

Single Versus Double Layer Uterine Closure Technique According to Development of Uterine Niche: A Literature Review

Mochammad Haikal Alhamdi¹, Ahmad Fawzy², Rudi Margono³, R. Alif Kuncorojati⁴

^{1,2,3,4}Margono Soekarjo County Hospital – Faculty of Medicine University of Jenderal Soedirman, Indonesia

ABSTRACT

Prevalence of cesarean deliveries increases globally. The prevalence of cesarean births increased from 5% in 1970 to 31.9% in 2016. There are short term and long-term complications of cesarean delivery including uterine niche. After a cesarean, the uterus is closed using a variety of methods, such as single- and double-layer closures with/without locking. This study compared single-layer and double-layer uterine closure with regard to the outcomes and complications. This review was synthesized and obtained from various online databases. Scientific articles were selected based on the inclusion criteria. The result showed that cesarean deliveries is a hysterotomy and an open abdominal incision (laparotomy) to deliver the fetus. An iatrogenic pouch-like defect known as a uterine niche result from improper tissue repair at the site of a prior cesarean scar. Up to 70% of women who have had a prior cesarean section experience uterine niche, of which 30% have symptoms. Compared to a single full-thickness closure, a single-layer, decidua sparing closure approach is more likely to result in an incomplete closure. No differences were discovered between the single- and double-layer closure techniques with locked first layers, but double-layer closures without locking resulted in thicker residual myometrium thickness when compared with locked single-layer closures. It is also possible that the locked suture can strangulate the scar tissue leading to poorer healing. Current evidence shows that no significant difference between single-layer and double-layer uterine closure techniques following in terms of uterine niche development.

KEYWORDS: Cesarean Delivery, Uterine Niche, Single-layer, Double-layer, Uterine Closure

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INTRODUCTION

A rising number of women are suffering from associated issues as the prevalence of cesarean deliveries (CD) increases globally.¹ While bleeding and infection are among the procedure's short-term side effects, there are also significant long-term complications such as placenta adhesion abnormalities, CD scar malformations, uterine rupture, dehiscence, and pregnancies with cesarean delivery scars.^{2,3}

On the optimum uterine closure method for avoiding cesarean scar deformities, there is no universal agreement. The most crucial elements impacting the integrity of the incision are known to be the surgical suture technique and mechanical forces affecting the surgical scar.⁴ After a cesarean, the uterus is closed using a variety of methods, such as single- and double-layer closures with/without locking, going through or omitting the decidua.

Iatrogenic consequences from cesareans are increasing along with the prevalence of the procedure. These include placenta accreta, scar ectopic pregnancy, and the uterine niche, a more modern phenomenon that has just recently been documented in the literature. The uterine niche, also known as uterine isthmocele, cesarean scar defect, and diverticulum, is an iatrogenic defect in the myometrium at the location of a prior cesarean scar caused by poor tissue recovery. By employing the proper surgical technique during a cesarean, niche formation may be avoided.^{5,6}

The uterine closure method is the major emphasis of this article, particularly for reducing the risk of uterine niche. Furthermore, these methods include parameters that may be changed, and several recent research have tried to establish a benchmark.⁷ But there's no such benchmarks. As a result, there is currently no agreement on which specific uterine closure method reduces the risk of uterine rupture and/or scar

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tissue abnormalities following cesarean birth the most effectively. In order to better understand the impact of single-layer (SL) and double-layer (DL) uterine closure on recess formation and residual myometrial thickness at 6–9 months after CD, this study looked at both techniques.

METHOD

This literature review description was synthesized and obtained from various online databases such as NCBI, Google Scholar, Science Direct, Elsevier, Springer Nature, Wiley Online Library, World Health Organization. The keywords used in the literature searching were Cesarean Section Technique, Single Layer Uterine Closure, Double

Layer Uterine Closure, Uterine Niche, and Wound Healing after Cesarean Section. Scientific articles were selected based on the following inclusion criteria: (1) RCTs that compared SL versus DL uterine closure techniques after CD, (2) The journal can be freely accessed, (3) Publication year of journal is not less than 2013, and (4) Matched with the material discussed in this literature review. All selected literature is analyzed and the material is combined into a logical flow of ideas.

RESULT

There are 9 studies that considered eligible for inclusion criteria in the **Table 1**.

Table 1. Summary of the included studies

ID	Country	Sample Size	Follow-Up	Outcomes
Stegwee, 2020 ⁶	Netherlands	2290	9 M	Niche presence was significantly lower among women who received single-layer closures
Bamberg, 2018 ⁸	New York	435	6-24 M	DL Closure is associated with a thicker myometrium scar only in primary or elective CD patients
Bennich, 2016 ⁹	Denmark	76	5 M	Unlocked DL doesn't increase RMT compared with SL
Hanacek, 2019 ¹⁰	Czech Republic	540	12 M	Unlocked DL followed by second unlocked suture is associated with better suture healing and greater RMT
Kalem, 2019 ¹¹	Turkey	138	-	Uterine closure using the FFNN technique is beneficial in terms of providing protection from isthmocele formation and ensuring sufficient RMT
Khamees, 2018 ¹²	Egypt	80	-	Unlocked DL was associated with higher RMT than locked SL and better uterine scar healing.
Roberge, 2016 ¹³	Canada	54	6-12 M	DL with unlocked first layer is associated with better uterine scar healing than locked SL
Sevket, 2014 ¹⁴	Turkey	36	6 M	DL locked/unlocked of the uterine incision at CD decreases the risk of poor uterine scar healing
El-Gharib, 2013 ¹⁵	Nepal	50	6 W	No significant differences in scar thickness between SL and DL
Yilmaz, 2021 ¹⁶	Turkey	282	6-9 M	SL or DL doesn't produce different impacts on uterine niche scar development

DISCUSSION

Cesarean Section

Introduction

A cesarean section is a hysterotomy and an open abdominal incision (laparotomy to deliver the fetus. The prevalence of cesarean births increased from 5% in 1970 to 31.9% in 2016.¹⁷ Despite ongoing attempts to lower the number of cesarean sections, researchers do not foresee a noticeable decrease for at least ten or twenty years.¹⁸

The uterus is made up of three layers: the perimetrium, the myometrium, and the endometrium, which is the mucosal layer on the inside. To create the uterine incision, also known as a hysterotomy, all three of these layers are cut. Care must be taken to avoid damaging these blood vessels when the uterine incision is made or extended.¹⁹

Indication

A. Maternal Indications for CD^{20,21}

Prior cesarean delivery, maternal request, pelvic deformity or cephalopelvic disproportion, previous perineal trauma, prior pelvic or anal/rectal reconstructive surgery, herpes simplex or HIV infection, cardiac or pulmonary disease, cerebral aneurysm or arteriovenous malformation, pathology requiring concurrent intraabdominal surgery, perimortem cesarean.

B. Uterine/Anatomic Indications for CD^{20,21}

Abnormal placentation (such as placenta previa, placenta accreta), placental abruption, prior classical hysterotomy, prior full-thickness myomectomy, history of uterine incision, dehiscence, invasive cervical cancer, prior

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trachelectomy, genital tract obstructive mass, permanent cerclage

C. Fetal Indications for CD^{20,21}

Nonreassuring fetal status (such as abnormal umbilical cord doppler study) or abnormal fetal heart tracing, umbilical cord prolaps, failed operative vaginal delivery, malpresentation, macrosomia, congenital anomaly, thrombocytopenia, prior neonatal birth trauma

Contraindication

There is no contraindication of the cesarean section medically. Cesarean section can be an option if either the pregnant woman or the fetus is dead or dying. While there are ideal circumstances for cesarean delivery, such as having access to anesthetic, antibiotics, and the right tools, their absence is not a contraindication if the clinical situation calls for it. A cesarean is ethically forbidden if the expectant patient objects. For informed consent, adequate education and counseling are essential. However, patient's autonomy is her right if the pregnant woman refuses to have surgery performed on her body.²²

Technique

It takes a lot of skill to perform a cesarean section. For wound healing and a reduction in ensuing adhesion development, proper tissue handling, appropriate hemostasis, avoiding tissue ischemia, and infection prevention are necessary. There are a number of surgical procedures that may be used at each phase or tissue layer. There are several factors that can influence the choice of surgical procedure and it should be based on evidence as with any other area of medical practice. Pfannenstiel-Kerr method, Joel-Cohen method, Misgav-Ladach method, and Modified Misgav-Ladach method is kind of cesarean delivery techniques.²²

Study on hysterotomy closure in one or two layers shows that short-term results including discomfort, blood transfusion, infectious morbidity, and hospital readmission did not differ between the two methods.²³ Whether a single-layer closure reduces operating time and blood loss is the subject of conflicting data. There is evidence that using a two-layer closure improves residual myometrial thickness, scar healing, and uterine rupture in subsequent pregnancies for women who want to try labor in the future. A locked closure approach might not always be preferred to an unlocked one.²⁴

Complications

The maternal mortality rate in the USA is approximately 2.2 per 100000 cesarean deliveries. Though this is overall low, it is significantly greater than for vaginal delivery. The maternal mortality for a vaginal birth is approximately 0.2 per 100000.^{25,26}

UTERINE NICHE

Introduction

An iatrogenic pouch-like defect known as a uterine niche result from improper tissue repair at the site of a prior cesarean scar. Other words include diverticulum, uterine

dehiscence, uterine isthmocele, and cesarean scar defect. Radiologically, the niche is described as a triangular, anechoic, or hypoechoic region at the scar site. Additionally, it also known as myometrial indentations that are at least 2 mm deep.²⁷

Up to 70% of women who have had a prior cesarean section experience uterine niche, of which 30% have symptoms.²⁸ Prevalence rates of uterine niche that has been reported are 24-70% with transvaginal sonography (TVS) and 56-84% with gel/saline instillation sonohysterography (SHG).^{29,30}

Potential Risk Factors

Niche forms due to poor healing of cesarean scar. Risk factors may be surgery related or patient related.³¹

A. Factors Affecting Lower Uterine Segment

Cervical dilatation of > 5 cm, > 5 h duration of labour and advanced fetal station predisposes to large niche due to thinner or lesser vascularized myometrium resulting in inadequate healing.³¹

B. Level of Uterine Incision

Poor healing occurs as a result of lower uterine incisions that are made closer to the cervix because mucus released by the cervical glands prevents myometrial approximation. Mucus also gradually enlarges the niche. The degree of uterine incision is affected by the Cesarean performed in an advanced labor after cervical effacement and the development of uterovesical fold of peritoneum.³¹

C. Uterine Closure Techniques

Compared to a single full-thickness closure, a single-layer, decidua sparing closure approach is more likely to result in an incomplete closure. Nearly 95% of patients with niches had single-layer closure without peritoneum closure. Solid myometrial scar that is properly anatomically approximated without tissue strangling reduces danger of niches. If the muscle edges are thick, the deeper portion should be included in the first layer and the remaining superficial cut edges should be included in the second layer to best imitate them.³¹

A poorly healed scar predisposes to niche development due to non-perpendicular sutures causing an uneven myometrium closure, locking sutures, or a second layer that is too tight. Therefore, the ideal closure method—double-layer uterine closure with non-locking sutures—leads to thicker remaining myometrium and, consequently, potentially decreased risk of infection.³¹

D. Adhesions

Adhesion formation with abdominal wall pulls the uterine scar towards abdominal wall, exerting counteracting force opposite to the direction of retracting uterine scar tissue and causing impaired wound healing.³¹

E. Retroflexed Uterus

Effect of gravity on uterine corpus also increases counteracting forces. Large niches are mostly found with retroflexed uterus.³¹

F. Patient Factors

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Genetic predisposition contributes to impaired healing, poor haemostasis, inflammation, or adhesion formation, post-operative infection. Gestational diabetes (odds ratio, 1.73), previous cesarean (OR, 3.14) and advanced body mass index (OR, 1.06) are independent risk factors.³¹

DIAGNOSIS

Using TVS (**Figure 1**), SHG, 3-D ultrasound, magnetic resonance imaging, or hysteroscopy, niche can be seen in a non-pregnant condition. Additionally, hysterosalpingography can identify a niche. The diagnosis is made when there is an anechoic void in the myometrium at the location of the cesarean scar that is at least 1 mm deep (vertical distance between base and apex), with or without fluid, and at least 2 mm deep. Although there is not yet agreement on diagnostic standards, the following characteristics have been reported:^{4,23,28,32}

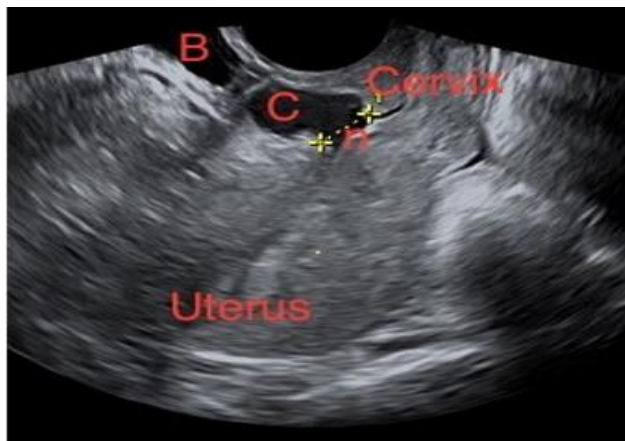


Figure 1. TVS showing uterus, cervix, niche (n) measuring 1 cm, collection in the niche (C) and bladder (B)

A. Niche Size and Residual Myometrium

The vertical distance between the uterine serosa and the defect's apex is known as residual myometrial thickness (RMT). RMT is characterized as being more than 50% of the neighboring myometrium, 2.2 millimeters on TVS, or 2.5 millimeters on SHG. A 3 mm cut-off has been established; a 3 mm RMT is a modest fault. A complete defect is described as lacking any remaining myometrium.³³

B. Niche Shape

Most defects are triangular or semicircular, though round, oval, droplet shape and inclusion cysts are also described. A niche can also be seen as an inward protrusion, i.e internal scar surface bulging toward uterine cavity, outward protrusion, i.e external scar surface bulging toward bladder or peritoneal cavity or inward retraction, i.e external scar surface dimpled toward the myometrium.

C. Other Niche Features

Other niche characteristics including concavity, aberrant vascularity, visible serosa, and cyst- or polyp-like structure.

MANAGEMENT

Indications of treatment: Treatment is indicated only in symptomatic women presenting with secondary infertility, previous scar ectopic, recurrent miscarriage, AUB and bothersome post-menstrual spotting. However, efficacy of treatment is yet to be ascertained.

Treatment options for a uterine niche are as follows:

A. Medical Treatment

Hormonal therapy symptomatically relieves AUB. Oral contraceptives are suitable if pregnancy is not desired. LNG-IUS was not found to decrease menstrual length.³³

B. Uterine Sparing Surgical Treatment

Conservative surgical interventions should be considered after eliminating other causes of presenting symptoms. The options include either resection by hysteroscopic route or excision plus repair by transabdominal (laparotomy, laparoscopic, robotic) or vaginal route.³³

C. Hysterectomy

Hysterectomy offers definitive treatment for niche-related gynaecological symptoms.

Prevention

The basis in preventing uterine niches will continue to be efforts to reduce the rate of cesarean sections and secondary preventative methods that ensure thicker residual myometrium and a robust scar. According to research involving 138 women, utilizing the far-far-near-near double-layer unlocking approach to close the uterus may help prevent isthmocele development and ensure that there is enough leftover myometrium.³³

SINGLE VERSUS DOUBLE LAYER UTERINE CLOSURE AS A PREVENTION OF UTERINE NICHE

A recent multicentric study by Stegwee *et al.* placed 2290 women into single- and double-layer closure groups. Symptoms were then assessed at the third month by transvaginal ultrasonography/saline infusion sonohysterography, and surveys were conducted to provide long-term data. Single-layer closures were made without locking and without regard to crossing the decidua, and double-layer closures were made by passing through the endometrium, without locking in the first layer, and continuously without locking in the second layer. Preliminary results showed that niche presence was significantly lower among women who received single-layer closures.⁶

No significant intergroup differences were found in niche development or residual myometrium thickness in Bamberg *et al.*'s study, which randomly divided participants into three groups (single-layer closure of the uterus without locking, single-layer closure with locking, and double-layer closure), but a trend was found that thicker residual myometrium thickness was produced via double-layer closures.⁸ Bennich *et al.* revealed that Unlocked double layer uterine closure doesn't increase RMT compared with single layer uterine closure.⁹ Randomized investigation by Hanacek

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et al. found greater rates of scar defects in the single-layer closure group; single- and double-layer closure groups exhibited 83.2% and 72.6% scar-defect rates, respectively.¹⁰ In addition, Kalem *et al.* claimed that a double-layer far-far-near-near unlocked approach is superior to a single-layer continuous locked uterine closure in terms of protecting against the development of isthmocele and guaranteeing enough residual myometrium thickness.¹¹ Khamees *et al.* also showed that Unlocked double layer uterine closure was associated with higher RMT than locked single layer uterine closure and better uterine scar healing.¹²

Roberge *et al.* revealed that locked first layer and single-layer closure may be related to a lower residual myometrium thickness. As evidence for these conclusions, a recent randomized study compared the residual myometrium thickness of three different uterine closure techniques (locked single-layer including the decidua, double-layer with locked first layer including the decidua, and double-layer with unlocked first layer excluding the decidua); no differences were discovered between the single- and double-layer closure techniques with locked first layers, but double-layer closures without locking resulted in thicker residual myometrium thickness when compared with locked single-layer closures.¹³ These findings supported a hypothesis in which the locking suture technique was thought to develop ischemic necrosis in tissues as the result of increased pressure. It is also possible that the locked suture can strangulate the scar tissue leading to poorer healing.

Sevket *et al.* revealed that locked/unlocked double layer uterine closure of the uterine incision at caesarean delivery decreases the risk of poor uterine scar healing.¹⁴ In contrast with study carried by Shrestha *et al.*, there is no significant differences in scar thickness between single layer and double layer uterine closure.¹⁵ However, many surgeons prefer sutures with locking because they provide better hemostasis. More pronounced niches were observed in participants with double-layer closures, but these differences were not statistically significant. This may be caused by the combination of second-layer closures with first-layer locking. Specifically, this may have increased tissue stress while disrupting vascularization.¹⁶

Based on specific evaluations in the third postoperative month, Tekiner *et al.* reported no significant changes between single- and double-layer uterine closures. Due to the double-layer group's greater rates of emergency cesarean deliveries, which have a higher propensity for niche development, their study was, however, constrained. It is clear that identical findings were reached since the distribution of emergency cases in this study was similar across groups.³⁴

The most recent research demonstrates that sonohysterography is a more accurate tool than transvaginal ultrasonography for evaluating cesarean birth scar abnormalities.³² In situations where isthmocele was found,

the rate of postmenstrual bleeding was 32.1%, but in cases where it wasn't, the rate was 5.2%. Additionally, compared to other women, those whose isthmocele was identified at least six months following a cesarean delivery had more pronounced postmenstrual bleeding problems.³⁰

CONCLUSION

Current evidence shows that no significant difference between single-layer and double-layer uterine closure techniques following in terms of uterine niche development. However, double-layer uterine closure improves residual myometrial thickness, scar healing, and uterine rupture. Double-layer is associated with thicker residual myometrium thickness and greater healing of scar.

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