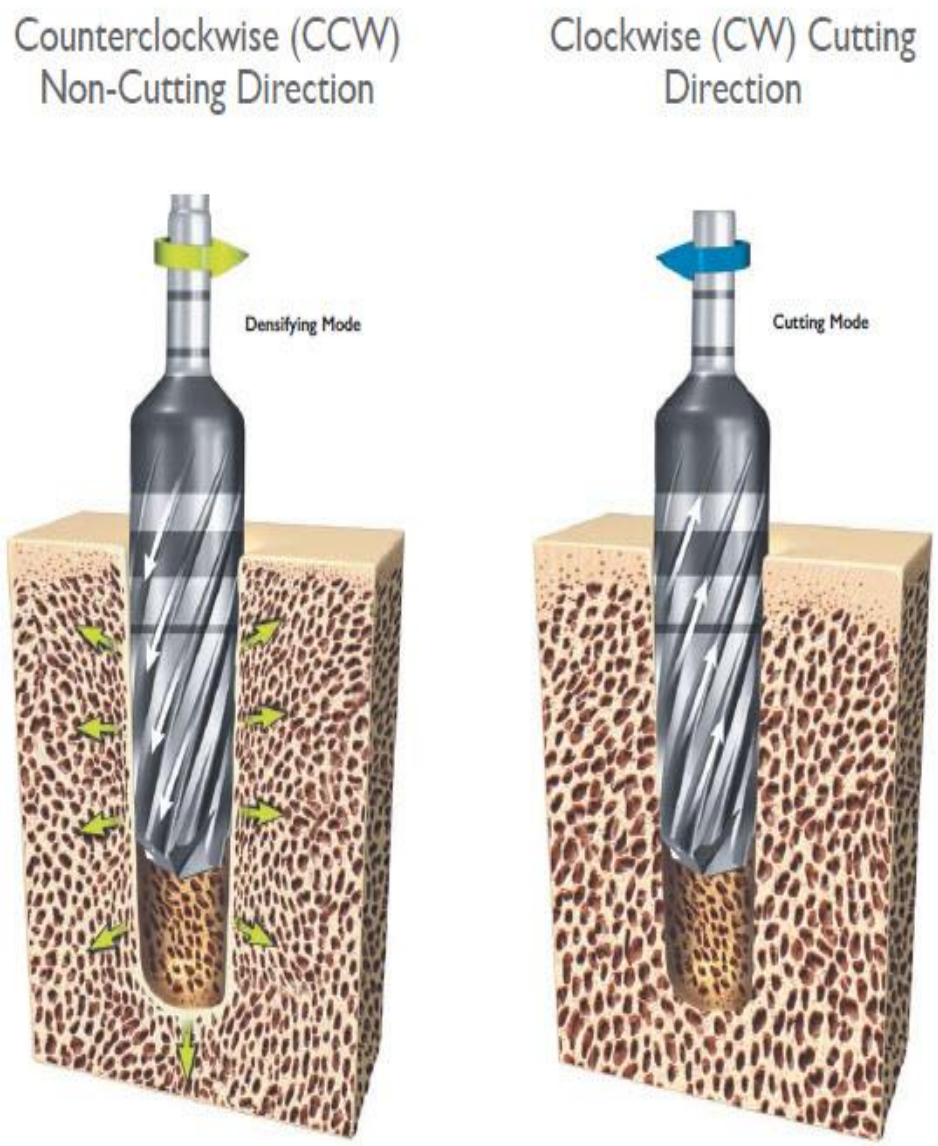
General Rule

Final Implant Diameter

used

1 mm plus the initial ridge width

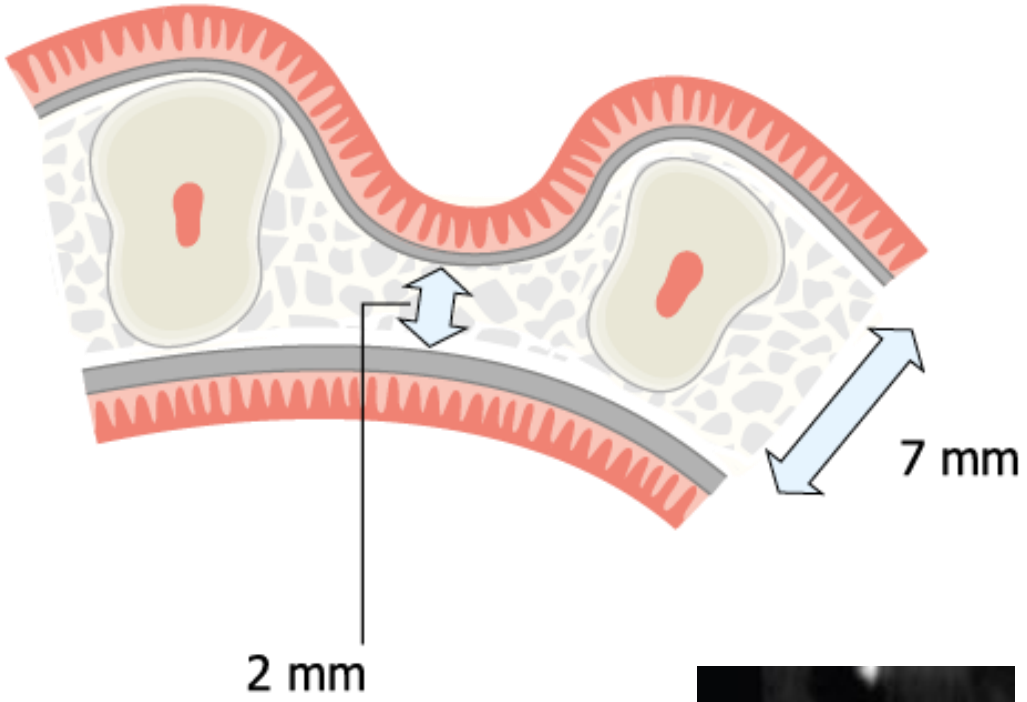
Avoid under sizing the osteotomy as in the regular drills



Case Selection

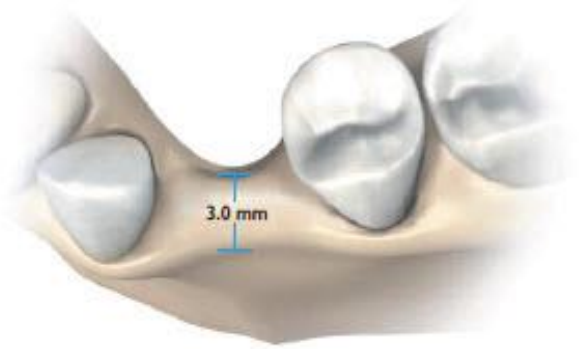
Bone Morphology - Composition

- 1 mm Buccal
- 1 mm Lingual
- 2 mms sponge bone

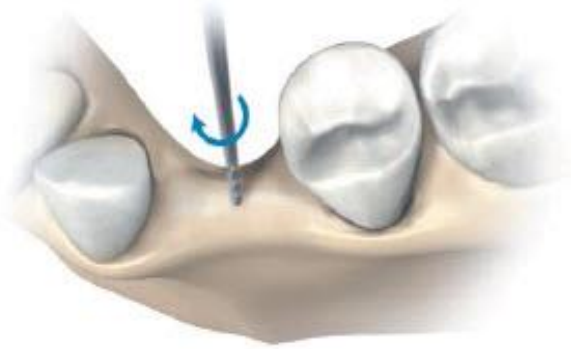


Case Selection

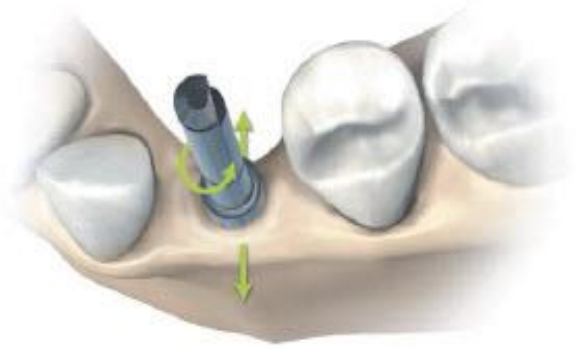
Bone Morphology - Composition



1.



2.



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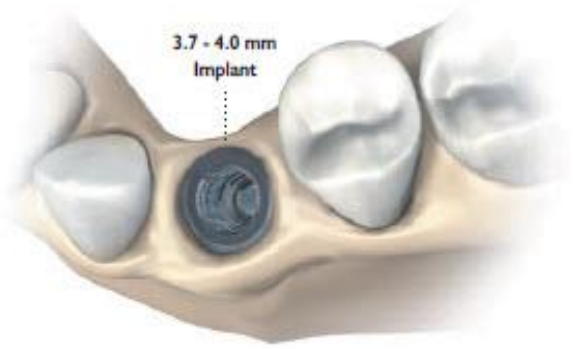

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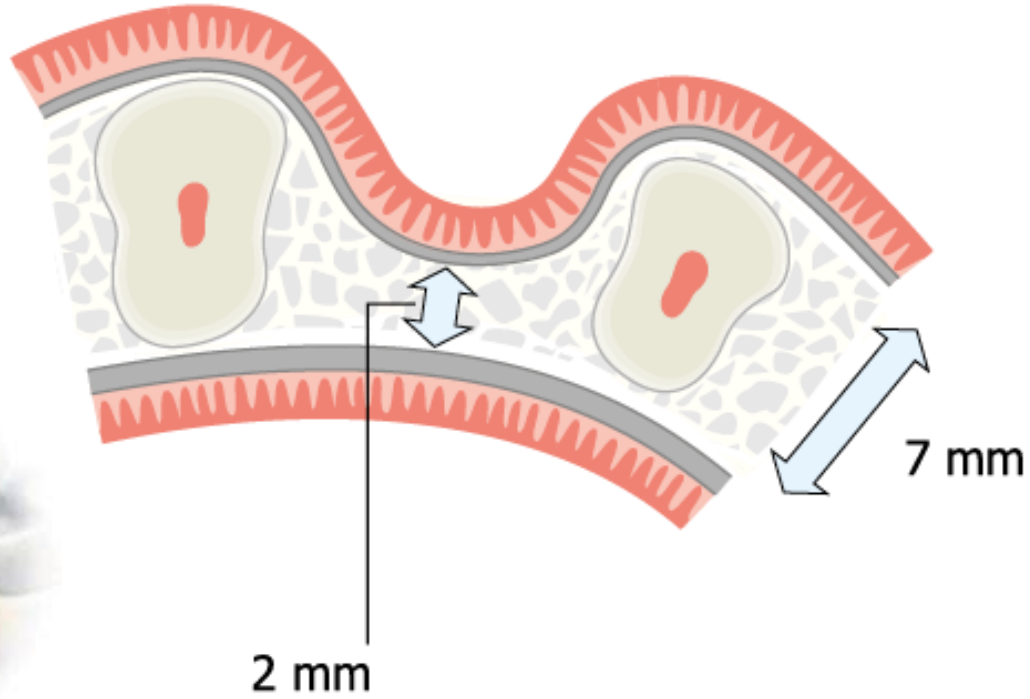
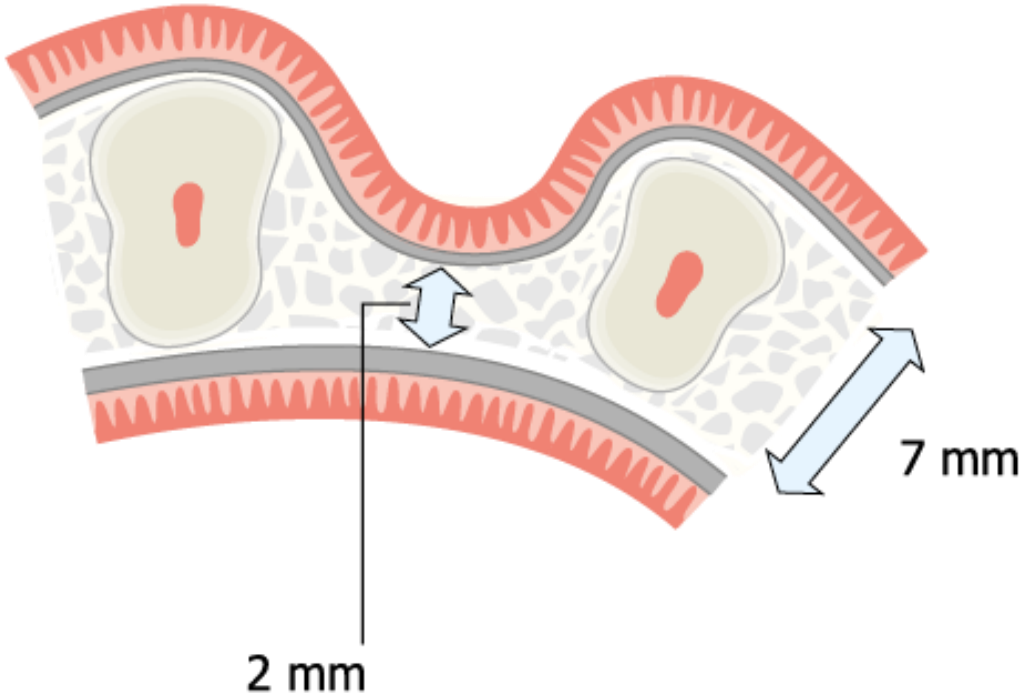


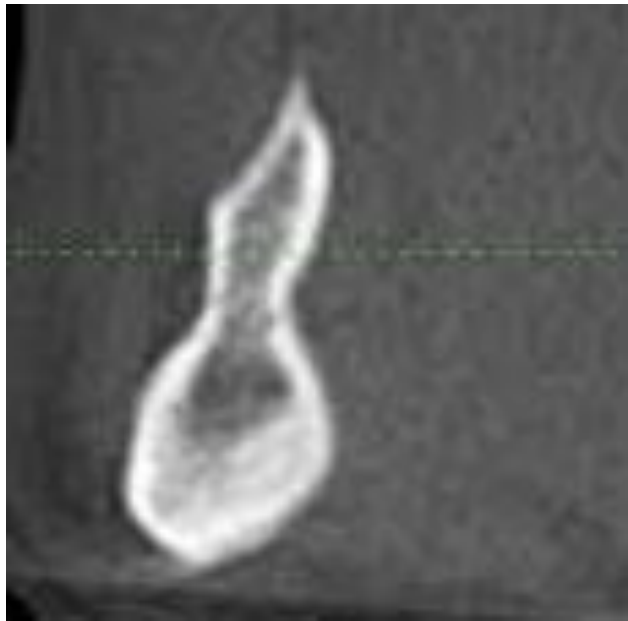
Requires a ridge of at least 3 mm
(to place a implant with 4 mm)

Case Selection

Avoid

- Knife edge bone
- D1 bone (Hard Bone)





Ridge Splitting

Osseo-densification

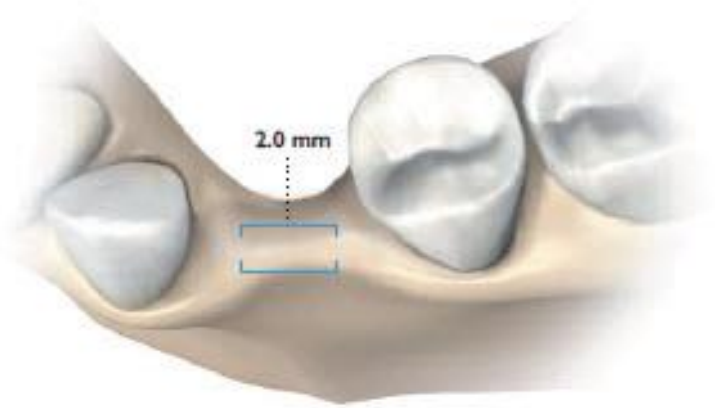
Ridge Expansion Protocol

- Create Intra-bony Trough in Narrow Ridge
- No Need for Vertical Cuts
- Use Densah Burs in Small Increments
- Osteotomy 1mm deeper than implant length
- Over-size Osteotomy — Spring-Back Effect
- Use Veneer Graft when expanded buccal plate thickness is < 2mm

Narrow ridge 4 mm
≤ 2 mm of trabecular-bone core or high cortical bone ratio

20 mm length
10 mm depth

Guided Bone Expansion



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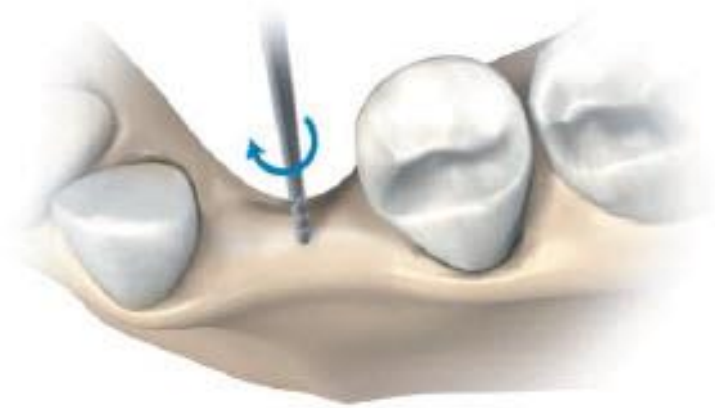

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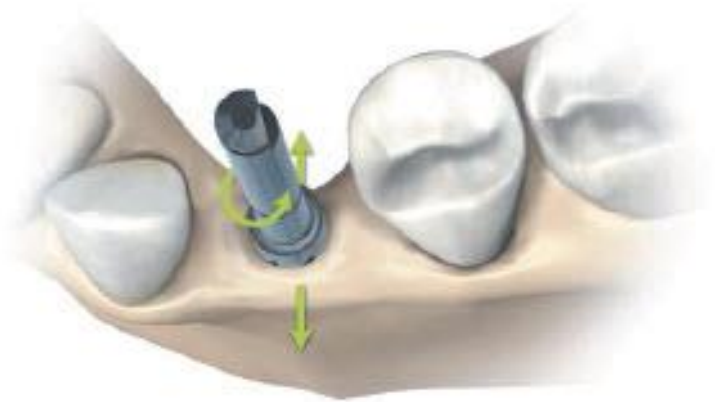

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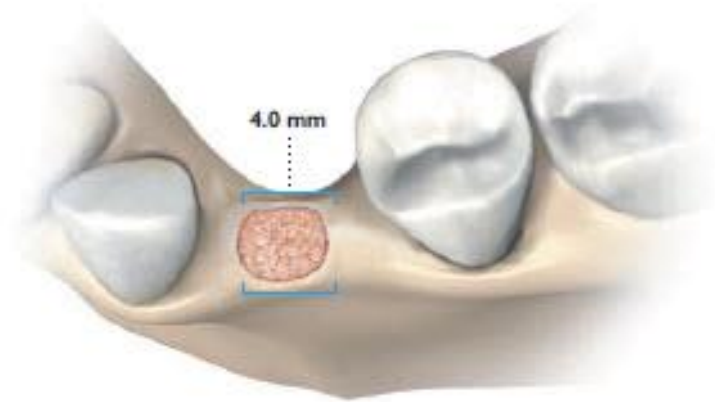
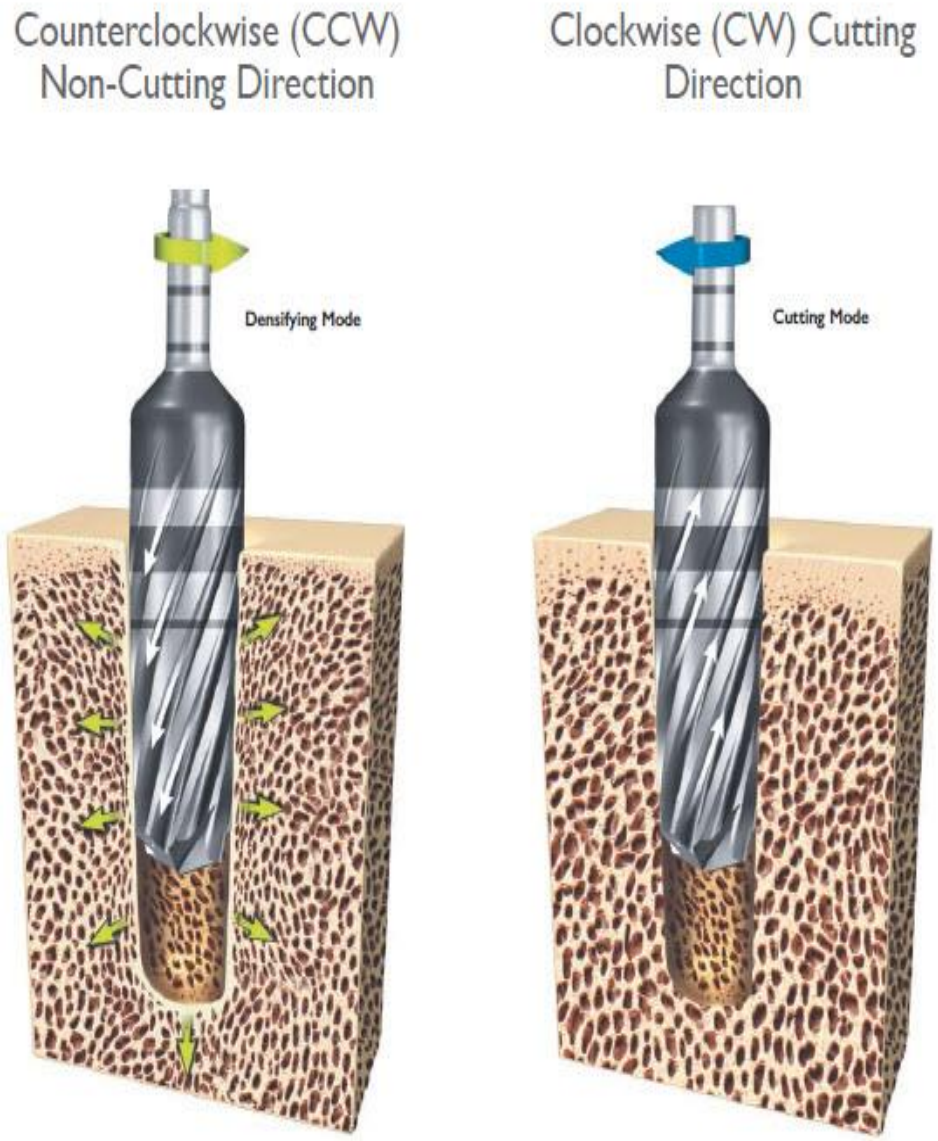


4.

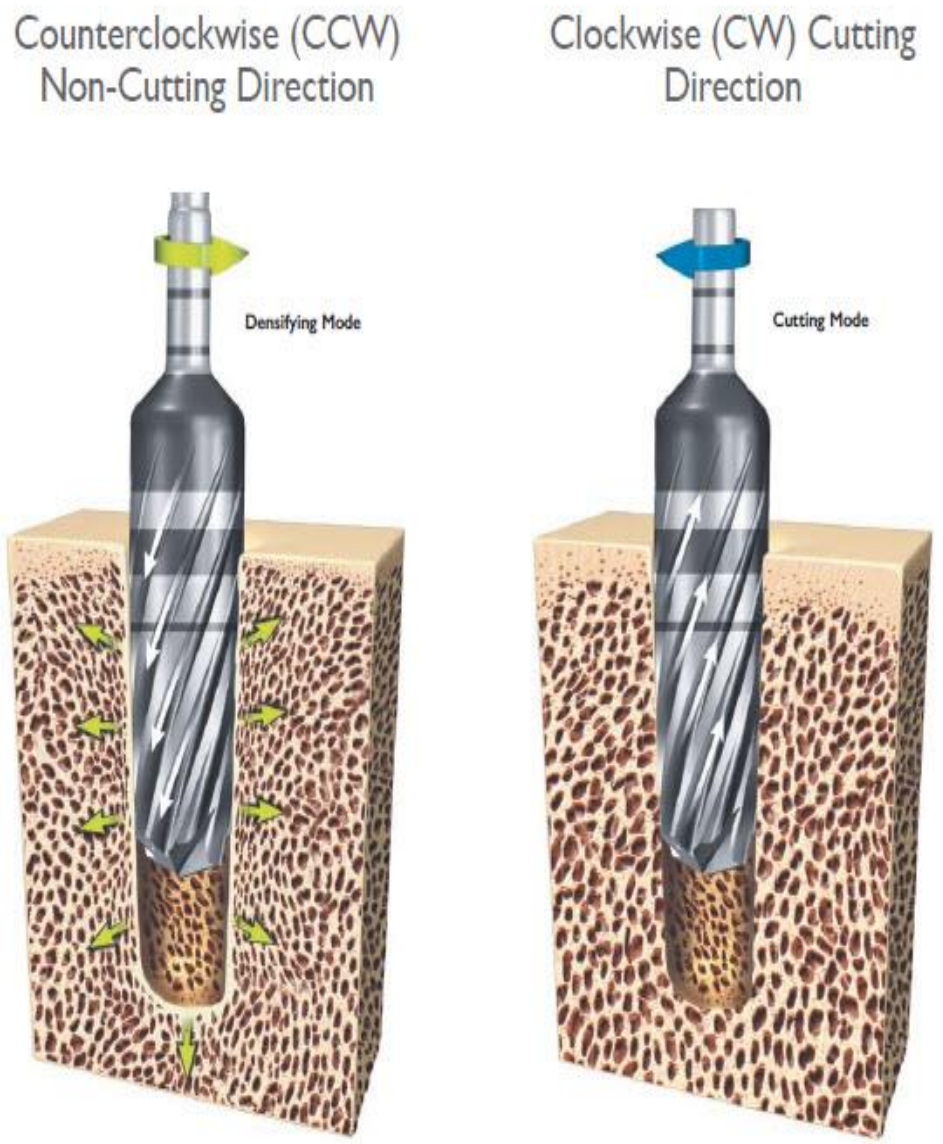
Advantages

1. No hammering needed
2. Less traumatic
3. Condensing bone & increasing its density leading to a higher bone to implant contact (BIC)
4. shorter osseointegration & healing period before loading
5. Increasing the residual strain enhances the osteogenic activity through mechano-biology



Disadvantages

1. Lengthy procedure
2. Expensive
3. Over expectations
4. More heat generation
5. Drills are not color coded



Platelet Concentrates

Platelet Concentrates

- Are known to release several growth factors which stimulate tissue regeneration by stimulating cell proliferation and regulating angiogenesis.

- Several techniques for platelet concentrates have been introduced in surgical field for the prevention of hemorrhage and acceleration of tissue regeneration.

Platelet Concentrates

- Different generations were introduced

First generation includes:

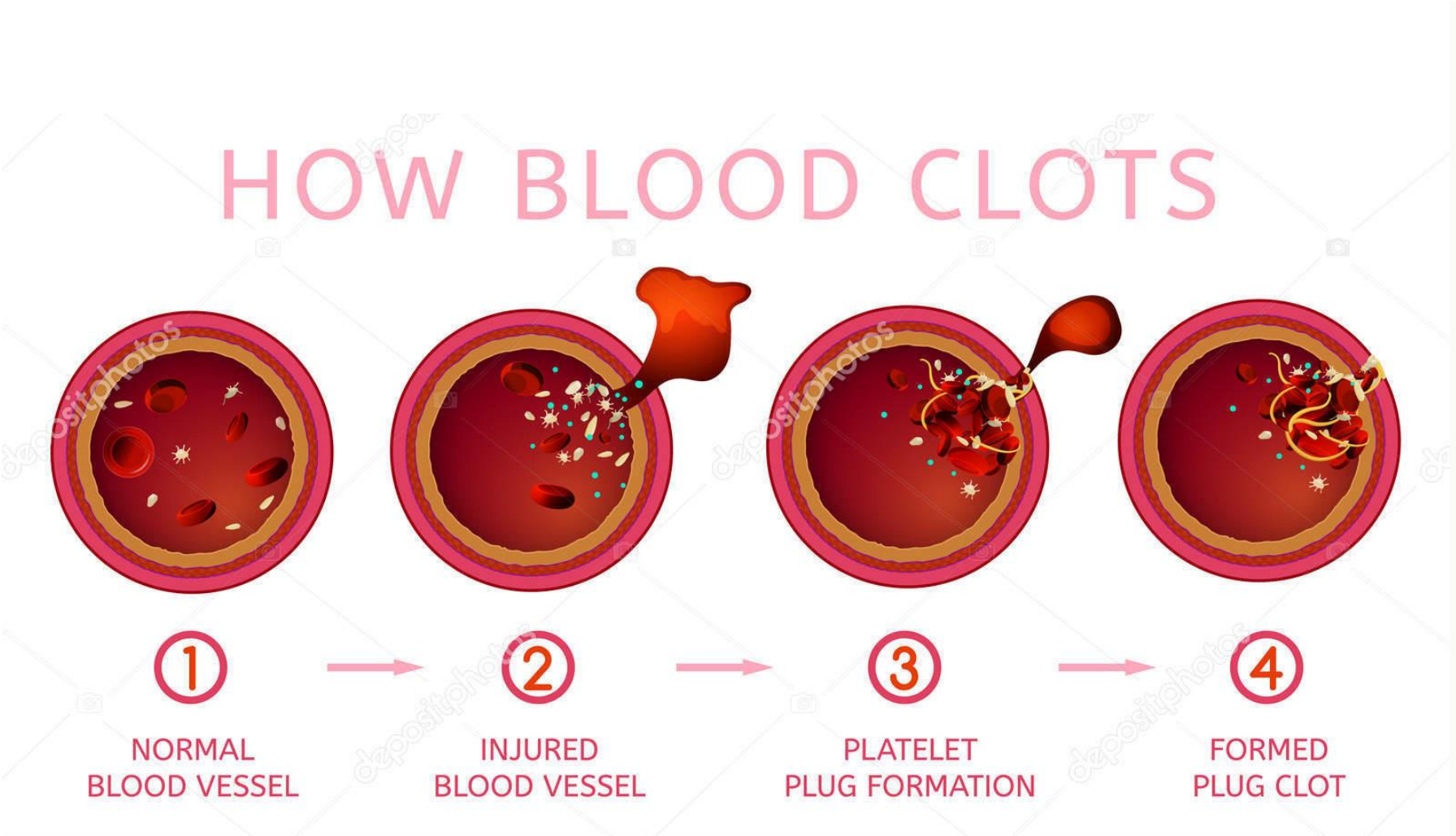
- Platelet rich plasma (PRP)
- Plasma rich in growth factors (PRGF)

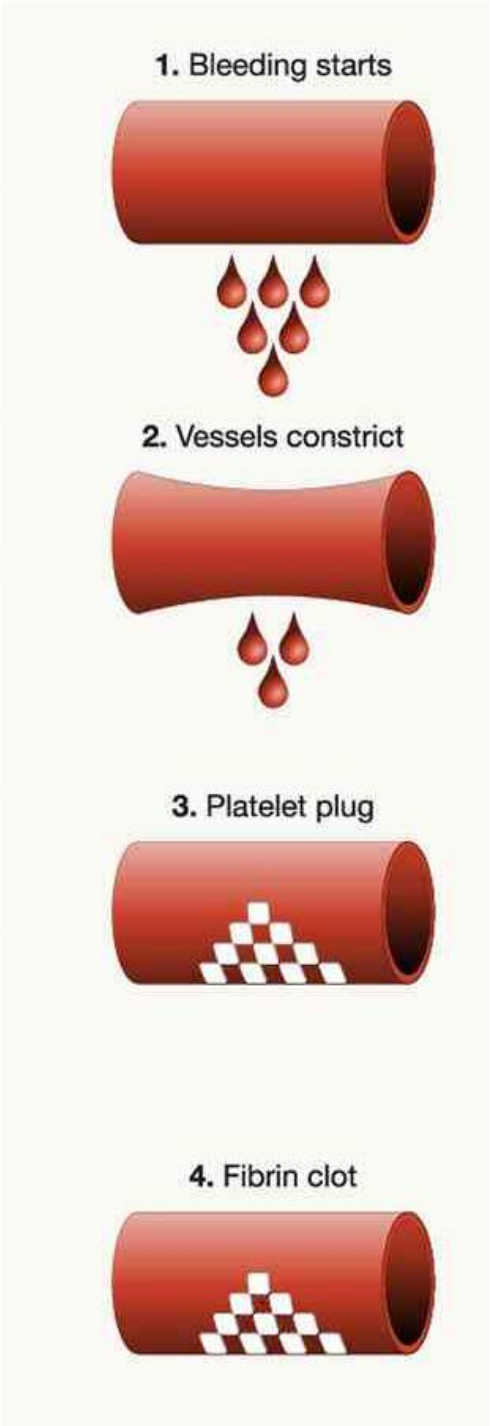
Second Generation includes:

- Platelet rich fibrin (PRF)
- Concentrated growth factors (CGF)

PRF Modifications includes:

- Advanced PRF (A-PRF)
- Injectable PRF (I-PRF)
- Titanium PRF (T-PRF)





Activation of Platelets

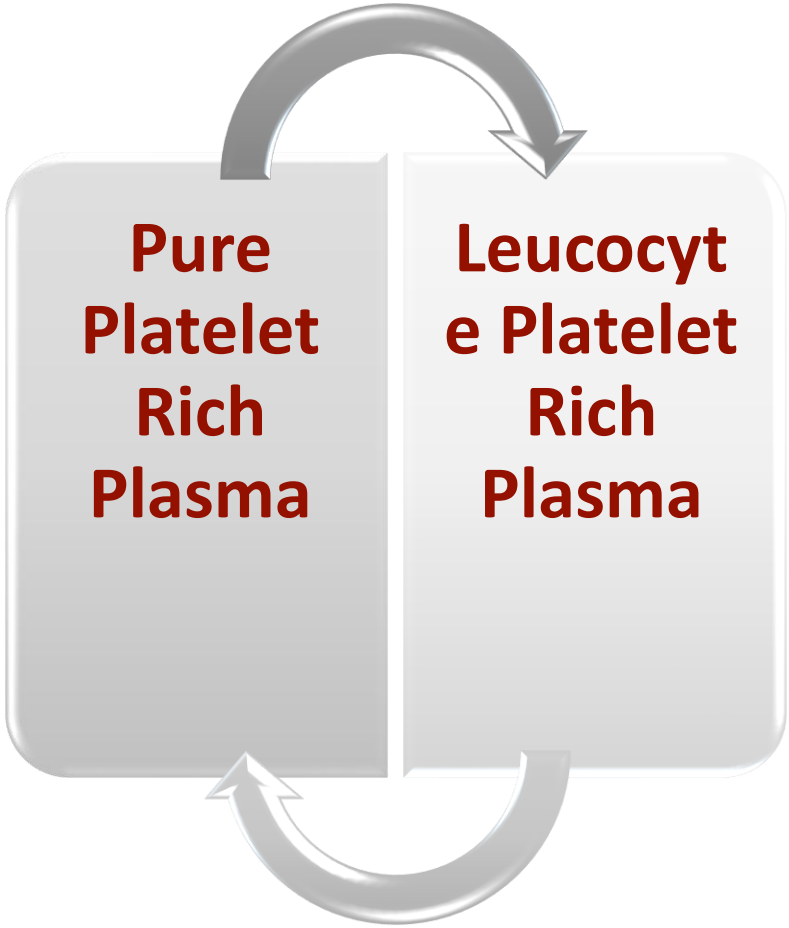
Coagulation Activation

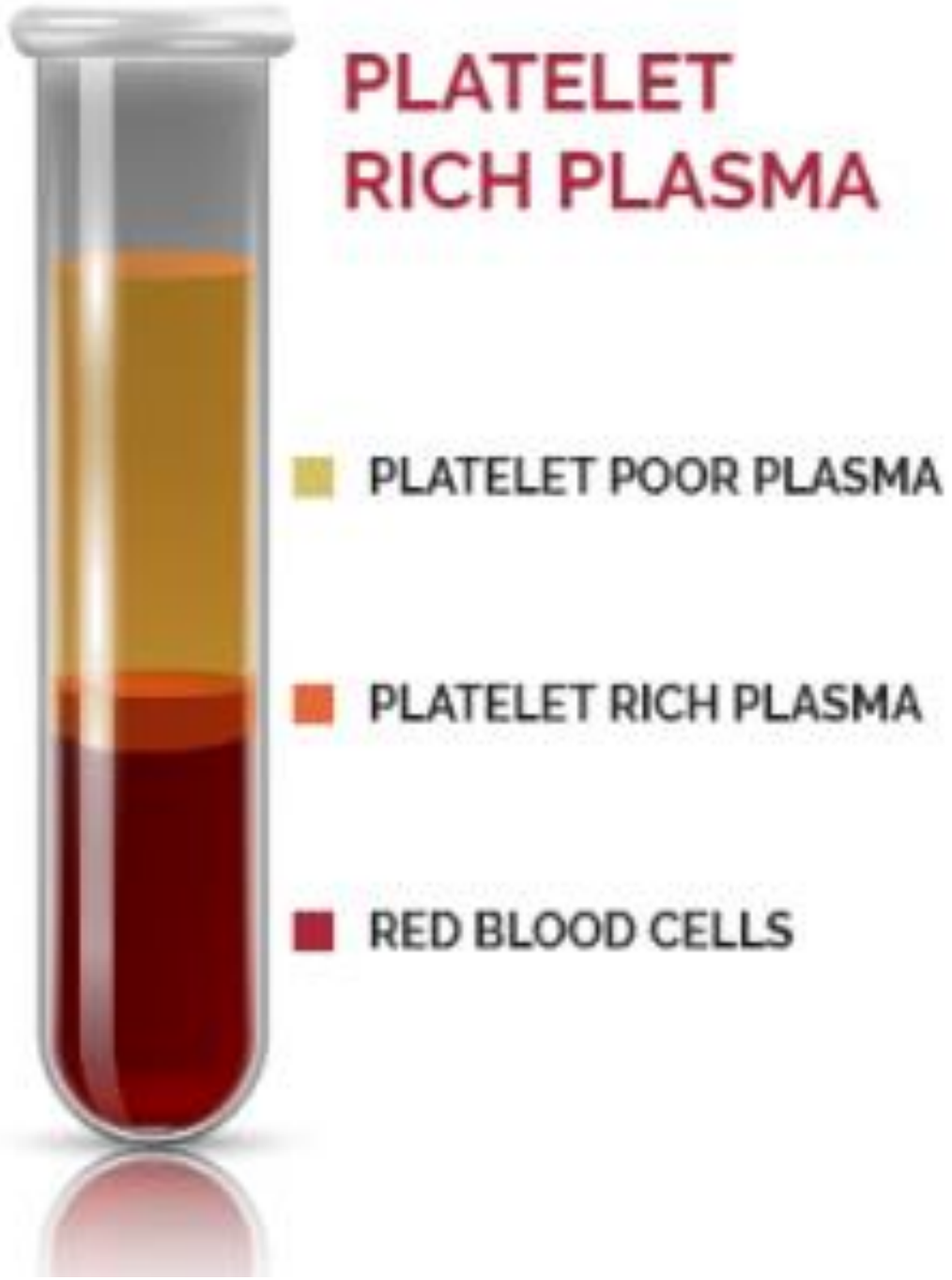
Platelet rich plasma (PRP)

- First form of autologous platelet concentrate to replace commercial fibrin glue
- 2 spins for preparation of PRP
- PRP is mixed with bovine thrombin to achieve fibrin polymerization.
- Needs anticoagulant in the collecting tube

First spin (Soft Spin)

- 300g for 5 min at 12°C or
  240g for 8 min at 16°C



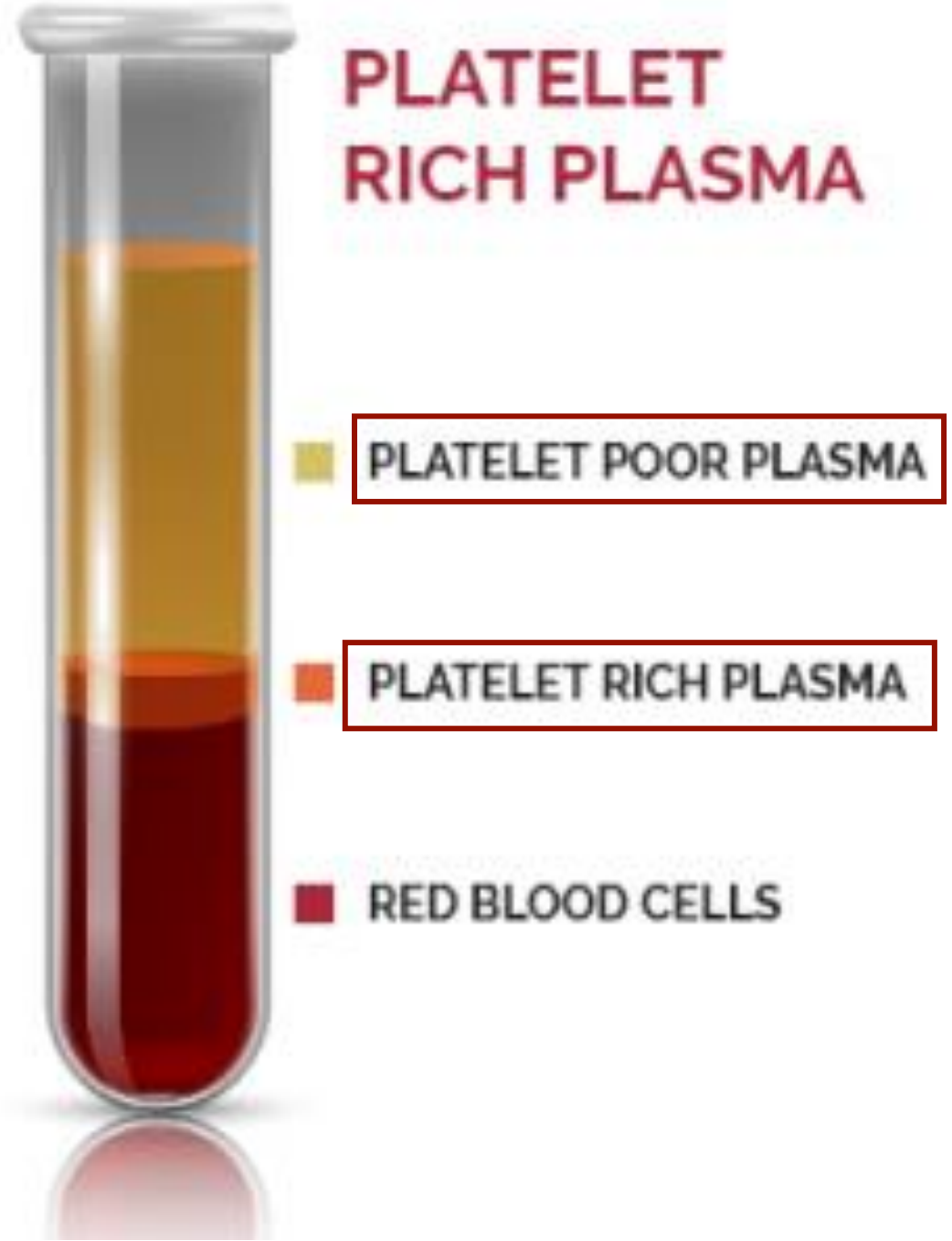


Pure Platelet rich plasma (P-PRP)

Second Spin (Hard spin)

- 700g for 17 min at 12°C

Then coagulation cascade is activated by thrombin (animal) and permit to clot at 37 degree

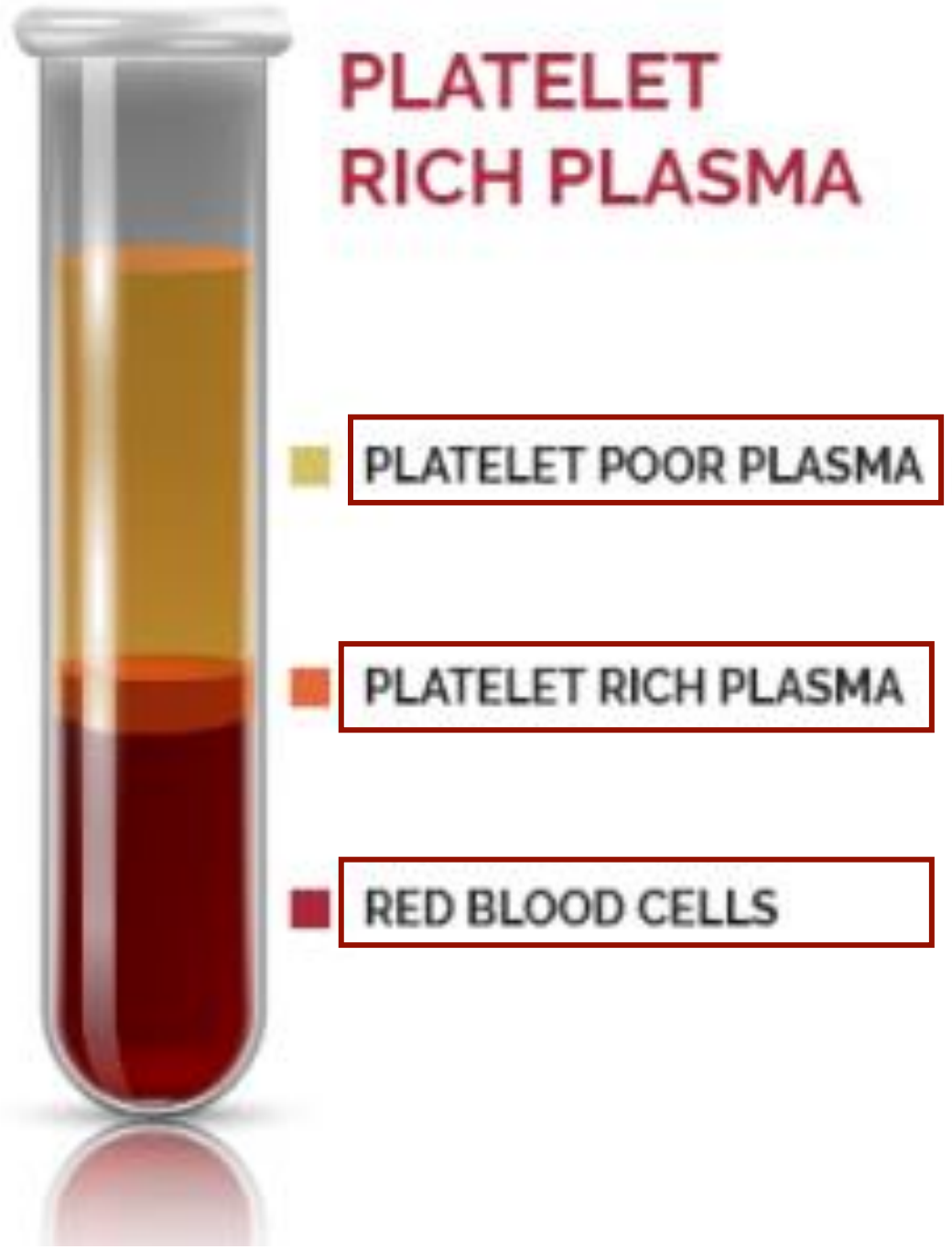


Leucocyte Platelet rich plasma (L-PRP)

Second Spin (Hard spin)

- 700g for 17 min at 12°C

Then coagulation cascade is activated by thrombin (animal) and permit to clot at 37 degree



PRP

PLATED RICH PLASMA

IMPROVES BONE AND TISSUE GROWTH AROUND DENTAL IMPLANTS

Liquid injectable form

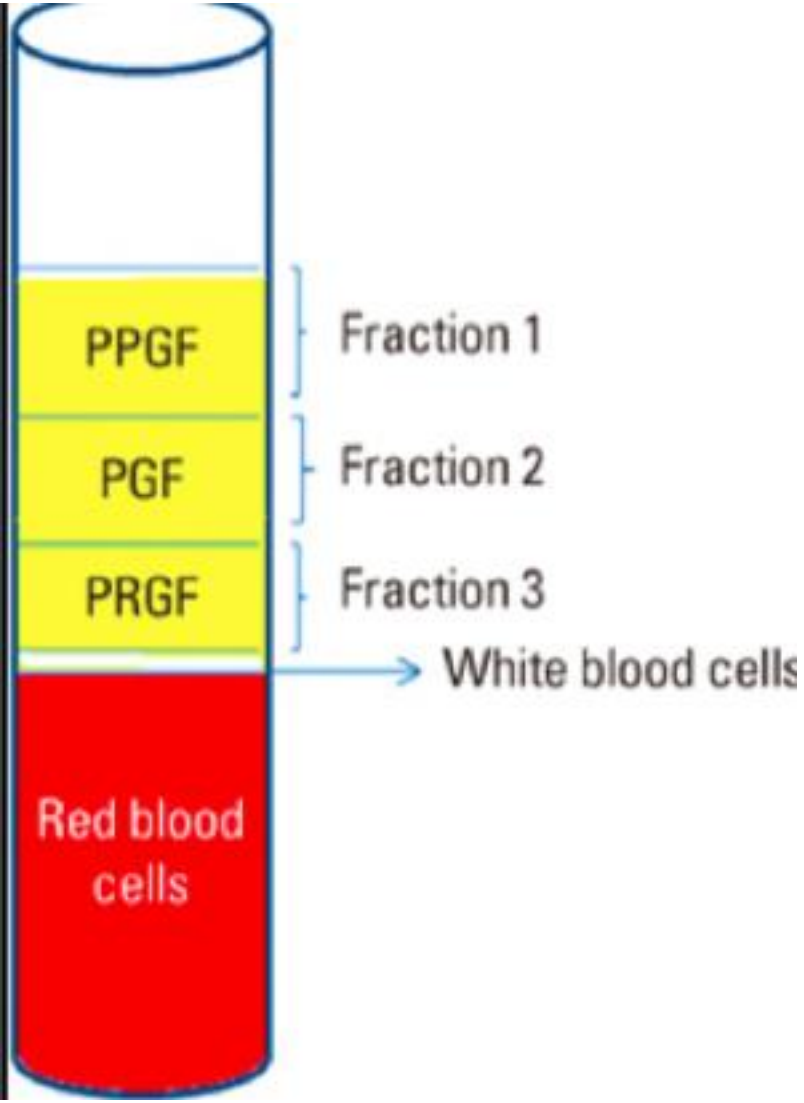
Plasma rich in Growth factors (PRGF)

Dr. Anitua

- It is a type of (P-PRP) using special single spin protocol
- Citrated tubes (contained 0.2 ml sodium citrate)
- The tubes are centrifuged at 2270 rpm for 8 mins.

Plasma rich in Growth factors (PRGF)

Dr. Anitua

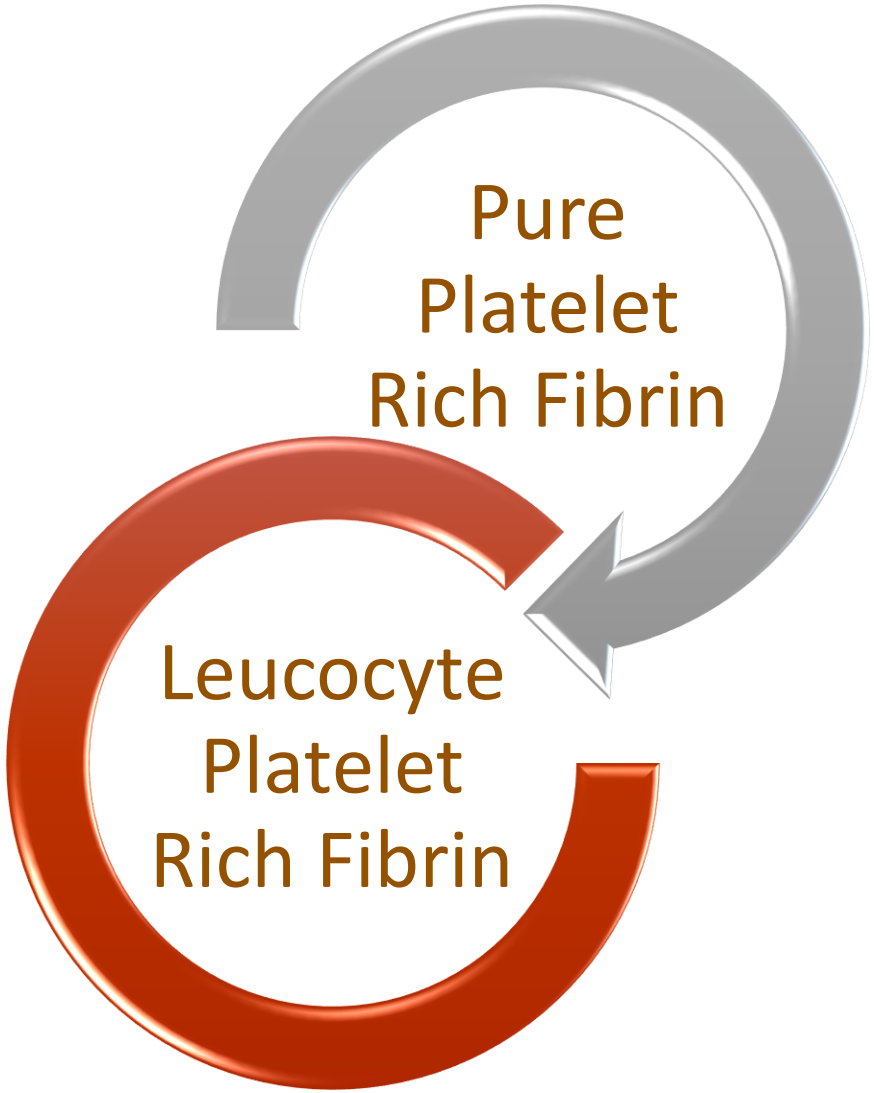


- PRGF is separated in a tube for activation
- Activation by Calcium Chloride (instead of animal thrombin)
- Left for 20 mins at 37 degrees

In the form of a Membrane

Platelet rich Fibrin (PRF)

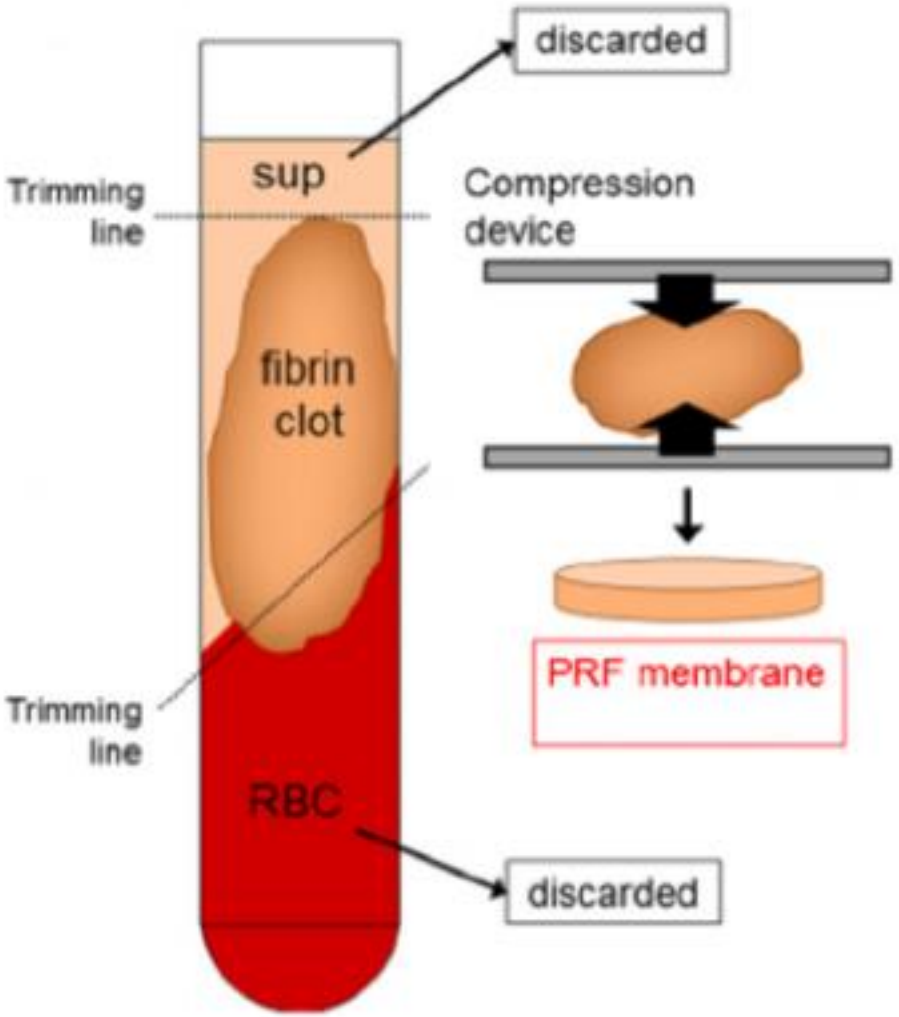
J. Choukroun et al. 2001



Pure Platelet rich Fibrin (P-PRF)

- P-PRF is high-density fibrin network preparation with poor leukocyte content.
- Blood is collected in sterile glass coated plastic tubes without anticoagulant then are immediately centrifuged
- The tubes are centrifuged at *3000* rpm for *10* minutes.
- During the centrifugation process, when the blood gets in contact with the test tube wall the platelet gets activated leading to the initiation of coagulation cascade.

Pure Platelet rich Fibrin (P-PRF)



1 spin for preparation of PRF to collect from the tube the following

- *Natural coagulation of fibrin layer*
- *Red blood cell layer*
- *Platelet-rich fibrin*

- It is manipulated as a solid material

Leucocyte Platelet rich Fibrin (L-PRF)

- Blood is collected in sterile glass coated plastic tubes without anticoagulant then are immediately centrifuged
- The tubes are centrifuged at *2700* rpm for *12* minutes.
- It contains most of the platelets and leukocytes present in the initial blood harvest
- It gives a stronger membrane with better polymerization

Platelet rich Fibrin Kit (PRF)

For collection, preparation and compression

Advanced Platelet rich Fibrin (A-PRF)

- Decrease the rpm while increasing the centrifugation time *Choukroun 2014*
- This gave an enhanced presence of monocytes and neutrophilic granulocytes in the distal part of the clot, increased and prolonged release of growth factors.

Titanium Platelet rich Fibrin (T-PRF)

Tunali et al in 2014

- Titanium (Grade IV) is more efficient platelet activator than Silica
- Tubes are immediately centrifuged (*2800 rpm for 12 minutes*).
- More organized, thicker and longer fibrin network are found

Injectable Platelet rich Fibrin (I-PRF)

Mourão et al 2015

- To use PRF in liquid Formulation (Alone or combined).
- Shorter and slower centrifugation (*700 rpm for 3 mins*).
- Plain tubes with no anticoagulant
- If added to particulate bone for 15 mins it will polymerize and produce red colored sticky bone.

Concentrated Growth Factors (CGF)

Sacco's 2006

A special centrifuge called Medifuge (Italy) was introduced

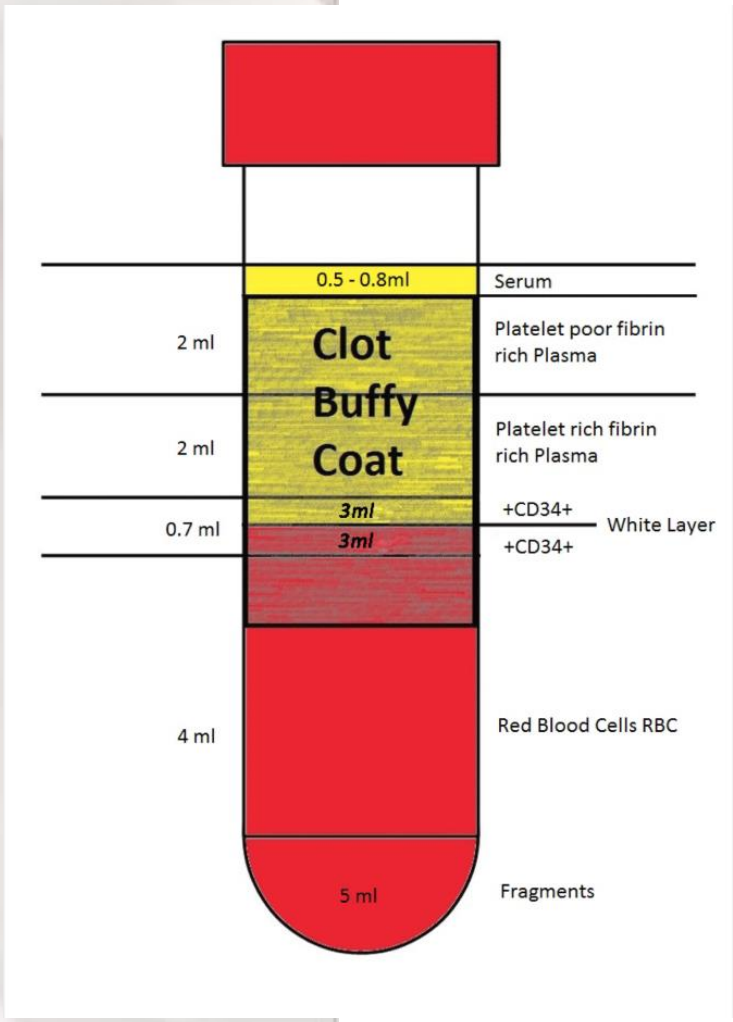
Altered centrifugation from 2,400 – 2,700 rpm for 12 minutes to obtain much larger, denser and richer growth factors fibrin matrix.

Accelerated for 30s, Centrifuged at 2700 rpm for 4 min, 2400 rpm for 4 min, 2700 rpm for 4 min, and 3000 rpm for 3 min, decelerated for 30s.

Concentrated Growth Factors (CGF)

Sacco's 2006

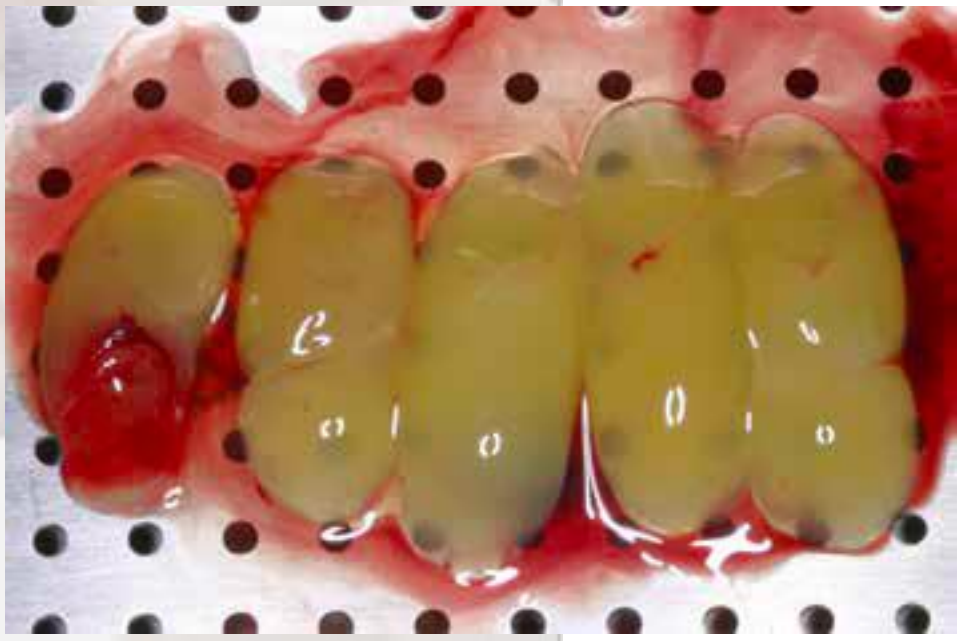
- Three layers were observed in the tube
- The layer in the form of a membrane containing the concentrated growth membrane was held with the aid of a hemostatic clamp
- Separated from the red blood cell layer by cutting with a pair of scissors
- and then pressed to form a membrane



Concentrated Growth Factors (CGF)

Sacco's 2006

- On pressing exudate is collected at the base of the metal box and can be used later



PRP

- 12 mins
- 2 spin Protocol

PRGF

- 2270 rpm
- 8 mins
- Single prot-ocol
- Citrat-ed tube
- Activa-tion by CACL

P-PRF

- 3000 rpm
- 10 mins

L-PRF

- 2700 rpm
- 12 mins

I-PRF

- 700 rpm
- 3 mins
- liquid

A-PRF

- 1300 rpm
- 14 mins

T-PRF

- 2800 rpm
- 12 mins
- Ti Tube

CGF

- 2400-2700 rpm
- 12 mins
- Altered cent.

Sticky Bone

Sohn DS 2010, Tokyo

Concept of fabricating growth factors-enriched bone graft matrix

Glass coated Non-coated

Sticky Bone

Preparation

- CGF membrane
- Autologous fibrin glue (AFG)

Are prepared at the same time to make sticky bone

- Normal centrifugation of CGF
- Centrifugation stops after 2 mins and AFG tube is removed

Glass coated Non-coated

Sticky Bone

Preparation

- AFG will contain 2 layers (AFG superficial layer and RBCs deep layer)
- The upper AFG is obtained with syringe and mixed with particulate bone powder and allows for 5-10 minutes for polymerization

Sticky Bone

Preparation

- After Polymerization sticky bone which is yellow color is produced.
- Exudate obtained in the bottom of metal storage box after compression of CGF layer is added when AFG and particulate bone graft.

Sticky Bone

Preparation

- The exudate contains growth factors and autologous thrombin in RBC layer.
- Auto-polymerization will be completed very rapidly.
- The sticky bone mixed with autologous thrombin in RBC layer is red in color

Sticky Bone

Advantages

- Provides stabilization of bone graft in the defect.
- Accelerates tissue healing.
- Minimizes bone loss during healing period.

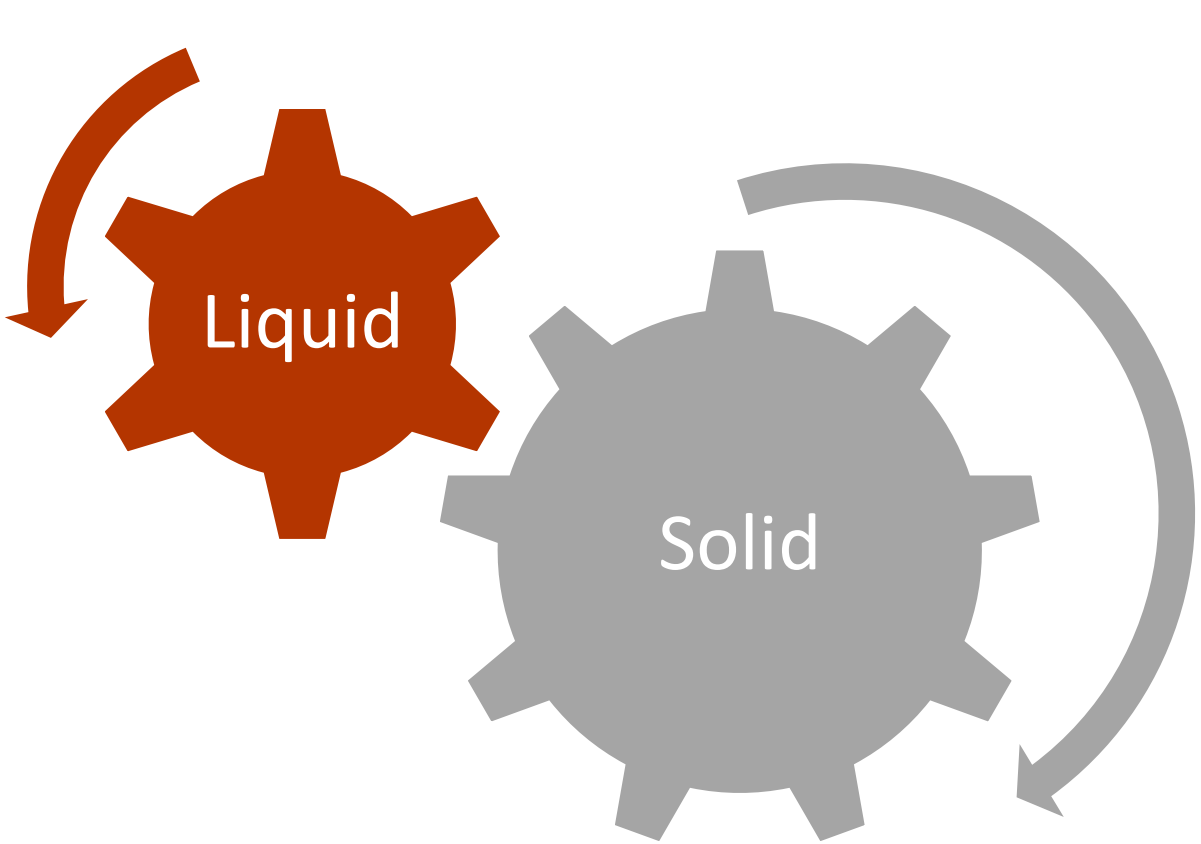
OF PLATELET CONCENTRATES

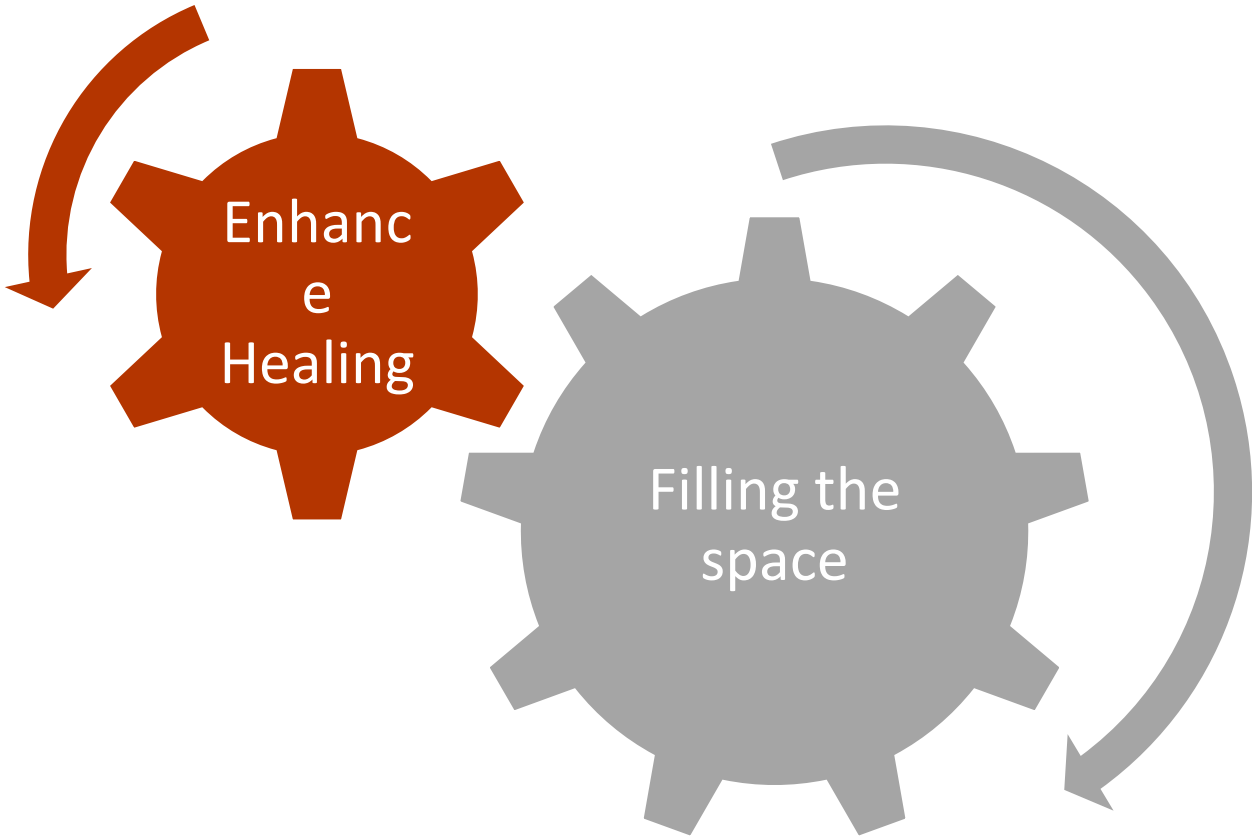
- The PRF membrane has a mechanical role, as it maintains and protects the bone graft and its fragments
- It also Serves as biological connectors between bone particles when incorporated in the body of bone graft.
- The fibrin network promotes cellular migration, to allow the neo-angiogenesis, vascularization and survival of the graft.
- The platelet cytokines (PDGF, TGF-beta, IGF-1) enhance healing
- The leukocytes and cytokines regulates inflammatory and infectious phenomena within the grafted material

Research Article

Intra-Oral Applications of Platelet Concentrates: A Comprehensive Overview of Systematic Reviews

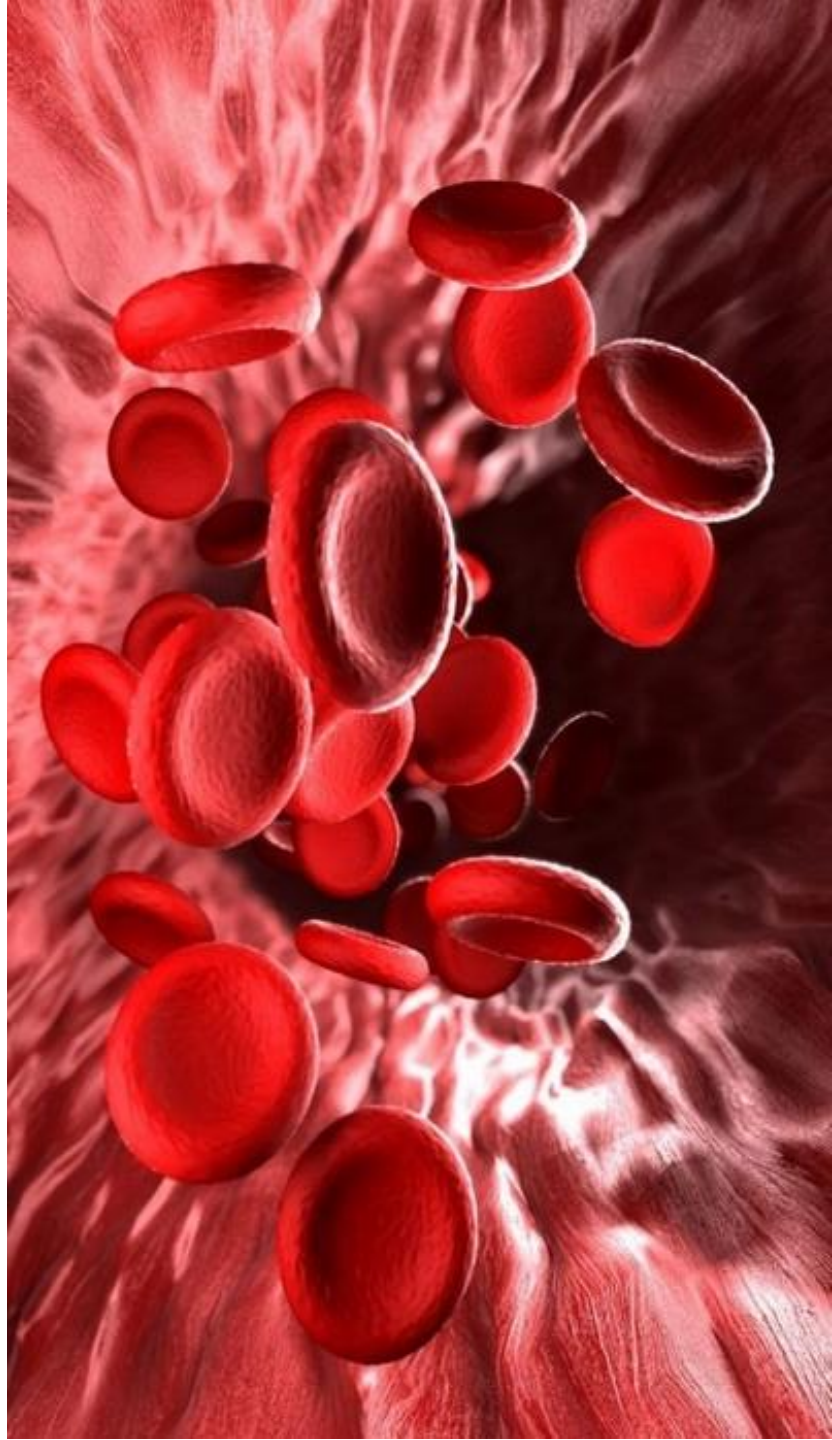
Ting M[1*], Tadepalli NS[2], Kondaveeti R[2], Braid SM[3], Lee CYS[4] and Suzuki JB[4]





Uses of Platelets Concentrates

- Soft Tissue
  - Increase Keratinization
  - Enhance tissue Biotype
  - Act as a membrane
- Hard Tissue
  - Sinus Augmentation
  - Socket preservation
  - Accompanied by other graft
  - Immediate implant



Role in Soft Tissue

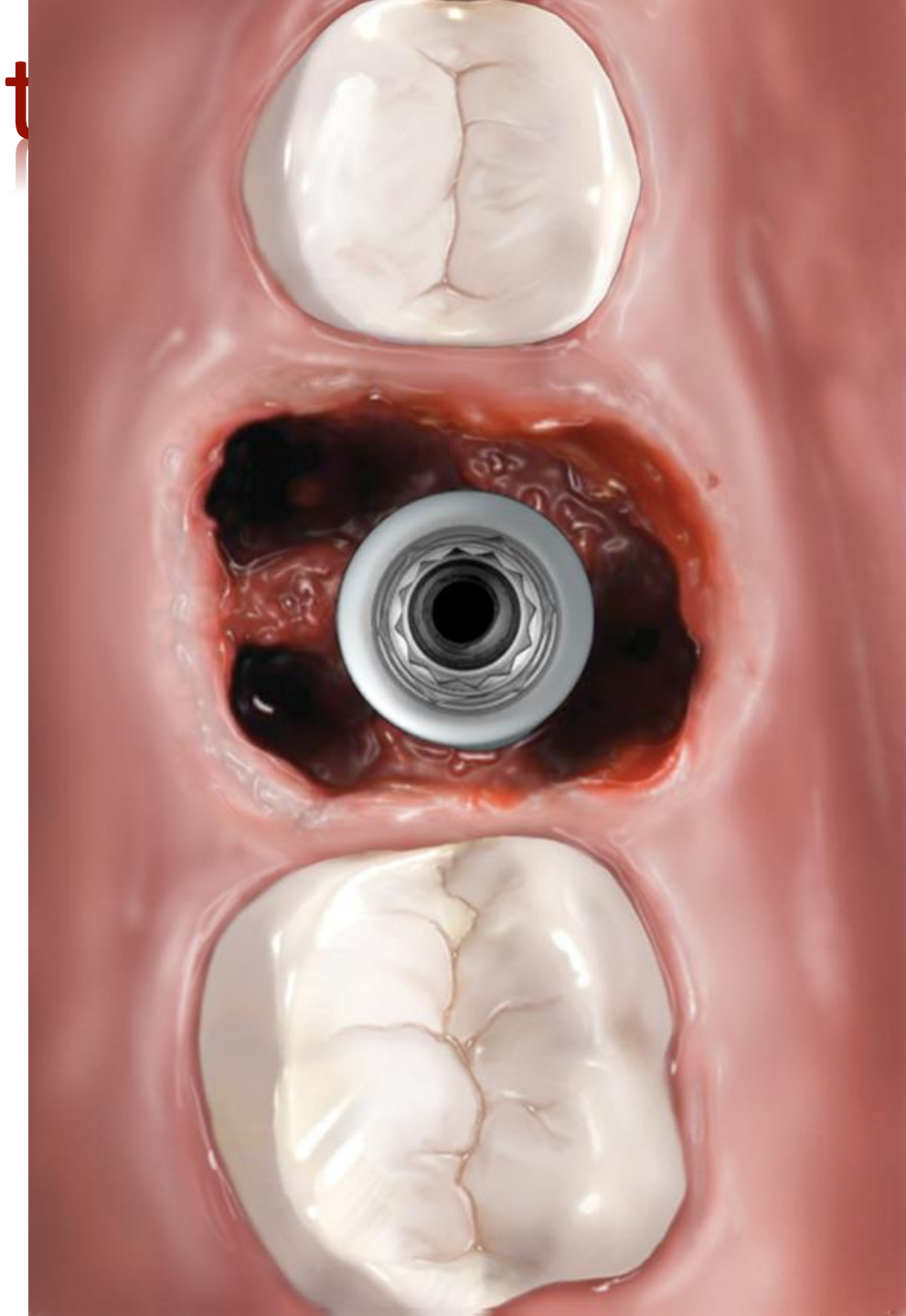
- A greater degree of gingival maturation post- healing.
- Thickening of keratinized gingival tissues that eventually enhanced the esthetic integration and final result of their prosthesis.
- It seemed to reduce postoperative edema and pain, and even minor chances of infectious phenomena

Role in Sinus Augmentation

- PRF can be used as a substitute for particulate grafting to predictably elevate the sinus floor using a crestal approach
- can also provide protection for the sinus membrane during the use of an osteotome.
- in case of sinus membrane perforation, the fibrin matrix can aid in wound closure

Role in Immediate Implant

- PRF membrane maintains and stabilize particulate bone graft
- help achieve primary coverage over immediately placed implants.



Utilization of Autologous Concentrated Growth Factors (CGF) Enriched Bone Graft Matrix (Sticky Bone) and CGF-Enriched Fibrin Membrane in Implant Dentistry

Dong-Seok Sohn, DDS, PhD[1] • Bingzhen Huang, MD, PhD[2] • Jin Kim, DDS, MS[3]
W. Eric Park, DDS[4] • Charles C. Park DDS[5]

- Compared CGF membrane and collagen membrane for alveolar ridge augmentation.
- Their bone biopsy results showed favorable new bone formation along mineral allograft without sign of inflammation.

Utilization of Autologous Concentrated Growth Factors (CGF) Enriched Bone Graft Matrix (Sticky Bone) and CGF-Enriched Fibrin Membrane in Implant Dentistry

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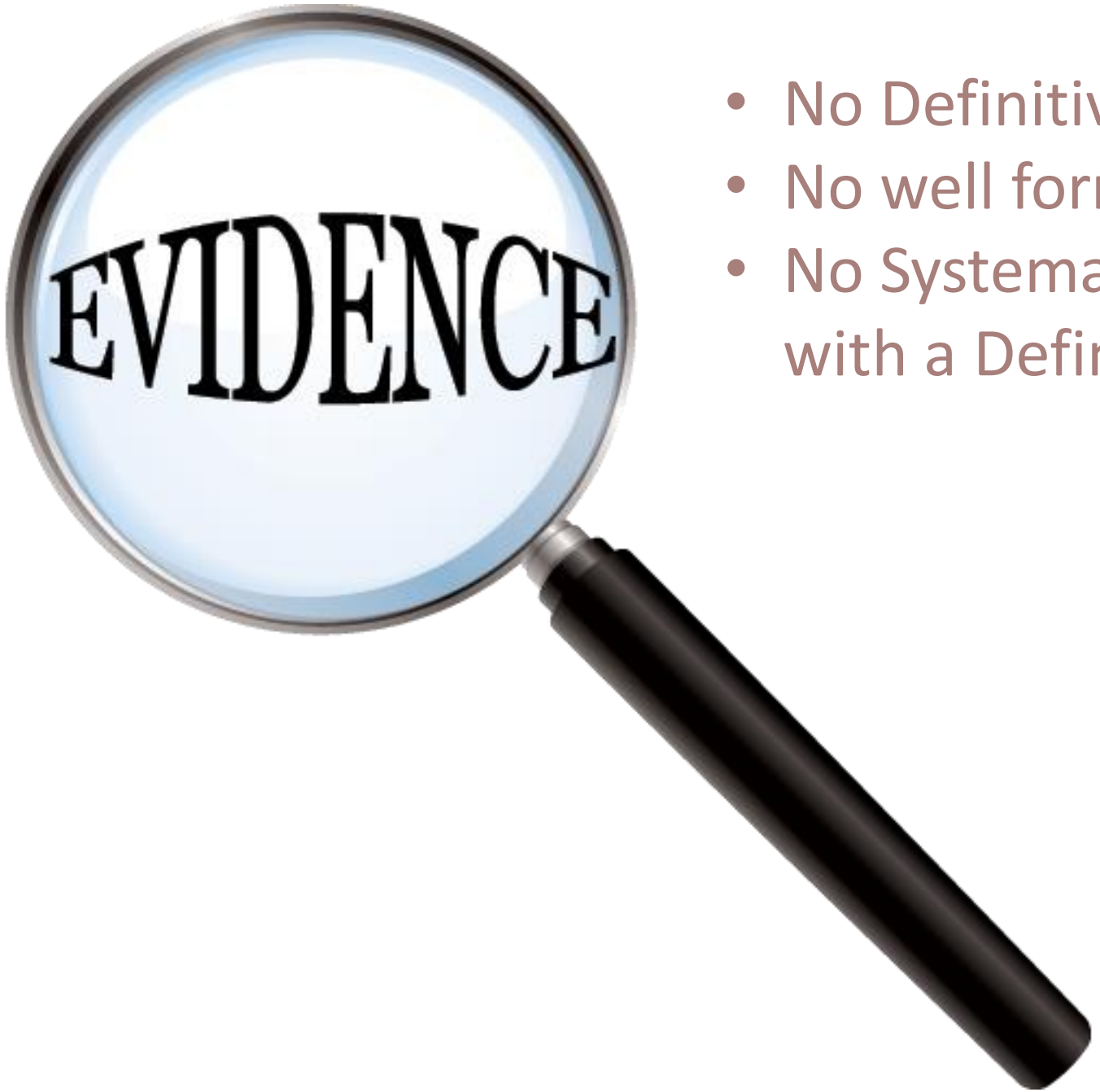
- They also evaluated three dimensional ridge augmentation using sticky bone with or without use of titanium mesh

- They found favorable augmentation even without the use of titanium mesh



- No Definitive Results
- No well formulated RCTs
- No Systematic Reviews with a Definitive opinion


Thank you!

Platelet Concentrates

- Are known to release several growth factors which stimulate tissue regeneration by stimulating cell proliferation and regulating angiogenesis.

- Several techniques for platelet concentrates have been introduced in surgical field for the prevention of hemorrhage and acceleration of tissue regeneration.

Platelet Concentrates

- Different generations were introduced

First generation includes:

- Platelet rich plasma (PRP)
- Plasma rich in growth factors (PRGF)

Second Generation includes:

- Platelet rich fibrin (PRF)
- Concentrated growth factors (CGF)

Third Generation includes:

- Advanced PRF
- Injectable PRF

Platelet rich plasma (PRP)

First form of autologous platelet concentrate to replace commercial fibrin glue

2 spins for preparation of PRP

- *First centrifuge red cell layer is discarded*
- *Second spin produce concentrated platelets with fibrinogen*

PRP is mixed with bone powder, and bovine thrombin and calcium chloride is added to achieve fibrin polymerization.

Needs anticoagulant in the collecting tube

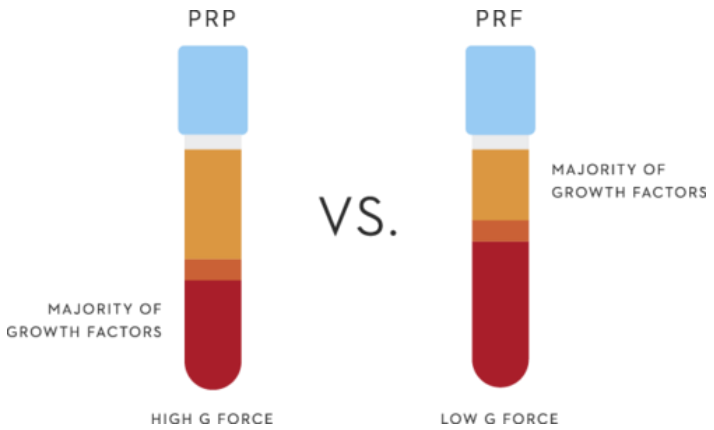
Platelet rich Fibrin (PRF)

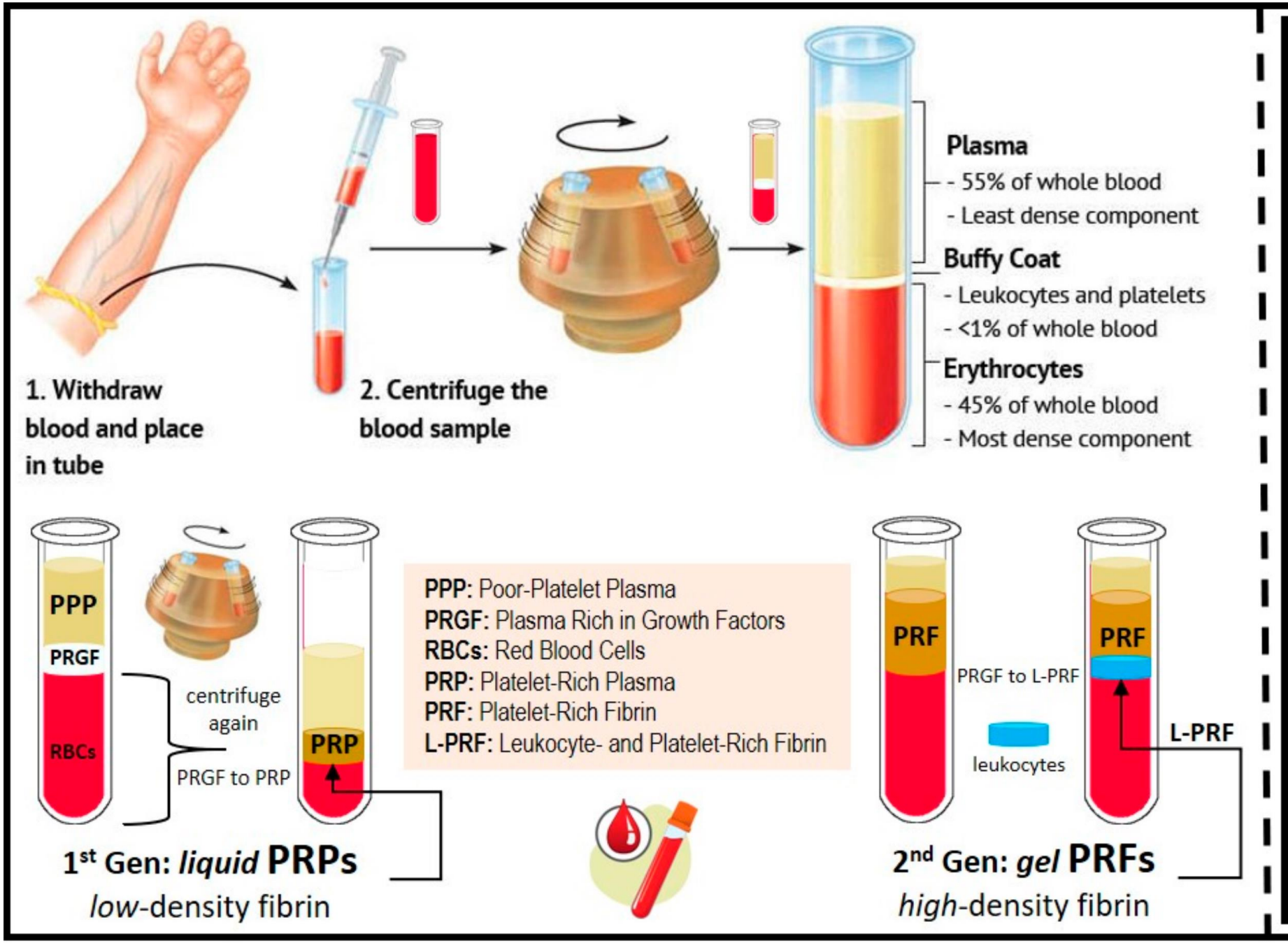
J. Choukroun et al. 2001

- Blood collected in silica-coated Vacutainers without anticoagulants.
- The Vacutainers are immediately centrifuged at 2,700 rpm for 12 minutes.

1 spin for preparation of PRF to collect from the tube the following

- *Natural coagulation of fibrin layer*
- *Red blood cell layer*
- *Platelet-rich fibrin*


PRP
PRF
MAJORITY OF GROWTH FACTORS
VS.
MAJORITY OF GROWTH FACTORS
HIGH G FORCE
LOW G FORCE


1. Withdraw blood and place in tube
2. Centrifuge the blood sample
Plasma
- 55% of whole blood
- Least dense component
Buffy Coat
- Leukocytes and platelets
- <1% of whole blood
Erythrocytes
- 45% of whole blood
- Most dense component
PPP
PRGF
RBCs
centrifuge again
PRGF to PRP
PRP
PPP: Poor-Platelet Plasma
PRGF: Plasma Rich in Growth Factors
RBCs: Red Blood Cells
PRP: Platelet-Rich Plasma
PRF: Platelet-Rich Fibrin
L-PRF: Leukocyte- and Platelet-Rich Fibrin
1st Gen: liquid PRPs
low-density fibrin
PRF
PRGF to L-PRF
leukocytes
PRF
L-PRF
2nd Gen: gel PRFs
high-density fibrin

Concentrated Growth Factors (CGF)

Sacco's 2006

Altered centrifugation from 2,400 – 2,700 rpm for 12 minutes to obtain much larger, denser and richer growth factors fibrin matrix.

Sticky Bone

Sticky Bone

2010

Concept of fabricating growth factors-enriched bone graft matrix


Thank you!