

# Preface

Surgery can no more be learned from text books than can cycling or swimming. Similarly, hardly any other discipline is both a teaching and learning profession with such a close teacher–pupil relationship. But rarely does the young surgeon of today have the opportunity to gain enough continuous practice under supervision to the point of reaching subcortical implementation. The restrictions of working-time reduction, rare opportunities to practice techniques on laboratory animals, and the early division of surgery into subspecialties have completely changed the face of mandatory training guidelines for basic surgical operations. As a result, the young surgeon rarely gets to see many an operation, and those operations in which he has managed to gather a greater amount of personal experience are few and far between. Even surgical simulators, which are becoming increasingly available and provide excellent training opportunities, especially in the field of laparoscopic surgery, cannot convey the entire spectrum of basic surgical operations. In some specific fields they do allow manual skills and tactile coordination to be practiced, but cannot provide broad surgical expertise together with the understanding and mastering of standard operative techniques. Alongside video films, surgical atlases are therefore the most important sources of information for the young surgeon when it comes to practicing all the stages of certain operations.

The concept of this surgical atlas is directed toward presenting the most common 16 general and 150 special operations of everyday surgical practice to surgeons in training, to students as well as to qualified surgeons. In this respect, it is neither my intention with this single-volume atlas to vie with the more detailed, multi-volume surgical atlases nor to undermine the essential principle of specializa-

tion. Its content is general surgery—not that which remains after separation of the specialist disciplines, but rather that which a general surgeon from the respective specialist disciplines must learn in order to stand his ground as a surgeon.

We are glad that this concept has proven itself to the extent that an English edition is now available. The aim of this surgical atlas is to serve trainee surgeons as a reference book, to allow them to learn new things, and to arouse their curiosity to learn more. But even qualified surgeons may use the opportunity to recall a technique they have already learned and to compare standards. For easy memorization and mental preparation of the respective operations, all the operative stages are structured and schematized so that the continuity of the operation is divided into labeled and reproducible single steps. Just as racing drivers mentally prepare themselves before the race by imagining each individual leg of the race course, the surgeon should, before any operation, recall before his or her mind's eye each operative stage step by step so as to proceed only along familiar lines at the operating table.

We are grateful to the staff of Thieme Publishers for their support during the preparation of this English edition. But above all we should also like to thank Mr. Grahame Larkin for his excellent work in translating this atlas into English. We are looking forward to an equally favorable English-speaking readership of this *Atlas of General Surgery*.

*Volker Schumpelick*

# 16 Arterial Puncture and Arterial Catheterization

## Arterial Puncture

### 1 Indications

- ▶ Blood gas analysis
- ▶ Insertion of catheters for angiography, heart catheterization, dialysis, measurement of blood pressure
- ▶ Intra-arterial injection of medications

### 2 Approach

Puncture of the radial or femoral artery

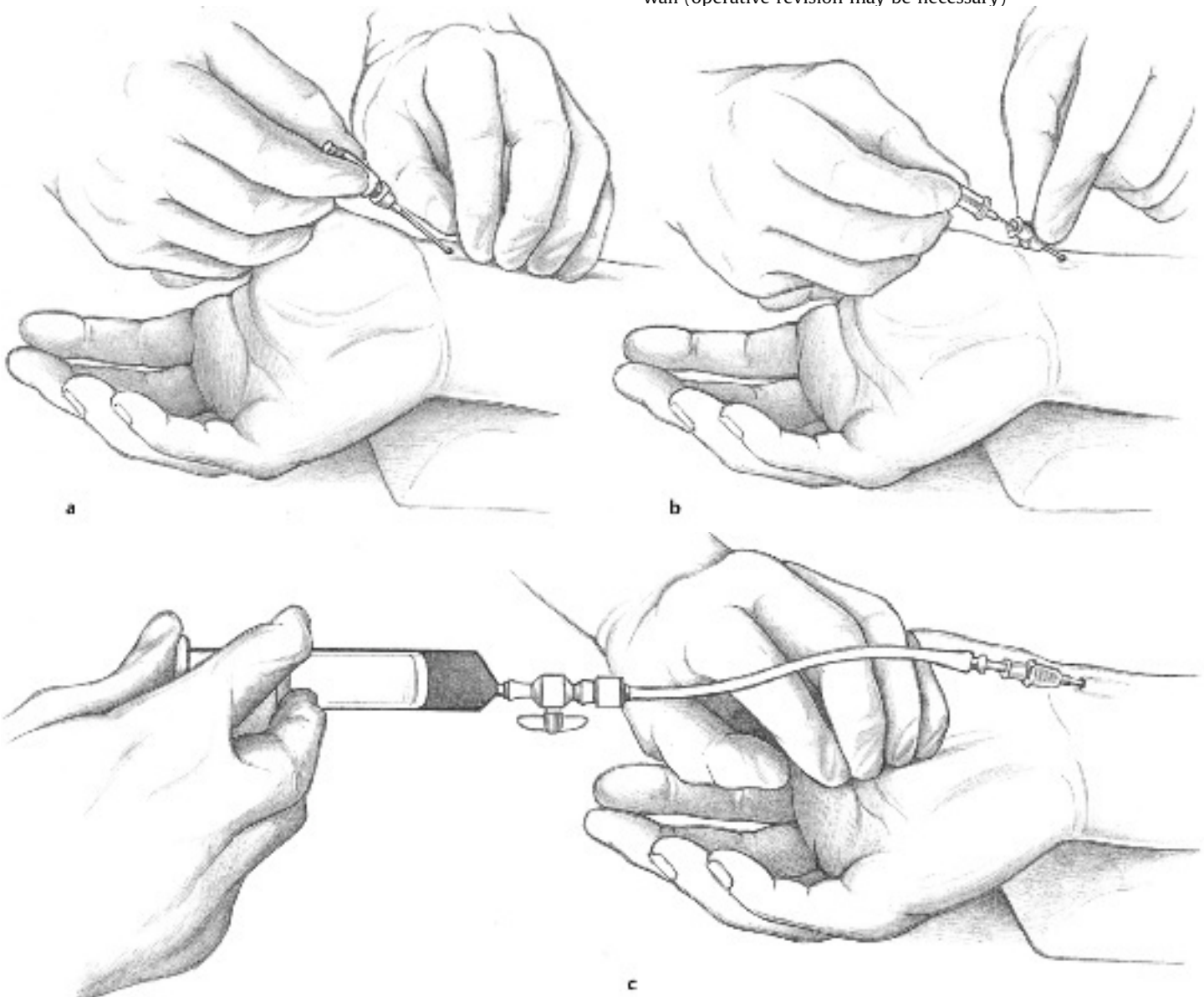
### 3 Technique

Coagulation studies, ensure correct anatomical location

The puncture cannula is inserted under sterile conditions, aiming at a point below the fingertips palpating the artery. A pulsating flow of bright red blood is encountered on correct placement of the cannula. Manual compression of the puncture site is maintained for 5 to 10 minutes after removing the cannula; consider using a sandbag or pressure dressing.

### 4 Complications

Inguinal hematoma, false aneurysm, arteriovenous fistula, retroperitoneal hematoma secondary to unrecognized injury of the posterior wall (operative revision may be necessary)



Cannulation of the radial artery. (a) Puncture of the artery, (b) advancement of the plastic cannula and subsequent removal of the steel needle, and (c) connection of a short extension with a three-way tap.

# Arterial Catheterization

## 1 Indications

Invasive measurement of blood pressure in high-risk patients under intensive care, blood gas analysis, long-term drug instillation

## 2 Approach

Radial, femoral, brachial, and dorsal pedal arteries

## 3 Technique

Under sterile conditions with the patient supine, the artery is palpated and a thin cannula is inserted at a 45 degree angle. Continue to proceed as with the Seldinger technique (see Chapter 8, Venous Access). Assess circulation of the extremity.

Radial artery catheterization is contraindicated without conducting an Allen test beforehand. The Allen test provides information re-

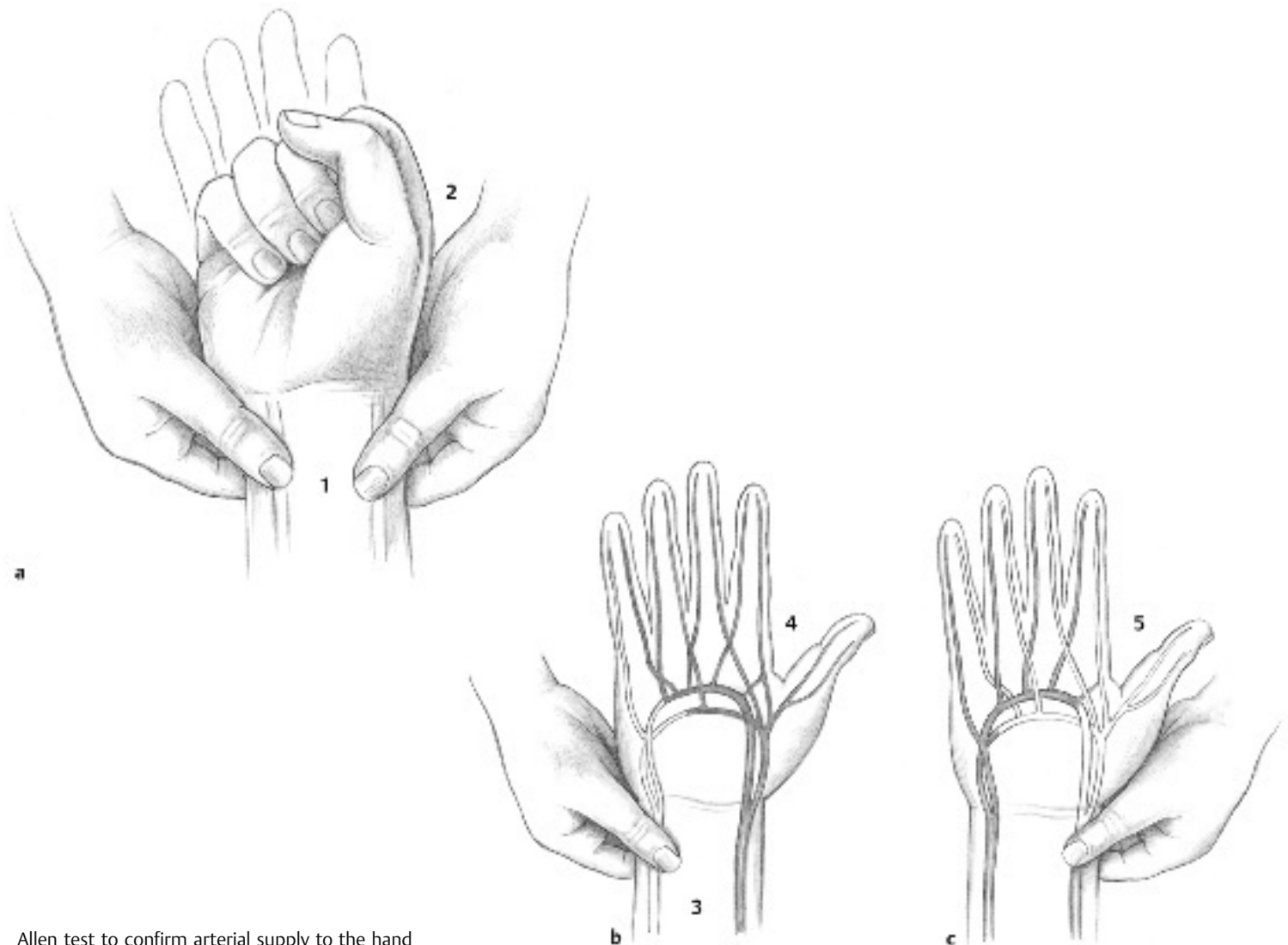
garding the patency of the superficial palmar arch by alternately compressing the ulnar and radial arteries. Radial artery catheterization is contraindicated if, on complete compression and occlusion of the radial artery, there is inadequate perfusion of the fingers and loss of pulsation from the ulnar artery. The technique of radial artery catheterization corresponds to that of vascular cannulation using the Seldinger technique (see p. 23).

## 4 Complications

See Chapter 10, Venous Cutdown.

Risk of gangrene in the presence of arteriosclerotic vessels, which could result in amputation

*Mark the arterial catheter clearly "Do not use for the administration of medications".*



Allen test to confirm arterial supply to the hand

# 34 Subtotal Thyroidectomy

## 1 Indications

**Elective:** Nodular goiter with circumscribed and diffuse changes to the thyroid gland, especially where there is suspected malignancy or hyperfunction that is not controllable by medication

**Contraindications:** Confirmed (e.g., by frozen section) malignancy

**Alternative Procedures:** Enucleation, (hemi-)thyroidectomy, radioiodine therapy

## 2 Preoperative Preparation

**Preoperative Investigations:** Thyroid function parameters and antibodies, scintigraphy, ultrasound (consider puncture cytology), rarely computed tomography; exclusion of a multiple endocrine neoplasia

**Patient Preparation:** Euthyroid state is required: administration of thyrostatic agents,  $\beta$ -blockers, iodine for overactive thyroids

## 3 Specific Risks, Patient Information, and Consent

- Recurrent goiter (5%, especially in the presence of hyperthyroidism)
- Vascular injury
- Nerve injury, especially the recurrent laryngeal nerve (0.5% at the primary operation) with subsequent hoarseness, tracheostoma after bilateral injury (0.1%)
- Calcium insufficiency secondary to hypoparathyroidism (< 2%)
- Extension of the operation/aftercare for malignancy
- Possible need for sternotomy

## 4 Anesthesia

General anesthesia (intubation)

## 5 Positioning

Supine, reclined head, pillow between the shoulder blades, upper body slightly elevated

## 6 Approach

Kocher collar incision, just reaching the sternocleidomastoid laterally, possible need for (partial) sternotomy for intrathoracic goiter

## 7 Operative Steps

- 1 Positioning
- 2 Draping
- 3 Skin incision and division of the platysma
- 4 Division of the superficial neck veins
- 5 Mobilization of wound margins
- 6 Division of the strap muscles
- 7 Identification of the superior pole vessels
- 8 Division of the superior pole vessels
- 9 Ligation of the superior pole vessels
- 10 Ligation of the inferior thyroid artery
- 11 Division of the inferior pole vessels
- 12 Division of the thyroid isthmus
- 13 Separation from the anterior tracheal aspect
- 14 Incision of the thyroid capsule
- 15 Capsule suture
- 16 Wound closure

## 8 Relevant Anatomy, Serious Risks, Tricks

- The superior thyroid artery emerges from the external carotid and leads to the superior pole; the inferior thyroid artery from the thyrocervical trunk courses more from lateral than caudal to the thyroid, showing close proximity to the recurrent laryngeal nerve and the inferior thyroid.
- The recurrent laryngeal nerve runs in the groove between the trachea and the esophagus. Delicate and careful identification of the nerve is the best protection against injury.
- In cases of potential malignancy, begin initially as a hemithyroidectomy on the affected side to avoid any necessary revision.

## 9 Measures for Specific Complications

- Sternotomy is only rarely necessary, even for retrosternal and so-called intrathoracic goiters.
- If an unexpected anaplastic carcinoma is encountered intraoperatively, which has diffusely invaded the surrounding structures, a formal resection should not be forced. Only a possible resection of the isthmus to decompress the trachea and, of course, histological confirmation is important.

## 10 Postoperative Care

**Medical Aftercare:** Remove suction drain on day 2. Begin hormone substitution therapy only after confirmation of benign histology and depending on the underlying disease.

**Dietary Progression:** Immediately

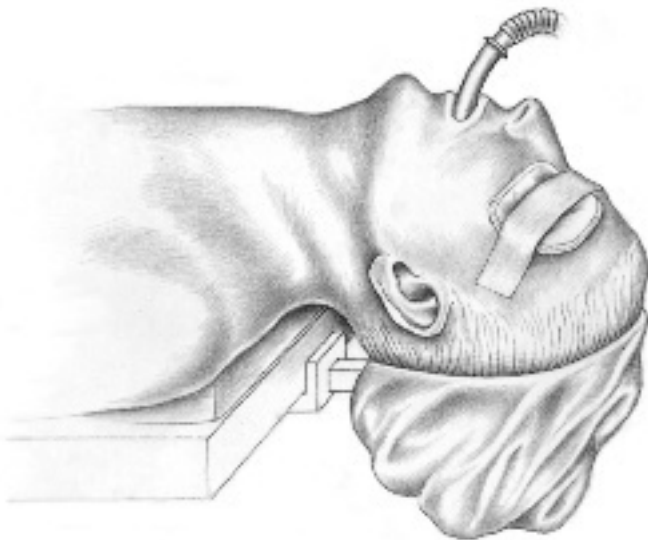
**Mobilization:** Immediately

**Physiotherapy:** Speech therapy for paralysis of the recurrent nerve

**Time Off Work:** 1 to 2 weeks

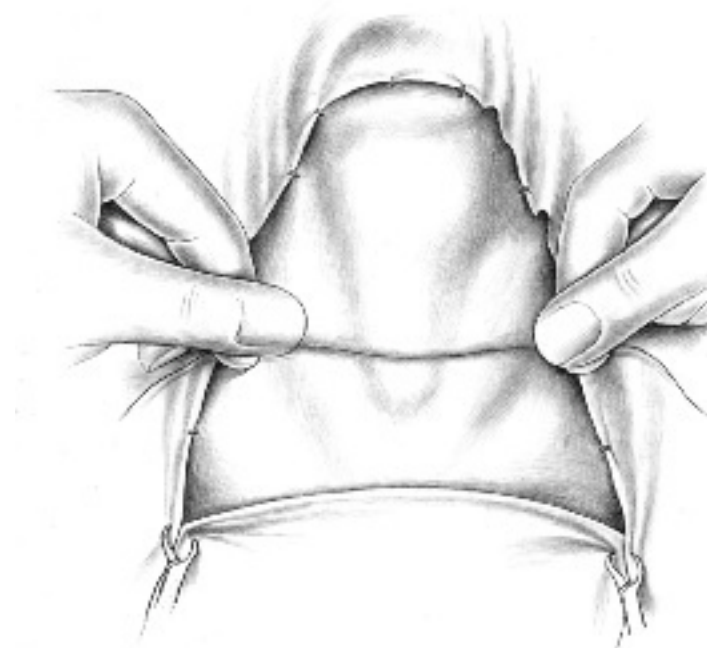
## Operative Technique

- 1 Positioning
- 2 Draping
- 3 Skin incision and division of the platysma
- 4 Division of the superficial neck veins
- 5 Mobilization of the wound margins
- 6 Division of the strap muscles
- 7 Identification of the superior pole vessels
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- 14 Incision of the thyroid capsule
- 15 Capsule suture
- 16 Wound closure



### 1 Positioning

Positioning is with the head maximally reclined in a headrest. A pillow is placed beneath the shoulder blades. The head is completely draped and the breathing tube has an extension attached. The eyes can be protected with gauze swabs against accidental pressure damage.

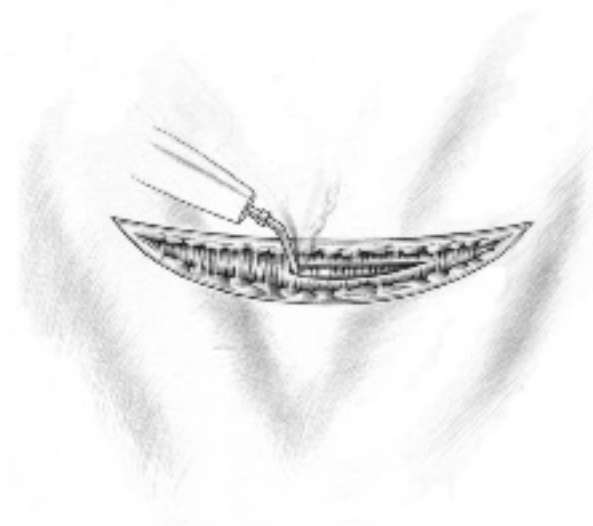


### 2 Draping

The operating field is draped to expose the lower jaw cranially, the suprasternal notch caudally, and the sternocleidomastoids laterally on either side. For marking, it is recommended to take a size 2-0 thread and press it symmetrically against the neck 2 to 3 cm above the suprasternal notch. The resulting imprint can then be taken as the incision line. A symmetrical scar is imperative for cosmetic reasons. Natural skin crease lines serve as a guide.



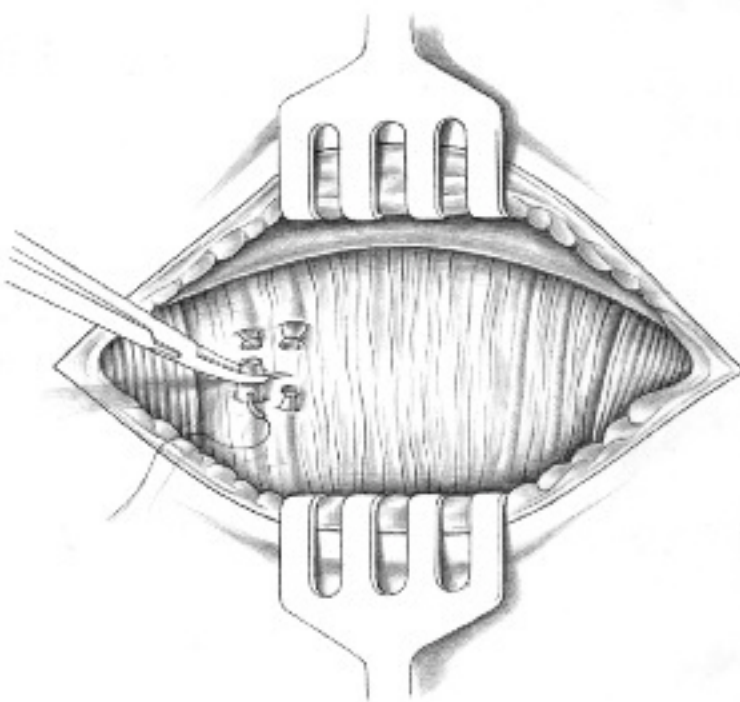
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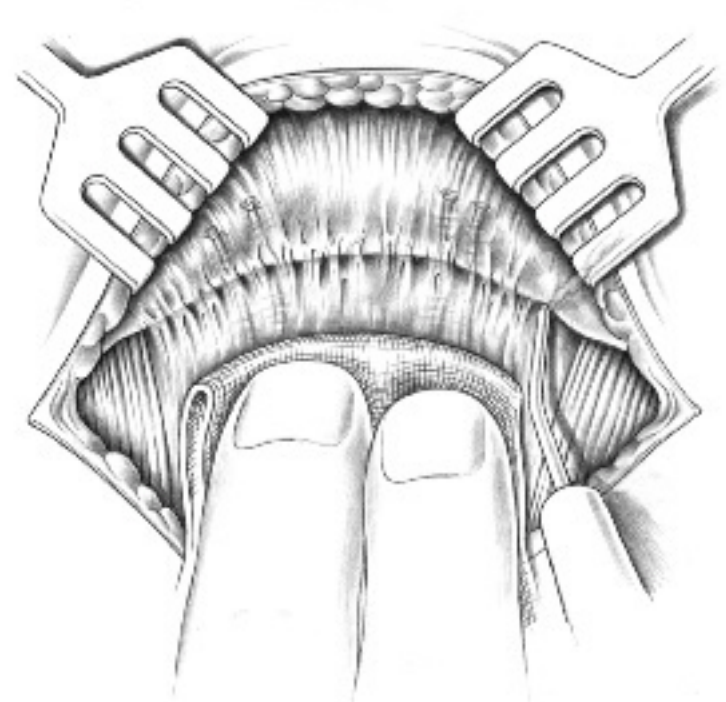
### 3 Skin incision and division of the platysma

The skin incision is the Kocher collar incision between the muscle bellies of the sternocleidomastoid on either side. After division of the skin, the platysma is divided with the diathermy. Small vessels are coagulated individually.



### 4 Division of the superficial neck veins

Both skin and platysma flaps are mobilized cranially and caudally. The superficial veins of the neck are divided between clamps and suture ligated (3–0 PGA) because simple ligatures often slip off during the operation.



### 5 Mobilization of the wound margins

Mobilization of the cranial and caudal skin and platysma flaps is performed dorsal to the divided veins, holding the flaps continuously under traction ventrally with sharp hooks until the larynx is just exposed cranially and the suprasternal notch caudally. Laterally, the medial border of the sternocleidomastoid should be displayed on either side. This preparation is done in a layer that is practically free of vessels.

# 69 Cholecystectomy

## 1 Indication

**Elective:** Symptomatic cholelithiasis

**Alternative Procedures:** Laparoscopic procedure

## 2 Preoperative Preparation

**Preoperative Investigations:** Ultrasound, gastroscopy, consider intravenous cholangiography, contrast study of the stomach (exclusion of ulcers and hiatal hernia)

**Patient Preparation:** Nasogastric tube for acute cholecystitis or choledocholithiasis, perioperative antibiotic therapy for cholecystitis, choledocholithiasis, or patients over 70 years of age

## 3 Specific Risks, Patient Information, and Consent

- Bile leak, biliary fistula (0.5%)
- Peritonitis (0.1%)
- Missed stone (1%)
- Injury to the bile duct (0.3%)
- Injury to liver, duodenum or colon (0.1%)
- Vascular injury (portal vein, hepatic artery; 0.1%)
- Abscess (0.2%)

## 4 Anesthesia

General anesthesia (intubation)

## 5 Positioning

Supine (consider X-ray table)

## 6 Approach

Right subcostal incision, right upper transverse abdominal incision

## 7 Operative Steps

- ① Skin incision
- ② Dissection of the Calot triangle
- ③ Exposure of the cystic duct
- ④ Division of the cystic duct
- ⑤ Division of the cystic artery
- ⑥ Retrograde dissection of the gallbladder
- ⑦ Hemostasis of the gallbladder bed
- ⑧ Drainage of the gallbladder bed
- ⑨ Antegrade („fundus first“) dissection of the gallbladder

## 8 Relevant Anatomy, Serious Risks, Tricks

- The course of the cystic duct is very variable.

*Caution: Watch out for confusion with the common hepatic duct or the right hepatic duct, confusion of the cystic artery with the right hepatic artery*

- Small bile ducts may drain directly into the gallbladder and will possibly require suture ligation.

## 9 Measures for Specific Complications

- Postoperative secretion of bile via the drain: usually a small accessory duct in the gallbladder bed. Leave the drain and manage expectantly; consider draining the bile ducts via a nasobiliary tube or endoscopic placement of a removable stent.
- Perform ERC for all unclear postoperative problems.

## 10 Postoperative Care

**Medical Aftercare:** Remove the nasogastric tube on day 1, remove the drain on day 2 or 3.

**Dietary Progression:** Give oral fluids from day 1, then advance quickly.

**Mobilization:** Immediately

**Physiotherapy:** Consider breathing exercises.

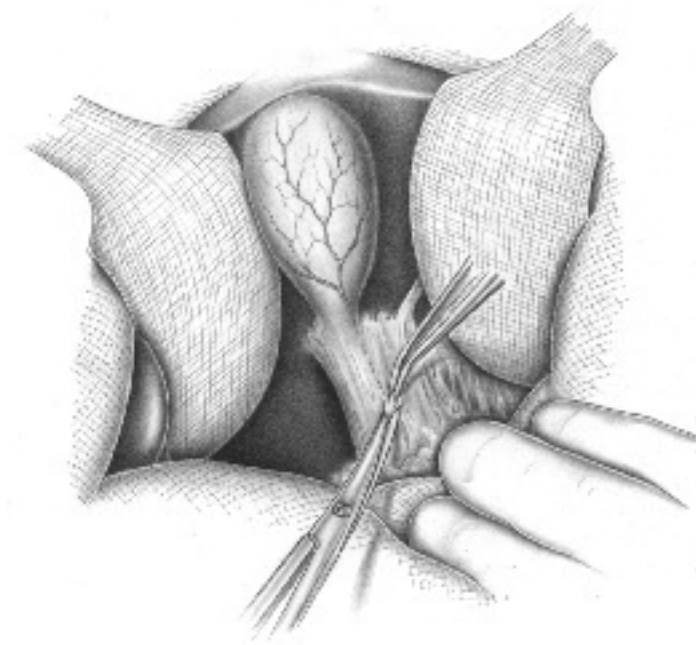
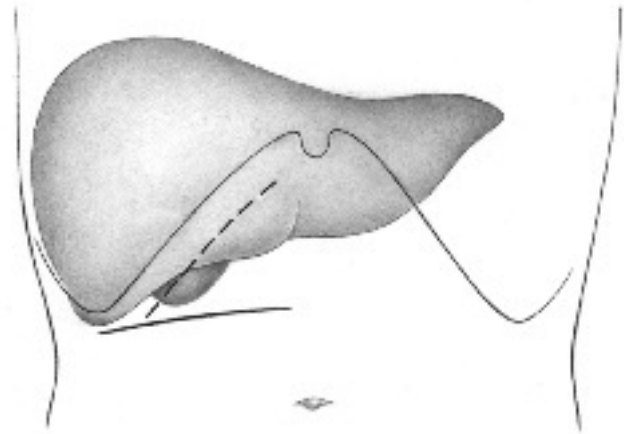
**Time Off Work:** 1 week

## Operative Technique

- 1 Skin incision
- 2 Dissection of the Calot triangle
- 3 Exposure of the cystic duct
- 4 Division of the cystic duct
- 5 Division of the cystic artery
- 6 Retrograde dissection of the gallbladder
- 7 Hemostasis of the gallbladder bed
- 8 Drainage of the gallbladder bed
- 9 Antegrade ("fundus first") dissection of the gallbladder

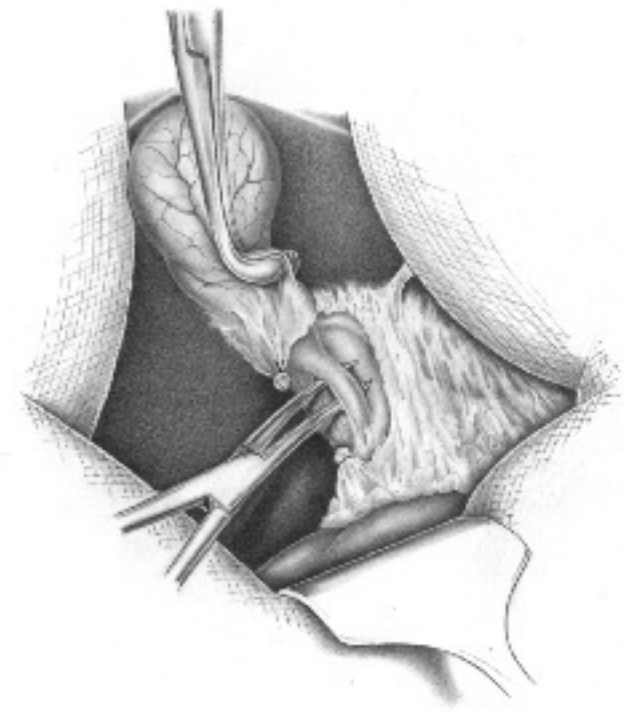
### 1 Skin incision

Today, conventional cholecystectomy is the exception. Nevertheless, certain circumstances still require conventional open cholecystectomy (approx. 10%), even in the era of laparoscopy. The right upper transverse abdominal incision has best proven itself. The right subcostal incision is the traditional approach, but produces less favorable results cosmetically.



### 2 Dissection of the Calot triangle

After opening the abdominal cavity and insertion of two liver retractors, dissection begins below the gallbladder at the Calot triangle. The common bile duct and the cystic duct are dissected toward the gallbladder. For this purpose, the overlying superficial peritoneal reflection is incised, allowing the structures to be clearly displayed.



### 3 Exposure of the cystic duct

After the peritoneal reflection is opened, it is recommended to grasp the gallbladder with sponge-holding forceps and draw it ventrally. This puts the cystic duct on stretch. Small accompanying veins (commonly ventral to the cystic duct) are divided between ligatures. The cystic duct is only definitely identified when the common bile duct has been clearly defined above the confluence with the cystic duct. This includes the definite identification of the difference in caliber, its continuation in a cranial direction, and the clearly visible confluence with the cystic duct. Only then may an Overholt clamp be passed beneath the cystic duct.



# 87 Segmental Resection of the Small Intestine

## 1 Indications

**Elective:** Circumscribed pathological lesion (tumor, Crohn disease, mesenteric infarction, and the like)

**Alternative Procedures:** Bypass surgery if unresectable (palliative operation)

## 2 Preoperative Preparation

**Preoperative Investigations:** Ultrasound, computed tomography, contrast imaging (Sellink method; if obstruction is suspected then upper gastrointestinal tract X-ray using water-soluble contrast).

**Patient Preparation:** Nasogastric tube

## 3 Specific Risks, Patient Information, and Consent

- ▶ Anastomotic failure (rare, e.g., with Crohn disease and after radiation therapy)
- ▶ Anastomotic stenosis (rare occurrence with end-to-end technique)
- ▶ Vascular injury
- ▶ Short-bowel syndrome after loss of > 50% of small intestine

## 4 Anesthesia

General anesthesia (intubation)

## 5 Positioning

Supine

## 6 Approach

Usually midline laparotomy

## 7 Operative Steps

- 1 Principle of small-intestine resection
- 2 Skeletonization of the mesentery of the small intestine I
- 3 Skeletonization of the mesentery of the small intestine II
- 4 Resection of the segment of the small intestine
- 5 Posterior wall anastomosis
- 6 Anterior wall anastomosis
- 7 Confirmation of lumen width
- 8 Closure of the mesenteric defect

## 8 Relevant Anatomy, Serious Risks, Tricks

- ▶ Determine the resection margins using transillumination while giving due consideration to the vascular arcades.

*Caution: Watch out for injury to the superior mesenteric artery and vein when skeletonizing the mesentery of the small intestine*

- ▶ Always create an end-to-end anastomosis and only use a side-to-side anastomosis for construction of a palliative bypass.
- ▶ With lumen discrepancy secondary to a longer-standing obstruction, cut the smaller lumen obliquely toward its anti-mesenteric border.
- ▶ The serosa in the area of the mesenteric attachment must be freed for a short distance of fat and vessels in preparation for the anastomosis: circumferential serosa-to-serosa approximation.
- ▶ Exert a controlled pull on the threads when knotting, do not overtighten.
- ▶ Use a standardized approach. Corner → posterior wall → corner → anterior wall, always begin at the mesenteric or antimesenteric border.
- ▶ After completing the anastomosis, carefully inspect the entire circumference for gaps between the stitches.
- ▶ If the viability of the intestinal segment is in question (intestinal ischemia), either resect and bring the ends out as stomas or create an anastomosis and plan a second-look procedure after 24 hours.

*Caution: Watch out for primary anastomosis in the presence of peritonitis*

- ▶ Consider intraoperative endoscopy when looking for sources of bleeding in the small intestine.

## 9 Measures for Specific Complications

- ▶ Intraoperative ischemia of the anastomosed segment of small bowel (e.g., due to injury to the vessels within the mesentery): take down the anastomosis, resect back to healthy tissue, and construct a new anastomosis.
- ▶ Anastomotic breakdown, but well drained and without peritonitis: manage expectantly, perform immediate revision at the first clinical and laboratory signs of inflammation.

## 10 Postoperative Care

**Medical Aftercare:** Depends on the overall situation. Remove the nasogastric tube on day 1 to 3.

**Dietary Progression:** Allow drinking from day 4 and a solid diet once bowel sounds have returned.

**Bowel Function:** Consider administering a small-volume enema.

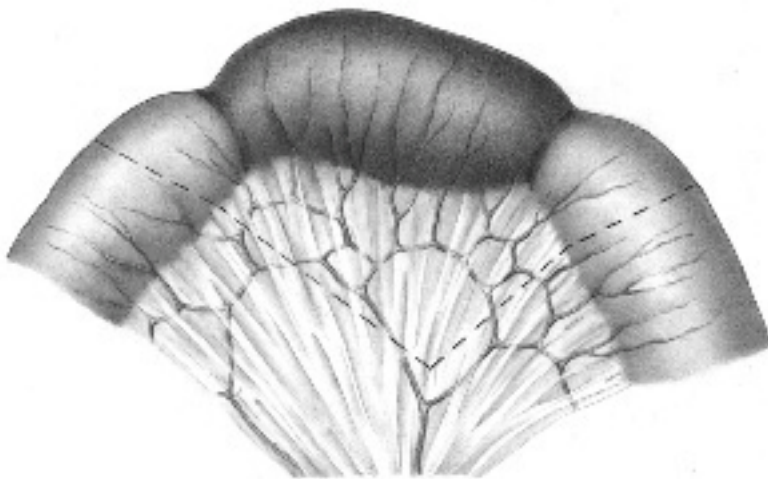
**Mobilization:** Immediately

**Physiotherapy:** Breathing exercises

**Time Off Work:** 1 to 2 weeks

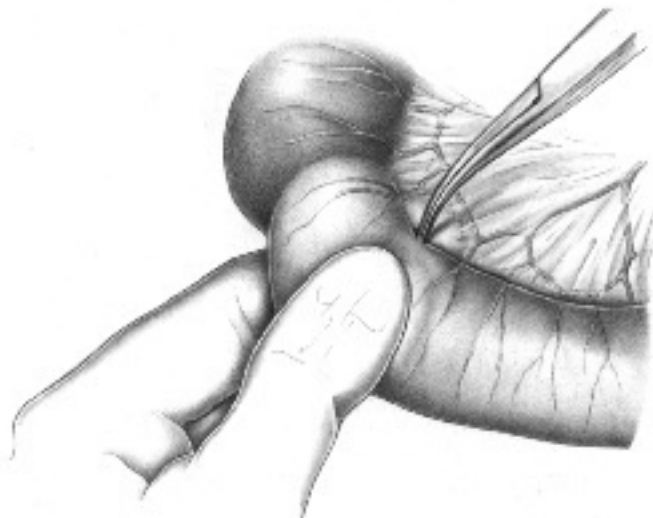
## Operative Technique

- 1 Principle of small-intestine resection
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- 8 Closure of the mesenteric defect



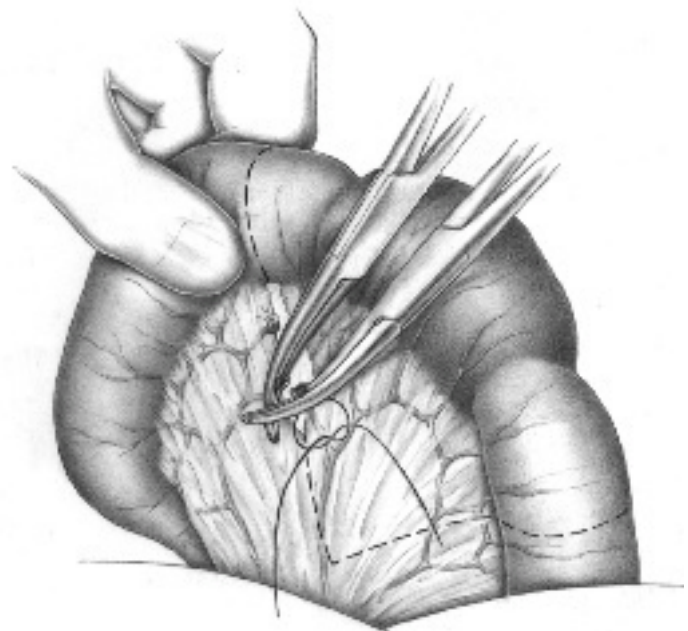
### 1 Principle of small-intestine resection

Regardless of the type of small bowel disease in question (inflammation, tumor, defect, ischemia, or necrosis), the approach to segmental resection of the small intestine is always the same. The principle involves resection of the affected bowel segment, while being as conservative as possible with the resection margins. These should lie macroscopically in healthy tissue and be guided by the vascular supply of the mesenteric pedicle. The distal and proximal resection margins must have an adequate blood supply to guarantee safe healing of the anastomosis. Marking the resection margins is best accomplished by using transillumination to identify the vascular arcades.



### 2 Skeletonization of the mesentery of the small intestine I

Skeletonization of the vascular arcades within the mesentery begins close to the bowel. A thickened and inflamed mesentery may make the boundary between mesentery and bowel difficult to recognize; it is best identified by palpation between the index finger and thumb.



### 3 Skeletonization of the mesentery of the small intestine II

The mesenteric vessels are divided between Overholt clamps and the vessel stumps ligated. A very friable or fat-laden mesentery will require suture ligatures (3-0 PGA). Smaller vessels are grasped with mosquito clamps.

# 156 Pelvic External Fixation

## 1 Indications

Emergency management of unstable pelvic fractures, alternatively a pelvic clamp or internal fixation during laparotomy (e.g., symphysis), depending on the type of fracture

## 2 Preoperative Preparation

**Preoperative Investigations:** Pelvic view, if possible computed tomography

**Patient Preparation:** Positioning should allow for the image intensifier; supine position; bladder catheter.

## 3 Specific Risks, Patient Information, and Consent

- Neurovascular injury
- Definitive treatment by internal fixation

## 4 Anesthesia

General anesthesia (intubation)

## 5 Positioning

Supine, image intensifier

## 6 Approach

Skin incision 2 cm distal and medial to the anterosuperior iliac spine

## 7 Operative Steps

- ① Positioning
- ② Marking the femoral vessels
- ③ Skin incision
- ④ Palpation of the anterosuperior iliac spine
- ⑤ Insertion of the drill sheath and determining the direction of drilling under image-intensifier control
- ⑥ Drilling to a depth of ~4 to 5 cm
- ⑦ Insertion of the Schanz screws via the outer drill sheath
- ⑧ Reduction
- ⑨ Definitive application of the fixator

## 8 Relevant Anatomy, Serious Risks, Tricks

- The direction of drilling is inclined ~20 degrees in a cranial direction and 30 degrees in a medial direction, with the patient supine.
- Do not insert the screws in the region of the anterosuperior iliac spine to avoid injury to the lateral femoral cutaneous nerve.

## 9 Measures for Specific Complications

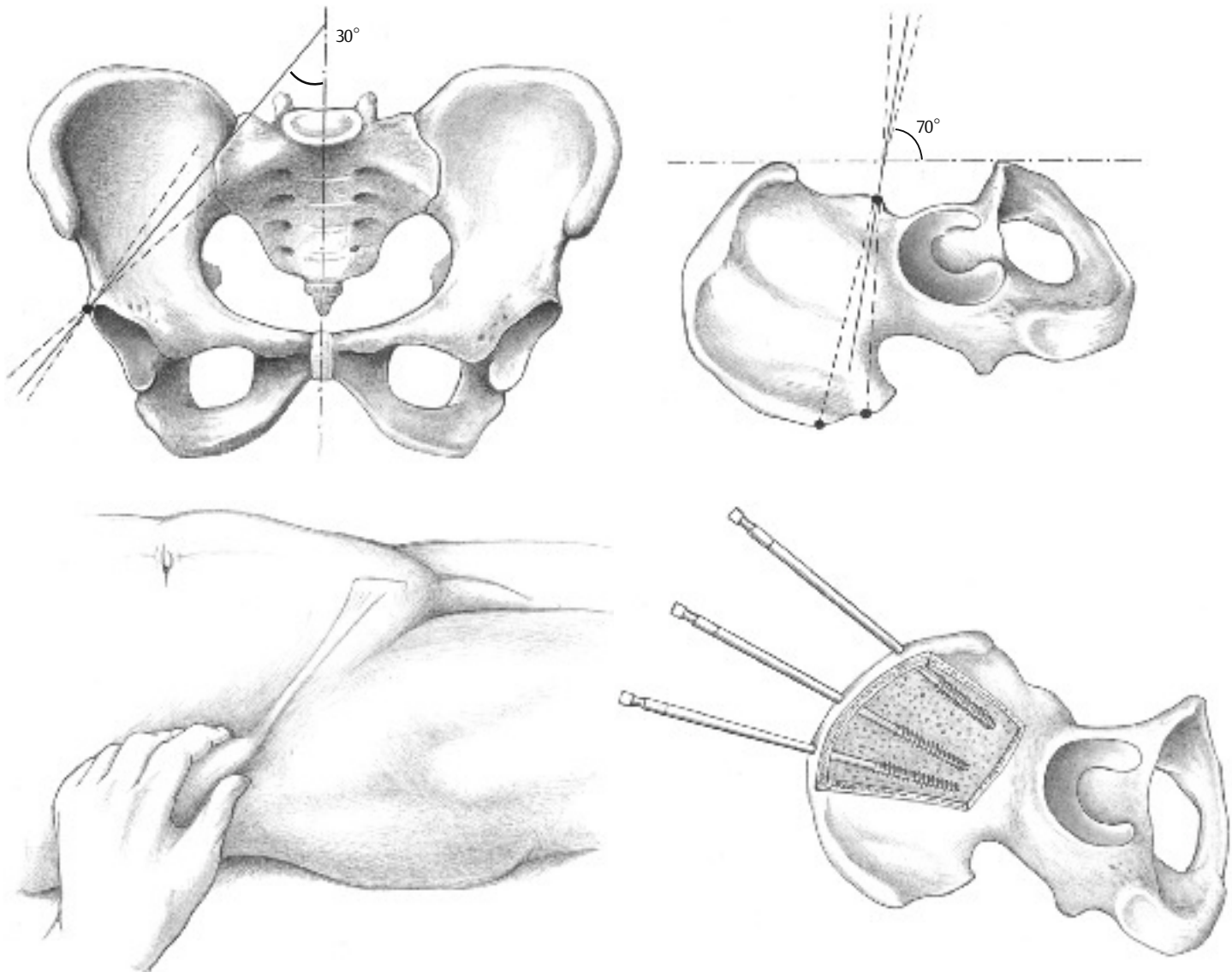
No particular measures required

## 10 Postoperative Care

Definitive treatment when the patient is stable, depending on the type of injury

## Operative Technique

- 1 Placement of the Schanz screws
- 2 Application of the external fixator on the pelvic girdle



### 1 Placement of the Schanz screws

Orientation for the drill or the Schanz screws to achieve supra-acetabular fixation. With the patient lying supine, the direction of drilling is inclined ~20 degrees cranially and ~30 degrees medially. After inserting the

screws, the fracture is reduced by traction and rotation of the leg and using the Schanz screws as joysticks. Reduction is secured by the connecting rods.

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