Suture choice in general gynaecological surgery

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Although good sutures cannot make up for poor surgery, poor sutures can let down a good surgeon. Until 1970, only naturally occurring suture materials, such as catgut, silk and cotton, were available. The first synthetic absorbable suture (Dexon™) was introduced in 1970; since then, synthetic absorbable materials have replaced natural substances. This article looks at the choice of suture material that is available to the present-day gynaecologist.

WOUND HEALING

Healing begins as soon as an incision is made, when platelets are activated and release a series of growth factors. Within minutes, the wound displays a mild inflammatory reaction characterised by the migration of neutrophils which are attracted by degradation products of fibrin and fibrinogen. During this time, and until the proliferative phase of healing begins, wound strength is low. Macrophages peak at 24 hours and produce lactate. This promotes the release of angiogenic endothelial chemo-attracants and increases the rate of collagen synthesis by fibroblasts. By the fifth day, fibroblasts are found in high numbers and the formation of a microcirculation begins. After the second week, although collagen synthesis and angiogenesis are reduced, the pattern of repair is reorganised and the strength of the wound increases, although never to its original level.

Collagen synthesis and lysis are delicately balanced. During the first 12–14 days the rate at which wound strength increases is the same, irrespective of the type of tissue. Thus, relatively weak tissues, such as bladder mucosa, may have regained full strength, whereas fascia will only have recovered by 15%. Moreover, it takes three months for an aponeurosis to recover 70% of its strength and it probably never regains its full strength.

FACTORS AFFECTING HEALING

Many factors influence healing, including age, nutrition, vascularity, sepsis and hypoxia (Table 1). Some medical conditions, such as diabetes, use of steroids, uraemia, jaundice and anaemia, affect healing adversely. Another factor of relevance to the gynaecologist is the menopause, since it has been shown that oestrogen accelerates cutaneous healing by increasing local growth factors. Postmenopausal women having vaginal surgery are therefore advised to use pre-operative local oestrogen. Cigarette smoking can also affect healing adversely.

With regard to infection, the main source of contamination is endogenous, with only about 5% of infections being airborne. Most gynaecological operations are clean (<2% rate of infection) or clean-contaminated when the vagina is incised (2–5% rate of infection). Other surgical factors in infection include local trauma from excessive retraction, over-zealous diathermy and operations lasting more than two hours.

Table 1. Factors that influence healing

<table>
<thead>
<tr>
<th>Factors that promote healing</th>
<th>Factors that inhibit healing</th>
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<tbody>
<tr>
<td>Younger age</td>
<td>Postmenopausal status</td>
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<tr>
<td>Good blood supply</td>
<td>Poor blood supply</td>
</tr>
<tr>
<td>Absence of infection</td>
<td>Infection</td>
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<tr>
<td>Good nutritional status</td>
<td>Poor nutrition</td>
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<tr>
<td></td>
<td>Chronic medical conditions</td>
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<td></td>
<td>(e.g. diabetes)</td>
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<td></td>
<td>Steroid use</td>
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FEATURES OF SUTURE MATERIALS

The ideal suture material should be easy to handle, maintain good knot security, produce minimal tissue drag and have lasting tensile strength. It should be non-allergenic and retain its holding power even in the presence of infection. It should be absorbed in a predictable way during the wound-healing process. Such a suture does not exist, although some do possess many of these features. The range of sutures available has increased with the advent of synthetic materials that offer superior strength, durability and predictability (Table 2).

Gynaecologists have perhaps been slow to use newer materials, despite evidence from the general surgery literature. The requirement for evidence-based decisions in all aspects of clinical practice clearly applies also to suture usage. Moreover, evidence of the use of the product in laboratory and animal studies is equally as important as in
the clinical setting because valid clinical studies are often difficult to conduct and analyse due to multiple variables.

When assessing a suture, the following need to be evaluated:

- **Tensile strength**: this is the force needed to break the suture divided by the cross-sectional area and is particularly important in the presence of infection. If an abscess forms, the suture should be removed.

- **Inflammatory response**: this was thought to lie beneficial (the greater the reaction the better the scar); however, inflammation destroys and weakens tissue, leading to a weaker scar.

- **Ease of handling**: this is important and should improve with practice.

- **Stiffness and flexibility**.

- **Memory**: this refers to the tendency of a suture to return to its original packaged configuration. Sutures with a strong memory are more difficult to tie and thus may threaten knot security; they should not be pulled hard to straighten.

- **Knot security**: this refers to the capacity of a knot to stay tight. Stiffer sutures require more knots, thus creating more inflammation and a larger nidus for infection.

- **Thickness or calibre**: The thinnest possible suture should be used, although heavier threads will be required for tissues under the greatest strain.

- **Tissue drag**: this refers to the friction generated as the suture passes through tissue; the smoother the passage, the less the tissue damage.

- **Elasticity**: is not usually a desirable quality because the suture will tend to stretch over time.

- **Allergic potential**: especially with natural sutures.

- **Rate of absorption**: synthetic sutures have a predictable rate of absorption but those made of natural materials do not.

- **Coating**: this usually improves tensile strength and handling, giving less tissue drag and better knots.

### TYPES OF SUTURES

The sutures that are currently available are natural or synthetic, absorbable or non-absorbable, single-filament or braided. A decision as to which suture to use can be made from the scientific data on each suture and a knowledge of wound healing. The question then is whether each type of suture should be tested clinically by randomised trials before being introduced. Such trials exist for many situations but are not necessarily specific to gynaecology.

#### Natural sutures

Cougut and silk are the only suture materials that are used to any extent in gynaecology.

**Catgut**

Catgut is made by treating ribbons of sheep small intestine with dilute formaldehyde. Because catgut is a natural substance, it acts as a foreign body and can elicit a severe tissue reaction. It is quickly degraded by the inflammatory reaction but maintains its tensile strength for five days. If treated with chromium salts, so-called chromic catgut becomes stronger and more resistant to absorption. It maintains its tensile strength for 14–21 days, although marked inflammation still occurs. These problems translate into more wound infections and thus synthetic sutures are now considered preferable.

**Silk**

Silk was a popular suture material because of its ease of handling, low memory and ability to form secure knots. However, its capacity to produce intense inflammation and act as a nidus for bacterial infection often leads to a weak wound and synthetic sutures that do not have such adverse properties are now available.
**Absorbable synthetic sutures**

**Polyfilaments**
Sutures made of polyglycolic acid (Dexon™) and polylactin (Vicryl™) were devised to overcome the shortcomings of catgut. They are virtually identical biologically, are degraded by slow hydrolysis and are absorbed at a reliable and constant rate, although with some inflammation. More recent modifications, such as coating the suture, have improved the tensile strength, which is maintained for 15 days. Resorption, however, can take up to 90 days, long after tensile strength has been lost. Knot security is good and is probably better than that of catgut. The main criticism is that handling is not as good as catgut, although coating has improved this. Dexon-IT™ only requires one turn on the first throw during knotting, as the second throw will bring both knots down securely.

**Monofilaments**
Polyglyconate (Maxon™) and polydioxanone (PDS™) represent a new class of absorbable monofilament sutures. They are similar in properties to the polyfilaments but maintain their tensile strength for longer. Polyglyconate (Maxon™) is stronger but polydioxanone (PDS™) retains its strength for longer. 50% of tensile strength remaining at 28 days. A comparative study of the two sutures showed Maxon™ (polyglyconate) to be superior in lack of tissue drag, tensile strength and first-throw knot holding, although equal in other features. The sutures of monofilaments are stiffer, with more memory and less knot security than polyfilaments. Knots do not hold well if a double turn is used on the first throw and each knot should be placed flat. This is particularly useful if wound healing is delayed, or for wounds involving fascia because these sutures can support the problem of sinus formation. A randomised controlled trial of polyglyconate (Maxon™) versus nylon in 225 patients showed that polyglyconate was as effective at two-year follow-up. Suture length should be approximately four times the length of the wound to allow for the 30% increase in abdominal circumference postoperatively. Permanent sutures should still be considered where the risk of wound failure is particularly high.

**Clinical Scenarios**

**Abdominal wound closure**
Modern sutures are uniform and strong and wound dehiscence will only be due to suture failure in exceptional circumstances, with improper tying of knots or damage to the suture by instruments. The suture can cut through if wide enough bites are not taken and if the suture is too tight. Premature loss of strength only occurs with absorbable sutures, especially catgut.

The closure of low transverse incisions is simplified by the fact that they generally heal well, with a low incidence of dehiscence and hernia whatever suture is used. Closure of midline incisions presents more problems. The integrity of any wound is completely dependent on the suture until reparative tissue has developed. Premature loss of strength only occurs with absorbable sutures. Four well-designed controlled studies have shown that catgut is associated with an unacceptably high risk of evisceration and incisional hernia and should not be used. Experimental work on rats has shown that mass closure with monofilament nylon significantly reduces the dehiscence rate compared with braided suture, as bacteria reside in the interstices of infected multifilament sutures. However, in some patients, removal of suture material will be required due to sinus formation. Delayed absorbable sutures have been assessed for abdominal wound closure and it was found that wound dehiscence is similar without the problem of sinus formation. A randomised controlled trial of polyglyconate (Maxon™) versus nylon in 225 patients showed that polyglyconate was as effective at two-year follow-up. Suture length should be approximately four times the length of the wound to allow for the 30% increase in abdominal circumference postoperatively. Permanent sutures should still be considered where the risk of wound failure is particularly high.

**Skin closure**
In gynaecological practice, there are many options for skin closure, but cosmesis is more important than in general surgery where the avoidance of infection is more of a
concern. Lower transverse incisions heal well because of the lack of tension. Full-thickness interrupted stitches must not be too tight as oedema may lead to disfiguring cross-hatching, particularly if infection forms along the track. Very thin monofilament non-absorbable sutures are preferable but a subcuticular stitch leaves less of a scar (Figure 1). Polybutester (Novatil™) leaves a better scar than polypropylene or nylon when assessed for hypertrophy, width colour and cross-hatching at 18 months. Similar assessment of laparoscopy scars suggests that subcuticular polyglactin (Vicryl™) is better than transdermal nylon. Staples are popular because there is less chance of bacterial migration into the wound, although the risk of infection in most gynaecological surgery is low. Properly conducted clinical trials have shown the only benefit of staples to be speed,\(^1\) as there is more wound pain and a worse cosmetic result compared with subcuticular sutures.\(^2\)

Figure 1. (a) Postoperative wound oedema is confined by percutaneous sutures, which cut in, causing pain and ischaemia. (b) With subcuticular sutures, the tissues ride up over the oedema; discomfort is thus minimal and infection not enhanced

Pelvic reconstructive surgery

Anti-incontinence procedures

Burch colposuspension is generally considered to give better results than anterior repair, even with absorbable sutures.\(^3\) Other comparative studies, however, have often not stated the material used, although Beck and McCormick showed an improved success rate on changing from catgut to polyglycolic acid (Dexon™) in an observational study.\(^4\) Other studies on incontinence surgery show an improvement in the results of vaginal surgery with delayed absorbable\(^5\) and permanent sutures.\(^6\)

Prolapse

Rapidly absorbable sutures are widely used in prolapse surgery. It appears that as many as 30\% of operations for incontinence or prolapse are repeat procedures and therefore the question arises as to whether technique or choice of suture material at primary surgery is implicated. If the analogy with hernia is used and prolapse were due to breaks in fascial supports, then it is clear from results with hernia repair that only delayed absorbable or permanent sutures should be used.\(^7\) However, permanent sutures in the vagina cause problems with infection, granulations, bleeding and even fistula formation, and may require removal.\(^8\) Delayed absorbable sutures may be an option but this is an area that clearly requires further study. For recurrent prolapse surgery, including sacrospinous fixation, both absorbable, delayed and non-absorbable sutures have been used.\(^9\) Observational data suggest that permanent sutures such as braided polyester (Ethibond™),\(^10\) polypropylene (Prolene™)\(^11\) or PTFE (Gore-Tex™)\(^12\) give improved results. However, data from hernia repair suggests an increased risk of infection with PTFE compared with monofilament sutures.\(^13\) More data on suture material in pelvic reconstructive surgery are required.

CONCLUSION

Evidence exists on which gynaecological surgeons should base their choice of suture material for closure of fascia, skin and the vaginal vault. More evidence is required for other operations, particularly for pelvic reconstructive surgery.

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References

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REVIEW

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