

BIOLOGY OF THE PERIODONTAL TISSUES. PRINCIPLES OF PERIODONTAL REGENERATION TECHNIQUES

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Diagnose based comprehensive periodontal therapy

Diagnose

↓

Initial phase therapy ☹ → REFRACTER

reassessment

INDICATIONS??

Periodontal surgery ☹

reassessment

Supportive periodontal th. ← Comprehensive rehabilitation

Periodontal defects

Suprabony-
Horizontal bone resorption

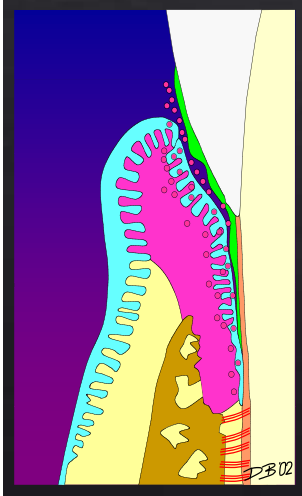
Infrabony-vertical bony defects:
-intrabony
- interdental crater

Interradicular-furcation laesions

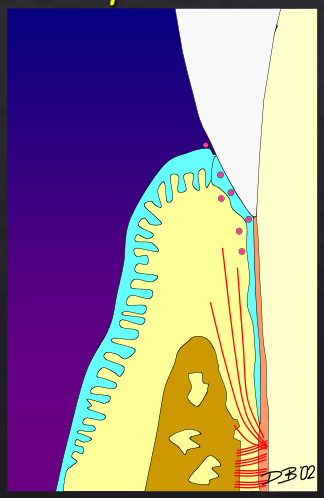
INDICATION!!

Periodontal healing potentials

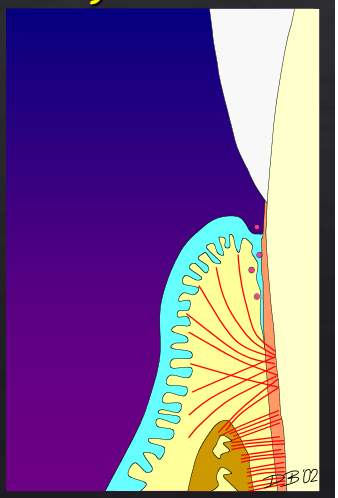
Periodontitis



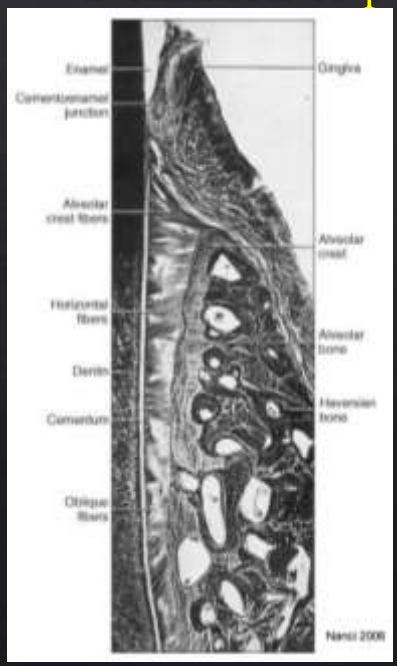
Reparation



Regeneration



Definition of periodontal regeneration

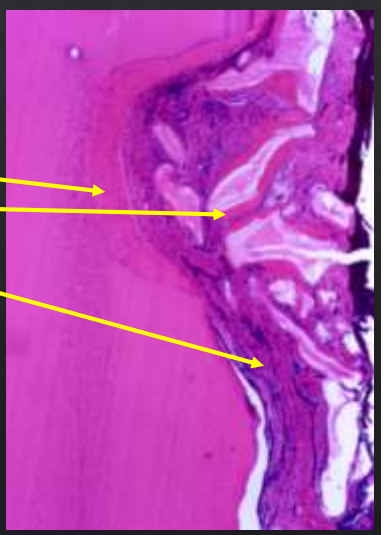


"The reproduction or reconstruction of a lost or injured part of the body in such a way that the architecture and function of the lost or injured tissues are completely restored."

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:

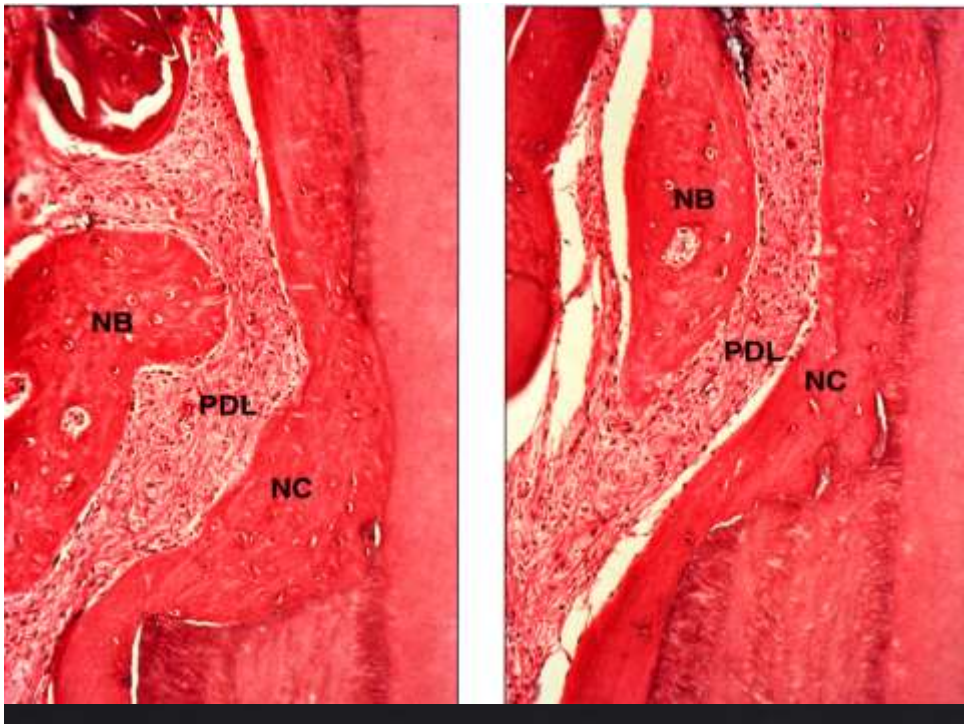
(cementum - bone – Sharpey-fibers)

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

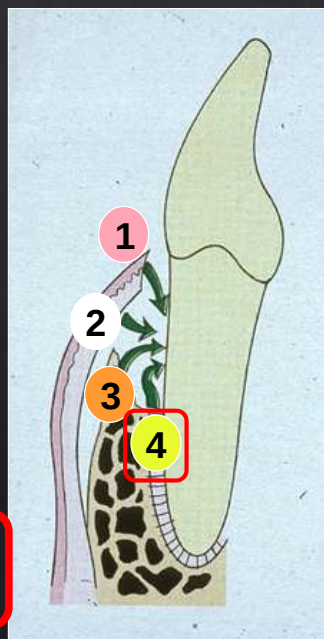


After surgery the key factor for the healing nature is: the type of cells whereby the cleaned root surface will be recultured/repopulated

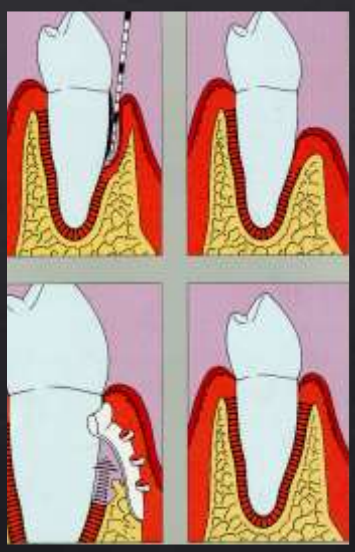
Melcher, 1976

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*):

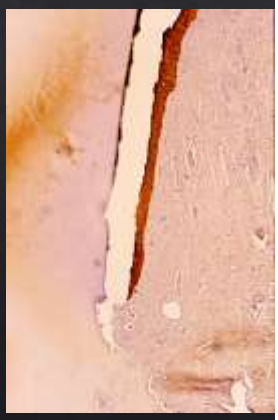
- RSD
- RSD+MWF
- RSD+MWF+ autologous bone
- RSD+MWF+ bone substitute (ßTCP)

LIP: ligature induced periodontitis

1. Caton et al. 1980-

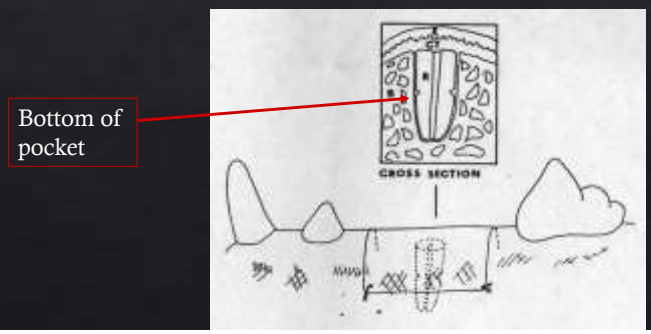
Histometric analysis: all 4 treatment modalities resulted LONG JUNCTIONAL EPITHELIUM.

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 and total decoronation were replanted in artificial sockets prepared in the edentulous ridge.
- The gingival flap was tightly sutured to prevent the apical migration of the epithelium (totally submerged roots).

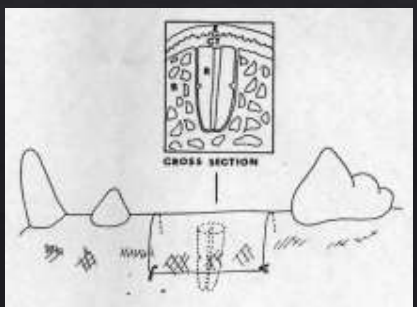


2. Karring és mtsai (1980)

- New connective tissue attachment could develop around decoronated roots if the gingival flap was tightly closed during the whole period of postoperative healing
- 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 és mtsai (1980)

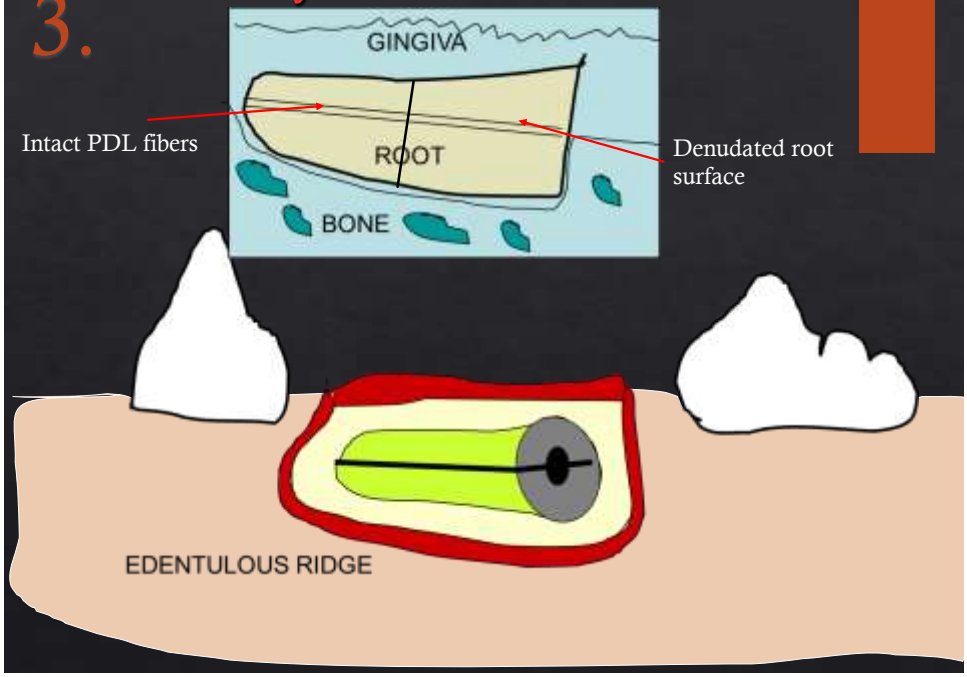
CONCLUSION: The epithelial migration is the biggest obstacle of the connective tissue regeneration, junctional epithelial cells has faster migration on root surface, that will prevent mesenchymal cells from PDL to populate the root surface



3. Nyman et al. 1980

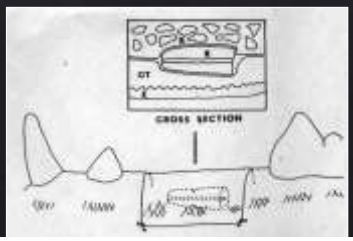
- LIP induced around experimental teeth in monkeys and dogs
- Teeth were extracted, decoronated and notches were placed at the level of the marginal bone crest. Diseased parts of the root was scaled and root planed
- Recipient sites (horizontal grooves) in the edentulous mandible for subsequent implantation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

3. Nyman et al. 1980



3. Nyman et al 1980

- Those root surfaces with intact PDL fibers created new connective tissue attachment 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 fond on the denudated root surface facing toward the bone

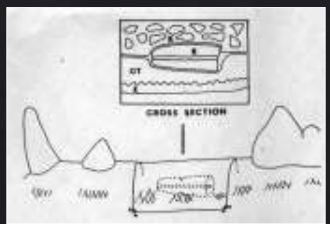


3. Nyman et al. 1980

CONCLUSION:

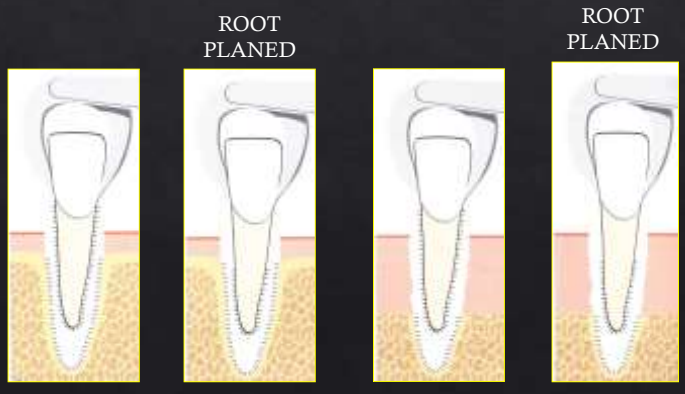
CELLS ORIGINATING FROM NEITHER ALVEOLAR BONE NOR GINGIVAL CONNECTIVE TISSUE LACKS THE ABILITY TO ESTABLISH A NEW CONNECTIVE TISSUE ATTACHMENT.

MESENCHYMAL CELLS FROM PDL PREVENT ANKYLOSIS AND ROOT RESORPTION.



4. Lindhe 1984

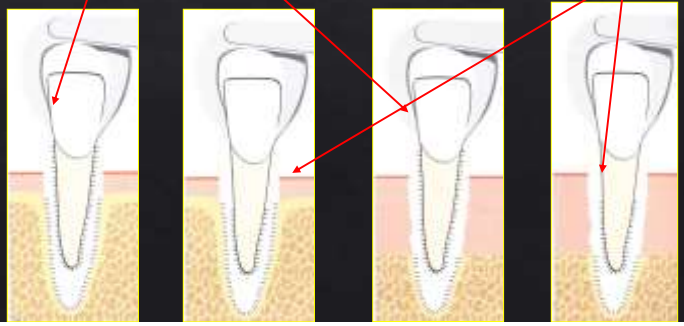
- Incisors were extracted and then reimplanted in their own sockets as follows:



5. Lindhe 1984

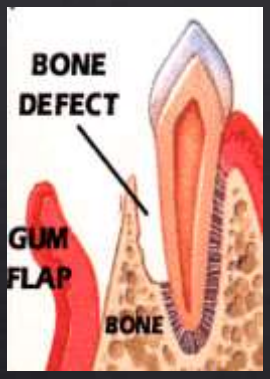
Histology after 6 months:

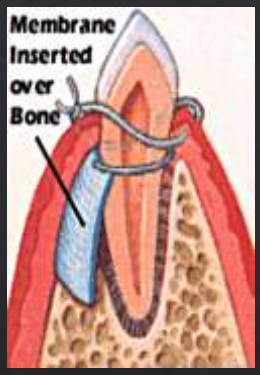
- Fibrous reunion (reattachment) was established in areas where the original Sharpey fibers were preserved:
- In areas where the Sharpey fibers were destroyed only long epithelial attachment occurred:

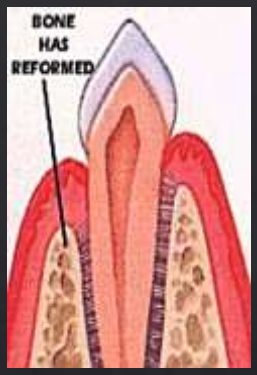


6. Gottlow és mtsai 1982

- 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



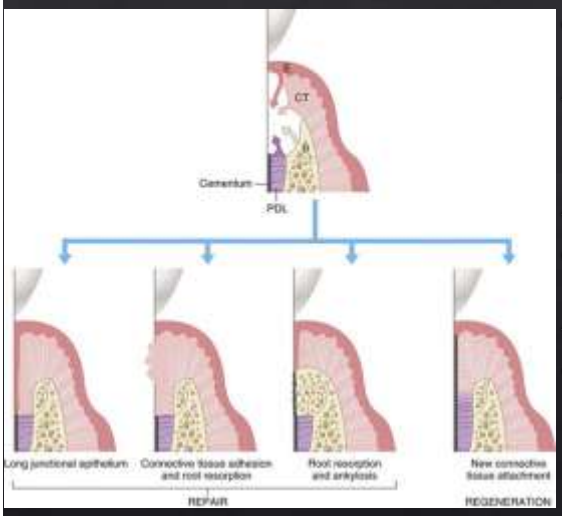




CONCLUSION:

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

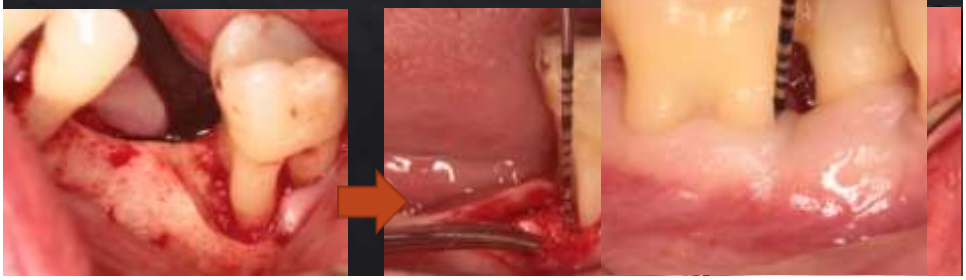
Healing patterns in line with cell sources



- Sulcular epithelial cells
  - ➔ LONG JUNCTIONAL EPITHELIUM
- Gingival connective tissue cells
  - ➔CONNECTIVE TISSUE ATTACHEMENT
- Alvolar bony cells
  - ➔ ANKYLOSIS, ROOT RESORPTION
- Periodontal ligament cells
  - ➔BONE, CEMENTUM AND SHARPEY-FIBERS

Methodological pathways in the investigation of regeneration

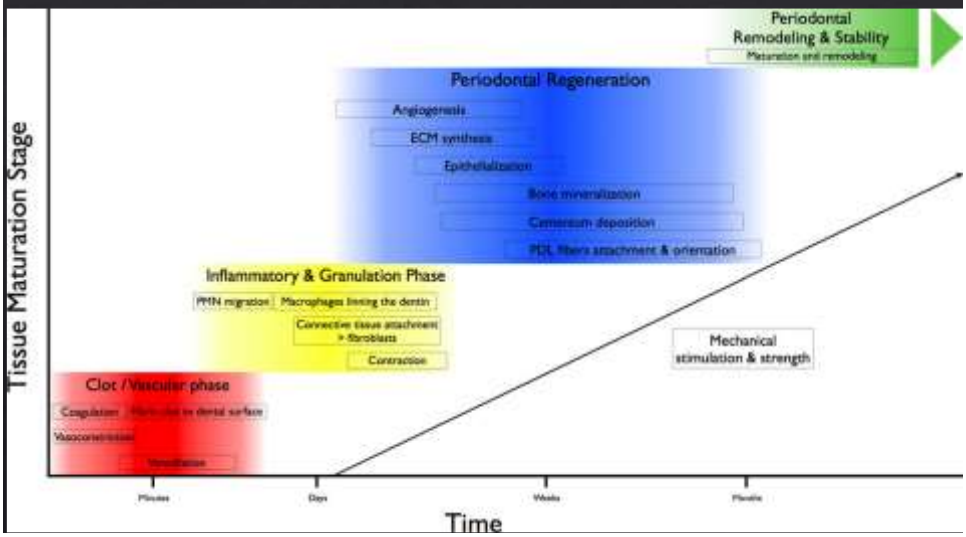
- Clinical
  - PPD measurement
  - X-ray examination
  - Reentry
- Histology!!!
- Animal studies



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



Criterions of periodontal regeneration

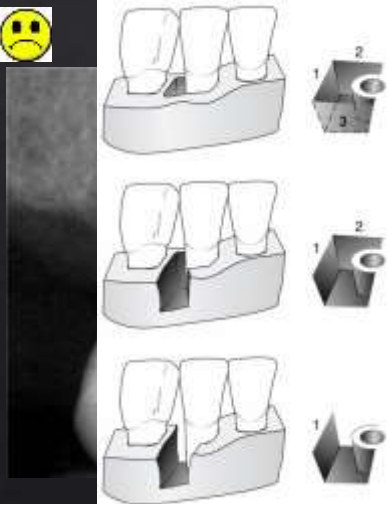
Influence factors - PATIENT

- 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



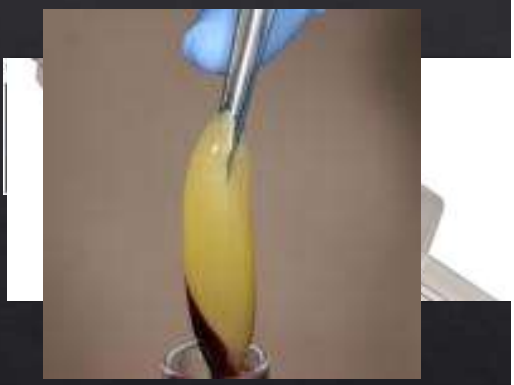
Cortellini P, Tonetti MS. Clinical concepts for regenerative therapy in intrabony defects. Periodontol 2000. 2015 Jun;68(1):282-307.

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

Materials

- Grafts
- GTR (guided tissue regeneration)
- Biologically active materials:
  - Enamel matrix derivative (EMD)
  - Growth factors (PDGF, TGFβ, BMP-2, FGF)
  - Platelet rich plasma (PRP)
- 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.

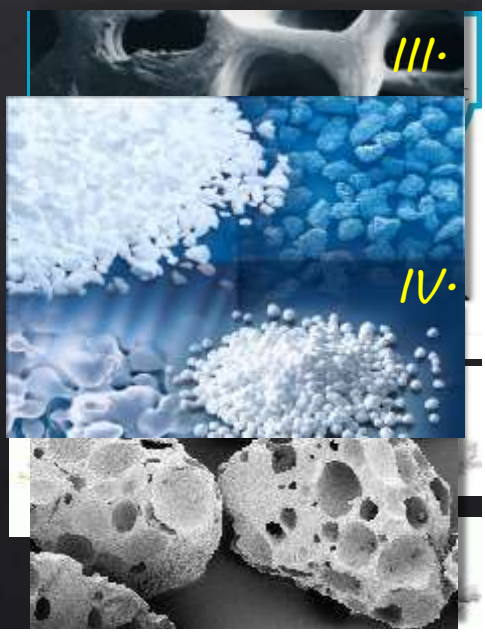
I. Grafts

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

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

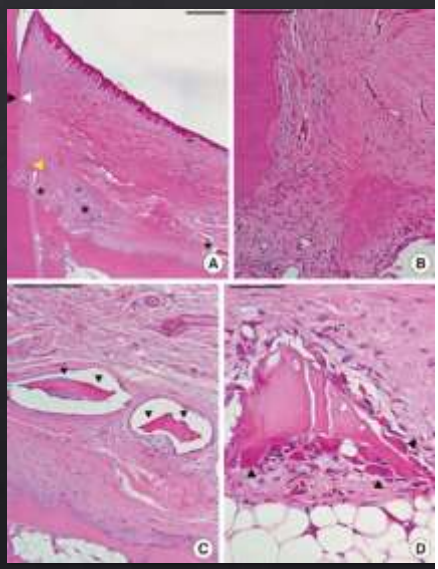
III. Xenograft (bovin, porcin; HA-pentacalcium-phosphate)

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

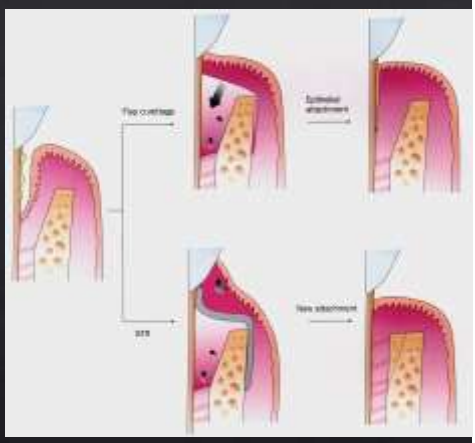


Trombelli L, Heitz-Mayfield LJ, Needleman I, Moles D, Scabbia A. A systematic review of graft materials and biological agents for periodontal intraosseous defects. J Clin Periodontol. 2002;29 Suppl 3:117-35; discussion 160-2. Review.

II. GTR, membranes

- Bio-inert
- Barrier function (cellocclusion)
- Space maintener, (stabilization of the blood clot)
- Tissue-inegration
- Complications:

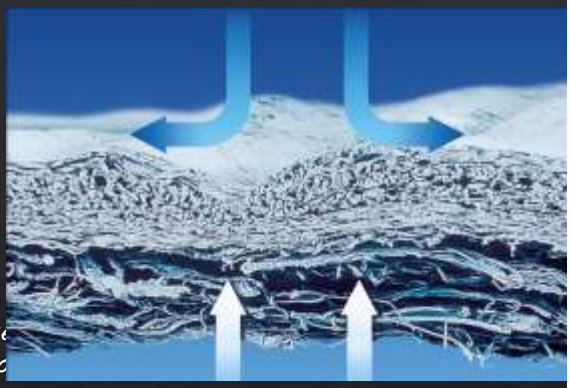
  (infections, gingival dehiscency, not „so userfriendly")



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 (crosslinke
    longer resorption perio
  - Synthetic



V. Combinations

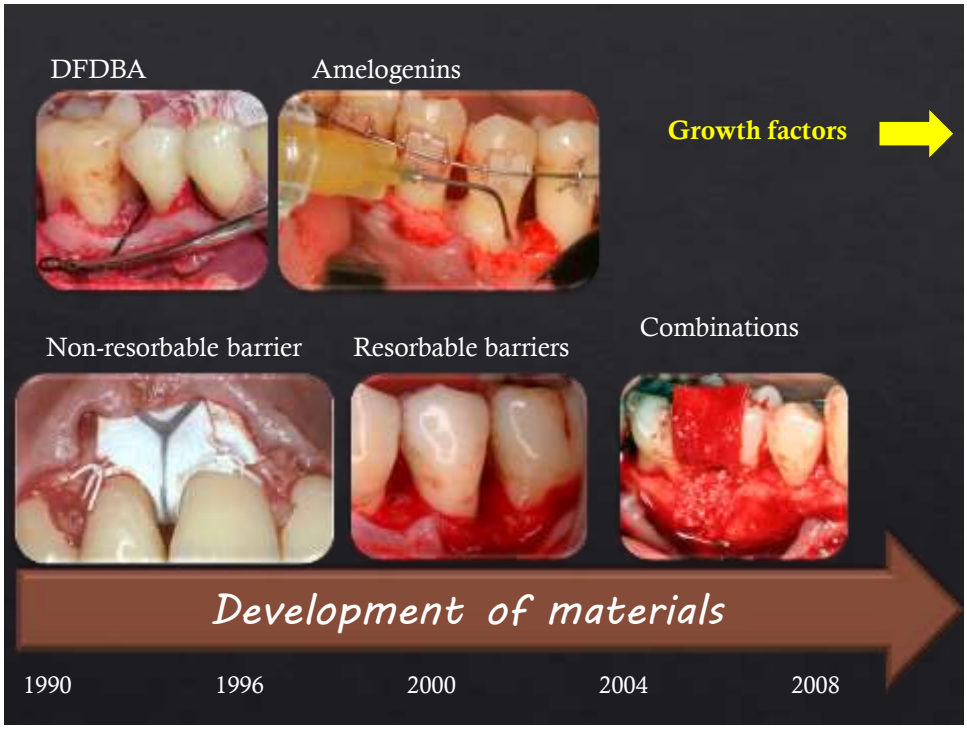
- EMD + GTR: no any cumulative effect (Sculean 2004, 2008, Tu 2010)
- EMD + Graft
- GTR + Graft

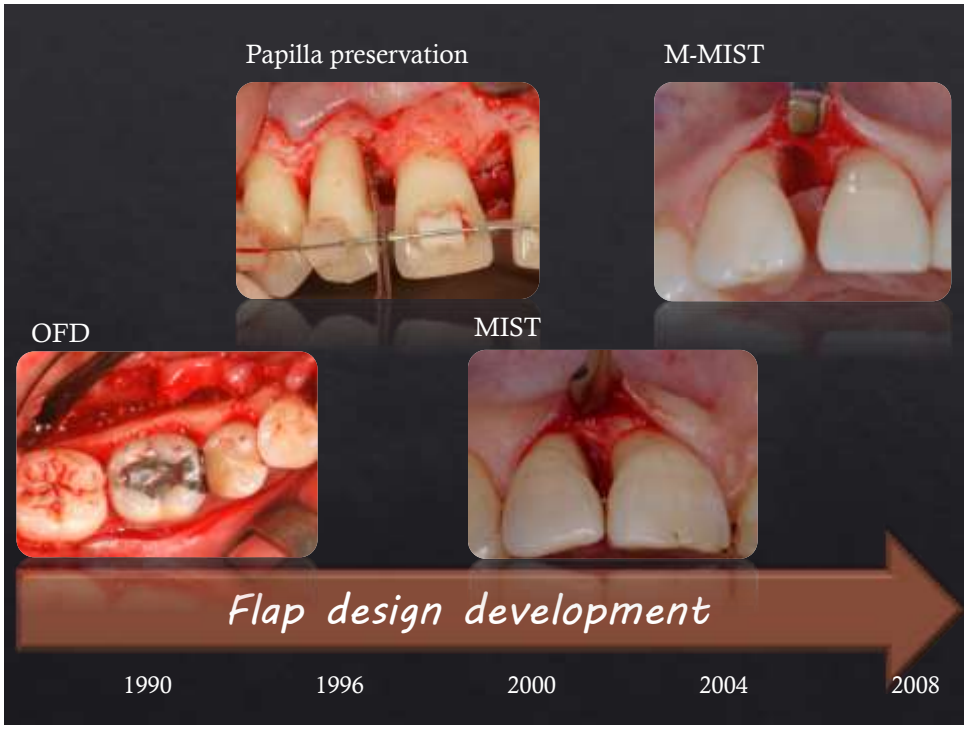
} Depends on the defect morphology

- Graft + PRP: confused data
- Graft + growth factors: more studies needed

+

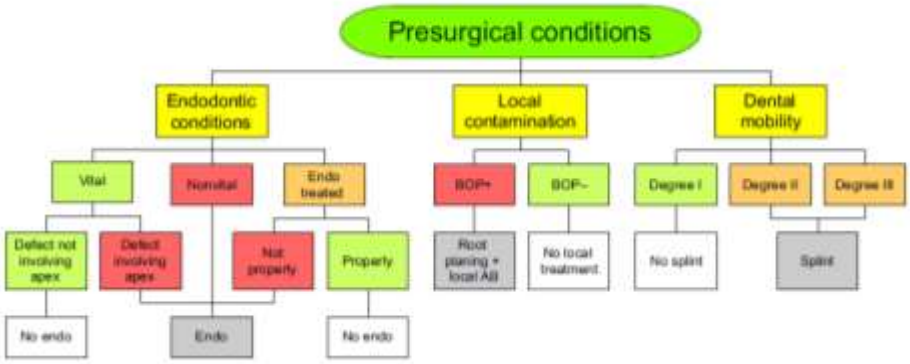
Trombelli L, Farina R. Clinical outcomes with bioactive agents alone or in combination with grafting or guided tissue regeneration. J Clin Periodontol 2008: 35(Suppl.): 117–135.


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 protocoll!!

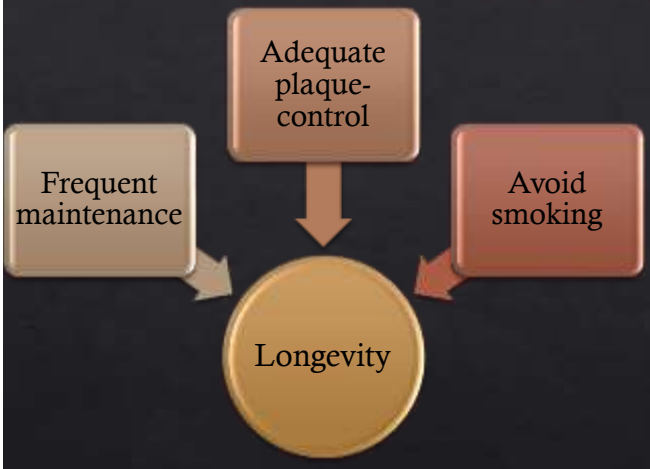
Doxycyclin 100mg 2X/day 1 week
Amoxicillin+clavulanic acid
625mg 3x/day 1week

Local chemoprophilaxis:
0.12% chlorhexidine
3X/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!