Sutures and Suture Materials in Oral Surgery

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Wound healing

PRIMARY (PER PRIMAM INTENTIONEM, PER PRIMAM, PP)

Galenus: the main task of the doctor: gapless wound closeur and linear scar healing

In primary wound healing there is no tissue loss. Incised wound is held together by a blood clot and possibly by sutures. An inflammatory process begins in adjacent tissue at the moment of injury. After several days, granulation tissue forms as a result of migration of fibroblasts to the area of injury and formation of new capillaries. Epithelial cells at wound margin migrate to clot and seal the wound. Regenerating epithelium covers the wound. Scarring occurs as a granulation tissue matures and injured tissue is replaced with connective tissue.
Wound healing

SECONDARY (PER SECUNDAM INTENTIONEM, PER SEC)

Healing by second intention occurs when there is tissue loss, as in extensive burns and deep ulcers. The healing process is more prolonged than in healing by primary intention because large amounts of dead tissue must be removed with viable cells. Open area is more extensive, inflammatory reaction is more widespread and tends to become chronic. Healing may occur under a scab formed of dried exudate, or dried plasma proteins and dead cells. Fibroblasts and capillary buds migrate toward center of wound to form granulation tissue, which becomes a translucent red color as capillary network develops. Granulation tissue is fragile and bleeds easily. As granulation tissue matures, marginal epithelial cell migrate and proliferate over connective tissue base to form a scar. Contraction of skin around scar is the result of movement of epithelial cells toward center of wound in an attempt to close the defect. Surrounding skin moves toward center of wound in an effort to close the defect.
Wounds of various origins

- Puncture wound (vulnus punctum)
- Incised wound (vulnus scissum)
- Cut wound (vulnus caesum)
- Contuse wound (vulnus contusum)
- Lacerated wound (vulnus lacerum)
- Gunshot wound (vulnus sclopetarium)
- Bite wound (vulnus morsum)
- Burn wound (chemical, fire)
- Radiation wound
Methods of uniting wound edges

The basic condition for wound healing to be accurate and free of tension suturing, not to create blind spots and ensure optimal blood flow to the wound.

- Surface adhesives (eg. Steri Strip)
- Tissue adhesives (eg. human fibrin adhesives)
- Clamps
- Sutures
Necessary for suturing

- Suture material
- Needle
- Needle holder
- (Tweezers)
- (Surgical scissors)
Selection of suture materials

The choice of suture materials should be based on the physical and biological characteristics of the suture material and the healing properties of the sutured tissue.

Factors influencing selection includes:

- Adequate tensile strength
- Should hold tissue together safely
- Should be no stronger than sutured tissue
- Secured knots to prevent loosening of suture material which can be affected by:
  - Type of suture material
  - Length of the cut end
- Should be easy to handle
- Minimal tissue reaction
- Condition of sutured tissue (dirty, contaminated or infected wound)
Characteristics of the ideal suture material

- Optimal characteristics of application (flexibility, slides well in tissues, easy to tie a knot, knot safety)
- Minimal tissue trauma
- High tear strength, should hold edges together until healing
- Minimal tissue reaction
- Complete resorption or removable
- Other important characteristics: thickness, elasticity, capillarity, structure, sterilization
Classification of suture materials

- Types of suture material according to origin:
  - natural
  - synthetic

- Types of suture material according to resorption:
  - non-absorbable suture materials
  - absorbable suture materials

- Types of suture material according to their structure/filament:
  - monofilament
  - multifilament
  - pseudomonofilament
Structure of suture materials

- **monofilament**: made of a single elementary fiber

- **multifilament**: made of a number of elementary filaments, twisted or braided

- **pseudomonofilament**: multifilament thread coated with some kind of material (e.g. serous membrane, silicone, ethylene-propylene, etc.)
Comparison of the monofilament and multifilament thread

<table>
<thead>
<tr>
<th></th>
<th>Monofilament thread</th>
<th>Multifilament thread</th>
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<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Smooth surface</td>
<td>Strong</td>
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<tr>
<td></td>
<td>Strong</td>
<td>Softness and flexibility</td>
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<td></td>
<td>Low friction</td>
<td>Ease of use</td>
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<td></td>
<td>Lower resistance</td>
<td>Knot safety</td>
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<td></td>
<td>Less tissue trauma</td>
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<td></td>
<td>No bacterial culture</td>
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<td></td>
<td>No capillarity</td>
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<td></td>
<td>No tumor cell transport</td>
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<tr>
<td><strong>Disadvantages</strong></td>
<td>Not very elastic</td>
<td>Rough surface</td>
</tr>
<tr>
<td></td>
<td>Difficult handling and knotting</td>
<td>Bacterial culture</td>
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<tr>
<td></td>
<td></td>
<td>Capillarity</td>
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<tr>
<td></td>
<td></td>
<td>Tumor cell transport</td>
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<tr>
<td></td>
<td></td>
<td>Elongation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tissue trauma</td>
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<tr>
<td></td>
<td></td>
<td>Tissue damage (kerf, sawing)</td>
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Comparison of natural and synthetic suture material

<table>
<thead>
<tr>
<th></th>
<th>Natural</th>
<th>Synthetic</th>
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<tbody>
<tr>
<td>Advantages</td>
<td>Easy to use</td>
<td>Economic</td>
</tr>
<tr>
<td></td>
<td>Easy to knot</td>
<td>Similar to the natural materials</td>
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<tr>
<td></td>
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<td>Absorption: hydrolisis</td>
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<td></td>
<td></td>
<td>Calcuable absorption</td>
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<tr>
<td></td>
<td></td>
<td>Strength</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Absorption: enzymatic</td>
<td>The monofilaments difficult to handle</td>
</tr>
<tr>
<td></td>
<td>Tissue reaction</td>
<td></td>
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<tr>
<td></td>
<td>Unpredictable absorption</td>
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</tbody>
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Comparison of non-absorbable and absorbable suture materials

<table>
<thead>
<tr>
<th></th>
<th>Absorbable</th>
<th>Non-absorbable</th>
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</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>It’s degraded in the human body</td>
<td>It keeps closure of the wound for unlimited time periode</td>
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<tr>
<td></td>
<td>Not perceived as foreign matter</td>
<td></td>
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<tr>
<td></td>
<td>No foreign body reaction</td>
<td></td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>Closure of the wound is for a limited time period</td>
<td>Foreign matter</td>
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<td></td>
<td></td>
<td>Foreign body reaction</td>
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<td>Rejection of the suture</td>
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Natural absorbable suture material

► catgut:

Animal intestine (cattle, sheep, goat, sometimes horse, donkey, mule, pig, but not cat!) purified, clean collagen fibres.

Used by al-Zahrawi in the 10th century, also for instrument strings, bow strings, suturing.

Resorption: proteolysis in 30-40 days, but reduced tensile strength after 7 days

► chromic catgut:

Reduced tensile strength only after 18-21 days.
Synthetic, absorbable materials

- Polyglycolic acid (eg. Dexon)
  - Keeps tensile strength (TS) for 1 week, after 3 weeks only 20%

- Polyglactin (eg. Vicryl)
  - TS: 14 days, 50-70 days degradation

- Polydioxane (PDS)
  - TS: 6 weeks, 90 days to 6 months degradation

- Polyglyconate (eg. Maxon)
  - After 4 weeks 50% TS

Resorption: mainly hydrolysis
Natural, non-absorbable materials

- Silk – naturally strong multifilament or pseudomonofilament
- Steel
- Linen
Synthetic, non-resorbable materials

- Polyamide (eg. Supramid) – 6-0, 7-0 monofilament, thickers are multifilament, pseudomonofilament

- Polyester (eg. Dacron) – easy to handle, to make knots, holds the knot well, inflammatory reactions may occur

- Polypropylene (eg. Prolene) – strong, slides well, minimal tissue reaction, expensive, more difficult to handle, stubby suture ends

- Teflon (Gore-Tex)
# Size of suture materials

<table>
<thead>
<tr>
<th>USP (United States Pharmacopeia)</th>
<th>Diameter (mm)</th>
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<tbody>
<tr>
<td>6</td>
<td>0.8</td>
</tr>
<tr>
<td>5</td>
<td>0.7</td>
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<tr>
<td>4</td>
<td>0.6</td>
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<tr>
<td>3</td>
<td>0.6</td>
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<tr>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>0</td>
<td>0.35</td>
</tr>
<tr>
<td>2-0</td>
<td>0.3</td>
</tr>
<tr>
<td>3-0</td>
<td>0.2</td>
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<tr>
<td>4-0</td>
<td>0.15</td>
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<tr>
<td>5-0</td>
<td>0.1</td>
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<tr>
<td>6-0</td>
<td>0.07</td>
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<tr>
<td>7-0</td>
<td>0.05</td>
</tr>
<tr>
<td>8-0</td>
<td>0.04</td>
</tr>
<tr>
<td>9-0</td>
<td>0.03</td>
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<tr>
<td>10-0</td>
<td>0.02</td>
</tr>
<tr>
<td>11-0</td>
<td>0.01</td>
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</tbody>
</table>
Neckles

The ideal needles:

- Should be elastic
- Should strain resistant
- Should not bend easily
- Should not break
Needle shapes

May have various shapes

- 3/8ths of a circle (B-needle)
- 1/2 of a circle (G-needle)
Cross section of the needle

- Round

- Triangular (cutting needle)
Traditional and atraumatic needles

- End of a traditional needle
- Atraumatic suture material
Suture material / needle
Needle holder

- Hegar-Mayo
- Mathieu
Special needle holders

- Palatinal needle holder
- Micro needle holder
- Needle holders without a lock
Principles of suturing

- Use suture needle of suitable shape and size
- Use suture material that is of suitable type and size for the tissue being sutured
- Good bite (2-3 mm from the free edge of the soft tissue)
- Sutures should NOT be placed under tension
- Knots should be tied 2-3 mm away from the incision line
- Suture material is cut 4-5 mm away from the knot
- Superficial sutures should be removed 5-7 days after (exception: sinus closure) surgery to prevent infection / foreign body reaction
Advantages of suturing (closure)

- Promotes healing
- Prevents complications
  - INFECTION
  - HAEMORRHAGE
  - TISSUE NECROSIS
- Preserve the normal contour and shape of tissues
Grasping the needle
HOW TO MAKE A KNOT?
Suture techniques 1.

Single interrupted suture
Suture techniques 2.

Figure 8 suture (Z-stitch, crossed matrass suture)
Suture techniques 3.

Horizontal matrass suture
Suture techniques 4.

Vertical matrass stitch (Donáti)
Suture techniques 5.

Continuous sutures
Suture techniques 5.

Continuous interlocking sutures
Thank you for attention!