

# Sutures in general surgery. New materials and advice



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## Sutures in general surgery. New materials and advice

*The suture thread used in digestive surgery must have several characteristics, including resistance to tension until the anastomosis coalescence, rapid absorption to avoid complications, biocompatibility and ease of handling. The preference is for monofilament polymers as they offer greater guarantees in biliary-digestive anastomoses. Suturing with synthetic polymers and mechanical devices such as staplers are the most suitable techniques. It is believed that staplers may become the gold standard technique in robotic surgery based on their experience and experimental data. In general, the goal is to use materials that minimize the risk of post-operative complications and offer maximum reliability in the anastomosis.*

KEY WORD: Suture material, Stapler

## Introduction

For the synthesis of tissues the most commonly threads in use are composed of organic, synthetic and natural fibers.

Suture materials play a critical role in the preparation of anastomoses in surgical procedures. The most commonly used organic materials for sutures are catgut and chromic catgut. Synthetic materials such as polyester are popular for multifilaments, while prolene and polypropy-

lene are commonly used for monofilaments. Natural fibers like linen and silk are also commonly used in anastomoses.

## CASE REPORT

This report focuses on the results obtained using various suture materials in the preparation of anastomoses performed on patients who underwent digestive system surgeries at the III Surgical Clinic between 1977 and 1985. In the decade from 2012 to 2022, the same surgeons examined the use of new synthetic devices such as staplers and mechanical staplers<sup>26,31</sup>. These devices have standardized surgical procedures in open surgery, video-laparoscopy, and robotic surgery. As a result, all surgeons can work in the same way, and surgical times have been reduced.

Despite the introduction of new synthetic devices, there are still some manual sutures used in certain types of anastomoses procedures, including choledoch-duodenum, ureter-bladder anastomoses, all transplant anastomoses,

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and vascular sutures. The choice of suture material depends on several factors such as the type of tissue being sutured, the expected strength, and the healing process.

### Materials and Methods

Between February 1977 and May 1985, a total of 154 intestinal anastomoses<sup>28</sup> were performed on 93 male and 61 female patients at the III Surgical Clinic. The types of surgeries included 29 right hemicolectomies, 23 anterior sigmoid resections, 7 sub-total colectomies, and 21 left hemicolectomies. Of these, 48 cases involved monofilament sutures, while traditional materials were used in the other 106 cases.

In the decade from 2012 to 2022, a total of 168 intestinal anastomoses were performed using a stapler device. The use of the stapler has become a standard practice in many surgeries and has greatly improved the efficiency and accuracy of anastomoses procedures (Table I).

### Results

In the 48 anastomoses performed using monofilament sutures, the canalization took place on average on the third to fourth day, while the hospital stay was on average fifteen to eighteen days. In the other 106 anastomoses performed using multifilament sutures, the intestinal canalization was restored on the fifth to sixth day and the patients were discharged on average in eighteen to twenty days. The most frequently observed complications related to the anastomosis were infection<sup>2,5</sup> and dehiscence<sup>25</sup>.

Regarding dehiscence, in the first group of patients (monofilament), six cases of infection and two cases of dehiscence were observed when the suture was performed in a single layer, and no cases were observed in the double layer anastomosis.

In the second group of patients in which the anastomosis was made using multifilament sutures, there were ten cases of infection and three cases of dehiscence in the single-layer anastomoses, and four cases of infection and one case of dehiscence in the double-layer anastomoses.

However, analyzing the data collected with our study, it has been observed that with the use of mechanical staplers, the recovery of normal bowel function occurred on the third day after the surgical operation, and dehiscences have been reduced, resulting in shorter recovery times. Despite the benefits of mechanical staplers, the costs associated with these devices remain expensive (Table II).

### Discussion

The choice of suture material in digestive surgery must consider several characteristics that can be generally defined as “manageability,” including sterility, softness, knotability, smoothness, low capillarity, compatibility with tissues, possibility of being colored, resistance to tension, and reduced elasticity.

Today, suture materials must be absolutely sterile to avoid infections caused by poorly sterilized threads, which can lead to dehiscences<sup>3</sup>. Softness is a characteristic of silk, linen, and almost all multifilaments, and is important for good knotability, particularly with silk and linen. Multifilaments are typically tight when knot-

TABLE I

| Type of Anastomosis | 1977-1985 | 2012-2022 (Open) | 2012-2022 (Video laparoscopy) | 2012-2022 (Robotic) |
|---------------------|-----------|------------------|-------------------------------|---------------------|
| Ileocolic           | 29        | 31               | 9                             | 11                  |
| Colocolic           | 21        | 39               | 10                            | 9                   |
| Ileorectal          | 7         | 5                | 11                            | 7                   |
| Colorectal          | 23        | 8                | 15                            | 13                  |

TABLE II - Colorectal anastomoses

| Material  | Characteristics   | Choice   | Suture Layers                | Surgeon's Habits  |
|-----------|---|--|------------------------------|-------------------|
| Natural   | Sterility, resistance, knot strength<br>Manageability, capillarity, | Silk   | Single Layer<br>Double Layer | Used infrequently |
| Synthetic | Tolerability, absorbability   | Polyamide, polypropylene<br>Polyester, polyglycolic acid,<br>polyglactin 910 |                              | Used frequently   |
| Metallic  |   | Stainless steel, titanium  |                              | Used infrequently |

ted, but if intertwined, they can be rough and cause a "saw" effect on tissues <sup>29</sup>.

Suture materials must also be visible in the operating field and are often produced in colors such as blue, black, and green using natural substances that are well tolerated by the body. The non-capillarity of a thread is crucial in abdominal surgery, as capillarity can allow organic liquids and microorganisms to pass through the individual fibers, causing dehiscences, foreign body granulomas, and prolonged inflammatory reactions. To address this, multifilaments can be coated with silicone or Teflon to make them partly waterproof.

The antigenic power of suture materials is also a concern, as all commonly used threads can cause the release of histiocytes, granulocytes, and inflammation mediators within the tissue, leading to a foreign body reaction of varying intensity.

The same inflammatory reaction occurs after repair of an inguinal hernia with a resorbable mesh <sup>32</sup>. This reaction negatively affects the healing times of anastomoses and persists until the suture material is expelled or completely reabsorbed. Stainless steel is the least reactive material in disposable staples of mechanical staplers and is covered in a short time and incorporated into a cicatricial connective tissue capsule.

Previously, catgut, silk, and linen were the most commonly used materials in digestive surgery, but their organic and natural structure led to significant drawbacks, including problems with sterility. For example, catgut polluted with pathogenic germs led to frequent cases of tetanus, while repeated sterilization in an autoclave caused linen and silk to lose their tensile strength. Sterilization using "ethylene oxide" or radiation has solved this problem. Research has shown that catgut causes the most intense and prolonged antigenic response, and its use is discouraged in intestinal anastomoses due to its tendency to lose tensile strength and trigger significant inflammatory responses. Catgut may still be used for muco-mucous sutures or full-thickness sutures for hemostasis, with the seal being entrusted to the serum-muscular suture using silk or linen. In biliary surgery, catgut is not recommended due to its potential to cause long-term stenosis (Fig. 1).

Synthetic materials such as polyglatin 910 (Vycril) <sup>6,9</sup>, polyglycolic acid <sup>1,14,20</sup> (Dexon), and polydioxanone (PDS) are rigid polymers that do not have antigenic

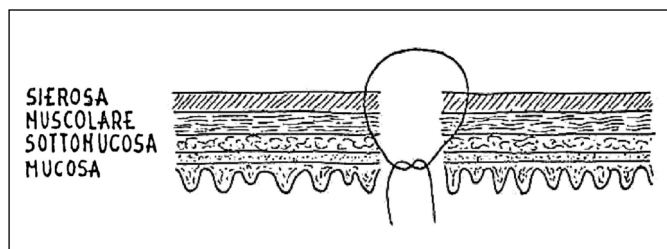


Fig. 1

power, and they stimulate only a slight inflammatory and sclerotic reaction that minimally interferes with the normal wound healing process <sup>27</sup>. These materials are not absorbed by digestion as organic materials are but instead undergo a hydrolytic depolymerization process, which transforms the polymer into glycolic acid over time. The glycolic acid is then eliminated by the kidneys and lungs. Reabsorption occurs uniformly and is completed within approximately ninety days, and this process does not appear to be influenced by inflammation or any other factor. The tensile strength of these materials decreases slightly over time, by about 25% on the fifteenth post-operative day.

Non-resorbable synthetic materials, whether multifilament or monofilament, composed of prolene or polypropylene, generate a modest and limited inflammatory reaction that is much lower than that produced by organic materials and natural fibers. These materials exhibit considerable resistance to both physical and chemical agents, good handling, absence of capillarity, resistance, and biological inertia.

The main inconvenience is due to the poor hold of the knots, which have a tendency to untie so that it is generally necessary to tie more than five knots; this involves a considerable loss of time and a greater quantity of filament left in the tissues. Due to their characteristics, the latter described materials can be used to make very secure sutures without particularly interfering with the wound healing process; their stimulating action on fibroblasts is quite limited.

## Conclusion

Based on the aforementioned information, we believe that a suture thread suitable for digestive surgery must possess the following characteristics: it should maintain resistance to tension until the coalescence of an anastomosis; it should be rapidly absorbed <sup>30</sup> to avoid the formation of foreign body granulomas or stones in renal and biliary surgery; it should behave like biologically inert material, without causing any significant tissue reactions; and lastly, it should be easy to handle and have a color that stands out from the dominant red color of the operating field.

Our experience, along with that of other authors, suggests that it is preferable to use polymers, particularly those that are packaged in the form of monofilament, as they have a lower incidence of complications and offer greater guarantees in biliary-digestive anastomoses.

Based on our experience and experimental data <sup>13,15</sup>, we believe that synthetic polymers and modern mechanical devices, such as staplers and mechanical staplers <sup>33</sup>, are the most suitable suture techniques. Therefore, we agree that the mechanical stapler may be the gold standard technique in robotic surgery, according to our surgical experience (Table III).

TABLE III - Colorectal anastomoses

| Sutures                      | N. of cases | Dehiscence | %     |
|------------------------------|-------------|------------|-------|
| DOUBLE LAYER                 |             |            |       |
| Cotton 3 «O»                 |             |            |       |
| Chromic catgut 5 «O»         | 218         | 17         | 7.8   |
| Silk 3 «O»                   |             |            |       |
| Chromic catgut 5 «O»         | 20          | 3          | 15    |
| Multifilament 5 «O»          |             |            |       |
| Chromic catgut 5 «O»         | 17          | 4          | 24.5  |
| Chromic catgut 3 «O»         |             |            |       |
| Chromic catgut 5 «O»         | 6           | 3          | 50    |
| Polypropylene 5 «O»          |             |            |       |
| Chromic catgut 5 «O»         | 4           | 1          | 25    |
| Multiti. Dacron 5 «O»        |             |            |       |
| Chromic catgut 5 «O»         | 2           | 1          | 50    |
| TOTAL                        | 267         | 29         | 10.8% |
| MONOLAYER                    |             |            |       |
| Metallic monofilament 5 «O»  | 588         | 15         | 2.56  |
| Metallic multifilament 5 «O» | 1115        | 7          | 0.63  |
| Mersilene 5 «O»              | 7           | 4          | 57.1  |
| Propylene 5 «O»              | 4           | 1          | 25    |
| Nylon monofilament 5 «O»     | 3           | 1          | 33.3  |
| TOTAL                        | 1717        | 28         | 3.9%  |

(H.D. Trimpi, 1977)

The significant advantage in favor of synthetic<sup>17</sup> monofilaments can be attributed to their ability to maintain adequate resistance to tension for the necessary period for the definitive coalescence of a suture, despite being absorbable like catgut<sup>12,22,23</sup>. Additionally, these materials have predictable tensile behavior. Studies have shown that polydioxanone<sup>7,10,18,24</sup> monofilament exhibits very low capillarity and post-operative "evening bile" does not occur. The use of monofilaments in general, and specifically polydioxanone<sup>4</sup>, has proven useful in cases where the patient's condition has deteriorated, jaundice is present, or in cases of infections or tumors where wound repair is slower than usual, necessitating the use of a material that ensures the suture is held for a longer period. The advantage of polydioxanone is that it disappears from the tissues after six months.

### Riassunto

Il filo di sutura utilizzato in chirurgia digestiva deve possedere diverse caratteristiche, tra cui la resistenza alla tensione fino alla coalescenza dell'anastomosi, il rapido assorbimento<sup>8,11,16,21</sup> per evitare complicanze, la biocompatibilità e la maneggevolezza.

La preferenza è per i polimeri monofilamento in quanto offrono maggiori garanzie nelle anastomosi bilio-digestive<sup>19</sup>. La sutura con polimeri sintetici e dispositivi meccanici come le suturatrici meccaniche sono le tecniche più adatte.

Si ritiene che la suturatrice meccanica possa diventare la tecnica gold standard nella chirurgia robotica sulla base della loro esperienza e dei dati sperimentali. In generale, l'obiettivo è utilizzare materiali che riducano al minimo il rischio di complicanze post-operatorie e offrano la massima affidabilità nell'anastomosi.

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