# SUTURES AND LIGATURES IN SURGERY

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## History of suture material

The history of sutures is largely a reflection in miniature of the major phases in the history of surgery itself. The earliest known text on surgery is found in the Edwin Smith papyrus (circa 3000 B.C.) where it is recorded that the ancient Egyptians were already aware of the importance of approximating the edges of a lacerated wound. For this purpose they used strips of linen cloth. In India about this time dried animal intestines were being used as ligatures while in China silk threads were employed for the same purpose.

Even the origin of modern skin clips is hallowed in antiquity. About the year 1000 B.C. giant ant or beetle were used, in India, to clip wound margins together — these were the original skin clips.

By the sixth century B.C. several materials had been modified and adapted for use as sutures, including cotton, silk, animal tendons, strips of leather and horse hair.

Hippocrates (500 B.C.) stressed the importance of closing open wounds and he further advocated the ligation of bleeding vessels. Galen, whose teachings were destined to dominate the practice of surgery for the next fifteen centures, also ligated arteries and makes special mention of catgut: "Select from those materials that substance which is least putrescible, such as very thin catgut which rots easily and quickly falls from the vessels."

In the thirteen century A.D. there was re-awakening of interest in the techniques of wound suture and vessel ligation. Theodoric (1205 — 1296 A.D.) and Mundinus (1275 — 1326 A.D.) both wrote extensively on the subject.

Ambroise Pare (1510 — 1590) whose extensive experience of war wounds was unparalleled, advocated the cleaning and drainage of wounds and the arrest of bleeding by ligature rather than by cauterising with boiling tar or hot irons as was then customary.

John Hunter and his students, Abernethy and Astley Cooper, favoured the ligation of arteries. Lembert described the technique of successful suture of the intestine by apposition of serosa to serosa.

At this time ligatures were generally non absorbable and, ofcourse, non-sterile. Surgeons usually left the ends of the ligatures long and extending out of the wounds. The introduction of antisepsis by Lister revolutionised surgical technique. In 1908, Lister demonstrated that by soaking catgut, in his carbolic solution it could be left in the tissues and the wound closed. He first used plain catgut ligatures but after extensive research he developed chromic catgut.

The spectacular advances in organic chemistry, in the physical sciences and in engineering technology which characterise the last three decades have led to the introduction of an array of new suture materials particularly the metallic wires and the synthetic non-absorbable fibres.

## The 'ideal' suture material

The ideal suture material should:

1. have no delaying effects in the course of healing;
2. retain its tensile strength unimpaired for an indefinite period;
3. be inert in the tissues.

Such a suture has yet to be developed.

## Classification of sutures

The different types of absorbable and non-absorbable sutures are summarised in Table 1.

## TABLE 1

### Classification of suture materials

**A. Absorbable sutures**

| | |
|---|---|
| **Natural:** | Catgut |
| | Collagen |
| | others (e.g. skin, fascia lata, kangaroo tendon). |
| **Synthetic:** | Polyglycolic acid |

**B. Non-absorbable sutures**

| | |
|---|---|
| **Natural:** | Silk |
| | Silkworm gut |
| | Cotton |
| | Linen |
| | Hair |
| **Synthetic:** | Polyamides: Nylon (monofilament or multifilament). |
| | Polyesters ('Dacron,' 'Teflon,' 'Terylene'). |
| | Polyethylenes (sheeting or 'Marlex' mesh-. |
| | Poypropylene. |
| **Metallic:** | Stainless steel |
| | Tantalum |
| | Silver |
| | Aluminium. |

### Absorbable sutures

### Catgut (plain and chromic)

Catgut is the most widely used suture material. As described above it has stood the test of time having been used for its present purpose since the earliest medical records were made.

Surgical catgut is prepared from the submucosa of sheep small intestine. Excised intestine is mechanically cleared at the abattoir, packaged and deep frozen. At the suture factory they are thawed out, washed and hand stripped of loose fat particles. Each piece is then split into ribbons which are further mechanically processed to remove mucosa, serosa and muscle leaving a thin ribbon of submucosa. Further treatment of the submucosa ensures that only pure collagen fibres are preserved: this is the *plain* catgut. Treatment with chromium salt will harden the gut and slow down its absorption by tissues: this is the *chromic* catgut.

#### Advantages of catgut

1. as it is absorbed it is less likely to form sinuses if the wound turns septic.
2. it is valuable in situations where a non-absorbable suture might act as a nidus for a foreign body, such as in joints, the biliary tree and the urinary tract.
3. in suturing the mucosa of the gastro-intestinal tract where a non-absorbable suture might cause chronic ulceration or haemorrage.
4. in certain situations it might be used as a skin suture e.g. scrotum, vulva, perianal region. In this situation removing a non-absorbable suture might be painful.

#### Disadvantages

1. Its preparation is complex and involves considerable expense. The source is undeniably septic and sterilisation is a problem.
2. It tends to lose its tensile strength quickly and cannot be used where continued support is necessary because healing is naturally slow, as in fascia.
3. It frequently tends to cause an intense tissue reaction which is not always desireable (Lawrie, 1959).
4. Knot holding is still not ideal.

Plain catgut has many other disadvantages of its own. The knots are unreliable, it causes an intense tissue reaction but quickly loses its tensile strength so that it is useless as a scaffold after three days. Many surgeons have completely dropped plain catgut from their armamentarium for this reason.

### Polyglycolic acid (P.G.A.): "Dexon"

Recently, a new completely synthetic absorbable suture has become available. It is composed of polymerised hydroacetic acid (polyglycolic acid). It is a non-toxic, non-collagen product; it is flexible and can be handled like silk. It is available in all the standard gauges, including those used with all types of atraumatic needles.

P.G.A. retains a high percentage of its initial tensile strength during the first two weeks after implantation, the most critical period of wound repair. Catgut, on the other hand, loses at least half its strength in the first five days.

Unlike catgut, P.G.A. is very inert causing only a very mild tissue reaction both in clean and in infected wounds. The different response can be explained on the basis of the different modes of absorption of the two materials: catgut is absorbed by proteolytic enzymatic digestion whereas P.G.A. is absorbed by hydrolysis.

Used as a skin suture P.G.A. gives excellent cosmetic results. The sutures need not be removed as they are absorbable. The advantages of this in paediatric surgery are obvious while adult patients also been used successfully in bowel anastom- appreciate being spared the apprehension of having their sutures removed. As a corollary to the above, patients can be discharged home earlier once the risk of early complications has passed. P.G.A. has also osis. On theoretical grounds one would expect P.G.A. to hold an advantage over catgut in view of its minimal tissue reaction. There is now experimental evidence that this in fact so (Echeverria *et. al.*, 1970).

## Non-absorbable sutures

A non-absorbable suture is one that is made from a material that is neither digested nor absorbed during the process of wound healing. The buried suture becomes encapsulated with fibrous tissue and remains permanently in the tissues except when surgically removed or extruded.

Natural sutures, like silk, silkworm gut, cotton, linen and hair have been used since the earliest days of surgery. The same applies to the metallic sutures. More recently synthetic non-absorbable sutures have been used such as nylon, Dacron, Teflon, Terylene and polypropylene.

Non-absorbable sutures cause far less tissue reaction than the absorbable ones (Madsen, 1953). The least reactive are the synthetic sutures such as Nylon, Teflon and Dacron (Dettinger & Bowers, 1957; Postlethwait *et. al.* 1959).

Whereas absorbable sutures have little effective strength after two weeks (Haxton, 1963) the majority of synthetic materials maintain their strength in tissues for long periods. Maloney (1961) in reviewing nylon used in hernia repairs, reported that monofilament nylon still retained 70% of its initial strength after eleven years whereas multifilament nylon was fragmented and useless after six months. Propylene is the best monofilament in this respect. Metallic sutures maintain full strength until they break.

Non-absorbable sutures should not be used in the presence of infection as they give rise to wound sinuses which persist until the suture is removed or extruded. The braided sutures are much more troublesome in this respect than the monofilament ones.

## Conclusions

The ideal suture material would be a perfect union of easy sterilisation, adequate tensile strength, handling ease, absence of foreign body reaction, and complete tissue absorption. Such a suture has yet to be developed. However, technological progress and experimental research will surely provide the answer in the not too distant future.

## References


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