List of figures

Note that many of these illustrations are multi-part.

Section I Access to vital structures

Fig. 1.1: Landmarks for three of the four incisions used to gain access to the chest.

Fig. 1.2: An anterior sternocleidomastoid (SCM) incision crosses all three 'zones of injury' of the neck.

Fig. 1.3: Extending the midline laparotomy incision as a right thoracotomy.

Fig. 1.4: Medial visceral rotation from the LEFT (the 'Mattox manoeuvre').

Fig. 1.5: Medial visceral rotation from the RIGHT (the Cattell–Braasch manoeuvre).

Fig. 1.6: DJ flexure mobilisation to the right. Exposure of the infrarenal aorta.

Fig. 1.7: DJ flexure mobilisation to the right. Exposure of the renal vascular pedicles.

Fig. 1.8: Access to the main retroperitoneal arteries – a composite diagram of the four approaches described in the text.

Fig. 1.9: The two transversely lying veins in the 'middle layer'.

Fig. 1.10: The relationship of the splenic and left renal veins (lying in the 'middle layer') to the pancreas (the 'superficial layer') and the aorta and inferior vena cava (in the 'deep layer').

Fig. 1.11: Cross-section of Fig. 1.10. Notice how the origin of the SMA lies on the left renal vein.

Fig. 1.12: Three approaches to the duodenum and pancreas.

Fig. 1.13: The anterior aspect of the right upper limb showing the incisions used for arterial access.

Fig. 1.14: The relationship of the right brachial artery (shown in red) and the main nerves in the flexor compartment of the arm, viewed from the front.

Fig. 1.15: The relationship of the ulnar artery to the flexor muscles of the forearm (right upper limb viewed from the front and in cross-section).

Fig. 1.16: The incisions used for arterial access in the thigh.

Fig. 1.17: The posterior approach to the popliteal artery at the knee joint.

Fig. 1.18: The incisions used for arterial access in the leg.

Fig. 1.19: Three landmarks for the course of the femoral artery in the front of the thigh.

Fig. 1.20: The 'X' guarding the medial approach to the distal popliteal artery in a supine casualty with medial aspect of right leg, viewed from the left.

Fig. 1.21: The incision bisects the 'gothic arch' in the right leg, viewed from the front.

Fig. 1.22: The course of the neurovascular bundle in the anterior compartment of the right leg, viewed from the front.

Fig. 1.23: View from the left of a skin incision over the medial aspect of the right leg.

Fig. 1.24: The relationship of the posterior tibial and peroneal arteries to the deep muscles in the RIGHT CALF, viewed from behind.

Fig. 1.25: Three 'danger areas' to be avoided in the head: the frontal air sinuses; the superior sagittal sinus; and he posterior fossa (covered by neck muscles).

Fig. 1.26: Turning a scalp and bone flap.

Section II Initial actions

Fig. 2.1: Facial injury: massive tissue disruption; and the associated CT scan. A definitive airway in the form of an endotracheal tube has been established.

Fig. 2.2: Use of a cricoid hook.

Fig. 2.3: Lower facial swelling from penetrating injury showing a tracheostomy in situ (placed early).

Fig. 2.4: Closing a main bronchus.

Fig. 2.5: The incision through the intercostal muscles.

Fig. 2.6: A method of abdominal retraction.

Fig. 2.7: So-called 'component separation'.

Fig. 2.8: The use of two Foley catheters to provide 'balloon' tamponade.

Fig. 2.9: Starting a vein patch.

Fig. 2.10: The path of the needle[].

Fig. 2.11: Suturing (e.g. a cephalic vein patch on a brachial artery defect).

Fig. 2.12: Direct anastomosis of a large-calibre artery: placement of the stay sutures; continuous suture from one stay to the other; and rotation of the artery and completion of the anastomosis.

Fig. 2.13: Organising interrupted sutures.

Fig. 2.14: Exposing the great saphenous vein: landmarks for a proximal thigh incision.

Fig. 2.15: Overcoming artery-vein mismatch using a combination of bevelling and spatulating.

Fig. 2.16: A parachute anastomosis.

Fig. 2.17: The key to an effective fasciotomy is an extensive incision.

Fig. 2.18: Exsanguination from a lung injury. The opened pericardium reveals an empty collapsed heart.

Fig. 2.19: Closing an ATRIAL defect with a vascular clamp using an 'over-and-over' suture and a 'sewing-machine' suture.

Fig. 2.20a: Closing a VENTRICULAR defect.

Fig. 2.20b: Closing a ventricular defect close to a coronary artery.

Fig. 2.21: Gaining access to bleeding from a deep penetrating lung wound with a tractotomy.

Fig. 2.22: Pathways to control bleeding from the lung.

Fig. 2.24: The pathways to controlling bleeding from the liver and retrohepatic IVC.

Fig. 2.25: Mobilising the spleen: transverse section through the splenic hilum; and division of the splenic vascular pedicle.

Fig. 2.26: A seromuscular mucosal-inverting suture.

Fig. 2.27: The Mathieson technique, starting with the anterior half or the posterior half.

Fig. 2.28: Using two stay sutures, placing a few interrupted seromuscular sutures at one end.

Fig. 2.29: A two-layer anastomosis. A running all-coats layer is invaginated with a second (interrupted) seromuscular layer.

Fig. 2.30: The first step [of]. Bowel 'mobile'.

Fig. 2.32: Actions for managing penetrating oesophageal injury.

Fig. 2.33: Formation of a cervical loop oesophagostomy.

Fig. 2.34: Strategies for re-establishing bowel continuity in penetrating duodenal injuries.

Fig. 2.35: A segment of damaged small bowel, and the four steps of a small bowel resection.

Fig. 2.36: A double-barrelled colostomy.

Fig. 2.37: Treatment options for a penetrating large-bowel injury.

Fig. 2.38: Ureteric anastomosis.

Fig. 2.39: A 'through-and-through' gunshot wound to the left thigh.

Fig. 2.40: Wounds to both legs caused by an improvised explosive device (IED), with bilateral fibular fractures.

Fig. 2.41: The essential components of the initial operative management of a penetrating limb wound.

Fig. 2.42: Incision of the (presumed entry) wound.

Fig. 2.43: Wound excision. Removing 2-cm square pieces of tissue and loose pieces of bone.

Fig. 2.44: Incision of (presumed exit) wound, revealing underlying bulging bruised muscle.

Fig. 2.45: Developing the 'track' between the entry and exit wounds.

Fig. 2.46: Wound irrigation.

Fig. 2.47: Wound excision and dressing of bilateral leg wounds from an IED.

Fig. 2.48: Dressing a wound with a first layer of fluffy gauze and a second/outer layer of crepe bandages.

Fig. 2.49: Options for holding the bone.

Fig. 2.50: Blast from a grenade in a child, showing unsalvageable damage to the hand, wrist and distal forearm and early-stage per-operative period ((after proximal section of bone).

Fig. 2.51: The 'handbreadth' rule.

Fig. 2.52: Above-knee amputation of the right thigh.

Fig. 2.53: The 'rule of thirds' for below-knee amputation.

Fig. 2.54: Below-knee amputation of the left leg.

Fig. 2.55: Circumzygomatic wiring to fix mid-face fractures.

Fig. 2.56: Intermaxillary fixation with interdental eyelet wiring.

Fig. 2.57: Intermaxillary fixation using arch bars.

Fig. 2.58: A wound of the frontal scalp and skull after wound excision, and using a rotational scalp flap to obtain primary closure.

Fig. 2.59: Limited excision and primary closure of a head wound.

Fig. 2.60: A penetrating frontal wound of the head, with CT scan showing a localised haemorrhagic track containing bone and metal fragments.

Fig. 2.61: Spontaneous extrusion of clot from an underlying track in the brain, thirty seconds after extending the dural entry wound with a cruciate incision.

Fig. 2.62: A cranioplasty procedure in the same case 8 weeks later.

Section III Decision making

Fig. 3.1: Decision-making based on manually measured systolic blood pressure in casualties with penetrating wounds and ongoing resuscitation attempts.

Fig. 3.2: Initial incisions for gaining rapid access to exsanguinating penetrating wounds of the thoracic cavity.

Fig. 3.3: Penetrating wounds between the right midclavicular line (MCL) and left anterior axillary line (AAL).

Fig. 3.4: Pathway for the release of tamponade and repair of the underlying cardiac injury.

Fig. 3.5: Repair of the right ventricle using a Satinsky clamp to control bleeding from a defect in the right ventricle (accessed via a sternotomy).

Fig. 3.6: A summary of the initial incisions for managing exsanguinating penetrating wounds of the abdominal cavity.

Fig. 3.7: An isolated penetrating wound below the right nipple with blood in the chest drain and abdominal distension; and a similar entry wound with an exit wound in the left upper chest with blood in the left chest drain and associated abdominal distension.

Fig. 3.8: The pathways for obtaining access for proximal control in exsanguinating wounds in zone 1 of the neck.

Fig. 3.9: Management of exsanguinating wounds of the lower limbs.

Fig. 3.10: Exsanguination from extensive bilateral buttock wounds caused by an IED.

Fig. 3.11: Summary of the initial incisions for management of penetrating wounds of zone 1 of the neck and the torso, resulting in ongoing major haemorrhage. A non-operative option for the management of ongoing major haemorrhage from penetrating wounds of the thoracic cavity is also shown.

Fig. 3.12: A penetrating wound of the abdomen. After closure of the laparotomy incision, the entry and exit wounds were excised. The long track was irrigated, and a drain was placed to allow subsequent wound irrigation.

Fig. 3.13: Bilateral limb wounds caused by an improvised explosive device (IED) containing gravel.

Fig. 3.14: Traumatic right mid-thigh amputation caused by an improvised explosive device (IED).

Section IV Closing the wound

Fig. 4.1: The pathway to delayed closure of a laparotomy wound.

Fig. 4.2: The pathway to delayed primary closure of a wound

Fig. 4.3: The pathway to granulation tissue formation.

Fig. 4.4: Application of a meshed split-skin graft.

Fig. 4.5: Application of a full-thickness graft.

Fig. 4.6: Landmarks for the correct insertion of tibial pins.

Fig. 4.7: A Braun frame.

Fig. 4.8a: Shaft and distal femoral fractures – a pathway to union.

Fig. 4.8b: Hip region fractures – a pathway to function.

Fig. 4.9: Safe pin insertion sites in the femur.

Fig. 4.10: Safe pin insertion sites for a knee-bridging external fixation construct.

Fig. 4.11: Initial wound excision and external fixation of a distal femoral fracture.

Fig. 4.12: A tibial plateau fracture secondary to a gunshot wound. Three pins in the femoral shaft and three in the tibial shaft create a rigid construct that bridges the knee.

Fig. 4.13: A gunshot wound through the distal tibia and fibula showing external fixation bridging the ankle joint, flexed to 90°, with two pins in the tibial shaft, one in the calcaneum, and one in the shaft of the first metatarsal.

Fig. 4.14: Calcaneal traction for tibial fractures.

Fig. 4.15: Application of a 'U' slab.

Fig. 4.16: Safe sites for pin insertion in the upper limb.

Fig. 4.17: Two views of a severely comminuted distal humeral fracture secondary to a gunshot wound. At the initial wound excision (5 days previously), the bone was held with an above-elbow POP slab. At the next operation the proximal wound was closed (by DPC) and the distal wound was left open, with a view to later split-skin grafting.

Fig. 4.18: A two-layer flexor tendon repair. The 'vertical' dotted lines lie superficial to the 'horizontal' ones.

Fig. 4.19: Extensor tendon repair.

Fig. 4.20: Pathway to fulfilling the pre-conditions for the use of a flap.

Fig. 4.21: A medial gastrocnemius flap showing the site of division of the tendon.

Fig. 4.22: Components of a fasciocutaneous flap.

Fig. 4.23: The relationship of the leg perforators to the medial malleolus.

Fig. 4.24: The first four steps in planning and executing a medial distally based fasciocutaneous flap to cover a wound over the anterior aspect of the middle-third of the left leg.

Fig. 4.25: Mobilising the flap.

Fig. 4.26: 'Sliding' soleus.

Fig. 4.27: Covering lower-third defects of the anterior aspect of the RIGHT leg with a flap created from the LEFT leg.

Fig. 4.28: The steps involved in covering a heel defect with a sural flap.

Fig. 4.29a: A latissimus dorsi flap with a skin paddle.

Fig. 4.29b: Exposing the boundaries of the muscle.

Fig. 4.30a: The appearance of the wound 7 days after injury, following two previous operations.

Fig. 4.30b: The steps for covering the remaining defect.

Fig 4.31: The steps involved in mobilising a groin flap to cover a defect.

Fig. 4.32: Wounds with a long bone fracture but NO significant vascular injury – pathways to wound healing and mobilisation.

Fig. 4.33: Wounds with a long-bone fracture AND WITH significant vascular injury, showing pathways to wound healing and mobilisation.

Section V Appendix

Fig. 5.1: An effective method for securing a chest drain.

Fig. 5.2: A method for inserting and securing a tube into the jejunum.

Fig. 5.3: The natural history of an untreated burn.

Fig. 5.4: The burden of regular changes of dressing under general anaesthetic.

Fig. 5.5: An aide memoire for holding upper-limb fractures.

Fig. 5.6: An aide memoire for holding lower-limb fractures.

Fig. 5.7: A B-Lynch suture for the management of postpartum haemorrhage.

Fig. 5.8: Pathways to controlling postpartum haemorrhage (PPH) after vaginal delivery or caesarean section.