

A modified abdominal incision reduces dissection. Complete abdominal entry by stretching the full thickness of the abdominal wall transversely to the full size of the skin incision using 1 or 2 fingers of each hand.

A self-retaining retractor facilitates delivery of the fetal head by creating a rigid border around the abdominal incision.

Minimally invasive cesarean

Improving an innovative technique

Short operative time, less surgical dissection, and reduced risk of infection are among the advantages of this newly updated procedure.

Is the extensive dissection of the Pfannenstiel incision necessary in cesarean delivery? Is bladder dissection essential? Must the visceral and parietal peritoneum be closed?

The success of our minimally invasive cesarean technique suggests the answer is “no.”

The approach described here features a short operative time; minimal instrumentation; reduced surgical dissection; decreased postoperative pain; and reduced risk of blood loss, infection, and wound complications. It is easily learned and cost-effective, with a brief postoperative recovery period.

Among the updates made from the tech-

nique’s initial publication in the mid-1990s^{1,2}:

- addition of routine perioperative oxygen (80%), to reduce the risk of surgical wound infection (see “Perioperative considerations,” page 61)
- regular use of forced warm air covers applied to the anterior skin surface, to help patients maintain normothermia
- addition of a soft, self-retaining abdominal retractor—which creates an atraumatic circle of exposure up to a calculated 177 cm² for a 15-cm incision (versus 113 cm² calculated for traditional retraction)
- vertical, rather than lateral, digital exten-

sion of the initial transverse uterine incision

- identification of a subgroup in whom peritoneal closure is strongly recommended
- new data on the procedure's effectiveness.³

Modified abdominal incision reduces dissection

Make a straight low transverse incision with a scalpel, at a point approximately 3 to 4 cm above the symphysis pubis (FIGURE 1A).

The length of the incision is individualized (13 to 15 cm), though difficult fetal extraction is more likely if the abdominal incision is less than 15 cm.^{4,5}

Divide the subcutaneous tissue transversely with an electrocautery knife. In a cutting and coagulation blend mode, the knife divides the fat while achieving hemostasis. To improve hemostasis, coagulate the blood vessels that cross the subcutaneous fat layer in a brushing manner before dividing them. To prevent unnecessary dead space, avoid filleting the fat and separating adherent subcutaneous fat from the anterior rectus fascia beyond what is needed to expose the fascia.

Open the fascia transversely with the electrocautery knife to the same length as the skin incision. Coagulate the blood vessels that cross the fascia before dividing them. Identify the median raphe by pulling up the superior edge of the abdominal incision.

Separate the rectus muscles in the midline by vertical blunt finger dissection (FIGURE 1B). If digital dissection is inefficient due to a dense, thick, or scarred median raphe, use an electrocautery knife, a scalpel, or scissors.

Open the peritoneum. This is facilitated by upward traction and elevation of the superior edge of the abdominal incision that lifts the peritoneum, allowing easy digital perforation using the index or middle finger (FIGURE 1C).

If this maneuver is not feasible, open the peritoneum in the traditional fashion.

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Stretch the full thickness of the abdominal wall to full size of the skin incision, using 1 or 2 fingers of each hand (FIGURE 1D). Incorporate the skin, subcutaneous tissue, fascia layer, rectus muscles, and peritoneum. An assistant's hands may be required. When needed, extend the peritoneal opening transversely on either side, to the midline and away from the bladder.

Digitally stretching the full-thickness abdominal incision is easily achieved due to the mechanical stretching of the anterior abdominal wall, edema, and increased vascularization that occur during pregnancy.

Retractor facilitates exposure

Our positive experience with the soft, self-retaining abdominal retractor for minilaparotomy and laparotomy⁶⁻⁸ compelled us to incorporate its use for cesarean 3 years ago.

The device consists of a flexible plastic inner ring and a firmer outer ring connected by a soft plastic sleeve. We use the large size of either of the 2 models currently available: the Mobius (*Apple Medical Corporation, Marlboro, Miss*) and the Protractor (*Weck Closure Systems, Research Triangle Park, NC*).

Introduce a hand through the laparotomy incision and evaluate the pelvis to ensure that no significant adhesions are present that may interfere with swift placement of the inner ring. If significant adhesions are found, use traditional metal retractors instead.

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KEY POINTS

- A simplified abdominal incision makes the traditional extensive dissection associated with the Pfannenstiel incision unnecessary.
- A soft, self-retaining abdominal retractor offers increased exposure, atraumatic retraction, incision protection, and adjustable height while facilitating delivery of the fetal head by creating a rigid border around the abdominal incision.
- Bladder-flap omission has been associated with reduced operative time and incision-delivery interval, decreased blood loss, and less need for postoperative analgesics.

FIGURE 1

Create a modified abdominal incision



A. After making a straight low transverse incision with a scalpel, divide the subcutaneous tissue transversely with an electrocautery knife. Open the fascia transversely with the electrocautery knife to the same length as the skin incision.



B. Separate the rectus muscles in the midline by vertical blunt finger dissection.



C. Open the peritoneum by finger perforation.



D. Stretch the full thickness of the abdominal wall to full size of the skin incision. Include the skin, subcutaneous tissue, fascia layer, rectus muscles, and peritoneum.

Squeeze the inner ring and insert it into the abdominal cavity toward the patient's head, allowing the device to spring open against the parietal peritoneum (FIGURE 2A). Apply upper traction and elevate the superior edge of the abdominal incision to facilitate placement. Perform a digital check to ensure no tissue is trapped between the inner ring and the abdominal wall.

Hold up the outer ring, then roll the plastic sleeve until the ring completely inverts (FIGURE 2B). Repeat the process until the top ring is snug against the patient's skin.

Advantages of the soft, self-retaining abdominal retractor include atraumatic retraction; incision protection; and adjustable height, making it ideal for obese patients.

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Perioperative considerations

Routinely use prophylactic antibiotics. Several recent studies have concluded that perioperative antibiotics reduce the incidence of endometritis and wound infection following elective and nonelective cesarean section.³⁷ Administer ampicillin or a first-generation cephalosporin at umbilical cord clamping. For patients allergic to penicillin and cephalosporins, choose an alternative, such as clindamycin.

Give antacids 30 minutes before anesthesia (general or regional) to prevent pneumonitis from inhalation of gastric contents.

Clip pubic hair, rather than shave, to reduce the risk of wound infection.

Insert a Foley catheter, empty the bladder, and keep the catheter in place.

Position the patient in a 10° left lateral tilt, to avoid hypotension associated with aortocaval occlusion.

Routinely administer supplemental perioperative oxygen (80%), with either general or regional

anesthesia; this activates alveolar immune defenses and halves the risk of surgical wound infections.

Neutrophil oxidative killing and phagocytosis—the most important defenses against surgical pathogens—depend on the partial pressure of oxygen in contaminated tissue. Giving supplemental oxygen during and for the first 2 hours after the procedure (by mask) is a practical, inexpensive way to reduce the incidence of surgical wound infection.^{38,39}

Using 80% oxygen during and, for a short period, after surgery does not cause pulmonary toxicity such as atelectasis or impaired pulmonary function.⁴⁰

Ensure normal body heat during and after cesarean to reduce the risk of postoperative surgical infection.^{40,41} Forced warm air covers applied to the anterior skin surface are the most effective way for warming surgical patients.⁹ IV fluid warming, though appropriate when large volumes are to be administered, is unnecessary for smaller operations.⁴¹

Transverse hysterotomy in lower uterine segment

Make a transverse 2-cm uterine incision with a scalpel, approximately 1 cm above the vesicouterine peritoneal fold (identify this using gentle digital pressure to elevate the uterus) (FIGURE 3A).

■ **Traditional bladder dissection is eliminated.** We have found that when an adequate transverse hysterotomy is performed, a bladder flap is not required.¹⁻³ In a recent randomized trial, Hohlagschwandtner et al⁹ confirmed our findings that bladder-flap omission was associated with reduced operative time and incision-delivery interval, decreased blood loss, and less need for postoperative analgesics.

An additional advantage of this omission: We can avoid making the uterine incision too low—especially when the cervix is fully dilated. Further, making the hysterotomy (uterine serosa and myometrium together) slightly above the vesicouterine peritoneal

fold without bladder flap dissection frees the loose connective tissue between the uterus and the urinary bladder, allowing the spontaneous descent of the bladder.

Digitally extend the transverse uterine incision. We extend the initial incision not laterally but, instead, vertically (FIGURE 3B). The vertical digital traction on the initial transverse uterine incision creates a transverse dissociation of the horizontal myometrium fibers; this results in a transverse extension of the original incision.

This modification prevents unintended and uncontrolled lateral extensions of the incision that may lacerate the uterine vessels.¹⁰ It also prevents the uterine incision from becoming an inverted “U” and the undesirable accumulation of myometrium fibers at the ends of the incision. Such incisions usually do not reapproximate well during hysterotomy closure and may lead to sacculum-type defects.¹¹

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FIGURE 2

Place the abdominal retractor



A. While applying upper traction and elevating the superior edge of the abdominal incision, squeeze the inner ring and insert it into the abdominal cavity toward the patient's head, allowing the device to spring open against the parietal peritoneum.



B. Hold up the outer ring, then roll it into the plastic sleeve until the ring completely inverts. Repeat until the top ring is snug against the patient's skin.

Delivering the fetus

For vertex presentations, place your hand into the uterine cavity between the lower edge of the hysterotomy and fetal head. While applying transabdominal fundal pressure, lift the head with your fingers and deliver it through the incision (FIGURE 4A).

The self-retaining retractor facilitates delivery of the fetal head by creating a rigid border around the abdominal incision. The back of the surgeon's hand that is in the uterine cavity achieves better leverage, as it now rests on a rigid plane on the inferior part of the incision rather than on the back hand and the softer and pliable wound edge of the standard abdominal incision.

▪ **Vacuum-assistance.** When delivery of the fetal head proves difficult, we use the soft vacuum cup, which avoids unnecessary intrauterine manipulation that may result in fetal or maternal trauma (FIGURE 4B).¹²

Breech extraction or transverse lie delivery is performed using standard extraction maneuvers (FIGURE 4C).¹³ We have found

no need to perform T or J vertical extensions of the low transverse uterine incision, even in cases of a poorly developed lower uterine segment, abnormal presentation, or prematurity.

Uterine incision:

1-layer, in situ close

Remove the placenta only after it separates spontaneously—this greatly reduces blood loss compared with immediate manual placental delivery or umbilical-cord traction. Manually deliver the placenta only if it has not separated spontaneously after 5 minutes. Avoid routine manual clean-out of the uterine cavity if the placenta is completely delivered.^{1-3,14}

Dilate the cervix to facilitate lochial discharge, when necessary.

Decrease uterine bleeding by massaging the uterus and administering diluted oxytocin.

Close the uterine incision in situ. Disadvantages of routine uterine exteriorization include discomfort and vomiting resulting from traction, exposure of the fallopian tubes to unnecessary trauma, increased risk

FIGURE 3**Use a standard hysterotomy in the lower uterine segment**

A. Make a transverse 2-cm uterine incision with a scalpel, approximately 1 cm above the vesicouterine peritoneal fold, omitting bladder-flap creation.



B. Digitally extend the incision vertically.

of infection, possible rupture of the utero-ovarian veins, and pulmonary embolism.

Exteriorization may also increase the risk of adhesion formation by exposing the uterine serosa to the abrasive effects of drying or microscopic abrasion if sponges are used to hold the uterus in place.^{1,14-17}

Use a single-layer closure with a running suture of polyglycolic acid to close the uterine incision (FIGURE 5A). If needed, use atraumatic clamps to grasp the edges of the hysterotomy to facilitate visualization and closure.

Begin suturing at a point just beyond one end of the incision, continuing to the opposite side. Be sure to penetrate the full thickness of the myometrium and avoid incorporating the decidua in the suture line. After the uterine closure, use individual figure-of-8 sutures to control areas of persistent bleeding.

Compared with 2-layer closures, single-layer closure of a low transverse incision is associated with reduced operating time, improved hemostasis, and less tissue disruption; introduces less foreign material into the surgical site; reduces the need for postoperative analgesia; and potentially reduces infectious

morbidity. A trial of labor after a cesarean section with 1-layer closure appears safe.¹⁸⁻²²

We do not close the vesicouterine fold and parietal peritoneum (FIGURE 5B) or reapproximate the rectus muscles. It has been shown that a new peritoneal layer is formed within days of the original incision closure.

Leaving the peritoneum open leads to no increased postoperative complications, nor obvious differences in wound healing, wound dehiscence, or incidence of postoperative adhesions. Compared to women without peritoneal closure, those with peritoneal closure require a longer operative time, greater amounts of postoperative narcotics for postoperative pain, a greater need for bowel stimulants, and a longer postoperative hospitalization.²³

In 1995, we performed laparoscopy for gynecologic conditions in 23 patients and repeat cesarean in 10 patients who had undergone our technique (with visceral and parietal peritoneum left open).² We found no adhesions and a normal peritoneal lining in all cases.

■ **In 1 subgroup, peritoneal closure is strongly recommended:** cases in which 1 or both rectus muscles have been transected to

FIGURE 4

Deliver the fetal head



A. Deliver the fetal head in the standard fashion. The self-retaining retractor facilitates delivery of the fetal head by creating a rigid border around the abdominal incision.



B. When head extraction proves difficult, a soft vacuum cup may be used.



C. Breech extraction is performed using standard extraction maneuvers.

increase surgical exposure. Extremely thick fibromuscular adhesions between the low anterior surface of the uterus and the under-surface of the rectus musculature may develop if the parietal peritoneum is not closed.

Abdominal closure

Close the rectus fascia with a continuous nonlocking 0 suture after the rectus muscles fall into place. Place entry and exit sites at 1-cm intervals, 1.5 cm beyond the wound edges—this minimizes the risk of sutures pulling through fascia. Interrupted sutures offer no greater tensile strength than continuous suturing.²⁴ Tight, continuous suturing can lead to tissue ischemia, which may weaken the sutured fascia, and thus should be avoided.

The subcutaneous layer is not closed separately. One exception is obese patients with at least 2 cm of thick subcutaneous tissue. Thickness of subcutaneous tissue appears to be a significant risk factor for wound infection after cesarean section.²⁵

In patients with thick subcutaneous tissue, you can reduce tension on the skin edges and the risk of subcutaneous infection, seroma formation, and wound disruption by placing interrupted 3-0 absorbable synthetic sutures to eliminate dead space.²⁶⁻²⁸ We have found no need to place Penrose drains or closed drainage systems in the subcutaneous layer.²⁹⁻³¹

Close the skin using a subcuticular continuous absorbable 4-0 suture or, alternatively, metal staples, which are removed 4 days after surgery (FIGURE 5C).

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Prompt postoperative recovery

The patient may drink fluids in the recovery room, can resume a regular solid food diet within 4 hours after surgery, and may resume mobility as soon as anesthesia wears off.

Early breast-feeding is also allowed in the recovery room. In our experience, this has not been associated with complications, has been highly appreciated by the patients, and has led to earlier hospital discharge.

Control pain with meperidine (50–75 mg) or morphine (10 mg) parenterally every 3 to 4 hours. Other options include oxycodone and acetaminophen, oxycodone and aspirin, and ibuprofen.

Patients are usually discharged 48 to 72 hours following surgery.

Our experience:

The numbers

Using this updated system, we have successfully completed 300 consecutive cesarean sections (210 primary, 90 repeat).

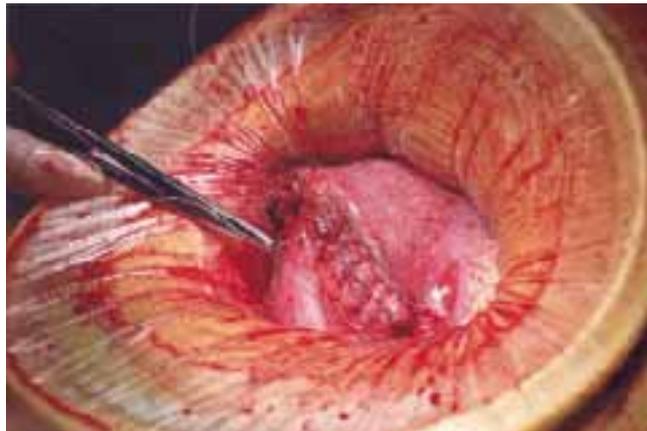
The average operating time was 19 minutes; average blood loss, 405 mL.

There was no postoperative febrile morbidity, wound infection, wound disruption, or wound hematoma. Only 3 patients developed superficial wound seromas, which were easily resolved. There were no intraoperative or postoperative complications.

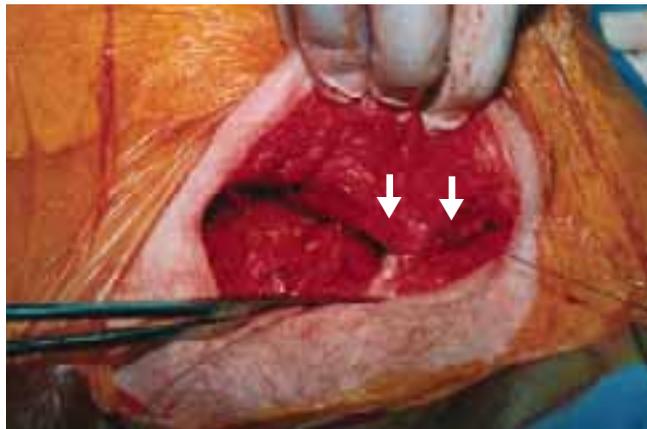
We attribute the absence of wound infection to routine prophylactic antibiotics; supplemental perioperative oxygen; maintenance of normothermia; use of an electrocautery knife to create rapid hemo-

FIGURE 5

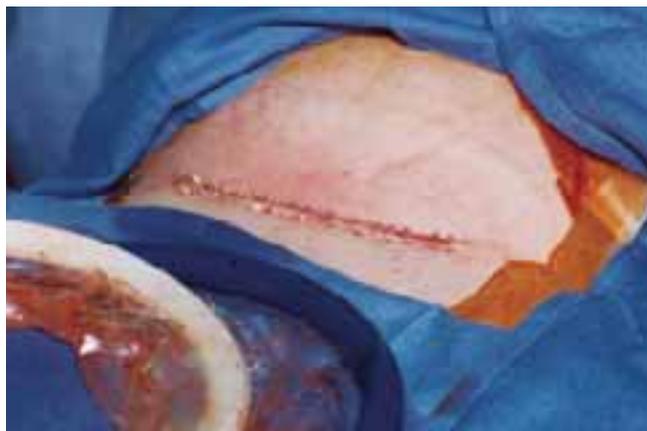
Close the incisions



A. Repair the hysterothorax in situ in a single layer, using figure-of-8 sutures as needed to control areas of persistent bleeding.



B. Close the rectus fascia in a continuous, nonlocking fashion with delayed-absorbable sutures placed at least 1 cm from the fascial wound edge (arrows). The visceral and parietal peritoneum are not closed, nor are the rectus muscles reapproximated.



C. Close the skin with metal staples (pictured) or subcuticular sutures.

■ Minimally invasive cesarean: Improving an innovative technique

static division of subcutaneous fat and anterior rectus fascia; a simplified abdominal wall opening; and placement of a self-retaining atraumatic retractor.^{10,32-36}

Additional surgical procedures (tubal sterilization, myomectomy, appendectomy, and adhesiolysis) did not alter the recovery period, and all patients were able to get out of bed, shower, breast-feed, and care for their infants within 8 hours of surgery.

No infant complications related to the cesarean procedure occurred.

Patients were discharged from the hospital within 72 hours.

A prospective comparison study demonstrated that the original Pelosi-type of cesarean delivery was faster to perform, more cost-effective, and resulted in less maternal morbidity than the traditional cesarean technique.³ ■

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