Practical note of General Surgery

By Staff members

Table of contest

ASEPTIC TECHNIQUE GUIDE

Sepsis: -

Presence of living pathogenic microorganism within the tissue

Sterile: -

Complete absence microorganisms

Sanitize: -

Reduction of the number of microorganisms to a safe level

Antiseptics: -

They are drugs, substances, or chemicals that applied topically to the living tissue to kill microorganisms

Disinfectants: -

They are drugs, substances, or chemicals that applied to inanimate objects or non-living surfaces to kill microorganisms

Principles of aseptic surgical technique: -

I-OPERATING ROOM

Control of contamination starts with construction of the surgery room to limit or to prevent contamination as much as possible

1-Construction of operating room

It is preferred to be isolated. It must be subjected to rigid policies. It should be constructed with one exit (one door) in order to restrict unnecessary movement of personnel as well as to minimize the opening and closing of doors during surgery. The operating room should be in direct connection with the surgery preparation room and the surgical scrub area (used for preparation of surgical patients and used as post-surgical recovery room).

The operating room should be supplied with good lighting facilities, casting beds, operating tables, instrument carts, and trolleys. Permanently installed hydraulic operating table is likely to be used in large animal surgery room. When circumstances entail that surgery must be carried out in an open yard, the clinician must select the site most suitable for the procedure. If a minor surgical procedure is to be carried out on the standing position and measures should be taken, to secure the animal either in stanchion or in a box stall. When recumbency is mandatory, consideration must be given to the area or location in

which the surgery will be performed preferably in a grass field or paddock in which a casting bed is required. The major drawbacks to this are the saturation of air with dust as well as the insect problems.

2-Surgery room cleanliness

Cleaning of the surgery room should be done by well-trained housekeeping personnel. Daily cleaning consists of damp dusting of all flat surfaces, lights, and furniture approximately one hour before surgery. Weekly cleansing routines must be established and it consists of whipping down of walls and ceilings with a germicidal cleaning solution. Cabinets and other operating room equipment should be cleansed. Operating tables should be cleansed after each operation with germicidal solution. Buckets should be carefully cleansed and disinfected. After surgery, areas contaminated by organic debris like blood and other body fluids should be cleaned with detergent and disinfectant

II-SURGERY PACKS

All materials and equipment used in a surgical procedure or entering the operative field must be sterilized. Instruments and materials must be clean prior to sterilization. Post-operative cleaning to remove blood can be facilitated by soaking all materials and instruments in cold water and detergent. Gowns, drapes and other fabrics must be laundered. After drying the equipment and supplies they are arranged for pack preparation. The instruments and materials included in a pack vary with the surgical procedure or with the surgeon preference. All materials are packed either in sterilizing drums or wrapped with clean towel and double thick paper without contamination. Autoclaving is the most widely used method of surgical pack sterilization. Properly wrapped sterilized packs will remain sterile for up to 6 months if properly stored. Packs stored in sealed plastic bags remain sterile for up to one year.

Methods of sterilization: -

I-PHYSICAL STERILIZATION: -

1-By heat: -

A-Dry heat (flaming or baking): -

i-Direct flaming: -

ii-Hot air Oven: -

It is an effective method of sterilizing metal instruments and glassware (1-2 hours at a temperature over 200°C)

B-Moist heat: -

i-Boiling: -

Boiling can be performed by using distilled water (to which sodium carbonate 2 % can be added) at 100°C for at least 20 minutes. It can be used for sterilization of suture materials (silk), syringes and needles

ii-Steam under pressure sterilization (autoclaving): -

An autoclave is a self-locking machine that sterilizes with steam under pressure. Sterilization is achieved by the high temperature of steam under pressure. The high pressure also ensures saturation of wrapped surgical packs.

All instruments must be double wrapped in linen or special paper or placed in a special metal box equipped with a filter before sterilization. 'Flashing' is when an instrument is autoclaved unwrapped for a

shorter period of time. Flashing is often used when a critical instrument is dropped

Autoclave Settings	Temperature	Pressure (PSI)	Time (min)
General Wrapped Items	120°C (250°F)	20	30
Bottled Solutions	120°C (250°F)	20	30
Flashing	131°C (270°F)	30	4-7

2-By radiation: -

Like by using Gamma radiation

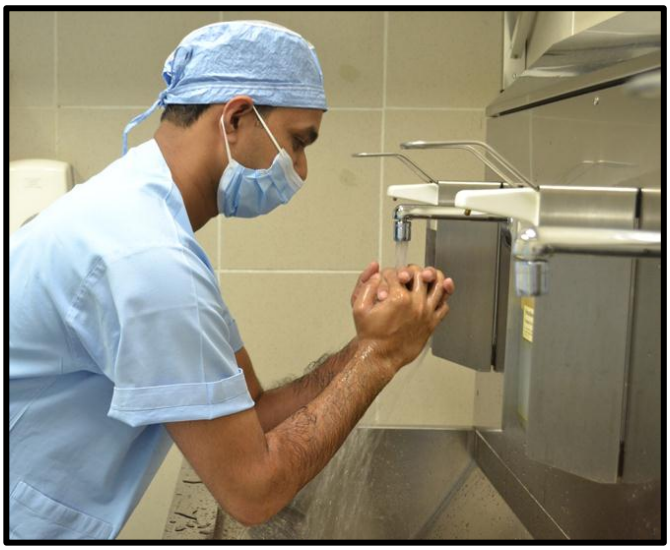
II-CHEMICAL STERILIZATION: -

1-Gas sterilization (ethylene oxide gas, EO): -

2-By Liquid Antiseptics: -

III-PREPARATION OF THE SURGEON AND ASSISTANTS

A-Scrubbing: -



1-Before preparation of the hands for sterile surgery, the fingernails are cut short and cleaned

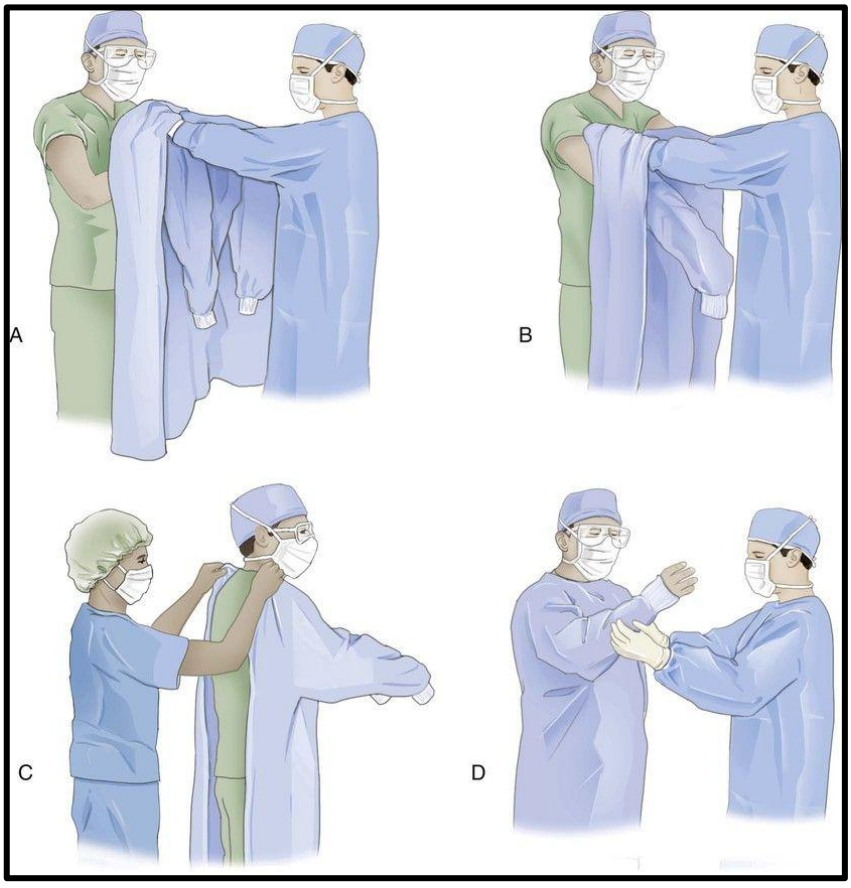
2-Hands are scrubbed with sterile brush, scrubbing agent, and water. Each surface of each finger should be scrubbed and also the surface of the hands and arms. Both hands are then rinsed and rescrubbed while the hands re held above the level of the elbow.

3-As soon as scrubbing is completed, hands are still held above the elbow, then they dried with sterile towel.

B-Gowning and gloving: -

1-Hands inserted into the arm hole of the grown, without touching its outer surface

2-the gown is tied at the neck and secured at the waist by an assistant



3-The gloves are worn that the gloves cuffs cover over that of the gown

4-The surgeon is waiting to commence surgery holding their hands flexed in front to avoid touching of any unsterilized surface.

IV-THE OPERATION SITE

A-Scrubbing: -

1-Th area surrounding the proposed site of surgery is clipped and shaved

2-Antiseptic solution is applied by sterile sponge

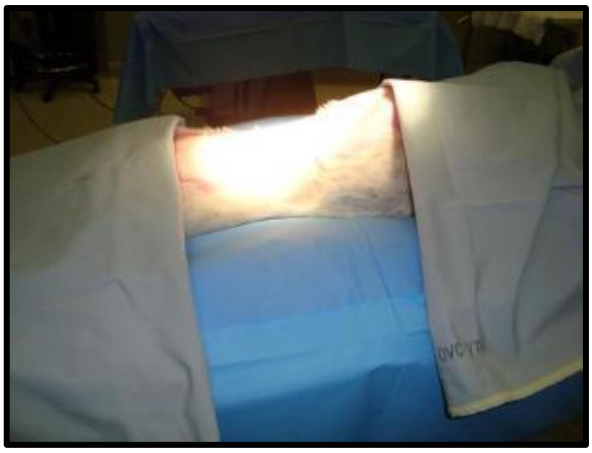
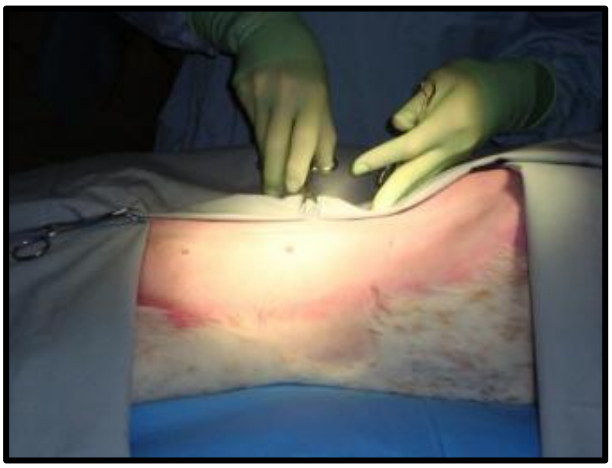
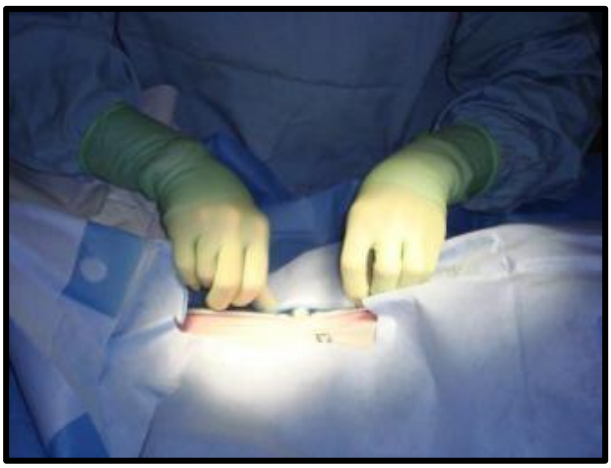
3-The shaved area is scrubbed by antiseptic in a circular manner starting from center to periphery

B-Draping: -

1-For abdominal surgery: -

1-The animal is covered with four towels (anterior, posterior, right side, and left side) leaving a window through which the surgical field can be seen

2-A large towel with central hole covers the whole body and the four towels and the surgical field shows through the central hole of the large towel

2-For surgery of limbs: -

Limb draping is often performed in a hanging limb position. The shaved limb is draped to cover any unshaved skin. A foot drape is often applied to cover the base of the prepared limb and the patient. The limb is draped similar to any other surgical site by four drapes held in position by towel clamps. Each drape is folded over 10

cm and applied. The 1st drape usually applied at the cranial aspect of the leg and the 2nd drape is applied to the caudal aspect of the limb, then the 3rd and 4th drapes are applied and secured in position by towel clamps.

C-Instrument layout: -

1-An assistant makes draping of instrument carts

2-this assistant, opens sterile packs of blades, surgery materials, and supplies

Review question

Mention the most suitable method for sterilization of the following materials

1-Chromic cat gut

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2-Rubber catheter

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3-Silk suture

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4-Gowns

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5-Towels

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6-Metal instrument

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7-Metal instrument contains rubber

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8-Metal instrument contains glass

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9-Gloves

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10-Needle holder

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SURGICAL INSTRUMENTS

The most important aspect of instrumentation is knowing which instrument to use at which time; this is essential to good surgical technique. It ensures that the particular surgical procedure is undertaken with minimal trauma to the tissues, is performed in the minimal amount of time, and ultimately results in the least harm to the patient

Scalpel: -

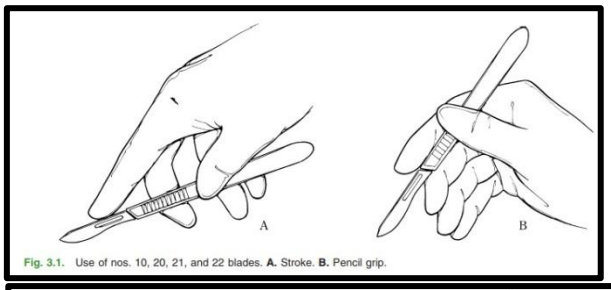


Fig. 3.1. Use of nos. 10, 20, 21, and 22 blades. **A.** Stroke. **B.** Pencil grip.

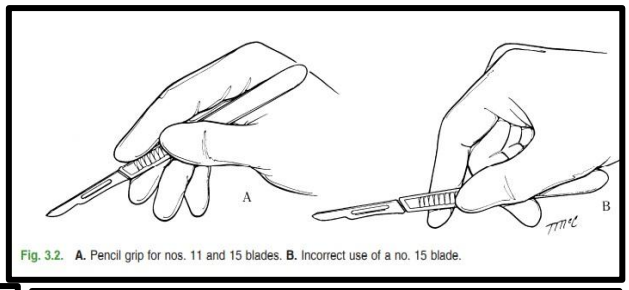
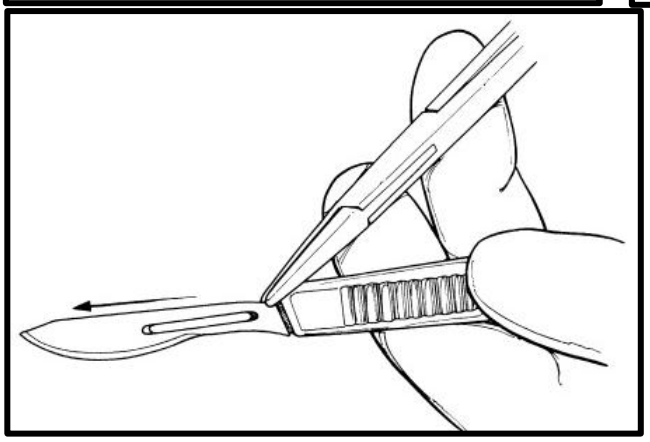


Fig. 3.2. **A.** Pencil grip for nos. 11 and 15 blades. **B.** Incorrect use of a no. 15 blade.



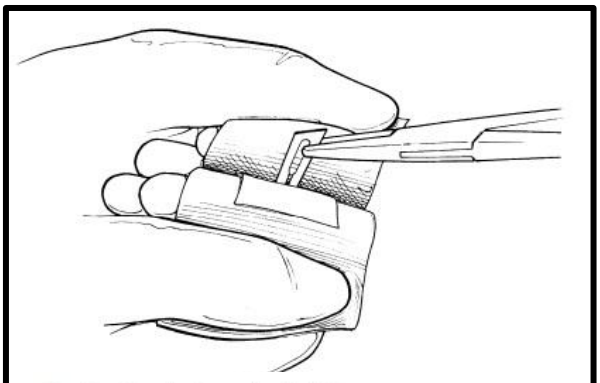


Fig. 3.3. Removing the used scalpel blade.

The scalpel is used for the sharp division of tissue with minimal damage to nearby structures. Today, scalpels come with a variety of blade configurations, each designed for a specific purpose. The blades are disposable, thereby avoiding the need to be sharpened. The scalpel must be held so that it is under complete control. It is grasped between the thumb and the third and fourth fingers, with the index finger placed over the back. To cut, make a smooth sweep with the rounded portion, or belly, of the blade, rather than with the point. The amount of pressure applied varies, but the aim is to produce a bold, single, full-thickness skin incision with a single sweep of the scalpel blade. Every time the blade contacts the tissue it creates another incision. Each of these incisions will need to heal. Figure 3.1A shows the stroke made with nos. 10, 20, 21, and 22 scalpel blades. The handle should be at an angle of 30° to 40° to the surface incised. Figure 3.1B depicts the pencil grip with nos. 10, 20, 21, and 22 scalpel blades. The pencil grip

is used for nos. 11 and 15 blades when more precise incisions are required (Figure 3.2A). Figure 3.2B shows the incorrect use of a no. 15 blade. The bistoury blade (no. 12) has a hook shape and is used for lancing abscesses. The bayonet tip blade (no. 11) can also be used for lancing abscesses and for severing ligaments. When the scalpel blade becomes dull, the blade is removed carefully by grasping the blade with a needle holder or hemostat (Figure 3.3). The proximal end of the blade is then bent slightly to clear the blade from the hub of the handle. Then the blade is pushed up and over the end of the scalpel handle. The reverse process is used to replace a scalpel blade. Although the blade may be too dull for a particular surgical procedure, the blade is still sharp enough to cause serious injury if care is not taken while removing it from the scalpel handle. The spent blade should be discarded appropriately. To remove the new scalpel from its packet, the ends of the packet are grasped by the operating room nurse or nonscrubbed assistant and peeled open, exposing the end of the blade. The blade is carefully plucked out of the packet, contacting only the blade itself, to avoid a break in aseptic technique (Figure 3.4). Various types of scalpel blades and scalpel handles are illustrated later in this chapter. While many practitioners sterilize scalpel blades in their surgery packs so that they can be opened by the gloved surgeon, it should be noted that repeated steril

Fig. 3.4. Aseptic technique for handling a new blade.

dull scalpel blades

Scissors: -

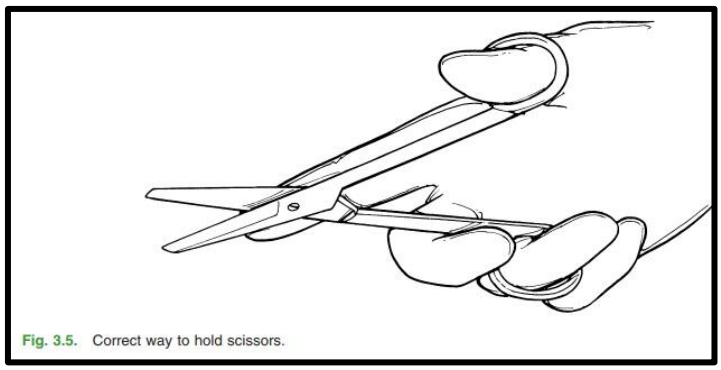


Fig. 3.5. Correct way to hold scissors.

A variety of scissors are available and are used for such procedures as cutting tissues or dissecting between tissue planes. Generally scissors used for tissue are light. They must be kept sharp or they will crush tissues rather than cut them. Mayo or Metzenbaum scissors are used for most tissues. They are available with curved or straight blades. Straight scissors are used for working close to the surface of the wound, whereas the curved scissors are used for working deeper in the wound. Scissors are also classified according to the shape of the tips, for example, sharp/sharp, sharp/ blunt, and blunt/blunt. Some scissors are designed to cut wire. The scissors are grasped by placing the thumb and ring finger through the rings and setting the index finger against the blades. The index finger provides control of the tips of the scissors. The scissors must be kept near the last joint of the finger, and the fingers must not be allowed to slip through the rings of the handle (Figure 3.5).

The end of the blade is used for cutting; however, when tough structures are encountered, the heel of the blade is used. The scissors should not be closed unless the surgeon can see the tips of the blades; otherwise, vital structures may be endangered. For blunt dissection, insert the closed tips of the scissors into the tissue, and then open the points. Scissors used for tissue work should not be used for cutting suture material; one of the various types of suture scissors should be used instead. Bandage scissors are an essential part of large animal surgery instrumentation, especially in equine limb surgery, in which the areas to be treated are commonly under bandage, and much of one's day may be spent changing bandages on horses' limbs. Some bandage scissors have slightly angled blades, and the lower blade has a small button tip on it to protect structures under the bandage. If bandage scissors are used against soiled or contaminated wounds, they must be sterilized after use to prevent transfer of infection to another wound or another patient.

Needle Holders (Needle Drivers): -

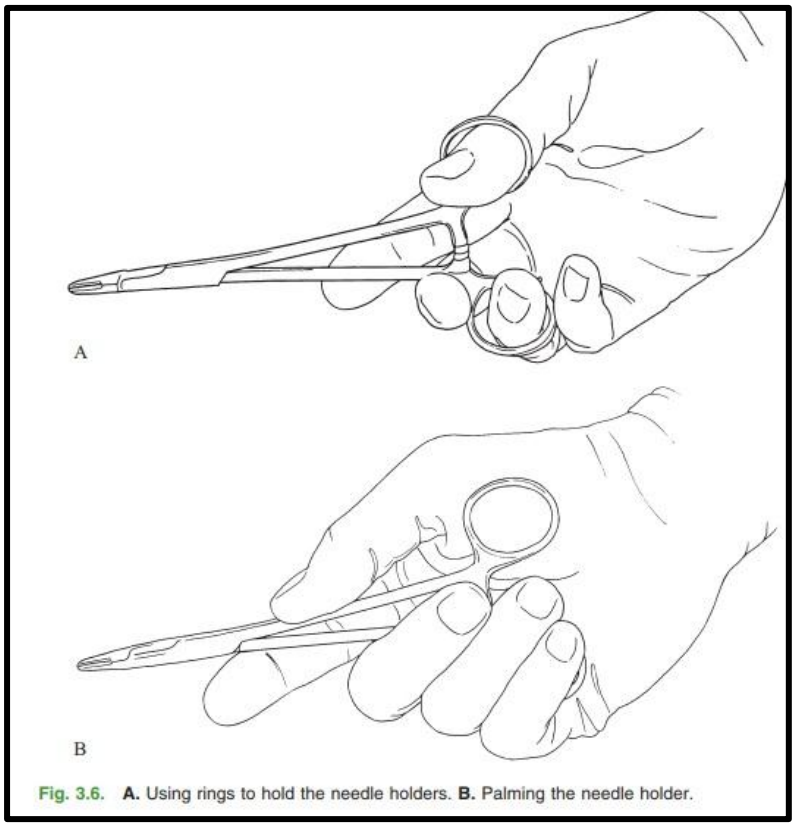


Fig. 3.6. **A.** Using rings to hold the needle holders. **B.** Palming the needle holder.

Some needle holders, such as OlsenHegar or Gillies, have suture-cutting scissors incorporated into the jaws to enable the surgeon to cut sutures without reaching for suture-cutting scissors. These needle holders are useful in large animal practice where the surgeon is commonly working on their own. Care must be taken to avoid cutting the suture accidentally during the procedure. There are many variations of width and serrations in the heads of the needle holders. There are two different ways to hold needle holders. The first is to hold the needle holder as the surgeon would hold scissors, that is, with the thumb and the ring finger in the rings of the handles (Figure 3.6A). The other option is to palm the needle holder. Palming generally provides the surgeon with better control over the tip of the needle holder. The needles used with needle

holders are curved; straight needles are held by hand only and are usually reserved for the skin and bowel. With the needle holder, the needle should be driven through the tissues in an arc like motion, following the curve of the needle. The needle holder is then removed and is reapplied to the protruding point of the needle, which is extracted from the tissue. The needle should be grasped by its thicker portion, rather than by the tip, because the tip may be easily bent or broken. Some needle holders, such as the Mathieu, have a ratchet on the handle that releases when additional pressure is applied to the spring handles. These are time saving, but if the tissues resist passage of the needle, a firm grip cannot be applied to a needle without causing the needle holder to unsnap. Various types of needle holders are illustrated later in this chapter.

Thumb Forceps: -

Thumb forceps are used for grasping and holding tissues. They are held between the thumb and the middle and index fingers (Figure 3.7). It is common for the inexperienced surgeon to hold thumb forceps incorrectly, like a scalpel handle, especially toward the end of the operation when fatigue is setting in. Thumb forceps are usually held in the left hand while the right hand holds the scalpel or needle holder. Thumb forceps with teeth bite into tissue and prevent the instrument from slipping. Some surgeons consider these forceps too traumatic for use on hollow organs or blood vessels and reserve them for skin. Thumb forceps are illustrated later in this chapter.

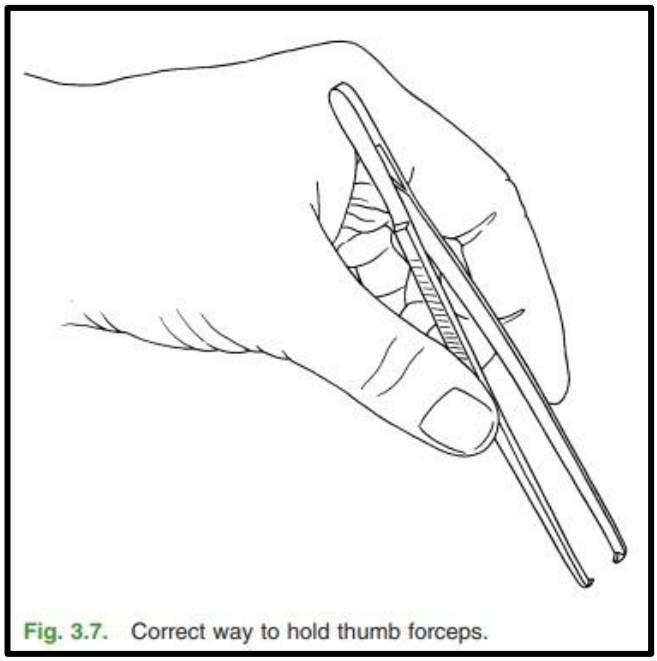


Fig. 3.7. Correct way to hold thumb forceps.

Grasping Forceps: -

A variety of forceps used for larger portions of tissue maintain their hold with the use of a ratchet device on the handle. Allis tissue forceps have opposing edges with short teeth. They should be used sparingly and generally only on tissue that is going to be removed. They should not be used on skin edges or viscera. Vulsellum forceps are useful for grasping the uterine walls of the various large animal species, to stabilize the walls during closure. Sponge forceps are used in the inguinal approach for cryptorchidism, to grasp the vaginal process. Towel

holding forceps (clamps) are useful for grasping skin edges, as well as for holding drapes in position.

Hemostatic Forceps: -

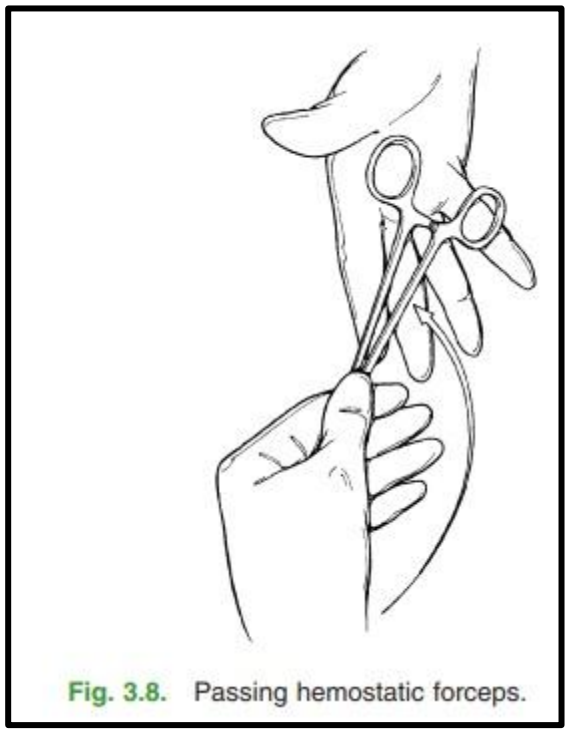


Fig. 3.8. Passing hemostatic forceps.

Hemostatic forceps are used to clamp the ends of blood vessels and thereby to establish hemostasis. They vary not only in size; they also vary in the shape and direction of the serrations. Halsted mosquito forceps are used for clamping small vessels. When larger vessels are encountered, Kelly forceps may be more suitable. The amount of tissue crushed should be kept to a minimum. Hemostatic forceps are frequently used in conjunction with electrocautery. When ligating bleeding points, the tips of the instruments should be elevated to facilitate passage of the ligature. Curved hemostats should be affixed with the curved jaws pointing upward. If a scrubbed assistant is present during an operation, he or she should pass the instruments by slapping them, handles first, into the hands of the surgeon (Figure 3.8). It is not within the scope of this chapter to describe the applications of more than a few forceps. A variety of the forceps used in large animal practice are shown later in this chapter.

Retractors: -

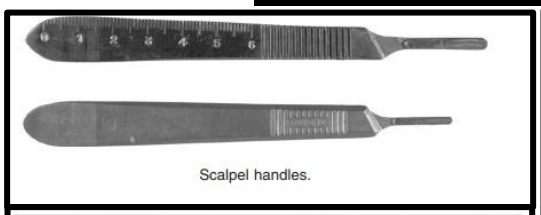
Retractors are used to maintain exposure at various surgical sites. Handheld retractors are held by an assistant. If the surgeon does not have the luxury of an assistant, as is often the case in large animal practice, self-retaining retractors can be used. Self-retaining retractors anchor themselves against the wound edges by maintaining fixed pressure on the retractor arms. When abdominal or thoracic retractors are used, moist sponges or towels are placed between the retractor blades and the tissues to minimize trauma to the wound edges. Examples of handheld retractors are U.S. Army retractors, malleable retractors, Volkmann retractors, Jansen retractors, and Senn retractors. Among the self-retaining retractors, Weitlaner retractors and Gelpi retractors are useful for small incisions, such as laryngotomy and arthrotomy incisions in the horse. The large Balfour retractors are predominantly used in laparotomy incisions. Occasionally, if

thoracotomy is indicated, Finochietto rib retractors are the instruments of choice. Retractors are illustrated later in this chapter.

General Surgery Pack: -

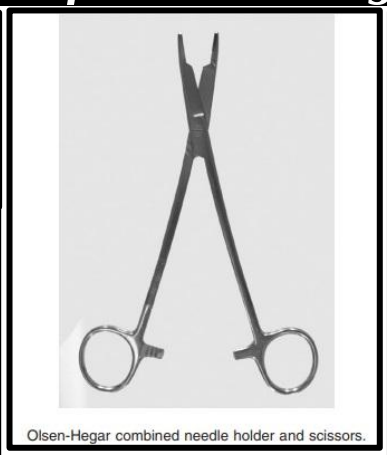
Listed below is a standard set of instruments routinely used by our hospital. Such a set of instruments suffices for most basic procedures. In the remainder of the text, these standard instruments are included as a general surgery pack, and any additional instruments required will be noted individually. Instruments in this standard set are

16 Towel forceps
4 Curved mosquito hemostats
4 Straight mosquito hemostats
2 Curved Kelly/Crile hemostatic forceps
2 Straight Kelly/Crile hemostatic forceps
2 Allis tissue forceps
1 Curved Mayo scissors
1 Straight Mayo scissors
1 S/S operating scissors (sharp/sharp)
1 Curved Metzenbaum scissors
1 Straight Metzenbaum scissors
2 Needle holders (1 Mayo-Hegar or Olsen-Hegar)
2 Right-angle forceps
1 Curved 6″ Ochsner forceps
1 Straight 6″ Ochsner forceps
1 No. 3 scalpel handle
1 No. 4 scalpel handle
3 3″ × 4″ thumb tissue forceps
2 1″ × 2″ Adson tissue forceps
1 Sponge forceps (curved or straight)
1 Saline bowl
4 Towels Sponges in inverted bowl

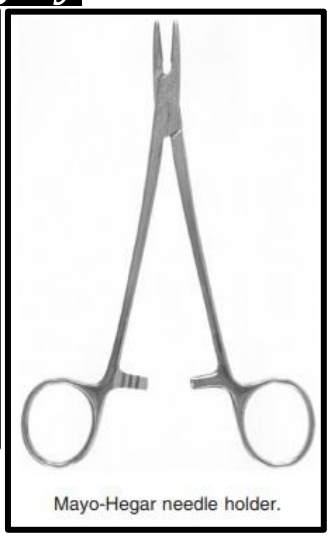


Scalpel handles.

Scalpel blades.



Olsen-Hegar combined needle holder and scissors.



Mayo-Hegar needle holder.

Lister bandage scissors.

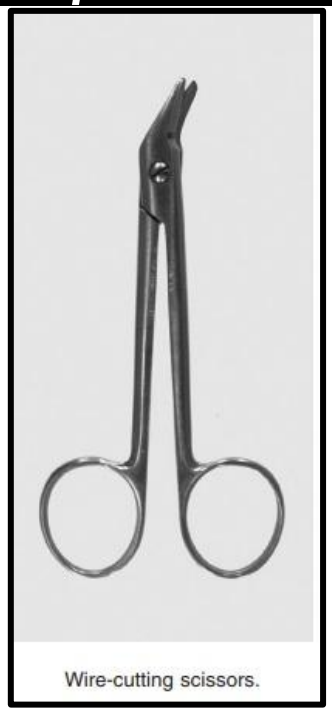
Littauer stitch scissors.

Mayo straight and curved dissecting scissors.

Metzenbaum straight and curved scissors.

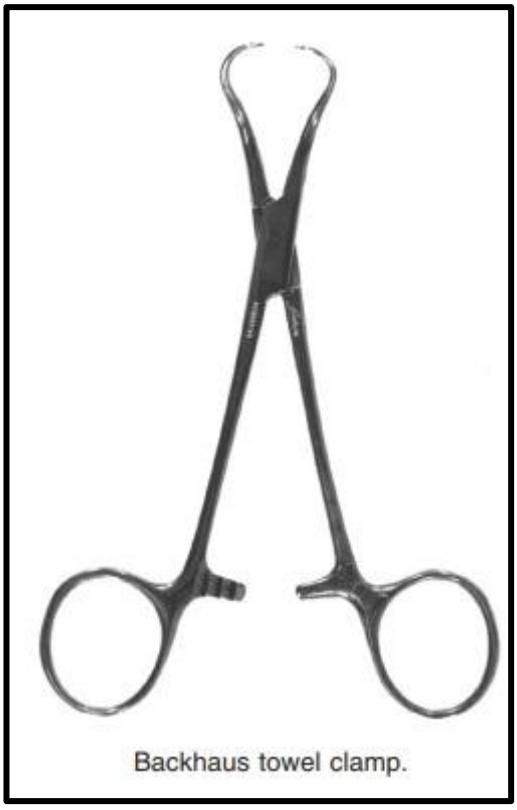
Operating scissors with blunt/blunt points.

Operating scissors with sharp/sharp points.



Wire-cutting scissors.

Operating scissors with sharp/blunt points.

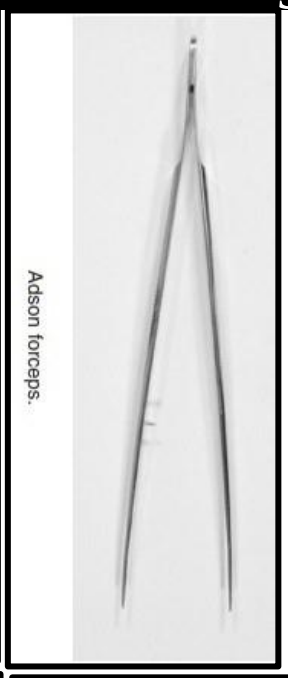


Backhaus towel clamp.

Roeder towel clamp.

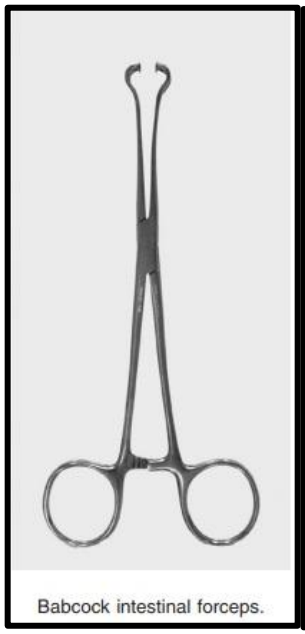
Tissue forceps.

Brown-Adson forceps.

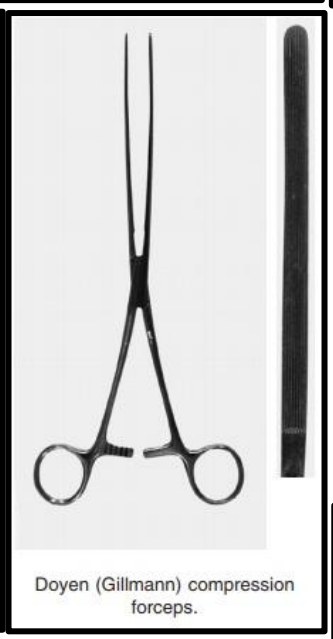


Adson forceps.

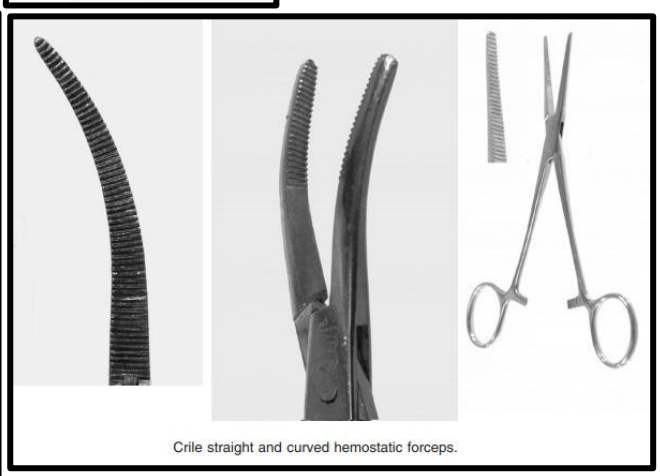
Allis tissue forceps.



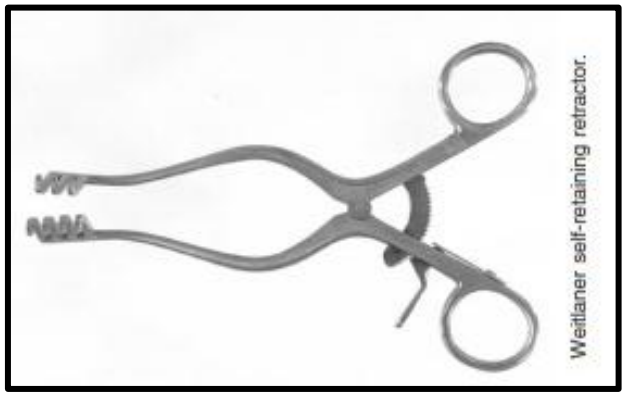
Babcock intestinal forceps.



Doyen (Gillmann) compression forceps.

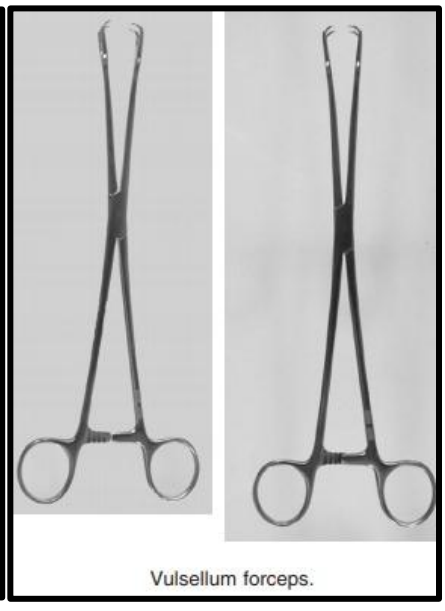


Crile straight and curved hemostatic forceps.

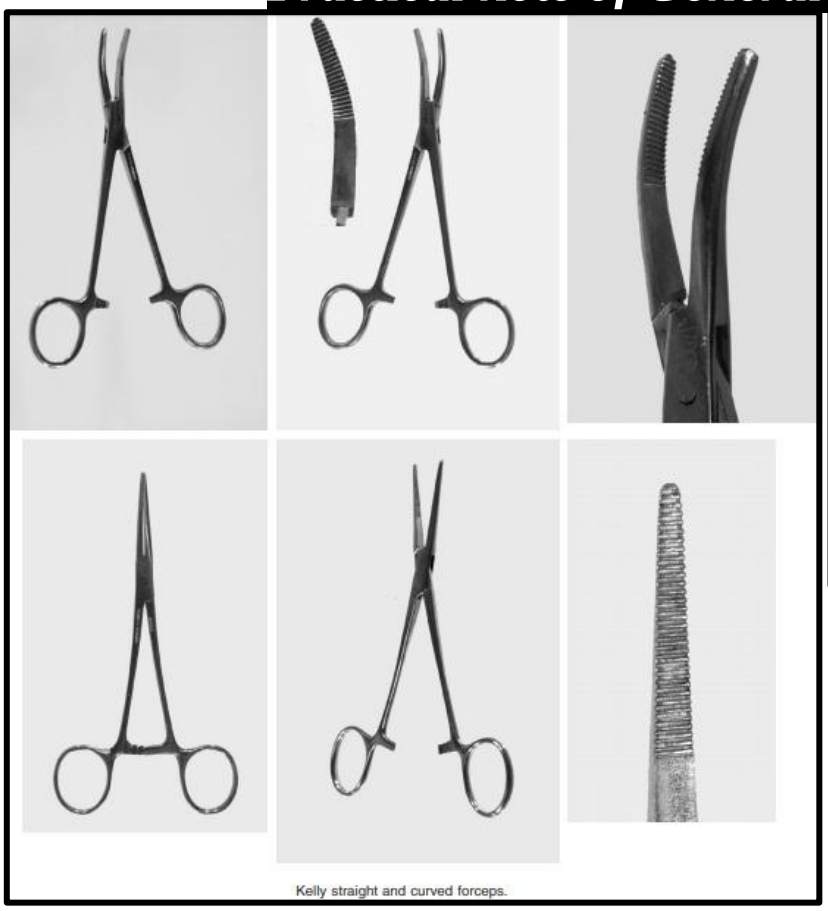


Weitlaner self-retaining retractor.

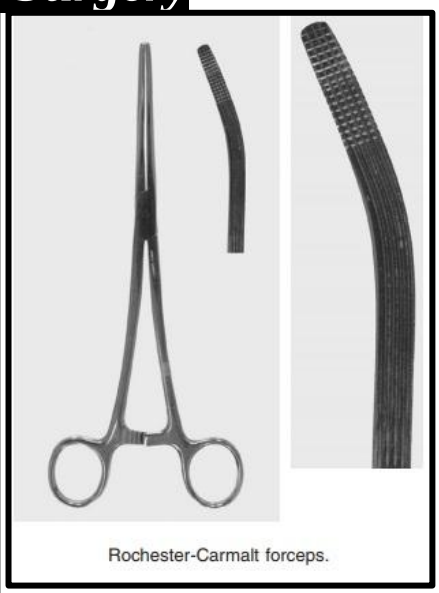
Foerster straight sponge forceps.



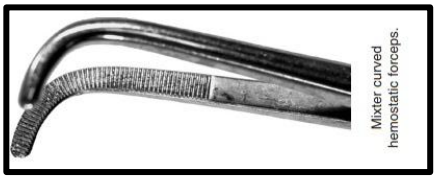
Vulsellum forceps.



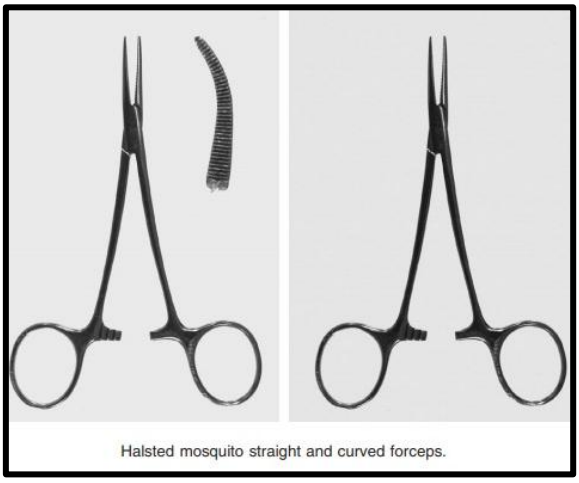
Kelly straight and curved forceps.



Rochester-Carmalt forceps.

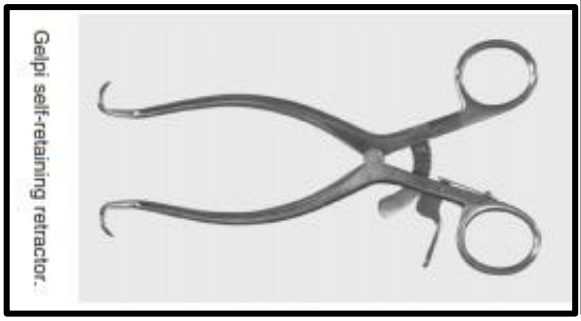


Mixter curved hemostatic forceps.

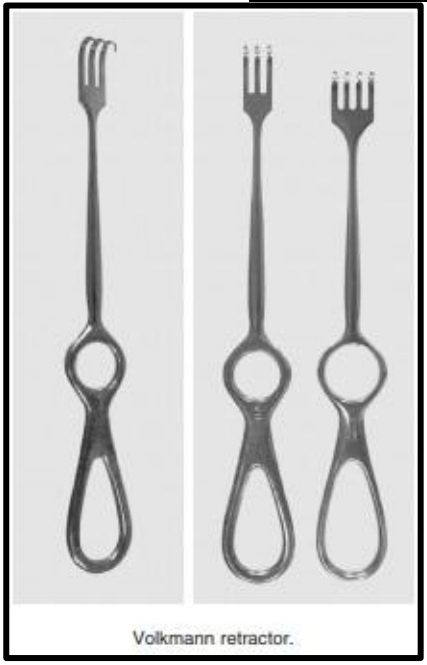


Halsted mosquito straight and curved forceps.

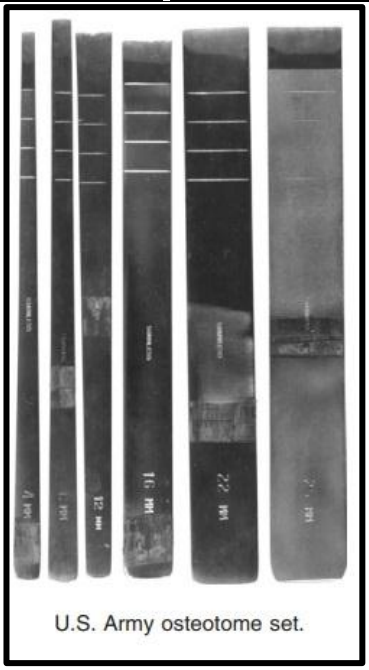
Ochsner straight and curved forceps.



Gelpi self-retaining retractor.



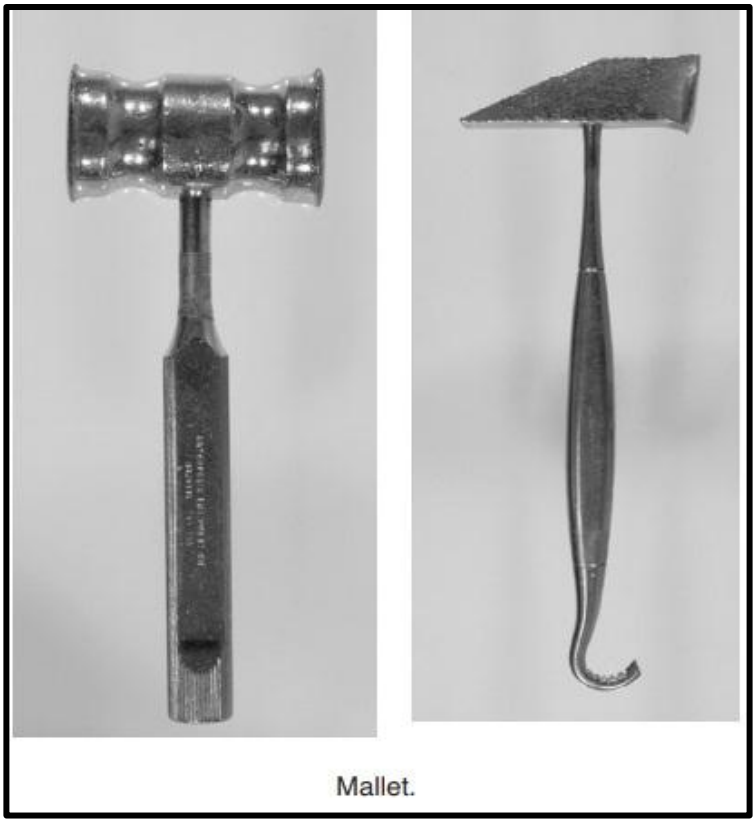
Volkmann retractor.



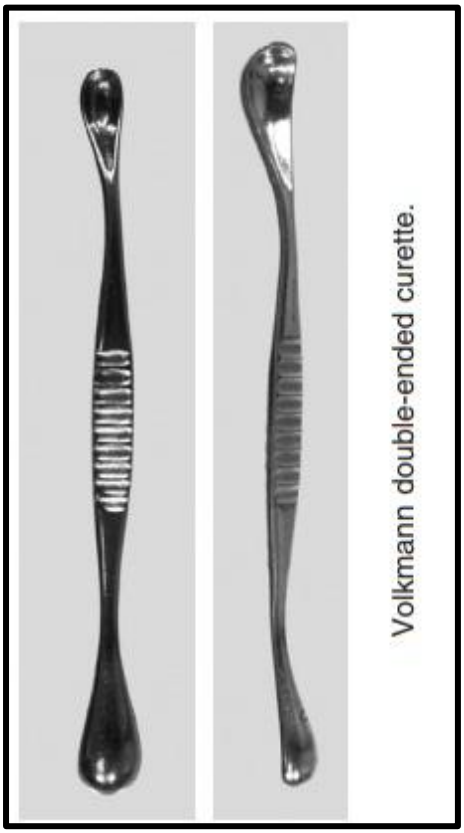
U.S. Army osteotome set.

U.S. Army chisel set.

Alexander chisel.



Mallet.



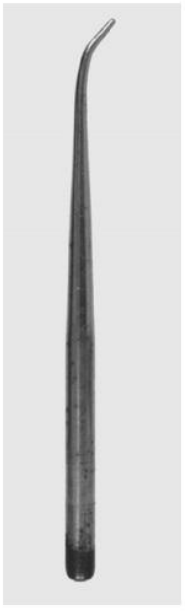
Volkmann double-ended curette.

Still-Luer bone rongeurs.

Pennyback rongeurs.

Bone rasp.

Dental elevator.



Periodontal probe.

Keyes skin punch.

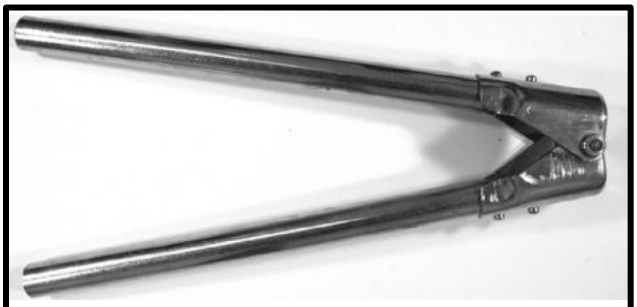
Tenotomy knife.

Plain emasculator.

Serra emasculator.

Reimer emasculator.

Keystone dehorner.



Barnes-type dehorner.

Dental float.

Galt trephine.

BANDAGES

Bandages are applied to cover wounds protected by dressings, to prevent edema formation after injuries of the limb, and to support the limb in conjunction with an added splint in the case of a fracture of a bone. The type of bandage is chosen on the basis of the location and the nature of the injury

Aim of use: -

1-To prevent wound contamination
2-To keep the dressing in position
3-To exert an appreciable pressure on the wound
4-To provide warming
5-To support the circulation of the area
6-To prevent self-mutilation
7-To prevent seromas

Bandaging materials: -

A-Cotton: -

Characters: -

1-Woven fabric
2-Porous and good absorbent
3-Folded into square or rectangular shape

B-Gauze: -

Characters: -

1-Woven fabric
2-Inexpensive
3-Porous and good absorbent

C-Elastic bandage: -

Characters: -

1-Pliable and highly elastic
2-Apply some pressure
3-Tends to adhere to themselves
4-Easily removed
5-Has no ability to shrink

D-Adhesive tape: -

Characters: -

1-Porus to allow air to enter the wound
2-It has variable degree of pressure

3-It gives support to the underlying gauze

E-Other materials: -

1-Nonstick bandage
2-Foam rubber and fur materials

Types of bandages: -

A-Protective bandage: -

It is used to keep wound dressing in position and to prevent wound contamination. It is composed of thin layer of gauze under the cotton.

B-Supporting bandage: -

They are used to reinforce tendons of limbs in the horse or when the animal has sprained ligament, strained tendon or join problems.

C-Pressure bandage: -

They r used to prevent seromas or excessive granulation tissue and they are applied with little pressure.

D-Bandage with splint: -

They are used with fracture, to provide sufficient immobilization of the fractured bone, like with Thomas tube or modified Thomas tube in the hind limb.

E-Plaster of Paris: -

It is special form of bandage used for treatment of fracture to prevent movement of fractured bone.

General considerations: -

1-Cotton padding should be applied in an even manner over the bandaged area.

2-When apply bandage to upper part of limb, the distal part should be involved to maintain the bandage in position and to prevent edema of the distal part.

3-During applying bandage, each successive turn should cover the upper border of the preceding turn.

4-Make sure the cotton padding is in excess in the upper and lower part of the bandage.

5-Tie the end of the bandage on the lateral side for easy untying later.

6-Apply 8 figure bandage on the joints

Examples of bandages: -

Ear Bandage: -

Apply padding in the form of piece of cotton of foam sponge in the inner aspect on the ear flap then fix it in place by adhesive tape.

Sometimes the whole ear is included in a bandage that rolls around the head and neck.

Horn Bandage: -

It I a special form of 8 figure bandage that is used with fractured horn or after dehorning. Following application of antiseptic pad, the gauze is fixed to the sound horn then rolled in 8 figure manner between the two horns.

Foot Bandage: -

Foot bandages are applied to manage a variety of problems. Part of a roll of cotton is placed over a primary wound dressing (Fig. 18-12). The padding is secured with gauze, and it can be held in place with either cohesive or adhesive bandaging tape. Duct tape placed over the bottom of the bandage will render the bandage more durable and less permeable to urine and water (see Fig. 18-12). Moisture can be controlled from entering the bandage by placing plastic over the foot. An empty 5-L fluid-bag can be opened with a pair of scissors and placed over the hoof capsule and fastened with adhesive tape, attaching it effectively

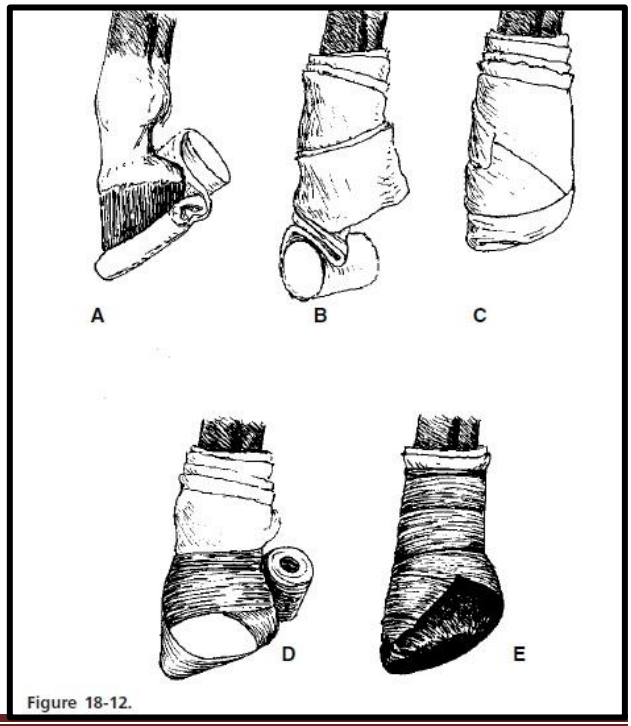


Figure 18-12.

to the foot. This type of bandage is useful if it is desirable to exclude water from the wound environment, when a poultice or soak is applied to the foot, or when preparing a foot or pastern for any type of surgery.

Lower Limb Bandage: -

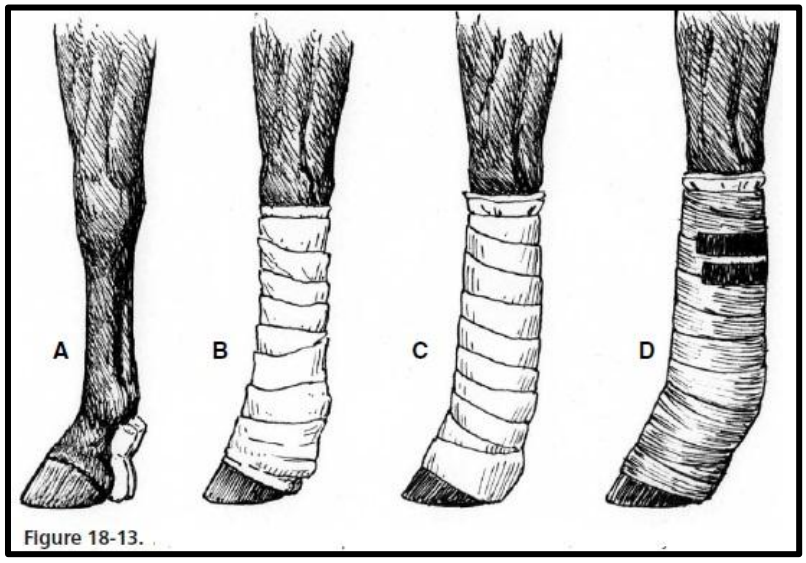


Figure 18-13.

A lower limb bandage is applied from the bulbs of the heel up to just below the carpus or tarsus. It usually consists of a roll of cotton, applied in the standard clockwise fashion (pulling the tendons to the inside) (Fig. 18-13). The thickness, or number of layers, of the bandage is dictated by the underlying medical problem. Each layer is secured with conforming roll gauze, wrapped snugly in a spiral pattern, overlapping half the tape width, to prevent the padding from slipping or bunching. The gauze is overlaid with either adhesive or cohesive bandaging tape securing the bandage in position. A single wrap of adhesive tape around the bottom of the hoof and the top of the bandage prevents bedding materials from gaining access to the underlying skin or wound respectively. Care should be taken to extend the bandage to the level of the carpometacarpal or tarsometatarsal joint, to prevent inadvertent tendon damage if a considerable amount of tension is applied to the elastic bandage tape. At the level of those joints, the tendons are lodged between the vestigial metacarpal bones, which provide protection. Additionally, the coronary band should be included in the bandage so that tape can be applied directly to the hoof capsule.

Full Forelimb Bandage -: -

A full limb bandage is applied from the bulbs of the heel up to the elbow region (Fig. 18-14). When applying a full limb bandage, movement of the carpus requires that special attention be given to this area to prevent decubital ulcers.

The bandage is usually “stacked” to prevent slippage and subsequent irritation over bony prominences. Padding materials are the same as for the lower limb bandage and therefore require placement in two stages.

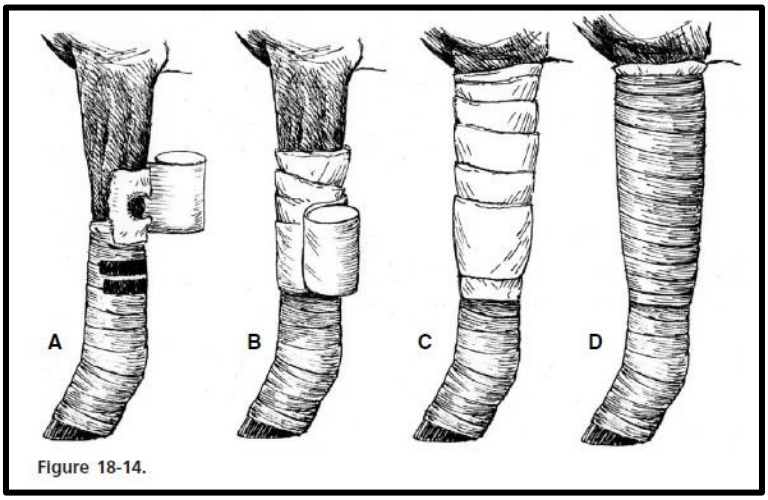
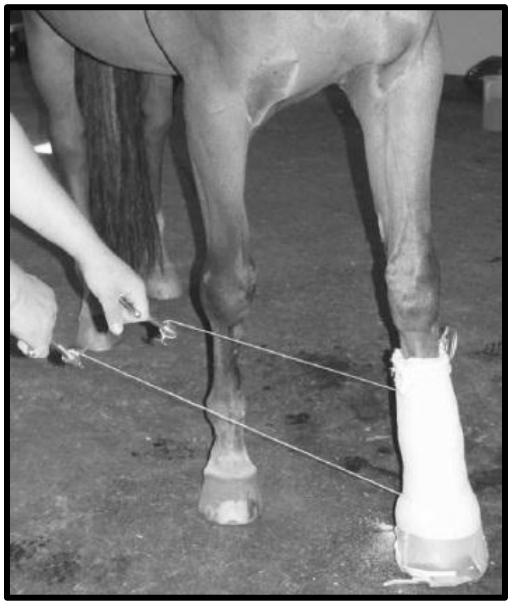


Figure 18-14.

The distal bandage is initially applied as previously described. The proximal part is subsequently added on top of the lower limb bandage, overlapping it for 5 to 10 cm. Applying a doughnut shaped cotton ring or incising the gauze over the accessory carpal bone helps prevent skin irritation over that area and potential development of skin ulcers. Tightening of the bandage in layers provides more stability and increases the support. If the bandage becomes displaced distally, it is imperative that it be changed at once to prevent skin ulcers from developing over bony prominences.

Plaster of paris - Coaptation (casts)



Historically, plaster of Paris casts have been popular for external coaptation. Plaster is still a viable casting material, because it is easy to apply, has good molding capability, and is inexpensive. Unfortunately, plaster casts also are heavy, disintegrate when wet, and do not allow exchange of air, which makes this type of cast uncomfortable when worn for a prolonged period.15 Furthermore, plaster is not as strong as fiberglass and thus requires more material to prevent breakage. This results in a heavier cast.

Removal of the cast with the horse under general anesthesia is usually uneventful. Removal of the cast while the horse is standing may be more complicated. In most cases, some degree of chemical or physical restraint is necessary to permit safe removal of the cast.

Cast complications may develop from an overly tight application, resulting in dermal pressure necrosis (that will damage deeper structures if undetected) or in an overly loose application. If the cast is too loose, the limb can shift in the cast, which may result in the development of skin pressure in areas not anticipated. Cast loosening may result from a decrease in the limb swelling, from muscle atrophy, or from compacting of cast padding materials. Application of too-short a

half-cast may result in severe tendon injury, because the limb may be partially flexed, causing the top end of the cast to apply a considerable amount of linear pressure on the unprotected tendons. In a properly applied cast, the tendons are protected by the proximal ends of the vestigial metacarpal or metatarsal bones. Wear on the bottom of the cast will also cause the limb to shift within the cast, resulting in serious dermal pressure necrosis.

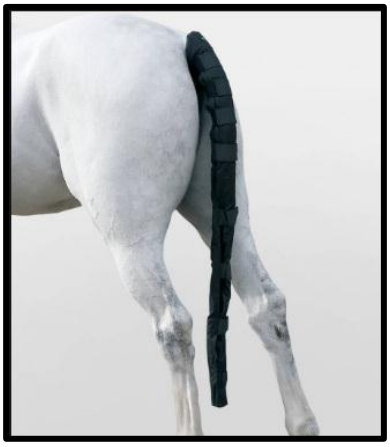
Abdominal Bandage: -

Usually it is dressing bandage applied to the abdomen of the animal after surgery like hernia, and it is made by rolling the gauze around the body on an antiseptic bad.

8 figure Bandage: -

It is special form of bandage usually applied to joints while applying a bandage on the limb, to prevent fixation of the join. While rolling the gauze around the limb, make a turn upper to the joint then pass the tape on the flexor aspect of the joint downward, then make a roll of the tape and go back to the upper part of the limb, with the tape passing on the flexor surface of the joint again making a litter X shape on the flexor surface. This manner will not interfere with joint function and allows the cotton to show through the bandage.

Tail Bandage: -



Special form of bandage applied to tail either due to surgery on the tail or during horse shows. Bandage starts at the base of the tail by making two rolls as a lock then commence downward till reaching the hair of the tail, then the hair is bend up and involved in the bandage for fixation of the bandage.

Review question

With diagram illustrate how to make

Tail bandage in horse	Ear bandage in dog
Abdominal bandage in cat	Horn bandage in cow

Mention

1-The most common types of padding materials

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2-The most common types of taping materials

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3-Characterisitcs of padding and taping materials

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SUTURE MATERIALS AND NEEDLES KNOTS AND LIGATURES SUTURE PATTERNS

Sutures and ligatures are fundamental to any surgical technique because they maintain approximation of tissues as the wound heals. All sutures should maintain their strength until the wound has healed and as a general rule should be as strong as the healthy tissue through which they are placed. The ideal suture material should

- Elicit minimal tissue reaction
- Not create a situation favorable for bacterial growth
- Be nonelectrolytic, noncapillary, nonallergenic, and noncarcinogenic
- Be comfortable for the surgeon to handle
- Hold knots securely without cutting or fraying
- Disappear as soon as it is no longer needed
- Be economical to use

Absorbable Sutures: -

Surgical Gut: -

Gut is a natural absorbable suture that consists mainly of collagen obtained from the submucosa of sheep intestine or from the serosa of beef intestine. It is packaged in at least 85% alcohol, is sterilized with gamma irradiation, and cannot be resterilized once the package is open. Many of the synthetic sutures have essentially replaced gut as they cause significantly less tissue reaction, possess a greater tensile strength for the same diameter, and offer more consistent absorption profiles. Gut may be plain or chromic. Plain gut loses its strength so rapidly that its use in certain regions may be contraindicated. Chromic gut is produced by exposure to basic chromium salts. This process increases the intermolecular bonding and results in greater strength, decreased reaction in tissues, and slower absorption. Gut is further classified according to the degree of chromicization: type A (plain) is untreated; type B has mild treatment; type C has medium treatment; and type D (extra chromic gut) has prolonged treatment. Because the absorption pattern of gut is quite variable, newer synthetic sutures are better choices for most procedures. The patient's reaction to gut is variable, but in general, plain gut loses its strength in 3–7 days. Gut is gradually digested by acid proteases from inflammatory cells and may be used when a suture is needed for only a week or two and absorption is desirable. The rate of absorption varies, depending on where the gut is implanted and, to some extent, on the size

of the suture. It is rapidly absorbed if it is implanted in regions with a greater blood supply. Similarly, it is absorbed rapidly if exposed to gastric juices or other organ enzymes. Gut may be used in the presence of infection; however, the increased environment for enzyme digestion causes it to be absorbed rapidly. Gut, in smaller sizes, handles well and possesses some elasticity. Larger diameter gut retains much of its memory and has poor handling characteristics. Three throws are required for knotting, and, when wet, the knot-holding ability decreases. The ends should be left slightly longer than other types of suture material to minimize the chances of untying. Despite the advent of synthetic absorbable sutures, gut is still used in large animal surgery for purely economic reasons, which is not generally a good reason for selecting a suture material.

Braided Absorbable Sutures: -

In our experience, the synthetic absorbable suture materials have, with few exceptions, replaced gut. Synthetic suture materials are advantageous for their good knot security, handling characteristics, consistent absorption patterns, and minimal tissue reaction. These materials are polymers that are extruded as filaments and include polyglycolic acid (Dexon-Tyco), Polyglactin 910 (Vicryl-Ethicon), and lactomer 9-1 (Polysorb-Tyco). These compounds differ from gut in their reaction in tissues. They are invaded by macrophages, yet their disappearance is independent of the local cellular reaction. These compounds are hydrolyzed into natural body metabolites, rather than absorbed by an enzymatic process. The breaking strength of these synthetic sutures diminishes more or less in a straight line, when compared to the almost exponential decline of the strength of gut in tissues. This characteristic absorption pattern was the main reason for the introduction of these synthetic materials, because they are more consistent and reliable in this regard than gut. Unlike gut, synthetic sutures do not swell when wet. These materials have a low coefficient of friction, and it is necessary to use a surgeon's knot with multiple throws to prevent slippage or untying of the knots.

Absorbable Monofilament Sutures: -

Absorbable monofilament sutures minimize the tissue drag that occurs with braided sutures, and monofilament nature of the suture is believed to reduce the potentiation of infection and the harboring of bacteria. Polydioxanone (PDS), a homopolymer of paradioxanone, and polyglyconate (Maxon), a copolymer of trimethylene carbonate and glycolide, are two synthetic monofilament sutures with similar properties. Like polyglycolic acid and polyglactin 910, both are degraded by hydrolysis in a predictable manner, although more slowly. Studies show that polydioxanone has a superior breaking strength, longerlasting

mechanical performance over 28 days, and less stiffness compared to polyglactin. Similarly, polyglyconate can withstand high immediate loads for up to 21 days before weakening due to absorption. Polyglyconate surpasses polydioxanone in strength up to 4 weeks after implantation and knot security. When comparing immediate strength and knot security in an in-vitro model, polyglyconate was stronger than polydioxanoe.

Nonabsorbable Sutures: -

Silk: -

Silk, a continuous protein filament produced by silkworms, has traditionally been considered a nonabsorbable suture. However, the consensus in recent literature is that silk is indeed slowly absorbed in vivo at a rate dependent upon the type and condition of the tissue in which it is implanted, the physiological status of the patient, and characteristics of the silk (virgin vs. extracted black braided fibrion and the diameter of the silk fiber). Research shows that silk fibers in vivo are susceptible to proteolytic degradation, lose tensile strength within a year of implantation, and are undetectable within 2 years. Silk fibrion fibers are usually braided, dyed, and coated with wax or silicone for use as sutures, which are referred to as black braided silk. Virgin silk is not commonly used due to its potential allergenic nature in some patients, although it is still commercially available. Silk suture has been widely used in human surgery although its use has declined with the availability of synthetic sutures. A similar trend has been seen in veterinary surgery. It is popular with some veterinary surgeons, however, and its superb handling quality is the standard for the producers of the synthetic suture materials. It has excellent knotholding properties as well. Silk possesses capillary action, which means it should not be used in the presence of infection because it will provide a refuge for bacteria and will result in a nidus of infection. Silk is still used for vascular surgery, although the newer synthetic sutures are better for this purpose.

Cotton: -

The most common application of cotton in large animal practice is as umbilical tape. Cotton is the twisted yarn from the filament of the cotton plant. It handles well, but it produces more tissue reaction than silk. Cotton can potentiate infection because it can harbor bacteria, and the fistulation that may result resolves only when the offending suture material has been removed. Nevertheless, cotton is a useful, economical suture material in a variety of situations, especially those involving food animals. It has been used as a suture in the perineal region for prolapses of the uterus, vagina, and rectum, where the suture will be removed.

Nylon: -

Nylon (Dermalon, Ethilon, Supramid) is a long-chain polymer available in monofilament and multifilament forms. It is most commonly used in the monofilament form. Nylon is a stiff suture that should be stretched out following its removal from the manufacturer's packet. It has significant memory, which is defined as the suture's ability to resist bending forces and to return to its original configuration. The new varieties of nylon are more pliable and provide very good knot security. Similar to other monofilament materials, plastic deformation occurs during knot tightening, locking the suture in place. Nylon is relatively inert when implanted in tissues; a thin connective tissue capsule is produced around the suture, and this characteristic is one of its major advantages when it is used as a buried suture. Nylon loses a slight amount of strength initially, after which no appreciable diminution in strength is noted. Because there are no interstices to harbor bacteria, the monofilament form of nylon fares better than multifilament sutures in the presence of infection. Nylon is available in multifilament forms (Nurolon). Braiding this suture gives it some better handling characteristics than the monofilament form, but increases the possibility of harboring bacteria.

Polypropylene and Polyethylene: -

Polypropylene (Prolene and Surgilene) and polyethylene are polyolefins that are usually available in monofilament form. These sutures are relatively biologically inert and lose little strength in situ over a 2-year period. However, knot security has been shown to be inversely proportional to the memory and size of the suture, and because these sutures have very high memory, their knot retention is poor compared to the smaller monofilament alternatives. It is very important to securely tighten each throw as the knot is tied. Multiple loosely tied knots should be avoided. The first throw of a knot with polypropylene tends to slip unless tension is maintained. Both these suture materials are more suitable for use in infected wounds than the braided synthetic materials. Polypropylene has been recommended for closure of abdominal incisions in patients that are predisposed to developing postoperative infection because of its high tensile strength. However, due to its mechanical properties and persistence in the tissues, polypropylene has been associated with suture sinus formation following equine abdominal wall closure. The amount of tissue incorporated in the suture loops, the suture tension, and the knot volume should be minimized to reduce the risk of sinus formation. The slower degrading, synthetic, monofilament sutures, such as polyglyconate and polydioxanone, may be better options for equine abdominal wall closure.

Polymerized Caprolactam: -

Polymerized caprolactam (Supramid, Vetafil) is a synthetic suture material used extensively in large animal practice, especially livestock practice. It is available for veterinary use only. The twisted fibers are made from a material related to nylon and coated to minimize capillarity. Compared to gut or silk, the material has a high tensile strength and causes little cellular reaction in tissues. Polymerized caprolactam is packaged in plastic dispenser bottles in which it is chemically sterilized; in this form, it is suitable for use in skin closure. Because of its smoothness, some knot slippage occurs with this material, and at least three knots are required for a safe knot.4 In general, the material behaves like the other braided synthetics. The suture should not be used in the presence of infection, nor should the suture material be buried. Either of these events can lead to the formation of a chronic draining tract that will not resolve until the suture is removed. For this reason, this material should only be used for skin suture. From the standpoint of economics, polymerized caprolactam has a useful place in large animal practice. Surprisingly, little has been written about its behavior in the tissues of domestic animals.

Polyesters: -

Polyesters consist of Dacron, a polymer of ethlylene glycol and terapthalic acid, that has been coated or impregnated with various finishes. Tevdek and Ethiflex are Teflon impregnated Dacron, whereas Polydek is Teflon-coated Dacron. Ethibond is Dacron coated with polybutylate, and Ticron is silicone-impregnated Dacron. The suture is also available in uncoated forms (Mersilene and Dacron), but these sutures naturally have more tissue drag than the coated forms.20 Coating or impregnating the suture decreases capillary action and tissue drag, but also reduces the knot-holding ability. These materials need four throws, all squared, or five throws, two slip and three squared. The polyesters are strong sutures and are used when prolonged strength is required. Because of the multifilament nature of this material, bacteria and tissue fluids can penetrate the interstices of the polyester sutures. This can produce a nidus of infection, converting contamination to infection. Immobile bacteria have been transported inside the suture material; this is more significant than the spread of infection on the surface of the suture material. Consequently, these suture materials must be used under aseptic circumstances, circumstances that unfortunately may not always exist in large animal practice.

Stainless Steel: -

Stainless steel is an alloy of iron (iron-nickel-chromium) and is available in multi- or monofilament forms. It is difficult to handle because it is easily kinked;

yet it is the strongest of all suture materials. Stainless steel holds knots well, but the knots tend to be bulky. It is one of the most unreactive suture materials and can be repeatedly sterilized, but it has a tendency to cut tissues, as well as surgeons' gloves. Unlike the braided synthetics, stainless steel does not harbor bacteria and can be used in the presence of infection. Its use in large animal practice is infrequent. Skin Stapling Devices Disposable skin stapling devices have become available for use in surgery. They are commonly used for closing the skin of horses following laparotomy for the surgical correction of colic. One advantage of the device is its speed: the instrument closes skin incisions that are up to 2 feet long in a minute or so. This factor is important when the survival of the animal could be adversely affected by a longer anesthetic time. One study showed that the use of staples saved an average of 15.5 minutes of closing time per incision. In a meta-analysis, if staples were used in human orthopedic surgery, it was noted that there was a significantly higher risk of developing a wound infection when using staples compared to sutures.23 The review is based upon 6 papers and included 683 wounds and 332 patients. In hip replacement alone, the patients were four times more likely to have an infection after staple closure then after suture closure. There was no significant difference in the development of inflammation, discharge, the dehiscence, necrosis, or allergic reaction. Although staples are well tolerated by horses and can remain in the skin almost indefinitely, it is best to remove them in 2–3 weeks before the hair grows back


SURGICAL SUTURES
PLAIN CATGUT
OPEN
Absorbable Suture
USP 4/0 (2 Metric)
75cm
3/8 Circle
Round Bodied
18 mm
STERILE R
LOT 120615
06/2012
05/2017
CE 0434
medicalogy


2-0 (3.5 metric)
27" (70 cm)
Cutting
CP-1
TEAR LEFT
816
CHROMIC GUT
Sterile, Absorbable Surgical Suture, U.S.P.
Do Not Resterilize.
1/2 36mm
ETHICON.
©ETHICON, INC. *Trademark
816.01


1 (4.0 metric)
27" (70 cm)
Coated VICRYL*
(Polyglactin 910) Suture
VIOLET BRAIDED
J341
CT-1
36 mm 1/2c
Taper
ETHICON
STERILE EO
Sterile, Synthetic Absorbable Suture. U.S.P.
*Trademark © ETHICON, INC 2007
Do not reuse/ resterilize
See instructions for use
J341.P35
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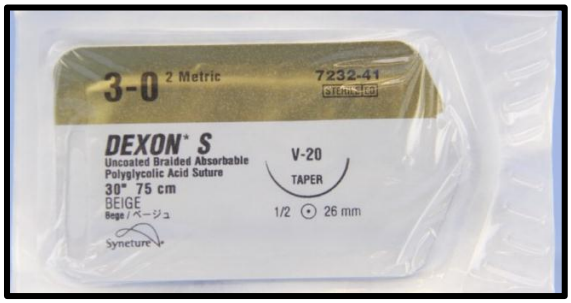
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7232-41
DEXON* S
Uncoated Braided Absorbable
Polyglycolic Acid Suture
30" 75 cm
BEIGE
Beige / ベージュ
V-20
TAPER
1/2 26 mm
Syneture


6-0
(0.7 Ph. Eur.)
ETHICON
MPP8873
PROLENE*
Polypropylene
PC-3
16 mm 3/8c
CUTTING
45 cm
* Trademark
ETHICON, LLC
CE 0086
MultiPass
PRIME
KB967
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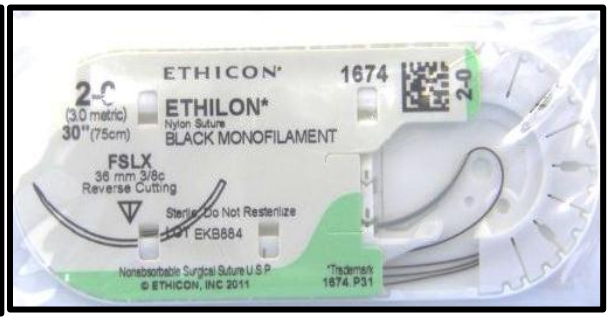
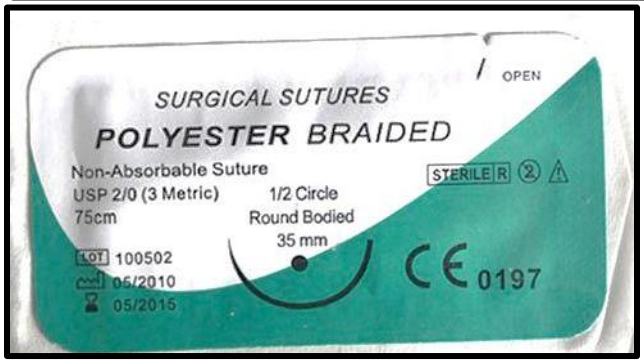

ETHICON
1674
2-0
(3.0 metric)
30" (75cm)
ETHILON*
Nylon Suture
BLACK MONOFILAMENT
FSLX
36 mm 3/8c
Reverse Cutting
Sterile, Do Not Resterilize
LOT EKB884
Nonabsorbable Surgical Suture U.S.P.
© ETHICON, INC 2011
*Trademark
1674.P31


SURGICAL SUTURES
POLYESTER BRAIDED
OPEN
Non-Absorbable Suture
USP 2/0 (3 Metric)
75cm
1/2 Circle
Round Bodied
35 mm
STERILE R
LOT 100502
06/2010
05/2015
CE 0197


2/0
(3 METRIC)
30mm 3/8 c
reverse cutting
75cm
KEEBOMED
SILK Braided
Non Absorbable suture
CE 1023
STERILE R
www.keebomed.com
LOT 130434
05 2013
05 2018


5-0 (1.0 metric)
18" (45 cm)
Sabreloc*
Spatula Needle
ETHALLOY*
Needle Alloy
Spatula
S-24
1/4 8.0mm
MERSILENE* 1764
Polyester Fiber Suture
WHITE BRAIDED
ETHICON.
Nonabsorbable Surgical
Suture, U.S.P. 1764.03
Sterile. Do Not Resterilize.
©ETHICON, INC. *Trademark


1 (4 METRIC)
STAINLESS STEEL
1 (4 METRIC)
STAINLESS STEEL WIRE
STERILE
LOT: 050520
MFG: 05 2005
EXP: 05 2010
75cm
1/2 circle
curved cutting
45mm

Needles: -

Surgical needles are essential for the placement of sutures in tissues. They must be designed to penetrate the tissue with a minimum of resistance and trauma; they should be rigid enough to prevent bending, yet flexible enough to prevent breaking. Naturally, they must be clean and resistant to corrosion. The selection of the needle is determined by the type of tissue to be sutured, its location and accessibility, and the size of the suture material. Surgical needles have three basic components: the eye, the body (or shaft), and the point. The eye is usually of two types—closed eye or swaged (eyeless). The closed eye is similar to a household sewing needle, and the eye itself is available in a variety of shapes. Swaged-on needles are permanently attached to the suture (Figure 4.1). The suture and needle are of approximately the same diameter. The outstanding advantage of a swaged-on needle is that tissues are subjected to less trauma, because only a single strand, rather than a double strand, of suture is pulled through the tissue. In addition, handling of the suture and needle is minimal, and it is ready for immediate use. At the end of surgery, the needle and the remaining piece of suture are discarded, and dull needles are continually culled. Tying the suture to the eye of the needle lessens the possibility of separation, but further increases the trauma as the suture material is drawn through the tissue. Needles are usually curved, although some surgeons prefer to use straight needles, especially when suturing skin or bowel. Needles have a variable curvature, and they may be 1/4-, 3/8-, 1/2-, or 5/8-circle or half-curved (Figure 4.2). Selection of a needle depends on the depth of the region to be sutured. When suturing deep in a wound, for example, the needle will have to "turn a sharp corner." In this case, a 1/2-circle or 5/8-circle needle would be most suitable. Curved needles must be used with needle holders. The body of the needle is available in a number of different shapes: round, oval, flat, or triangular. Flat and triangular bodies have cutting edges; round and ovalbodied needles usually taper from the small diameter at the point to a larger diameter at the eye. Needles are also available with varying types of points (Figure 4.3). Cutting needles are designed to cut through dense, thick, connective tissue, such as bovine skin. Cutting needles can be reverse cutting, where the cutting edge is provided along the convex side of the needle, rather than on the concave surface. The purpose of a reverse-cutting needle is to minimize the excessive cutting of transfixed tissue. Another modification of the cutting needle combines the cutting point with a round needle shaft so that the needle will readily penetrate the dense tissue but not cut through it; this has been called a taper cut needle. One company manufactures a needle of similar concept that is useful in tough, dense tissues such as cartilage (K-point needle). This needle readily penetrates the cartilage of the equine larynx. Noncutting needles,

or round needles, have no edges and are less likely to cut through tissues (Figure 4.3). They are used for abdominal viscera, connective tissue, vessels, and other fragile tissues. Round (atraumatic) needles are actually round behind the tip, but the remaining portion of the shaft is oval. This design prevents angular or rotational displacement of needle within jaws of needle holder. Long-stemmed needles are also used in food animal practice. They are useful for placing heavy suture materials into the tissues, such as in vaginal prolapse in cattle.

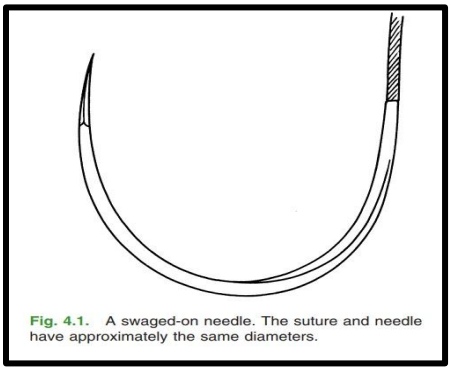


Fig. 4.1. A swaged-on needle. The suture and needle have approximately the same diameters.

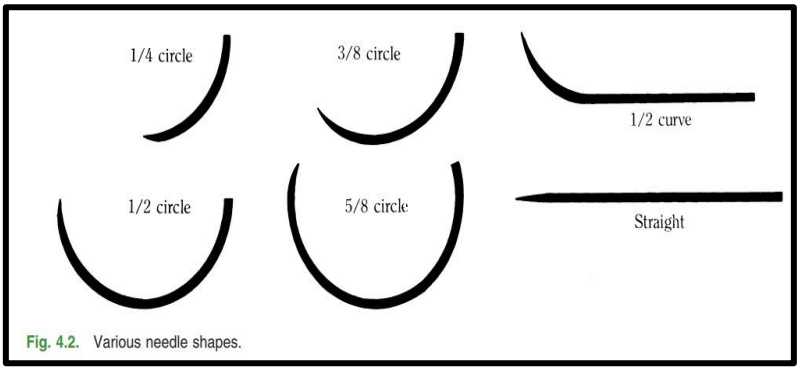


Fig. 4.2. Various needle shapes.

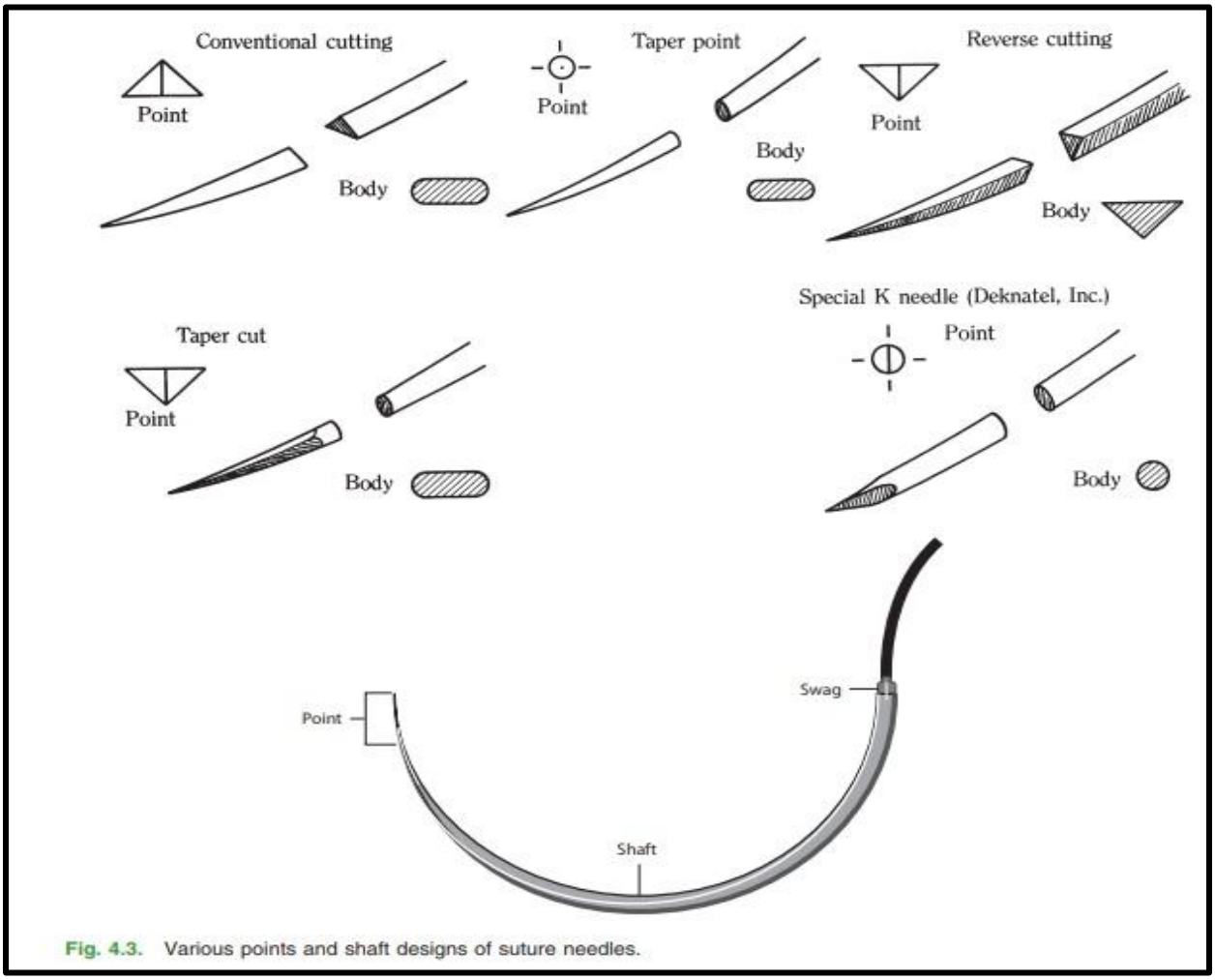


Fig. 4.3. Various points and shaft designs of suture needles.

Principles of Knot Tying: -

The following are several important principles of knots and ligatures that the surgeon should consider:

• The amount of friction between the strands of suture determines knot security.
• Suture size and type impact the amount of friction between strands and thus knot security; the smallest size suture and knot that will not jeopardize wound strength should be used.
• Monofilaments create less friction against one another and the tissue. They have been designed to deform when tied to provide increased knot security.
• The length to which the suture ends should be cut depends on the security of the knot. For example, catgut suture tends to swell and untie when exposed to moisture, so the surgeon should leave the suture ends slightly longer than other sutures.
• Studies show that regardless of suture type, maximum knot security is reached at a maximum of two additional throws to the starting square knot (four throws total). Additional throws will exacerbate tissue irritation and impede healing. They should be used when a surgeon's knot or slipknot is used
• If instruments such as clamps are to be applied to the suture, as in herniorrhaphy in foals and calves, they should not be applied to those parts of the suture material that will remain in situ.

Knotting Techniques: -

The square knot is the knot used most in surgery (Figure 5.1). The knot is usually tied with needle holders, which should remain parallel to the wound, whereas all movements are made perpendicular to the wound. Uniform tension to the ends of the suture ensures that the knot ends up as a square and not as two half-hitches (slipknot). Two half-hitches result from unequal tension on the two ends during tying (Figure 5.1). The granny knot is a slipknot that will not hold, especially if the strain on the ends is unequal; its use is not recommended (Figure 5.1). Knots that tighten when the second throw is pressed home, as well as knots that end a continuous suture in which two strands are tied to one, are also prone to slippage. Knots stay tied because of the friction of one component against another. At least three separate throws are required to achieve the minimum amount of friction with the square knot. Monofilament suture materials, such as nylon, polypropylene, and braided synthetics, especially those that are Teflon coated, have poor knot security. With these materials, the first throw may loosen before the next throw is applied. Knotting technique warrants careful attention when using such suture materials. However, newer monofilament suture materials are designed to deform when the knot is tightened to improve knot security beyond

that of braided suture. The surgeon can ensure knot security with braided synthetics with four throws, all squared (a double square knot) or with a knot with five throws, two slip and three squared. Care must be taken with steel because it also is prone to slippage if the knots are poorly placed. A surgeon's knot is used when the first throw of a square knot cannot be held in position because of excessive tension on the wound edge (Figure 5.1). The surgeon's knot is basically the same as a square knot, except the first part of the knot consists of two wraps. The surgeon's knot should be further reinforced by four additional throws (Figure 5.1). The Miller's knot is very useful for ligating pedicles. There are two encircling wraps of suture to increase friction between the suture and pedicle (Figure 5.1). The knot should be finished with four throws, all squared. In locations where tying knots is difficult, such as deep in the abdomen, or in laparoscopy, a 4-S modified Roeder knot can be very helpful (Figure 5.1). It is essentially a slipknot that uses friction to keep from loosening. The knot is tied, the loop placed over the structure to ligate, and the knot is pushed down with a knot pusher to tighten.

Tying with the Needle Holder: -

In most instances, knots are tied with the aid of a needle holder (Figure 5.2A to F). The instrument tie is recommended for most surgery because of its adaptability and because it is economical, when compared with the onehand or two-hand tie. It is possible to use short pieces of suture material and still grasp the suture firmly. The technique for an instrument tie is as follows: a loop of the long end of the suture is made around the end of the instrument with the instrument in front of the suture (Figure 5.2A). The short end of the suture is grasped by the needle holder, which is then pulled through the loop, setting the knot down securely (Figure 5.2B and C). Traction must be applied in the same plane as the knot (Figure 5.2D) while keeping the instrument and hand with suture close to the tissue. The second throw is begun by wrapping the long end of the suture around the instrument, but in the opposite direction (Figure 5.2E). It is important to not lift the suture ends or the first throw will loosen. The short end of the suture is grasped and pulled through the loop (Figure 5.2F). The surgeon's knot is made using essentially the same procedure, except the first loop is doubled by placing a double loop around the needle holder. Knots should be tied with the correct tension. Excessive tension results in strangulation of the tissues, which leads to necrosis and delayed wound healing. Similarly, the wound should not be allowed to gape, because of either too few sutures or lack of tension. To relieve the tension on individual sutures, the number of sutures used to close the incision should be increased; the underlying principle is that when sutures are uniformly spaced, the tension is distributed equally among the sutures.

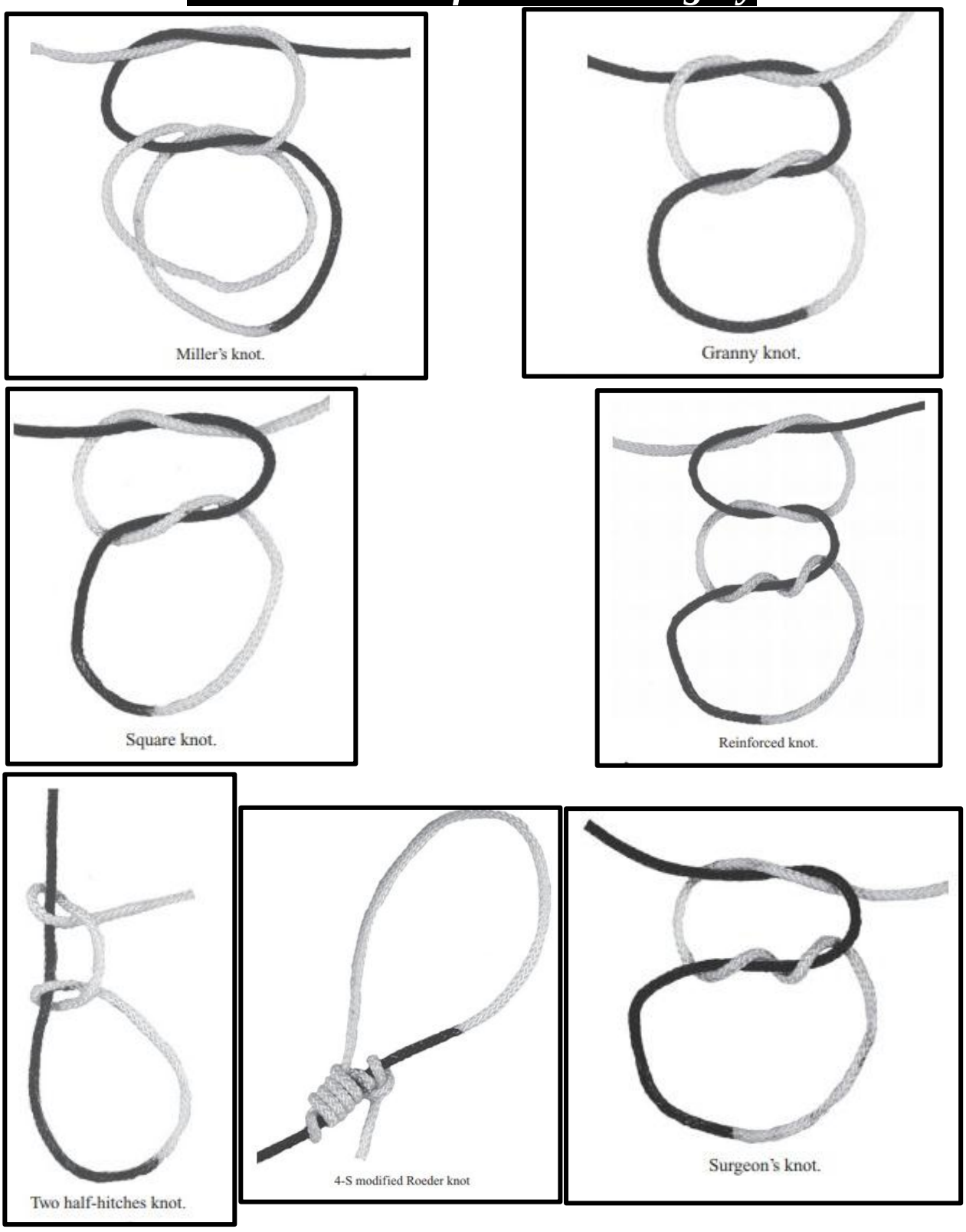


Fig. 5.1. Surgical knots

Ligatures: -

A ligature is a loop of suture used for occluding a blood vessel either before or after it is severed. Ligature loops are frequently used in laparoscopy for structures within the abdominal cavity. Laparoscopic ligatures, such as the 4-S modified Roeder knot, are usually formed using a knot pushing device and a slipknot. These techniques are covered in depth elsewhere.5,6 To prevent slipping, a ligature can be converted to a transfixation ligature by passing it through the middle of the vessel. It is tied around half the vessel and then around the entire vessel. Transfixation ligatures can be used to ligate several blood vessels within tissues (Figure 5.3). As little tissue as possible should be left distal to the ligature because the stump so created will become necrotic and will have to be absorbed by the animal. Care must be taken not to cut the stump too short or the ligature may slip over the end and result in the loss of fixation. Double loops are stronger than single loops because of the distribution of friction and tensile forces. In addition, the bursting strength of a loop is inversely proportional to the volume that it encloses. In other words, the tension on the suture is proportional to the volume. Practically speaking, mass ligation of tissue is more apt to break than are ligatures around small bleeding points or isolated vessels. Furthermore, vessels can recannulize within a large mass of ligated tissue. When large amounts of tissues must be ligated, the three-forceps method can be used. The forceps are placed on the pedicle, as shown in Figure 5.4. Forceps A are distal and forceps C are proximal. The pedicle is divided between forceps A and B, and the ligature is placed proximal to forceps C. The first throw on the ligature is made; and, as forceps C are removed, the ligature is tied into the crease left by forceps C. Further throws are then placed on the ligature, and forceps B are loosened to check for hemorrhage. The main drawback of this technique is that the tissue in the crease has been crushed and could allow hemorrhage on the proximal side of the ligature. A better option in this instance is a Miller’s knot without the use of a crushing forceps technique.

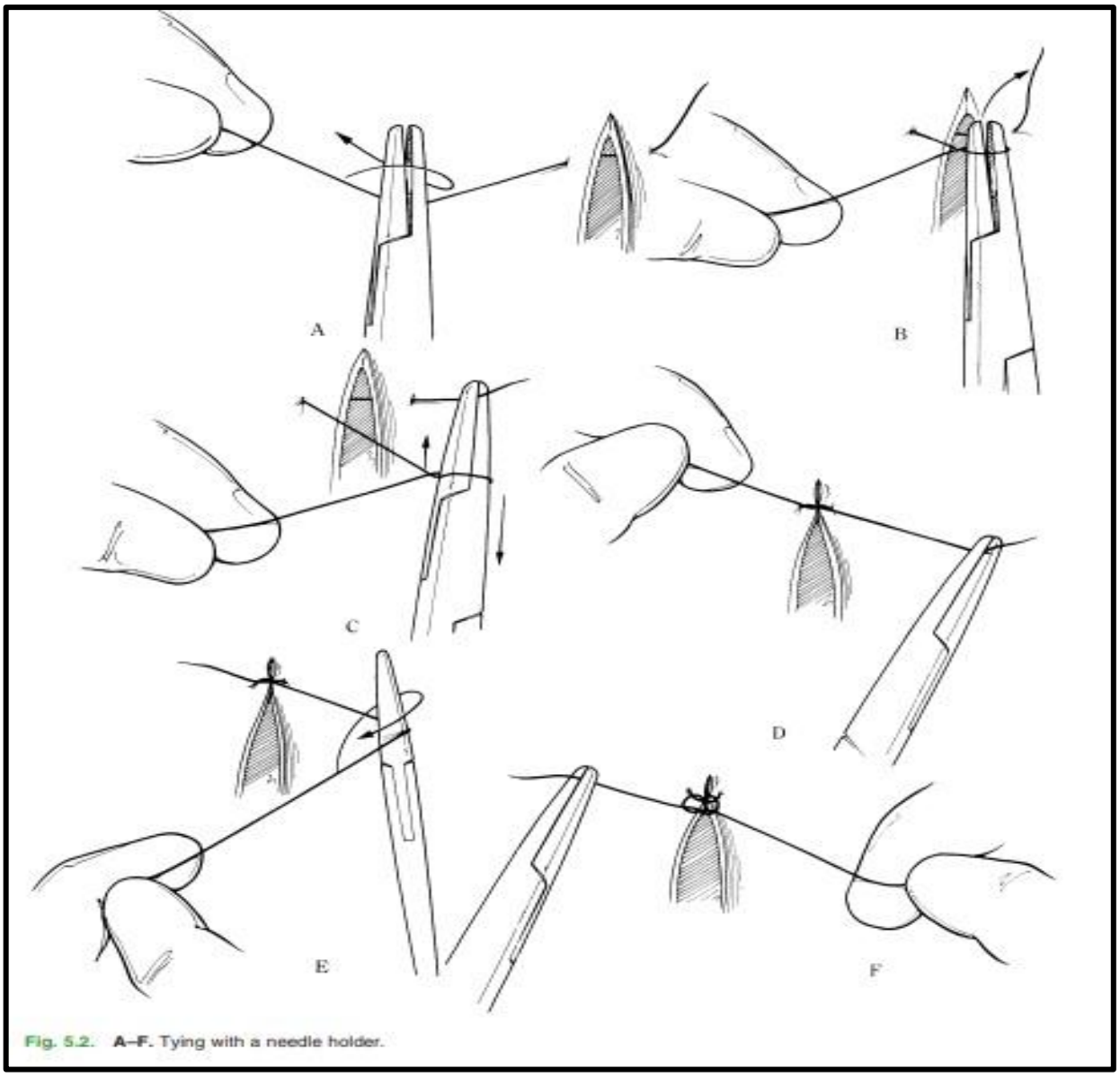


Fig. 5.2. **A–F.** Tying with a needle holder.

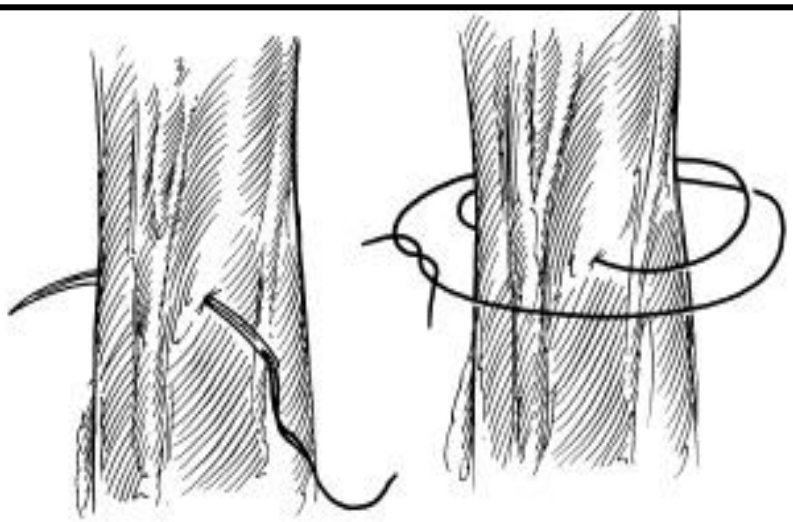


Fig. 5.3. Transfixation ligature.

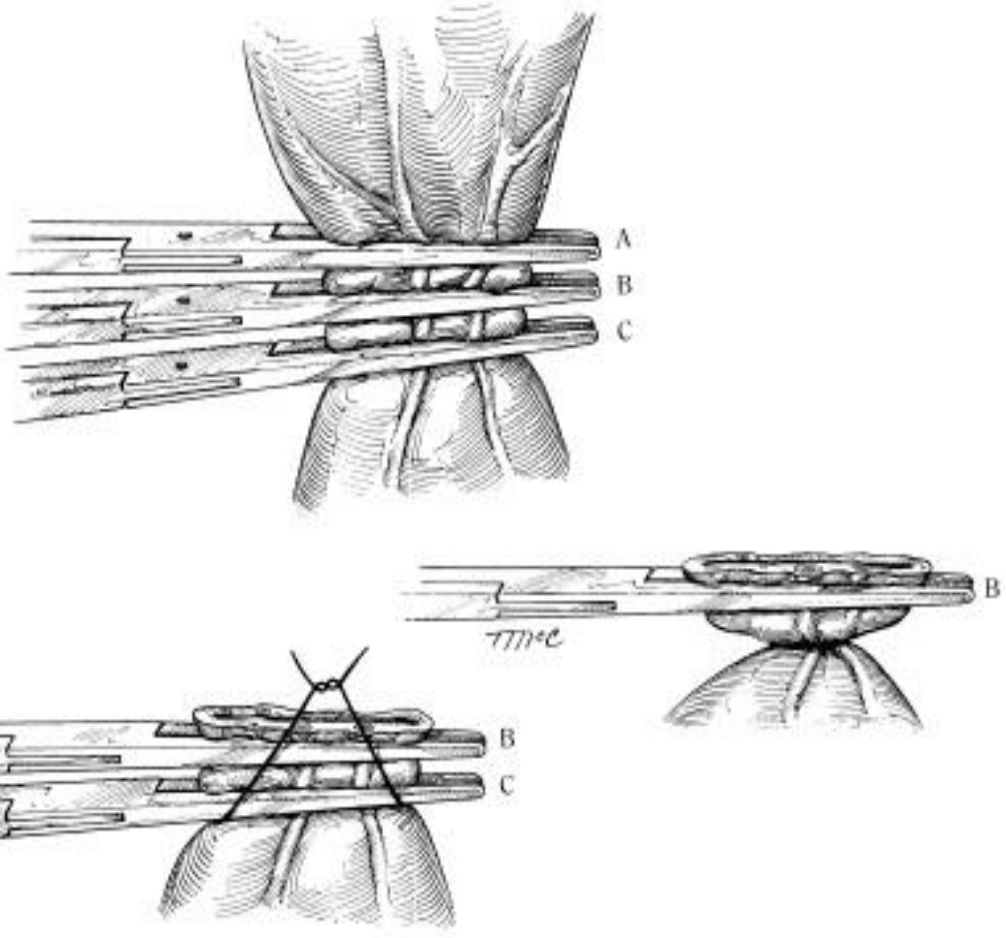


Fig. 5.4. Three-forceps method of tissue ligation.

SUTURE PATTERNS: -

1-Basic Suture Patterns

A-Simple interrupted suture

Technique: -

It is a simple pattern by which the needle is inserted perpendicular at a right angle at one side of the wound (considerable distance far from the edge according to the species), passes through the wound, and exits at the same distance from other wound edge at the other side of the wound, then after the two free ends knotted, accordingly this pattern opposes the skin. This pattern is used in tissues that will not be subjected to a lot of tension.

Advantages: -

1-Simplicity

2-Opposition of the skin

3-Parallel to the blood supply of the wound and not retard healing

4-When one knot untied; the other knots maintain the strength of the suture line

Disadvantages: -

1-Time consuming because of the high number of knots

2-Consuming of large amount of silk material

3-Not suitable for areas subjected to tension

B-Simple continuous suture

Technique: -

It is the same as simple interrupted but it has only two knots, one at the beginning and the other at the end of the wound. This pattern is used for tissues that will not be subjected to a lot of tension.

Advantages: -

1-Simplicity

2-Opposition of the skin

3-It is performed faster than simple interrupted pattern

4-Consumption of lesser amount of silk

5-It is parallel to the blood supply so it will not cause retardation of healing

Disadvantage: -

1-When one stitch is untied the strength of the suture line can't be maintained

2-Not suitable for areas subjected to tension

C-Continuous lock stitch (Ford interlocking suture)

Technique: -

It is a modification of continuous suture pattern. After the needle is inserted perpendicular on the wound and exits from the other side, it is drawn through the performed loop and tightened.

Advantages: -

1-Simplicity

2-Opposition of the skin

3-Consumption of lesser amount of silk and lesser time than simple interrupted

4-Relative maintenance of the suture line strength when one stitch is untied

5-It is parallel to the blood supply so it will not cause retardation of healing

Disadvantage: -

1-It is not as simple as the previously mentioned patterns

2-Time consuming than simple continuous pattern

3-Not suitable for areas subjected to tension

D-Horizontal mattress suture

Techniques: -

This pattern can be performed either in interrupted or continuous manners. With respect to the interrupted pattern, the needle passes through one side of the wound at point number one and exits from the other side at point number two, in the same manner as simple interrupted pattern, leaving considerable length of tissue on both sides (according to species), then at a considerable distance lower to the exit point, the needle is reinserted at point three and passes to the 1st side again to exit through point number four (at lower level than entrance point one), thus two pieces of the silk can be seen parallel to the incision. The needle should be inserted with acute angle through the skin to prevent eversion of the skin. Finally the two free ends of silk are knotted. The four points of entrance and exit form rectangle.

Regarding continuous pattern, only one knot is created at the beginning of the wound by simple interrupted stitch then the same mentioned technique is performed from one side to the other in zigzag manner with creation of another knot at the end of the wound.

Advantages: -

1-It can be used in areas where much tension is placed on the skin

2-Interrupted manner has advantages of interrupted pattern in relation to continuous patter, i.e. cutting of one stitch will not affect the other stitches etc, and continuous pattern has advantages of continuous pattern at lesser time and suture materials consumption etc

Disadvantages: -

1-The main disadvantage of that pattern is that it interferes with blood supply to the skin and interferes with healing as the suture material is perpendicular to the blood supply

2-Other disadvantages are the same general disadvantages of interrupted and continuous patterns

E-Vertical mattress suture

Technique: -

In this type of suture pattern, the needle is inserted at point number one at considerable distance from the edge of the wound (according to the species) and passes through the wound to exit at point number two at the same distance from the wound edge but on the other side of the wound.

Then the needle is reinserted at the same level at point number three that lies medial to point number two (midway between the wound edge and point number two), passes through the wound and exits at point number four medial to point number one and midway between point number one and wound edge.

Finally the two free ends of the suture material are knotted to form the stitch with two suture material lines presented perpendicular on the suture line, one on each side of the wound, at the same time the four points of entrance and exit presented at the same level. This type of suture can be used in areas where much tension is placed on the skin.

Advantages: -

1-The main advantage of that pattern than horizontal mattress pattern is that it doesn't interfere with blood supply of the skin like horizontal type as the stitch is parallel to blood supply

2-It has the same general advantages of interrupted pattern

Disadvantages: -

1-It has the same general disadvantages of interrupted patter as consumption of much suture material and more time.

2-It causes much more eversion of the wound lips

F-Cruciate suture (Cross mattress)

Technique: -

In this type of suture, the needle is inserted at point number one at one side of the wound at considerable distance from the wound edge, passes through the wound to exit through point number two in the same manner as simple interrupted.

Then the needle is inserted at point number three at the same side of point number one and at lower level, passes through the wound and exits from point number four at the other side of the wound and at lower level than point number two but at the same level of point three.

Finally the two free ends of the suture materials are knotted. The four points of entrance and exit create rectangle and two lines of suture materials can be seen on the surface of the wound. These two lines make X or cross over the two lips of the wound and prevent eversion.

Advantages: -

1-The main advantage of that pattern than other mattress patterns is that it doesn't interfere with blood supply nor it causes much eversion

2-It has the same general advantages of interrupted pattern

Disadvantages: -

It has the same general disadvantages of interrupted patter as consumption of much suture material and more time

G-Near-far-far-near suture

Technique: -

This type is a mixture of cross mattress and vertical mattress sutures. The needle is inserted at point number one at considerable distance from the wound edge, passes through the wound and exits at point number two at the other side of the wound but at higher level and much more far from the wound edge.

Then the needle is inserted at point number three at the same level of point number two and far from the wound edge with a distance similar to that of point

number two, passes through the wound and exit at point number four at the other side of the wound, at the same level of point number one and far from the wound edge with a distance equal to that between point number one and wound edge. Finally the two free ends of the suture materials are knotted and the four points of entrance and exit creates trapezoidal shape with two unequal suture material lines that are perpendicular at the wound and parallel to each other, can be seen on the surface of the wound.

Advantages: -

1-The main advantage of that technique is that it mainly used for linea alba of horse as it is a good tension suture

2-It has the general advantages of interrupted pattern

3-It doesn't interfere with blood supply of the wound

Disadvantages: -

It has the same general disadvantages of interrupted pattern as time and suture materials consuming pattern.

H-Subcuticular suture

Technique: -

This type of suture is used to avoid the small scars produced around suture holes in other patterns. The needle is inserted into the subcutaneous tissue in the apex of the wound and passes to the other side and a knots is tied subcutaneously, then the suture is advanced like continuous horizontal mattress, but the needle is inserted in one side and exits at lower level in the same side, then it is advanced to the other side and inserted then drawn at lower level till the end of the wound. At the end of the wound the suture material is knotted subcuticular and no suture materials can be seen after suturing of the wound as the knots are subcutaneous.

2-Suture Patterns for Hollow Organs

These patterns are either opposing or inverting patterns and can be applied in as single or double rows. Single row patterns have high incidence of leakage, dehiscence, adhesion and peritonitis, while double row patterns associated with high incidence of stenosis. Whither single row or double row is the best, it stills questionable.

A-Lembert suture

Technique: -

This pattern can be used in an interrupted or continuous manner. The needle passes through the serosa, muscularis and submucosa but it doesn't involve the mucosa.

The needle is inserted at point number one in a perpendicular manner on the wound at one side of the wound and passes the mentioned layers then it is exit at point number two that is nearer to the wound edge and at the same level of point number one and at the same side.

Then after the needle is inserted at point number three at the same level with the other two points and with a distance from the wound edge similar to that between point number two and the wound, passes the mentioned layers and exit at point number four at the same level of the other three points and far from the wound lips with same distance between point number one and the wound.

The four points exist at the same level, and after knotting the stitch, only one line of the suture material can be seen perpendicular on the wound.

Regarding the continuous manner, only two knots are created at the beginning and at the end of the wound and the only parts that can be seen after completing the pattern, are oblique and parallel lines that are perpendicular on the wound edge.

Advantages: -

1-It is the simplest pattern for the internal organs

2-It is relatively rapidly performed

3-It inverts lips of the wound, and never involves the mucosa so the possibility of contamination is low

4-The interrupted manner has the same general advantages of interrupted manner and the continuous manner has the same general advantages of continuous manner.

Disadvantages: -

1-It produces slight stenosis of the bowel

2-Interrupted Lembert has the same general disadvantages of interrupted manner and continuous Lembert has the same general disadvantages of continuous manner

3-It cause retardation of healing when it is applied perpendicular on blood supply

B-Halsted suture (interrupted Quilt)

Technique: -

It is a modification of Lembert pattern that has 8 points of entrance and exit divided on two lines (four points for each line) and can be performed either in interrupted or continuous manners. The needle passes through the serosa, muscularis and submucosa but it doesn't involve the mucosa. The needle is inserted at point number one in a perpendicular manner on the wound at one side of the wound and passes the mentioned layers then it is exit at point number two that is nearer to the wound edge and at the same level of point number one and at the same side.

Then after the needle is inserted at point number three at the same level with the other two points and with a distance from the wound edge similar to that between point number two and the wound, passes the mentioned layers and exit at point number four at the same level of the other three points and far from the wound lips with same distance between point number one and the wound. Then the needle inserted at point number five at a level lower to that of point number four and advanced to exit through the point number six at one side of the wound then advanced to point number seven at the 1st side of the wound to exit through point number 8. The two free ends at point number one and number 8 are knotted so that only two lines of suture material can be seen parallel to the wound (one on each side).

Advantages: -

1-It inverts lips of the wound, and never involves the mucosa so the possibility of contamination is low

2-The interrupted manner has the same general advantages of interrupted manner and the continuous manner has the same general advantages of continuous manner

Disadvantages: -

1-It produces slight stenosis of the bowel

2-Interrupted type has the same general disadvantages of interrupted manner and continuous type has the same general disadvantages of continuous manner

3-It cause retardation of healing as it will be always perpendicular on blood supply

C-Interrupting inverting mattress suture: -

Technique: -

This pattern is similar to the horizontal mattress suture pattern but the bites of the stitch are parallel to the edges to the wound. The needle is inserted at point number one at one side of the wound at considerable distance from the wound

edges and advanced parallel to the wound to exit at the same side of the wound but at lower level.

Then the needle advanced to the other side and inserted at point number three at the same level of point number two and advanced parallel to wound to exit from point number four.

The four points of entrance and exit form rectangle, and after knotting the two free ends at point number one and four, only two lines of suture material can be seen perpendicular on the wound, parallel to each other and of the same length.

The technique should be performed in interrupted manner and it causes inversion of the wound edges. The mucosa may be or not involved during suturing.

Advantages: -

1-It inverts lips of the wound, that lowers the possibility of contamination and if doesn't involve the mucosa, the possibility of contamination is maintained at minimal level

2-It has the same general advantages of interrupted manner

Disadvantages: -

1-It produces slight stenosis of the bowel

2-It has the same general disadvantages of interrupted manner

3-It causes retardation of healing (it is perpendicular on blood supply)

D-Cushing suture

Technique: -

It resembles inverting mattress suture but it is performed in *continuous* manner, and the *mucosa* is not involved.

Following creation of the knot at the beginning of the wound, the needle is inserted at one side of the wound at point number one and advanced parallel to the wound without penetrating the mucosa then it exits from point number two at the same side of the wound.

Then after the needle is advanced to the other side of the wound and inserted at point number three at the same level of point number two, and advanced without penetrating mucosa to exit through point number four that has level lower than that of point number three.

The final shape of the pattern shows lines of the suture material that parallel each other and perpendicular on the wound.

Advantages: -

1-It inverts lips of the wound and doesn't involve the mucosa that lowers the possibility of contamination

2-It has the same general advantages of continuous manner

Disadvantages: -

1-It produces slight stenosis of the bowel

2-It has the same general disadvantages of continuous manner

3-It cause retardation of healing as it will be always perpendicular on blood supply

E-Connell suture

Technique: -

It resembles cushing suture pattern, but the needle passes all intestinal layers, so the possibility of contamination is higher.

Advantages: -

1-It inverts lips of the wound, that lowers the possibility of contamination but it involves the mucosa, the increases possibility of contamination

2-It has the same general advantages of continuous manner

Disadvantages: -

1-It produces slight stenosis of the bowel

2-It has the same general disadvantages of continuous manner

3-It cause retardation of healing as it will be always perpendicular on blood supply

4-It has higher possibility of contamination when compared with techniques that don't involve the mucosa

F-Schemieden's suture

Technique: -

It is an inverting suture pattern that doesn't involve the mucosa. Stitches are brought through from inside the gut into the muscularis and drawn from the serosa

Advantages: -

It has the same general advantages of continuous pattern (rapid and consumes lesser amount of suture materials)

Disadvantages: -

1-It has higher probability of infection as the mucosa is involved and the two serosal surfaces are not permitted to come in contact as they are separated by the suture material

2-It has the same general disadvantages of continuous pattern

G-Simple interrupted suture

Technique: -

It involves the mucosa and can be performed in two manners, either simple interrupted that doesn't interfere with circulation, or crushing manner that interferes with blood supply.

Advantages: -

It has the same general advantages of interrupted pattern

Disadvantages: -

It has the same general disadvantages of interrupted pattern

H-Gambee suture

Technique: -

It is an interrupted pattern in which the needle is inserted in a perpendicular manner into the serosa of one side of the wound at considerable distance from the wound edge, exits from the mucosa and reinserted through the mucosa to exit from the submucosa. Then it passes to the submucosa of the other side, exits from the mucosa, reinserted through the mucosa to exit through the serosa

Advantages: -

1-It has the same general advantages of interrupted pattern

Disadvantages: -

1-Less simple than other technique

2-It has the same general disadvantages of interrupted pattern

I-Parker-Kerr oversew

Technique: -

It is a mixture of cushing over which another Lambert pattern is performed. A hemostatic forceps is applied perpendicular on the hollow organ, and then the organ is severed

The 1st layer of cushing is applied after which the forceps is removed and a Lambert pattern is applied

Advantages: -

1-It has the same general advantages of continuous pattern

2-It has lower possibility of contamination

Disadvantages: -

1-It has the same general disadvantages of continuous pattern

2-It is associated with higher possibility of retardation of healing

J-Purse string suture

Technique: -

This pattern can be used to close small holes that evacuate gas from the bowel or to keep cannulae in situ, but it is mostly used with anus to retain rectum during rectal prolapse.

The needle is inserted parallel to the anal opening, 1.5 cm far, and advances subcutaneously for 1.5 cm then drawn, then reinserted with the direction of watch 360 degree, then the two ends of the suture material are tied in special manner that facilitates untying and retying for frequent evacuation of rectal contents.

3-Suture Patterns for Severed Tendons

A-Bunnell suture

Technique: -

Most of suture materials are kept inside the tendon to maintain the gliding function of the outer surface of the tendon and the suture material presented parallel to the tendon.

Double round needle suture materials are used in this pattern. Starting at the right side, one needle is inserted at considerable distance from the edge of the severed tendon at right angle, and then the needle is reinserted 0.2 cm far to this site in diagonal or oblique direction toward the other surface of the tendon and exits at a point about 40% of the remaining distance. The same needle is reinserted 0.2 cm far and diagonally to exit at about 80% of the whole distance to the original surface.

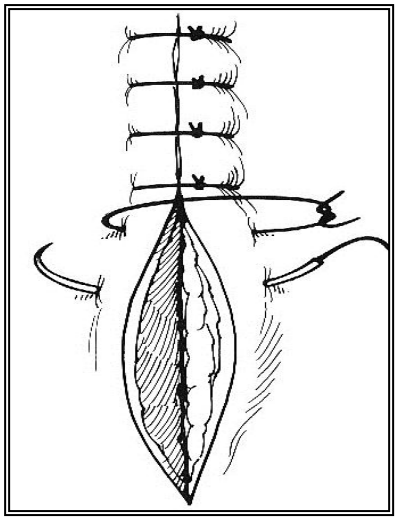
The other needle is advanced in the same manner, so finally an eight figure is formed inside one end of the tendon. In the other side of the severed tendon, the two needles are advanced from the end of the tendon and in the same mentioned manner.

All we can see are seven 0.2 cm long suture materials parallel to the tendon, two longer lines (one on each surface of the tendonn), and a knot. They all constitute 10 points.

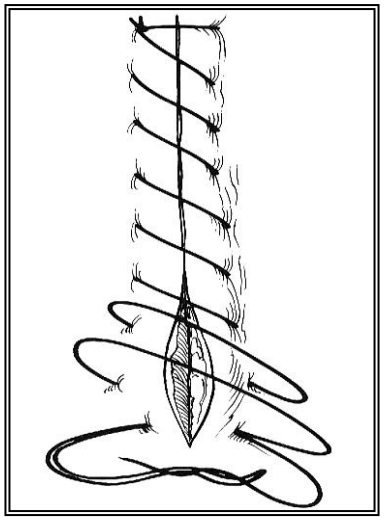
B-Locking-loop tendon suture

Technique: -

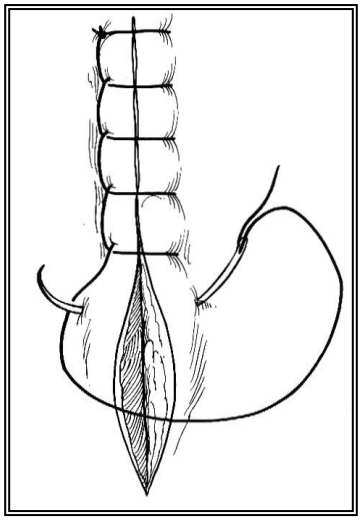
The needle is inserted through the cut surface of the tendon and advanced in the tendon to a considerable distance then drawn from one surface, at a point 0.3 cm lower and lateral to the point of puling of the needle, the needle is reinserted and passes perpendicular on the tendon, exits through the same surface, reinserted 0.3 cm higher and medial to the point of drawing, and then advanced parallel to the tendon and drawn from the cut edge at the same level of the 1st bite. The needle is advanced in the other side of the severed tendon in the same manner and the knot is made in the cut surface of the tendon.



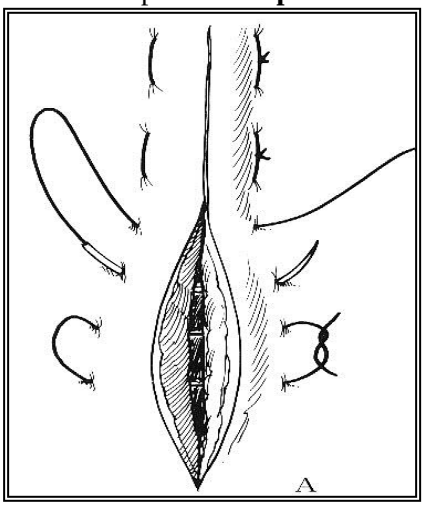
Simple **interrupted**



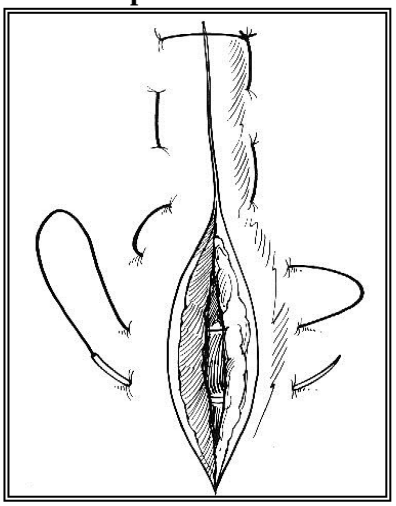
Simple continuous



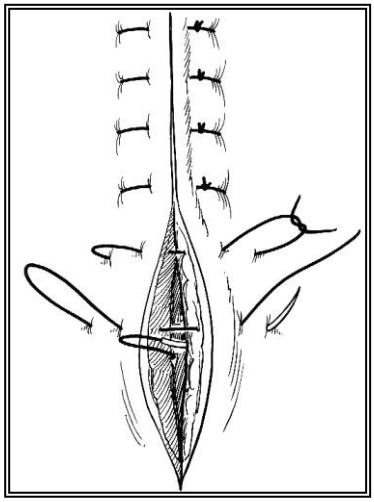
Interlocked



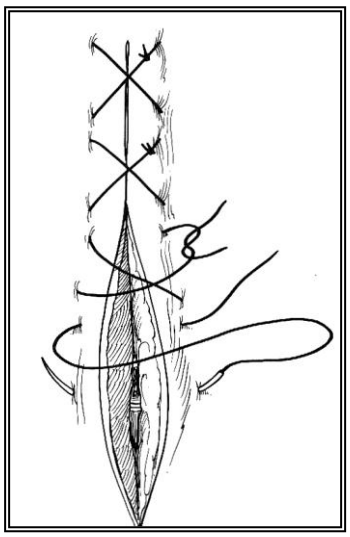
Interrupted horizontal mattress



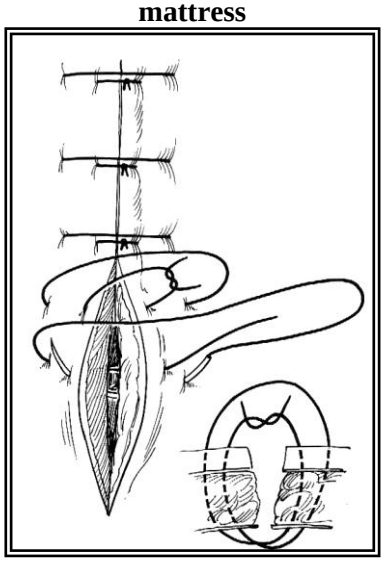
Continuous horizontal mattress



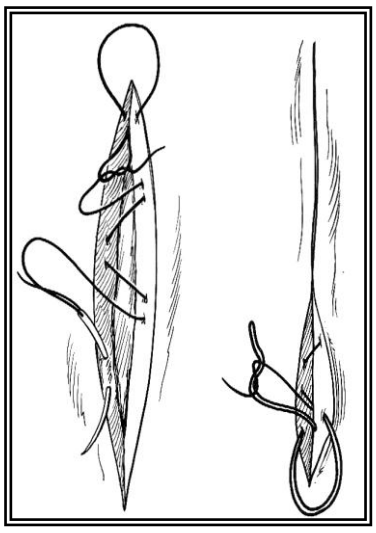
Vertical Mattress



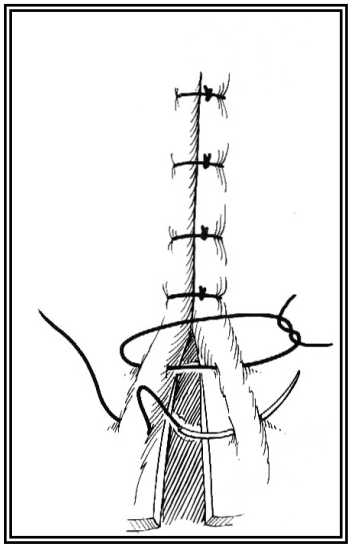
Cross Mattress



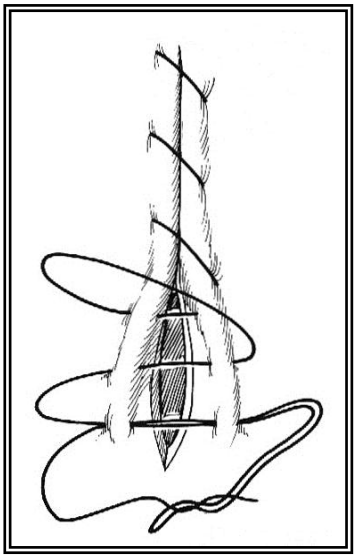
Near-far-far-near



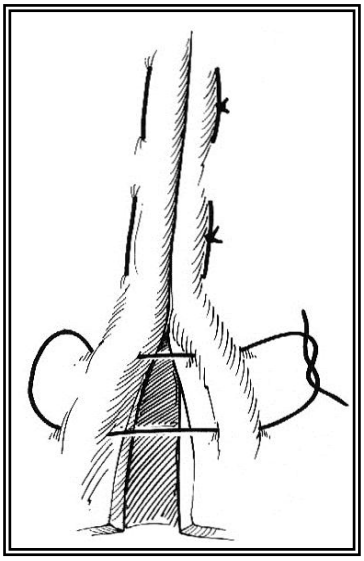
Sub-cuticular



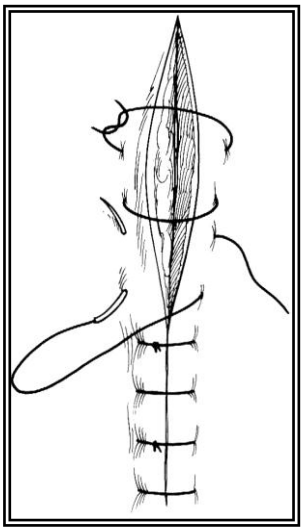
Interrupted Lambert suture



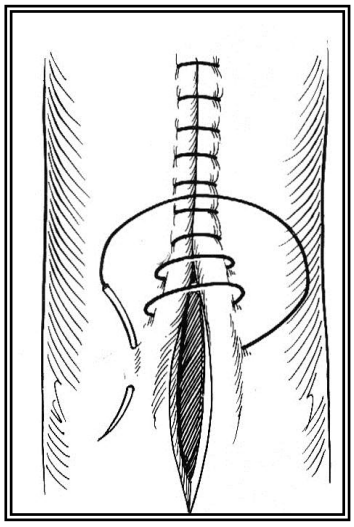
Continuous Lambert suture



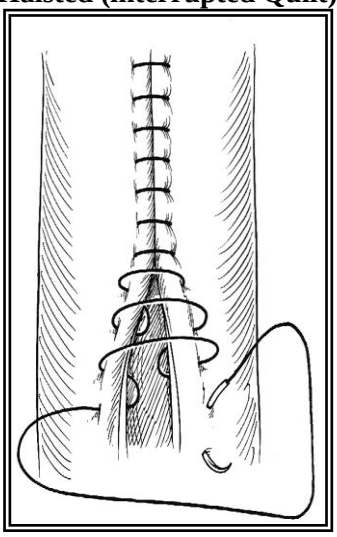
Halsted (interrupted Quilt)



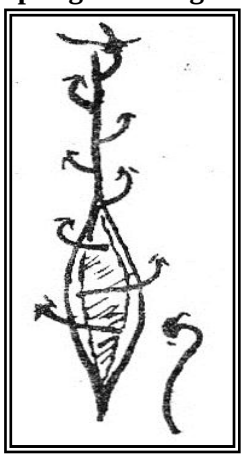
Interrupting inverting mattress



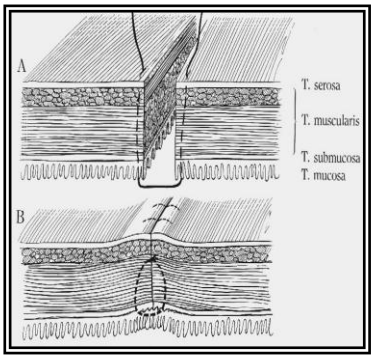
Cushing suture



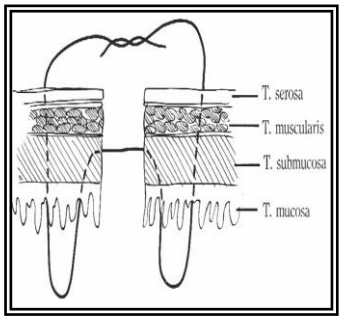
Connell suture



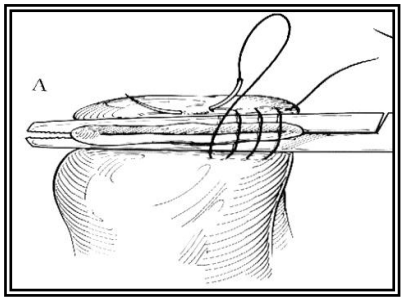
Schemieden's suture



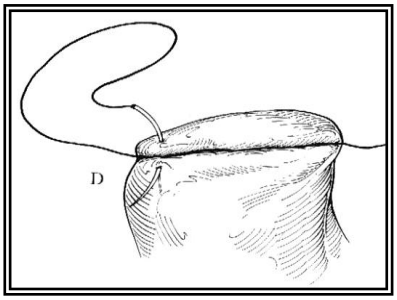
Simple interrupted suture

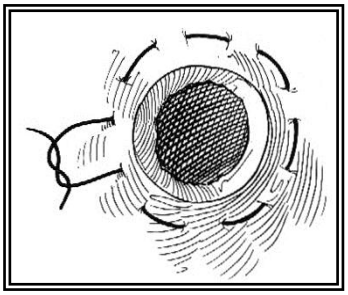


Gambee suture

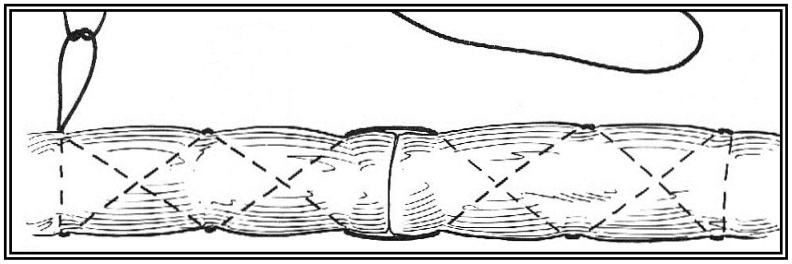


Parker-Kerr oversew

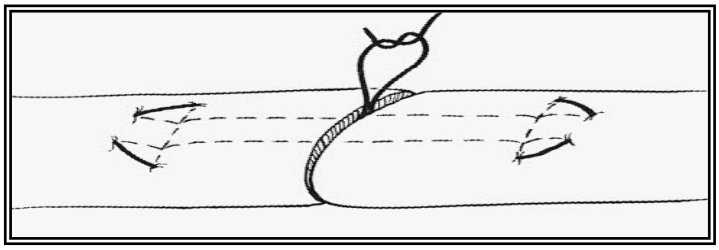




Purse string



Bunnell suture



Locking-loop tendon suture

Review question

Mention the most suitable pattern and suture material for suturing

1-Abdomenal muscles in horse

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2-Flank muscles in buffalo

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3-Skin behind elbow in horse

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4-Skin on the back of cow

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5-Skin on the belly of goat

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6-Skin on the side of neck of buffalo

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7-Rumen in cow

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8-Small intestine of dog

……..

9-Stomach in cat

……..

10-Uterus of cow

……..

11-Flexor tendon of horse

……..

12-Tongue of sheep

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By a diagram, illustrate the following suture patterns

Simple **interrupted**	**Simple continuous**	**Interlocked**
Cross Mattress	**Near-far-far-near**	**Sub-cuticular**
Interrupting inverting mattress	**Cushing suture**	**Connell suture**

Case report (number)

Date: - ……..

Species: - ……. **Gender: -** ……

Temperature: - …….. **Pregnancy: -** ……..

Complain: -……

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Diagnosis: -

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Treatment: -

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Case report (number)

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Complain: -……

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Diagnosis: -

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Temperature: - …….. **Pregnancy: -** ……..

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