

Suturing Techniques

Introduction



The use of sutures and ligatures is an integral part of surgical procedures. Being proficient in suturing and ligating will not only make your treatments more effective but also shorten the time of the procedure. All that you do that can cut down surgical and anesthesia time will help reduce post-operative complications

References

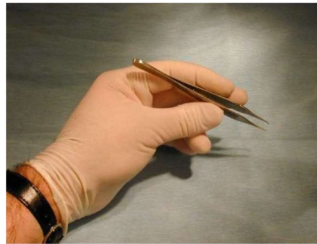
- Wound Closure Manual, Ethicon, Inc. Somerville, NJ
- LMS Clinical Medicine Wound Care videos

Topics

- Use of instruments
- Suture needles
- Suture materials
- Suturing fundamentals
- Suture patterns
- Suture removal and care
- Skin staplers
- Vessel ligation

Use of Instruments

- Adson Forceps
 - Used to support tissue and evert wound edges that the needle is passing through
 - Hold like a pencil not like a y/o holds a spoon
 - They are not "tweezers"



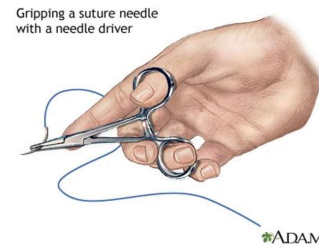
Adson forceps are used for a variety of things and are minimally traumatic to tissues. You should get used to using them and using them correctly.

Simple things such as holding an instruments correctly make a difference in the effectiveness of the instrument and you ability to perform the procedure.

Use of Instruments

- **Needle Drivers**

- Used to drive suture needles and arm scalpel handles
- Distal Ring finger and thumb in ringlets with Index finger resting on hinge
- Turn the door knob
- Hemostats are not needle drivers and will damage needles



By holding the needle drivers correctly, you have more control and enable you to perform the task more efficiently and timely. Hemostats are not needle drivers and should not be used as such. Needle drivers' jaws are finished so they will not damage suture needles. Hemostat jaws are serrated and will damage the needle especially the edges on a cutting needle.

Suture Needles

- Parts of the needle
 - Point
 - Body
 - Eye
- Always grasp the body of the needle between $\frac{1}{2}$ to $\frac{2}{3}$ the length from the tip with needle drivers



These are the three parts of the suture needle. As we can see in this picture that the point is different than the body. We will discuss more the different types of needles and their uses. Never grasp the eye or swaged end of the needle with the needle drivers. This is the weakest part of the needle as well as the pinch point that holds the suture to the needles. If you do, you will most likely bend the needle or damage the connection that holds the suture on the needle. Besides, in a needle with $\frac{1}{2}$ circle, it would almost be impossible to make the point enter at 90 degrees. To suture correctly, the needle point should enter at 90 degrees.

Suture Needles

- Eyed needles

- More traumatic
- Pass suture through eye only once (at least enough to pass through the tissues)
- Good in UW situation

- Swaged needles

- Almost all suture now is swaged
- Less traumatic
- Do not hold swaged end of needle with needle drivers!

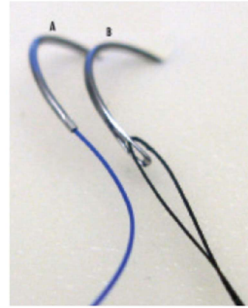


Figure 1: Example of Eyeless (Swaged) Needle (A) and Eyed Needle (B).





Eyed needles are still in your TAC set. These are more traumatic since you must pull 2 lines of thread through the tissue and the eye is larger than the rest of the needle's diameter. Only pass the suture through this eye once and with enough length that it will pass through the amount of tissue that you are suturing through. You may encounter other ways to thread suture to a needle in which it will not become undone. These ways are not preferred since they will cause even more trauma to the tissues. By having these eyed needles in your TAC set, as long as you have some thread, these needles and a way to sterilize, you have the ability to suture.

Almost all sutures that you will see will be swaged, meaning that the suture is already connected to the needle. We've already talked about the pitfalls of holding this incorrectly with the needle drivers.

Suture Needles

- Types of needles
 - Taper-Point
 - Reverse cutting
 - Conventional cutting
 - Taper-cutting
 - There are many other more specialized needles

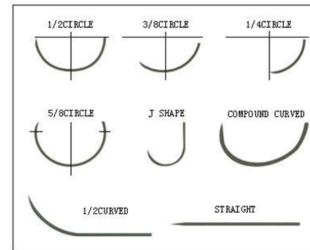
Needle point Geometry

○		Taper-Point	<ul style="list-style-type: none"> • Suited to soft tissue • Dilates rather than cuts
▼		Reverse cutting	<ul style="list-style-type: none"> • Very sharp • Ideal for skin • Cuts rather than dilates
▲		Conventional Cutting	<ul style="list-style-type: none"> • Very sharp • Cuts rather than dilates • Creates weakness allowing suture tear out
⊕		Taper-cutting	<ul style="list-style-type: none"> • Ideal in tough or calcified tissues • Mainly used in Cardiac & Vascular procedures.

This chart is self-explanatory. One note is the difference between conventional and reverse cutting needles. The reason for the reverse cutting is that they discovered that with a conventional cutting needle, there is a cutting edge where the suture will be applying tension to which makes the tissue weaker and more probable to tearing. A reverse cutting needle is usually considered a better choice. Also note that on the left side of the chart are symbols of the type of point that is on the needle. Most packaging will give you symbols for both the point and the body like they do in the taper-cutting needle in the chart.

Suture Needles

- Needle circles
 - Most often $\frac{1}{2}$ or $\frac{3}{8}$ circle will be used
 - Other types are usually for specialties



Self Explanatory

Suture Materials

- Absorbable
 - Losses tensile strength within 60 days
 - Usually used *in vivo*
 - Will be broken down and absorbed by the body
- Non-Absorbable
 - Maintains tensile strength
 - Usually used
 - For skin closure
 - Pt. Hx of reaction to absorbable
 - Prosthesis attachment
 - Will remain permanently in body (except Silk)

For the most part, absorbable will be used inside the body and non-absorbable outside. There may be occasions that this may not be, but this is the case most often. Silk, for example, can be used to ligate blood vessels and an absorbable could be used in a skin closure in someone that there is a question about being able to remove the sutures.

Suture Materials

- Monofilament
 - Less tissue resistance
 - Less likely to harbor organisms
 - Tie down easily
 - Usually has memory
 - Knots have tendency to slip
 - Can become weakened if crushed, crimped or nicked
- Braided
 - Greater
 - Strength
 - Pliability
 - Flexibility
 - Coated helps with tissue resistance
 - Braids can harbor organisms

Both absorbable and non-absorbable suture materials come in both monofilament and multi-strand (braided). Anyone who is a fisherman can identify with the difference between monofilament and braided lines.

Suture Materials

- How to remove memory
 - Hold firmly between gloved fingers
 - Pull strand through the gloved fingers
 - Result is nice, straight suture strand



Self explanatory.

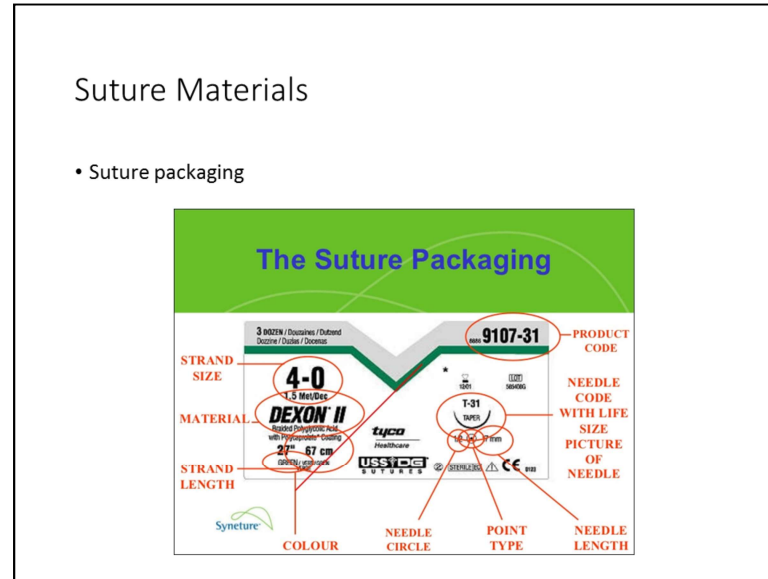
Suture Materials

- Size and strength
 - Size denotes diameter
 - Number of "0"s increase, diameter decrease
 - 2-0 = 00, 5-0 = 00000
 - Accepted rule
 - Tensile strength should never exceed tissue strength
- Tensile strengths
 - Muscle tears before 4-0 breaks (muscle is often closed with fascia so a heavier suture can be used)
 - Fascia can withstand 2-0 to 3-0 suture
 - Dermis will hold any suture but 4-0 to 6-0 should be used depending on the area

You would want the suture to break much more than causing more trauma to the tissues by allowing them to break. If something is going to give, it should be the suture.

Suture Materials

- Suture packaging



The individual packages will tell you if it's absorbable or non-absorbable. You might get generic suture or a type that you have not seen before. The individual package will tell you all the information that you need to know. Note the needle picture. It is the exact size of the needle within the package and what the body is as well as the point.

Suture Materials

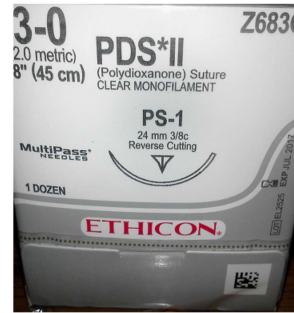
- Polyglactin 910 (Vicryl)
 - Absorbable
 - Braided
 - Good for general use
 - Plain or coated
 - Coated has less drag, easier to handle and increased knot security
 - At 2 weeks retains 75% tensile strength, 50% at 3, 20—30% at 4



Vicryl is a common absorbable suture. It basically has no tensile strength at 5 weeks. You will become very familiar with its characteristics while you are training in the ORs.

Suture Materials

- Polydioxane (PDS II)
 - Absorbable
 - Monofilament
 - Tensile strength 50% at 4 weeks, 25% at 6



This is another common absorbable suture material. Note that this one is monofilament. It retains its strength longer than Vicryl.

Suture Materials

- Chromic Gut
 - Absorbable
 - Tensile strength may be retained for 10-14 days with some measurable strength up to 21 days



Chromic gut will cause more tissue inflammation than other absorbable suture.

Suture Materials

- Nylon (Ethilon)
 - Non-absorbable
 - Monofilament
 - Memory
 - Knot slippage



Probably the most common non-absorbable suture material that you will see. It does have considerable memory and since it is somewhat smooth, knots do tighten down easily but have a tendency to loosen. Nylon's advantage is that it is less expensive and more abundant than other non-absorbable sutures.

Suture Materials

- Polyester (Ethibond)
 - Non-absorbable
 - Braided
 - Coated



Polyester is much nicer to work with than nylon. Since it is braided and coated, it is easy to tie and holds knots better than nylon.

Suture Materials

- Polypropylene (Prolene)
 - Non-absorbable
 - Monofilament
 - Less tissue reaction
 - Holds knots better than nylon



Polypropylene is also easier to work with than nylon.

Suture Materials

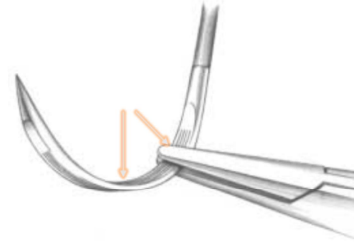
- Silk
 - Non-absorbable
 - Braided
 - Loses tensile strength *in vivo* in 1 year
 - Undetectable *in vivo* in 2 years
 - Behaves as a very slowly absorbing suture



Silk is very nice to work with. Since it is braided and not coated, it does have a greater chance of harboring organisms.

Suturing Fundamentals

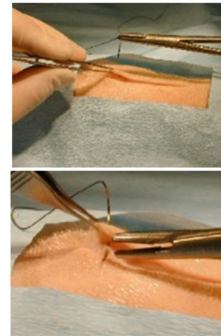
- Holding the needle
 - Always grasp the Body of the needle – never the swaged eye
 - Grasp between $\frac{1}{2}$ to $\frac{2}{3}$ from the point



We've already discussed the importance of not grasping the swaged eye with the needle drivers.

Suturing Fundamentals

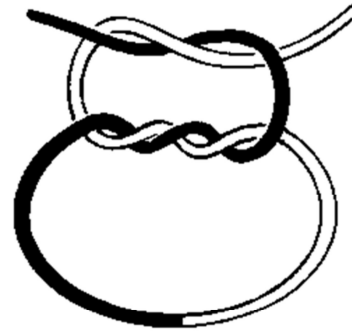
- Drive the needle
 - Point enters at 90 degrees
 - Drive the needle like turning a doorknob
 - Support the tissue(s) with Adson forceps
 - Grasp the point of the needle with the drivers



Always support the tissues with forceps when driving a needle through them. Always use forceps – never your fingers! You should never support tissue with your finger that you are putting a sharp instrument through. Sometimes you may not be able to grasp the point with the drivers because if you let go of their grip, the needle will slip back into the tissue. In this case, you can hold the tip with your forceps, preventing the needle from slipping into the tissue, then grasp the needle and pull it through the tissues with the needle drivers.

Suturing Fundamentals

- Tie the knot
 - Surgeon's knot
 - 1st throw has 2 passes
 - 2nd throw has one pass which completes a SQUARE KNOT
 - 3rd throw has one pass which is another SQUARE KNOT
 - Throws equal suture size (minimum 3 throws) e.g. 6-0 = six throws



It is not 3-2-1, 5-4-7 or any other combination of throws! It is 2+1+1! Always make sure that you are tying square knots. Square knots don't slip. Granny knots will slip and become undone.

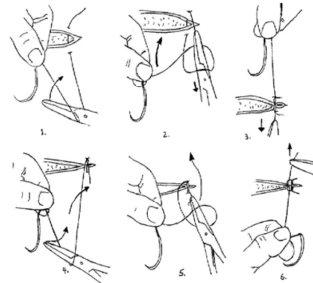
Suturing Fundamentals

SURGEONS KNOT = 2 + 1 + 1 + any additional throws for suture size

Once again!

Suturing Fundamentals

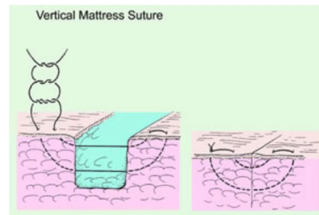
- Instrument Tie
 - Quick
 - Efficient
 - Watch video on LMS or YouTube
 - Always grab tail at the end of it
 - Eliminates waste
 - Eliminates trying to pull a loop through the knot



The video that Clinical Medicine uses on LMS tell you how to do this. You must practice! YouTube also has many videos showing step by step instruction. When tying a knot, always grab the end of the tail and not halfway on the tail. When you grab more of the tail than just the end, you will be wasting suture material and also struggle with trying to pull a loop of suture material through the knot. Be efficient!

Suturing Fundamentals

- Apposition



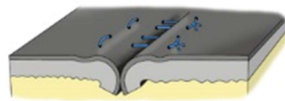
- Approximation



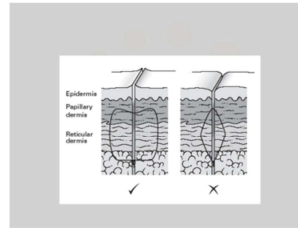
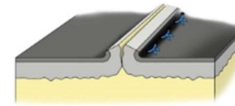
Apposition is lining the depth of the wound up with each other. Approximation is lining the width of the wound up with each other. Failure to correctly appose and approximate a wound could end up leaving dead space, more scar tissue and prolong healing time.

Suturing Fundamentals

• Inversion



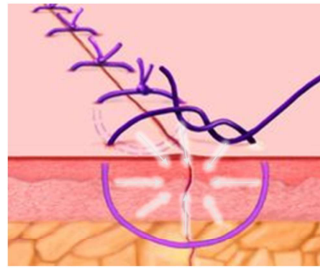
• Eversion



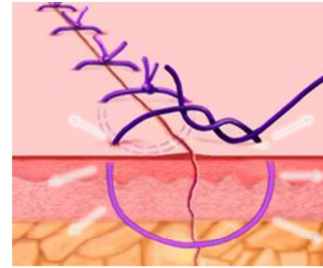
Inversion of the wound edges will always have poor, delayed healing and scarring. This is because the epidermal edges (dying layer) is in contact with each other and does not generate proper healing. Over eversion will often provide the same results. The base layer of the dermis (growing layer) is not really in contact with each other and as a result, poor healing. Optimally we should strive to have all layers of the dermis line up with each other with slight eversion of the wound edges. This ensures that the base layer of the dermis is in contact with each other as well as the other layers. This results in optimal healing.

Suture Fundamentals

- Intrinsic tension



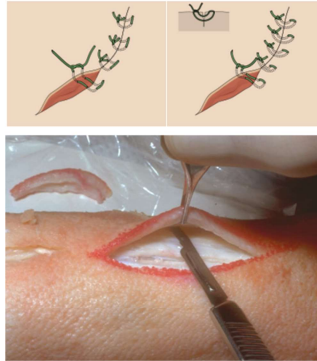
- Extrinsic tension



Intrinsic tension is the tension with the suture loop. This is due to putting too much tension on the tissue with your suture. Too much tension within the loop will cause ischemia, necrosis and dehiscence. Extrinsic tension is the force in which the wound edges want to pull apart. A wound extrinsic tension will cause someone to also place intrinsic tension by trying to pull it closed. If there is a question about the amount of tension there is, the stay safe and don't close it.

Suture Fundamentals

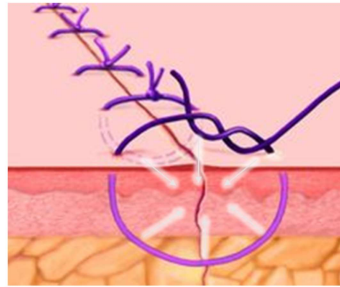
- Relieving Extrinsic Tension
 - Number of sutures
 - More sutures = less tension
 - Type of sutures
 - Mattresses
 - Undermining



The amount of tension is inversely affected by the number of sutures put in the wound. Each suture takes up that much more of the load (load sharing). Mattress sutures provide load sharing.

Suture Fundamentals

- Relieving Intrinsic Tension
 - Do not tie sutures too tightly (don't choke the dog!)



We know that we need to be cautious about how tight we make sutures. We also know that we must consider any extrinsic tension as well.

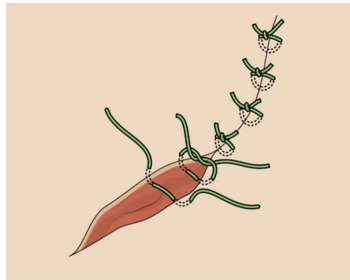
Suture Patterns

- Interrupted
 - Interrupted sutures less likely to become or spread infection
 - More secure than continuous
- Continuous (running)
 - Take less time but not as secure as interrupted
 - Infection may spread along the length of the suture
 - Care must be taken with tension

In your surgeries, you should always use an interrupted suture pattern. Continuous patterns are fine for scalp wounds that you may see in the ER since you can achieve closure quickly.

Suture Patterns

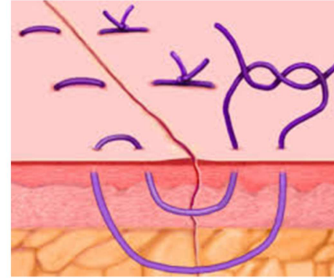
- Simple Interrupted
 - Basic pattern most often used
 - Where needles enter and exit should equal the spacing of sutures
 - Between 1-3 centimeters apart



You should be a master at this pattern.

Suture Patterns

- Vertical Mattress
 - Relieves tension
 - Everts wound edges
 - Far throw is as deep as the throw
 - Near throw is as deep as the throw
 - Difficult to remove



Very useful pattern. You should also master this one.

Suture Patterns

- Horizontal Mattress
 - Relieves tension
 - Everts wound edges
 - Difficult to remove



Another pattern you should master.

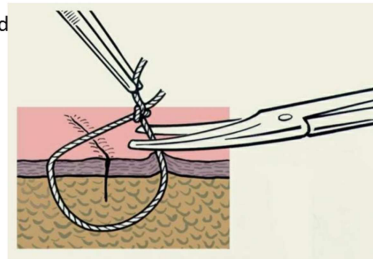
Suture Patterns

- Mix of patterns can be applied over large wounds with mattress sutures taking up tension and interspaced with simple interrupted approximating in between

A good technique.

Suture Removal

- Grasp the knot with forceps and lift
- Cut the suture under the knot and close to the skin with iris scissors or #11 blade
- Pull the knot straight up or slightly toward the suture line (not away from)



Never cut the suture far from the skin. By doing this you will be pulling all the contaminated suture material through the tissues. Also do not pull the suture out by pulling it away from the suture line. Some sutures will have a tendency to stick a bit and by pulling away, you may pull apart the wound.

Suture Removal Times

- Average time – 7-10 days
 - Face/oral mucosa – 3-5 days
 - Neck – 5-7 days
 - Scalp – 7-12 days
 - Hands/back/over joints – 10 days
 - Upper extremities/trunk – 10-14 days
 - Lower extremities – 14-28 days

Areas of better perfusion heal faster. Areas farther away from your heart heal slower.

Suture Care

- Keep clean
- Keep covered until suture removal
 - Dressed
 - Replace if dressing becomes wet or soiled
- Keep dry
 - Can shower or rinse (in most cases) but don't immerse
- RTC if Sx of infection



You must provide the patient with written instructions on wound care and extra dressing material when discharged and a time to return to clinic for suture removal. You must include the signs and symptoms of infections with order to RTC if infection is suspected.

Skin Staples

- Used in large wounds and lacerations (not on the face)
- Decrease tissue reactivity
- Same timelines and precautions as sutures
- Not as comfortable as sutures
- Extremely fast closure



Usually come with 35 staples to a stapler. Comes in regular and wide variety (35R or 35W). You should evert the wound edges with forceps when using this. Staples are probably a little better than sutures because they do not pass through the tissues like suture and less likely to carry organisms into the wound.

Skin Staples

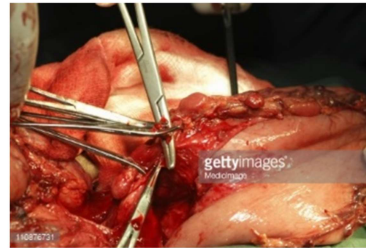
- **Staple removal**
 - **Use the removal tool**
 - Place the 2 prongs underneath and the 1 on top
 - **Use small hemostats**
 - Place tips of closed hemostats between legs of the staple
 - Open the jaws – spreading the legs open
 - Apply digital pressure on the staple when doing this



By placing the 2 prongs under and the one on top, this bends the staple in a “V” shape and it is removed. It will not work the other way. Place a finger on the staple or cover with your hand when using hemostats as the removal tool. This will keep the staple from flying through the air and hitting someone in the eye.

Vessel Ligation

- Clamping vessels
 - Adson forceps
 - Use Adson forceps to pick up vessel
 - Small hemostats
 - Place curved tips up
 - Place tips past vessel
 - Once 1st throw of surgeons knot placed, relax jaws to check for effectiveness (flash)



This is not CTM or SOCOM when you can get away with grabbing a bunch of tissue with hemostats because there is a bleeding vessel in it. Clamping tissue causes damage which you do not want to leave in a wound. No one will be shooting at you if you are in a position to perform surgery. Take your time and do things correctly. A good way to isolate a bleeding vessel is to blot the area with gauze, identify the vessel and grab the end with Adson forceps. Adson's are fine pointed and will pinpoint the vessel better than the jaws of hemostats. Once you have the vessel with the Adson's, lift a little so you can place the hemostats on the vessel. You can always do a little blunt dissection to isolate the vessel too. When using curved hemostats, always place the tips up. This allows for you to easily get your ligature under the instrument. This is also why you should place the tips past the vessel. If the very tips are holding the vessel, it is easy to entrap them in your suture loop. Once the first throw of the surgeons knot is placed, relax the jaws to check for bleeding. If there is, tighten the knot. This is better to know before you finish a knot and then find out it is ineffective. Once you perform a "flash", you can either remove the hemostat or retighten it depending on the situation.

Vessel Ligation

- Surgical hand ties

- Designed to

- Be fast
 - Be efficient
 - Keep tension on the knot between throws

- One handed or two handed (it doesn't matter)

- Find video of one you like on LMS or YouTube



You must find a technique that you like and practice, practice and practice. This is a muscle memory exercise. You shouldn't go on rotation and be in an OR looking like a preschooler trying to tie his shoes!

Vessel Ligation

- Transfixing suture (stick tie)
 - Should be used on any vessel that may produce moderate or severe bleeding
 - Provides an anchor point so the ligature doesn't slip off
 - Through vessel or through surrounding tissues



If you use a transfixing suture that goes through the vessel, you should also put a regular ligation proximal to it. A vessel under pressure will expand as well as the holes in its walls that the suture is passing through and result in extravasation. Any vessel that is important enough to transfix should have two ligations on it, either two transfixing sutures or a transfixing suture and a ligation.