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Wound treatment, vessel injuries, covering of skin defects, replantation, revascularisation

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www: traumatologia.deoec.hu
login: traumatology
keyword: lectures
Wound treatment
Type of skin injury:

- mechanical
- thermal
- chemical
- irradiation
The wound healing process:

- Acut inflammation phase
- Cellproliferation phase
- Epithelisation phase
- Development of extracellular matrix (fibroblasts produce collagens)
- Collagen remodellation
Patient examination:

- inspection
- palpation
- functional examination (Moberg test on hand)
- active and passive range of motion of the joints (Neutral-O-Methode)
- innervation
- blood supply (Allen test)
Examination of the hand, Moberg test
Type of mechanical skin injuries (in Latin):

- vulnus caesum (cut)
- vulnus scissum (section)
- vulnus punctum (puncture)
- vulnus contusum (contuse)
- vulnus morsum (animal bite)
- vulnus lacerum (destruction)
- vulnus sclopetarium (gunshot)
Wound treatment:

- Tetanus profilaxis
- Time factor:
  - in 6 hours, new, fresh, „clean” wound: **primary closure**: excision, debridement, haemostatis, drainage,
  - after 6 hours: **delayed wound treatment**, open wound treatment (anaerob bacteria)
Open wound treatment, delayed wound treatment:

- infected wound
- gunshot, explosion injury
- butcher’s wound
- sewage/canal worker’s wound
- puncture wound
- animal bite
- high pressure spray-gun injury
Proper skin incisions on the hand
Drainage
intracutan suture of skin angle
Covering skin defects on the hand

(Basics of plastic surgery)
Techniques for covering skin defects

- Primery skin closure
- Local flap
  - Free skin transplantation (Freehand graft)
- Distant flap
- Free microvascular flap
- Composite flap
Covering skin defects on the hand:

- **Split thickness skin graft** transplantation: Getting by Humby knife or electrodermatome (mesh graft). Not good for covering bone, vessel, nerve, tendon or tendon sheath.
Split thickness mesh graft skin transplantation
Covering skin defects on the hand:

- Full thickness skin graft: Krause flap (fingertip defect)
- Z skin plasty: (simple, multiple)

Simple Z skin plasty

Multiple Z skin plasty
Four-flap Z plasty
Classification of flaps by blood supply:

- **Random pattern flaps:**
  - length - width ratio 3 : 1
- **Axial pattern, pedicled flaps**
- **Free microvascular flaps:**
  (microsurgical anastomosis)
Classification of flaps by location:

- Local flaps
- Regional flaps
- Distant flaps
- Free microvascular flaps
<table>
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<tr>
<th>Types of Flaps on the Hand</th>
<th>Random</th>
<th>Axial</th>
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<tr>
<td>Local</td>
<td>Transposition</td>
<td>Axial flag</td>
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<td>SDMA</td>
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<td>Reversed dorsal metacarpal</td>
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<td>Rotation</td>
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<td>Advancement-rectangular</td>
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<td>Regional</td>
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<td>Thenar</td>
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<td>Neurovascular island</td>
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<td>Scapular</td>
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<td>Forearm</td>
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<td>Reversed PIA</td>
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<td>Latissimus</td>
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<td>Distant</td>
<td>Infraclavicular</td>
<td>Groin</td>
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<td>Cross-arm</td>
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FDMA, first dorsal metacarpal artery; SDMA, second dorsal metacarpal artery; PIA, posterior interosseous artery.
Local fasciocutan flaps:
5a és 5b: Advancement flap, 5c: V-Y plasty,
5d: Transposition flap, 5e: Rotation flap
5f: Combined rotation flap, 5g: Romboid (Limberg) flap,
5h: „Verschiebeschwenklappen” flap
V-Y plasty

Double V – Y plasty

„Bridge” plasty
Rotation flap
Rotation flap

„Bridge” flap
Cross finger flap
Axial flag flap
Fillet flap
Island flap
Dorsal intermetacarpal and dorsocomissural flaps
Pedicled abdominal flap
Tubed groin flap
„Bridge” abdominal flap
Free radial artery fasciocutaneous flap
TREATMENT OF LOWER EXTREMITY SOFT TISSUE DEFECTS
CAUSING LOWER EXTRIMITY SOFT TISSUE DEFECTS

- High energy trauma injuries, often complicated with open fractures
- Infections
- Tumor excisions
Indications

- Location of the defect
- Size
- Depth
- Infectious status
- Exposed bone
- Neighbouring scars
We prefer as far as possible local flaps and one stage pedicled island flaps to cover lower extremity soft tissue defects.

- More reliable
- Fasciocutaneous or muscular flaps
Free microsurgical flaps are used to cover extremely big soft tissue defects of the lower limb

- Latissimus dorsi
- Radial artery
Location of the defect: knee and proximal tibia

- Fasciocutaneous saphenous artery flap
- Gastrocnemius medial head
- Gastrocnemius lateral head
Location of the defect: middle and distal third of the leg

- Soleus flap
- Distally based hemisoleus flap
- Flexor flaps (flexor hallucis longus and flexor digitorum communis)
- Extensor flaps (tibialis anterior and extensor hallucis longus)
Location of the defect: distal part of the leg and heel

- Peroneus brevis flap
- Lateral supramalleolar flap
- Distally based sural artery neurocutaneous flap
Location of the defect: foot and heel

- **Dorsalis pedis flap**
- **Extensor digitorum brevis**
- **Medial plantar flap**
- **Medialis pedis flap**
- **Abductor hallucis flap**
Gastrocnemius
Lateral head

Gastrocnemius medial head

Hemisoleus

Soleus

Hemisoleus

Sural artery flap

Dorsalis pedis flap
Gastrocnemius medial head
Distally based sural artery neurocutaneous flap
Distally based sural artery fasciocutaneous flap
Pedicled dorsalis pedis flap
Radial artery free flap
Latissimus dorsi free flap
DISCUSSION 1.

- Most soft tissue losses at the level of lower extremity may be covered with a local cutaneous flap or a neighbouring muscular flap.
- One stage pedicled island flaps are more reliable than any other flaps.
DISCUSSION 2.

- Fasciocutaneous flaps are used to resurface mobile skin areas.

- Muscle flaps are used for coverage of exposed bone, the filling of cavities and the treatment of bone infection.

- Free flaps are used to cover extremely big soft tissue defects.
Vessel injuries
Wound treatment on the site:

Wound:
steril bandage

Bleeding:
Compresson bandage or pneumatic cuff
(max. 2 hours)
Anatomy

- Blood supply to the hand: radial and ulnar arteries

- The ulnar artery forms the **superficial palmar arterial arch** and the radial artery forms the **deep palmar arterial arch**.

- Variations

- The superficial palmar arterial arch is more important.
The superficial and deep palmar arterial arches

- Radial a.
- Median n.
- Ulnar a.
- Ulnar n.
- Pisiform bone
- Deep palmar branches of ulnar a. and n.
- Hook of hamate bone
- Superficial palmar branch of ulnar n.
- Communication between median and ulnar nn.

- Distal limit of superficial arterial arch
- Anterior carpal arterial arch and rete
- Superficial palmar branch of radial a.
- Deep palmar arterial arch
- Superficial palmar arterial arch
- 1st volar metacarpal a.
- Proper digital aa.
- and nn. of thumb
- Common volar digital aa. and nn.
- Volar metacarpal aa.
- Proper volar digital aa. and nn.
Types of vessel injuries

- Arterial and venous bleeding
- Open and closed vessel injuries
- Cutting and puncture arterial injuries (knife, glass)
- Crush - Destruction injuries
  (the adventitia is intact but the intima injured)
- Explosion (vessel defect !)
- Displaced fracture (i.e. closed supracondylar humeral fracture)
Symptoms, Diagnosis:

- Open vessel injury
  - arterial: pulsative, shoot out type bleeding,
  - venous: darker colour, slowly flowing bleeding
- Weak or no peripheral pulse
- No capillary refill
Diagnosis:

- Allen-test
- Angiography
- Doppler ultrasound
- Operative exploration
Allen test
Allen test
Treatment of bleeding:

- Compresson bandage or pneumatic cuff (max. 2 hours) + elevation of the extremity
- Never use vessel clamp on the site (only in operation room)

On the site, first responder
Types of vessel injury:

Macrovessel injury: proximal from wrist

Microvessel injury: distal from wrist
Treatment of vessel injury:

Operative techniques for macrovessel anastomosis:

- Preparation of vessel stumps, removal of adventicia, vessel clips, heparin
- Anastomosis: after sharp injury, with 5/0-8/0 atraumatically suture material, running suture
- Vena graft: after destructive injury or defect (vena saphena magna, cephalica, basilica)
Treatment of vessel injury:

Operative techniques for microvessel anastomosis:

- **Microvessel**: vessel with 2-0,3 mm lumen.

Magnification: Operation microscope or glasses

Microsurgical suture materials and instruments.

Preparation of vessel stumps, removal of adventicia, vessel clips, heparin. **Simple interrupted sutures with** (8/0-11/0) suture materials.
End-to-end arterial anastomosis (removal of the adventitia, stay stitches)
End-to-end arterial anastomosis
(back wall sutures)
End-to-end anastomosis
(front wall sutures)
End-to-end arterial anastomosis
(the completed anastomosis)
Interposition vein graft
Replantation, revascularisation
Replantation

Definition

Reconstruction of a totally or subtotally amputated extremity or part of extremity.
Replantation

Definition

- **Macoreplantation**: proximal from wrist
- **Microreplantation**: distal from wrist
Revascularisation

Definition

Reconstruction of main blood supply
(at subtotal amputation, some insufficient vessel flow may be present).
Transportation of the amputatum by Biemer.
Replantation

Indication

Time factor:
- Amputatum without muscle
  - without cooling: 8-12 hours
  - cooling at +4 grade Celsius: 24 hours
- Amputatum with muscle
  - without cooling: 4-5 hours
  - cooling at +4 grade Celsius: 8 hours

Revascularisation syndrome!
### Replantation

**Indication of replantation**

**Absolut indication:**
- Thumb amputation proximal from IP joint
- Amputation of more long fingers
- Hand amputation
- Amputation on child
Steps of digital replantation (microreplantation):

1. bone
2. flexor tendon
3. artery
4. nerve
5. extensor tendon
6. vein (at least two)

In case of macroreplantation: fasciotomy!
Replantation

Postoperative treatment

- **Elevation of the extremity**

- **Medication**: low molecular weight dextran, salicylic acid

- **Monitoring of colour, capillary refill and temperature of the extremity**

- In case of thrombosis: emergency operation
Thank you for your attention!