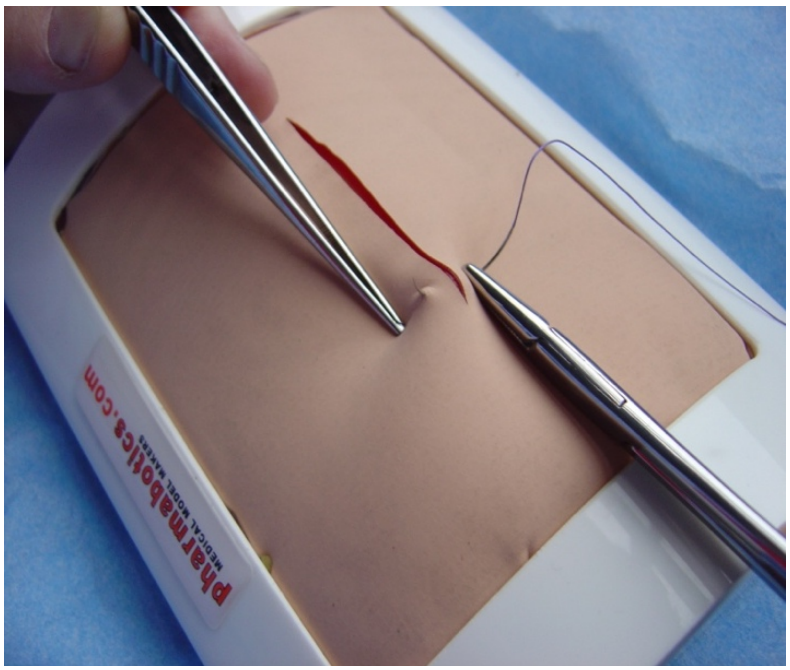
University of Glasgow

School of Medicine, Dentistry & Nursing

Suturing Procedures Guidance



Suturing - Contents

Learning Outcomes

On completion of the clinical skills programme, the Registered Practitioner will be able to:

1) **Discuss the role of the practitioner in suturing, in relation to**:

a) Medico - legal aspects
b) Scope of Professional Practice
c) Risk management
d) Explaining the criteria enabling registered practitioners to suture

2) **Assess the condition of the wound for suturing by**:

a) Describing the normal anatomy of the wound.
b) Critically analysing factors which may delay healing.

3) **Plan the suturing by**:

a) Selecting the appropriate wound closure material.
b) Identifying infection risk factors and critically analysing interventions to reduce the potential for infection.
c) Explaining the risk associated with local anaesthesia.

4) **Implement the suturing by:**

a) Demonstrating correct injection of local anaesthetic.
b) Demonstrating safe suturing technique.
c) Disposing of equipment appropriately.

5) **Evaluate suturing by:**

a) Analysing any difficulties, which may have occurred.
b) Discussing the risks associated with suturing.
c) Discuss how the identified risks can be minimised.

The Practitioner's role in suturing

Health care practitioners have become increasingly autonomous in anticipating and responding to individual patient needs in the context of changing health care.

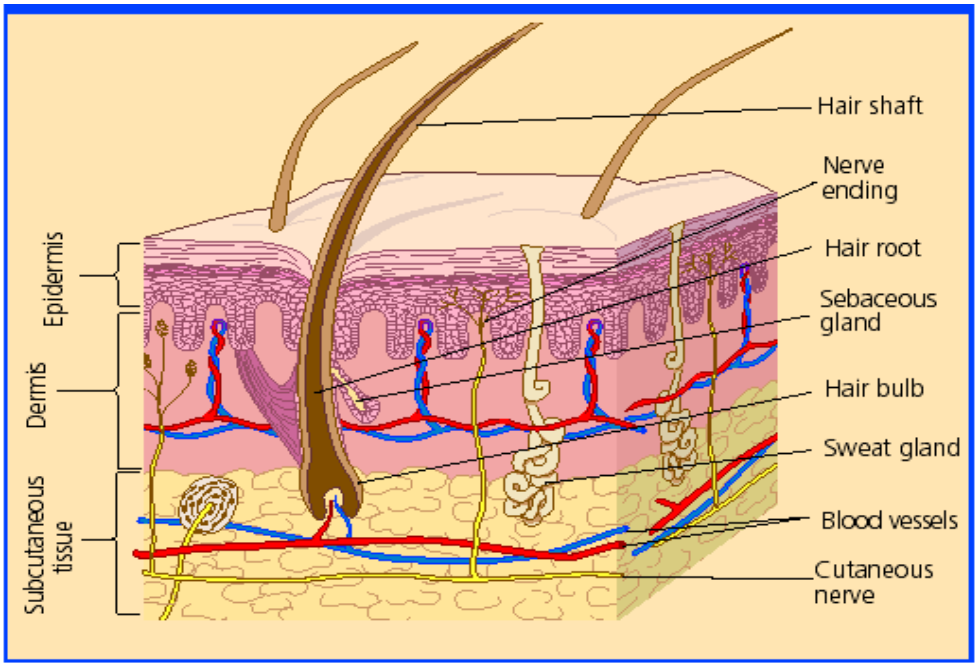
Practitioners need to consider methods of addressing needs in an innovative, flexible way but must first consider the implications of acquiring, developing and maintaining new skills.

When developing new skills, it is not the activity that is the issue, but the context in which it is undertaken that is important. Integral to this is accountability, which encompasses responsibility, autonomy and authority.

Anatomy and physiology of the skin

Refer to an anatomy textbook and label this diagram of the skin.

1. _____



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Epidermis

This is composed of keratinised, stratified, squamous epithelium which varies in thickness in different parts of the body, for example it is thick and heavily keratinised over the palms of the hands and the soles of the feet. There are no blood vessels or nerve endings in the epidermis. It consists of 5 layers of cells. The deeper layers contain interstitial fluid, which is drained away as lymph. Damage repair occurs via the germinal cell layer at the base of the epidermis. Repaired epidermis has normal cell structure and function.

Dermis

This is the living part of the skin and is the only area that bleeds when cut. It is composed of bundles of collagen which give it tensile strength, elastic which gives skin its elastic recoil and a gel matrix in which the collagen bundles, tissue cells, blood vessels and nerves are embedded. The following structures are contained within the dermis:

- Blood vessels

- Lymph vessels
- Sensory nerve endings
- Sweat glands and their ducts
- Hairs and their roots and follicles
- Sebaceous glands
- Arrectores pilorum.

Repair to the dermis requires granulation. Hair follicles, sweat and sebaceous glands do not regenerate when granulation occurs. The nerve supply to the wounded area is also damaged. The scar tissue that forms is therefore dry in nature and less sensitive to further injury.

Principle functions of the skin

1. **Protection**
   It provides a barrier against aqueous, chemical or mechanical injury, viral or bacterial invasion and environmental irradiation's.

2. **Thermoregulation**
   It does this by utilising the circulatory system and by sweating (2.43 joules of body heat are lost for each programme of sweat evaporated from the body surface).

3. **Sensation**
   It contains nerve receptors which are sensitive to the stimuli of pain, temperature, pressure and touch.

4. **Metabolisation**
   The biosynthesis of Vitamin D takes place in the skin and this is important for bone structure and formation.

5. **Communication**
   Scarring from damage to the skin can result in altered body image. This in turn may alter the methods a person uses to communicate in order to compensate for this change.(Benbow, 1995)

The Four Stages of the Healing Process

The same basic biochemical and cellular processes are involved in the healing of all soft tissue injuries, whether they are chronic ulcerative wounds (leg ulcers, pressure sores), traumatic wounds (lacerations, skin flaps, abrasions, burns) or surgical wounds. Each phase can overlap and merge with the next.

***Stage One*:**
• **Inflammatory Stage**
This stage begins within a few minutes of wounding occurring and lasts approximately 3 days in a clean wound. This stage may be prolonged in an infected or necrotic wound.

Redness, swelling and local heat are all signs of the inflammatory stage but do not indicate the presence of infection unless there are other clinical signs, e.g. pyrexia, excessive pain at the site, odour, hardness of the surrounding tissue that may suggest a collection of pus under the skin, or a yellow/green discharge from the wound.

Coagulation factors are activated and clot formation begins. Platelets at the wound site release growth factors which attract the cells and chemicals necessary for wound healing. Damaged cells release histamine which causes the surrounding capillaries to dilate and increase their blood flow, hence the local swelling and heat.

***Stage Two*:**
• **Destructive Stage**
This lasts from 2 to 5 days. There is huge cellular activity and enzymatic breakdown of unwanted fibrin and dead cells. This activity by the white cells can be compromised in dry, exposed wounds. Osmolarity to the areas is increased and water is thus attracted to the area causing swelling. The debris produced is often mistaken for 'slough' and the wound treated as if infected.

The two stages below are sometimes combined to become the 'regenerative phase'.

***Stage Three*:**
• **Proliferative Stage**
Can last from 3 to 24 days. Strands of collagen are produced at this stage to rebuild the damaged tissue (**GRANULATION**). Without vitamin C collagen synthesis is thought to be inhibited.

Stage Four:
• **Maturation Stage**
May last from 24 days to 1 year. During this stage there is progressive decrease in the vascularity of the scar. The skin tissue changes to pale, white scar tissue as this occurs. The wound gains strength at this stage.
(Collier, 1996).

Healing by Primary Secondary and Tertiary Intention

1. **Primary Intention:**
The wound margins are very close together. Epithelialisation and the laying down of collagen fibres takes place quickly due to this marrying of the wound edges. Surgical incisions or clean, sutured trauma wounds heal in this fashion.

2. **Secondary Intention:**
The wound margins are not joined and granulation is needed to heal from the base of the wound. More collagen is required to form new tissue and epithelialisation takes longer as the cells have a greater distance to migrate over the wound surface. Leg ulcers and pressure sores heal in this manner. (Emmet, 1992, Hollingsworth, 1994*)*

3. **Tertiary Intention:**
Occurs when a wound, which breaks down, is resutured at a later date, bringing two opposing granulating surfaces together. This results in a deeper and more pronounced scar, e.g. surgical debridement.

(Collier, 1996*)*

The Healing Environment

- Moisture:

A dressing that creates a moist healing environment may accelerate healing by up to 40%. (Collier, 1996)

- Removal of Dead Tissue and Exudate

The presence of necrotic tissue, excess exudate and slough will delay wound healing. Excess exudate will saturate the wound and cause maceration at the wound edges where epithelialisation should be taking place. Hydrocolloids are good at debriding dirty wounds of this nature.

- Wound Protection

There is a need to avoid any leakage that will link the wound with the outside environment and lead to infection. The dressing also needs to be non-adherent to prevent damage to the wound surface. The majority of occlusive dressings achieve good wound protection, but paraffin gauze may remove granulation tissue when changed.

- Acidity

This is an area that the literature suggests requires further research. It has been put forward that acidity improves the oxygenation of the wound and a less alkaline environment helps to prevent infection. (Thomas, 1990*).* Hydrocolloids provide a healing environment of 5.6 - 6.7 pH.

- Oxygenation

Obviously a vital element in wound healing. The formation of new blood vessels takes place more rapidly in a hypoxic environment, such as that provided by a hydrocolloid. The epidermis repairs more effectively in an oxygen-rich environment, such as that provided by semi-permeable film dressings.

- Temperature

The ideal wound interface temperature is 37c. Mitotic activity slows down when wound temperature falls and takes 3 hours to return to normal, (Miller & Dyson 1997)

Types of wounds

Sheehy (1992) describes six types of wound:

a) Abrasions:
Commonly referred to as “brush burn” and caused by skin rubbing on hard surfaces, the friction removes epithelial cells and possibly dermal. Healing is by secondary intention.

b) Abscess:
A cavity containing pus and surrounded by inflamed tissue formed as a result of suppuration in a localised infection. Healing usually occurs when abscess is drained or excised

c) Avulsion:
This type of wound produces full thickness skin loss. Healing is by secondary intention.

d) Contusion:
Collection of blood under the tissues without breaking the skin's integrity.

e) Laceration:
Two types of laceration
- Superficial (involves dermis/epidermis)
- Deep (extends through tissues)
repair is by primary intention

f) Puncture or Incision:
Penetration of the tissues by a sharp object. Healing is by primary intention.

It is important for the practitioner to be able to identify types of wounds to enable appropriate assessment and treatment.

Wound Management & Suturing

Accurate assessment of the patient and the wound is imperative. The wound should not be treated in isolation but a holistic approach adopted in caring for the patient. (Castille 1998).

Obtain a clear history of how the wound occurred

- Establish the possibility of foreign material in the wound (Always x-ray if caused by glass)
- Depth of wound
- Is healing through primary closure appropriate
- Tetanus status (joint committee on vaccination / immunisation 1996)
- Allergies to drugs/dressing
- General health i.e. diabetic, anti-coagulation
- Patients' age/physical condition/occupation/medical history
- When the wound was inflicted. Suturing a wound > than 6 hours old may increases the risk of infection and be contraindicated

The type of wound will dictate the technique of suturing for example, closure of small fresh wounds is best achieved using interrupted sutures

All Dog bites are "high risk" wounds and **should not** be sutured unless the failure to do so may have cosmetic implications.

More serious injuries with tendon and nerve damage are often overlooked as the patient will not complain so readily of pain (Purcell 2003).

Evaluate Wound for suturing:

- Determine where wound is - location can affect cosmetic appearance or mobility.
- Arrest and control bleeding (Wyatt et al 2003)
- A facial wound is best sutured by very experienced practitioners, or medical staff due to increased risk of scarring
- Determine condition of surrounding skin (is wound jaggy/smooth).

Principles of Wound Management

There are four main principles of wound management

- deal with priorities first ABC.
- check area distal to wound for neurovascular + motor damage, skin colour temperature, and distal pulses.
- Decrease likelihood of infection
- Promote optimal healing which may require suturing

Wound Cleansing

Wound cleansing is perhaps the most important aspect of wound management. All wounds will heal eventually if infection is avoided and this is best achieved by thorough cleansing of the wound.
Wounds which are not grossly contaminated should be thoroughly cleansed with warm sterile solution of 0.9% sodium chloride.
Cleaning of a wound may be more of a physical than a clinical process and the need to irrigate, clean or even scrub the wound should be considered. Wounds that are obviously contaminated should be thoroughly irrigated, then cleaned with a broad-spectrum antiseptic solution. The main aim of irrigation is to flush out small particles of dirt. Scrubbing with a sterile nail brush or

toothbrush may also be necessary to remove dirt which, if left in place, could cause infection or tattooing.

Suturing Procedure

1. Selecting the suture material

Suture material should be flexible enough for use in any operation, the only variable being determined by tensile strength.

There are two types of sutures:
a) Absorbable (temporary support)
b) Non-absorbable (permanent support).

A) Absorbable (catgut)
This type of suture is capable of being absorbed by living mammalian tissue. It is manufactured from the submucosal layer of sheep intestine or the serosal layer of beef intestine, and is available in plain or chromic.

Plain: looses half its strength in 10-14 days and all its effective strength in 21 days. Complete absorption occurs within 30-50 days.

Chromic: looses half its strength in 11-14 days and all its effective strength in 28 days. Complete absorption occurs within 45-90 days.

B) Non - absorbable

These sutures can be made from silk, polyester, polypropylene or stainless steel.

2. Selecting the Size of Suture Material

If the suture used for wound closure is too thick wound healing can be delayed.

Suture materials are gauged using metric figures however many individuals continue to refer to the old BPC gauges when referring to the size of materials used in suturing.
In Metric, size 0.1 refers to the finest material, and 9 metric refers to the thickest.

The table below shows comparisons between metric & BPC gauges.

Metric	1	1.5	2	3	3.5	4	5	6	7	8
BPC	6/0	5/0	4/0	3/0	2/0	0	1	2	3	4

Figure 2. below lists the clinical application of different sutures

Tissue	Type of Suture	BPC
Ligature	Catgut - coated vicryl Silk - mersilk	3/0 - 0
Skin	Ethilon Prolene Mersilk	6/0 - 2/0
Subcuticular	Coated Vicryl	2/0 - 1
Muscle	Coated Vicryl	3/0 - 2
Stomach/Bowel	Coated Vicryl	3/0 - 1
Tendons	Prolene	8/0 - 2/0
Cornea	Ethilon	
Nerves	Ethilon	10/0 - 5/0

Figure3. below provides an approximate guide for skin suture gauges in adults and children:

Location	Size (adults)	Size (Children)
Trunk / lower limbs	3/0	4/0
Scalp	3/0 - 4/0	4/0 - 5/0
Upper Limbs	4/0	5/0
Face	5/0 - 6/0	6/0 - 7/0

As a general rule of thumb - in children reduce gauge size by one.

Castille (1998) indicates that recent trends show a decrease in the use of silk as it may cause tissue reaction and an increased preference for synthetic materials which have increased biocompatibility and are less likely to cause reaction.

Thickness of suture *suture material*

Shape of needle Length of suture Type of needle

3. Selecting the surgical needles for suturing

1. Needle Types
   - Round bodied: designed to separate tissue fibres rather than cut ~ used for soft tissue cardiovascular / intestinal surgery.
   - *Conventional cutting: a cross section, cutting edges restricted to front section of needle has three cutting edges*.
   - Reverse cutting: is particularly resistant to bending and reduces the tendency for the suture to be pulled through the tissue
   - Trocar point: has strong cutting head and ensures powerful penetration when in dense tissue.
   - Taper cut: contains initial penetration of cutting needle with characteristics or round-bodied.

2. Needle Shape

For most applications, curved suture needles are used. The curve of the needle is governed by the accessibility of the tissue to be sutured. The more confined the operative site, the greater the curvature required.

3. Needle Strength
Diameter of the wire from which the needle is manufactured is a major factor in determining its strength. A factor also to be considered is where the force is applied greater than that for which it is designed.
The needle should bend, not break. When bending occurs, it is an indication that the critical point has been passed, so the needle should be discarded rather than attempt to straighten it.

4. Use of Needle Holders
The needle holder should be carefully selected to match the size of needle used.
Needles should be held on flatted area, not at the needle point or attachment area.

(Benbow, 1995)

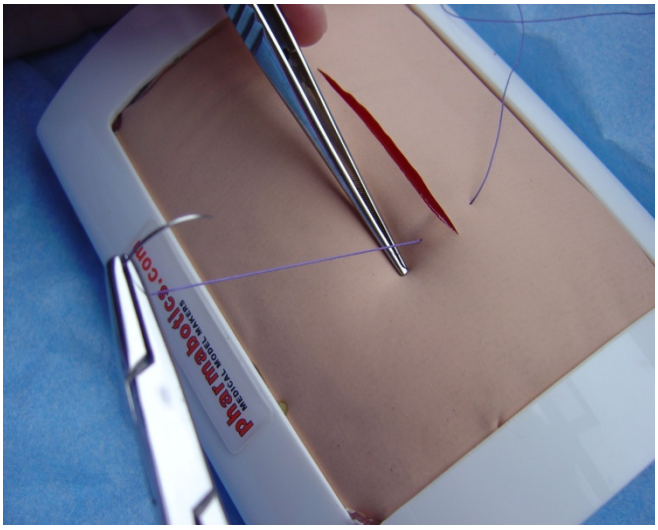
4. Selecting the type of suture

The following are the most common:

- Simple interrupted
- Vertical mattress
- Horizontal mattress
- Sub-cuticular.

Simple interrupted suture

This technique is usually applied to simple wounds, both traumatic and surgical, following excision of a skin lesion, for example.
The needle is placed perpendicular to the wound on the opposite side approximately 3-5mms away (depending on the size and position of the wound) from the wound edge. The needle is passed preferably in a way so that it produces a pathway, which is wider at the base of the wound than at its surface. The proximal side is dealt with a reverse fashion. This will result in a “brandy” glass shape to the suture pathway. When the wound is approximated, eversion will occur.



Demonstrates that equal bites are taken on either side of the wound.

(The depth of the bites is also equal)

It is important to ensure that the width and depth of the ‘bites” are similar on both sides to prevent an overlap of the wound edges. Small bites will produce precise approximation of small wounds, whereas larger bites are useful for eliminating dead space and for reducing tension in larger wounds (preventing ischaemia of the wound edges).

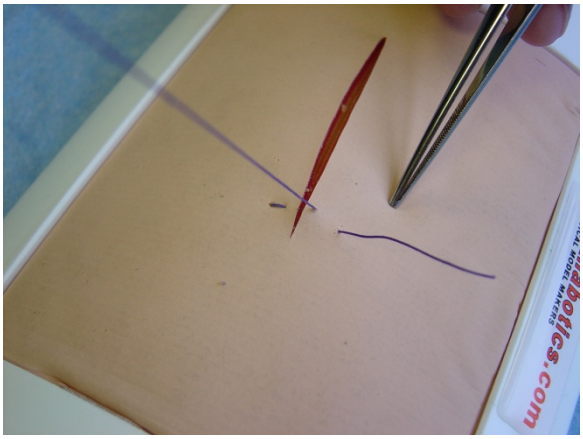
The interval between sutures will vary with the particular wound. Too many sutures will lead to ischaemia; too little may lead to a poorly approximated wound.
Continuous suturing instead of placing individual simple sutures is an alternative method. However, in day-to-day closure of simple wounds it is rarely used. It can produce ugly crosshatch marks and it may be difficult in making fine adjustments.

Mattress sutures

There are two different types of mattress sutures: vertical and horizontal.

Vertical mattress

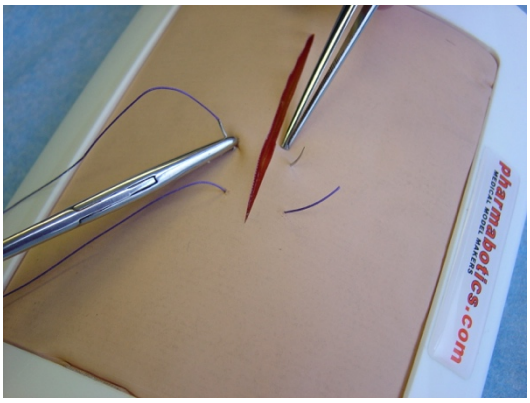
A wide bite is taken on the opposite side of the wound and is passed as in a simple suture. A wide bite is taken on the proximal side before passing the suture back, by taking smaller proximal and distal bites.



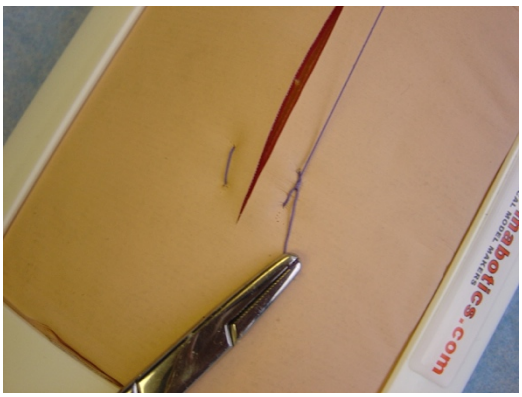
Vertical mattress suture

Horizontal mattress
As above, the first part of the stitch is placed. However, the suture returns to the opposite side by placing the stitch a short distance from the exit point so that it lies parallel to the first pass. The knot is tied on the side where the needle was first inserted.

These stitches are useful in producing eversion, eliminating dead space and reducing tension. However, it can lead to major cross-hatching marks.



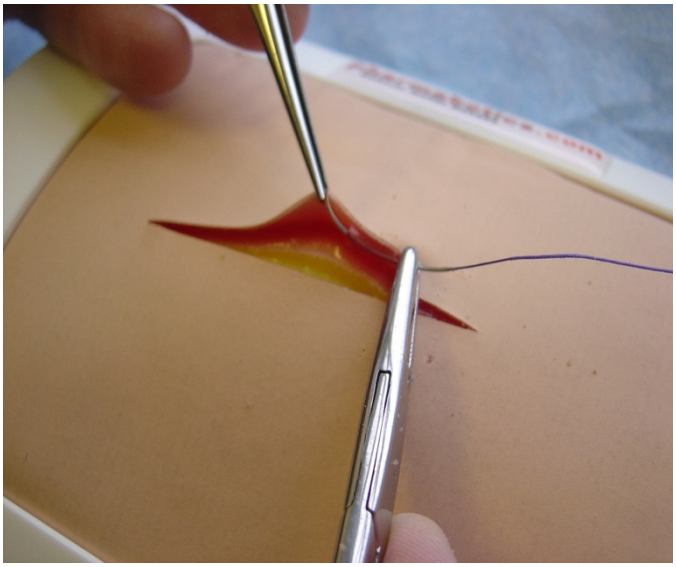
Placement of horizontal mattress suture



Completion of horizontal mattress suture

Subcuticular

Sutures are placed in the subdermis level in a horizontal fashion taking equal bites. The ends are knotted so that they are also lying subcutaneously. Normally the intention is to leave the suture in-situ so an absorbable suture is needed. The suture is useful where the dead space and tension is minimal. If these situations exist, deep sutures are placed before inserting the subcuticular stitch. As the stitch is placed in the subdermis, cross-hatching is prevented.



Subcuticular is placed longitudinally in the subcuticular plane

Advantages of interrupted sutures are:

- easier to insert
- alternate sutures can removed
- suture removal is simpler
- easier to achieve accurate alignment of the wound surfaces

Castille (1991)

Advantages of continuous sutures are:

- Less risk of scarring / tattooing from sutures
- Less irritation caused by suture knots.

Tissue Adhesive

Histoacryl glue can be used to close minor wounds and lacerations and is particularly suitable for children, since the procedure is less traumatic and quicker than suturing. (Barnett 1998, Richardson 2004)

When using glue it is important the child is told the wound may feel warm when the special glue is applied. This prepares them for the exothermic reaction during polymerisation. The wound is cleaned with prescribed solution using an aseptic technique, then dried.

Wound edges should be pushed and held together with your thumb and forefinger. A very thin layer or several dabs of histocryl is then applied to the surface to close the wound. Maintain pressure around the wound until the glue hardens - around 30 seconds.

Avoid placing fingers too close to the wound as accidental spillage may adhere your glove to the patient.

Wounds which require expert advice:

- Lacerations with ragged edges
- Deep wounds with excessive haemorrhagia
- Wounds close to the eye
- Wounds around the mouth.

Preparation for suturing:

The aims of closing a wound by placing sutures are to:

- Eliminate any dead space (Mackay-Wiggan et Ratner 2007)
- Support the wound until tensile strength is recovered, to prevent wound from dehiscing
- Allow skin edges to be accurately approximated to produce a cosmetically and functionally acceptable wound. i.e. primary intention
- Prevent healing by secondary intention, which may result in an unacceptable scar
- Reduce bleeding and infection.

Explanation and consent

Ensure patient has understood what is happening and given consent.
Explain the procedure to the child and carer in language which is easily understood. Obtain consent from a guardian. Ideally the child should sit or lie on the parent's lap.

Infection Control Aspects of Suturing

Universal Precautions
The practice of Universal precautions is based upon the principle that **all blood / body fluids are assumed to be infected with bloodborne viruses.**

Universal blood and body fluid precautions represent a standard of care which should be used routinely with all patients to minimise the spread of bloodborne viruses and other bloodborne infections, both from recognised and unrecognised sources of infection.

The most likely means of transmission of these viruses to health care workers is by **direct percutaneous inoculation of infected blood** by a sharps injury or by **blood splashing onto broken skin or mucous membranes.**

All health care workers should, as a matter of good practice, routinely use appropriate methods to prevent contamination by blood / body fluids.

🗣Best practice statement 1:
All cuts and abrasions to any area of exposed skin should be covered with a waterproof dressing.
Evidence: local and national guidelines on hand hygiene and use of personal protective equipment

🗣Best practice statement 2:
The use of gloves does not preclude the need for thorough "Surgical Handwashing" prior to suturing.
Evidence: local and national guidelines on hand hygiene and use of personal protective equipment

Surgical handwashing is intended to remove or destroy transient micro-organisms and substantially reduce detachable resident micro-organisms. It is achieved using an antiseptic hand wash solution; however the Infection Control Nurses' Association Guidelines on hand hygiene emphasise that a defined handwashing technique is more important than the antiseptic solution used.

(Benbow, 1995)

- Sterile gloves should be worn during this type of procedure.

Always wash and dry hands thoroughly after removing gloves.
Be aware of the risk of latex sensitisation - powdered latex gloves should be avoided wherever possible.

- Disposable plastic aprons should be worn if there is a possibility of splashing by blood / body fluids.

🗣Best practice statement 3:
Protective eyewear or goggles should be worn if there is a risk of blood / body fluid splashes or spray.
Evidence: local and national guidelines on hand hygiene and use of personal protective equipment.

Safe Disposal of Sharps

- The person actually suturing is responsible for the safe handling and disposal of all sharps used in the procedure.
- Prepare equipment before starting the procedure, including a sharps container.
- Sharps container should be attached to the trolley and taken to the patient being sutured.
- Take a note of all sharps used in the procedure and make sure they are all safely disposed of afterwards.
- Keep hands behind the sharps point or blade at all times.
- Dispose of used needles at the point of use.

Disposal of Clinical Waste

Any waste which is contaminated wholly or partly with body fluids will generally be placed in an orange plastic bag which is marked “Clinical Waste”. Waste generated during a suturing procedure is classified as clinical waste.

(Benbow, 1995)

Pharmacology Considerations related to Suturing

Pharmacological considerations in relation to suturing focus almost exclusively on local anaesthesia and Tetanus prophylaxis.

Local anaesthesia

Lignocaine 1% without adrenaline is most commonly used.
It temporarily inhibits nerve impulses from the sensory nerves by stabilising neuronal impulses, causing a reversible block. This endures for between 30-120 minutes. (Smithing 2002)
Safe doses: 3mg / Kg body weight.
Great care should be taken to avoid intravascular injection of Lignocaine. Any local anaesthesia should not be injected into inflamed tissue or directly into the traumatised tissue, as this can result in the Lignocaine being so rapidly absorbed that a systemic rather than a local reaction is produced.

Adverse / side effects

As with any drug, side effects / reactions are possible. However, allergy to commonly used local anaesthetics is extremely rare.

The following are potential symptoms and side effects of **toxicity**, which may occur as a result of accidental intravascular injection of Lignocaine:

- Perioral tingling
- metallic taste
- restlessness
- dizzy
- slurred speech
- convulsions/coma
- bradycardia
- circulatory collapse.

(Brown 1992)

Tetanus

Clostridium tetani gram-positive, spore-forming anaerobic bacillus causes tetanus. Once activated, it becomes highly resistant because of its ability to produce spores. Incubation ranges from two days to two weeks. It exists in soil, garden moss and animal/human excreta and enters the body through open wounds.

The bacillus attaches to cells in the CNS, causing respiratory depression in the medulla.

Signs & Symptoms

local joint stiffness trismus	———	generalised stiffness trismus difficulty swallowing	———	trismus seizures back pain tacchycardia Hypertension hyperpyrexia opisthotonus

Tetanus Toxoid is used for Tetanus prophylaxis.
This is normally given as an IM injection followed by 2 booster injections at 4 weeks and two years.
The Tetanus status of any patient with a wound should be assessed and treated as outlined in the table below:

INSERT TETANUS TABLE

Procedural Guidelines

The aim of suturing is to appose the edges of a wound together without tension.

Assess the wound and determine the most appropriate course of action. Refer to more experienced practitioners or medical staff if wound is complicated or beyond your existing skill level.

Equipment

Dressing Trolley
Dressing pack
Appropriate suture
Stitch set
- Needle holder
- Dissecting forceps
- Suture scissors

Skin Cleansing Solution
Sterile Gloves
Needle pad.
Local Anaesthetic - Lignocaine 1%
Eye Protection
Plastic Apron
Sharps Box
Disposal bag
Light source

Procedure

1. Explain the procedure to the patient.
   It is good practice to determine the patient's previous experience of needles i.e. suturing, cannulation etc - some patients may faint or experience great anxiety.
2. Position the patient in a comfortable position on a trolley (A&E) or if a dialysis central line – a reclining chair, flat if possible.
3. Prepare all equipment required on a sterile field.
4. Adjust lighting and make sure you are comfortable.
5. Expose the area to be sutured.
6. Wash hands with skin antiseptic, rinse thoroughly and dry with sterile towel.

Put on sterile gloves.

7. Draw up local anaesthetic and change to orange (24g) needle.
8. Clean area around wound and infiltrate with 1-% Lignocaine - **no adrenaline**!
9. Check effectiveness of anaesthesia by gentle pressure from a needle.
10. Clean wound and assess:
    - Any foreign bodies? - if history suggests shattered or broken glass caused damaged - x-ray
    - Tendon or nerve damage.
11. Suture the wound
12. Apply dressing if necessary.
13. Provide discharge instructions to the patient.
14. Document procedure / complications / difficulties encountered.

Surgical Principles

- Good choice of incision. Follow Langer's lines (figure 1) that follow natural tension-free lines. Failure to follow this principle will lead to an unacceptable cosmetic appearance and sometimes, poor function.
- Do not remove too much tissue, which may make closure difficult. Excessive undermining of skin edges will not lead to tension-free closure. Ischaemia of the skin edges and dehiscence of the wound and infection will follow.

- Gentle handling of tissue. Some aspects of this will be discussed later.

- Ensure eversion of wound edges. If the wound is inverted poor wound healing and an ugly wound will ensue.

Figure 1: This drawing illustrates Langer's lines of the head and neck

The most important pieces of equipment (Figure 2) for suturing a skin wound are:

- Needle holder
- Dissecting forceps
- Suture scissors

Figure 2: This photograph shows a needle holder, dissecting forceps and suture scissors

It is important to choose the correct needle holder and dissecting forceps, which will allow "control" of the needle and the wound. The finer the wound, the smaller the needle and suture

required. If too large a needle holder is used, the needle will be damaged and will not be held correctly, resulting in loss of control.
If too small a needle holder is used the needle will not be held securely - again resulting in loss of control.
The choice of dissecting forceps follows similar rules. i.e. the thicker the tissue, the larger the forceps required and vice versa. Dissecting forceps can be either toothed or non-toothed. Which one is preferred is often a personal choice. However it is important to realise that if the tissue is handled roughly e.g. grabbing skin edges tightly with toothed forceps, the skin will be damaged resulting in local ischaemia, infection and an unacceptable scar.

Handling the instruments
It is important to hold the instruments in a way which will allow for maximal “feel” and control. This will allow for accurate placement of the suture and minimal damage to the tissue.

Inserting the thumb into one ring and the middle or ring finger into the other holds the needle holder. The index finger should be positioned onto the area of the hinge of the needle holder. (Figure 3) Alternatively the holder can be “palmed” (Figure 4)

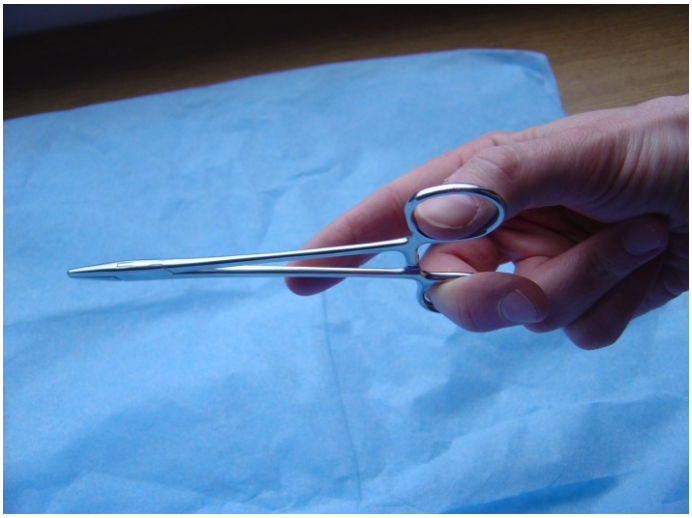


Figure 3: The needle holder is held in this fashion to allow maximum control

Figure 4: This illustrates the needle holder being held in the palm ("palming")

The **suture scissors** should be grasped in a similar fashion. (Figure 5)

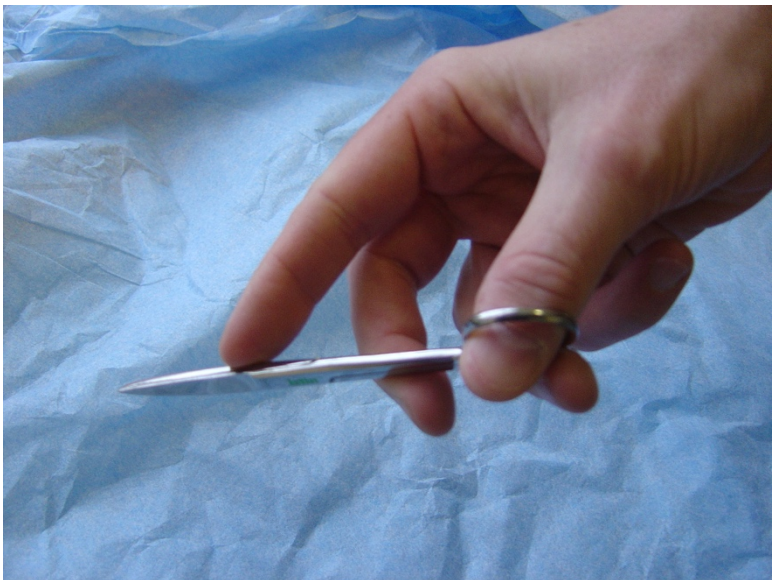


Figure 5: Demonstrates how to hold the suture scissors

The **dissecting forceps** should be held as shown. (Figure 6) This position maximises "touch" and control. If the forceps are held in the palm, these attributes are reduced. The forceps are used to stabilise the edges of the wound by producing counter-pressure and it may not be necessary to grasp the edges of the wound.

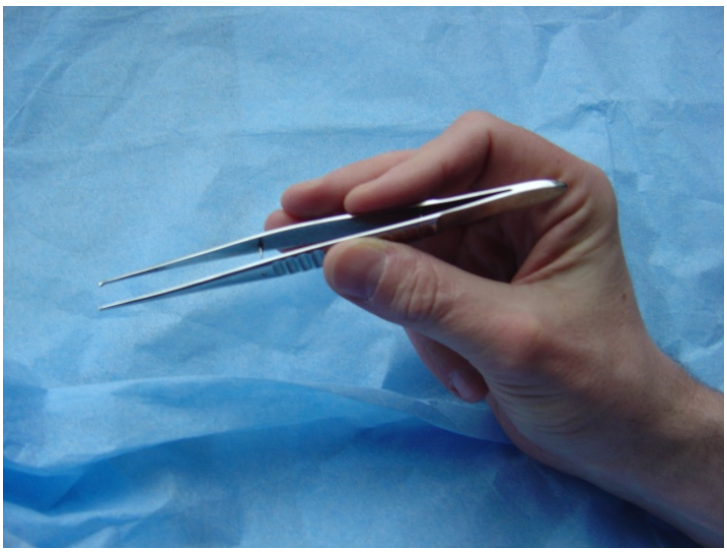


Figure 6: This illustrates how the dissecting forceps should be held to gain maximum feel and control

Needle management
In order to gain control of the point of the needle and to ease the passage of the needle, the needle needs to be held correctly. Figures 7 and 8 show the body of the needle being held halfway to two-thirds away from the point of the needle. It is grasped by the tip of the needle holder and the needle should lie vertically and horizontally perpendicular to the holder.
If the needle is placed incorrectly, the needle will be damaged and insertion through the tissue will be difficult or impossible.

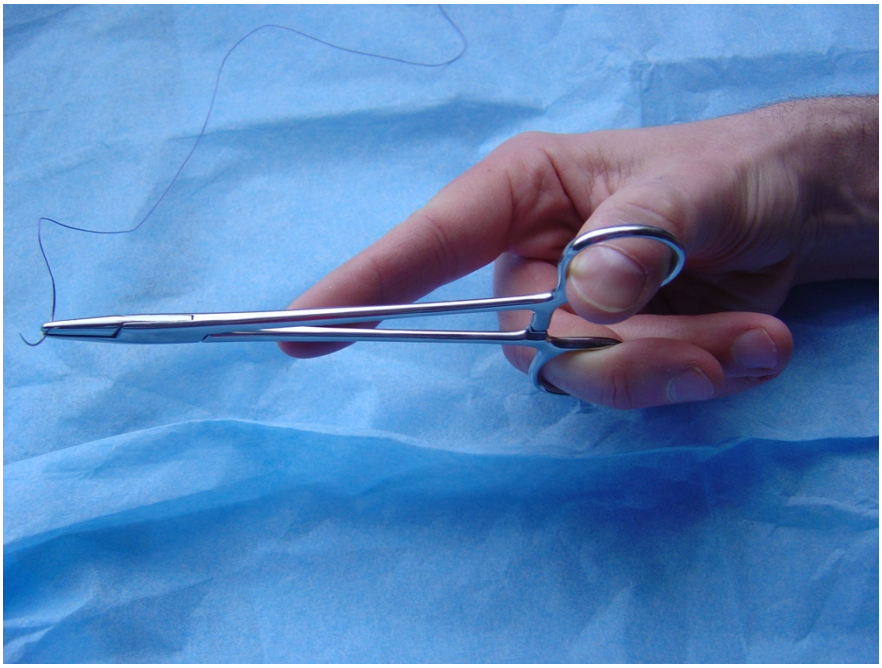


Figure 7: This photograph illustrates how the needle should be held

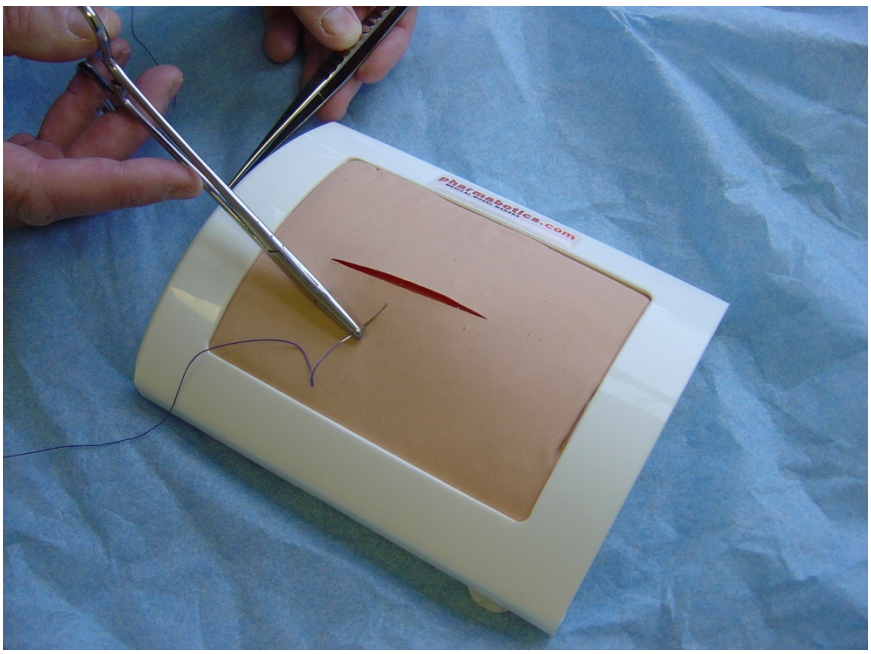


Figure 8: Demonstrates the positioning of needle.

It is advantageous to sew towards oneself i.e. from the far side of the wound to the nearest. (Figure 9) Although there are occasions when the needle has to be placed differently or the surgeon has to suture away from the operator, this situation would be unusual when suturing skin wounds e.g. when placing a mattress stitch, the suture will be passed from the closest to the opposite skin edge.

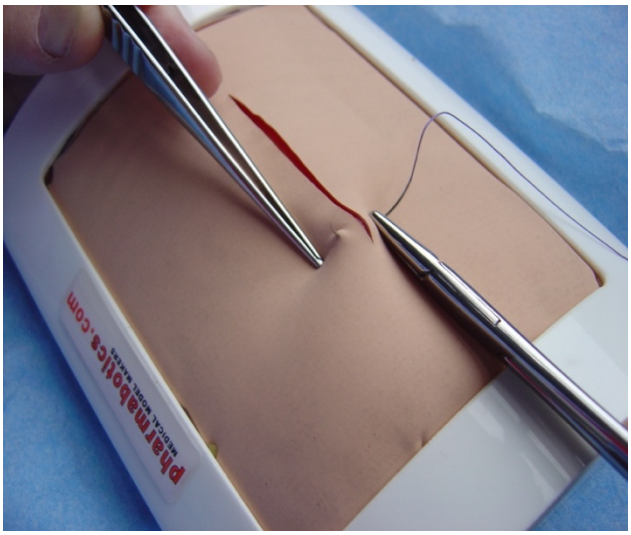


Figure 9: This illustrates the stitch being placed from "far to near".

The holder should be closed gently to engage the first ratchet as over-tightening could cause damage to the needle.

Releasing the needle can be difficult for the novice. There is a tendency to try and simply pull the rings of the holder in the opposite direction. This results in further engagement of the ratchet. The ratchet can be disengaged by pushing the ring being held by the thumb towards and out from the stabilised ring held by the ring finger.

“Instrument” knot tying

Tying knots using the needle holder i.e. instrument knot tying is used commonly. The main features of this technique are shown below:

- The suture having been placed is pulled gently until a short length is left on the distal side of the wound.
- For a right-handed surgeon, the dissecting forceps is placed on the operating table or is held in the palm.
- The needle is released from the holder and is placed on the table.
- The long end of the suture attached to the needle is held in the left hand.
- It is then rotated twice around the needle holder in a clockwise direction.
- The needle holder picks up the short end of the suture, which is then pulled off the needle holder. The first throw of the knot is gently tightened to approximate the wound edges. The second throw is made in a similar way, except the suture is wrapped around the holder in a counter-clockwise direction. It is slipped off the holder and the knot tightened.
- It is important to ensure that the throws lie “square” and not crossed, as a “granny knot” will form.
- It is important not to over-tighten the knot. As the wound heals, it will become oedematous and swell and if the suture is tied too tightly, it will cut into the edges of the wound causing pain and necrosis.

Several extra throws may be required to ensure that the knot does not unwind. Certain sutures such as nylon have this tendency. This is inherent to the suture’s “memory," which is dependent on its molecular structure. C/f silk, due to its different memory, knots and handles easily.

The suture is cut in such a way that it does not interfere with the next suture or make removal difficult.

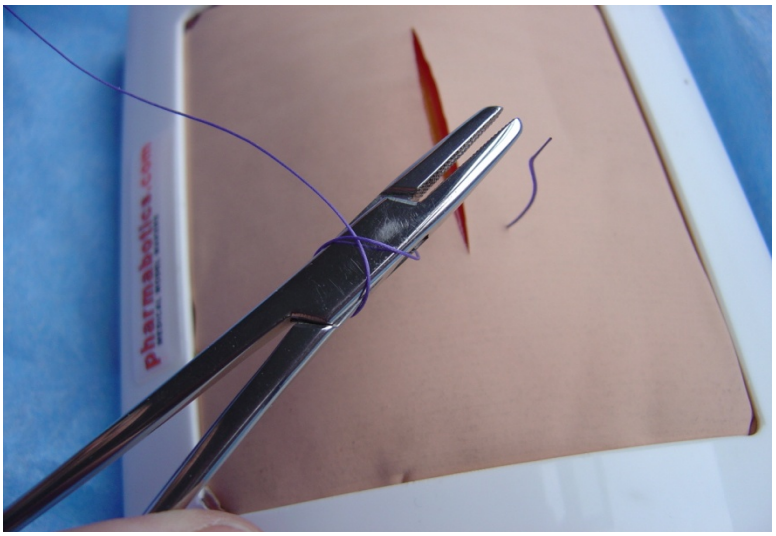


Figure 10: Demonstrates the first throw of the knot; the second throw is placed in the opposite direction

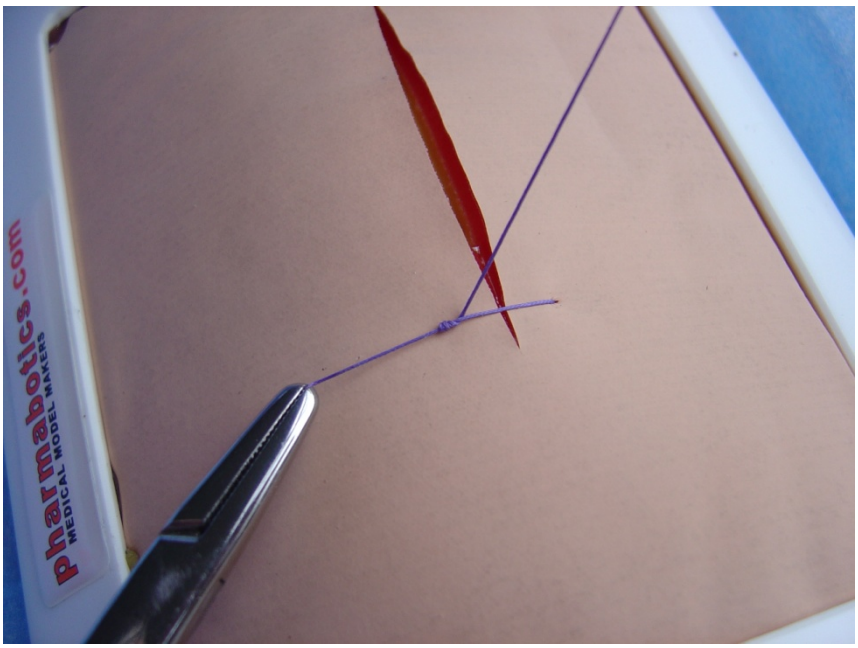


Figure 11: The knot is gently tightened, producing a square knot

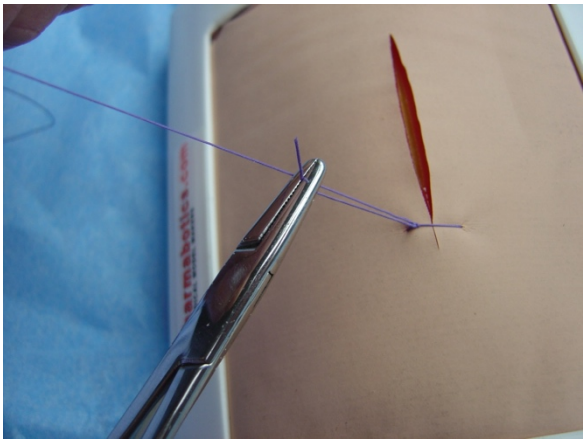


Figure 12: The knot is ready for cutting

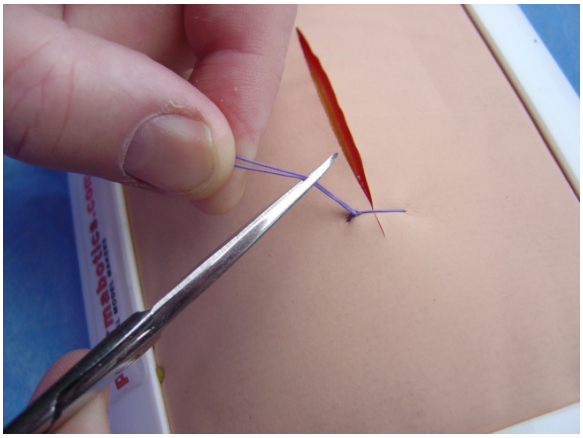


Figure 13: Cutting the knot

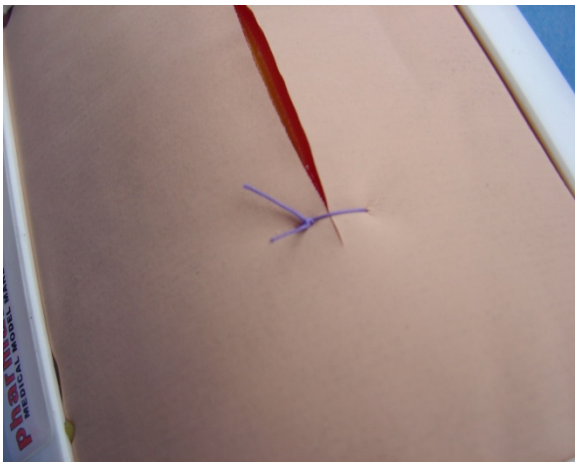


Figure 14: The completed knot

Documentation / record keeping

The use of documentation should be the means by which the practitioner can demonstrate that a safe standard of care has been provided.

Carson & Minard (1994) recommend that a suture treatment record be used to record the following:

- Time between injury and repair.
- Wound assessment regarding contamination.
- Wound cleansing / preparation / irrigation.
- Medications used (i.e. local anaesthetic / Tetanus booster)
- Suture size & material
- Identification of personnel performing procedure.

Advice to Patients post-Suturing

Patients must be provided with written information regarding care of their wound prior to discharge.
They should know how to care for their wound, when to return for suture removal and what action to take and where to seek help, should something go wrong, e.g.

- wound opens up
- experiencing pain
- wound starts to ooze
- wound appears red and inflamed
- stitches fall out before removal time.

Removal of Sutures
Generally, sutures can be removed earlier from tissues with a good blood supply (i.e. face and scalp); however sutures should be left in situ a little longer over particularly mobile skin.

The following list gives approximate durations of suture insertions:

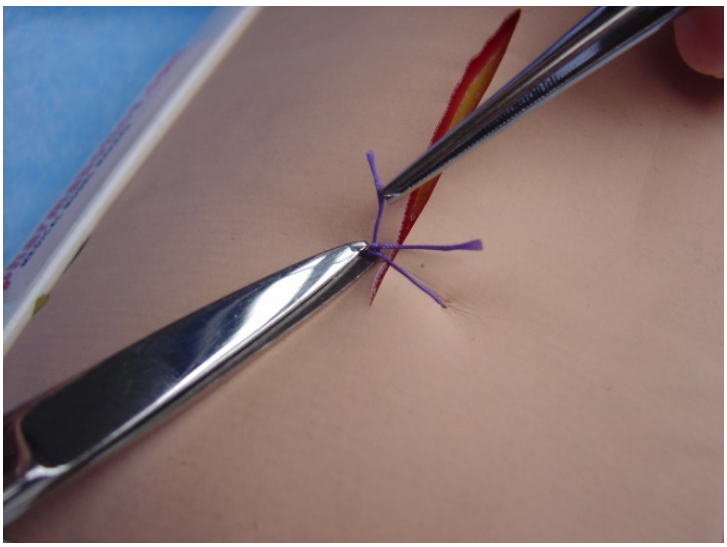
Facial wounds: 5 days
Scalp wounds: 7 days
Arm/hand: 7-10 days
Lower limb or joints: 10-14 days

The main principles are:

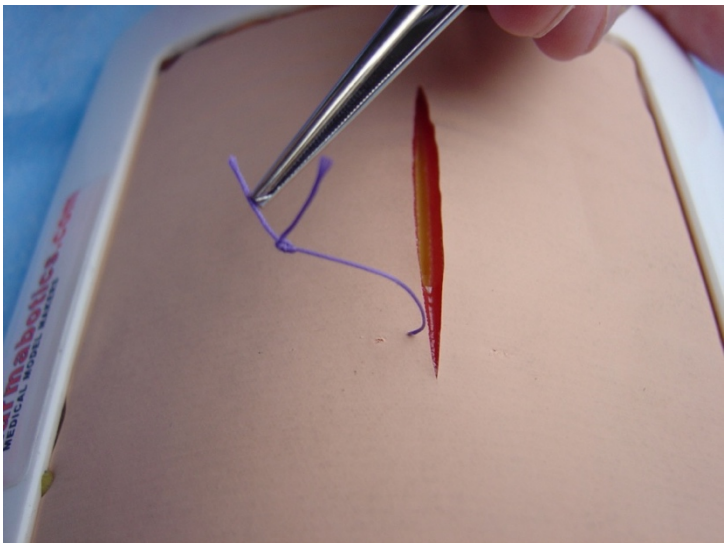
- Use appropriate suture scissors or stitch cutter
- Cut below knot
- Pull the knot and suture towards the wound
- Remove the suture.

This technique will result in pulling a small amount of the suture and not the knot through the wound. Any tension produced will not distract the wound.

The timing of removal of the sutures will vary. Where there is little tension and good blood supply e.g. the face, the suture can be moved from 3-7 days. Where the wound is subjected to increased tension e.g. over a joint, the suture should be left for 10-14 days.



Scissors cutting the suture



Suture removed

Sutures that are inserted too near wound edge - are likely to pull out causing more injury.

Practitioners' Risks

- Needle stick injury
- Blood borne infection

Refer to: Local Joint Infection Control Guidelines.

Guidelines for Good Practice

- Maintain a safe environment for patient and practitioner by following guidelines on infection control.
- Provide a full explanation of the procedure to the patient
- Avoid using Lignocaine which contains adrenaline - this can cause vasoconstriction with potential complications in areas of poor vascularity - i.e. fingers, toes, ears.
- Suturing of deep / facial, difficult or high-risk wounds should only be undertaken by expert practitioners or medical staff according to local policy.
- Practise this skill on a regular basis and be aware of your limitations.
- Ensure accurate documentation of the procedure and any difficulties encountered.
- Provide the patient & family with wound care advice and information regarding suture removal.

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Appendix A

Suturing Checklist	Mark √ **X N/A**		
Preparation			
Choose appropriate suture material			
Organise dressing pack, gloves, suture kit, sterile solution, local anaesthetic, needles and syringe on a clean trolley			
Take sharps bin to bedside*			
Introduce self to patient by name and title			
Explain procedure to patient			
Explain to patient that they will have a permanent scar			
Gain informed consent from patient (verbal)			
Ensure that patient is at appropriate height, lighting is good, and you have space and are comfortable			
Decontaminate hands*			
Put on well-fitting disposable non powdered latex gloves (not vinyl)			
Clean area with sterile solution using sterile swabs and forceps and allow to dry			
Drape area if appropriate			
Infiltrate area with local anaesthetic			
Explore wound if appropriate			
Suture placement			
Mount needle on needle holder using dissection forceps – not with fingers*			
Ensure needle is placed on holder approximately 1/3 from thread end			
Enter skin on far border of wound			
Enter approximately 5mm from wound edge			
Fully pronate hand (so needle enters skin perpendicularly)			
Supinate your hand to allow needle to pass through skin into centre of wound			
Grasp needle 1/3 from tip with forceps and withdraw from wound			
Re-mount needle on needle holder using dissection forceps - not using fingers*			
Pass needle from centre of wound with hand pronated			
Ensure needle exits on near border of wound at approximately 5mm			
Pull suture through leaving approximately 5cm of suture material on the far border			
Remove needle from needle holder – do not touch needle with fingers*			
Knot of suture			
Hold long length in non-dominant hand			
Holding needle holder in dominant hand place on top of long length			
Wrap suture material around needle holder twice			
Open needle holder and grasp short end of suture between jaws			
Draw needle holder towards you and take non dominant hand away from you with long length of suture			
Pull first throw of knot down to approximate wound edges			
***			
Place needle holder on top of long length of suture			
Wrap long length around needle holder once			
Grasp short length of suture material in jaws of needle holder			
Pull short length away from you and long length towards you			
Place knot to one side of wound			
***			
Repeat steps *** to ***			
Cut suture ends at a length of approx 1cm			
Continue suturing equi-distance apart			

Ensure wound edges completely apposed and not inverted			
Dispose of needles safely into sharps bin*			
Clean wound with sterile solution			
Dress the wound as appropriately			
Dispose of clinical waste into clinical waste bag			
Advise patient on suture removal			