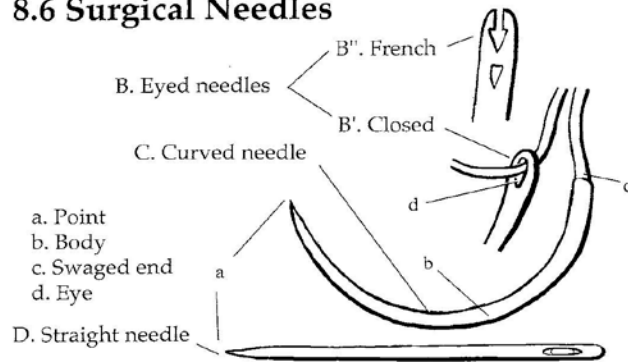


Instruments, Needles & Sutures

8.6 Surgical Needles



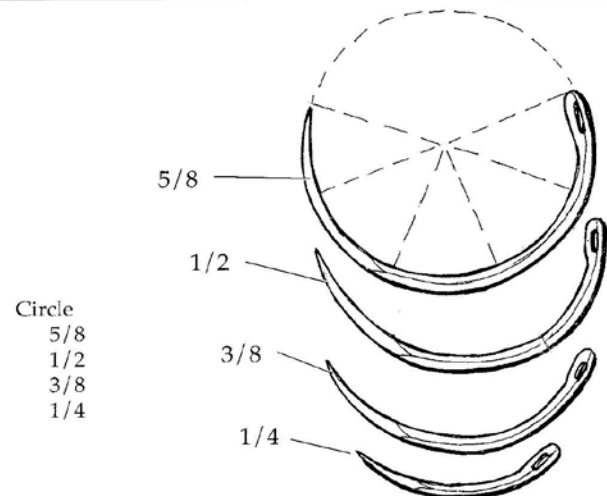
Surgical needles: come in a wide variety of type and sizes.

The parts of a surgery needle are:

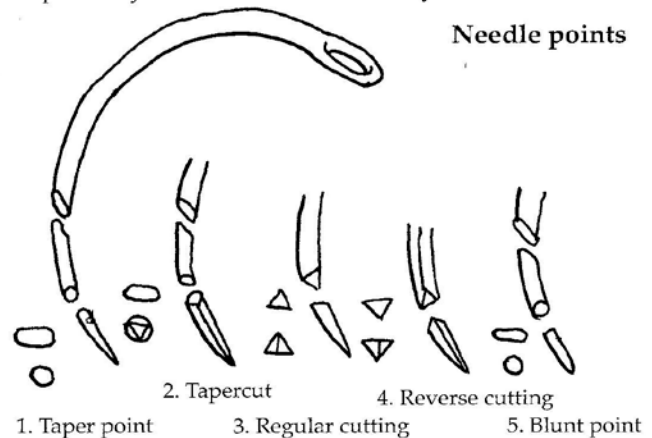
- **Attached end:** can be either with or without an eye.
 - **Swaged (atraumatic, eyeless) needles:** have the suture affixed to the hollow end of the needle during manufacture in a continuous manner, thus, minimizing the trauma as only a single strand of suture is pulled through the tissue. They are preferred for all surgeries. Control release® needles will release the suture from the needle by a purposeful straight tug.
 - **Eyed needles:** require that the suture be threaded through the eye and, thus, are more traumatic to tissue (make a bigger perforation) than a swaged needle because of the double-strand. They are, therefore, not used on easily damaged tissue such as blood vessels and visceral organs. The hole/eye can be closed (round, oblong or square) or French/spring-eyed with a slit from the outside to the hole for ease of threading.
- **Body of the needle:** comes in a number of shapes for different purposes.
 - **Straight (Keith) needles (D):** used for accessible areas that allow the needle to be manipulated directly by the fingers as in purse string sutures of the anus.
 - **Curved needles (C):** can be curved with a curvature 1/4, 3/8, 1/2, 5/8 circle or half curved.
 - Three-eighths (3/8) and one-half (1/2) circle needles are the most commonly used in veterinary medicine (laparotomy closure).
 - 3/8 circle: easily manipulated in accessible areas.
 - 1/2 to 5/8 circle: small arched needles are easier to use in deep or inaccessible areas.
 - 1/4 circle: commonly used in ophthalmic procedures.
- **Points (1-5):** varies, depending on the toughness of the tissue to be sutured.
 - **Taper point (round/noncutting/atraumatic) needles (1)** are sharp tipped to pierce tissue instead of cutting them. They are used on easily penetrated tissue such as subcutaneous tissue, fat, muscle, and intestine.
 - **Tapercut needles (2):** have a tapered body with a cutting edge tip. They are used for tough fibrous tissues such as tendons.
 - **Cutting needles (3-4):** have 2 or 3 cutting edges to penetrate tough tissue such as skin. The third cutting edge can vary in location.

Needles - Summary

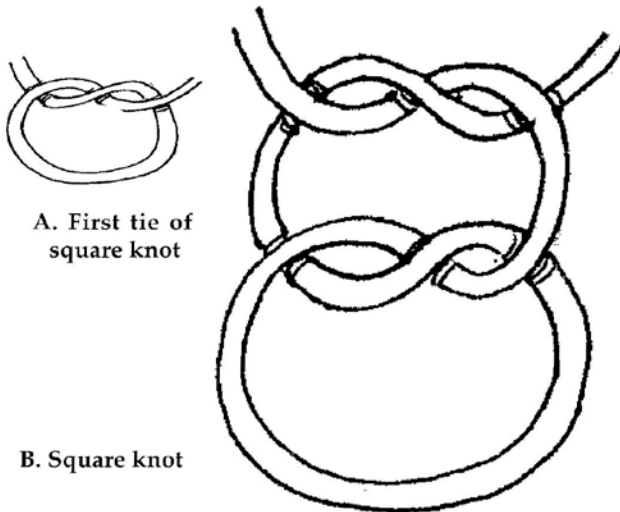
- **Attached end:**
 - **Swaged/atraumatic:** suture affixed to needle
 - **Eyed:** suture threaded through - more traumatic
- **Body:**
 - **Straight (Keith):** finger manipulation
 - **Curved:** needle holder manipulation: 1/4, 3/8, 1/2, 5/8 circle
- **Point:**
 - **Taperpoint:** tapered piercing tip
 - **Tapercut:** tapered cutting tip
 - **Cutting (regular or reverse):** 2 or 3 cutting edges
 - **Blunt:** rounded point (friable tissue)



- **Conventional/regular cutting needle (3):** the third cutting edge is located on the inside/concave side of the curve.
- **Reverse cutting needle (4):** the third cutting edge is located on the outside/convex side of the curve. This is advantageous when closing incisions as there is no tendency to "tearout" to the incision.
- **Blunt point needles (5):** have rounded points that don't cut friable tissue. They are rarely used, except in the parenchyma of the liver and kidney.



8.7 Surgical Knot Tying



A. First tie of square knot

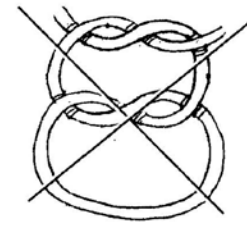
B. Square knot



C. Surgeon's knot



D. Triple surgeon's knot



E. Granny knot



F. Half hitch

8.7 Surgical Knot Tying

- **Sutures:** hold incisions and wounds together until healing can occur. If skin sutures come undone, the skin incision can dehiscence (open up, dehiscence).
- Loop: the part of the suture in the opposed or ligated tissue.
- Knot: part formed by the throws (wrapping of suture strands around each other).
- Ears: cut ends of the suture, usually 5 mm (1/4") long.
- **Just oppose edges:** generally just gently oppose the edges of the incision. Do not tie too tight or the sutures may cut through the tissues or compromise the blood supply (strangle the tissues). The suture should lie flat, but when lifted, there should be a space between the loop and tissue to accommodate the inflammation and edema that occurs.
- **Square (reef, true, flat) knot:** the most common knot tied, as it slips less frequently than a granny knot or half hitch. It is formed by two throws in which the ears come out the same side of the knot. This is accomplished by throwing two throws in reverse directions. For additional security additional half knots (extra throws) may be placed in reverse directions on the knot.
 - **Square knot (B):** will be thrown if the needle holder starts inside the suture strands for both throws (reverse throws) and even tension is maintained on each strand in the plane of the knot.
 - **Not granny knot:** unacceptable as it comes apart, will occur if the needle holder starts inside the strands of one throw and outside for the other.
 - **Not half hitch:** also unacceptable, may occur if even tension is not maintained on both strands in the plane of the knot as it is thrown.
- **3 reverse throws:** generally are enough to insure a secure knot with most suture material (those with high coefficients of friction and minimal tension).
- **4 or more:** use four or more throws, and if you are unsure of the suture knot's security (monofilament sutures

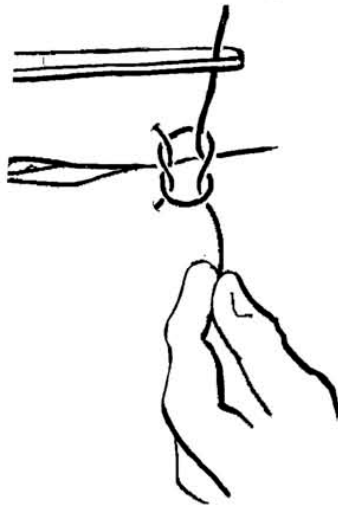
Surgical knot tying - Summary

- **Just oppose incision edges as swelling occurs**
- **Secure knot:**
 - Square knots: needle holder starts inside strands for both throws.
 - No granny knots: different sides for each throw.
 - 3 throws generally enough for catgut.
 - $\pm \geq 4$ throws for synthetic or monofilament.
 - Avoid surgeon's or double reef knots, only if square knot slipping or not apposing
- **Gently tie sutures**
- Cutting sutures: just steady suture
- Dispose of sharps
- Record
- Client: remove in 10 days

which have a low coefficient of friction).

- **4 throws:** are used when tying suture at the end of a continuous suture line.
- **Only use surgeon's knot, triple surgeon's knot or double reef knot (two surgeon's knots)** if tissue opposition is not possible with a square knot or to prevent the knot from slipping before placing the second throw. Do not use a surgeon's knot with cat gut, as it may result in fraying. Surgeon's knots add to the bulk of suture material in the wound.
- **Gently tie sutures:** to avoid suture breakage and tissue damage. Avoid excess tension and sawing or seesaw motions.
- When cutting sutures, place only enough tension to steady suture without pulling on tissue (see 9.18).
- Dispose of sharps and clinical waste appropriately
- Document procedure in notes/record.
- Inform the client the sutures can be removed in 10 days.
- Thank patient, check for any questions

8.8 Suture length & Spacing Guidelines



8.8 Skin incisions: heal better when the edges are gently apposed so that the epidermis grows directly across the defect to the epidermis (first intention healing). Inversion will delay healing of skin. Eversion is better, but still delays healing.

- External sutures, since they will be removed once the tissue heals, don't require the meticulous concern about the size of the knot and the length of the tags (ends) as buried sutures.

- Simple interrupted pattern is the most common closure. Take care to avoid its tendency to invert the skin.

Skin sutures measurements - rough guide:

- **From edge = 3-5 mm (<1/4"):** take the closest bite to the incision that apposes the wound edges without cutting through the tissue or interfering with healing.
- **First and last sutures: 10 mm (1/2")** from the end of the incision line.
- **Ends: 5-10 mm (1/4-3/8"):** longer than other to facilitate removal
- **Spacing: 5-8 mm (1/4-1/3")** apart: for proper spacing.
- . **Rule of halves:** for spacing use the rule of halves: 1st is half way along wound; next is half way between suture and end of wound, etc.
- . When done, sutures can be added if there are gaps where the incision's edges are not apposed (there is no too close in suture placement, although excessive sutures take up time).
- . Right handed surgeons usually place sutures from right to left on a horizontal incision; left handed the opposite.
- **Ends:** for all sutures, minimize surgical material by using the smallest adequate suture possible for the most secure knots, only use enough throws for a secure knot. Don't place excess sutures and don't leave cut ends too long.

- **Non-skin sutures:**

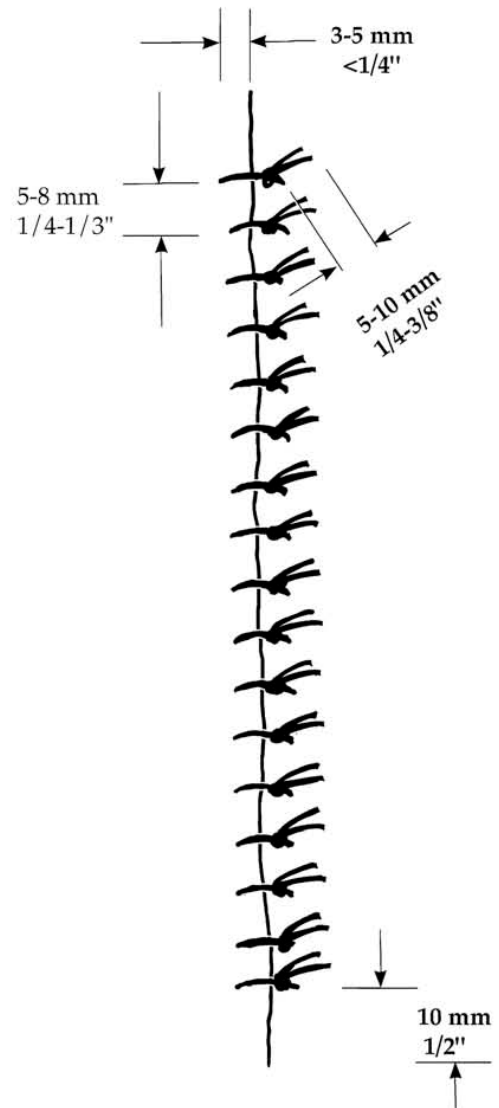
. **Multifilament and steel sutures:** generally cut off close to the knot: 2 mm (1/10").

. **Monofilament sutures:** need to be left longer so the knot doesn't come untied: 3-4 mm (1/8"-1/6").

. **Buried knots:** cut the suture ends as short as possible to minimize tissue irritation for synthetic sutures: 3 mm (1/8").

. **Catguts:** swells, thus, cut its ends a little longer: 8-10 mm (1/3").

- **Skin: 5-10 mm (1/4-3/8")** ends: longer to facilitate removal



• **Skin sutures measurements:**

- From edge = 3-5 mm <1/4"
- 1st & last sutures: 10 mm 1/2"
- Ends: 5-10 mm 1/4-3/8"
- Spacing: 5-8 mm 1/4-1/3"

Rule of halves: 1st = half way etc.

• **Ends:**

- **Non-skin sutures:**

. **Multifilament &**

steel: 2 mm 1/10"

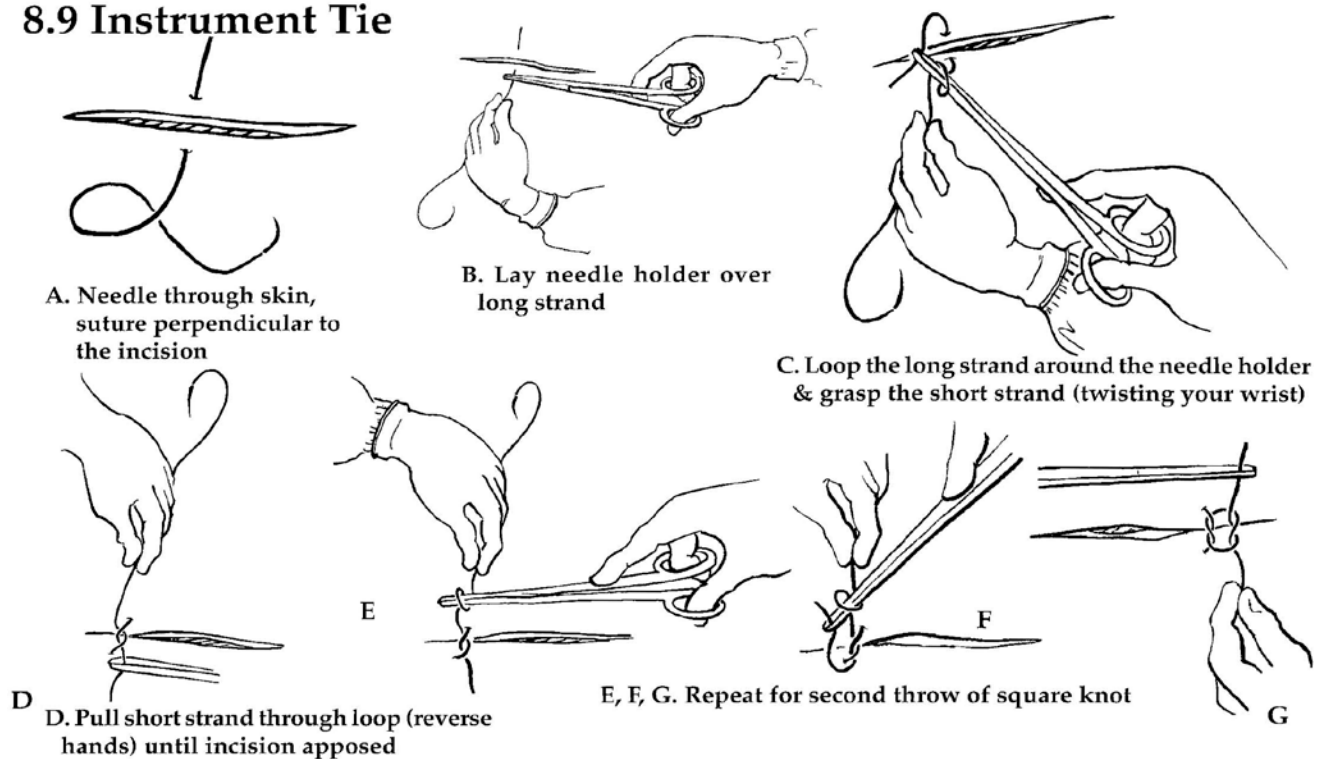
. **Monofilament:** 3-4 mm 1/8"-1/6"

. **Buried knots:** 3 mm 1/8"

. **Catguts:** 8-10 mm 1/3"

- **Skin:** 5-10 mm 1/4-3/8"

8.9 Instrument Tie



8.9 Instrument tie: uses a needle holder to make square knots. Hold your hands steady, do not let them float randomly while tying knots.

- Pass the needle and suture through the skin (tissue) on both sides of the incision, leaving a short end (1-2") exposed on one side (A).
- Pull the two suture ends perpendicular to the incision and keep in the same plane (flat against the skin) (A).
- Lay the needle holder over the long strand (attached to needle) keeping the needle holders parallel to the incision (B).
- Loop the long strand around the needle holder (C).
- Grasp the short strand with the tip of the needle holder by twisting your wrist (C).
- Pull the short end through the loop with even tension as you reverse your two hands to opposite sides of the incision line while untwisting your wrist (D).
- Pull the knot together until the sides of the incision are just apposed. Excessive tension will evert the skin, which should never be allowed. The suture should now be perpendicular to the incision with the two ends on the reverse sides of the incision (D).
- If the knot is too tight, cut and remove suture and start over. Loosening by spreading it with the end of the needle holder is not a good practice.
- Repeat the above steps for the second throw: lay the needle holders on the long strand, loop the strand around the holder, twist wrist and grasp short end and pull through the loop as you reverse and untwist your hands (E-G).
- The resulting square knot should lay flat with the incision edges just apposed.

Instrument Tie - Summary

- Needle through skin, short strand exposed (A).
- Pull ends perpendicular to incision (same plane) (A).
- Lay needle holder over long strand (B).
- Loop long strand around needle holder (B).
- Grasp short strand (C).
- Pull short strand through loop (reverse hands) until incision apposed (D).
- Repeat for second throw of square knot (E, F, G).
- \pm 3rd or 4th throw for security.
- Surgeon's knot same except double loop on 1st throw

- Lift the knot gently to check that the first knot is not too tight. There should be a space between the suture and the tissue to allow for normal swelling postoperatively. If too tight, cut, remove suture, and start over.
- For more security, a third and possibly a fourth throw may be done by repeating the above steps, reversing your hands with each throw.
- A surgeon's knot is thrown the same way, except during the first throw the long strand is looped twice around the needle holder instead of just once.

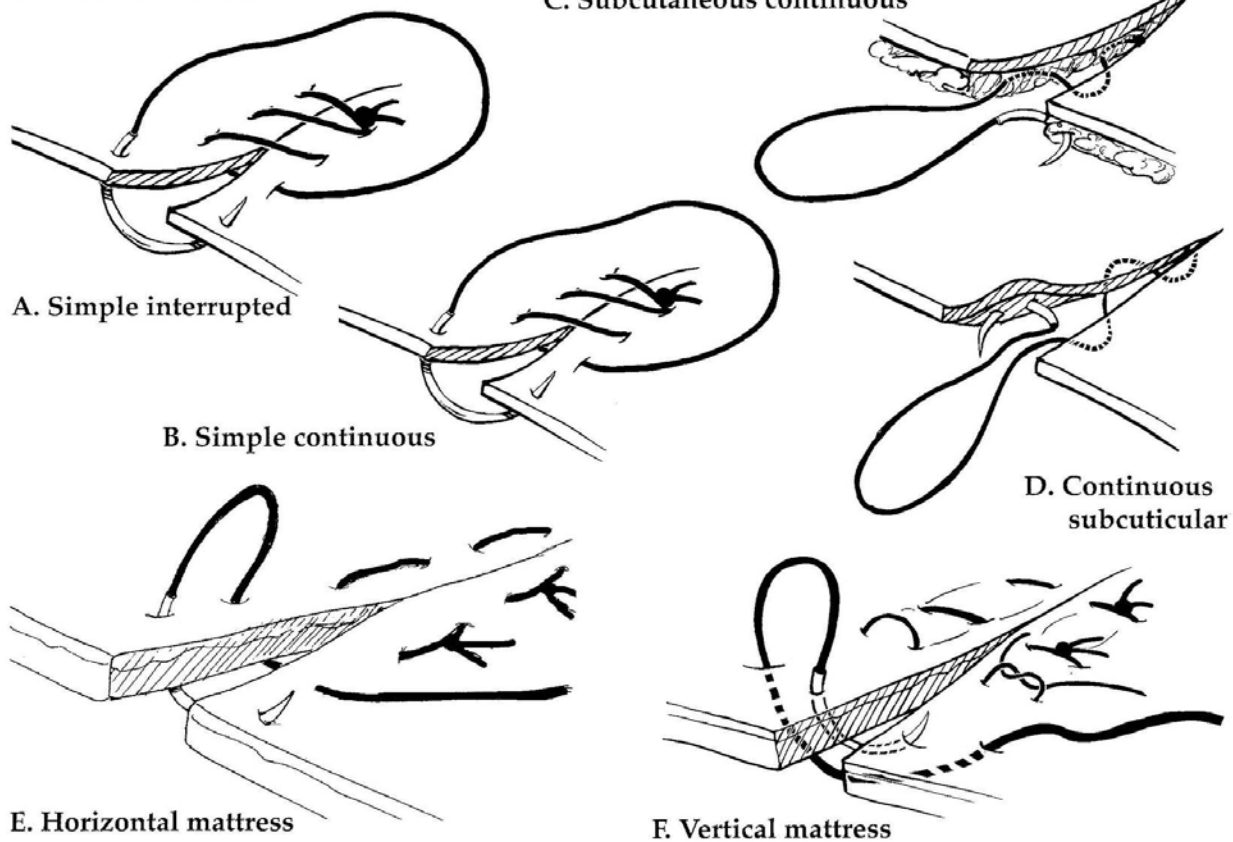
Note: while doing an instrument tie, pull both ends of the suture with the same tension and do not lift one, or pull to the side, resulting in a half hitch instead of a square knot. Practice is a must prior to surgical application.



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Instruments, Needles & Sutures

8.10 Stitch Classification



8.10 Suture patterns: are the "stitches" that hold (oppose) the edges of the incision (wound) together.

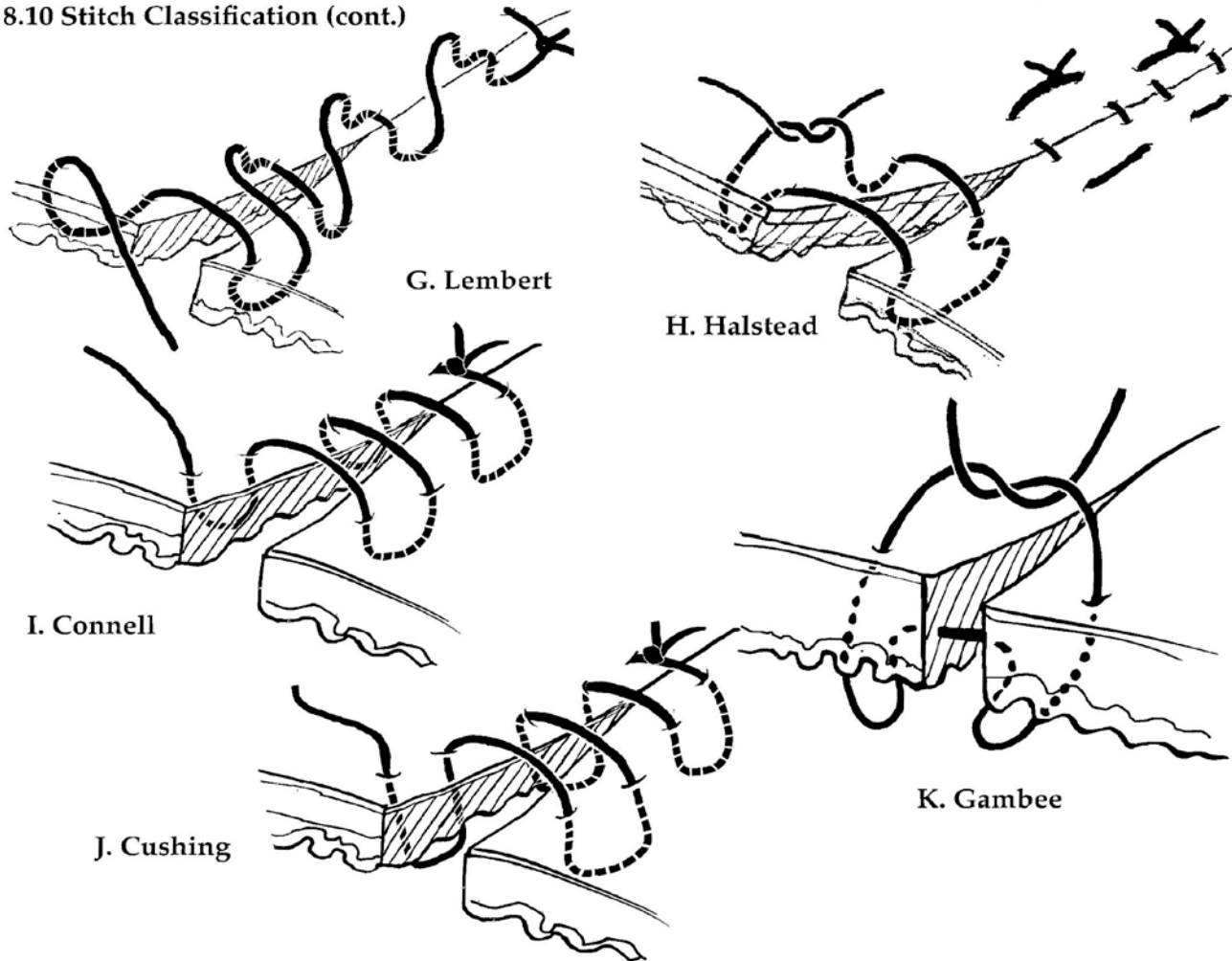
- **Approximation of tissue** - General rules:
 - **Normal position:** attempt to replace tissues in their normal position.
 - The suture pattern chosen depends on the wound and the surgeon's preference.
 - **Gentle and precise placement** of sutures is more important than the suture pattern chosen.
 - **Handle tissue gently:** excessive trauma by rough pulling, twisting, tearing, crushing, or rubbing with gauze delays healing.
 - **No fat:** do not interpose fat tissue in the closure as it prevents healing and may lead to dehiscence.
 - **Suture any dead space closed,** if not the body will eliminate any by filling it with fluid. They can be classified in different ways:
- **Simple suture pattern*:** the suture only passes once through the tissue on each side of the incision.
- **Continuous or interrupted patterns:**
 - **Continuous suture patterns** or running stitches: formed by taking multiple bites through the tissue without

cutting the suture. The suture is just tied at the two ends. The patterns is quick and minimizes material in the incision, but, if the suture breaks at some place the whole suture line may come undone. Thus, extra care of the suture material must be taken when using a continuous pattern.

- **Interrupted suture pattern:** each suture is cut and tied as it is placed. Thus, if one suture breaks, the rest of the line is not effected. An interrupted pattern allows precise adjustment of tension at each point of the incision.
- **Appositional and inverting patterns:** how the tissues are apposed:
 - **Appositional suture patterns:** bring the edges of the wound so they just touch (appose) (e.g., simple interrupted [A], simple continuous [B], subcuticular [D], Ford interlocking, Gambee [K]). Appositional suture patterns can be further divided into the tissue they appose (e.g., skin, subcutaneous, subcuticular).
 - **Inverting suture patterns:** turn the wound edges inward. They are used to close and seal incision/wounds of hollow internal organs such as the stomach, intestine, bladder, and uterus. Tightening the suture inverts the edges toward the lumen, forming a seal that prevents leakage due to serosa to serosa contact (e.g.; Cushing [J], Connell [L], Halsted [H], Lambert [G], purse string).

* Complex suture pattern: the suture passes through the tissue more than once on both sides of the incision (e.g., mattress suture) (this term, "complex suture pattern", is not used).

8.10 Stitch Classification (cont.)



- **Everting suture patterns:** turn the wound edges outward (e.g., mattress sutures [E, F]). These patterns are usually used when tension tends to pull the incision edges apart and are usually called tension sutures.
- **Tension suture patterns:** used to relieve tension on the closure (e.g., vertical and horizontal mattress [E, F], quilled, stent, near-and-far).
- Patterns for different areas:
 - **Subcutaneous sutures:** use a simple continuous pattern (C) of absorbable suture with the knots buried.
 - **Gastrointestinal tract sutures:** simple interrupted apposition or simple continuous patterns have gained favor over the inverting suture patterns (Cushing, Connell, Lembert, Halsted) of the past. Inverting patterns help prevent leakage from the gastrointestinal tract, but can result in stenosis (narrowing of lumen).
 - **Submucosal layer:** include in suture (s) as this is the holding layer of the intestine.
 - **Laparotomy incision closure:** opening of the abdomen.
 - The linea alba or the external rectus sheath **must** be sutured not muscle tissue, as they are the suture retaining

layers, or the sutures will not hold.

- **Not peritoneum:** do not suture the peritoneum or the abdominal muscle layers, as this will increase the chance of abdominal adhesions.
- **Skin:** close with simple interrupted (A) or a subcuticular pattern (D). A simple continuous pattern (B) that has an adequate number of throws at each end is also safe.
- **± Subcutaneous simple interrupted or continuous (C) layer:** can be used to minimize dead space.

Stitch Classification

- Continuous or interrupted:
 - **Continuous:** tied at 2 ends
 - **Interrupted:** each cut & tied
- Simple: pierce 1x each side
- Apposition:
 - **Appositional:** edges apposed (simple interrupted)
 - **Everting:** edges outward (mattress) - tension
 - **Inverting:** edges inward (Cushing, Lembert)

Instruments, Needles & Sutures

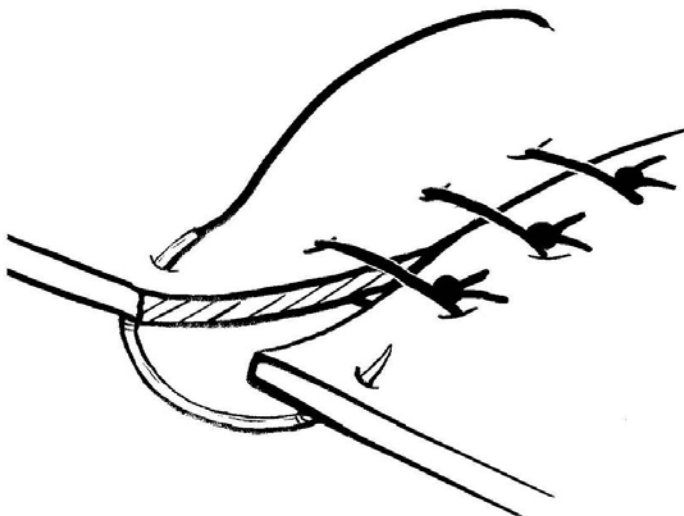
8.11 Simple Interrupted Stitch

Simple interrupted patterns: the most common pattern for skin closure as well as internal stitches because it is simple, easy and safe. Although more time consuming and using more suture material than a continuous pattern, if one suture breaks the rest of the line will hold the incision closed. It is commonly used for skin, subcutis, fascia, nerves, blood vessels, and the gastrointestinal tract.

- **From edge:** pierce the skin <1/4" (3-5 mm) lateral to the incision edge, just passing through the epidermis and dermis, not the subcutaneous tissue.
- Pass the needle under the incision and out through the same amount of skin on the opposite side of the incision.
- Tie the knot until the incision edges are just apposed on the first throw.
- Throw the second and third throws without tightening the first throw. Excess tension will invert the skin which should never be allowed, eversion is preferred. If a stitch everted skin cut suture and place it again.
- Offset the knots so they don't lie on the incision line.
- Cut the strands off (for skin incisions roughly 1/4-3/8" [5-10 mm] for easy removal).
- Continue placing sutures from one end of the incision to the other or use rule of halves (.
- Separate the sutures roughly 1/4-1/3" (6-8 mm) from each other and 1/2" (12 mm) from the ends of the incision. Thicker skin will require fewer sutures than thinner skin or when the incision cuts across tension lines.
- Check the suture line once completed. Additional sutures may be needed if appositional gaps are present.

Simple interrupted stitch - Summary

- Take a bite across incision
- Appose, offset knot, tie, & cut
- Repeat until closed

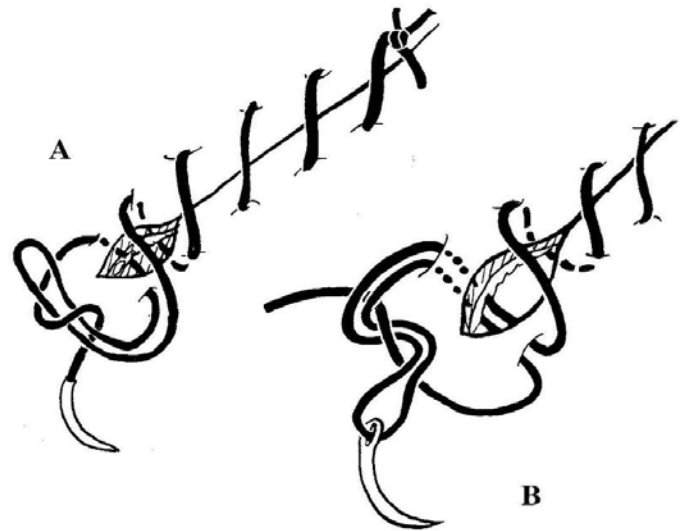


Simple interrupted stitch

Pasquini & Pasquini



Simple continuous stitch



Ending knot using swagged on (A) and open-eyed (B) needles

8.12 Continuous Stitch

Simple continuous suture pattern or running stitch: is formed by taking multiple bites along the incision without cutting the suture. The suture is only tied at the two ends. This pattern gives maximum tissue apposition and is, thus, relatively air and fluid tight. It uses minimal suture material and is easy to remove. The pattern is quick, but if the suture breaks at any place the entire suture line may come undone. This pattern is used in tissues requiring minimum holding with maximum apposition and to close subcutaneous tissue before closing the skin (skin, subcutis, fascia, blood vessels and gastrointestinal tract).

- Start just like a simple interrupted pattern by placing a simple interrupted suture across one end of the defect

Continuous Stitch - Summary

- Place & tie a simple interrupted suture across one end, cut short end
- Advance needle & bite across incision
- Repeat to end without cutting
- Tie last bite & cut

and tie a knot.

- Cut the short end of the suture, but not the long end.
- Advance the needle and take a bite perpendicular to the incision through both sides of the incision.
- Repeatedly advance the needle without cutting the suture and take bites across the incision until the end of the incision is reached. Examine and adjust the suture line for tightness frequently as bites are taken.
- At the end of the incision, tie a knot using three throws (the length of the pattern should not exceed 5 inches).
 - Swaged-on needle: do not pull the suture all the way through on the last stitch, leave a loop to tie to.
 - Open-eye needle: hold the short end of the suture from passing through on the last stitch to tie to.
- Cut the suture material.

Ford interlocking stitch - Summary

- Place & tie a simple interrupted suture across one end, cut short end
- Form a loop
- Advance needle & bite across incision
- Pass needle through loop & tighten
- Repeat loop & bite to end
- Tie last stitch, cut

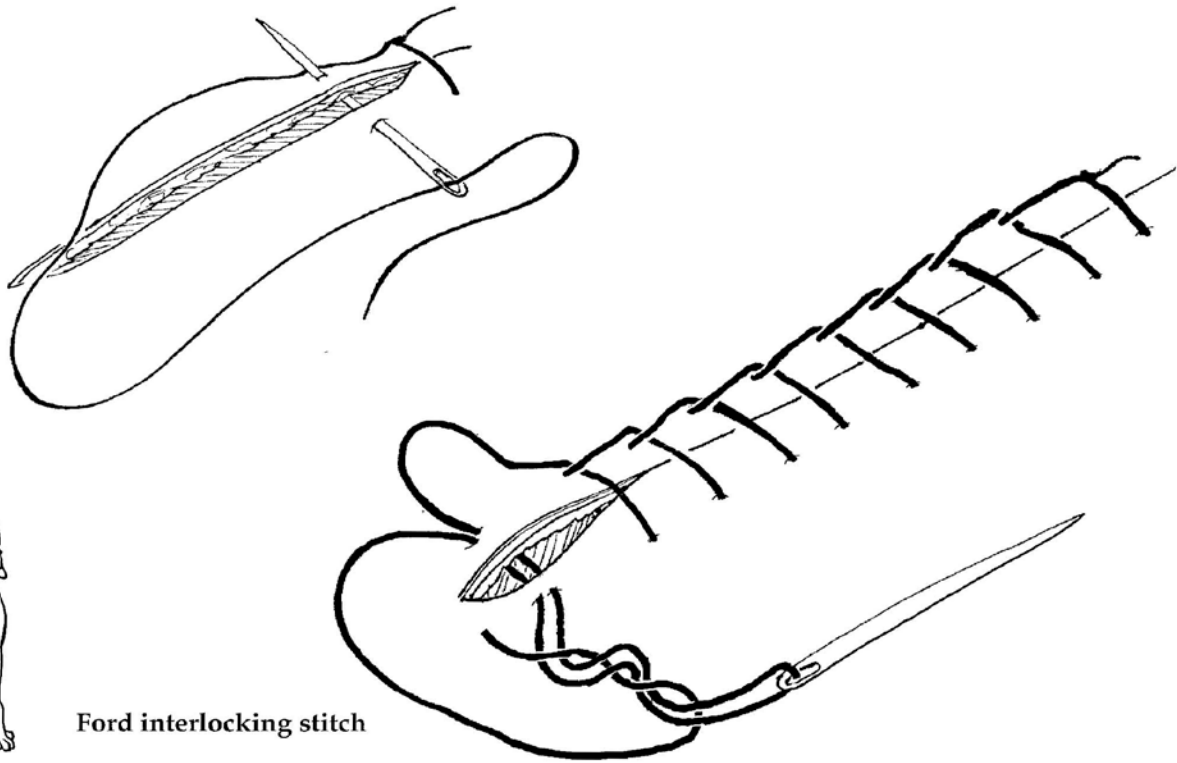
8.13 Ford Interlocking Stitch

Ford interlocking pattern (continuous-lock pattern or "blanket stitch"): a modified simple continuous suture that is partially locked at each bite. It is a fast stitch which provides some suture security if broken, but may be difficult to remove. It is commonly used for skin, especially for large small animal and large animals.

- Start as for a simple continuous pattern:
 - Place a simple interrupted suture and tie a knot.
 - Cut the short end of the suture, but not the long end.
- Lock stitches:
 - Form a loop.
 - Advance the needle and take a bite perpendicular to the incision in the same direction.
 - Pass the needle through the preformed loop and tighten to lock.
- Repeat the loop and bite, locking each stitch as it is thrown until the end of the incision is reached.
- Last stitch: tie a knot using three throws.
 - Open-eye needle: take bite with the needle from the opposite direction and hold the suture end on the side of insertion. Tie loop on needle to single strand.
 - Swaged-on needle: do not pull the suture all the way through on the last stitch; leave a loop to tie to, just as for a simple continuous pattern.
- Cut the suture material (1/4" tags).



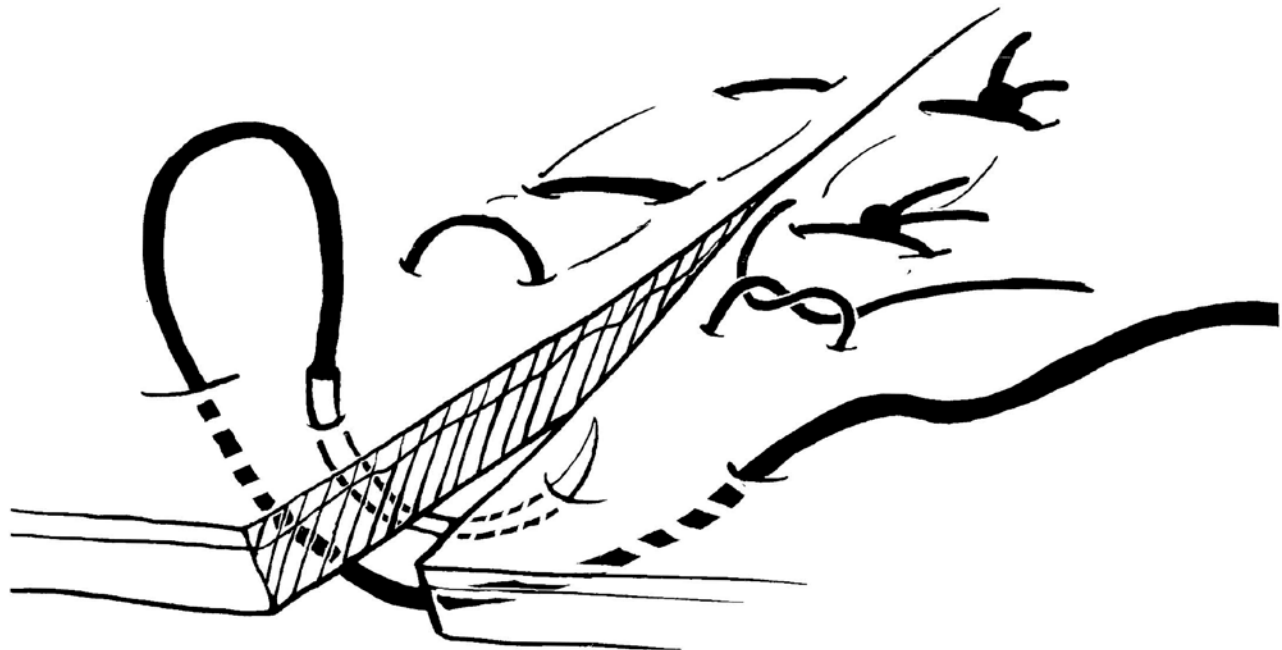
Ford interlocking stitch



8.16 Vertical Mattress Stitch

Vertical mattress suture pattern: a stronger tension pattern with less eversion problem than a horizontal mattress. One layer can be used to close the subcutis as well as the skin to eliminate dead space. A vertical mattress stitch may be used in the skin.

- Take a large bite across the incision.
 - Pierce the tissue far from one edge of the incision ($1/3$ ", 8-10 mm).
 - Pass the needle under the incision line and exit through the skin the same distance (far) from the edge of the incision (do not include subcutaneous tissue to close dead space with this pass).
- Reverse the needle.
- Take a small bite across the incision inside the first one.
 - Return to the first side by piercing the two sides near the incision edges ($1/6$ ", 4 mm) just passing deep to the dermis of the skin under the incision line.
- Tie the knot until the incision edges just appose on the first throw. Place a second and third throw without tightening the first.
- Cut the suture leaving tags: 5-10 mm ($1/4$ - $3/8$ ").
- Repeat from one end of the incision to the other.
- Place the suture roughly $1/2$ " (10 mm) from each other and $1/2$ " (10 mm) from the incision's ends.



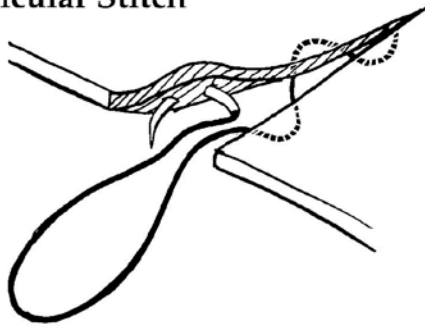
Vertical mattress stitch

Vertical mattress - Summary

- Take a large bite across incision
- Reverse needle
- Take a small bite inside first
- Appose tissue, tie & cut
- Space sutures $1/2$ " (10 mm) apart

Instruments, Needles & Sutures

8.17 Subcuticular Stitch

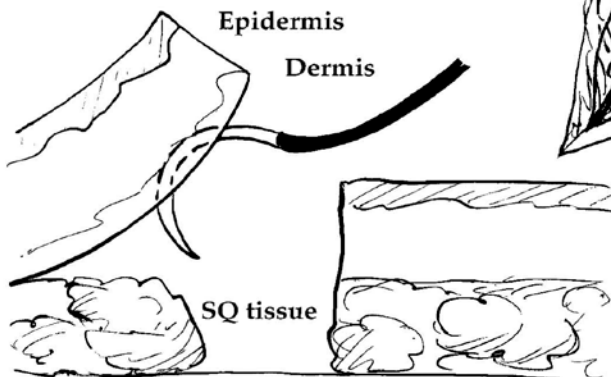


Subcuticular stitch - Summary

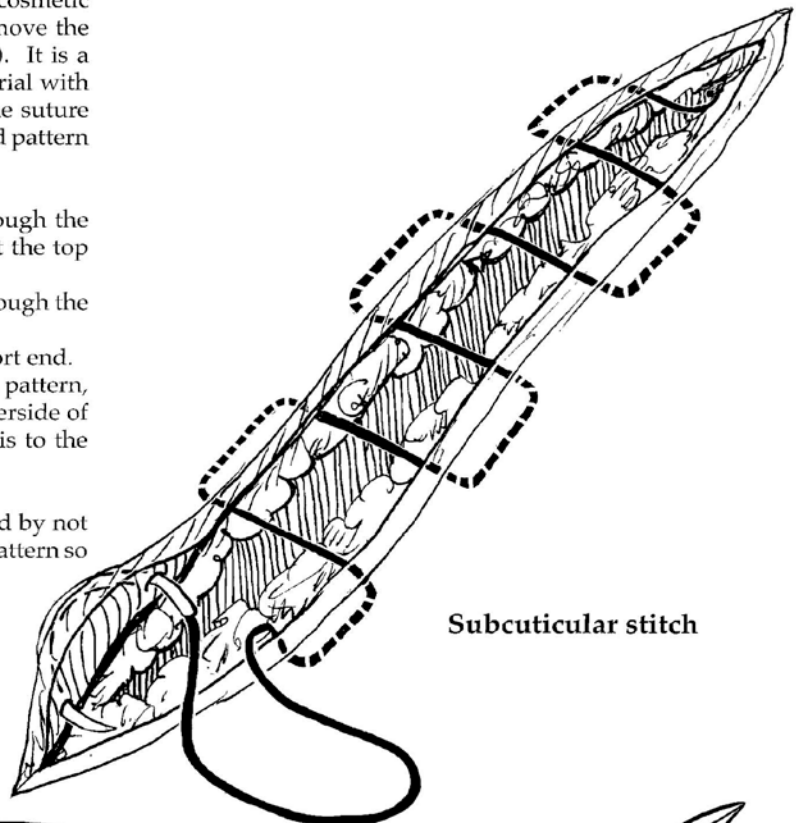
- Burying 1st knot:
 - Take bites into underside of skin on both sides of incision, tie & cut short end
- Upside-down horizontal mattress on underside of skin
- Bury end knot

8.17 Subcuticular (intradermal) suture pattern: may be used in place of skin sutures as it is more cosmetic (no stitch scars) or to eliminate the need to remove the stitches (e.g., fractious animals and castrations). It is a continuous stitch using absorbable suture material with the knot buried at the beginning and end of the suture pattern. Alternatively, a subcuticular interrupted pattern can be used.

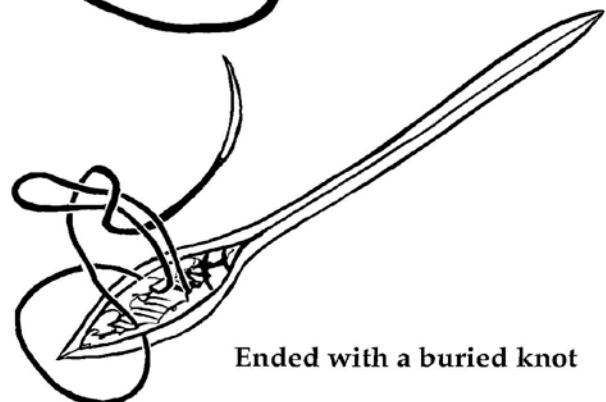
- Burying the beginning of the suture (18.9):
 - Take a bite into the underside of the skin through the dermis, but not the epidermis (don't come out the top of the skin).
 - Cross under the skin and take a similar bite through the underside of the dermis on the other side.
 - Tie the knot deep to the skin and cut off the short end.
- Continue an upside-down horizontal mattress pattern, taking bites parallel to the incision into the underside of the skin (dermis, do not perforate the epidermis to the outside) on alternate sides of the incision.
- Bury the knot at the end of the incision.
- Alternatively: nonabsorbable suture can be used by not burying the beginning and ending knots of the pattern so the suture material can be removed later.



Bite is taken in underside of skin (dermis)

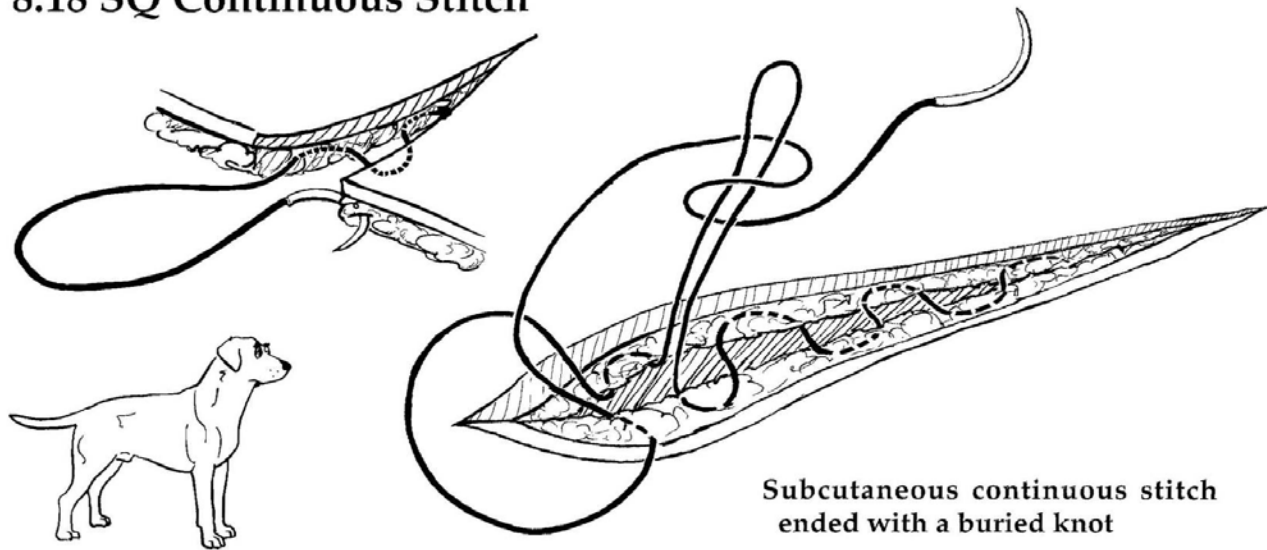


Subcuticular stitch



Ended with a buried knot

8.18 SQ Continuous Stitch



8.18 Subcutaneous simple continuous suture pattern: used to eliminate the dead space before closing the skin and to relieve tension on the skin sutures. The subcutaneous tissue is just deep to the dermis and consists of superficial fascia, elastic fibers, lymphatics, fat, vessels, and nerves. Properly suturing this tissue removes all tension from the skin and subsequently places skin sutures. The knot should be buried at the beginning and end of the suture pattern.

- Burying the beginning of the suture (8.19):
 - Take a bite in the subcutaneous tissue from deep to superficial. Do not enter the dermis.
 - Cross the incision and take a bite in the subcutaneous tissue from superficial to deep and tie the ends deep in the subcutaneous tissue.
- Continue to the end of the incision with a simple continuous or running stitch in the subcutaneous tissue.
- After every few bites incorporate the deep fascia (tough fascia around muscles) to help eliminate dead space.
- Burying the end of the pattern:
 - Before the last stitch is placed, leave a loop or suture lifted from the incision.
 - Take a bite of subcutaneous tissue from deep to superficial, cross the incision and take a bite from superficial to deep.
 - Tie the suture to the loop and cut off the ends.
- Alternately, simple interrupted sutures can be used to appose the subcutaneous tissue. Place each so the knot is buried.

SQ Continuous Stitch - Summary

- Bury a knot.
- Place a simple continuous stitch in SQ to end.
- Tie & bury knot of last bite, cut.

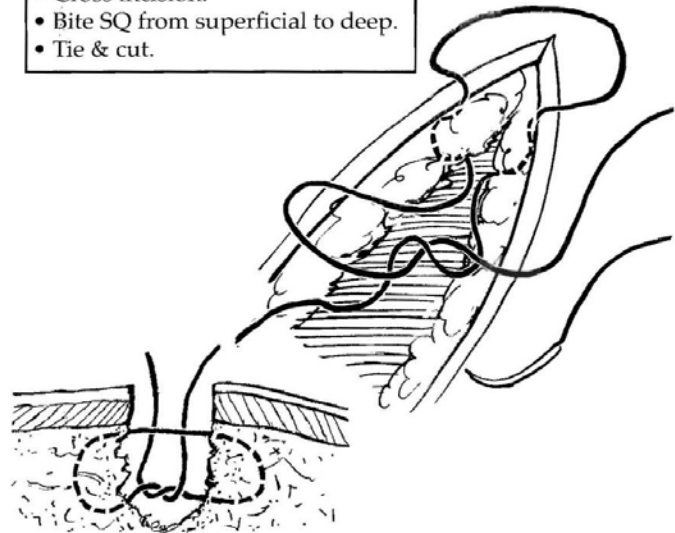
8.19 Burying the knot

Burying the knot or inverting the knot: reduces irritation in certain suture patterns. Bury suture in subcutaneous tissue to prevent necrosis of the skin due to pressure.

- Introduce the needle deep in the subcutaneous tissue.
- Pass the needle toward the dermis and out of the subcutaneous tissue just below the skin (dermal layer of skin).
- Pass the suture across the incision and into the subcutaneous tissue just beneath the dermal layer of the skin.
- Exit the needle deep in the subcutaneous tissue.
- Tie the ends deep in the subcutaneous tissue.

Bury knot- Summary

- Bite SQ from deep to superficial.
- Cross incision.
- Bite SQ from superficial to deep.
- Tie & cut.

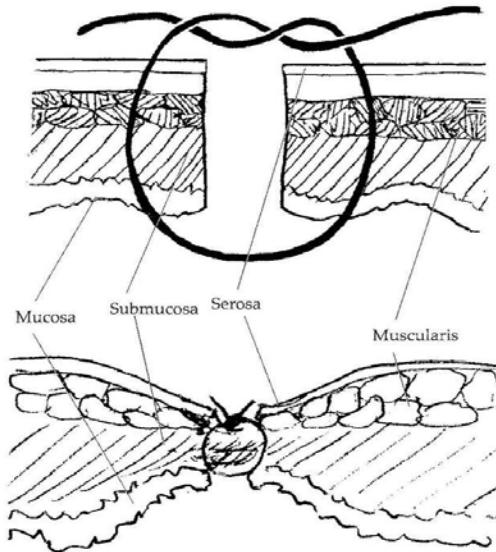


Bury knot: bite SQ from deep to superficial, cross incision & bite from superficial to deep

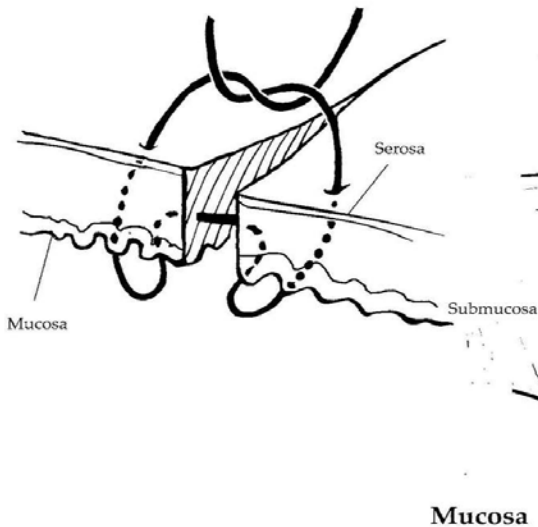
Instruments, Needles & Sutures

8.20 Simple Interrupted Crushing Stitch

Simple interrupted crushing suture pattern: used for an intestinal anastomosis. Not recommended as it may cause adhesions.



Simple interrupted crushing pattern



Mucosa

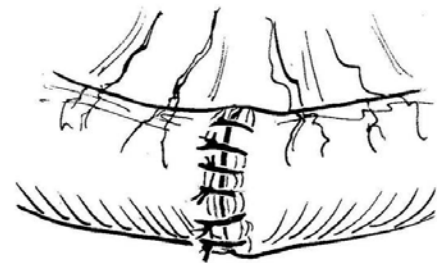
Gambee stitch - Summary

- Bite through far wall into lumen.
- Bite back through part of far wall & out side.
- Cross incision.
- Bite through side of near wall & into lumen.
- Bite through near wall.
- Tie tightly & cut ends
- Continue around anastomosis.

8.21 Gambee stitch

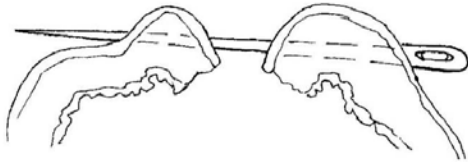
Gambee suture pattern: a modified simple interrupted stitch used in single-layer closure for an intestinal anastomosis. Unlike a simple interrupted stitch, it helps prevent eversion and is less susceptible to wicking of intestinal contents into abdomen. It is especially useful when there is redundant mucosa (mushrooming of mucosa into lumen).

- Place needle through the wall of the viscera into the lumen.
- Reintroduce the needle through the mucosa and into the muscularis and out the side of the incision (not out the serosa).
- Cross the incision.
- Enter the muscularis layer from the opposite side and pass through the mucosa into the lumen.
- Then pass the needle through all layers (mucosa, muscularis and serosa) to reach the outside of the viscera.
- Tie the two ends tightly and cut them off short (1/4"/5mm).
- Continue placing Gambee sutures connecting intestine segments until the anastomosis is complete.



Gambee pattern

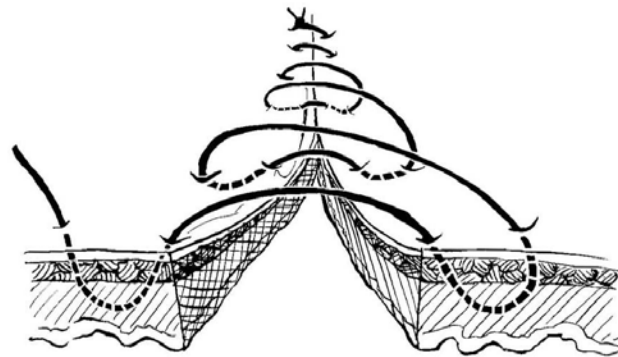
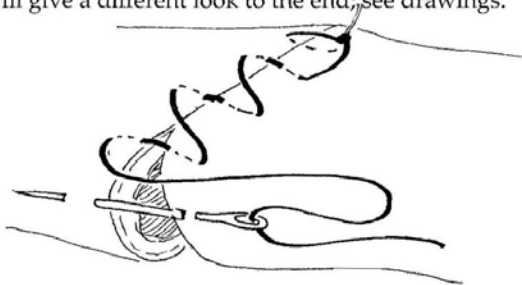
8.22. Lembert Stitch



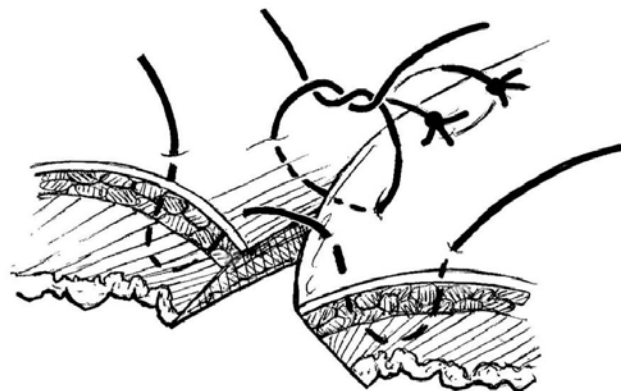
Lembert stitch takes partial thickness bites on both sides of incision

8.22 Lembert suture pattern: a variation on a vertical mattress suture that inverts the tissue (inverting pattern). It is used to close hollow organs (stomach, intestine, bladder or uterus) as the apposition of the two serosal surfaces seals quickly (unlike skin) to provide a watertight closure. It can also be used for fascial imbrication or plication (tightening).

- Place a Lembert suture:
 - Take a vertical, partial-thickness bite on the far side of the incision.
 - . Insert the taper-point needle through the serosa a distance from the incision.
 - . Pass the needle through the muscularis into the submucosa and out the serosa near the incision on the same side without passing into the lumen.
 - Cross over the incision.
 - Take another vertical, partial-thickness bite on the near side of the incision.
 - . Insert the needle into the serosa near the incision.
 - . Pass into the submucosa and out the serosa away from the incision on the same side, again without passing into the lumen.
 - Tie the long and short ends of the suture, inverting the incision.
- Lembert patterns may be interrupted or continuous:
 - Interrupted: cut both ends and repeat interrupted Lembert sutures until the incision is closed.
 - Continuous: cut the short end, advance the needle and cross over the incision; repeat, placing Lembert sutures without cutting the suture.
 - . At the end of the incision, tie a knot using three throws.
 - .. Open-eye needle: keep the short end of the suture from passing through on the last stitch, using it to tie to.
 - .. Swaged-on needle: do not pull the suture all the way through on the last stitch, leave a loop to tie to. This will give a different look to the end; see drawings.



Lembert continuous stitch



Lembert interrupted stitch

Lembert stitch - Summary

- Partial-thickness bite on one side
- Cross over incision
- Another partial-thickness bite on other side
- Tie:
 - Interrupted: cut & repeat
 - Continuous: advance, cross incision & repeat
 - . Tie last stitch & cut



Swaged needle tie off



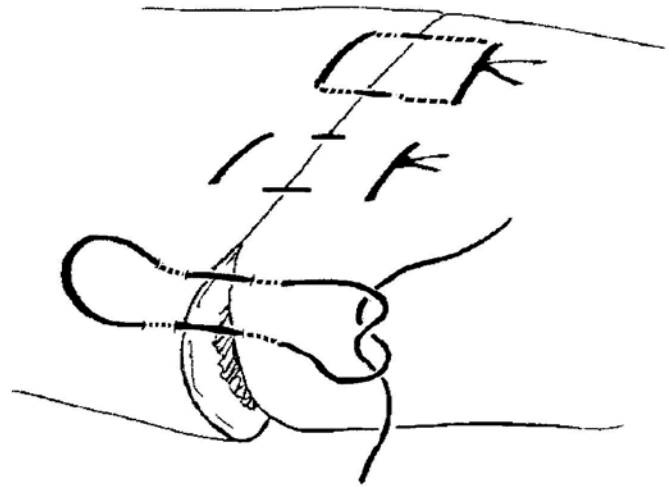
Eyed needle tie off

Instruments, Needles & Sutures

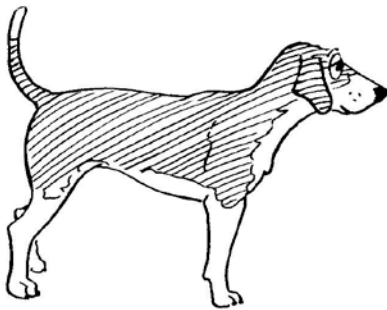
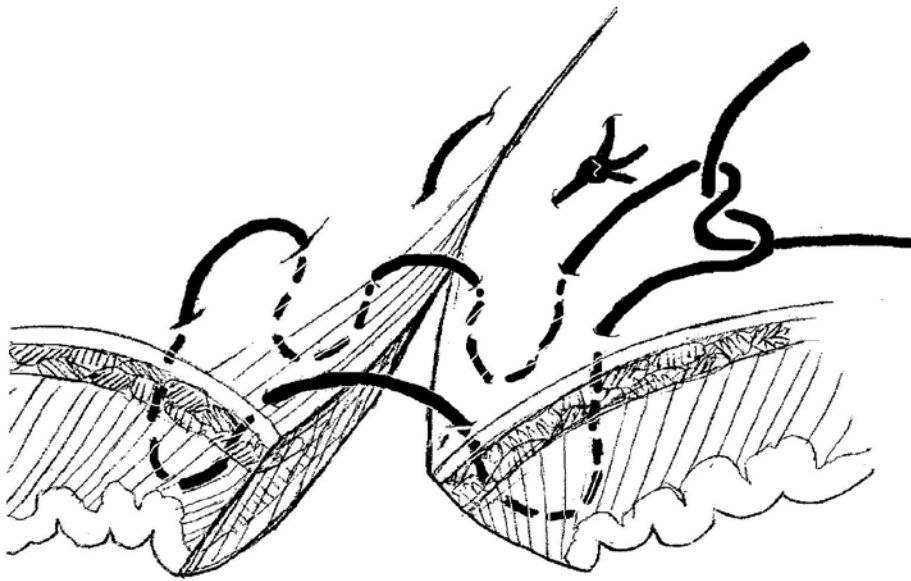
8.22 Halsted Stitch

Halsted suture pattern: two reversing Lembert sutures, thus, an interrupted horizontal mattress inverting pattern. It is commonly used as the second layer of closure of a hollow organ to ensure that there is no leakage.

- Start the first half of the stitch like a Lembert (inverting vertical mattress):
 - Take a vertical, partial-thickness bite on the far side of the incision.
 - Cross over the incision.
 - Take another vertical, partial-thickness bite on the near side of the incision.
- Advance and reverse the needle.
- Repeat the above (place another Lembert suture) to reach the far side (vertical, partial-thickness bites on both sides); completing an inverting, horizontal mattress (Halsted).
- Appose tissue and tie the ends of the suture and cut them off.
- Repeat until the incision is closed.



Halsted stitch



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Halsted stitch - Summary

- Place a Lembert suture (partial bites on either side of incision)
- Advance & reverse needle
- Repeat above
- Tie & cut
- Repeat until closed

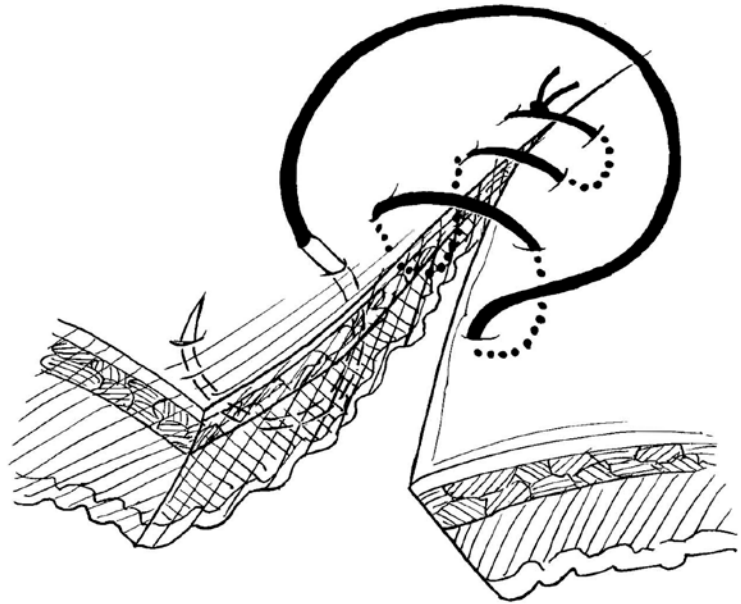
8.24 Cushing & Connell Stitches

Cushing and Connell suture patterns: inverting continuous horizontal mattress patterns used to close hollow organs because they make a watertight seal. The Connell suture passes into the lumen, whereas, the Cushing does not.

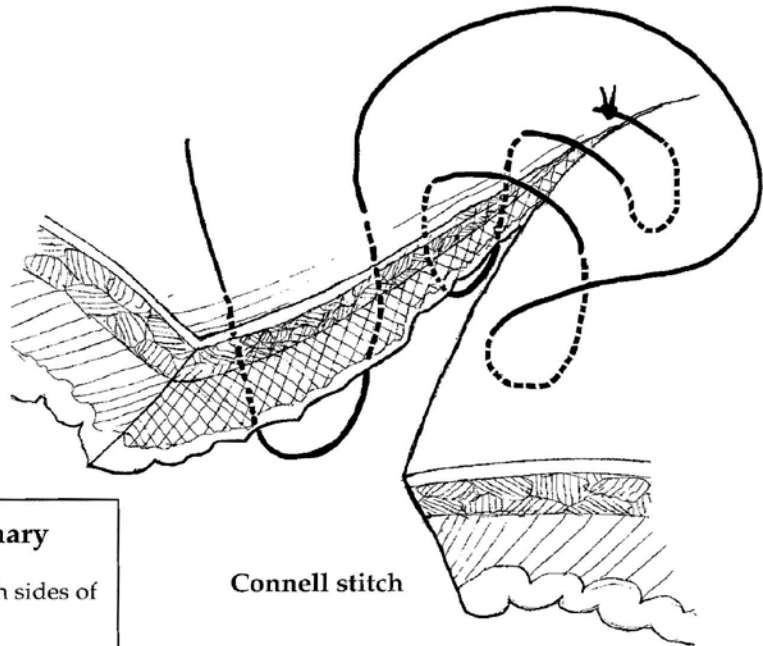
8.24a Cushing pattern: the same as a Connell, except the needle never enters the lumen. It is commonly used to close hollow organs.

- Place a Lembert interrupted stitch. Take vertical, partial-thickness bites on both sides of the incision. Tie and cut off the short end.
- Take a partial thickness bite parallel to the incision.
- . Insert the needle through the serosa where the first suture exited.
- . Pass the needle through the muscularis layer and back out the serosa, parallel to the incision, without entering the lumen.
- Pass perpendicularly over the incision and take an advancing bite parallel to the incision through the serosa and muscularis.
- Repeat, crossing the incision between bites until the end of the incision is reached.
- Pull the suture tight to invert the tissue.
- Tie and cut the suture.

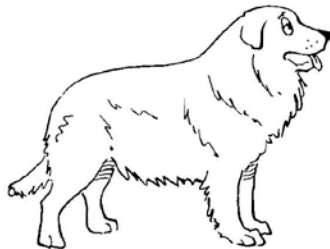
8.24b Connell pattern: the same as a Cushing stitch, except each bite passes into the lumen. Prone to wicking from the bowel, it is often used as a first layer of closure for a hollow organ, and then covered with a Cushing stitch (second layer).



Cushing stitch



Connell stitch



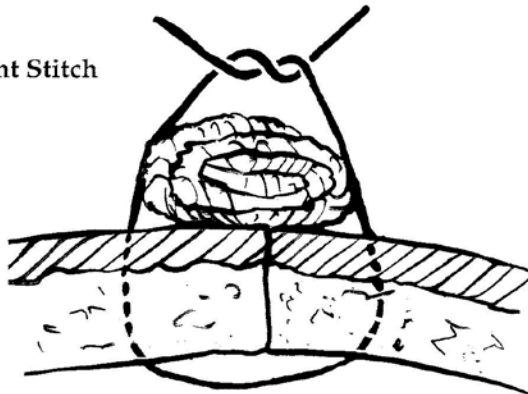
Cushing & Connell stitches - Summary

- **Cushing pattern:** not into lumen
 - Place & tie a Lembert suture (bites on both sides of incision)
 - Take horizontal partial-thickness bite
 - Cross perpendicularly over incision
 - Take horizontal partial thickness bite
 - Repeat until incision closed
 - Pull suture tight
 - Tie & cut
- **Connell:** same except enters lumen

Instruments, Needles & Sutures

8.25 Stent Stitch

Stent Stitch



8.25 Stent suture pattern: modified simple interrupted suture that incorporates a sterile gauze sponge to take tension off an incision / wound.

- Place a simple interrupted suture.
- Before tying, insert a gauze roll under it.
- Tie suture over gauze roll.
- Repeat along incision.

Stent suture pattern - Summary

- Place & tie a simple interrupted suture over a gauze roll
- Repeat along incision

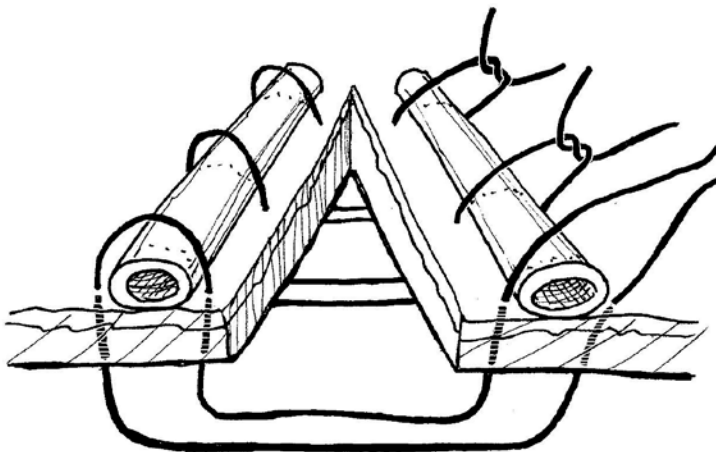
8.26 Quilled Stitch

Quilled suture pattern: incorporate a rubber, plastic, salastic, or gauze tube in the external loops of a vertical mattress suture on each side of the incision to, like stent sutures, take tension off an incision so it can be sutured close.

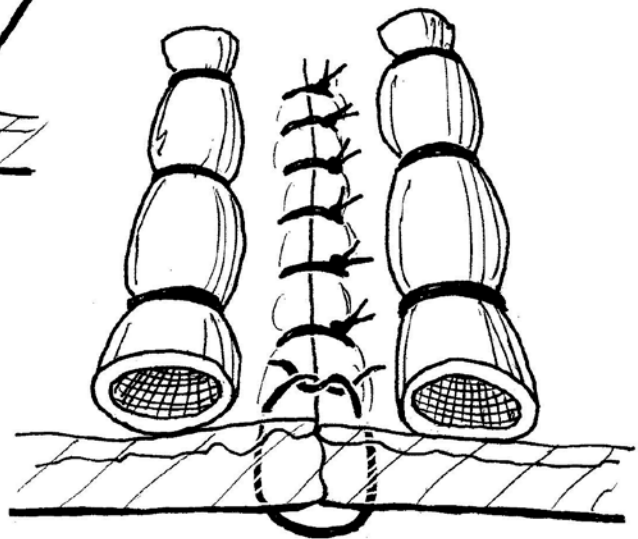
- Pierce the tissue away from one edge of the incision, cross the incision deep to subcutaneous tissue and exit other side away from the incision.
- Leave a loop to place a quill in when the suture is placed.
- Reverse the needle and return to the first side by piercing the two sides near the incision edges and form another loop with one throw.
- Place rubber, plastic or gauze tubes under each loop.
- Pull the suture tight so the edges of the incision are apposed.
- Tie suture and cut ends.
- Space quilled sutures along incision to distribute tension.
- Close the now apposed incision with simple interrupted skin sutures.
- Alternatively, the suture can be passed through, instead of around, the quilled material.

Quilled suture pattern - Summary

- Place & tie vertical mattress sutures over quills
- Close with simple interrupted sutures



Quilled stitch: vertical mattress sutures over quills



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8.27 Near & Far Stitches

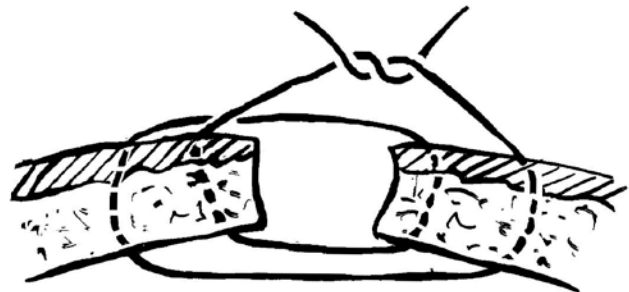
Near and far (interrupted pulley) suture patterns: variations on the interrupted vertical mattress pattern, they are used when the tension doesn't allow normal sutures to close an incision. A stronger pattern than Quilled sutures, they relieve tension on the incision without applying tension to the incision edge. Excessive tightening will cause inversion. These patterns include: the far-near, near-far pattern and the far-far, near-near pattern. They are used on skin, and fascia.

• Far-near, near-far pattern:

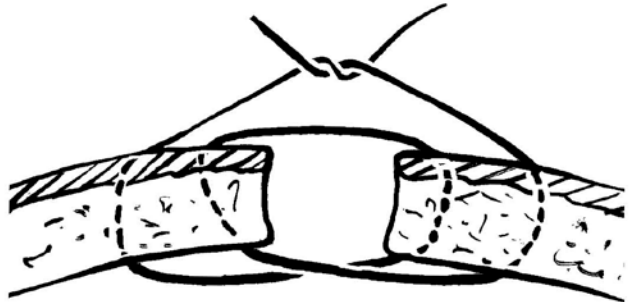
- Insert the needle through the skin and subcutaneous tissue farther (1"/25 mm) from the incision than normal.
- Cross under the incision and exit skin near the incision (1/2"/12 mm).
- Cross over the incision.
- Pierce the skin near the incision (1/4-1/2"/6-12 mm).
- Cross under the incision and exit skin far (1"/25 mm) from the incision.
- Tie the suture ends, pulling the incision edges into apposition.

• Far-far, near-near pattern:

- Insert the needle through the skin and subcutaneous tissue far from the incision (1"/25 mm).
- Cross under the incision and exit skin far (1"/25 mm) from the incision.
- Cross over the incision,
- Pierce skin near (1/2"/12 mm) the incision.
- Cross under the incision and exit skin near (1/2"/12 mm) the incision.
- Tie the suture ends, pulling the incision edges together.
- Once the edges are brought close, appose the edges with simple interrupted skin sutures.



Far-near, near-far pattern



Far-far, near-near pattern

8.28 Purse String Stitch

Purse string suture: a special stitch used to close the anus, other openings or tubular viscus or to close a defect or stoma (new opening).

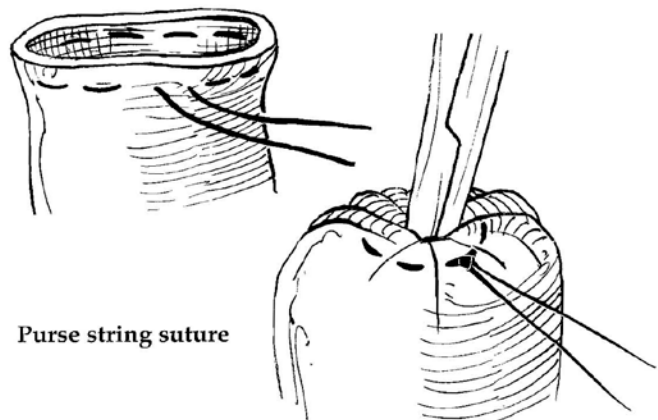
- Make multiple bites around the opening to distribute the tension evenly.
- Place bites deep enough so they won't be pulled out.
- Place bites 1/4" (6 mm) away from any mucocutaneous border.
- Tie with a knot.

Near & far sutures - Summary

- Far-near, near-far pattern:
 - Take bite under incisions from far to near
 - Cross over incision
 - Take bite under incisions from near to far
 - Appose, tie & cut
- Far-far, near-near pattern:
 - Take large bite under incisions
 - Cross over incisions
 - Take a small bite under incision
 - Appose, tie & cut

Purse String Stitch - Summary

- Make multiple bites around opening
- Tie with a knot



Purse string suture

