

Uterine incision closure: Is it the culprit in the cesarean scar niche and related complications?

Uterine closure technique is emerging as a significant factor in cesarean scar niche formation and its associated long-term complications. The authors recommend an endometrium-free closure technique and a high-volume surgeon for performing the procedure.

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While its etiology remains uncertain, cesarean scar niche (CSN) is well publicized, as are its pathological clinical manifestations. In a future pregnancy, they include cesarean scar pregnancy (CSP), which in turn can lead to placenta accreta spectrum, and possible uterine rupture/dehiscence of a residual thin myometrial layer. CSP refers to the implantation of an early pregnancy on the scar or in the niche at the site of a prior cesarean delivery (CD); it has an incidence of 1 per 1,000 pregnancies. An estimated 52% of CSPs occur after even just one CD.¹ CSP has been linked to placenta accreta spectrum and has been shown to be its precursor.² Both CSP and placenta accreta spectrum can be consequences of CD and share a common

histology of villous or placental attachment/invasion into the cesarean scar.³ The incidence of placenta accreta spectrum has risen from about 1 in 4,000 live births in the 1970s to 1 in 2,500 in the 1980s; in 2016, the incidence of placenta accreta spectrum was reported as 1 per 272 live births.⁴

Placenta accreta spectrum denotes the attachment of the placenta into and through the myometrium,⁵ and it can result in severe complications, including hemorrhage, hysterectomy, and intensive care treatment. The increasing rate of placenta accreta spectrum parallels the increasing CD rate, which rose from 5.8% in 1970 to 31.9% in 2016.⁶ Multiple repeat CDs are increasing in frequency as well. At the beginning of the century, placenta accreta spectrum mainly occurred after manual removal of the placenta, uterine curettage, or endometritis. Recently, experts are in agreement that the main determinant of placenta accreta spectrum is the uterine scar and niche formation after a previous CD.⁵ Larger niches are associated with an increased incidence of uterine rupture or dehiscence in a subsequent pregnancy.⁷

In the nonpregnant state, such niches are associated with intermenstrual bleeding, pelvic pain, painful intercourse, painful menses, and subfertility, becoming increasingly more severe in women with greater numbers of

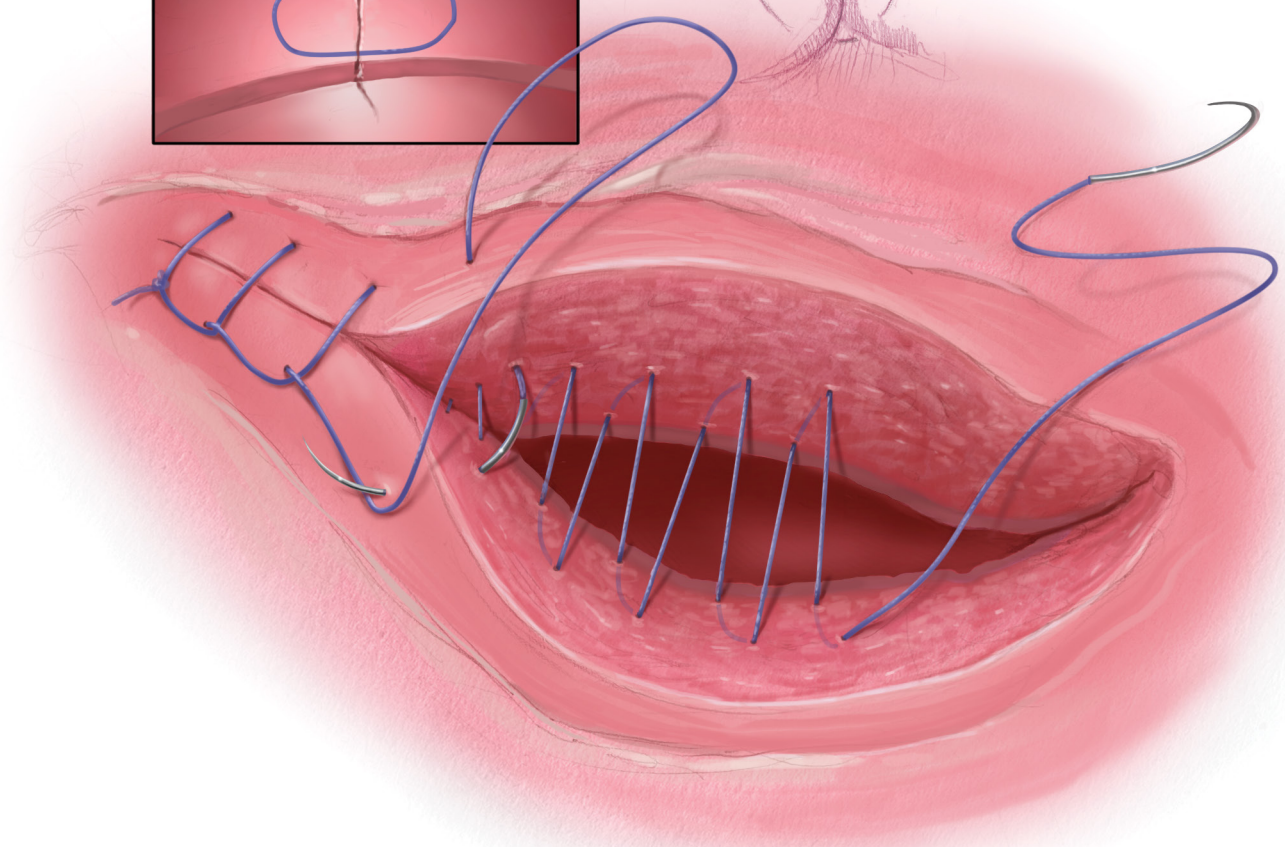
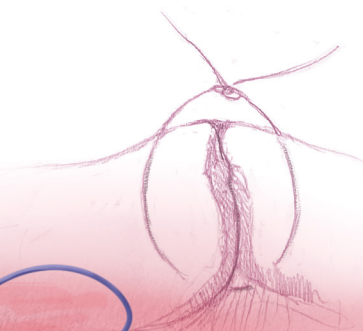
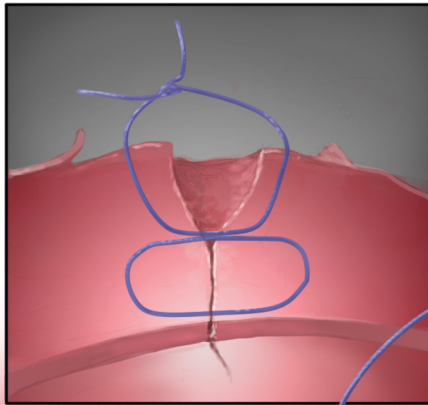
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CDs.⁸⁻¹⁰ Conception rate with assisted reproductive treatment is notably reduced.¹¹

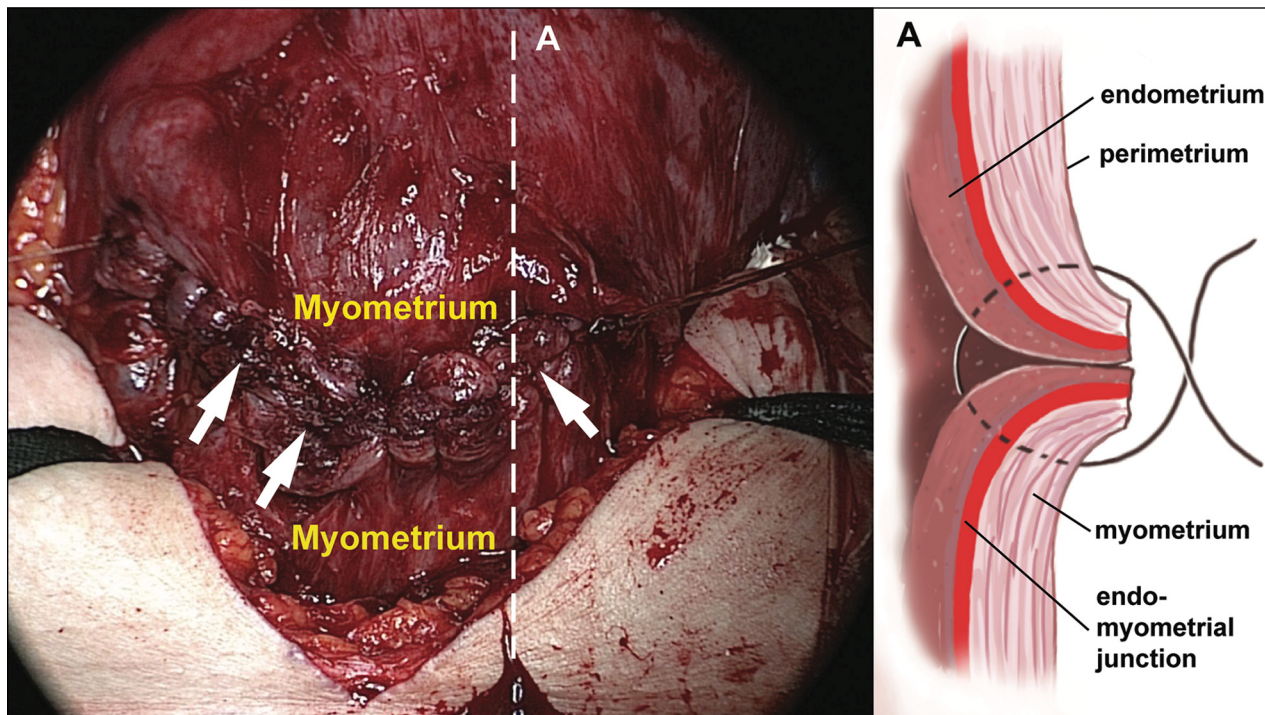
Understanding its etiology

Monteagudo and colleagues first described a “niche” in 100% of 44 women evaluated for postmenopausal bleeding who had a prior CD.¹² CSN has been the subject of well over 3,000 publications over the past 30 years. While the topic generates much interest among researchers, it is garnering little traction among practicing obstetricians. Such “niches,” also referred to as isthmocele, cesarean scar defect, or a diverticulum, was first described in 1961¹³ and later defined on ultrasonography as a hypoechoic triangular-shaped uterine defect outlined by saline

instillation sonohysterogram (SIS), reflecting a discontinuation of the myometrium at the site of a previous CD.¹² In 2019, a European task force further defined a CSN as an “indentation at the site in the cesarean section scar with a depth of at least 2 mm” and extended the classification to include branches as extensions toward the anterior uterine serosa.¹⁴ Using this criterion, sonographic postoperative evaluation after one CD revealed a CSN in 68.9% of women with one single-layer uterine closure and in 73.6% of women after a double-layer closure.¹⁵ Larger niche sizes with thinner residual myometrial thickness appeared more frequently when a single-layer closure technique was used, without closure of the peritoneum. Its prevalence varies from 56% to 84%.^{16,17}

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FIGURE 1 Continuous locked single-layer uterine closure with superficial visible endometrium (white arrows) within the myometrium and illustration of a cross section (dashed line)



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Etiology of CSN formation: Our hypotheses

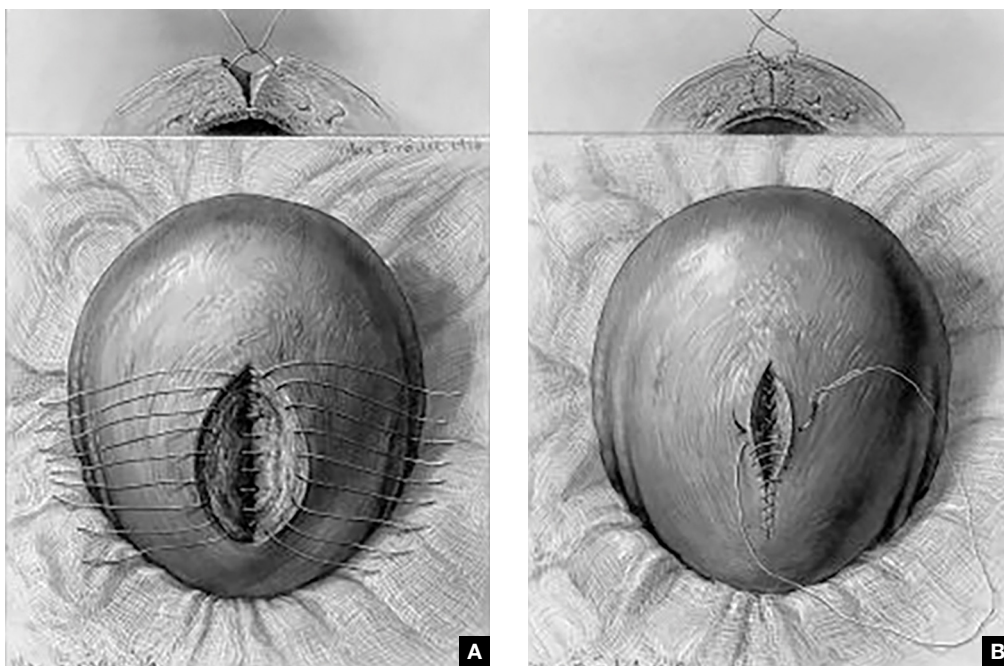
The precise pathophysiology of CSN remains elusive. Speculations attributed niche formation to numerous factors: timing of surgery, cervical incision, incomplete closure of the uterine incision, adhesion formation between the CD scar and the abdominal wall, and inherent maternal conditions which may impair healing, such as smoking, obesity, diabetes, maternal age, and labor status.¹⁸⁻²⁰ Retroflexion of the uterus is reportedly associated with increased incidence and size of the niche, with CSN 50% more likely to develop in women with a retroflexed versus an anteverted uterus.²¹ We demonstrated the origin of niche formation in real-time from the start to the completion of uterine closure by a video capture of a single-layer closure followed by an immediate SIS of the ex vivo hysterectomized uterus, and histopathologic proof of the presence of endometrial

cells defining the “niche.”²² This case exposes the misalignment of the uterine wall, while including the endometrium in the closure (FIGURE 1). Similarly, pathologic studies of hysteroscopy-resected isthmocele ridges of symptomatic women with niche-related subfertility revealed the tissue edges lined by endocervical, endometrial, or isthmic mucosa either combined or isolated in the scar.²³ The presence of endometrial/cervical tissue in the myometrial closure has been debated for over a century.^{24,25}

Uterine closure techniques: Historical perspective

In 1882, Max Sanger introduced a vertical uterine closure of a classical cesarean operation in response to hysterectomy as the contemporaneous alternative to prevent infection, bleeding, and death.²⁴ Dr. Sanger emphasized layer approximation, suturing,

FIGURE 2 Exclusion of the inner uterine layer (decidua) during uterine wall closure following cesarean delivery



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Studies into older uterine closure techniques versus newer ones were inconclusive; our recent study showed that endometrium-free uterine closure was associated with fewer and less severe defects than endometrium inclusion

and the avoidance of decidua in the first layer (FIGURE 2). This became the teaching of the classical CD until the 1970s. In 1926, Munro Kerr addressed uterine rupture with labor after a classical CD by introducing the lower uterine segment transverse incision. He cautioned to maintain the decidua inside the uterine 2-layer closure of the cavity.²⁵ These pioneers were joined by others to rally for endometrium exclusion while promoting layer approximation. These techniques became universally standard and were taught across teaching medical centers in the United States and abroad until about 50 years ago.

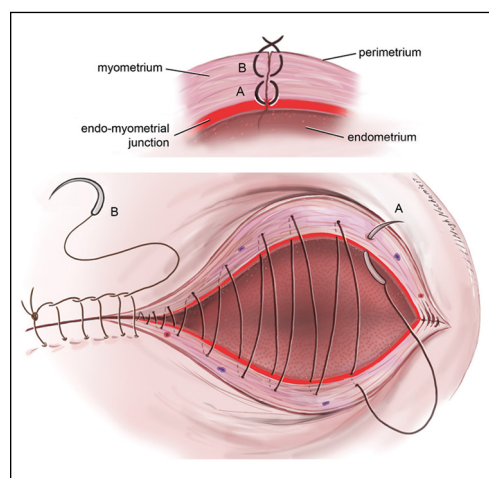
In the 1970s, newer developments brought significant changes to uterine closure techniques. Initiated by Joel-Cohen,²⁶ blunt dissection of the abdominal incision was adapted by Michael Stark, creating what came to be known as the Misgav-Ladach cesarean technique.²⁷ Stark emphasized blunt dissection and introduced single-layer closure. Thereby the exclusion of the

endometrium, used for more than 70 years, was abandoned by the present-day single- or double-layer uterine closure in favor of cost and time savings. Systematic reviews and meta-analyses comparing the two contrasting techniques were inconclusive, noting that the niche prevalence and size were similar in both groups. These studies did not take into account the variety of individual techniques or the position of the endometrium in the final closures.²⁸

Endometrium and uterine closure

Our recent study examining uterine scar defect in women after one primary CD by SIS concluded that a specific endometrium-free closure technique (EFCT) (FIGURE 3) is associated with fewer and less severe defects and a thicker residual myometrial thickness when compared with closures with unknown or endometrium inclusion.²⁹ The study found non-specific closure techniques to be 6 times

FIGURE 3 A cross-section of the closed uterine incision



Courtesy of Clarel Antoine, MD.

more likely to form a niche of 2-mm deep or greater than the EFCT.

Furthermore, we surveyed the diversity of uterine closures and the location of the endometrium among obstetricians in one institution.³⁰ Presence of endometrium on the surface of the final uterine closure was reported by 20% of respondents (see Figure 1). When asked for their opinion on the impact of CD techniques on placenta accreta spectrum, without available evidence 80% of the survey respondents reported no relationship to techniques, and only 20% suggested an association. This particular study demonstrates that the surgical techniques just described are random, unfettered, and applied without consideration of clinical outcomes.

Our recent retrospective study that spanned 30 years and examined the EFCT—performed anywhere between 3 to 9 consecutive CDs—revealed no abnormal placentation in any subsequent pregnancies.³¹ This was one of the few clinical studies of the long-term consequences of a uterine closure technique. In this study, the endometrium was excluded during the uterine closure, allowing its free edges to abut and heal. This step avoids scarring the endometrial-myometrial (EM) interface and unintentional inclu-

sion of endometrium in the closed uterine wall. In this context, Jauniaux and colleagues cited the destruction of the EM interface as the main factor for placenta-adherent disorders.³² Sholapurkar and others highlight the need to further examine intrinsic details of uterine closure beyond single- and double-layer techniques to better understand the etiology of cesarean scar formation.¹⁹ The search for the pathophysiology of CSN continues to present significant challenges imposed by the variety of currently practiced uterine closures.

Research: Focus on prevention

Our research aims to address the endometrium, a specific layer that was the topic of concern in nascent CD techniques, as a renewed and contemporary one. The presence of the endometrium in ectopic locations or its destruction from intrauterine surgeries or infections has been implicated in abnormal placentation.^{13,24} Our approach, in theory, is to limit the position of the endometrium to its innermost location and avoid its iatrogenic suturing and inclusion into the uterine wall closure. The rationale of sparing the endometrium in a layer-by-layer approximation is to allow for a closer restoration to normal anatomy and physiology than a random “en masse” uterine wall closure would permit. For this reason, the EM junction, the perimetrium, and the serosa must be identified and realigned for a more effective closure that incorporates the entire myometrial thickness. As evidence supports technical impact on the development of uterine scar defect in women after one CD, future studies are needed to evaluate uterine integrity by saline infusion sonohysterography in multiparous women with a prior random closure technique or a prior EFCT.

The potential long-term risks of blunt dissection for opening the uterus have not been studied. There are no physiologic lines in the uterine wall to facilitate a regular-bordered uterine stretch. The tissue stretch, which depends on the individual surgeon’s strength applied during the procedure and patient’s

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Many surgeons give an opinion that their CD techniques do not impact placenta accreta spectrum, without supporting evidence

labor status, may result in an irregular tear and a difficult repair. The EFCT technique shows a more optimized risk-benefit ratio for an anatomical repair and is replicable. The safety of uterine layer re-approximation has been demonstrated and can be studied in large populations using strict uniform criteria.

Current and future challenges

Residency training

Most recently, teachers of resident trainees are mostly familiar with blunt dissection, techniques of which are passed on unchallenged from resident to resident. The endometrium and peritoneum are neither identified nor treated as separate layers, thus becoming obsolete as surgical and anatomical landmarks.

Standardization of CD techniques

Front-line obstetricians are persuaded to practice a standardized approach that relies on the benefits of cost related to operating room turnover as well as surgeons' time savings without consideration of outcomes in subsequent pregnancies. Sholapurkar has warned that "wrong standardization" is far worse than no standardization, worse for the training of junior obstetricians, as it can inhibit critical reasoning about safe surgical techniques that can optimize outcomes of the condition of the lower uterine segment.³³

Emergence of cost and time savings in clinical practice

A time-cost savings argument is relatively negligible in an estimated 40-minute CD. By contrast, deliberate surgical technique and carrying out the appropriate steps for the particular condition at hand to achieve the best outcomes assume more weight.³² Furthermore, this short-term cost benefit is challenged by the comparatively larger costs associated with the diagnosis, the treatment of post-CD adverse consequences (outlined above), as well as the emotional impact on women and their families. Additionally, the emphasis on time savings creates a generation of surgeons fixated with total operative time

without consideration of long-term risks and adverse maternal outcomes.

Physician autonomy has led to the unmonitored freedom of obstetricians to choose their own technique for a CD, with some employing the commonly practiced culture of fastest turnaround even in nonurgent circumstances.

Documentation and terminology

Current documenting systems are not detail-oriented enough to assist in a thorough correlation between surgical techniques and outcomes. The use of single- or double-layer closure terminology is insufficient and has proven to be flawed, without describing the handling of the endometrium in terms of its inclusion or exclusion in the closure.

Quality improvement feedback

Long-term post-CD complications are often not reported to the physician or institution involved in the prior CD. In our opinion, some sort of registry would be of value. Perhaps then subsequent CD outcomes could be traced back and reported to the prior institution and surgeon. Feedback is critical to understanding the correlation between techniques and outcomes and more specifically to gathering learning points and using data for quality improvement of future cases.

Patient education

While women continue to have complications following the presently used surgical techniques, they often have expectations not discussed with their obstetricians. Women should be educated and empowered to realize the different approaches to all aspects and consequences of CDs.

Conclusion

The technique of excluding the endometrium in closing the uterine incision appears to reduce subsequent abnormal placentation and diminish the frequency and size of post-CD scar defect. The revival of the endometrium-free closure technique may allow significant change in the postoperative

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Creating a registry that captures long-term post-CD complications that are not typically reported to the physician or institution would be of value

results. Currently, standardization of CD technique is being promoted on the basis of time- and cost-savings rather than clinical outcomes. Simultaneously, inroads are being made to better understand the risks and consequences of CD.

Emerging evidence suggests that a post-CD niche is the result of poor layer approximation as well as inclusion of the endometrium, which prevent healing of the uterine wall and

often enables faulty implantation of the fertilized oocyte in the next pregnancy, potentially giving rise to placenta accreta spectrum. The prevalence and size of the defect can be minimized by techniques aimed at restoring the anatomy of the uterine wall and the physiology of the endometrium. Specialized training and education are necessary to stress the importance of anatomical assessment and decision making at the time of uterine closure. ●

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