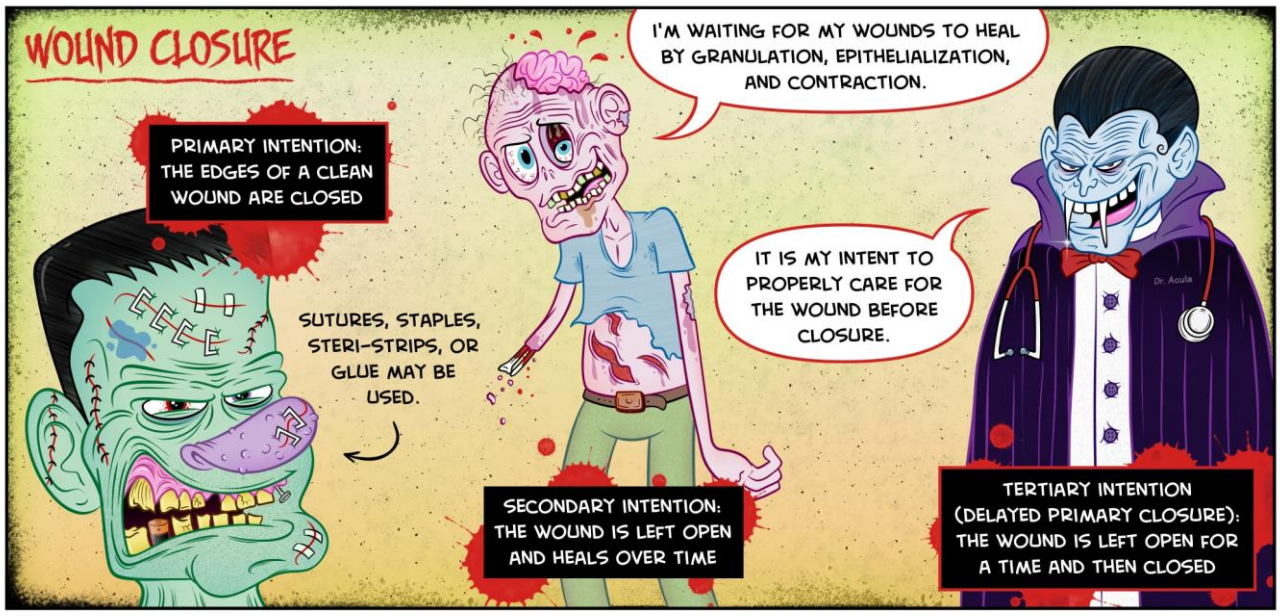
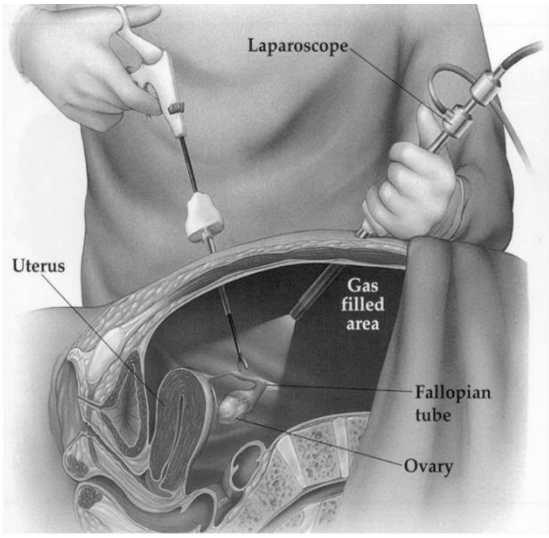


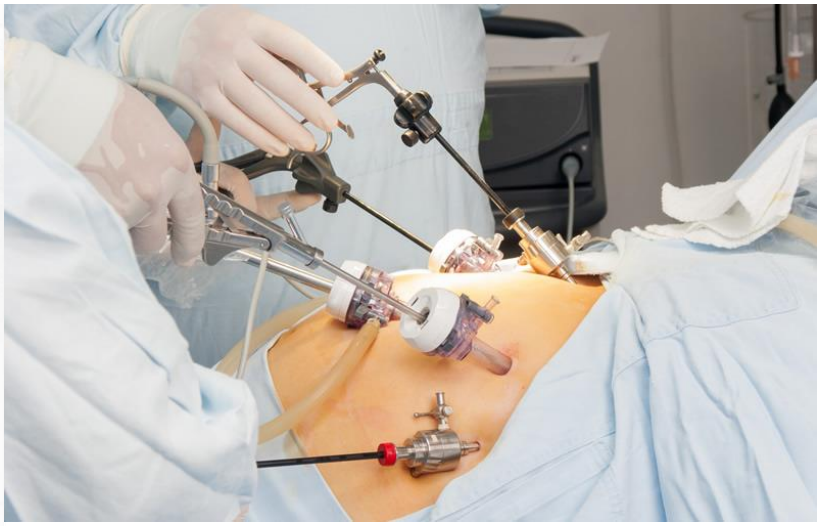
Gases For Laparoscopic Surgery

Laparoscopic surgery may be performed in a number of body cavities. In some areas irrigation solutions are preferred. In the abdomen insufflation with carbon dioxide gas is commonly used. The amount of gas delivered is adjusted to maintain a constant intra-abdominal pressure of between 12 and 15 mmHg. Excessive intra-abdominal pressure may reduce venous return and lead to hypotension. Too little insufflation will risk obscuring the surgical view.

Pneumoperitoneum - Therapeutic

During a laparoscopic procedure a surgeon will need to create a pneumoperitoneum. This can be achieved by use of a Veress needle (risk of visceral injury). An alternative is the open "Hassan" style technique. Once access to the abdominal cavity is secured carbon dioxide gas is insufflated to induce a working space. Higher intra-abdominal pressures may compromise venous return and reduce cardiac output. If the blood pressure is seen to drop in this way then release of air, will often improve matters. Should this not be the case then a laparotomy may be necessary to exclude a more significant internal injury.





Sterilisation

Surgical equipment has to be cleaned and sterilised prior to use. The extent to which these processes will be required varies according to the type of equipment and the purpose for which it will be used. In general, the three processes are relevant; cleaning, disinfection and sterilisation.

- Cleaning refers to removal of physical debris.
- Disinfection refers to reduction in numbers of viable organisms.
- Sterilisation is removal of all organisms and spores.

Methods

Method	Details	Indication
Autoclaving	Air removed and high pressure steam used (*usually 134°c for 3min*)	Most reusable surgical equipment, must be physically cleaned prior to autoclaving, unsuitable for fragile items
Glutaraldehyde solution (2%)	Colourless oily liquid, directly cytocidal and virucidal even at low temperatures	Specifically used for endoscopes and some laparoscopic items, staff can rapidly develop allergy to this substance which has limited its more widespread use
Ethylene oxide	3% mixture of gas with carbon dioxide used	Used for packaged materials that cannot be heated, the gas is explosive and environmentally toxic, it is used mainly in the industrial setting
Gamma irradiation	Gamma rays emitted from radioactive substance such as cobalt 60 or caesium 137	Suitable for batch treatment of relatively thermostable items, typically an industrial process

Suture Material

Agent	Classification	Durability	Uses	Special points
Silk	Braided Biological	Theoretically permanent although strength not preserved	Anchoring devices, skin closure	Knots easily, poor cosmesis
Catgut	Braided Biological	5-7 days	Short term wound approximation	Poor cosmesis Degrades rapidly Not available in UK
Chromic catgut	Braided Biological	Up to 12 weeks	Apposition of deeply sited tissues	Unpredictable degradation pattern Not in use in UK
Polydioxanone (PDS)	Synthetic Monofilament	Up to 3 months (longer with thicker sutures)	Widespread surgical applications including **visceral anastomoses**, dermal closure, **mass closure of abdominal wall***	Used in most surgical specialties (avoid dyed form in dermal closure)
Polyglycolic acid (Vicryl, Dexon)	Braided Synthetic	Up to 6 weeks	Most tissues can be apposed using polyglycolic acid	It has good handling properties, the dyed form of this suture should not be used for skin closure
Polypropylene (Prolene)	Synthetic Monofilament	Permanent	Widely used, agent of choice for vascular anastomoses	Poor handling properties
Polyester (Ethibond)	Synthetic Braided	Permanent	Its combination of permanency and braiding makes it useful for laparoscopic surgery	It is more expensive and has considerable tissue drag

**PDS or polydioxanone is the ideal suture material. Non absorbable sutures have higher incidence of incisional herniae.*
NB: Stainless steel clips for skin following thyroidectomy.
NB: For closure of sternum following CABG, a stainless steel wire is typically used.

Absorbable vs Non absorbable

- Time taken to degrade absorbable materials varies
- Usually by macrophages hydrolysing material
- Consider absorbable sutures in situations where long term tissue apposition is not required. In cardiac and vascular surgery non-absorbable sutures are usually used.

Suture size

- The higher the index number the smaller the suture i.e.: 6/0 Prolene is finer than 2/0 Prolene.
- Finer sutures have less tensile strength. For example, 6/0 Prolene would not be a suture suitable for abdominal mass closure but would be ideal for small Prolene distal arterial anastomoses.

Braided vs monofilament

Generally speaking braided sutures have better handling characteristics than non-braided. However, they are associated with higher bacterial counts. Braided materials are unsuitable for use in vascular surgery as they are potentially thrombogenic.

Suture Sizes

USP Suture size and corresponding suture diameter

USP Size	Diameter in mm
11-0	0.01
10-0	0.02
6-0	0.07
3-0	0.2
0	0.35
1	0.4

Tissue Reconstruction

Skin Grafts and Flaps

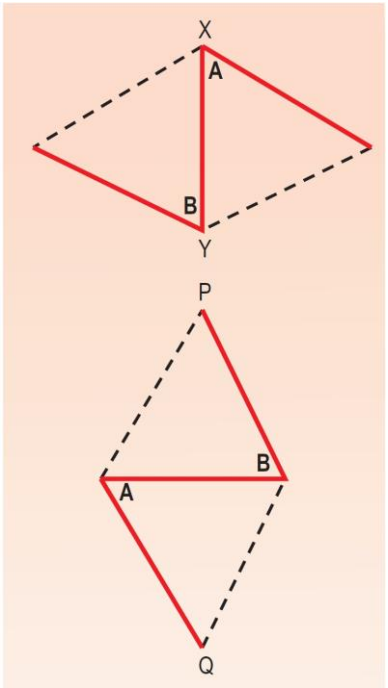
Skin flaps or grafts may be required where primary wound closure cannot be achieved or would entail either significant cosmetic defect or considerable functional disturbance as a result of wound contraction.

Reconstructive ladder

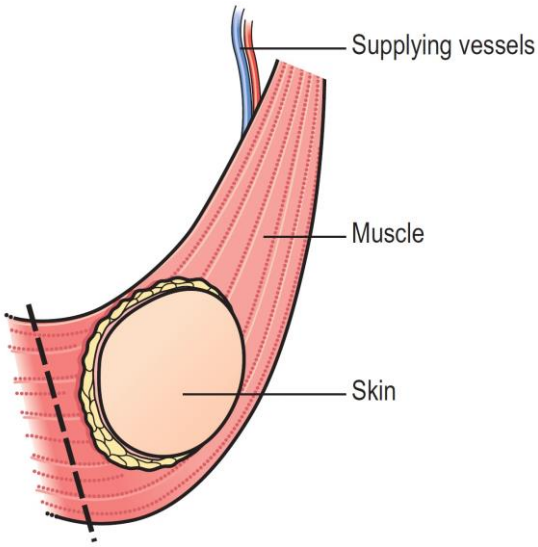
Method	Types
Direct closure	The simplest option where possible
Grafting techniques	• Split thickness • Full thickness • Skin Substitute • Composite
Flap technique	*Local:* • Transposition • Pivot • Alphabetplasty (e.g. Z-Y) *Regional:* • Myocutaneous • Fasciocutaneous • Neurocutaneous *Distant:* • Free tissue transfer
Prelamination techniques	Allows creation of specialised flaps e.g. buccal mucosa
Tissue expansion	Involves placement of tissue expanders to increase amount of tissue at donor sites

Flaps

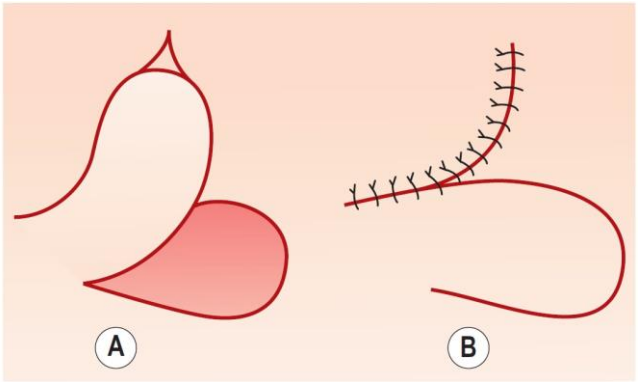
- Flaps have their own blood supply and may be pedicled or free.
- May have multiple components
  e.g. skin, skin + fat, skin + fat + muscle.
- They will have the ability to take regardless of the underlying tissue bed.
- The type of intrinsic blood supply is important. For example, in breast surgery pedicled latissimus dorsi flaps will be less prone to failure than microvascular anastomosed free DIEP (deep inferior epigastric perforators) flaps.



Z-plasty. To extend the length of the line XY in the upper diagram, raise the triangular flaps marked A and B as far as the dotted lines. Transpose them and suture them in place as in the lower drawing so that the length PQ is longer than XY, at the cost of width.



Myocutaneous flap. The muscle has been transected along the broken line. The overlying area of skin, which derives its blood supply from the muscle, can be moved together with the muscle belly, hinging on its supplying blood vessels.



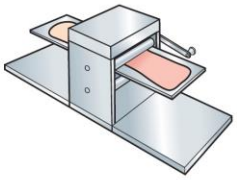
Transposition flap. (A) The excised area is shaded and the flap is raised. (B) The flap has been transposed into the defect and the gap left has been closed as a linear suture line.

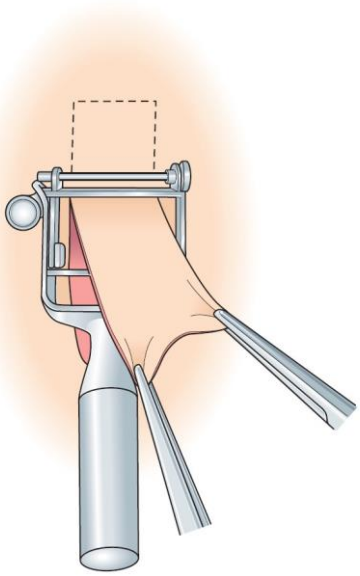
Split thickness skin grafts

- Available in range of thicknesses.
- Thigh is the commonest donor site
- Size may be increased by meshing the graft. However, this comes with compromise on cosmesis.
- Donor sites, especially if thin grafts are taken can be reused following re-epithelialisation

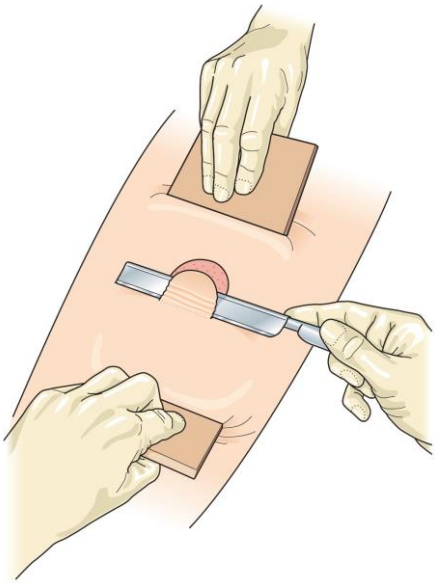
Full thickness grafts

- Most commonly used for facial reconstruction
- Include dermal appendages
- Provide superior cosmetic result

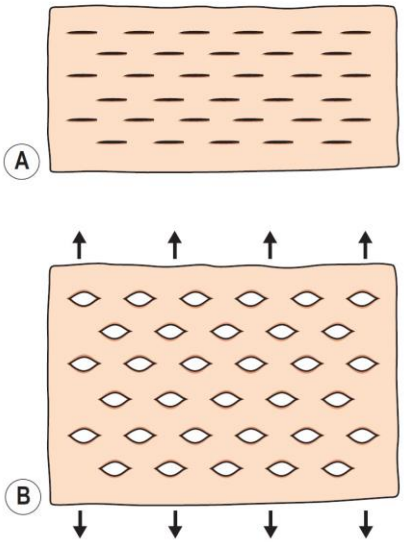




Grafts can be cut using powered dermatomes driven by electrical or compressed air motors.
They reliably cut even grafts



Cutting a split-skin graft. Hold a lubricated flat board in your left hand and slowly draw it ahead of the knife held in the right hand, to flatten and stretch the skin as you cut the graft with a back and forth movement. Your assistant holds a dry, fixed board above the start of the cut to flatten, stretch and fix the skin. The assistant's other hand may lift up the soft tissues from below to expose a larger area on the upper surface.



The skin graft can be passed through a mesher, which produces small cuts. You can mesh it using a scalpel. (A) Make a series of cuts in the split-skin graft. (B) The graft can be stretched to increase its area.

Composite grafts

- These are grafts containing more than one tissue type, such as skin and fat. They are usually used to cover small defects in cosmetically important areas.

Skin Grafts Vs. Flaps

Skin Grafts	Flaps
No size limit (Split)/ Relative size limit (full thickness)	Size limited by territory of blood supply
Rely on wound bed for blood supply	Tissue has its own blood supply
Take better on clean well vascularised wound beds	Will survive independent of the wound bed
Split skin graft donor site typically heals in 12 days	Direct closure of donor site or secondary skin graft
Donor site may be reused	Donor site cannot be reused

Methods of Wound Closure

Method of closure	Indication
Primary closure	• Clean wound, usually surgically created or following minor trauma • Standard suturing methods will usually suffice • Wound heals by primary intention
Delayed primary closure	• Similar methods of actual closure to primary closure • May be used in situations where primary closure is either not achievable or not advisable e.g. infection
Vacuum assisted closure	• Uses negative pressure therapy to facilitate wound closure • Sponge is inserted into wound cavity and then negative pressure applied • Advantages include removal of exudate and versatility • Disadvantages include cost and risk of fistulation if used incorrectly on sites such as bowel
Split thickness skin grafts	• Superficial dermis removed with Watson knife or dermatome (commonly from thigh) • Remaining epithelium regenerates from dermal appendages • Coverage may be increased by meshing
Full thickness skin grafts	• Whole dermal thickness is removed • Sub dermal fat is then removed and graft placed over donor site • Better cosmesis and flexibility at recipient site • Donor site "cost"
Flaps	• Viable tissue with a blood supply • May be pedicled or free • Pedicled flaps are more reliable, but limited in range • Free flaps have greater range but carry greater risk of breakdown as they require vascular anastomosis

Electrosurgery

Electrosurgery utilises the heat generated by the passage of high frequency alternating electrical current through living tissues. The application of a voltage across human tissue results in the formation of an electrical circuit between the voltage source and the tissue. The tissue acts as a resistor and the level of resistance is determined by the water content of the tissue. It is this resistance that results in the formation of heat.

An alternating current constantly changes the direction in which the current flows, the speed with which this occurs is measured in Hertz. Most diathermy units operate at a frequency of between 200,000 kHZ to 5MHz. This means that tissue such as nerves and muscles will not depolarise (since this seldom occurs at frequencies above 10,000Hz). The current waveform can be adjusted to deliver three main therapeutic modalities; cutting, coagulation and blend.

Types of current

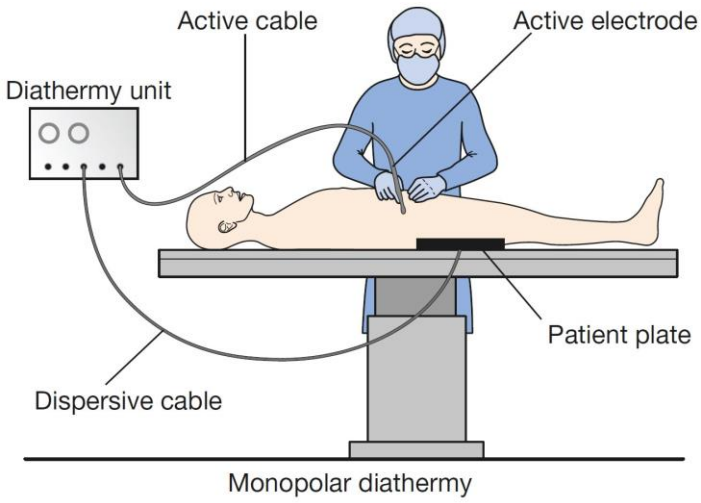
Cutting	• Sinusoidal and **non-modulated waveform** • High average power and current density • Precise cutting without thermal damage
Coagulation	• **Modulated current** with intermittent dampened sine waves of high peak voltage • Evaporation, rather than vaporisation of intracellular fluid occurs • Results in formation of coagulum
Desication	• Active electrode in **direct contact** with tissue • Low current and high voltage system • Results in loss of cellular water but no protein damage
Fulguration	• Electrode probe is **held away** from tissue • Produces spray effect with local, superficial tissue destruction • Low amplitude and high voltage system
Blend	• Alternating cutting and coagulation modes • Total average power is less than with cutting

Diathermy

- Diathermy devices are used by surgeons in all branches of surgery.
- Use electric currents to produce local heat and thereby facilitate haemostasis or surgical dissection.
- Consist of a generator unit that is located outside the patient and can be set to the level of power required by the surgeon.
- There are two major types of diathermy machine;

Monopolar

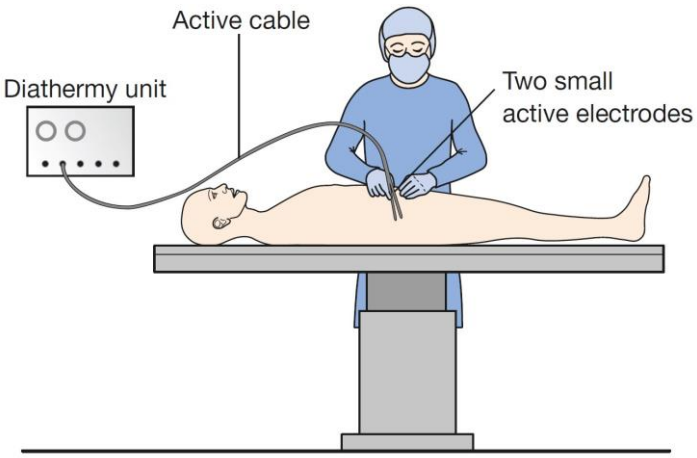
The current flows through the diathermy unit into a handheld device that is controlled by the surgeon. Electricity can flow from the tip of the device into the patient. The earth electrode is located some distance away. The relatively narrow tip of the diathermy device produces local heat and this can be used to vaporise and fulgurate tissues. The current can be adjusted in terms of frequency so that different actions can be effected. In cutting mode sufficient power is applied to the tissues to vaporise their water content. In coagulation mode the power level is reduced so that a coagulum is formed instead. Some diathermy machines can utilise a setting known as blend that alternates cutting and coagulation functions, these tend to be used during procedures such as colonoscopic polypectomy.



Monopolar diathermy

Bipolar

The electric current flows from one electrode to another however, both electrodes are usually contained within the same device e.g. a pair of forceps. The result is that heating is localised to the area between the two electrodes and surrounding tissue **damage is minimised**.



Bipolar diathermy

Ultrasound based devices

These include CUSA and Harmonic scalpel. They generate high frequency oscillations that seal and coagulate tissues. They have different energy settings that allow them to dissect and simultaneously seal vessels if required. The CUSA device leaves vessels intact that may then be divided.

Ligasure device

Delivers tailored energy levels to allow simultaneous haemostasis and dissection. The device senses the impedance of the tissues and tailors energy levels accordingly.

Hazards of diathermy

- Inadvertent patient burn. This may result of careless handling of the device or in the case of monopolar devices forgetting to apply a return electrode plate. In this situation patients may develop a contact burn when electricity flows to earth
- Explosion or fire. This may occur when volatile anaesthetic gases or skin preparation fluid have been used

Treatment of Suspicious Skin Lesions

Skin lesions may be referred to surgeons for treatment or discovered incidentally. The table below outlines the various therapeutic options:

Method	Indication
Tru-cut biopsy	Most often used for percutaneous sampling of deep seated lesions or used intra operatively for visceral lesions
5mm punch biopsy	Used for diagnostic confirmation of lesions that are suspected to be benign or where the definitive management is unlikely to be surgical. Of limited usefulness in pigmented lesions where they do not include sufficient tissue for accurate diagnosis. May be used in non-melanoma type skin disease to establish diagnosis prior to more extensive resection.
Wide excision	Where the complete excision of the lesion (with healthy margins) is the main objective. In cosmetically sensitive sites, or where the defect is large, this may need to be complemented with plastic surgical techniques
Incisional biopsy	Used mainly for deep seated or extensive lesions where there is diagnostic doubt (usually following core or tru-cut biopsy). Used rarely for skin lesions.
Diagnostic excision	Primarily used for lesions that are suspicious for melanoma, the lesion is excised with a rim of normal tissue. Excision of margins may be required subsequently.

Also check 'Tissue Sampling' in Surgical Oncology chapter…

Biological Agents

Agents	Target	Uses
Adalimumab **Infliximab** **Etanercept**	TNF alpha inhibitor	**Crohn's** disease Rheumatoid disease
Bevacizumab	Anti VEGF (anti angiogenic)	Colorectal cancer Renal Glioblastoma
Trastuzumab	HER receptor	**Breast** cancer
Imatinib	Tyrosine kinase inhibitor	Gastrointestinal stromal tumours (**GIST**) Chronic myeloid leukaemia
Basiliximab	IL2 binding site	Renal transplants
Cetuximab	Epidermal growth factor inhibitor	EGF positive colorectal cancers

Detailed understanding of the actions of biological agents is well beyond the scope of the MRCS syllabus. However, many of these drugs are being frequently encountered in surgical patients.