

BIOLOGY OF THE PERIODONTAL TISSUES. PRINCIPLES OF PERIODONTAL REGENERATION TECHNIQUES

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DEPARTMENT OF PERIODONTOLOGY

Diagnose based comprehensive periodontal therapy

Diagnose

Initial phase therapy ☹

REFRACTER

reassessment

INDICATIONS??

Periodontal surgery ☹

reassessment

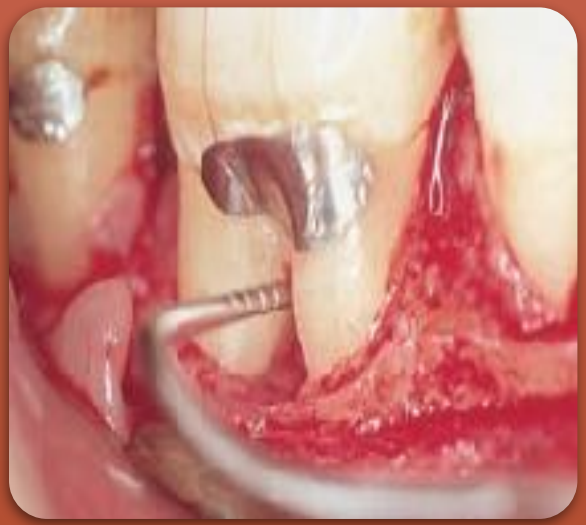
Supportive periodontal th.

Comprehensive rehabilitation

Periodontal defects

Suprabony defect-
Horizontal bone loss

Infrabony defect-
vertical bony loss:
- intrabony defect
- interdental crater

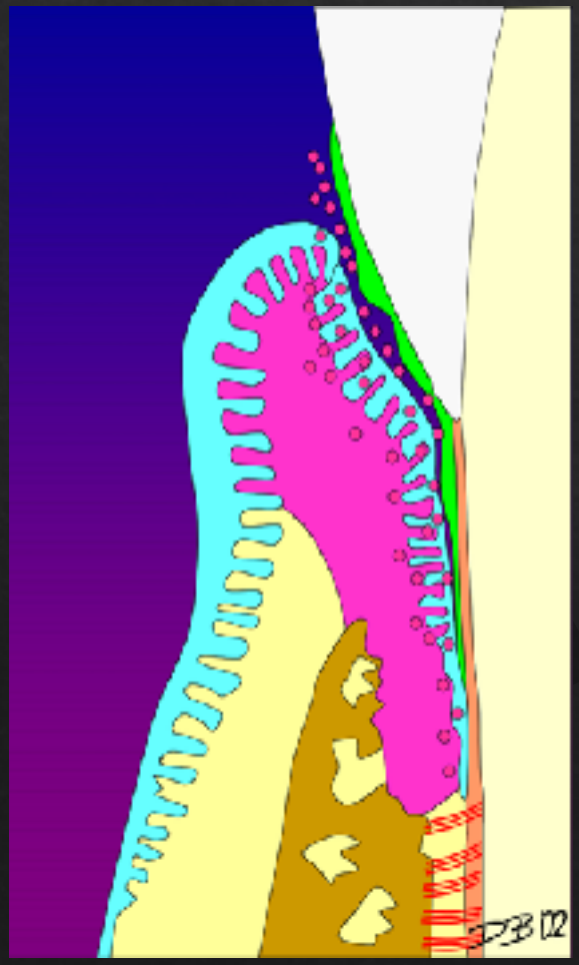


Interradicular defect-
furcation laesions (FII)

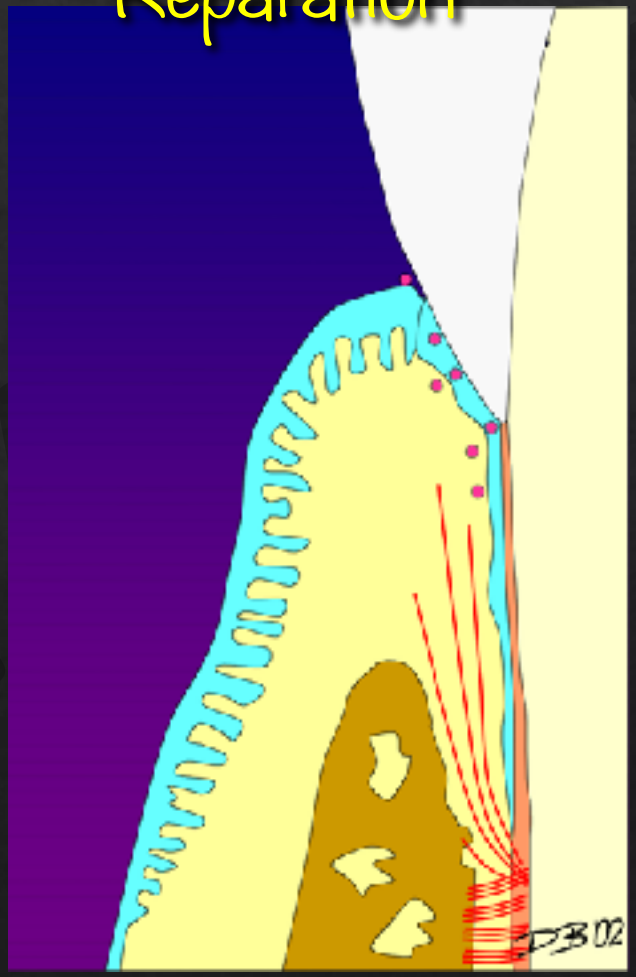
INDICATION!!

Periodontal healing potentials

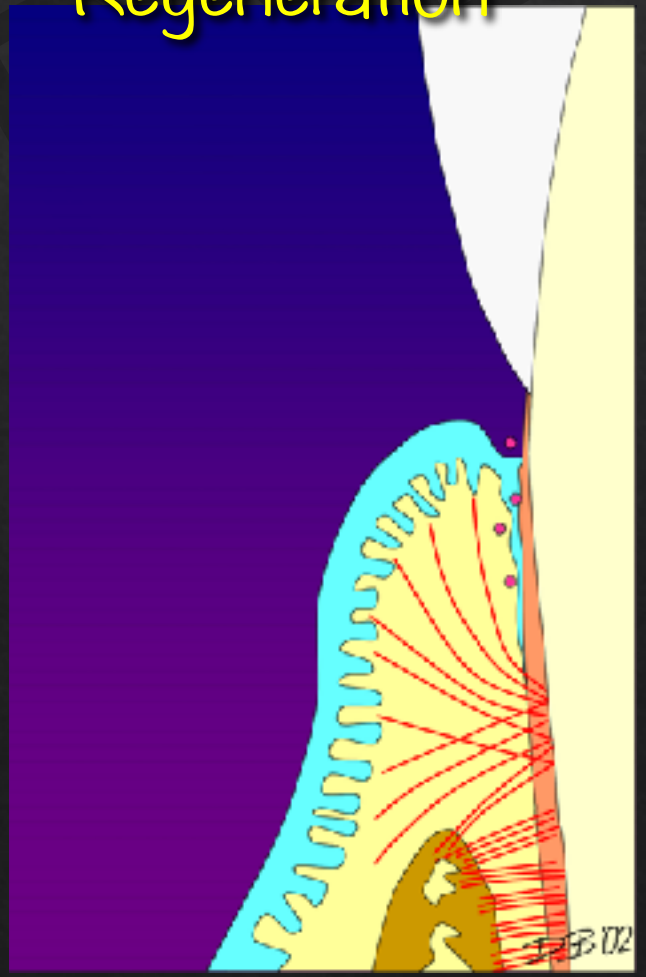
Periodontitis



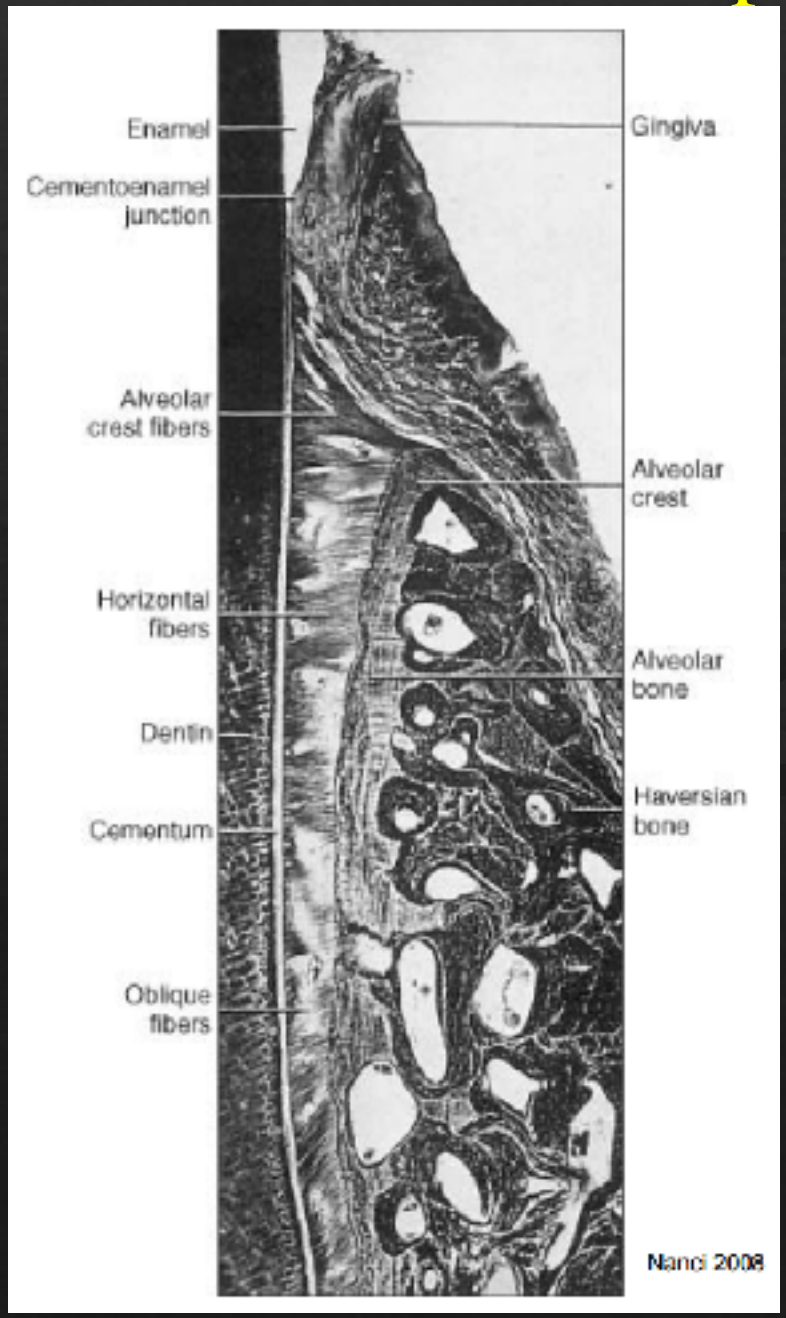
Reparation



Regeneration



Definition of periodontal regeneration

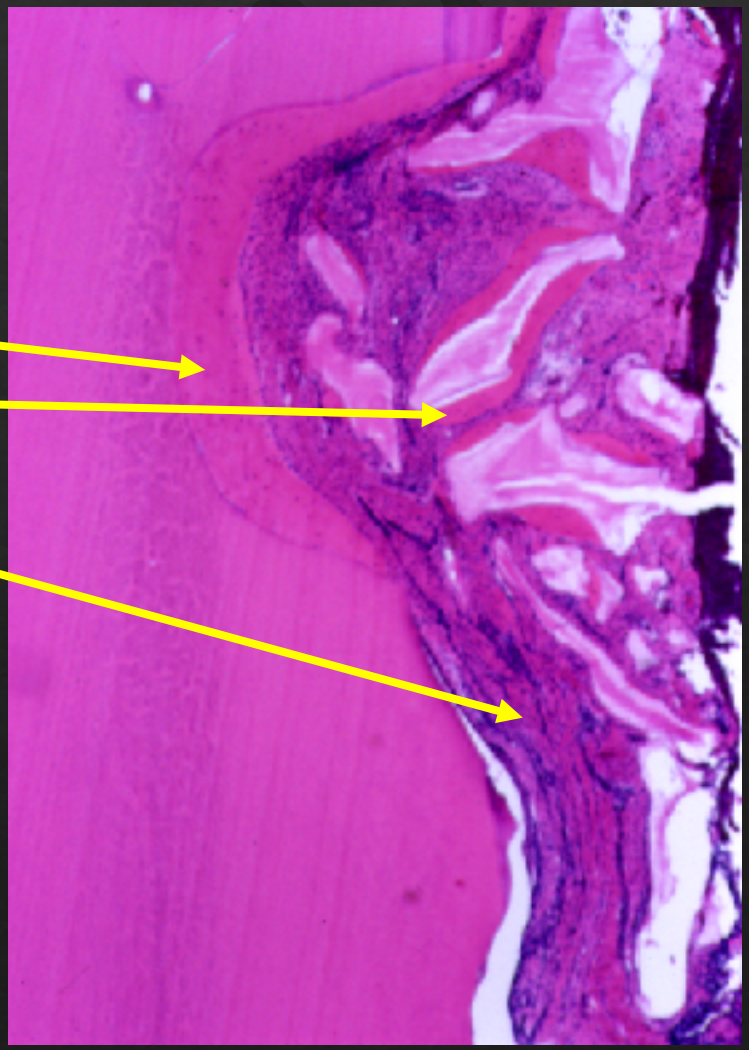


”The reproduction or reconstruction of a lost or injured part of the body in such a way that the architecture and function of the lost or injured tissues are completely restored.”

Same anatomical structure and function

Restore all the three different types of the supportive periodontal tissues

- Cementum
- Bone
- Periodontal ligaments



Types of regeneration

- **New attachment:** Occurs due to intervention when newly generated fibers are embedded in new cementum on a portion of the root that was uncovered by DISEASE (DENUDATED ROOT SURFACE)

- **Reattachment:** The reunion of the STILL LIVING SHARPEY-FIBERS on the root surface after surgical separation or acute trauma

Types of the NEW ATTACHMENT

- Complete periodontal regeneration:

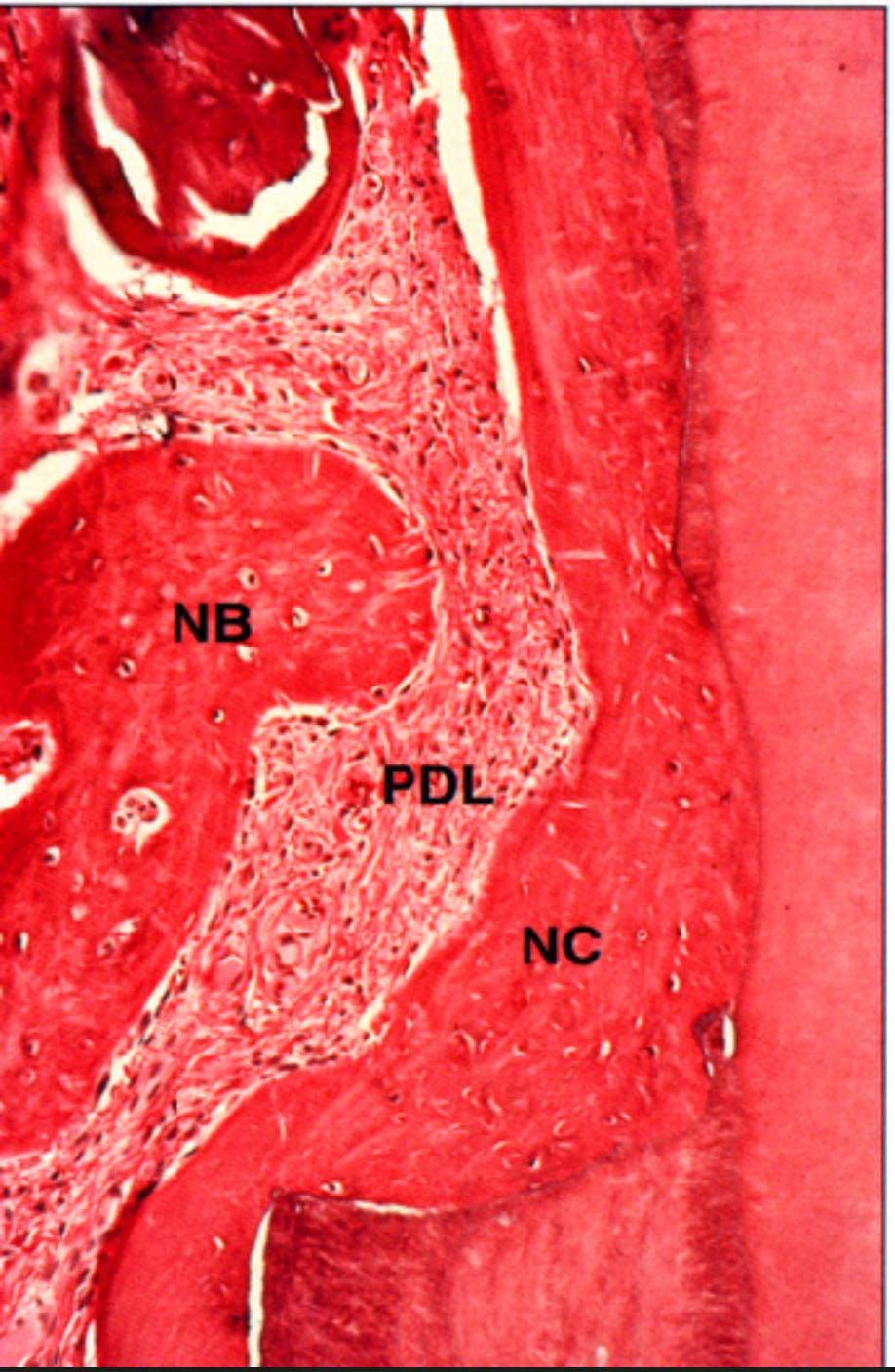
(cementum - bone – Sharpey-fibers)

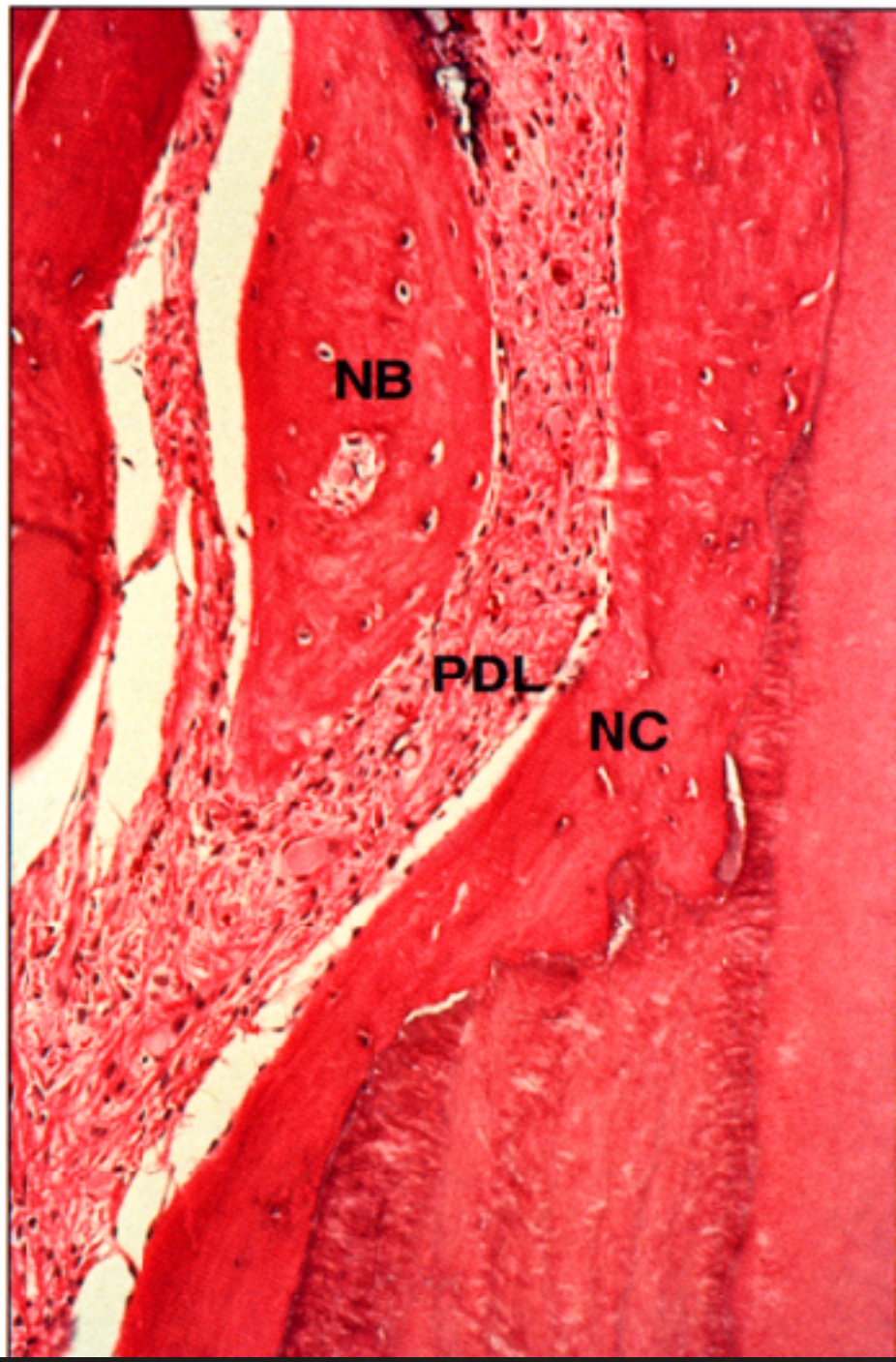
Histologically approved! formation of new: cementum layer, supporting alveolar bone and in those anchored Sharpey-fibers

- Partial regeneration:

(cementum – Sharpey - fibers)

New formation of cementum and therein anchored new Sharpey-fibers WITHOUT newly formed bone


NB
PDL
NC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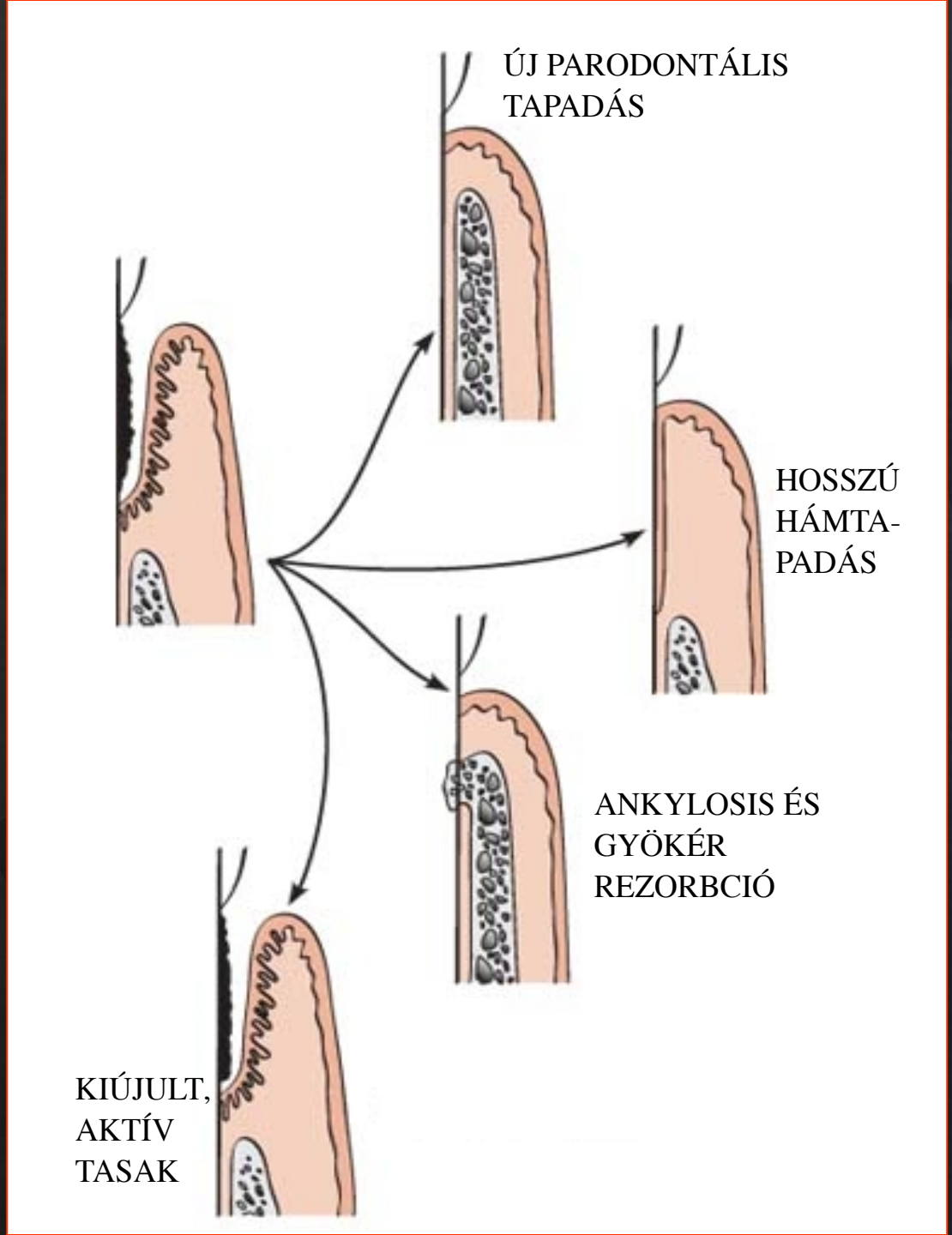
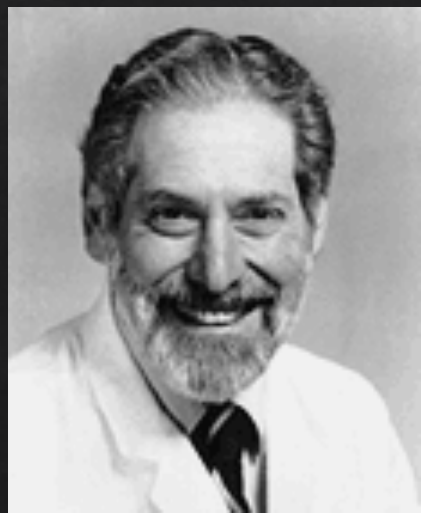
PDL
NC


ÚJ PARODONTÁLIS
TAPADÁS
HOSSZÚ
HÁMTA-
PADÁS
ANKYLOSIS ÉS
GYÖKÉR
REZORBCIÓ
KIÚJULT,
AKTÍV
TASAK

After surgery the key factor for the healing nature is: the type of cells whereby the cleaned root surface will be recultured/ repopulated



Melcher, 1976

Melcher AH. On the repair potential of periodontal tissues. J Periodontol 1976: 47: 256–260.

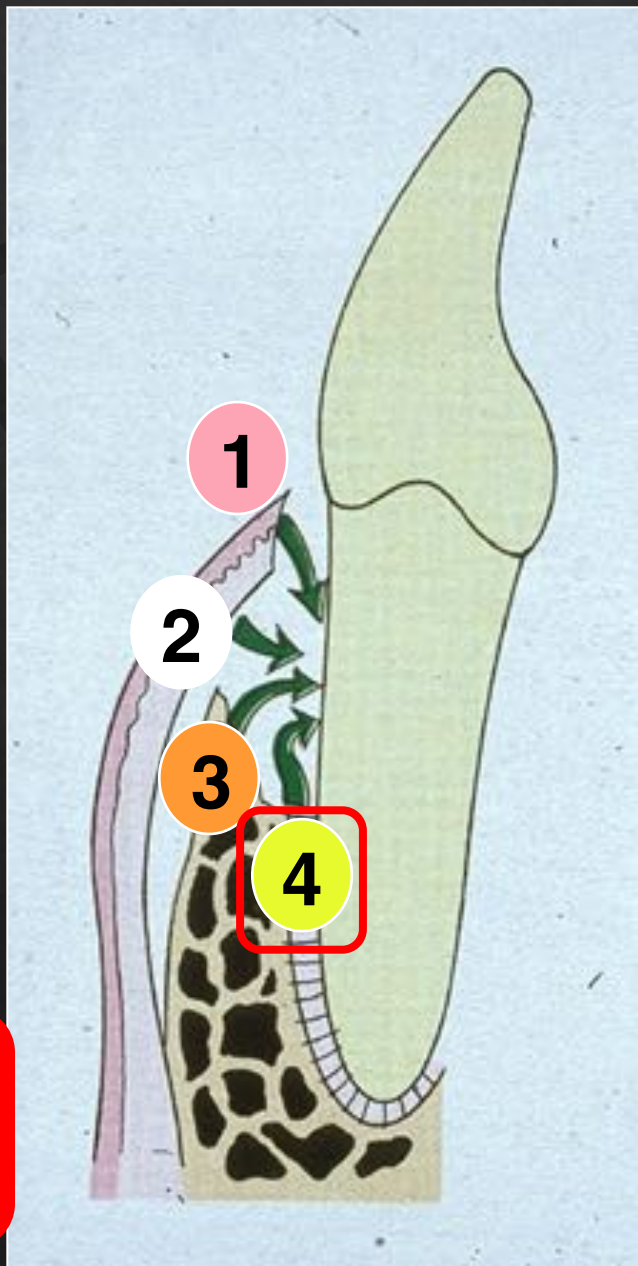
Sources of cells in the periodontal area

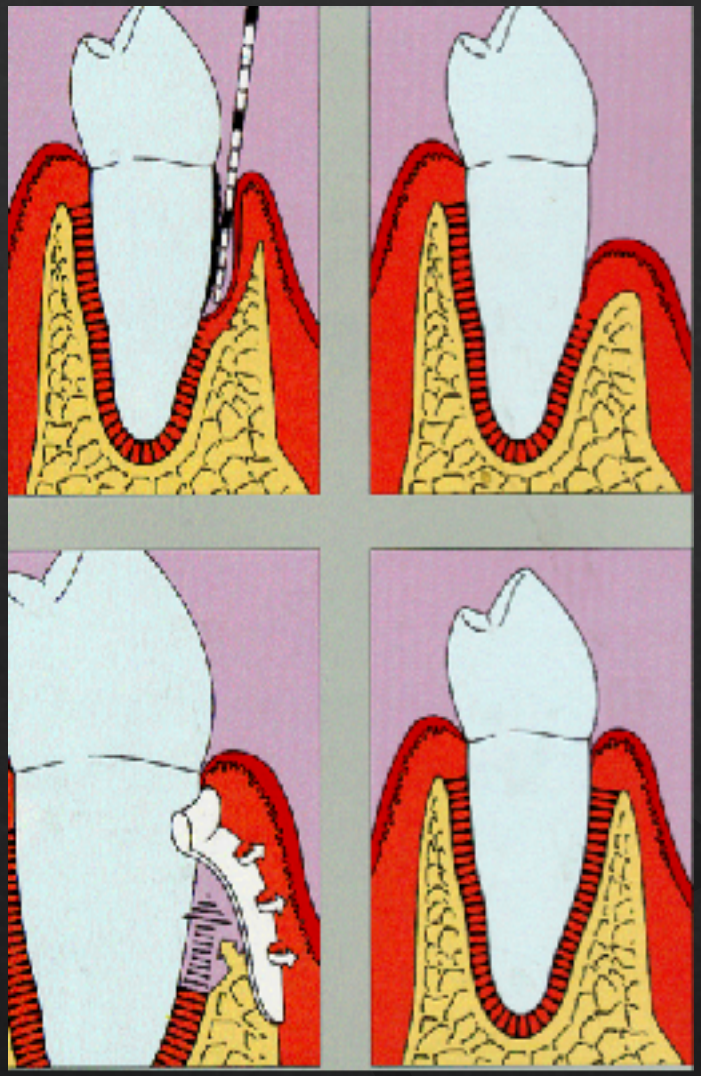
Epithelial cells

Connective tissue cells from gingiva

Alveolar bone cells

Mesenchymal stem cells from the periodontal ligaments





EXPERIMENTAL STUDIES

1. Caton et al. 1980-

Different interventions on monkey test teeth (LIP*):

- ± RSD
- ± RSD+MWF
- ± RSD+MWF+ autologous bone
- ± RSD+MWF+ bone substitute (ßTCP)

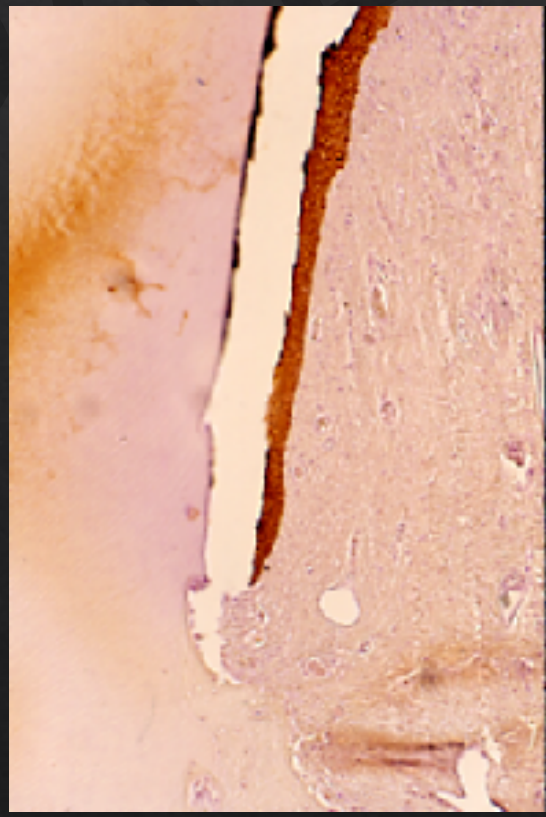
LIP: ligature induced periodontitis
MWF: modified Widman- flap

1.

Caton et al. 1980-

Histometric analysis: all 4 treatment modalities resulted LONG JUNCTIONAL EPITHELIUM.

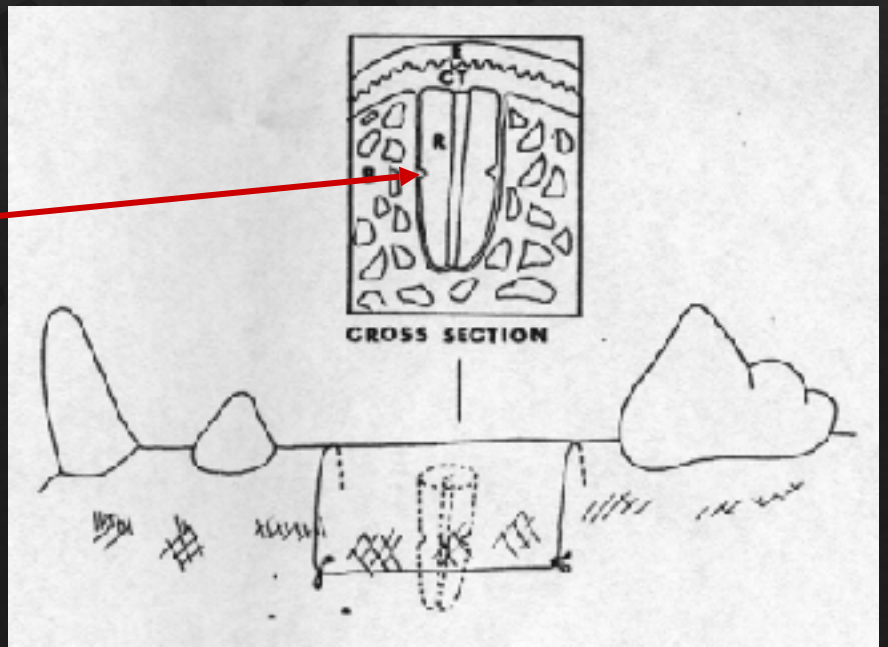
CONCLUSION: new attachment formation is inhibited by the apically migrating dentogingival epithelium.



2. Karring et al (1980)

- Experimental periodontitis in dogs
- Periodontitis- affected teeth after root-planing (on the coronal portion of the root) and total decoronation were replanted in an artificially created alveolar socket.
- The gingival flap was tightly sutured to prevent the apical migration of the epithelium (totally submerged roots).

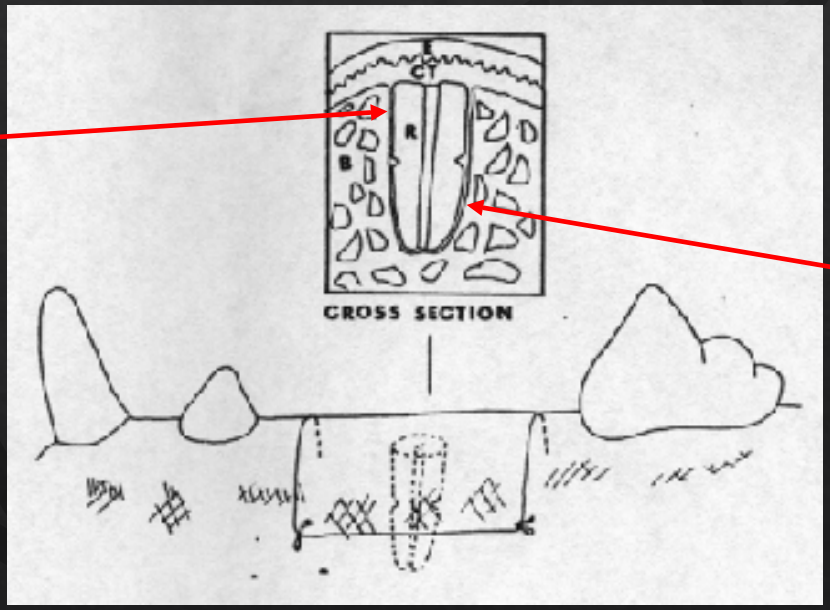
Bottom of pocket



2. Karring et al. (1980)

- Connective tissue attachment could develop at the apical (non root-planed) part of the roots (if the gingival flap was tightly closed during the whole period of postoperative healing). While the coronal portion healed mainly with ankylosis-repair.

Repair (Ankylosis)



Reattachment

- If the suture was not tight enough and the gingival flap opened up, the gingival epithelium could migrate apically, new connective tissue attachment never occurred.

2. Karring et al. (1980)

CONCLUSION:

Cells populating the wound can compromise new connective tissue attachment. (The greatest obstacle to regeneration is the junctional epithelium proliferating in the apical direction).

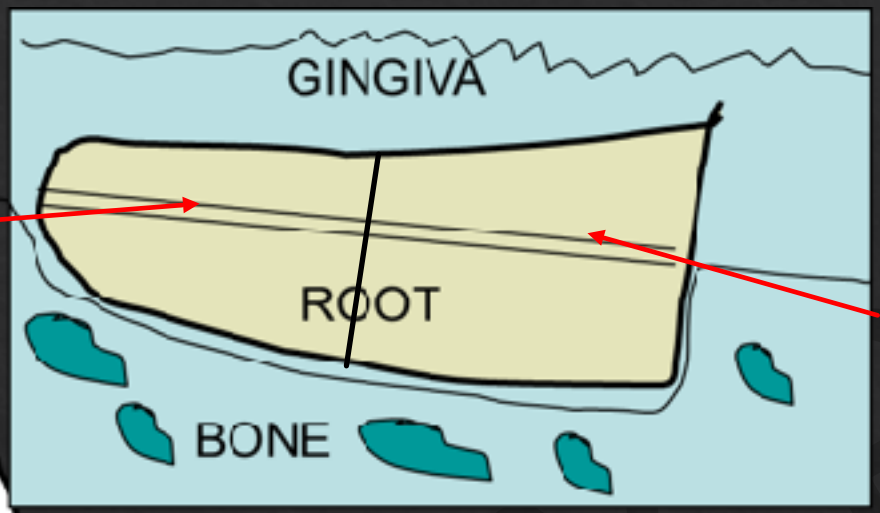
MESENCHYMAL CELLS OF THE STILL VITAL PDL ARE ABLE TO FORM CONNECTIVE TISSUE ATTACHMENT.

3. Nyman et al. 1980

- LIP induced around experimental teeth in monkeys.
- Teeth were extracted, decoronated and notches were placed at the level of the marginal bone crest. Diseased parts of the root was scaled and root planed
- Recipient sites (horizontal grooves) in the edentulous mandible for subsequent implantation of the diseased roots
- Flaps were closed per primam to completely cover the implanted root and the surrounding bone

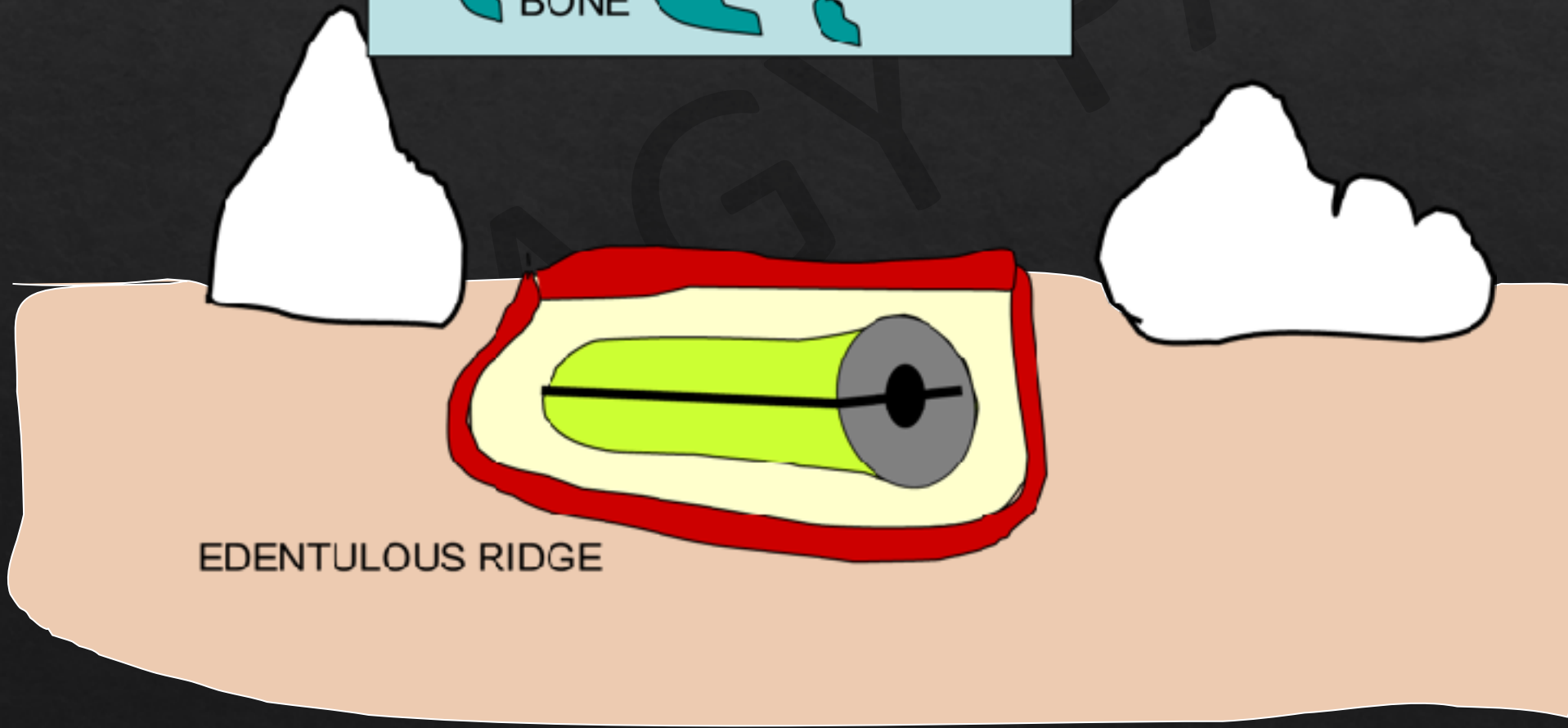
Nyman et al. 1980

3.



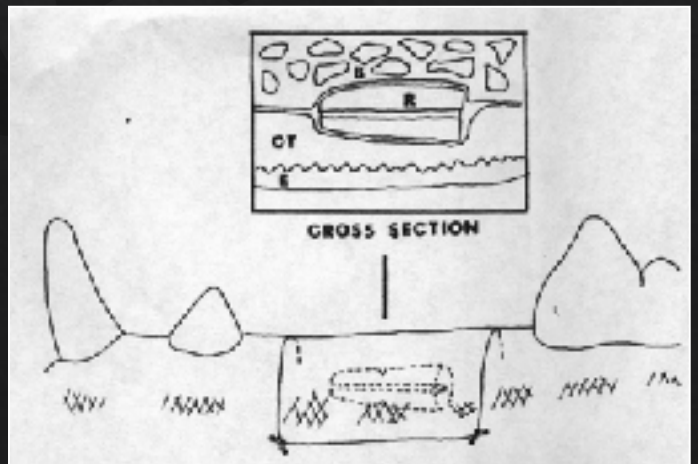
Intact PDL fibers

Denudated root surface



3. Nyman et al 1980

- ± Those root surfaces with intact PDL fibers created connective tissue attachment (REATTACHMENT) either with the bone and with the connective tissue.
- ± On the previously denudated root surface covered by gingiva were NO connective tissue attachment.
- ± Ankylosis and root resorption were found on the denudated root surface facing toward the bone

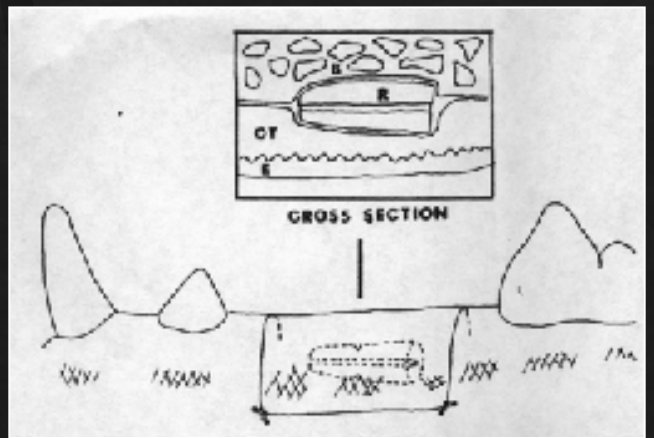


3. Nyman et al. 1980

CONCLUSION:

CELLS ORIGINATING FROM NEITHER ALVEOLAR BONE NOR GINGIVAL CONNECTIVE TISSUE LACKS THE ABILITY TO ESTABLISH A NEW CONNECTIVE TISSUE ATTACHMENT.

MESENCHYMAL CELLS FROM PDL PREVENT ANKYLOSIS AND ROOT RESORPTION.

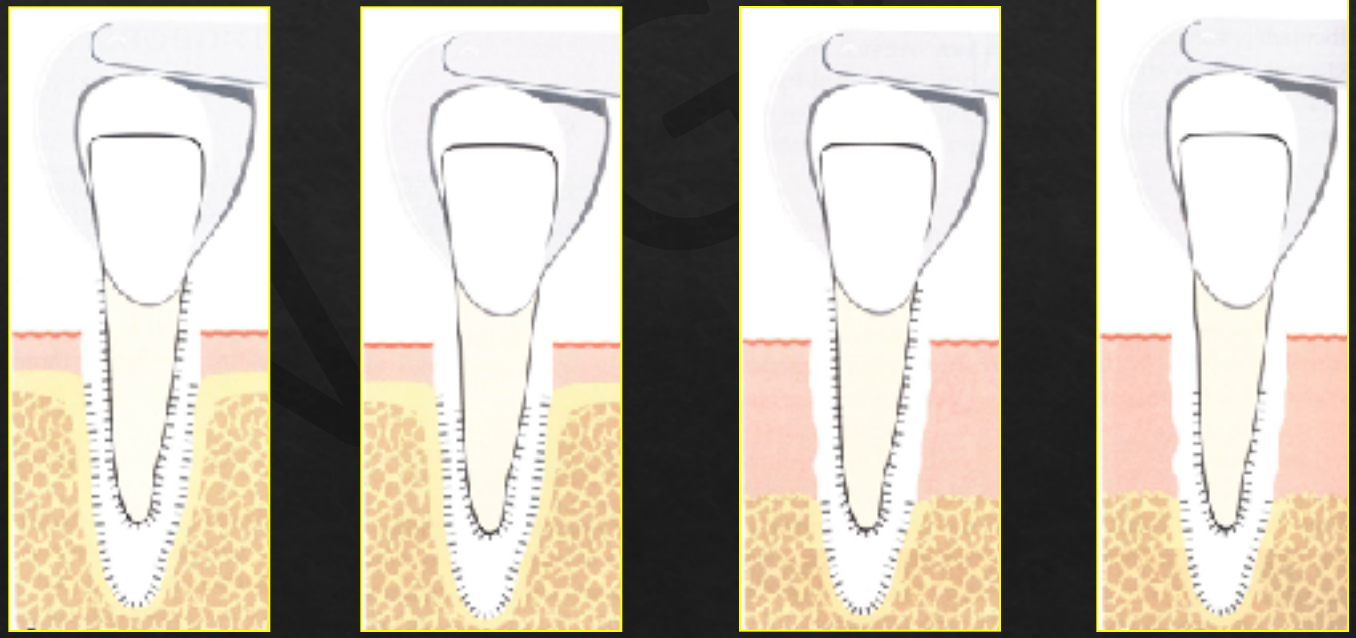


4. Lindhe 1984

- Incisors were extracted and then reimplanted in their own sockets as follows:

ROOT PLANED

ROOT PLANED



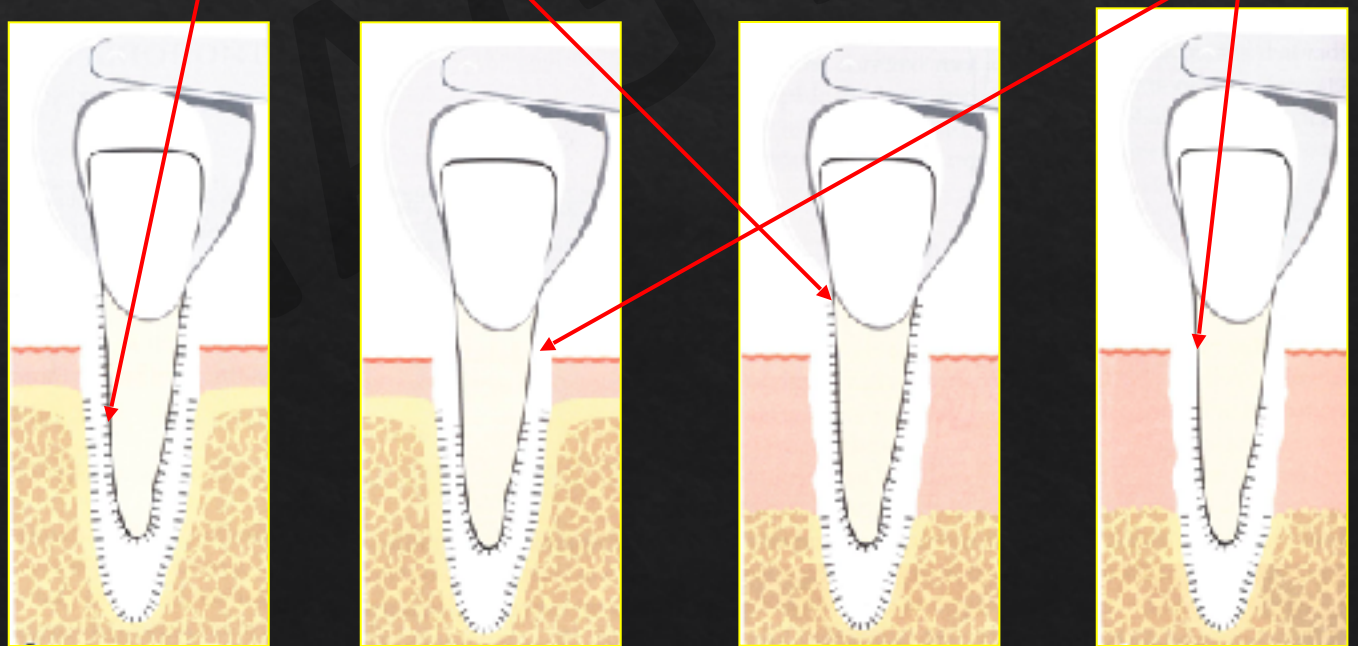
NORMAL BONE HEIGHT

REDUCED BONE HEIGHT

5. Lindhe 1984

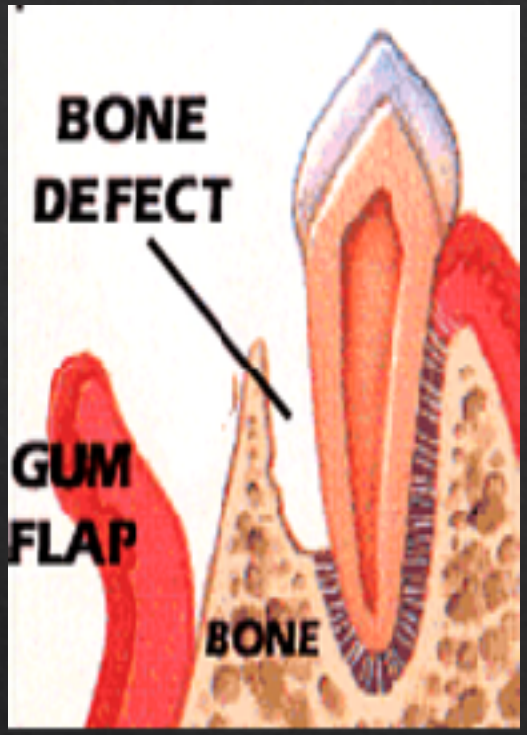
Histology after 6 months:

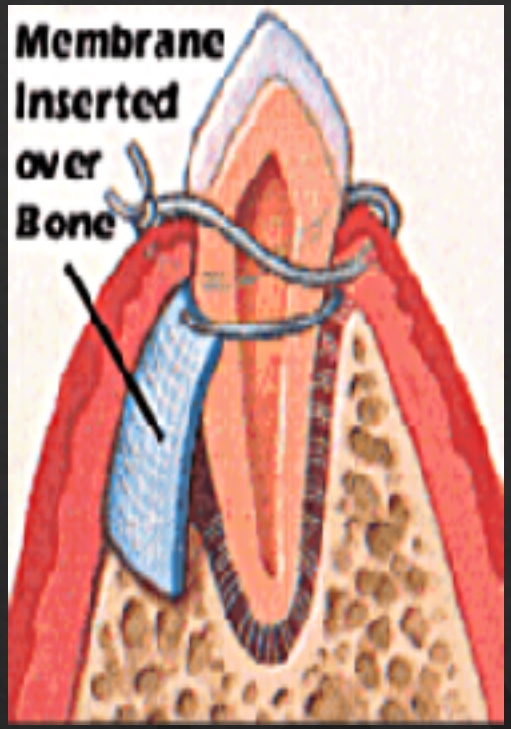
- ± Fibrous reunion (reattachment) was established in areas where the original Sharpey fibers were preserved:
- ± In areas where the Sharpey fibers were destroyed only long epithelial attachment occurred:

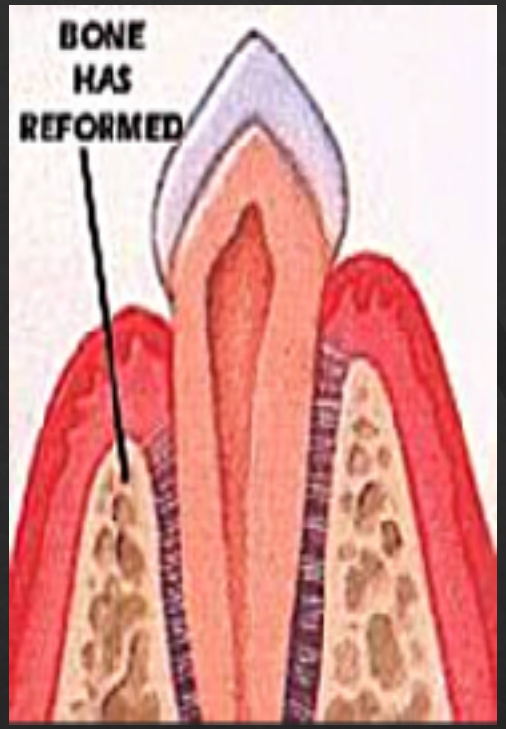


6. Gottlow és mtsai 1982

- After flap elevation the coronal portion of the bone were resected on monkey experimental teeth. Root surface was planed to remove all cementum and the teeth were decoronated
- In order to prevent the epithelium and gingival connective tissue from reaching contact with the root surface, a MEMBRANE WAS PLACED TO COVER THE FENESTRATION in the alveolar bone. The flap was repositioned and sutured
- Histological analysis of block sections presented formation of NEW ATTACHMENT including newly formed cementum with inserting Sharpy-fibers and also supporting bone



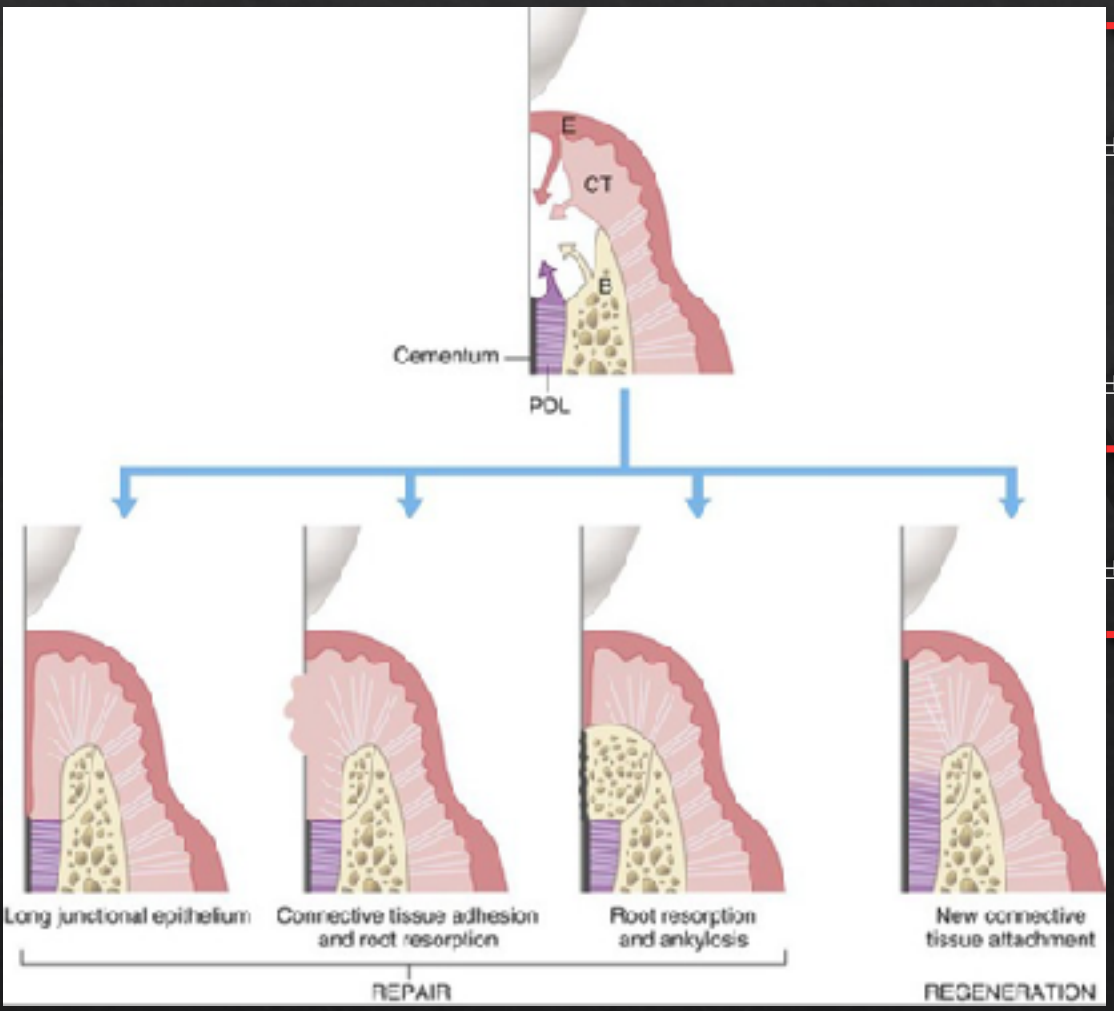




CONCLUSION:

PDL cells have a potential for regeneration but only if the epithelium and the gingival connective tissue are prevented from occupying the wound area adjecent to the root

Healing patterns in line with cell sources



- ± Sulcular epithelial cells
- → LONG JUNCTIONAL EPITHELIUM
- ± Gingival connective tissue cells
- →CONNECTIVE TISSUE ADHESION ☹ (NO ATACHMENT)
- ± Alvolar bony cells
- → ANKYLOSIS, ROOT RESORPTION
- ± Periodontal ligament cells
- →BONE, CEMENTUM AND SHARPEY-FIBERS

Methodological pathways in the investigation of regeneration

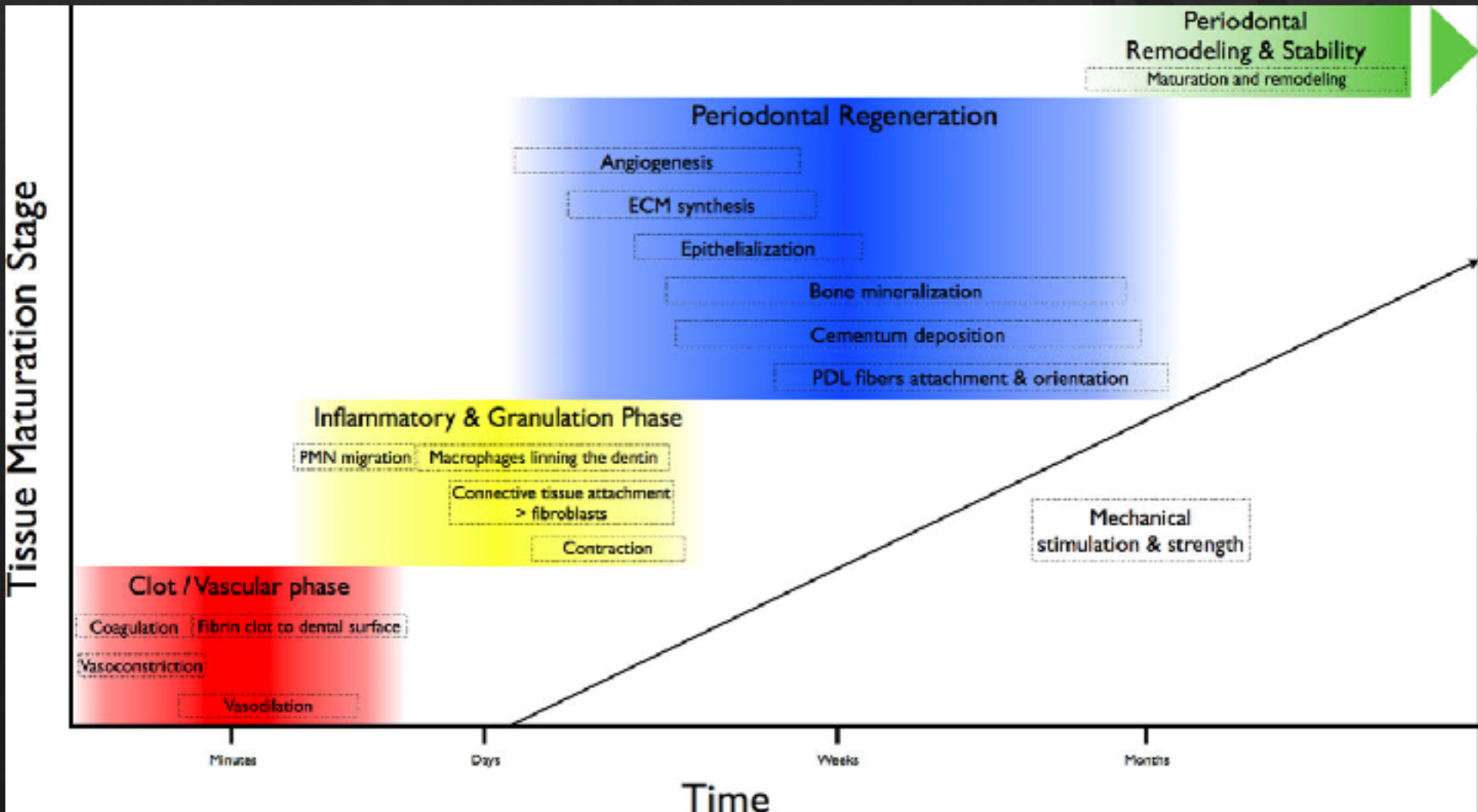
- Clinical
  - PPD measurement
  - X-ray examination
  - Reentry
- Histology!!!
- Animal studies

Limitations of the periodontal regeneration

- ± Opened system (through the sulcus)
- ± Poor blood supply (cementum)
- ± Immobilization (micromovement is not a disadvantage)
- ± Numerous cell sources – ingrowth ability and speed

Phases of periodontal healing

INTRINSIC WOUND HEAILNG POTENTIAL



Criterions of periodontal regeneration

Periodontal ligament cells

Space- maintenance

Per primam healing

Blod clot stability

Influence factors - PATIENT

± General health conditions of the patient:

- Smoking (dose dependent, frequency)
- Diabetes
- Age

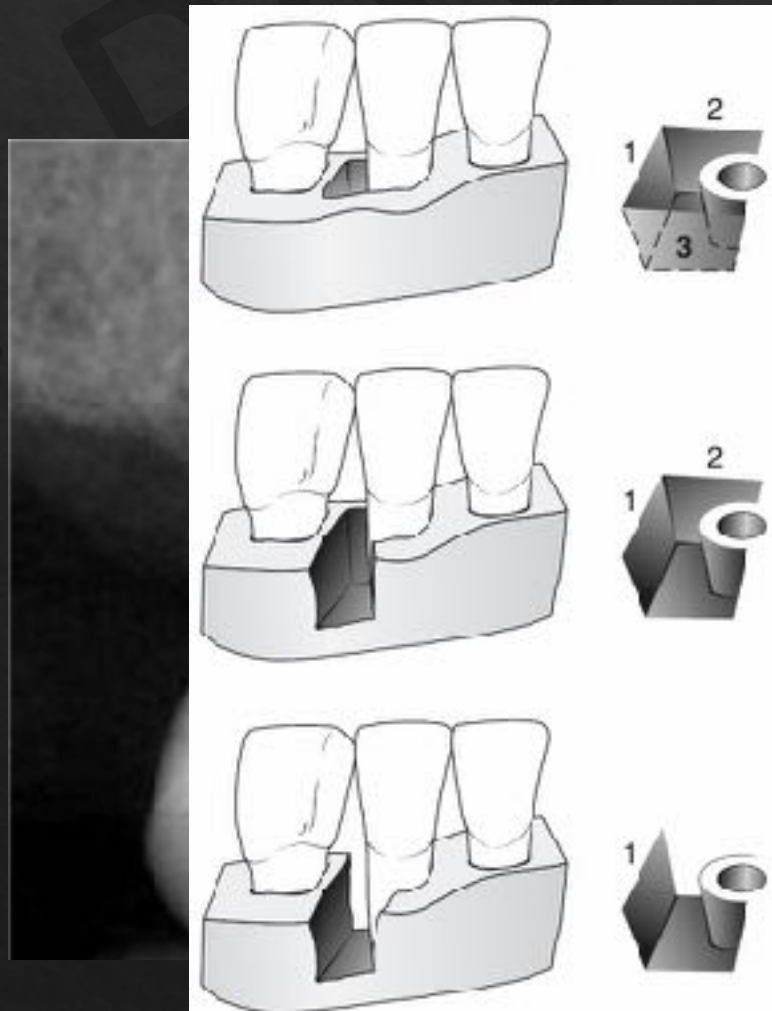
± Local factors:

- FMPS <20% („dose dependent effect")
- Cut the edge of the pyramid - microflora
- Endodontal conditions
- Tooth mobility: (>1mm horizontally) splinting!!!

Heitz-Mayfield L, Tonetti MS, Cortellini P, Lang NP, European Research Group on Periodontology (EUROPERIO). Microbial colonization patterns predict the outcomes of surgical treatment of intrabony defects. J Clin Periodontol 2006: 33: 62–68.

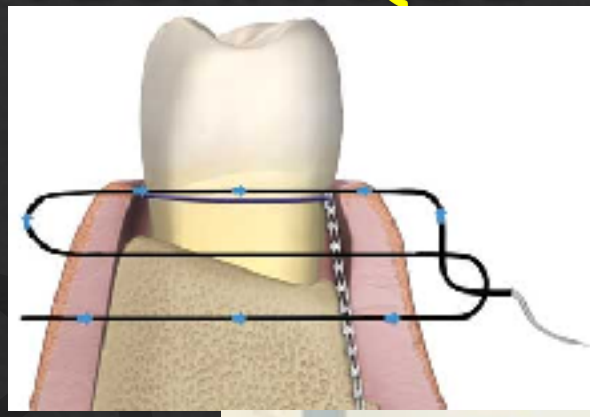
Influence factors – DEFECT morphology

- Depth: min 2mm intraosseal, deep -shallow
- Angulation: narrow - wide
- Number of walls:
  - Self containing: 3-(2) walls
  - Non-containing: 1-2 walls
  - 0(?) walls: circumdental crater



Cortellini P, Tonetti MS. Clinical concepts for regenerative therapy in intrabony defects. Periodontol 2000. 2015 Jun;68(1):282-307.

Influence factors – SURGICAL TECHNIQUE

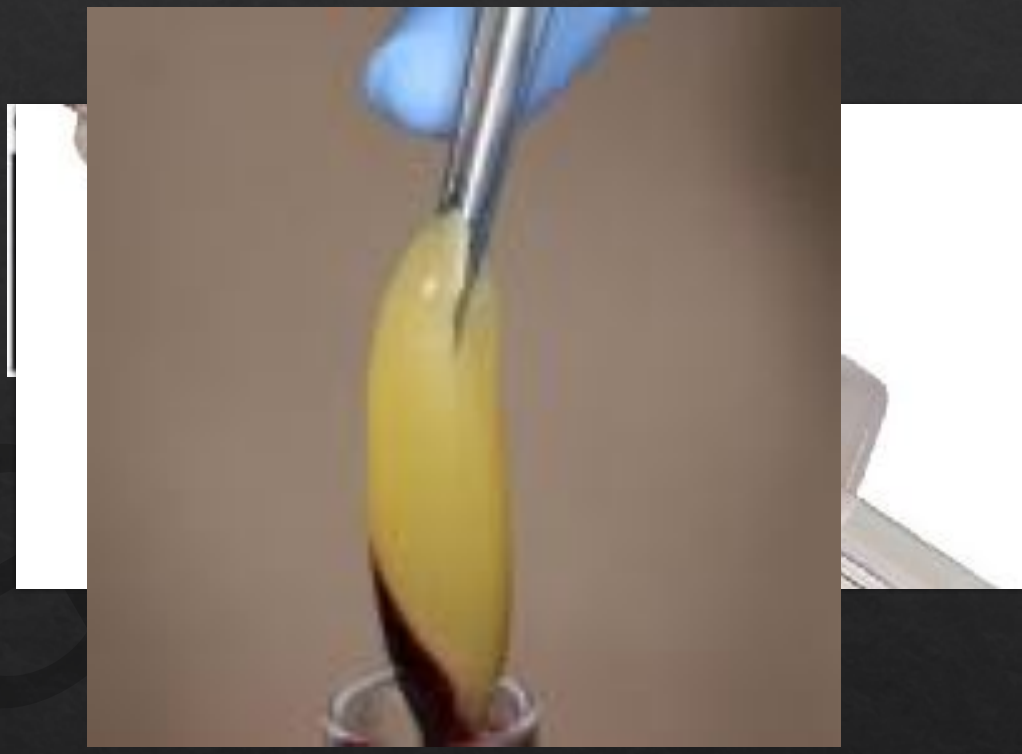


- Flap design with incision lines and suture techniques (criterion for regeneration)
- Usage of clinically approven materials and methods: EMD, GTR, PDGF, graft (auto-, allo-, xeno-)
- Postoperative care

QR code is coming

Materials

- ± Grafts
- ± GTR (guided tissue regeneration)
- ± Biologically active materials:
  - Enamel matrix derivative (EMD)
  - Growth factors (PDGF, TGFß, BMP-2, FGF)
  - Platelet rich plasma, fibrin (PRP, PRF)
- ± COMBINATIONS



Sculean A, Nikolidakis D, Nikou G, Ivanovic A, Chapple IL, Stavropoulos A. Biomaterials for promoting periodontal regeneration in human intrabony defects. A systematic review. Periodontol 2000 2015: 68: 182–216.

I. Grafts

- Data from the literature (Trombelli et al 2002): their clinical effectivity is not directly approven (several materials, numerous and heterogen examination, lots of variability)
- Prevention of the flap collaps
- Blood clot stability
- Carrier of biologically activ components/ molecules

Reynolds MA, Aichelmann-Reidy ME, Branch-Mays GL, Gunsolley JC. The efficacy of bone replacement grafts in the treatment of periodontal osseous defects. A systematic review. Ann Periodontol 2003: 8: 227–265.

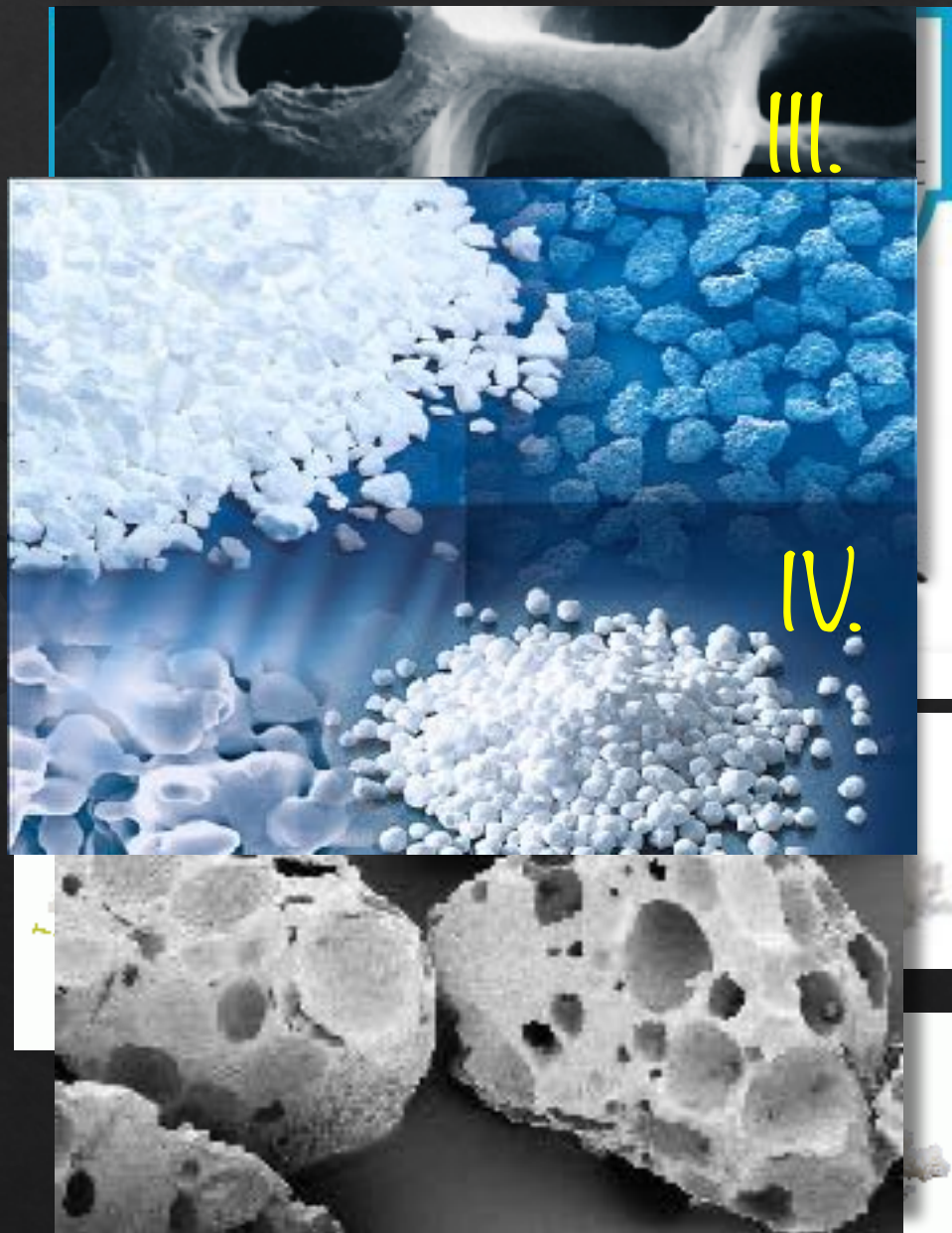
I. Grafts

I. Autograft (particular: scraper, bone mill, bone collector, Piezo UH)

II. Allograft (sterilized after lyophilization; FDBA, DFDBA - demineralized freeze-dried bone allograft)

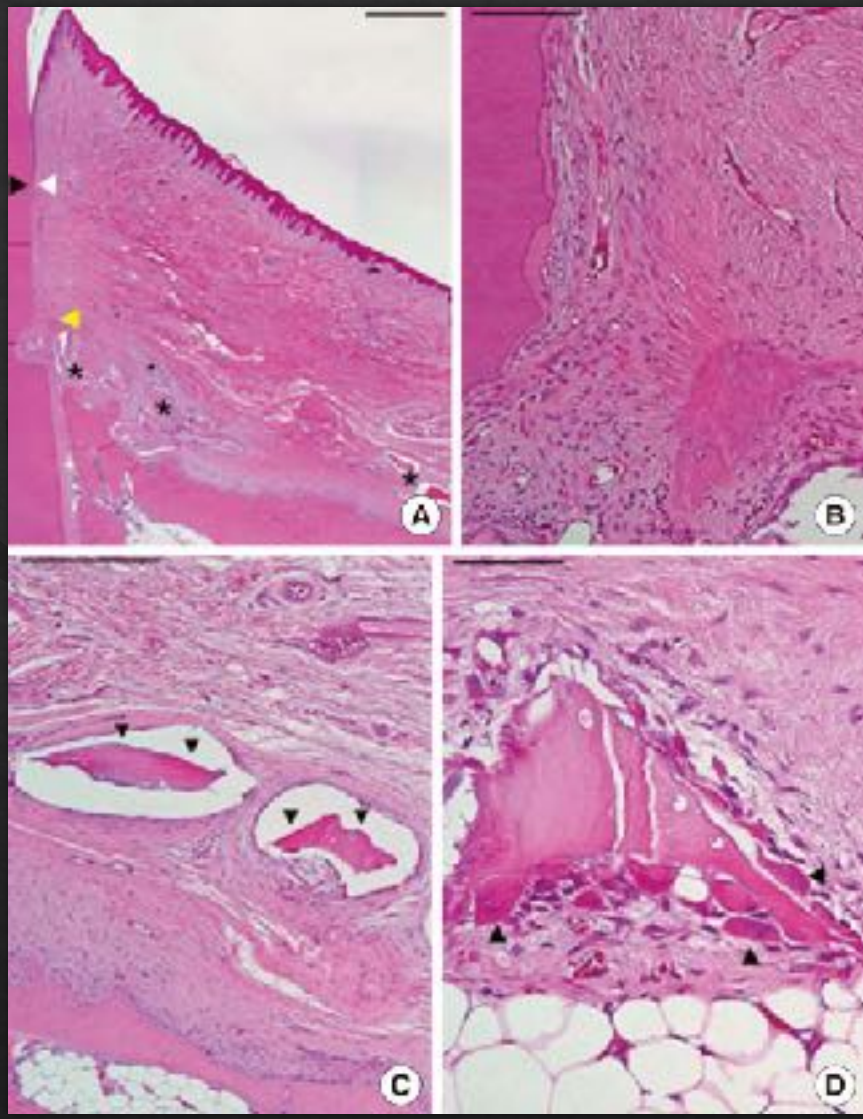
III. Xenograft (bovin, porcin; HA-pentacalcium-phosphate)

IV. Alloplastic (HA, βTCP, etc)



I. Grafts- Conclusions

- Not well established (lack of standards), confusing data about their regenerative potential (autograft, DFDBA, BDX)
- No clinical relevance
- Usage (in the periodontal lesions) alone – NO
- Recommendation: in combination

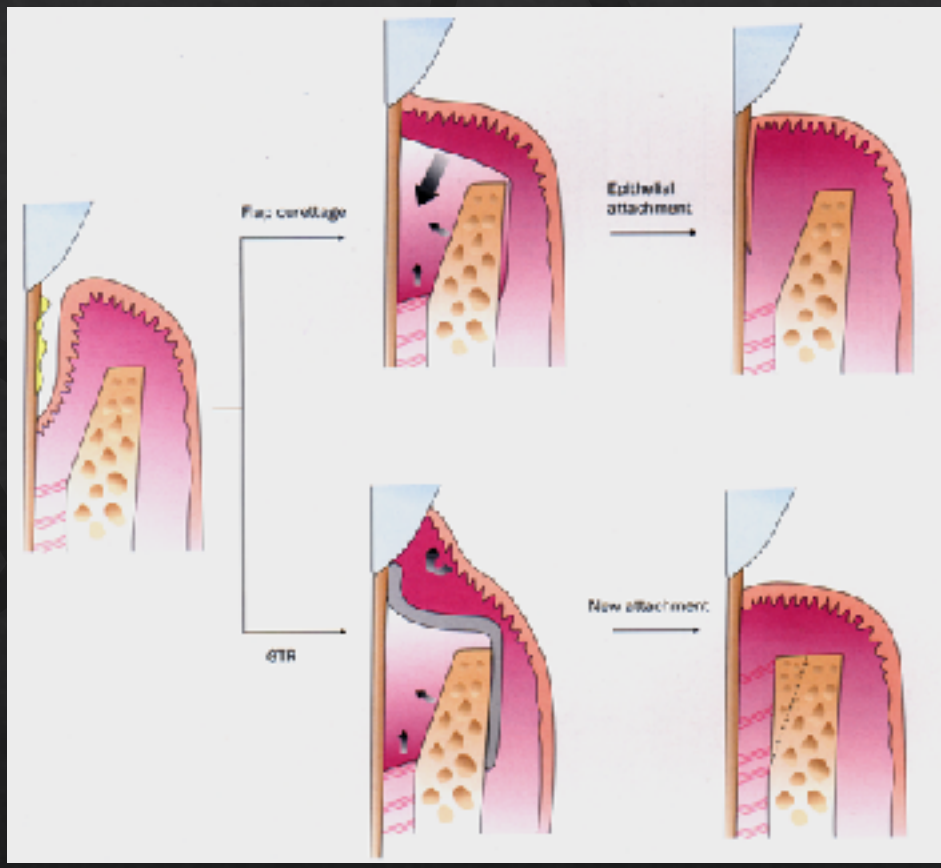


Trombelli L, Heitz-Mayfield LJ, Needleman I, Moles D, Scabbia A. A systematic review of graft materials and biological agents for periodontal intraosseous defects. J Clin Periodontol. 2002;29 Suppl 3:117-35; discussion 160-2. Review.

II. GTR, membranes

- Bio-inert
- Barrier function (cell-occlusion)
- Space maintainer (stabilization of the blood clot)
- Tissue-integration
- Complications:

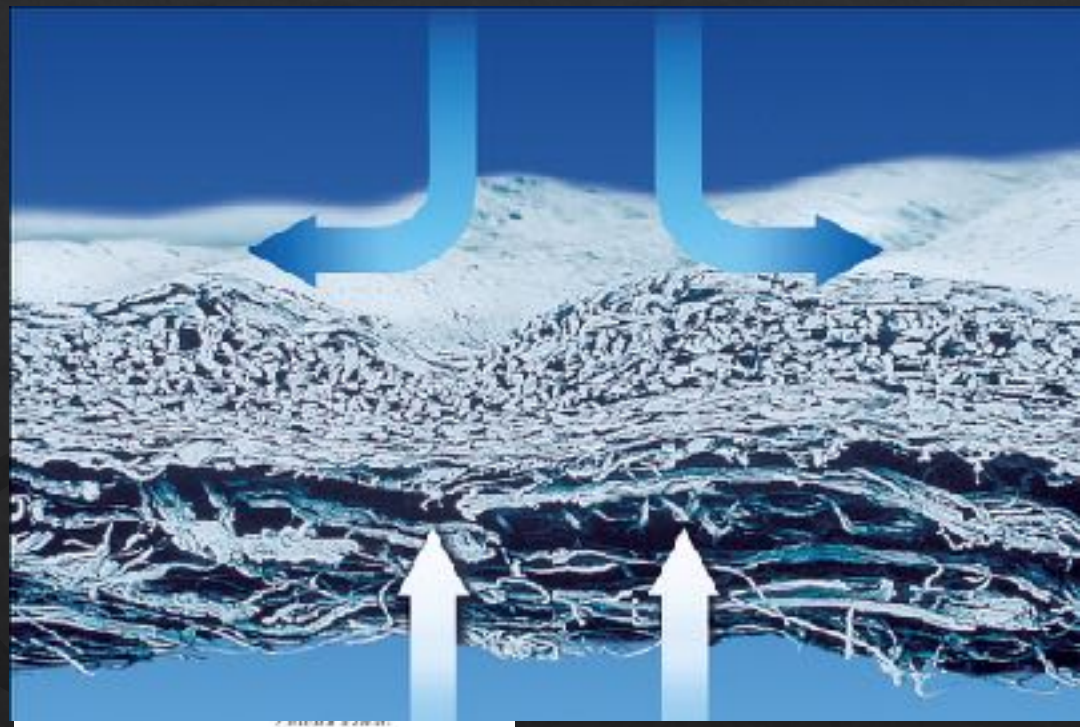
(infections, gingival dehiscence, not „so user-friendly")



Needleman IG, Worthington HV, Giedrys-Leeper E, Tucker RJ. Guided tissue regeneration for periodontal infra-bony defects. Cochrane Database Syst Rev 2006: 19: CD001724.

II. GTR, membranes

- ± Non-resorbable
  - PTFE, nPTFE
  - PTFE with titanium
  - Titanium mesh
- ± Resorbable
  - Collagen etc (crosslinked – longer resorption period)
  - Synthetic



III. EMD and autologous platelet concentrates

- More in details in Prof. Dőri Ferenc's lecture

IV. Combinations

- EMD + GTR: no any cumulative effect (except furcation laesion!)
- EMD + Graft (most data)
- GTR + Graft

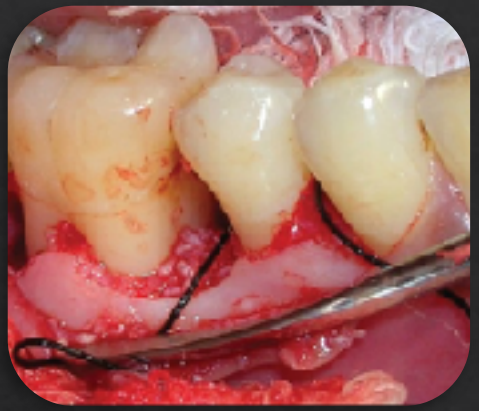
} Depends on the defect morphology

- Graft + PRP or PRF: promising results
- Graft + growth factors: more studies needed

+

Trombelli L, Farina R. Clinical outcomes with bioactive agents alone or in combination with grafting or guided tissue regeneration. J Clin Periodontol 2008: 35(Suppl.): 117–135.

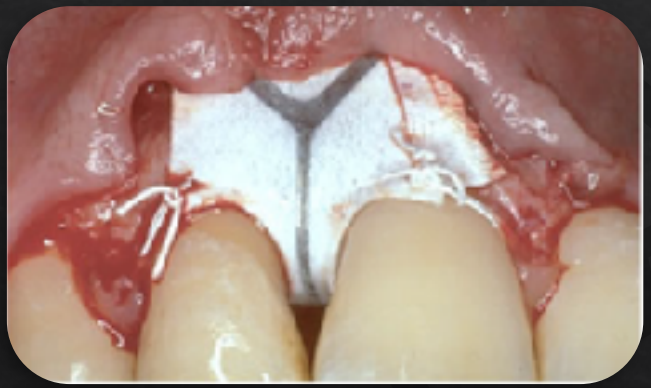
DFDBA



Amelogenins

Growth factors

Non-resorbable barrier



Resorbable barriers

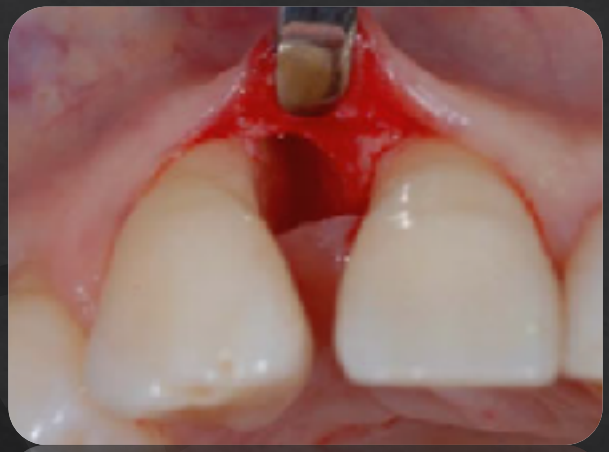
Combinations

Development of materials

1990 1996 2000 2004 2008

Papilla preservation

M-MIST



OFD

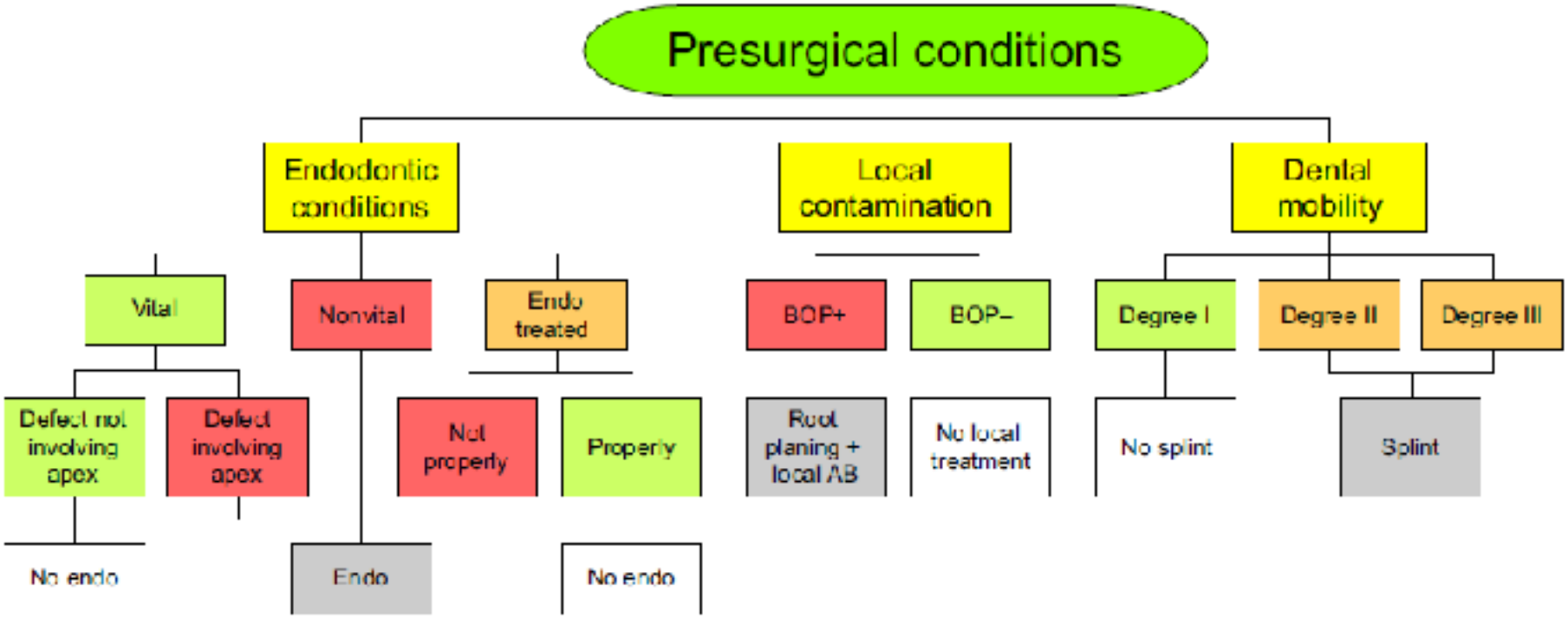
MIST

Flap design development

1990 1996 2000 2004 2008

Regenerative techniques – local preoperative factors

DECISION TREE



Cortellini P, Tonetti MS. Clinical concepts for regenerative therapy in intrabony defects. Periodontol 2000. 2015 Jun;68(1):282-307.

Postoperative protocol

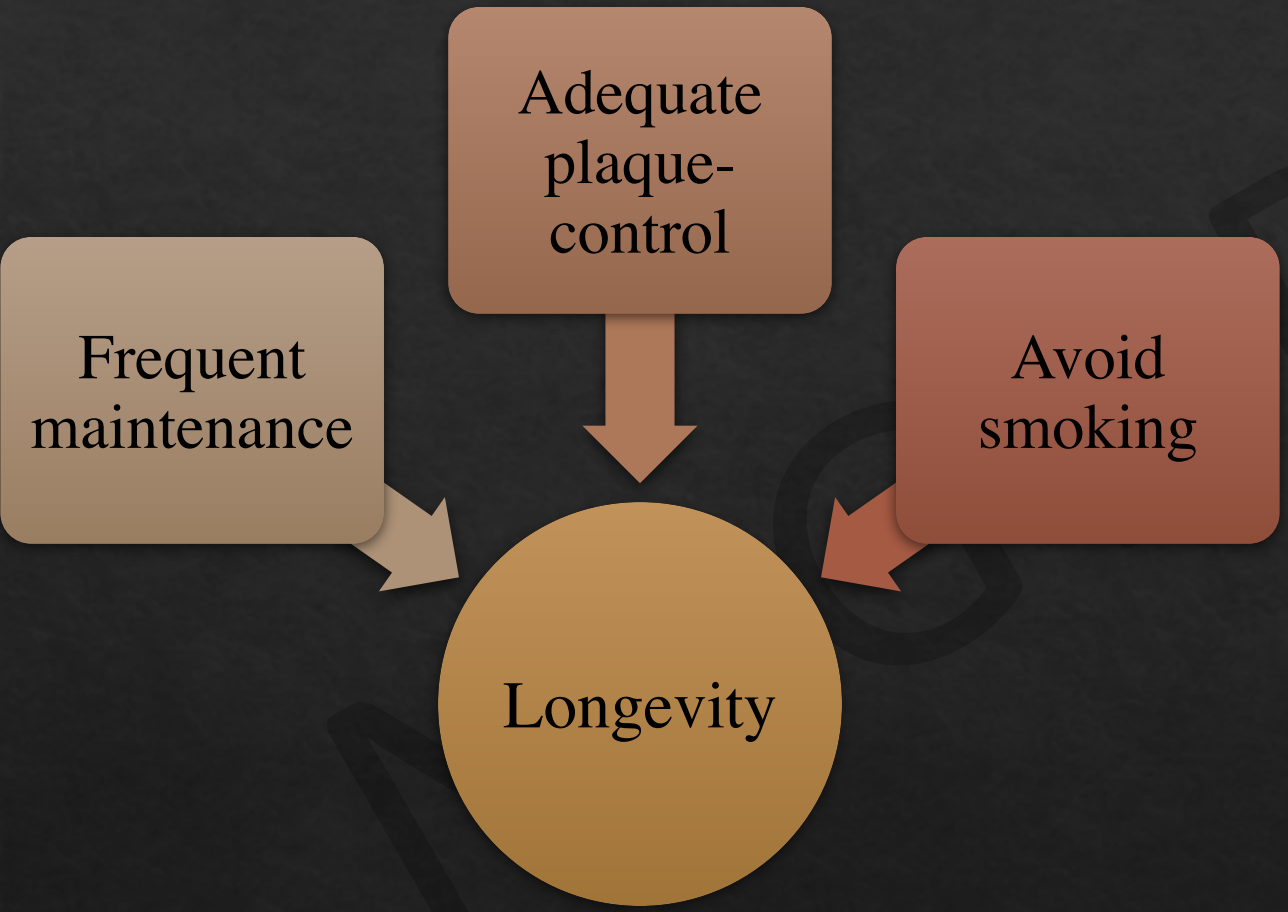
Doxycyclin 100mg 2X/ day for 1 week,
OR
Amoxicillin+clavulanic acid
625mg 3x/day 1week

Local chemoprophilaxis:
0.12% chlorhexidine
2X/day 2 weeks period

Absent till the removal of the sutures
Then soft brush!

Weekly for 3 weeks, then in every 3 months

SUSTAINABILITY??



175 patients,
2-16 (in average 8) years of observations,
96% tooth survival,
tooth loss in smokers

Cortellini P, Tonetti MS. Long-term tooth survival following regenerative treatment of intrabony defects. J Periodontol 2004: 75: 672–678.

Thank you for your attention!