

The Suture

David J. O'Regan

The concept of suture or suturing was depicted in hieroglyphic figures describing the 'drawing together of a gash'. It has been seen in Egyptian mummies of 1100 BC and described in Indian Sanskrit dating back 500 BC. The surgeon and physician of the Roman Empire, Aelius Galenus or Claudius Galenus (Greek: September 129 AD – c. 200/c. 216), and sometimes known as Galen of Pergamon is considered to be one of the most accomplished of all medical researchers of antiquity. He described the use of silk and catgut to sew up wounds predominantly received in battle. These unsterile threads have been used throughout history.

The turning point in sutures came with the recognition that things had to be sterilised. Joseph Lister was born in England on the 5 April 1827. Apparently, he wanted to become a surgeon from the age of sixteen. He was the Professor of Surgery at both the university of Glasgow and Edinburgh. His greatest contribution to medicine was to promote the use of carbolic acid as an antiseptic. Lister was influenced by Louis Pasteur's work on bacteria. The barber surgeons, until then, had little concern about cleanliness or hand washing. Lister tested what would happen if the surgical instruments and bandages were treated with carbolic acid – the rest is history so to speak.

It was in 1887 that Johnson & Johnson started mass producing sterile suture of catgut and silk. I recall doing my first bowel anastomoses with catgut to the mucosal layers and interrupted silk sutures to the bowel wall. In 1960, J&J started sterilising suture with radiation. In 1960 they developed polypropylene - a monofilament (Prolene) that is regarded as the gold standard suture in Cardiac Surgery. They went on to develop Vicryl (polyglactin 910) in 1974 that is a synthetic braided and absorbable suture. In 1979 they coated the Vicryl to improve handling and in 1982 polydioxanone (PDS) made its debut. This evolved into Monocryl in 1993 that was designed specifically for the skin. In 2003 they coated the Vicryl suture with a bactericidal agent - Vicryl plus.

Not unlike other companies in health care, their credo introduced by their chairman Robert Wood Johnson in 1943 was very progressive for its time. This is long before the concept of corporate responsibility is recognised but the conglomerates and is worth summarising as they are applicable in many areas today:

- The first responsibility is to patient, doctors and nurses, mother, and father and all those who use the product.
- We(J&J) must provide, and inclusive work environment were everyone is respected and valued. They have security, fulfilment, and purpose in their jobs.
- We are responsible for our communities to improve health and access health care and support charities.
- We are responsible to stockholders and have reserves for adverse times.

Types of sutures

Sutures are generally classified according to their properties.

		Absorbable	vs	Non absorbable		
Natural		Synthetic		Natural		Synthetic
			days to absorb			
Catgut		Monocryl	100	Cotton		Ethilon
		Vicryl	60	Silk		Prolene
		PDS	200	Steel		
	Understand how long they take to absorb and the time it takes for the tissue to recover its strength				Understand that this will stay in the body for ever. The knots and cut ends can cause discomfort and even perforate	

There is one final classification of sutures to bear in mind.

Braided	vs	Monofilament
No memory		Memory
Easy to use		Keep sutures straight (assistant)
Knots well		Can cheese wire though tissue
Less knots - 3-5		Needs more knots 5-10
Increased inflammation		Reduced inflammation
		Knots and cut ends can perforate
		Liabile to fracture
		Liabile to stretch

Pathophysiology of healing

To choose the suture and method of closure, it is useful to understand the basics of wound healing. **Non-absorbable sutures** are used to **provide long-term tissue support**, remaining walled-off by the body's inflammatory processes (until removed manually if required). This will include tissues **that heal slowly**, such as fascia or tendons, closure of abdominal wall, or vascular anastomoses. Steel is used for wiring the sternum together after a sternotomy.

- Bleeding and Clotting - minutes
 - Duke method – pin prick (3mm deep) on finger or ear lobe and wipe every 30 s – 2-5 minutes.
 - Dependent on the large surface area provided by the phospholipid membranes of the platelet.
 - Thrombin and plasmin form a clot that literally pugs the gap.
 - Activation of inflammatory cells
 - Affected by decreased platelet count impairs primary, sepsis, drug reactions, medications (aspirin, nonsteroidal anti-inflammatory drugs [NSAIDs], antibiotics [penicillin, Vitamin C deficiency)
- Inflammation and migration – hours to days-
 - This involves swelling of the tissues and therefore “approximate do not strangulate”.
 - Thrombin is a potent stimulus for inflammation and scarring – good haemostasis is crucial and requires attention to detail on the way IN.
 - Stimulated macrophages produce cytokines and attract lymphocytes to mop up any debris or foreign material (suture material is foreign and suture tracks cause inflammation that is increased with braided sutures)
 - Migration of cells
- Growth – weeks to months
 - Proliferative – new vessel formation or angiogenesis increase the blood supply. The new vessels appear granular end on and hence this is referred to as granulation tissue. If inflammation persists this process can continue unabated and cause problems
 - Rebuilding involves the influx of fibroblast to lay down the collagen matrix.
- Remodelling and strengthening – months to years
 - This process involves contraction and fibrosis.
 - Excess scar tissue and contraction can and does result in deformity and loss of function.
 - This can all be mitigated by respecting the tissues and attending to haemostasis from the very start.

Suture technique

It is important to recognise that all sutures have the potential to strangulate the tissues. The least likely is the simple interrupted suture but even the vertical mattress suture and especially the horizontal matters suture can cause strangulation. The tissue oedema of healing will cause swelling and will tighten your sutures. **It is apposition and not strangulation** – two edges should together without any tension. The skin and vascular anastomoses are everted. Mucosal surfaces and the urogenital tract the suture techniques is aimed to invert the tissues.

The continuous suture will almost certainly strangulate. Each stitch needs to be pulled through tissue to the right tension. Please do not go over and over and over and then drag the suture through – the proximal passes will strangulate and the first passes with be loose. Please bare this in mind when parachuting a continuous suture. Furthermore, a monofilament can cheese wire thought the tissues.

The technique you use will depend on the part of the body you are suturing and the relevant blood supply. Poor technique can hider blood supply and make things worse e.g., an elderly person with a gash over the tibia. Sometimes a haemostatic suture is critical because of bleeding e.g., bottle injury to the scalp after a Friday night drinking injury is quick and very effective.

Organ	Approximate healing time	Comment	
	(weeks)		
Skin	1 to 2	Extensor > Flexor surfaces	
Subcutaneous tissues	2		
Fat	2	Will not hold sutures- consider a drain	
Peritoneum	4 to 10		
Bowel	2 to 3		
Ureter	1		
Ligament	6 to 52		

Skin healing

The skin heals by migration from the edges. The new epithelial cells need a moist environment to migrate. Modern dressings are designed to maximise that migration and some even include negative pressure to reduce oedema and improve tissue perfusion. The best reason to leave a dressing on is to prevent the patient scratching the wound – itching is the mildest form pain!

Many recommend bio-oil to reduce and/or improve scarring. Simple massage of the area once the tissues have healed will enable the tissues layers to heal and function independent of each other. It is interesting to note that orthopaedic surgeons are mobilising patients within hours as they now realise that remaining immobilised after surgery reduces function and healing. Indeed, this is recognised in all aspects of surgery – bed rest is not good you!

‘Never judge a surgeon before you have seen him closing the wound’.

Lord Berkley Moynihan