

CHAPTER 8

BASIC SURGICAL SKILLS REQUIRED FOR SAFE CIRCUMCISION



This chapter provides information on the following:

- preparing a sterile operating field and maintaining sterility
- handling tissue safely
- handling needles and other sharp instruments safely
- placing surgical stitches (sutures)
- tying knots
- stopping bleeding by vessel ligation, suture transfixion or diathermy (haemostasis)
- setting up and safely using diathermy

8.1. INTRODUCTION

Surgical skill is the basis of safe surgery, irrespective of the type of surgery undertaken or the method used. Providers performing any of the conventional or device-based surgical circumcision methods discussed in this *Manual for male circumcision under local anaesthesia and HIV prevention services for adolescent boys and men (Manual)* need to be trained (see Box 8.1) and competent in all of the skills described in this chapter so that they can perform safe, high-quality male circumcisions. Having incompetent providers can lead to adverse effects and even loss of life in the people they are trying to help.

Box 8.1. Circumcision providers must be trained

Circumcision providers or those providing surgical backup for conventional or device-based surgical circumcision methods must be trained and competent in basic surgical skills.

The conventional or device-based surgical circumcision methods described in the 2009 edition of this *Manual* were based on assumptions that diathermy for haemostasis would not be available in most settings and that providers would control bleeding through vessel ligation and sutures. However, observation has shown that diathermy is more widely used than previously thought.

Diathermy can be used to stop minor bleeding if there is equipment and a provider skilled in the machine's setup and use. Providers who are competent in diathermy must also be competent in stopping the bleeding without using diathermy because severe bleeding cannot be controlled with diathermy, and there may be instances when the diathermy machine is unavailable or does not work. Therefore, this chapter describes other surgical techniques (vessel ligation and sutures) for haemostasis, which are a vital part of the circumcision provider's basic surgical skill set.

8.2. BASIC SAFETY MEASURES

In this section, the following topics are discussed: achieving and maintaining a sterile operating field, handling tissue safely, and handling needles and other sharp instruments safely during the conventional or device-based surgical circumcision procedure.

8.2.1. Preparing and maintaining the sterile operating field

The circumcision provider and anyone assisting them must always be aware of the sterile operating field and should adhere to the following infection prevention precautions and principles:

- Good aseptic technique should be used because it helps prevent wound infection.
- Everyone involved in the procedure should do the following:
 - Face the sterile operating field and be aware that everything to the side and back of those involved is not sterile.
 - Keep their hands in view, holding them upward and to the front of their bodies (that is, towards the sterile field).
 - Take care not to drop their hands to their sides.
 - Take care not to touch anything that is not in the sterile field.
- Anyone who is not directly involved in the procedure (that is, anyone other than the provider and their trained assistant) should not touch the sterile field.

When stitching sutures, care must be taken to keep suture material within the sterile field; otherwise, the loose end of the suture may accidentally move out of the sterile field and touch an area that is not sterile, particularly if the sterile drape is too small. If any instrument, suture or another item is contaminated during the procedure, it should be replaced with a sterile counterpart.

It is common to see mistakes in basic safety measures to protect the sterile operating field. These dangerous errors can be prevented through awareness and reminders of correct practice. Repeating correct practices over time can help establish them as habit.

Skin preparation and draping are described in Chapter 9.

8.2.2. Safe handling of tissue

In circumcision, safe handling of tissue is critical to achieve a good outcome. The following are guidelines for correct practice in handling tissue:

- Handle tissue gently. Handling it too firmly may crush the tissue and delay healing, which increases the risk of infection and worsens scarring.
- Use dissecting forceps (tweezers or pickup forceps) to hold the skin edges when suturing the circumcision wound; do not use artery forceps.
- Take the minimum piece of tissue needed.
- Hold the tissue firmly enough to prevent slippage, but do not apply excessive force.
- Place haemostatic sutures accurately, taking care to avoid inserting the needle too deeply into the surrounding tissue. Avoid pulling skin sutures too tight because this damages the tissue and can cause necrosis. This is particularly important for haemostatic stitches in the region of the frenulum and the 06:00 o'clock frenular skin closure stitch—necrosis in this region can cause urethral fistula (necrosis of tissue between the urinary passage and skin causing leakage of urine in the frenular area). The tension should be sufficient to bring the skin edges together so that they are just touching; there should be no gap between the edges, and the skin should not blanch or pucker.
- When suturing, ensure that the skin edges do not overlap because overlapping delays healing and gives a poor cosmetic result.

8.2.3. Safe handling of needles and other sharps

Handle sharps in a way that helps avoid injury. Sharps include needles, scalpel blades, disposable diathermy points and any other sharp instruments. The following are guidelines for correct practice in handling sharps:

- Sharps should always be taken or picked up using instruments; they should never be handled using fingers. Also, sharps should not be passed directly from one person to another; they should be placed on a sterile tray and taken or picked up using an instrument. These instructions apply to everyone who might come into contact with sharps, for example, the provider doing the procedure, any assistant or nurse, and anyone else in the procedure room.
- It is often necessary to reposition a needle while it is in the needle-holding forceps. Surgical providers should learn how to use dissecting forceps to reposition the needle. The correct technique should be emphasized during surgical training.
- Sutures should not be picked up or mounted on the needle using fingers. Rather, suture packets should be opened in such a way that the needle can be grasped with forceps or taken directly using the needle-holding forceps.
- At the end of the procedure, all sharps should be safely disposed of in a safety box. It is the responsibility of the provider doing the procedure to ensure that needles and other sharps are put into the safety box. If the provider doing the procedure neglects this duty, sharps—in particular, suture needles—are often accidentally bundled up with sterile drapes, and needle-stick (sharps) injuries often occur in staff who dispose of or launder drapes.

8.3. TYING SURGICAL KNOTS

Surgical knots are used to tie vessel ligatures and make sutures. Although knots can be tied by hand, it is better to tie the knots using instruments because this uses less suture material and has a lower risk of causing needle-stick (sharps) injury.

8.3.1. Square knot and surgeon's knot

The basic knot used in most surgical situations is a square knot with two or three throws (see Fig. 8.1). An alternative to use in particular situations is the surgeon's knot (see Fig. 8.2), which is the same as a square knot but with a double twist at the first throw. This double-twist knot is useful if the suture material is slippery or if there is some tension when placing the skin stitch because the knot can be gradually tightened to achieve the correct tension and help stop the slipping.

Fig. 8.3 shows the steps for making a two-throw square knot. To tie a surgeon's knot using instruments, follow the steps in Fig. 8.3 but, at Step 3, make a double-twist knot (see Fig. 8.2) instead of a single-twist knot.

Fig. 8.1. Square knot with two throws (A) and with three throws (B) (shown here to ligate a blood vessel)

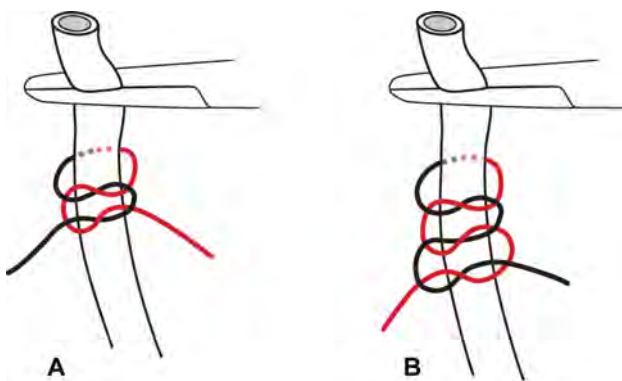
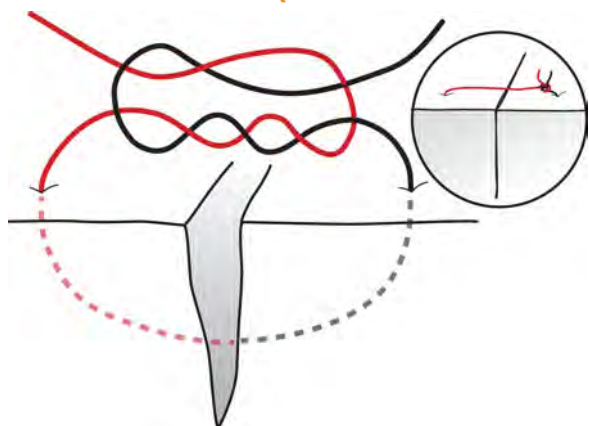
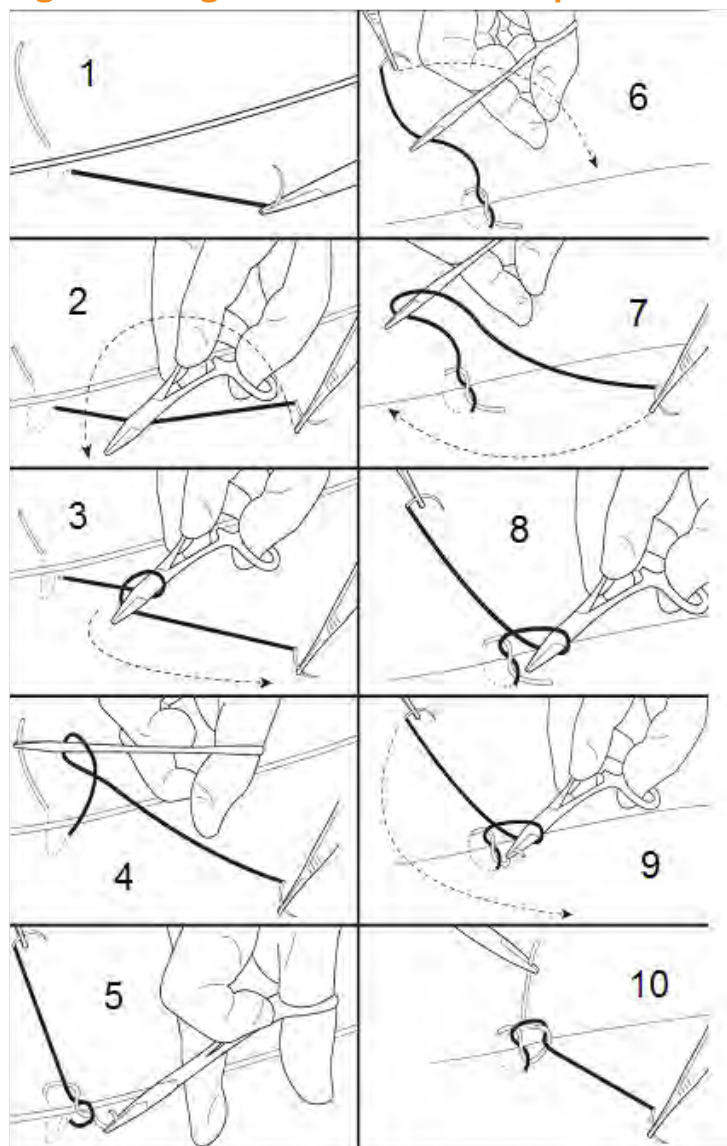


Fig. 8.2. Surgeon's knot with a double-twist knot at the first throw and a single-twist knot at the second throw (shown here for a skin stitch)^a



^a The inset shows that the knot should be tied in such a way that it overlies the skin side of the incision, not actually over the incision line.

Fig. 8.3. Using instruments to tie a square knot^a



^a The same process is used to tie a surgeon's knot (see Fig. 8.2), with a double-twist knot replacing the single-twist knot shown here in Step 3.

8.3.2. Cutting sutures

Once the knot has been tied, the ends (called the ears of the knot) should be cut approximately 3 mm from the knot. If the suture is cut too close to the knot, the knot is likely to come undone. If the suture is cut too far from the knot and the suture is subcutaneous, the excess suture material increases the chance of infection or nodule formation.

8.4. STOPPING THE BLEEDING

Minimizing blood loss is part of good surgical technique and safe medical practice—it reduces the risk of complications and the need for interventions that bring additional risks. This is particularly the case for clients who are anaemic; ideally, such clients should not be circumcised in the clinic but should be referred to the district hospital or a higher level of care. Minimizing blood loss also reduces contamination of items in the sterile field, such as instruments and operating drapes, and doing so reduces the risk of transmitting bloodborne infections, such as hepatitis B or C virus and HIV, to clinic staff who clean instruments and dispose of or launder drapes.

The following surgical techniques are used to reduce blood loss:

- **Compression:** Control oozing of blood by applying pressure over the surface with a gauze swab for two to three minutes. This will usually stop the bleeding and help identify blood vessels that have been accidentally cut and are bleeding profusely (referred to as bleeders), thereby requiring ligation or diathermy.
- **Temporary occlusion of blood vessels:** Control the bleeding from individual vessels by applying an artery forceps (see Fig. 8.4), taking care not to grasp too much tissue. An alternative technique is to pick up the vessel using dissecting forceps and then apply an artery forceps (see Fig. 8.5).
- **Tying and underrunning:** The simplest procedure is to tie the vessel below the artery forceps (see Fig. 8.1). Ensure that the tie is securely in place and not liable to slip off (for example, during a penile erection in the first few days after the operation). If there is any doubt about the security of the tie, it is better to use the underrunning technique (see Fig. 8.6). The steps for underrunning and tying are as follows:
 1. Secure the bleeding vessel with an artery forceps.
 2. Pass the suture needle beneath the blood vessel (but not too deep) and pull through, leaving enough suture material for the tie.
 3. Pass the suture beneath the vessel a second time, pull gently to occlude it and tie a knot as described in Section 8.3.1.

Fig. 8.4. Artery forceps applied to occlude a blood vessel

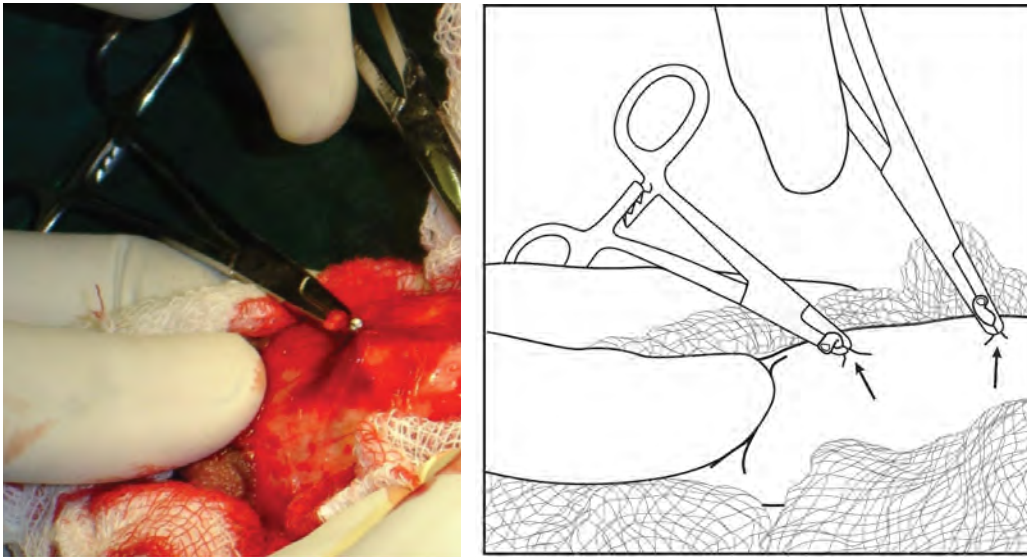


Fig. 8.5. Picking up a blood vessel with dissecting forceps (A) to facilitate accurate placement of the artery forceps (B)

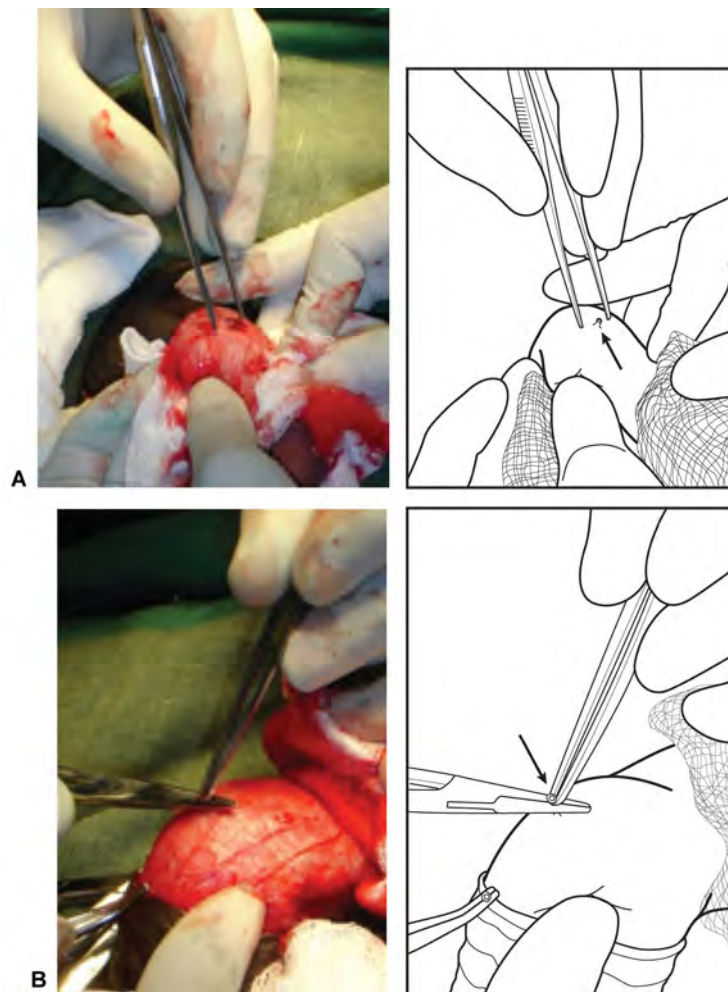
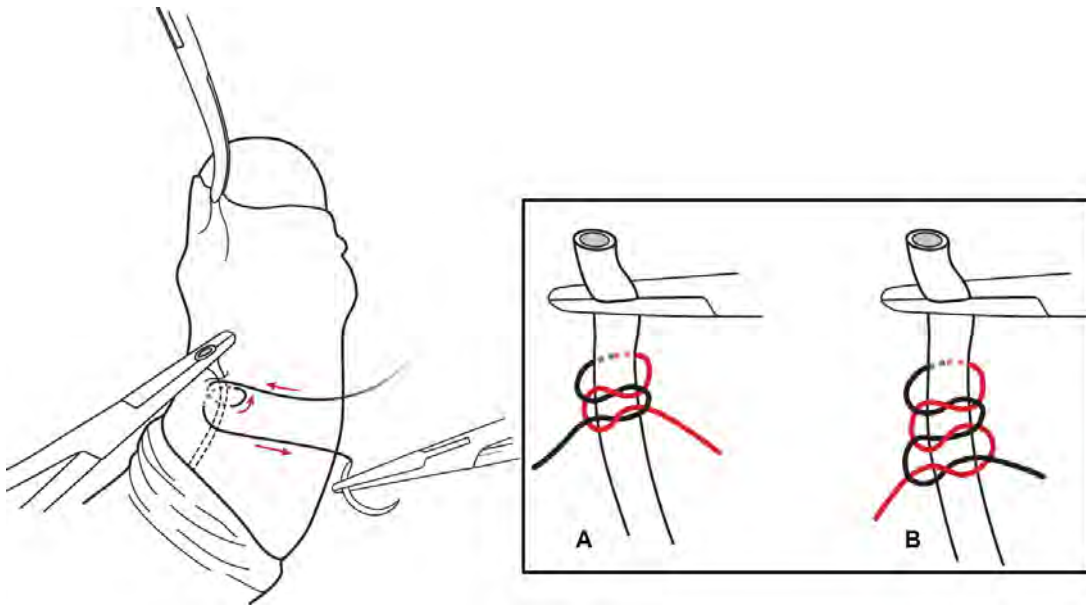


Fig. 8.6. Underrunning a blood vessel and tying the suture with a two-throw (A) or three-throw square knot (B)



8.4.1. Haemostasis

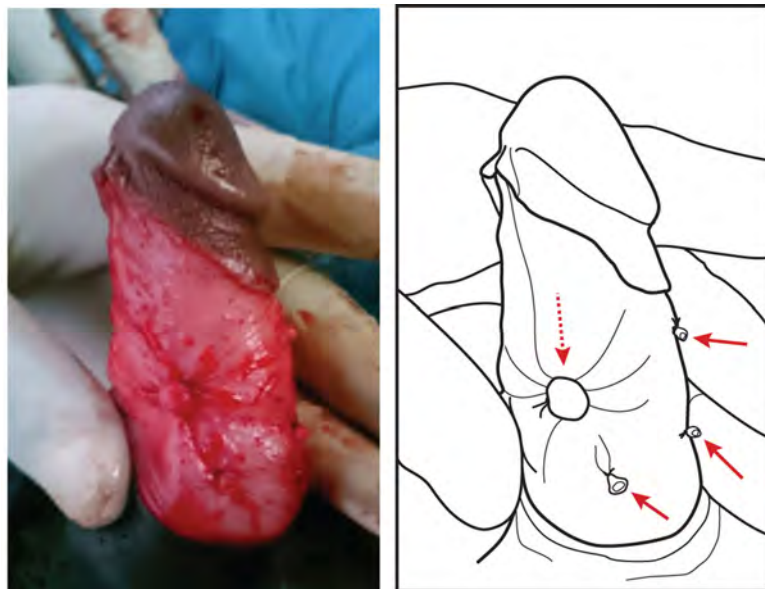
Bleeding that occurs after circumcision can lead to severe postprocedure complications. Such bleeding generally arises from a failure to control bleeding from vessels on the penile shaft. However, many providers focus more on bleeding from the skin edges; hence, it is important to correct this error of focus. The following guidelines are correct practices to use to prevent bleeding after circumcision:

- Following the removal of foreskin, pull the remaining skin towards the base to expose the whole penile shaft. At this stage, use a small, clean and dry swab to look for any bleeders that may have retracted under the skin. It is typical to find two or three such bleeding points on the shaft. These may be picked up at the tip with an artery forceps, then cauterized or ligated as described above.
- When bleeding is persistent, compression of the penile shaft, which is applied for at least five minutes, is effective in stopping most of the bleeding, thereby making it easier to see any major bleeders.
- Before starting to close the skin, always take a final look at the penile shaft and skin edges for any bleeding. Bleeding on the skin edges is less troublesome and will be controlled by both the skin sutures and compressive wound dressing.
- Bleeding from the frenulum (the fold of skin between the shaft of the penis and the foreskin in the 06:00 o'clock position) is a frequent problem and often difficult to manage. The frenular artery runs close to the base of the frenulum, and the risk of troublesome bleeding is reduced by taking particular care to cut the frenulum closer to its attachment to the foreskin and to avoid cutting the base of the frenulum where it is attached to the shaft of the penis. The frenular artery can be ligated, as described above, after pulling the skin down the shaft (see Chapter 9, Fig. 9.14–9.15). Care must be taken not to place this suture too deep because the urethra is immediately below; sutures placed too deep will enter the urethral wall and can cause tissue necrosis, resulting in a hole between the urethra and the outside skin (urethral fistula). If this happens, it can lead to lifelong disability, so all providers need to be especially alert to this potential problem.
- A troublesome minor adverse event is the formation of subcutaneous nodules under the skin of the shaft of the penis, which is caused by an excess of suture material or by the inclusion of too much tissue in the ligature during haemostasis. In some cases, these nodules are not bothersome enough to require surgical removal. The risk of developing subcutaneous nodules can be reduced by effective haemostasis (see Fig. 8.7):
 - Pick up bleeding vessels accurately and precisely. Do not take large pieces of tissue.

- Use 3/0 or 4/0 sutures, and tie surgical or square knots correctly using no more than three throws.
- Tie knots correctly, and avoid too many throws; this is especially important if polyglactin (Vicryl Rapide™) is used. This material becomes very slippery when wet, and if knots are not tied correctly, they come undone.

Finally, cut sutures accurately to leave a 3 mm ear (the cut end of the suture).

Fig. 8.7. Haemostatic ligature that has gathered too much tissue^a



^a Shown here is an example of a haemostatic ligature that has gathered too much tissue (red-dotted arrow) and will probably result in the formation of a subcutaneous nodule. Vessels should be picked up accurately, as shown in Fig. 8.4–8.6.

8.4.2. Using diathermy safely

Bleeding can be stopped by using diathermy to cause coagulation. However, diathermy requires a secure electricity supply and may not be available in some facilities; hence, providers who undertake conventional or device-based surgical circumcision should be skilled at performing the procedure and stopping the bleeding without diathermy. All techniques described in this *Manual* can be undertaken safely without using diathermy.

There are two types of diathermy: monopolar and bipolar. Bipolar diathermy is safer than monopolar diathermy but has some disadvantages: tips of the diathermy forceps can become charred, and diathermy forceps can stick to the tissue, thereby reducing their efficacy and requiring them to be cleaned frequently with a scratch pad. Thus, monopolar diathermy is widely employed and, when used correctly, is easier to perform than the bipolar procedure.

Safe diathermy requires the provider doing the procedure to understand diathermy, the machine connections, the power settings and surgical technique, and to apply that knowledge.

8.4.2.1. Diathermy machine setup

The setup for a diathermy machine is described in Annex 8.1. The provider undertaking the procedure is responsible for understanding the equipment and knowing the recommended connections and power settings for the diathermy machine's proper use in each clinic or procedure room where they work—and in the context of conventional or device-based surgical circumcision. The provider also needs to check that the connections and settings are correct before undertaking a circumcision. For male circumcision, only coagulation power settings are needed. If the diathermy machine has both cutting and coagulation outputs, the cutting power output should be switched off. If the machine has a blend switch to enable simultaneous application of coagulation and cutting outputs, this blend setting should be switched off.

The provider doing the procedure must take particular care when working in an unfamiliar facility or with an unfamiliar diathermy machine, or both. Machine settings vary for different surgical procedures. Hence, in an unfamiliar facility, or in a facility or room where other types of surgical procedures are performed, the provider doing the surgery should:

- Ask appropriate clinic staff about the normal or usual machine settings.
- Ensure that the coagulation and cutting outputs are correct.
- Ensure that the cutting current and blending setting are turned off.

Further generic guidance on this subject cannot be given in this *Manual* because of the variety of different diathermy machines. Refer to the diathermy machine's instructions for use for specific details.

8.4.2.2. When not to use diathermy

Diathermy is not appropriate in certain situations:

- Diathermy should not be used on a penis that is very small. This precaution applies to many boys aged less than 14 years because they are not yet physically mature.
- If the vessel lumen can be seen, diathermy is best avoided because a visible lumen indicates a larger blood vessel and more potential for excessive bleeding. In this situation, bleeding should be stopped with an artery forceps and ligation or underrunning the vessel (as described above in Section 8.4).
- Avoid the use of diathermy close to the incision edge or the skin surface because this can result in a full-thickness burn and an area of necrosis. These effects increase the chances of wound healing problems, including wound rupture along the surgical border (dehiscence), wound infection and delayed healing.
- Do not use diathermy at the frenulum. The urethra is close to the base of the frenulum, and diathermy of the frenular artery can cause a burn through the urethral wall. This may result in urethral fistula (urine coming out of the wound at the site of the frenular stitch, usually some days after the operation). It can take a few days for diathermy-related urethral fistula to appear because the full thickness of the burn through the urethral wall takes time to necrose and thin out. Once this happens, the fistula may become apparent.

8.4.2.3. Safe diathermy surgical technique

Whichever method of diathermy is used (bipolar or monopolar), the provider should take great care and should be trained and skilled in safe diathermy surgical technique. Most diathermy-related adverse events are caused by errors in technique (see Box 8.2). The following are guidelines for good practice when using diathermy:

- Accuracy and precision are important. When using diathermy, identify the correct vessel (the bleeder) and apply the forceps as precisely as possible. Best results will be obtained if the blood vessel is between the diathermy forceps with minimal other tissue. Do not grasp large pieces of tissue. Once the vessel has been accurately picked up, slightly lift the vessel before applying the current to confine the burn to the vessel. Take care not to pull too hard because small vessels may tear.
- Apply the diathermy current for a short time (about one to two seconds). If this does not stop the bleeding, reapply the forceps with greater precision. If the current is applied for too long, it will cause a large, deep burn that predisposes the client to infection, delayed wound healing, excess scar tissue and complications, such as a urethral fistula.
- Avoid traction on the penis. For diathermy to work, the point of greatest electrical resistance must be the tissue at the tip of the diathermy forceps. The provider doing the procedure must not pull on the penis while applying diathermy. Traction on the penis can narrow the base of the penile shaft, making that the point of greatest electrical resistance rather than the tissue at the tip of the diathermy forceps. In the worst case, this can result in a burn at the base of the shaft and loss of the entire penis. This dangerous situation is more likely to occur if the penis size is small (for example, in younger or less mature adolescents) or if the provider doing the procedure makes serious errors of technique, such as taking too large a piece of tissue with the diathermy forceps; pulling on the penis to get a better view, thereby channelling the current through a narrow area at the base of the penis; or applying the current for too long.

Box 8.2. Errors in diathermy technique

Errors in diathermy surgical technique can lead to serious complications. Therefore, it is important to be aware of common errors and understand how to avoid them; it is also important not to use diathermy in situations where it is contraindicated.

- Do not use diathermy when the penis size is small because there is a risk of a burn at the base of the penis, which can lead to a loss of the entire penis.
- Diathermy is best used on small (or narrow) vessels. If the vessel lumen is large enough to be seen, then the vessel should be picked up accurately and ligated because diathermy on such large vessels results in less secure haemostasis.
- Apply the diathermy accurately and with precision, taking the minimum amount of tissue in the forceps.
- Avoid prolonged application of the current.
- Avoid creating large burns, and avoid diathermy at the skin edges because extensive damage and burnt skin predispose the client to infection and delayed healing.
- Avoid diathermy at the frenulum because of the risk of a deep burn into the urethra, which can cause urethral fistula.
- Use diathermy only after receiving special training in its technique.
- All staff should take care not to trip on any cables on the floor; if this happens, then the cable connections and plug should be checked.
- All equipment, including cables and plugs, should be periodically inspected for fraying or insulation damage.
- All diathermy equipment should be serviced and tested according to manufacturer's instructions for use.
- Single-use diathermy pencils and single-use dispersive plates should not be reused.
- Do not ignore, lower the volume of or mute the audible beeps or alarm on the diathermy equipment—these sounds alert staff to equipment malfunction.
- Ensure that the machine is set up properly, in terms of connections and settings, to prevent adverse events resulting from a faulty machine connection.

8.5. PLACING SUTURES

The goal of suturing is to achieve apposition without tension and with correct skin orientation. Too much tension in any type of skin suture increases the likelihood that the suture will cut through and disrupt the wound. Information on suture material and the type of needle to use is in Box 8.3, followed by information on basic suturing techniques.

Box 8.3. Choice of suture material and needle

Determining the ideal suture size is a compromise between ensuring that there is adequate tensile strength and minimizing the amount of foreign material introduced into the body.

- Large suture sizes to tie blood vessels produce a more unsightly scar and can lead to small, persistent lumps.
- A fast-absorbing suture material should be used. These materials include polyglactin 910, which has been treated for a more rapid breakdown (Vicryl Rapide™), or chromic catgut (although, this is becoming less available).
- Standard (that is, not fast-absorbing) polyglactin sutures are listed as standard supplies by the United Nations Population Fund and United Nations Children's Fund (1, 2). Use undyed polyglactin to prevent a tattoo marking on the skin. The size of the polyglactin should be 3/0 or 4/0.

The suture may be mounted on a taper-cut, reverse cutting needle that is 3/8 of the circle. The taper-cut needle passes more easily through the skin; however, it also easily tears the skin on the inner aspect at the corona. For younger adolescent boys with soft skin, a round-bodied needle is often sufficient.

8.5.1. Different types of suturing techniques

This section describes the following suture techniques: simple interrupted, mattress, vertical mattress and horizontal mattress.

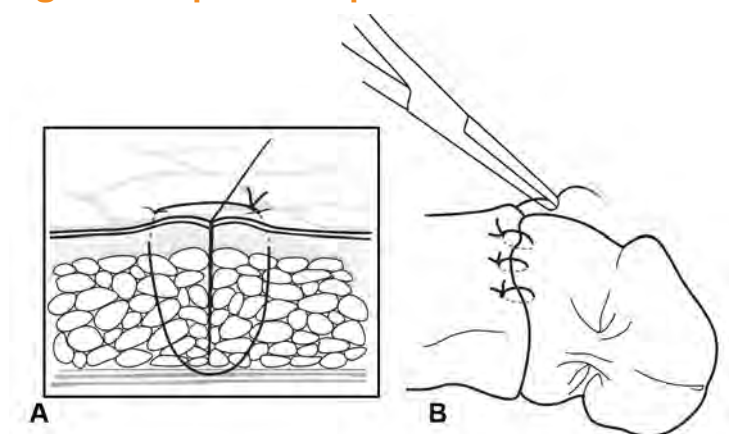
8.5.1.1. Simple interrupted suture

The simple interrupted suture is the simplest type of stitch and yields good apposition results.

1. Pass the point of the needle through the skin at 90° to the skin surface, and exit at the same angle (see Fig. 8.8[A]).
2. When suturing the penile shaft skin to the mucosal cuff, ensure that the knots are on the penile shaft side of the incision (see Fig. 8.8[B]).
3. Use as few simple interrupted sutures as possible between the 03:00, 06:00, 09:00 and 12:00 o'clock mattress sutures—typically two or three interrupted sutures (see Fig 8.11). This technique will result in a total of about 12–16 sutures.

The nearer to the skin edges the needle goes in, the better the apposition of the skin edges but higher the risk of the stitch cutting out. If stitches are placed too far from the wound's edge, there is a risk of inversion (burying) of the skin edges, which results in poor healing. **Hence, a combination of simple and mattress sutures is recommended.**

Fig. 8.8. Simple interrupted suture^a



^a(A) The suture is in place, holding the edges of the skin together. Source: (3). (B) Simple sutures close the circumcision incision—note that the knots are placed overlying the penile shaft skin and not overlying the mucosal cuff.

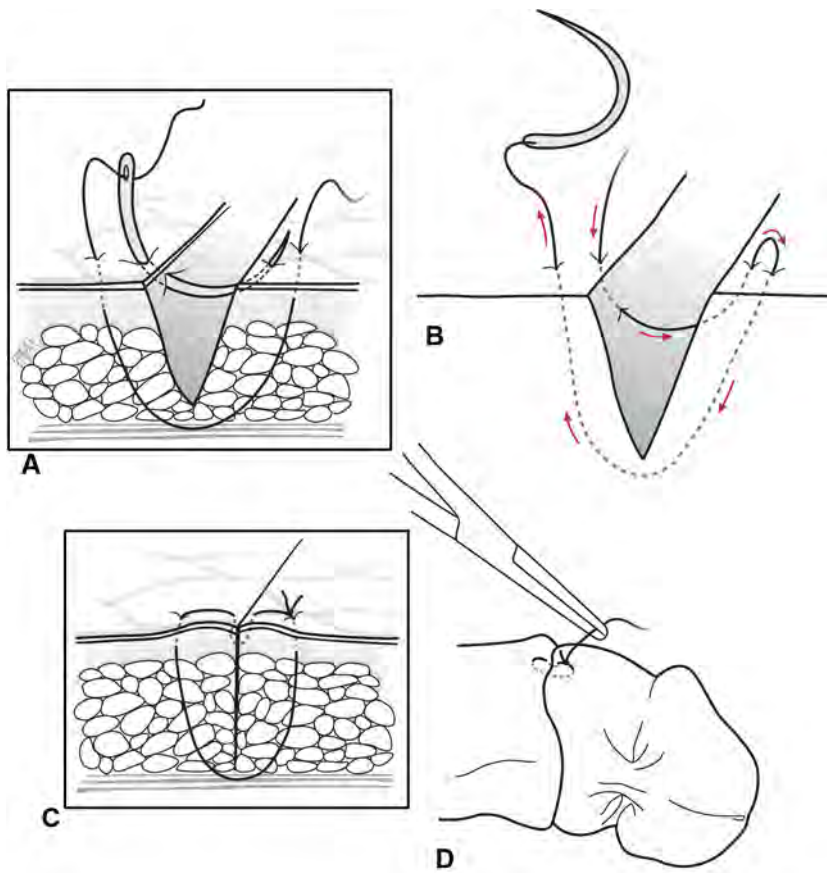
8.5.1.2. Mattress suture

Mattress sutures give a more precise apposition of the wound edges and reduce the risk of burying the skin edges. They are more complex than simple interrupted sutures; therefore, they require more time to put in.

8.5.1.3. Vertical mattress suture

The vertical mattress suture is illustrated in Fig. 8.9.

1. Start the first bite approximately 4–5 mm from the incision edge and pass to the same position on the other side of the wound.
2. Start the second bite approximately 1–2 mm from the incision edge, on the same side of the incision where the needle has just exited the skin. Pass the needle through the skin between the exit point and the wound edge, in line with the original entry point.
3. From this point, take a small bite; the final exit point is in a similar position on the other side of the wound.
4. Tie the knot so that it does not lie over the incision line. This suture approximates the subcutaneous tissue and the skin edges.

Fig. 8.9. Vertical mattress suture^a

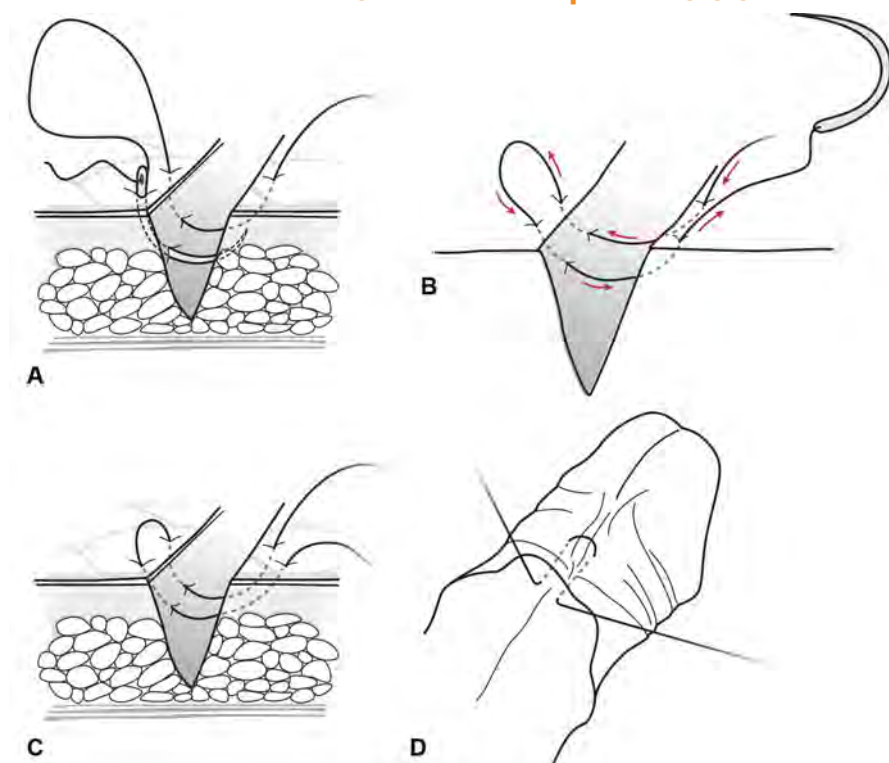
^a Vertical mattress suture technique (A,B); vertical mattress suture holding the skin edges and subcutaneous tissues together (C); and vertical mattress suture in the 09:00 o'clock position (D)

8.5.1.4. Horizontal mattress suture

This horizontal mattress suture is illustrated in Fig. 8.10.

1. Make two sutures beside one another. Align the first stitch across the wound; begin the second stitch on the side where the first ends.
2. Tie the knot on the side of the original entry point.
3. Use a horizontal mattress suture in the 06:00 o'clock position (frenulum), but keep the suture shallow. Great care must be taken to avoid placing the suture into deep layers, as the urethra is near the surface at the 06:00 o'clock position. Deep sutures can cause necrosis, resulting in urethral fistula—urethral fistula can be difficult to repair and may result in a lifelong problem.

Fig. 8.10. Horizontal mattress suture technique (A, B and C) and the horizontal mattress suture at the frenulum (06:00 o'clock position) (D)



8.5.2. Closing the circumcision wound

When suturing the circumcision wound, vertical mattress sutures should be placed in the 03:00, 09:00 and 12:00 o'clock positions (taking the frenulum at the 06:00 o'clock position; see Fig. 8.11), and a horizontal mattress suture should be placed at the 06:00 o'clock frenulum position. The 03:00, 09:00 and 12:00 o'clock mattress sutures are needed to ensure that the circumcision's wound edges do not invert (fold inwards).

The 12:00 o'clock vertical mattress suture is best placed as the first suture and the 06:00 o'clock frenulum horizontal mattress suture as the second suture. It is important to ensure that the midline raphe is in line with the frenular ridge and urethral meatus (if the raphe is naturally centred, see note below), and that there is an equal amount of skin on each side (see Box 8.4). If the ends of the 12:00 and 06:00 o'clock sutures are left long, they can be held with forceps and used to display the incision to be sutured (see Fig. 8.11).

Box 8.4. Note on alignment

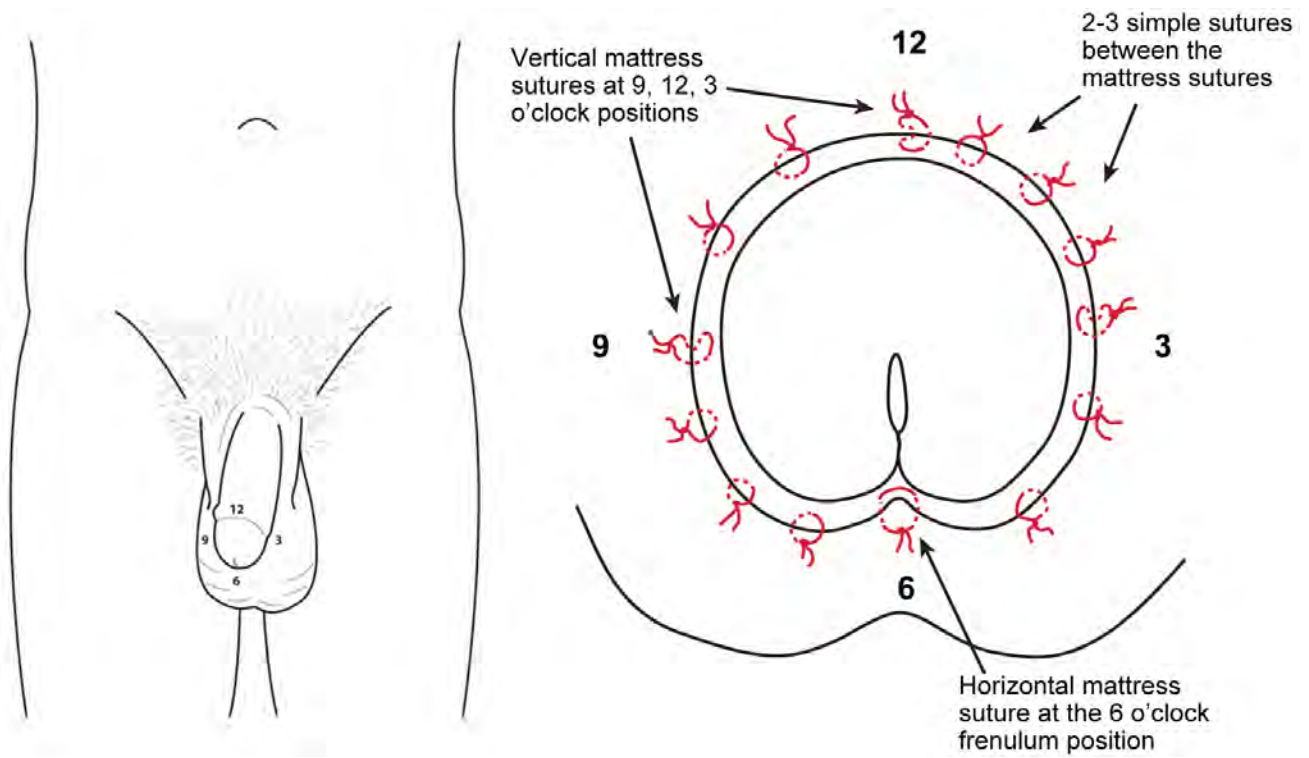
Normally, the raphe on the ventral aspect of the penis is in the midline and can be used for orientation. Alignment is achieved by lining up the midline raphe, frenulum and the urethral meatus. However, it is common for the raphe to be off-centre, so it helps to make additional marks to realign the skin when suturing (see Chapter 9, Fig 9.9).

In clients with a raphe not in the midline, extra alignment marks should be placed at the 03:00, 06:00, 09:00 and 12:00 o'clock positions when the circumcision line is marked, so the skin can be accurately realigned when the sutures are placed (see Chapter 9, Fig. 9.9). Using these orientation marks, mattress sutures should be placed at the 06:00 and 12:00 o'clock positions and then at the 03:00 and 09:00 o'clock positions. These mattress sutures should be placed first, before placing the remaining sutures. The tension and number of sutures must be just enough to achieve accurate apposition of the wound edges and avoid tissue strangulation.

8.5.3. Closing the suture wound and avoiding common problems with surgical technique

- Mark the line of the incision carefully. If the ventral raphe is not in the midline, extra alignment marks should be placed at the 03:00, 06:00, 09:00 and 12:00 o'clock positions when the circumcision line is marked, so the skin can be accurately realigned when the sutures are placed (see Chapter 9, Fig. 9.9).
- Take care with haemostasis.
 - If you can see the vessel lumen, then it is best and safest to avoid diathermy; instead, accurately pick up and tie the bleeder using proper technique.
 - If using diathermy, take small accurate pieces of tissue, and use the minimum burst of current.
 - If underrunning or ligating a blood vessel with sutures, avoid catching large pieces of tissue. Do not use excess knot throws, and do not leave long knot ears.
- Do not use too many sutures. Use about 12–16 sutures in total. This means the use of four mattress sutures with two or three simple sutures between each of the mattress sutures, that is, between the 12:00 and 03:00 o'clock positions, the 03:00 and 06:00 o'clock positions and so on.
- Make vertical mattress sutures at the 12:00, 03:00 and 09:00 o'clock positions for aligning and everting the skin.
- Make a horizontal mattress suture at the 06:00 o'clock position for haemostasis at the frenulum. Take care that the suture does not penetrate the urethra, which is near the surface in the 06:00 o'clock position. Do not pull sutures too tight. The skin edges should be together but not puckered. Too much tension cuts off the blood supply and increases the chance of tissue necrosis and infection.
- Tie the knots properly—use either a two-throw or three-throw square knot, or a double-throw and single-throw surgeon's knot.
- When using diathermy, use only the coagulation functions. Switch off all other functions, such as cutting, blending or fulguration. When the diathermy machine seems not to work, stop. Do not use diathermy at the frenulum because it can cause a burn through the urethral wall, which may result in a urethral fistula. The patient must only be in contact with the diathermy forceps and the diathermy plate (dispersive electrode). Ensure that the patient's skin is not in contact with any metal parts of the operating table to prevent the client experiencing an electric shock or skin burns.

Fig. 8.11. Orientation and positions of the horizontal and vertical mattress sutures, and the intervening simple interrupted sutures



KEY MESSAGES

- The provider and any assistant undertaking circumcision must always be aware of the sterile operating field. They should also adhere to standard precautions and principles to ensure that proper infection prevention and control practices are followed.
- Proper handling of tissue is critical to achieve a good outcome of the circumcision procedure. Handle the tissue gently because handling it too firmly may crush the tissue and delay healing, thereby increasing the risk of infection and worsening the scarring.
- Handle sharps in a way that helps avoid needle-stick (sharps) injury. Sharps include needles, scalpel blades, disposable diathermy points and any other sharp instruments.
- Minimizing blood loss is part of good surgical technique and safe medical practice. It reduces the risk of complications and need for interventions that bring additional risks. Minimizing blood loss also helps reduce the risk of contaminating the sterile field.
- Bleeding can be stopped by coagulation using diathermy. Safe diathermy requires the provider to understand and apply knowledge of the machine's electrical connections and power settings, and to know safe diathermy surgical technique.
- Even if diathermy is available, providers who undertake male circumcision should be skilled at stopping bleeding without diathermy. Surgical techniques for reducing blood loss are compression, temporary occlusion of blood vessels, and tying and underrunning.
- The goal of suturing (placing surgical stitches) is to achieve apposition without tension and with correct skin orientation. Too much tension in any type of skin suture increases the likelihood of cutting through the skin, resulting in wound disruption. Basic suturing techniques include simple interrupted sutures and mattress sutures (that is, the vertical mattress suture and the horizontal mattress suture).
- Particular care needs to be taken with haemostasis and suturing in the 06:00 o'clock frenular position, as the urethra is near the surface. Deep burns from diathermy or sutures placed too deeply, which catch the urethral wall, can result in tissue necrosis and urethral fistula (hole between the urethra and the outside).

ANNEX 8.1. DIATHERMY SETUP AND CONNECTIONS

Surgical diathermy is the use of high-frequency alternating current to produce heat with minimal stimulation of muscles and nerves, which occurs at frequencies below 20 000 Hz. Anaesthesia is necessary because the heat produced causes severe pain.

The main advantage of using diathermy for male circumcision is that it makes the procedure quicker; however, the provider doing the procedure must understand the diathermy circuit. Most diathermy units require electricity through a wall socket. If the electrical supply is unreliable, it is especially important that the provider is competent to undertake circumcision without the use of diathermy.

A8.1.1. Settings

Diathermy machines may have a number of different output settings. Depending on the output frequency and power, the current will cause the tissue to burn or vaporize. When the diathermy machine is set to coagulation, the current will yield a burn sufficient to stop bleeding from small blood vessels. When the machine is set to cutting, the current will vaporize tissue and produce a cutting effect, similar to using a scalpel. Some machines have a third setting called fulguration, in which the current will cause widespread superficial burns. There may also be a blending function that allows cutting and coagulation currents to be applied together.

Use only the coagulation function in diathermy machines, and switch off all other functions, such as cutting, blending or fulguration.

A8.1.1.1. False (dangerous) electrical circuits to earth (earth leakage)

When the diathermy machine seems not to work, stop.

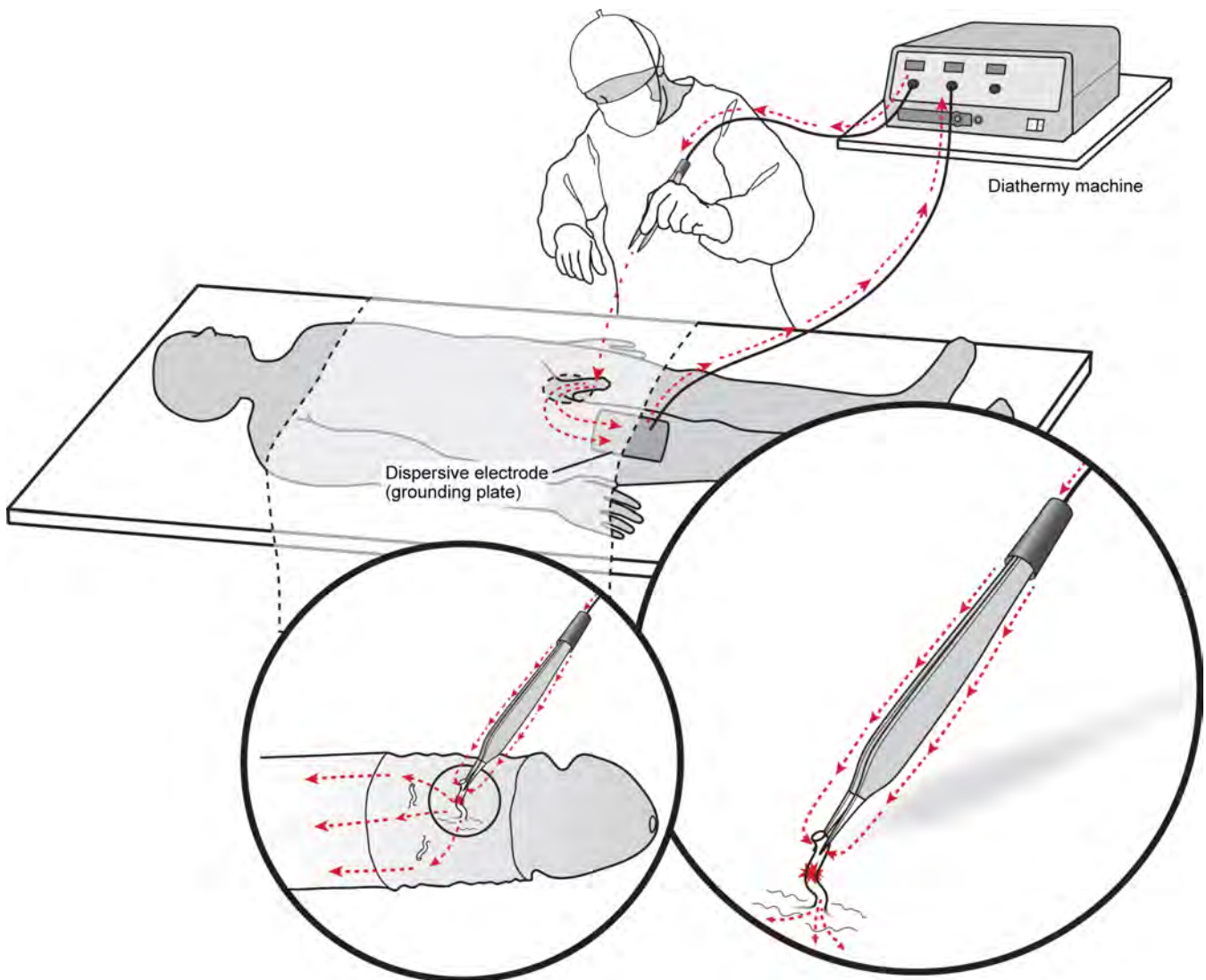
The patient must only be in contact with the diathermy forceps and the diathermy plate (dispersive electrode). The electrical current must only flow through the dispersive electrode (diathermy plate) back to the diathermy machine. The patient must not be in contact with any other material that will conduct electricity. Ensure that the patient's skin is not in contact with any metal parts of the operating table to prevent a false electrical circuit flowing from the diathermy forceps through the client's body and then through the client's skin. Otherwise, this false electrical current can result in the client experiencing an electric shock or skin burns.

To avoid any problems, the surgeon using the diathermy has the responsibility to ensure that the dispersive electrode (diathermy plate) has been placed correctly and that no other part of the client's skin is in contact with anything that will conduct electricity. The risk of a false circuit to earth is less with bipolar diathermy than monopolar diathermy, but it can happen with both methods. If there is a false circuit to earth, then this may cause the diathermy to seem as if it is not working because the energy is causing a burn at the skin that is (wrongly) in contact with the metal instead of the skin at the tip of the diathermy forceps.

A false circuit to earth is sometimes referred to as grounding, but the terms earthing or earth are used instead of ground or grounding to avoid confusion with the dispersive electrode (diathermy plate), which is also sometimes confusingly called the grounding plate.

A8.1.2. Monopolar diathermy

In monopolar diathermy, the current flows from the machine to the diathermy forceps that is held by the provider doing the procedure. The current then runs through the client's body to a dispersive electrode and back to the diathermy machine (see Fig. A8.1.1).

Fig. A8.1.1. Monopolar diathermy circuit

The effect of the coagulating diathermy current will occur at the point of greatest electrical resistance, which should be the tip of the diathermy forceps, where the diathermy forceps (tweezers) pick up a blood vessel. The dispersive electrode (diathermy plate) should be applied to bulky tissue as near to the surgical site as practical—usually the outer aspect of the upper part of the leg or under the buttock.

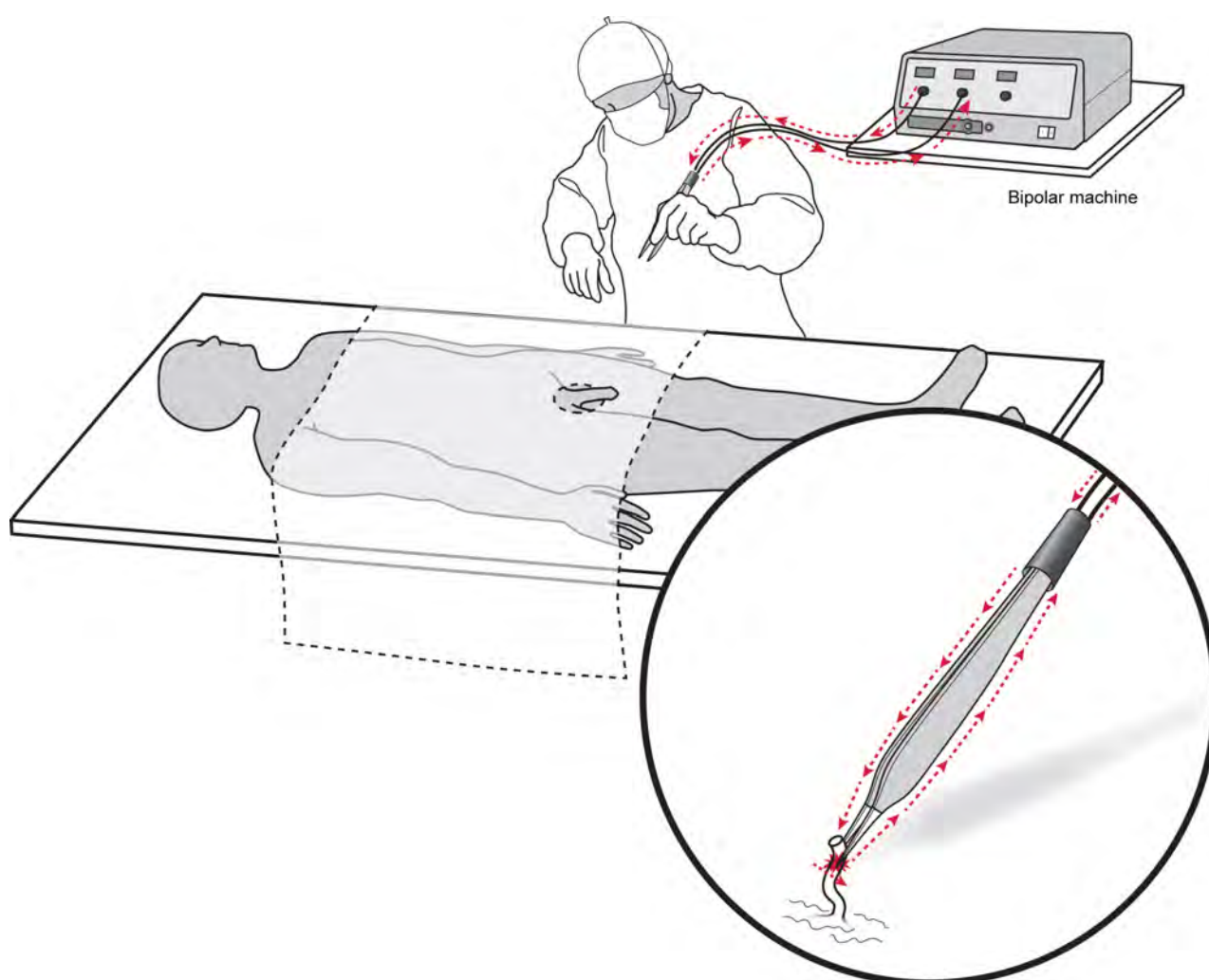
Dispersive electrodes may be reusable and held in place by bandages or disposable and stick-on fasteners. Particular care needs to be taken with the use of antiseptic cleaning agents and the placement of the dispersive electrode plate. The client's skin should be dry at the site of plate application. If antiseptic is accidentally spilled onto the plate of the dispersive electrode, then a new dry plate should be applied to a new area of dry skin. Also, the plate should not be applied to an area that is too hairy because this may prevent proper contact between the plate and skin; it is occasionally necessary to shave hair.

Care must be taken with diathermy technique. There is a risk that if the penis is put on traction at the same time as a large piece of tissue is taken with the diathermy forceps, then the base of the penis could be the point of greatest electrical resistance. When the current is channelled to the base of the penis, it could cause coagulation at that point rather than at the tip of the diathermy forceps.

A8.1.3. Bipolar diathermy

In bipolar diathermy, the current flows between two prongs of the diathermy probe, which is connected to the diathermy machine (see Fig. A8.1.2). There is no electrical circuit that flows through the client's body, and there is no need for a dispersive electrode (diathermy plate). Nevertheless, as with monopolar diathermy, care should be taken to ensure that the patient is not in contact with any metal because this contact can cause electricity to leak to the earth, thereby creating the potential for the client to experience electric shock or skin burn. Bipolar diathermy is safer than monopolar diathermy, but it is slightly harder to stop bleeding with bipolar diathermy and to use the technique effectively. If the current application is prolonged, charred tissue can stick to the diathermy forceps, and this can cause rebleeding when the forceps are pulled away. This charring reduces the effectiveness of the diathermy unless the diathermy forceps are frequently cleaned with a scratchpad.

Fig. A8.1.2. Bipolar diathermy circuit



A8.1.4. Diathermy setup precautions

- Do not use diathermy if the client has a pacemaker.
- Use correct diathermy surgical technique, as described in Section 8.4.2.
- Ensure that the client is not in contact with any metal because this can cause earth leakage. Many modern diathermy machines have an earth leakage detection circuit that automatically switches off the machine if there is any leakage of electrical current to earth. Earth leakage is less of a problem with bipolar diathermy.
- Be careful not to spill any liquid on the diathermy machine. Do not store bottles of cleaning fluids or anything else on top of the diathermy machine.
- Apply the diathermy plate (dispersive electrode, grounding plate) correctly:
 - Ensure that the diathermy plate has a broad area of contact with the skin. The plate should be applied to bulky tissue, such as the upper leg muscle, and as near to the surgical site as practical. Well-vascularized muscle conducts electricity well, but bone does not.
 - Ensure that the skin is clean and dry. Moisture on the skin may prevent proper sticking of disposable adhesive grounding places.
 - Shave hair if necessary.
 - Do not apply the diathermy plate over bony prominences to avoid burning the skin between the skin and the plate.
 - Use the whole of the diathermy plate, and do not cut a diathermy plate down in size. Many modern monopolar machines have circuitry to ensure that the diathermy plate has been properly applied. If the plate has not been properly applied, the machine alerts the user when the plate has become disconnected and prevents the machine from activating if a fault is detected.
- Do not pull on the machine's electrical cables.
- Be familiar with the safety features of the machine in use.
- Be familiar with the power settings normally used for diathermy in conventional or device-based surgical circumcision. Do not increase the power settings. If anyone asks to increase power settings, stop and check everything. A call to increase power settings is a red flag; it indicates a likely faulty connection and a risk of burning or incorrect diathermy surgical technique, especially taking too large a piece of tissue in the diathermy forceps.
- If the machine does not work when activated, check everything, as outlined below:
 - Check that only a small piece of tissue is being held and that the penis is not under tension.
 - Ensure that the connections are correct. On some old machines, it is possible to connect the diathermy plate (dispersive electrode) to the active output, but most modern machines have specially shaped plugs that make this impossible.
 - Check that the diathermy plate is in good contact with the client. One of the most common causes of diathermy burns is a poorly applied diathermy plate with only a narrow area of contact between the plate and the client; this can result in a skin burn at the site of contact with the diathermy plate.
 - If it seems that the connections are properly made, then check that the power is switched on at the wall plug and that the plug is working. Also, check that there has not been a power cut.
 - Check that the client is not in contact with any metal; many diathermy machines have an automatic power shut off if there is any earth leakage.

- If there is power in the machine and connections seem to be correct, then a lead may be faulty. Try replacing the various leads:
 - lead between the diathermy forceps and machine
 - diathermy plate (many machines have circuitry that shuts off when they detect faulty diathermy plate application or connection, or both)
 - lead between the diathermy plate and diathermy machine.
- If none of these measures solves the problem, then complete the procedure without diathermy and send the diathermy machine for repair.
- If there has been any malfunction of the diathermy machine, then, at the end of the procedure, the provider doing the procedure should check the client for adverse events, especially for burns at the site of the diathermy plate.

A8.1.5. Tips for using diathermy

- Know the diathermy machine, and be familiar with the normal settings. Read the manufacturer's instructions for use.
- Remember that the need to increase power settings is a red flag that something is wrong.
- Remember that most diathermy-related adverse events occur because of poor diathermy surgical techniques, such as the lack of accuracy or prolonged application of current.
- Know what to do if the diathermy machine does not work when it is activated.

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