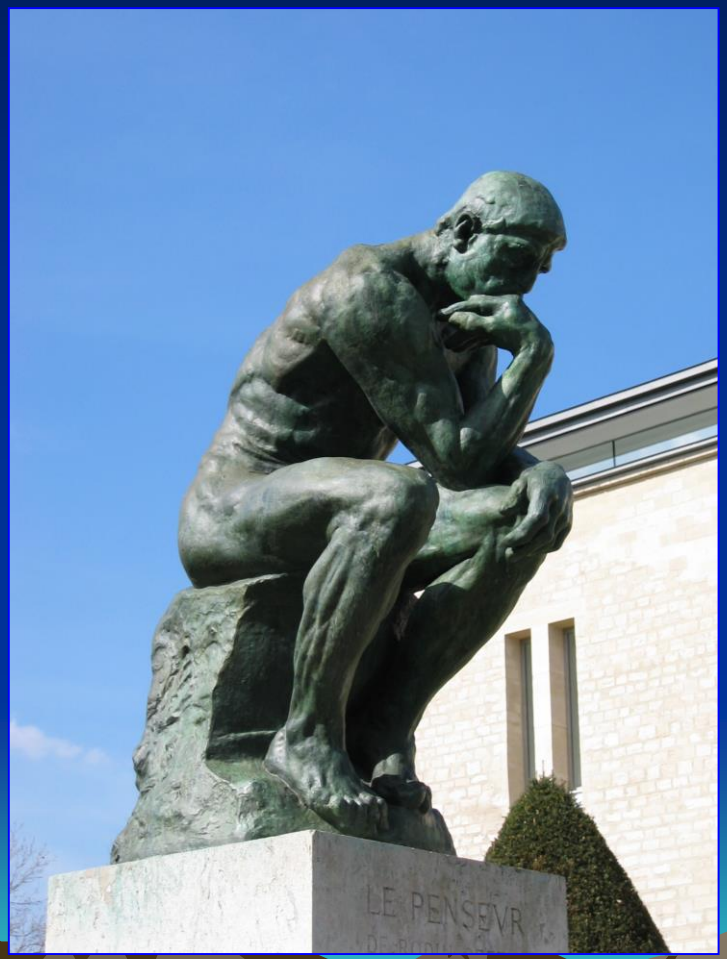
Wound healing, bone and soft tissue wounds, disorders of wound healing

Why is it especially important to speak about wound healing in oral surgery?



- After tooth extraction the wound is normally not closed!
- The number of bacteria in the mouth is extremely high!
- The oral milieu has a number of factors inhibiting wound healing!

The physiological process of wound healing

- Regeneration → The healing process of the body and organs when the tissue defect is filled with identical tissue.

- Reparation → The process is not specific, it involves the formation of fibrous scar tissue.

In the human body there is *regeneration* without the formation of scar tissue in the epithelium EXCLUSIVELY, in deeper tissues there is *reparative* healing!!

The physiological process of wound healing

- Inflammatory phase
- Proliferative phase
- Reparative phase

The physiological process of wound healing

- Inflammatory phase

- Neutrophil adhesion → phagocytosis of damaged tissues
- activation of T and B lymphocytes
- activation of the monocyte-macrophag system
- activaiton of endothelial cells
- Activation of kinin kallikrein system
- Edema formation→ vasodilatation in the tissues
  → hyperaemia
  → rubor, calor, tumor, dolor, functio laese

The physiological process of wound healing

➢ Proliferative phase

- Coagulum formation⟶ local vasoconstriction as a result of the immediate haemorrhage of the wound (minimizing blood loss)

  → thrombocyte aggregation (prothrombine-thrombine)

  → formation of a fibrin net (fibrinogen-fibrin)

The physiological process of wound healing

- Reparative phase

- Proliferation of capillaries, formation of granulation tissue and undifferentiated scar tissue
- Granulation tissue prepares re-epithelisation and wound closure
- The newly formed scar tissue prevents further bacterial invasion
- Under the scar tissue begins the differentiation of fibroblasts to fibrocytes, the wound edges are pulled together by myofibroblasts and finally epithelisation begins
- Desmogenic ossification→ the colony of collagen tissue is rebuilt into bone
- Fibroblasts transform into osteoblasts (oxygenisation, BMP, calm tissue environment)
- Reticular bone transforms into lamellar bone

Forms of wound healing

- **Primary wound healing** (”per primam intentionem”)

- Favourable form with clean wound edges and a small amount of reparative tissue.
- Wound healing is finished clinically (visibly) within 4-5 days.
- In most of the cases this is the form of wound healing occurring in the oral cavity.

- **Secondary wound healing** (”per secundam intentionem”)

- Inflamed wound edges are ”distant” from each other, big tissue defect between the wound edges.
- The wound is covered into inflammatory scar tissue.

Primary wound healing ("per primam intentionem")

- Wound edges are free of inflammation
- Epithelial tissue perfectly covers the effected region, the wound
- Wound healing free of exudate
- Process without the presence of reparative tissues

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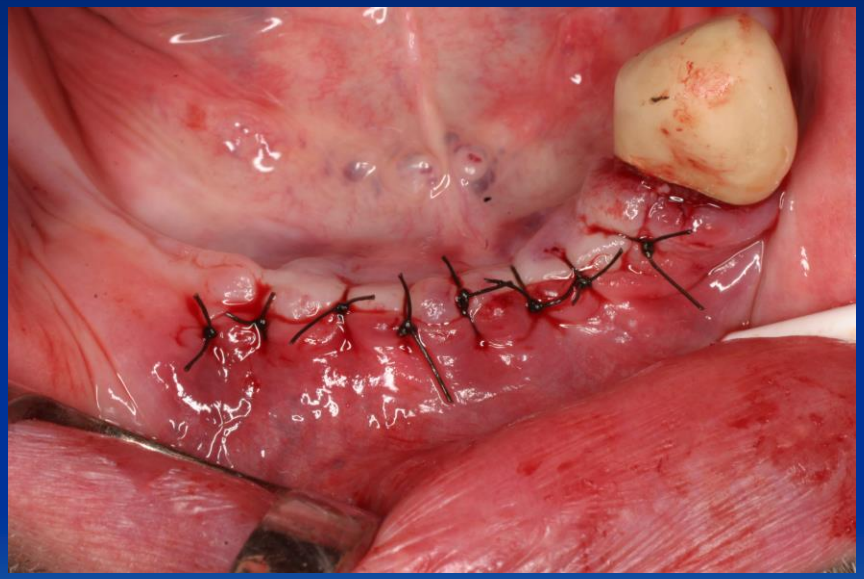

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Secondary healing ("per secundam intentionem")

- Wound edges are not united
- Wound edges have an inflammatory zone
- Wound healing is accompanied by exudation
- Reparative tissues are present

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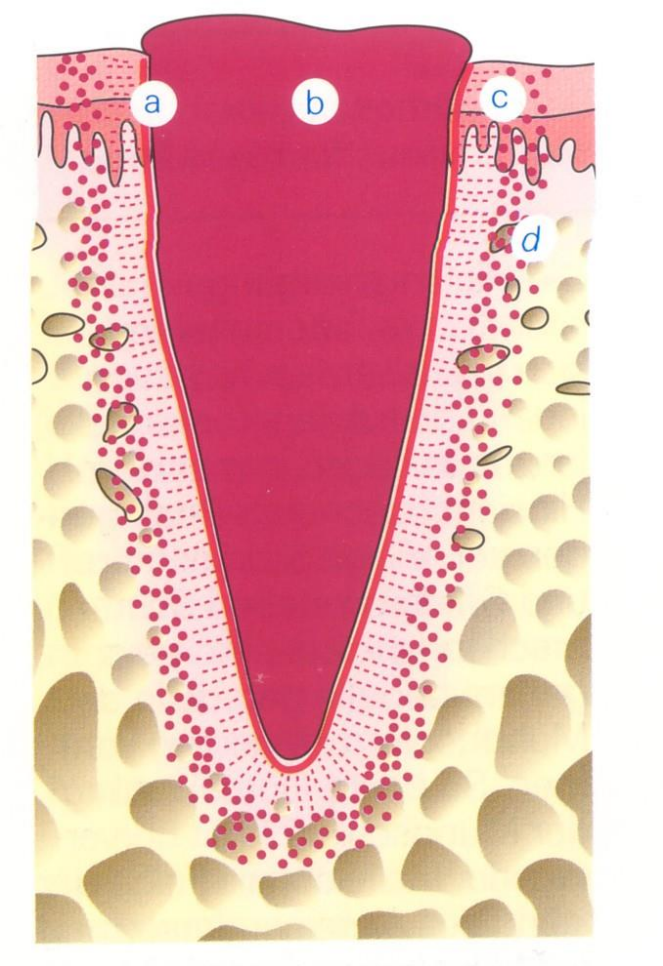
Healing of the extraction wound

- Combined wound healing as soft tissues, nerves and the bone are all injured together and heal together (restitutio ad integrum).
- There are many factors disturbing wound healing.
- The (primary) epithelisation of the wound takes 6-7 days, while bony healing may last for months.

Healing of the extraction wound



- a, 0.2 – 0.5 mm-thick necrotic zone
- b, coagulum
- c, demarcation zone
- d, outer zone

Healing of the extraction wound

	Maxilla	Mandible
Tooth	mm^2	mm^2
1	178	146
2	135	134
3	212	235
4	198	189
5	210	225
6	534	420
7	530	451
8	278	315

Factors influencing the healing of the extraction wound

- Saliva → - not a natural medium for wound healing
  - its production is increased in case of injury
  - it may dilute or ”wash out” the coagulum
  - high quantity of germs
    (109 -1011 germs/ml)
  - contains enzymes, immunoglobulines and – as a non-specific protective substance - mucine
  - contains lysosime - antibacterial susbstance

Factors influencing the healing of the extraction wound

- Mechanical forces

  - each time one swallows (1500 times a day) the tongue exerts pressure on the palate and the teeth (0.034 MPa)
  - mainly the lower front teeth and the upper canines are involved
  - cellular elements may be pressed out of the wound upon biting

Factors influencing the healing of the extraction wound

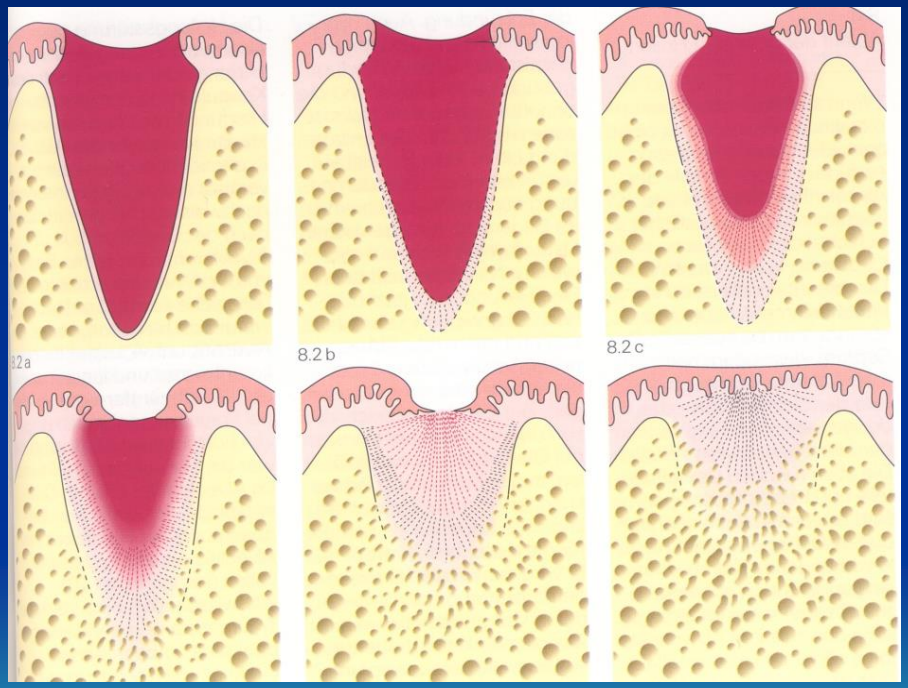
- Thermal effects

  - human proteins denature above 40 Cº , thus the consumption of too hot food is not recommended after tooth removal

- Chemical effects

  - high concentration chemical substances (salts, alcohols, drugs) can influence wound healing

The ”normal” course of healing of the extraction wound



- <u>1, the day of tooth extraction</u>

  the socket is filled with a coagulum

- <u>2, 2nd and 3rd day after extraction</u>

  granulation tissue grows from the socket wall towards the coagulum

- <u>3, 4th day after extraction</u>

  fibrous tissue appears at peripheral parts of the alveolar wall

The ”normal” course of healing of the extraction wound

- <u>2nd and 3rd day after extraction</u>

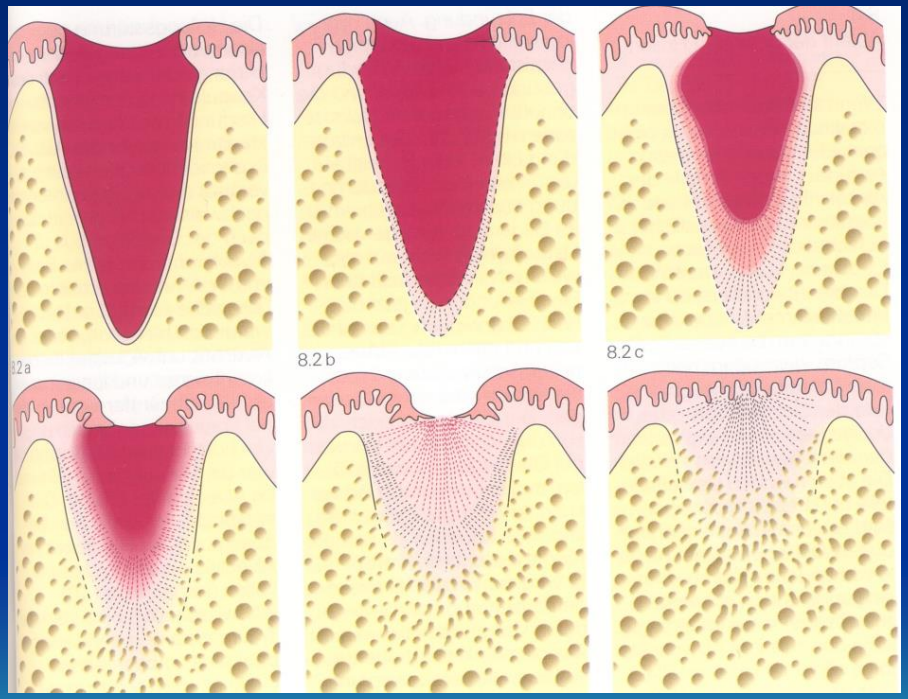
  granulation tissue grows from the socket wall towards the coagulum

The ”normal” course of healing of the extraction wound

- 4th day after extraction

  fibrous tissue appears at peripheral parts of the alveolar wall

The ”normal” course of healing of the extraction wound



- <u>4, 7th day after extraction</u>

  osteoid elements appear on the periphery of the original coagulum and it is almost completely transformed into granulation tissue.

  The epithelial wound edges close, the wound shrinks.
- <u>5, 3 weeks after extraction</u>

  Almost no granulation tissue is visible. The socket is filled with connective tissue and osteoid bone. The epithelium has already closed above the bone.

The ”normal” course of healing of the extraction wound

- 7th day after extraction

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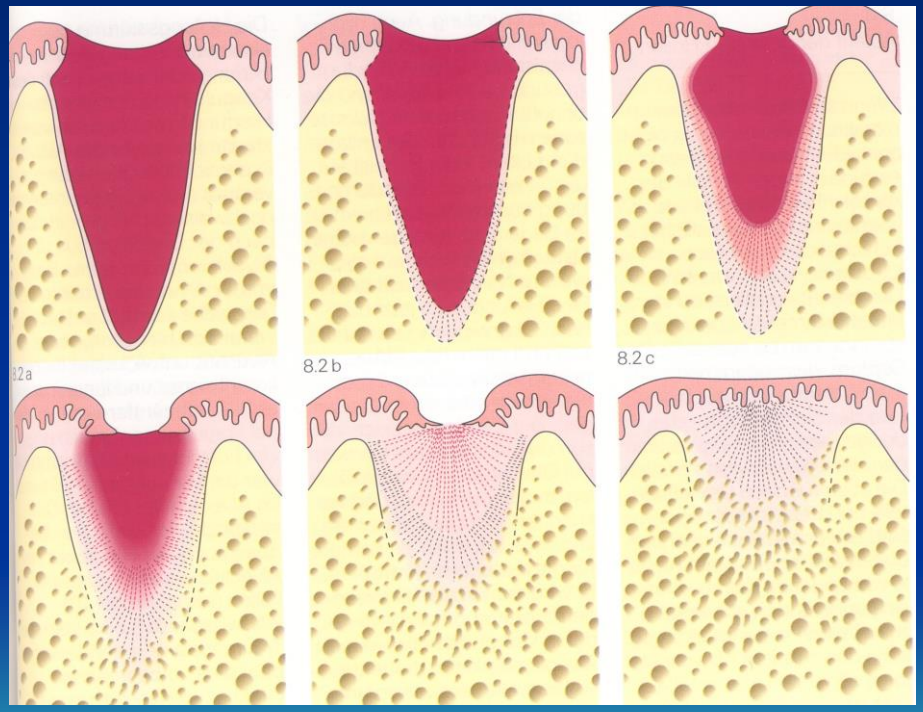
The ”normal” course of healing of the extraction wound



- <u>6, 40th day after extraction</u>

  Clinically the wound can be considered to be healed. The socket is filled with bone. Epithelisation above the wound is perfect and the epithelial tissue has regained its original thickness.

Disorders of wound healing

- Most often caused by wound infection
- Local disorders are caused by– radiation therapy, diseases (DM, leukaemia, agranulocytosis)
- Ostitis circumscripta post extractionem, ostitis alveolaris, dry socket, dolor st.post extractionem, alveolitis
- Complaints start 3-4 days following tooth extraction
- Cause: the infected coagulum falls apart and disappears
- Symptoms: strong pain, reduced mouth opening, foetor, subfebrility
- Therapy: conservative or surgical

Disorders of wound healing

- Conservative therapy

3% hydrogene peroxide irrigation

Inserting a gauze strip dipped into Chlumsky solution

Inserting a Pharodoran rod

Disorders of wound healing

- Surgical therapy

Following X-ray control cleaning (excochleating) the wound is performed in local anaesthesia.

A new haemorrhage is induced and the wound edges are refreshed.

Broken bone edges and root fragments are removed.

The presence of a coagulum in the socket has to be checked and its durability ensured.

Daily recall.

Thank you for your kind attention!