Absorbable Versus Nonabsorbable Suture for Laparotomy Closure

M.A. Carlson

Citation:

The choice of suture material is becoming increasingly complex. The multiple factors to consider when choosing a suture for closure of a fascial incision include its handling characteristics, ability to incite an inflammatory reaction, cost, knot security, and susceptibility to in vivo degradation. One of the more important factors to consider when picking a suture is the durability of tensile strength. Currently available sutures are described as rapidly absorbing, slowly absorbing, and nonabsorbable/permanent. These definitions are variable, and even some sutures described as permanent eventually degrade. Probably the most important criterion on which to judge a suture is its role in early and late wound failure (defined here as dehiscence and hernia, respectively). This review will emphasize the evaluation of suture using that criterion.

19.1 Requirements for the Ideal Suture

Seventy years ago, Moynihan wrote that the requirements for the ideal suture include adequate strength to keep tissue edges apposed and vessels ligated, no infection risk, low tissue irritability, and finally absorbability so that foreign material would not persist to cause problems [23]. The suture material which fulfilled these requirements at the time Moynihan wrote this was catgut. Unfortunately, the experience with catgut in fascial closure during the latter half of this century has been disastrous, with an average dehiscence rate of 10% or more [33,13]. Catgut has been condemned as a suture for fascial closure. The suture types used currently, with the possible exception of silk [18], have more than adequate strength in the fresh state to hold fascia together [15]. The issue currently of most concern is how long the suture will maintain its strength and when (if ever) will it be absorbed.

A suture used for fascial closure should maintain reasonable tensile strength for 4–6 weeks, because in animal studies this is the time required for a fascial incision to regain approximately 50% of its baseline strength [1, 10, 12, 21, 24]. The goal of 50% baseline strength is an intuition based on review of the literature; no one has ever determined the “safe” amount of healing must occur so that an abdominal incision can remain intact without the support of suture material. It would be reasonable to assume that the interval to 50% baseline strength would be longer in a patient with suspected slow healing (e.g., secondary to protein malnutrition, steroids, various metabolic diseases), which would argue for use of a more durable or permanent suture in these patients, but hard evidence for this choice is lacking.
The choice of a strong, permanent suture to close fascia would seem logical and final were it not for some long-term complications which are believed to be more common with nonabsorbable suture. "Buttonhole" hernia consists of one or more defects along the line of fascial closure and is attributed to the sawing motion of the suture on the fascia during abdominal wall motion [3]. Although the incidence of buttonhole hernia has yet to be defined, it seems to be exclusive to permanent suture. Suture sinus is a communication between the fascial suture (usually at a knot) and the skin [7, 9, 14, 16, 17]. Suture sinus has an incidence of about 1% and occurs predominantly with nonabsorbable suture (although it has been seen with absorbable suture).

19.2
Current Sutures: A Sampling

The durability of suture commonly is evaluated by placing it in the subcutaneous tissue of animals for specified lengths of time, removing it, and then subjecting it to a tensiometer (ex vivo stress testing). Initial tensile strength of fresh suture is not an issue, since it has been demonstrated that fresh fascial suture will rip through the fascia during abdominal wound bursting experiments before the suture breaks [25, 26]. The tensile strength half life (t_{1/2}) may be estimated using several time points from ex vivo stress testing; the t_{1/2} for some common absorbable sutures is given Table 1. Some "nonabsorbable" sutures are not actually so; silk has lost most of its strength at 1 year, and nylon (Ethilon, Dermalon) loses about 15%–25% of its strength per year. Polypropylene (Prolene, Surgilene), polyethylene (Ethibond, Ti-Cron, Tevdek), and polybutester (Novafil) seem to retain their strength indefinitely [22], although one study has noted some strength loss of polypropylene after 6 weeks [15].

19.3
Current Sutures: Randomized Trials

There are numerous retrospective reports (not reviewed here) in which the value of some suture is lauded based on a large experience. The use of polyglycolic acid (Dexon), which some surgeons avoid because of its relatively short t_{1/2}, resulted in dehiscence rates of 1.6% and 2% in a randomized trial of over 3000 patients comparing running to interrupted closure [11]. It would seem from this that using a suture which has lost half of its strength after 2 weeks (see Table 1) does not result in an inordinate incidence of wound dehiscence. The results of the eight available randomized trials which compare one suture against another do not demonstrate a difference in dehiscence rate between absorbable and nonabsorbable sutures [4–6, 8, 9, 19, 20, 27].

<table>
<thead>
<tr>
<th>Suture</th>
<th>t_{1/2} (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyglactron 25 (Monocryl)</td>
<td>1</td>
</tr>
<tr>
<td>Polyglactin 910 (Vicryl)</td>
<td>2</td>
</tr>
<tr>
<td>Polyglycolic acid (Dexon)</td>
<td>2</td>
</tr>
<tr>
<td>Polyglyconate (Maxon)</td>
<td>3</td>
</tr>
<tr>
<td>Polydioxanone (PDS)</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 1. Ex vivo tensile strength half life (t_{1/2}) for some common absorbable sutures (from product insert data and [3a, 22])
Table 2. Results of prospective randomized trials comparing absorbable versus nonabsorbable suture

<table>
<thead>
<tr>
<th>Location</th>
<th>Patients enrolled (n)</th>
<th>Sutures</th>
<th>Dehiscence (%)</th>
<th>Hernia (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands [27]</td>
<td>1156</td>
<td>Vicryl</td>
<td>1.9</td>
<td>18.8*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PDS</td>
<td>3.5</td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nylon</td>
<td>2.1</td>
<td>10.4*</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>Dexon</td>
<td>0</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prolene</td>
<td>1.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Montreal [20]</td>
<td>757</td>
<td>PDS</td>
<td>0.3</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prolene</td>
<td>0.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Aberdeen [19]</td>
<td>347</td>
<td>Dexon</td>
<td>0.6</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prolene</td>
<td>0.6</td>
<td>5.2</td>
</tr>
<tr>
<td>London [6]</td>
<td>210</td>
<td>Dexon</td>
<td>1.0</td>
<td>11.5*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nylon</td>
<td>1.0</td>
<td>3.8*</td>
</tr>
<tr>
<td>London [5]</td>
<td>161</td>
<td>Vicryl</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nurolon</td>
<td>0</td>
<td>8.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prolene</td>
<td>1.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Burlington MA [9]</td>
<td>229</td>
<td>PDS</td>
<td>0</td>
<td>10*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethibond</td>
<td>1.8</td>
<td>18*</td>
</tr>
<tr>
<td>New Brunswick [4]</td>
<td>225</td>
<td>Maxon</td>
<td>0</td>
<td>8.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nylon</td>
<td>2.7</td>
<td>4.4</td>
</tr>
</tbody>
</table>

PDS, polydioxanone.
*p<0.05.

higher ventral hernia rate with absorbable suture was found, however, in three of the eight studies (see Table 2). There does not appear to be an advantage of permanent suture over absorbable suture with respect to acute wound failure; there may be a trend for a lower hernia rate with permanent suture.

19.4 Summary

The requirements of Moynihan for the ideal suture are still applicable. The suture must have adequate strength and longevity for its job, and the suture should go away when it is no longer needed. The time required for sufficient fascial healing is not well defined and most likely is variable from patient to patient. The requirement for suture longevity, therefore, is vague. The small but real incidence of long-term complications secondary to nonabsorbable suture temper its election as the universal material for fascial closure. Conversely, the tendency to a higher ventral hernia rate may detract from the choice of absorbable suture. Knowledge of patient and suture factors should allow an intelligent choice of suture for fascial closure.

19.5 Discussion

Simmermacher: Were the techniques used in both studies comparable, or do the Dutch do something wrong compared with the rest of the world? When you used PDS, did you use the loop with a 4:1 ratio or single stitches?
Carlson: The closure technique was not constant, and therefore it is difficult to draw a conclusion.

Osther: In the Dutch study, the rate of high-risk patients is higher, and this might explain for the higher rate of recurrences.

Israelsson: Both studies lack a lot of science. For a real comparison, I think that the patient number, risk factors, closure technique, and anesthesia has to be the same in both groups.

Kingsnorth: We are probably too hung up on the small defects that the patient does not know about and which probably never become symptomatic. Therefore we have to have guidance to define what an incisional hernia is.

Israelsson: I think it is difficult to define, because in different countries the closure of symptomatic defects is a matter of social economics. We do not operate on patients with incisional hernias with the frequency that we did 10 years ago. We tend to operate on patients below the age of 65. In elderly patients, we do not operate even if they have symptoms because the economic incitement is missing.

Hartel: You mentioned that the monofilament sutures may have advantages in high-risk patients. Could you define these?

Osther: Old people, patients with a history of chronic obstructive pulmonary disease; diabetes was not included, because it was equal in both groups.

Schumpelick: How about the loop closure? Is there any experimental or clinically proven advantage?

Osther: No.

Amid: In subcuticular closures, there is less inflammatory reaction with nonabsorbable with than with absorbable sutures. This is attributed to the release of substances from the absorbable suture. Is this also true of deep closure?

Carlson: I would say it is, but I have no direct support for this view.

References


