

# Prevention of Incisional Hernias

## How to Close a Midline Incision

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### KEYWORDS

- Wound closure techniques • Postoperative complications • Surgical wound infection
- Surgical wound dehiscence • Hernia

### KEY POINTS

- To minimize the rate of wound complications in midline abdominal incision, it is recommended to:
  - Use a monofilament suture material, USP 2/0, slowly absorbable or nonabsorbable, mounted on a small needle
  - Use self-locking anchor knots
  - Use a continuous-suture technique and close the incision in one layer, avoiding high tension on the suture, adapting but not compressing wound edges
- Place the stitches:
  - In the aponeurosis only
  - 5 to 8 mm from the wound edge
  - 4 to 5 mm apart
- Measure the length of the wound and the suture remnants for calculation and documentation of the suture length to wound length ratio.
- Do not accept closure with a suture length to wound length ratio lower than 4.

### INTRODUCTION

Access to the abdominal cavity is often gained through a midline incision. An incision through the midline can be made rapidly and, because no major anatomic structures are crossing the midline, it causes minimal damage to muscles, nerves, and blood supply of the abdominal wall. Postoperative wound complications, such as surgical-site infection (SSI), wound dehiscence, and incisional hernia cause patients much suffering and generate costs for the welfare system.<sup>1-3</sup> In the United States the

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magnitude of the problem is illustrated by more than 2 million laparotomies annually being made for benign conditions alone,<sup>4</sup> with approximately 100,000 patients undergoing incisional hernia repair.<sup>3,5</sup>

Patient and operative factors important for the subsequent rate of wound complications may be given by the circumstances, for example, patient age or overweight, urgency of surgery, and the degree of contamination. Other important factors can, however, be totally controlled by the surgeon, for example, the choice of suture material, the method of wound closure, and the quality of the suture technique.

Numerous experimental and clinical studies are available showing that the quality of the suture technique is of utmost importance for the subsequent development of wound complications in midline incisions. As the surgical technique is within the surgeon's total control, adherence to the recommendations deriving from these studies offers a way of substantially reducing the rate of wound complications.

### THE CHOICE OF INCISION

Alternatives to the midline incision are a paramedian (medial or lateral), a transverse, an oblique, or a muscle-splitting incision. All incisions except the midline incision may compromise the placement of an ostomy, which is of importance in colorectal surgery and in emergent bowel surgery.

There are studies reporting a lower rate of incisional hernia with lateral paramedian incisions than with midline incisions,<sup>6-8</sup> but also studies that have failed to detect any difference.<sup>9,10</sup> Opening and closing a paramedian incision is time consuming, and later reentry may be difficult.<sup>7,8</sup>

For procedures in the lower abdomen muscle, splitting incisions such as the gridiron incision and the Pfannenstiel incision are alternatives often held to be associated with a low rate of wound complications.<sup>6,11</sup> However, the rate of wound dehiscence is similar with Pfannenstiel and midline incisions.<sup>12</sup> In a Swedish survey, incisional hernia repair after muscle-splitting incisions was frequent.<sup>13</sup> These incisions provide limited access to the abdomen and are associated with a risk of nerve injury.<sup>11,14</sup>

In a Cochrane review comparing transverse (including oblique) and midline incisions, it was concluded that no differences in infection rates could be detected, but that the likelihood of wound dehiscence and incisional hernia appeared to be lower with transverse incisions.<sup>15</sup> None of the included studies individually report any significant difference regarding wound dehiscence. There are only 3 studies available concerning incisional hernia with a follow-up of more than 1 year,<sup>16-18</sup> only 1 of which reports a monitored suture technique.<sup>18</sup>

### WOUND HEALING

The healing of a midline incision follows the general principles of tissue healing.<sup>19,20</sup> Wound healing is similar in all tissues, but the time needed for its completion differs.<sup>21</sup> Aponeurotic tissue needs a considerably longer time to heal than, for example, skin and mucosa.

The inflammatory phase starts immediately after the incision is made and lasts for about 4 days. Inflammation is seen within a zone up to 15 mm from the wound edge.<sup>22</sup> During this phase the wound has no intrinsic strength, and its integrity depends entirely on the suture and the suture-holding capacity of the tissues.<sup>20,21,23</sup>

A proliferative phase follows the inflammatory phase, and lasts for approximately 3 weeks.<sup>20,24</sup> The collagen deposition leads to an increase in the strength of the wound,

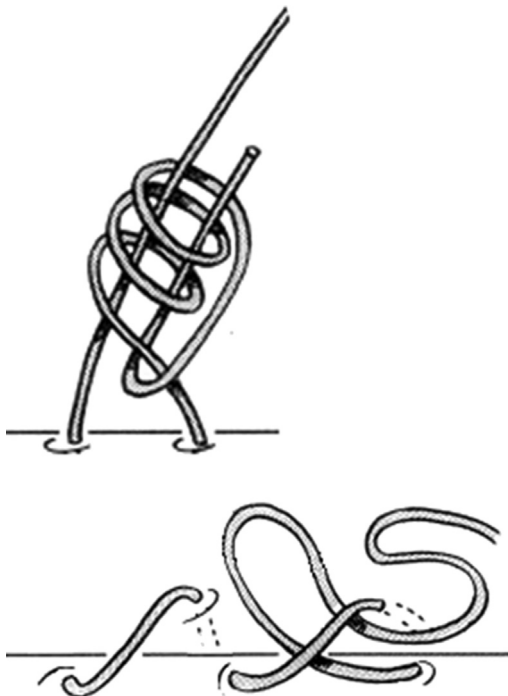
but at the end of this phase the strength is still only 15% to 20% of the unaffected abdominal wall.<sup>19,21,25</sup>

The following maturation phase may continue for more than 12 months.<sup>25</sup> It is characterized by cross-linking and remodeling of collagen fibers.<sup>19,21</sup> Up to the second postoperative month there is a rapid gain in wound strength.<sup>21</sup> After 1 month, 40% to 60% of normal wound strength can be expected, after 2 months 60% to 80%, and after 1 year 60% to 90%.<sup>21,26</sup> A normally healed wound has gained 50% of its original strength after approximately 6 weeks.<sup>27</sup> After an incision, the aponeurosis will never completely regain its original strength.<sup>21</sup>

### ***Suture Technique in Relation to Surgical-Site Infection***

SSI is defined as purulent discharge from the wound, irrespective of the presence of positive bacteriologic cultures.<sup>28</sup> After major surgery through a midline incision, the rate of SSI may be as high as 15%.<sup>29,30</sup> SSI increases the risk for the development of both wound dehiscence and incisional hernia.<sup>9,31-33</sup>

The choice of suture material affects the rate of SSI, and generally a monofilament suture material should always be chosen. The rate of SSI is higher with multifilament suture materials,<sup>34</sup> probably because bacteria escape phagocytosis within the filament interstitials.<sup>35</sup> It is more difficult to form secure knots with a monofilament suture than with a braided suture.<sup>36</sup> This drawback can be completely overcome by using self-locking knots for the anchor knots in a continuous suture line (**Fig. 1**). Self-locking knots cannot slip and are smaller than conventional knots.<sup>37</sup> With conventional knots the strength of the suture is reduced by at least 40%, whereas with self-locking knots the strength is lessened by only 5% to 10%.<sup>37</sup>



**Fig. 1.** Self-locking anchor knots. Starting knot and finishing knot.

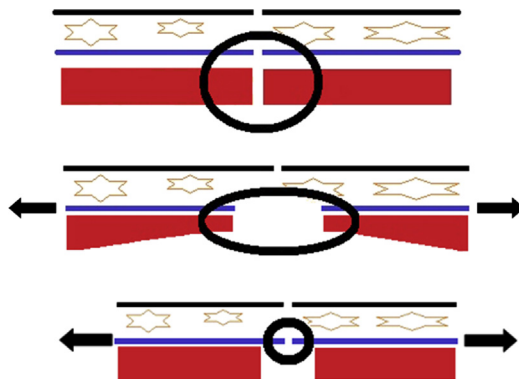
The degree of bacterial contamination in the wound affects the risk of developing an SSI,<sup>19</sup> and a high rate is often reported in gastrointestinal surgery and emergency surgery, and with long operation times.<sup>38,39</sup> The amount of necrotic tissue in the wound, constituting a nidus for bacterial growth, also seems to be very important for the risk of developing an SSI.<sup>19</sup> Qualities of the suture technique may affect the amount of necrotic tissue in the wound and, hence, the rate of SSI. One example is that with high tension on the suture line the rate of SSI is higher than with low tension,<sup>40</sup> probably because the soft tissues included in a tight stitch are compressed and devitalized to a larger extent than with low tension. It is difficult to standardize the tension applied on the suture in the clinical setting. The clinical recommendation is that wound edges should be adapted but not compressed. If in a closed midline incision the individual stitches are not visible because they are deeply embedded in soft tissue, the tension placed on the suture line is probably too high.

An association with an increased rate of SSI has also been found when closure is with large stitches.<sup>41,42</sup> It has been demonstrated that with large stitches, more soft tissue is compressed or cut through than with small stitches (**Fig. 2**).<sup>43,44</sup> In a randomized clinical trial, midline incisions were closed continuously with a suture length to wound length (SL to WL) ratio of more than 4 and was allocated to suture with either large stitches, placed more than 10 mm from the wound edge, or smaller stitches. With large stitches the rate of SSI was 10.2% and with small stitches it was 5.2% (**Table 1**). Thus, closing midline incisions with small stitches placed 5 to 8 mm from the wound edge reduced the rate of SSI significantly compared with stitches placed more than 10 mm from the edge (see **Table 1**).<sup>45</sup>

Thus several factors that can be completely controlled by the surgeon are important in minimizing the rate of SSI. A monofilament suture should be used, high tension on the suture line should be avoided, and wounds should be closed with small stitches at close intervals, placed 5 to 8 mm from the wound edge (**Table 2**).

### **Risk Factors for Wound Dehiscence and Incisional Hernia**

The mechanisms causing a wound dehiscence and an incisional hernia are similar, as are the identified risk factors. Overweight, male sex, abdominal distension, and



**Fig. 2.** A large stitch incorporating the aponeurosis (blue) as well as subcuticular fat (yellow) and muscle (red). When traction is applied on a large stitch, it compresses or cuts through subcuticular fat and muscle. Then the stitch slackens and aponeurotic edges separate. When traction is applied on a small stitch, no soft tissues are compressed and the aponeurotic edges do not separate.

**Table 1**  
Wound complications related to the size of stitches in a randomized trial

	Small Stitches	Large Stitches
Wound dehiscence	0% (0 of 356)	0.3% (1 of 381)
Surgical-site infection	5.2% (17 of 326)	10.2% (35 of 343)
Incisional hernia	5.6% (14 of 250)	18.0% (49 of 272)

Fisher's exact test.

Data from Millbourn D, Cengiz Y, Israelsson LA. Effect of stitch length on wound complications after closure of midline incisions: a randomized controlled trial. *Arch Surg* 2009;144(11):1056–9.

postoperative respiratory failure increase the tension on the suture line, and have been associated with a greater risk of dehiscence and incisional hernia.<sup>9,46–48</sup> Abdominal distension that elongates the wound and increases the pull on the suture line increases the risk of the suture breaking, the knots slipping, or the suture cutting through suture-holding tissues and causing a wound dehiscence.<sup>49</sup> Soft tissue held in the suture may be compressed, causing necrosis and inflammation, weakening the wound, and augmenting the risk of the suture cutting through the tissues.<sup>43</sup> Separation of wound edges leading to an incisional hernia may be a result of an incomplete early wound dehiscence. A raised risk of incisional hernia arises after multiple operations through the same scar and after wound dehiscence.<sup>50,51</sup>

Smoking is a risk factor for incisional hernia.<sup>52</sup> Old age, diabetes mellitus, malignant disease, malnutrition, jaundice, the use of glucocorticosteroids, among others, are factors that may delay wound healing and have been suggested to be associated with wound dehiscence and incisional hernia.<sup>6,9,46,47,50</sup> In patients operated on for abdominal aortic aneurysm (AAA), the rate of incisional hernia has been reported to be high,<sup>16,53</sup> but when taking the quality of the suture technique into account the rate has been similar in patients with AAA and in patients operated on for other diagnoses.<sup>54</sup>

An SSI may delay or even reverse the normal wound-healing process<sup>20</sup> and increases the risk for the development of both wound dehiscence and incisional hernia.<sup>9,31–33</sup> A severe necrotizing infection may disintegrate the aponeurosis, and the sutures placed in this tissue can then no longer support the wound.

During the early period the wound is entirely dependent on the suture line for its integrity,<sup>20,21,23</sup> and there is strong evidence that the suture technique is important for the prevention of a dehiscence or an incisional hernia.<sup>32,47,49</sup>

### **Suture Technique in Relation to Wound Dehiscence**

Wound dehiscence is a complete disruption of the sutured wound with evisceration, demanding emergent reoperation. Dehiscence usually happens within the first

**Table 2**  
Measurements necessary for calculating the suture length to wound length ratio in a continuously sutured wound

Original length of the suture	A
Length of suture remnants at the starting knot	B
Length of suture remnants at the finishing knot	C
Length of the skin incision	D

The suture length to wound length ratio is calculated as  $(A - (B + C))/D$ .

10 days<sup>31</sup> after wound closure, as the integrity of the wound is then entirely dependent on the suture and the suture-holding capacity of the tissues.<sup>20</sup> The main mechanism is the suture cutting through the suture-holding tissues.<sup>31,43,47</sup> A rate of wound dehiscence of less than 1% is often regarded as acceptable, although rates of 4% or higher continue to be reported.<sup>30,33</sup> Wound dehiscence is associated with a mortality rate as high as 35%<sup>55</sup> and with considerable morbidity, including a high rate of subsequent incisional hernia.<sup>47</sup>

A necrotizing infection may disintegrate the suture-holding tissues and reduce suture-holding capacity, and greatly increases the risk of wound dehiscence occurring. Dehiscence caused by a necrotizing infection may often occur relatively late, 7 to 10 days after wound closure, as a major infection takes some time to develop. However, this type of wound dehiscence does not seem to happen very often. In 1760 midline closures, wound dehiscence associated with a severe SSI occurred in only 2 (0.1%) patients.<sup>45,46</sup>

A wound dehiscence probably often occurs because the quality of the suture technique at wound closure was such that the suture-holding capacity of the normal tissues was exceeded. The SL to WL ratio achieved at wound closure is therefore crucial, and the strength of the sutured wound increases with a higher ratio.<sup>56</sup> In congruence, wound dehiscence seems to be a rare event when wound closure is with an SL to WL ratio higher than 4.<sup>32,45</sup> In 1760 patients, wound dehiscence occurred in a total of 6 (0.3%). In 2 patients (0.1%) this was in association with a severe wound infection, in 1 the suture broke, and in the other 4 the SL to WL ratio was very much lower than 4.<sup>45,46</sup> The size of stitches does not seem to be important; provided that the SL to WL ratio was higher than 4, similar rates of wound dehiscence were produced with small and large stitches (see **Table 1**).<sup>45</sup> In clinical practice the size of the suture material used is, in view of the experimental findings concerning the forces acting on the wound, often much larger than necessary.<sup>57</sup> In accordance, USP 2/0 was sufficiently strong to achieve a zero rate of wound dehiscence in 356 midline incisions (see **Table 1**).<sup>45</sup>

A continuous-suture technique produces a stronger wound than an interrupted technique<sup>56</sup> and is also more rapid.<sup>30,33</sup> Closing the wound in a single layer has produced lower rates of wound dehiscence than closure with several layers.<sup>9</sup> Including the peritoneum in the suture line does not contribute to the tensile strength<sup>58</sup> of the wound but may contribute to the formation of postoperative adhesions.<sup>59</sup>

It is very difficult to counter a wound dehiscence that occurs because the suture-holding tissues are disintegrated by a severe infection. Wound dehiscence related to the quality of the suture technique, however, can to a large extent be avoided if wounds are closed continuously in one layer with an SL to WL ratio higher than 4 (**Box 1**).

### ***Suture Technique in Relation to Wound Dehiscence***

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There is no definite information available on how to close the wound when a wound dehiscence has occurred. The situation is characterized by wound edges being severed by the suture cutting through the tissues, by inflammation distorting of the anatomy of the wound edges, and by weakening of the tissues by inflammation or a concomitant infection. Placing stitches in strong suture-holding tissue thus implies that sutures are placed at a fairly large distance from the wound edge, and often a distance of 3 cm is necessary. The stitch should include all layers of the abdominal wall except the skin, as a classic mass-closure stitch. Placing stitches at an interval of 4 to 5 mm means that the tension is distributed on a large volume of tissue, decreasing the risk of the suture cutting through the tissues. This goal may be accomplished if the

**Box 1****Recommendations on how to close a midline incision to minimize the rate of surgical-site infection**

Use a monofilament suture material

Avoid high tension on the suture; adapt but do not compress wound edges

Place stitches:

In the aponeurosis only

5 to 8 mm from the wound edge

4 to 5 mm apart

length of the suture used for wound closure is 10 to 15 times longer than the sutured wound (**Box 2**). This method has been used at the authors' department for decades, and the authors have not encountered any instance of re-dehiscence of the wound or, strangely enough, a higher rate of incisional hernias. Although it has been possible to close all dehiscenced wounds with this technique, there are of course wounds that should be left open and handled according to the principles of the treatment of an abdominal compartment syndrome.

***Suture Technique in Relation to Incisional Hernia***

Incisional hernia should be defined as any abdominal wall defect, with or without a bulge, in the area of a postoperative scar perceptible or palpable by clinical examination or imaging.<sup>60</sup> The definition used at follow-up affects the rate of incisional hernia reported. If any palpable defect or protrusion detected in the wound is regarded as an incisional hernia, higher rates will be reported than if only large visible bulges are regarded as a hernia.

An initially small defect in the wound may gradually develop into a protrusion and, eventually, a visible bulge, so the definition used at follow-up also affects the time at which an incisional hernia is detected.<sup>61</sup> Thus, if any palpable defect or protrusion in the wound is regarded as a hernia, less than 10% appear late, that is, after 5 to 10 years; if a palpable defect with a bulge is regarded as a hernia, 30% appear late; and if hernia is defined as a visible bulge at follow-up, more than 50% appear late.

Most incisional hernias probably develop during the early postoperative period, the main mechanism being early separation of aponeurotic edges.<sup>62</sup> In clinical studies an incisional hernia always develops if wound edges become separated more than

**Box 2****Recommendations on how to close a midline incision to minimize the rate of wound dehiscence**

Close the wound in one layer

Use a continuous-suture technique

Use self-locking anchor knots

Measure the length of the wound and the suture remnants for calculation of the SL to WL ratio

Document the SL to WL ratio

Do not accept closure with an SL to WL ratio lower than 4

12 mm during the first postoperative month.<sup>63</sup> As the regenerative power of the aponeurosis is limited, a defect larger than 12 mm cannot be bridged over. The ability of the suture line to hold wound edges into apposition during the early postoperative period is therefore very important for the subsequent development of incisional hernia. For midline incisions, there is considerable experimental and clinical evidence available concerning how this is to be achieved.

The suture material must contribute to the strength of the wound during a sufficiently long period and, as the aponeurosis heals rather slowly, it needs support of the suture for at least 6 weeks.<sup>27</sup> Nonabsorbable monofilament suture materials and slowly absorbable materials, supporting the wound for at least 6 weeks, produce similar rates of incisional hernia.<sup>64–66</sup> At present, polydioxanone is the only slowly absorbable monofilament suture material that has been evaluated in comparison with a nonabsorbable suture a randomized trial also monitoring the quality of the suture technique.<sup>66</sup> With quickly absorbable materials contributing to the strength of the wound for a shorter time than 6 weeks, the rate of incisional hernia is considerably higher than with slowly absorbable or nonabsorbable sutures.<sup>29,30</sup> In trials comparing sutures, monitoring the quality of the suture technique is vital because the introduction of a new suture material affects the surgeon, and wound closure is achieved with a more meticulous suture technique using the new material.<sup>67</sup>

The quality of the suture technique is easily monitored through the SL to WL ratio (**Box 3**), which correlates strongly with the subsequent rate of incisional hernia.<sup>32,45,68</sup> A low rate of incisional hernia is achieved when the SL to WL ratio is 4 or more,<sup>32</sup> and with a lower ratio the rate of incisional hernia is 4 times higher.<sup>45,46,68</sup> Measuring the ratio is easy and can be used as a means of a continuous quality control (see **Box 3**). Suturing with a high SL to WL ratio prolongs the operation by a few minutes, but is cost effective because the expense of subsequent incisional hernias is lower.<sup>1</sup>

A high SL to WL ratio can be accomplished with large stitches or with small stitches placed at closer intervals. Based entirely on experimental studies,<sup>24,57,69</sup> it has long been recommended to place large stitches at least 1 cm from the wound edge.<sup>6,70,71</sup> A clinical report actually pointed in the opposite direction and indicated a higher rate of incisional hernia with large stitches.<sup>48</sup> Recent experimental studies accounting also for the SL to WL ratio revealed that placing stitches close to the wound edge does not have any deleterious effects on wound strength.<sup>44,72</sup> After 4 days, a wound closed with an SL to WL ratio of 4 is stronger with stitches placed 3 mm

### Box 3

#### Recommendations on how to close a midline incision to minimize the rate of incisional hernia

Use a slowly absorbable or nonabsorbable suture material

Use a suture USP 2/0 mounted on a small needle

Place stitches:

In the aponeurosis only

5 to 8 mm from the wound edge

4 to 5 mm apart

Measure the wound length and the suture remnants for calculation of the SL to WL ratio

Document the SL to WL ratio

Do not accept closure with an SL to WL ratio lower than 4

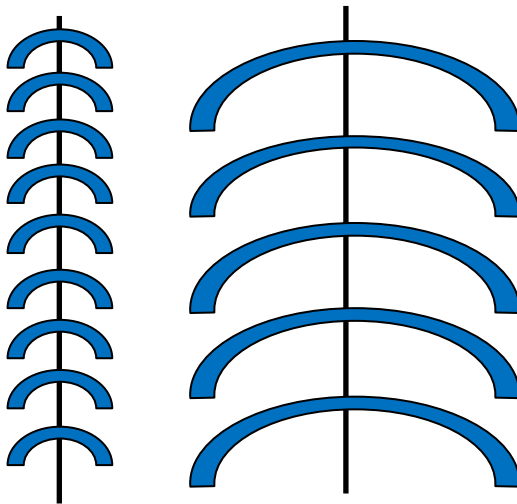


from the wound edge than with stitches placed 10 mm from the edge (**Fig. 3**).<sup>72</sup> This finding supports that a high ratio should be accomplished with many small stitches placed at short intervals rather than with fewer large stitches. A large stitch being related to the development of incisional hernia is probably due to the suture cutting through or compressing soft tissue such as muscle and subcuticular fat included in the stitch. As soft tissue gives way under the suture the stitch then slackens, allowing the aponeurotic edges to become separated more than 12 mm, and consequently an incisional hernia develops (see **Fig. 2**).<sup>43,44</sup>

The SL to WL ratio depends on the number of stitches, the size of the stitches, and the tension on the suture line. The tensile strength is higher in wounds approximated with low tension than in wounds closed with high tension.<sup>24,56</sup>

In a randomized trial including 737 patients, the effect on the rate of incisional hernia was studied with small stitches in comparison with large stitches. Closure with small stitches was made with a polydioxanone suture USP 2/0 mounted on a needle so small that stitches could not be placed more than 5 to 8 mm from the wound edge, only incorporating the aponeurosis. The rate of incisional hernia was 5.6% with small stitches, and was 3 times higher with large stitches placed more than 10 mm from the wound edge (see **Table 1**).<sup>45</sup> Closing wounds with many small stitches at close intervals prolonged each operation by about 4 minutes, but was cost effective owing to the reduced cost for subsequent hernia repairs.<sup>45,73</sup>

In this trial, closure was often with an SL to WL ratio very much higher than 4, and several patients had their wounds closed with a ratio of up to 12. With small stitches, increasing the SL to WL ratio very much above 4 had no deleterious effect on the rate of wound complications.<sup>74</sup> In fact, with small stitches an effect of classic risk factors, such as overweight and SSI, on the rate of herniation was not detected (**Box 4**).<sup>74</sup>



**Fig. 3.** (Right) a suture length to wound length ratio of 4 is achieved with large stitches. To achieve the same ratio with small stitches (left), the number of stitches placed in the wound must be increased. In an experimental study it was clear that 4 days after wound closure, the tensile strength of wounds closed with many small stitches was higher than with that with large stitches. (Data from Cengiz Y, Blomquist P, Israelsson LA. Small tissue bites and wound strength: an experimental study. Arch Surg 2001;136(3):272–5.)

**Box 4****Recommendations on how to resuture a dehiscid midline incision**

Use a monofilament suture material, slowly absorbable or nonabsorbable

Use a suture USP 0 mounted on a large needle

Use a continuous-suture technique and self-locking anchor knots

Close the wound in one layer

Avoid high tension on the suture; adapt but do not compress wound edges

Place stitches:

As mass closure stitches including all layers of the abdominal wall except the skin

30 mm from the wound edge

4 to 5 mm apart

Measure the wound length and the suture remnants for calculation of the SL to WL ratio

Document the SL to WL ratio

An SL to WL ratio of 10 to 15 should be achieved

**Discussion**

There is considerable accumulated evidence concerning how to close a midline incision to achieve a low rate of wound complications. Similar evidence is largely lacking regarding other abdominal incisions such as various transverse or muscle-splitting incisions, which constitutes a problem, especially as incisional hernia repair, to a surprisingly large extent, is performed after incisions not generally regarded to be associated with a substantial rate of herniation. Thus, during 1 year in Sweden 25% of all incisional hernia repairs performed were after muscle-splitting incisions in the right lower quadrant, laparoscopic ports, subcostal incisions, and Pfannenstiel incisions.<sup>13</sup>

Patients operated on because of an AAA have for a long time been held to be prone to develop incisional hernias. Several reports have shown, however, that with an adequate suture technique they do not develop incisional hernia to any larger extent than others.<sup>54,68</sup>

The choice to adhere to the experimental and clinical evidence accrued concerning the effect on the rate of wound complications of the closure technique and the quality of the suture technique is totally within the hands of the surgeon. The recommendations are easy to follow, and the effect on the subsequent rate of wound complications makes it cost effective. The only way to ascertain that the wound is closed with an adequate SL to WL ratio is to always measure, calculate, and document the ratio at every midline incision.

To the significance of a high SL to WL ratio must now be added the importance of closing wounds with small stitches. Thus, methods must be found to implement an adequate suture technique regarding both these factors. To achieve this, it is probably wise to focus on surgeons in training and teach them a proper technique during the early period of their education. In Sweden, the British Basic Surgical Skills Course has been adopted and slightly modified to be compatible with Swedish conditions. During this mandatory course, all Swedish residents in surgery are taught the principles outlined in this article.

Changing the technique to using small stitches is probably an easier task than implementing the SL to WL ratio. Having ensured a ratio greater than 4, wound closure

with small stitches is easily achieved by providing surgeons with a suture mounted on a needle so small that only small stitches can be accomplished.

Cost savings are generated and patient suffering is reduced if the basic principles of suturing with small stitches and an SL to WL ratio greater than 4 are followed. Suturing with small stitches and a high ratio can easily be achieved by individual surgeons, but the choice to do so cannot be left to each individual. An effective implementation is probably only possible if professionals in charge on a local, or even national level, direct this change.

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