**Different Uterine Suturing Techniques Following Cesarean Delivery: A Systematic Review**

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**ARTICLE INFO ABSTRACT**

A Systematic Review

Cesarean delivery is a commonly performed surgical procedure in women worldwide. However, the optimal technique for uterine suturing following cesarean delivery remains a topic of debate. This systematic review aims to evaluate the different uterine suturing techniques and their advantages and disadvantages. The review analyzed nine studies investigating the efficacy and outcomes of different suturing techniques. The review found nine different uterine suturing techniques, including Single-Layer Closure, Double-Layer Closure, Two-Layer Closure with an Interlocking Layer, Inverted-U Closure, Uterosacral Ligament Suspension, Single-Layer Closure with Inverting Lembert or Cushing Stitch, Two-Layer Closure with Separate Suture Materials, Locking Stitch Technique, Continuous Barbed Suture. Each technique has its advantages and disadvantages in terms of ease of use, hemostasis, prevention of scar dehiscence, and postoperative complications. The review also highlights the need for further research and development of new suturing techniques to improve the outcomes of cesarean delivery. In other words, we believe there is a need for innovative approaches and advancements in suturing techniques to enhance the safety and efficacy of cesarean delivery.

**Keywords:** Cesarean Delivery; Suture; Suturing Technique; Systematic Review.

***Article Type***

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**Introduction**

Cesarean delivery, commonly known as C-section, is a widely performed surgical procedure that plays a significant role in childbirth worldwide (1). It has been instrumental in improving the health outcomes of both mothers and newborns. However, among medical professionals, there is an ongoing debate about the most effective method of closing the uterus after Cesarean delivery (2, 3). The technique used for suturing the uterus after surgery is of paramount importance, as it directly impacts the integrity and strength of the incision. The primary objective is to minimize the occurrence of complications such as uterine rupture, dehiscence, and subsequent adverse outcomes for the mother and the infant. Over the years, various approaches have been employed, encompassing traditional methods and more innovative variations. Each technique comes with its own set of advantages and disadvantages (4, 5).

The aim of this systematic review is to evaluate the different uterine suturing techniques following cesarean delivery, including their procedures, advantages, and disadvantages. By analyzing various studies and clinical trials, we aim to provide a comprehensive assessment of the existing techniques and identify areas for improvement.

**Methods:**

The present study was conducted following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (6), Figure 1.



**Figure 1**. Flow chart of the number of studies selected into the study.

**Search strategy:**

The search strategy and eligibility criteria were designed based on the three primary roots of “uterine”, “suturing techniques" and "Cesarean delivery". The search strategy was as follows:

(“Suture Staple” OR “Surgical Staples” OR “Surgical Staples” OR “Surgical Staple”) AND (“Womb” OR “Uterine” OR “Cornua” OR “Uterus” OR “Uteri”) AND (“Cesarean Sections Delivery” OR “Abdominal Caesarean Section” OR “Caesarean Section” OR “Abdominal Delivery” OR “C-Section”). Only studies published in English and with full-text availability were included in the analysis. The systematic search was independently conducted by two researchers in PubMed, Scopus, and Web of Science (WoS) from inception until June 2023.

**Eligibility criteria and study selection:**

The study selection process was carried out in several stages using the EndNote reference management software to manage the obtained articles. Duplicate reports were identified and removed both by software and manual screening. The screening stage involved evaluating the title, abstract, and full texts of the studies based on the eligibility criteria. The selection process was independently conducted by two reviewers.

**Data extraction**:

Data extraction was performed by two independent researchers using data extraction forms that included information such as the author's name, year of publication, name of the technique, its description, advantages and disadvantages, and applications. In case of conflicts, the researchers resolved them through cooperation.

**Results:**

**Results of the systematic search:**

Through a systematic search process, a total of 467 articles were identified from various databases. To ensure the accuracy and reliability of the findings, duplicate records were eliminated using both software and manual methods. This resulted in a refined pool of 148 articles that were further screened based on predetermined eligibility criteria. After examining the articles' titles, abstracts, and full texts, a final selection of nine records was made. The selected articles were then subjected to a data extraction comprehensive qualitative analysis, focusing on the procedure and its advantages and disadvantages.

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**Description of identified methods:**

Nine uterine closure methods were identified based on systematic search. Table 1 demonstrates advantages, and disadvantages of uterine suturing. Following is an overview on procedure of each of these techniques; Single-layer closure is a technique used to suture the uterine incision after a cesarean section using a single layer of sutures. This technique involves suturing the uterine muscle and the uterine serosa together in one layer (7). Similarly, double-layer closure is a technique used to suture the uterine incision after a cesarean section using two layers of sutures. The first layer involves suturing the uterine muscle together, and the second layer involves suturing the uterine serosa (8). Likewise, two-layer closure with an interlocking layer is a technique used to suture the uterine incision after a cesarean section using two layers of sutures, with an interlocking layer between them. The interlocking layer involves suturing the uterine muscle in a way that the sutures from the first layer interlock with the sutures from the second layer, providing additional support and strength to the uterine scar (7, 9).

Inverted-U closure is a technique used to suture the uterine incision after a cesarean section in a U-shaped manner. This technique involves suturing the uterine muscle and the uterine serosa together in a U-shaped pattern, with the apex of the U facing towards the uterine cavity (10).

Uterosacral ligament suspension is a technique used to provide additional support to the uterine scar after a cesarean section. This technique involves suturing the uterine ligaments, specifically the uterosacral ligaments, to the uterine incision site (8, 11). Single-layer closure with inverting Lembert or Cushing stitch is a technique used to suture the uterine incision after a cesarean section using a single layer of sutures, with an inverting Lembert or Cushing stitch. This technique involves suturing the uterine muscle and the uterine serosa together in a continuous manner, with the sutures placed in a way that they invert the edges of the uterine incision (12).

Two-layer closure with separate suture materials is a technique used to suture the uterine incision after a cesarean section using two layers of sutures, with separate suture materials for each layer. The first layer involves suturing the uterine muscle together using one type of suture material, and the second layer involves suturing the uterine serosa using a different type of suture material (13). Locking stitch techniques are a group of techniques used to suture the uterine incision after a cesarean section using sutures that have a locking mechanism. These techniques involve using sutures that can be locked in place to provide better support and strength to the uterine scar (14). Continuous barbed suture is a technique used to suture the uterine incision after a cesarean section using a continuous suture that has barbs or small projections along its length. This technique involves suturing the uterine muscle and the uterine serosa together using a continuous suture that can be easily tightened and secured in place due to the barbs (15).

**Table 1**. Comparing advantages and disadvantages of different uterine suturing techniques.

|  |  |  |
| --- | --- | --- |
| **Technique** | **Advantages** | **Disadvantages** |
| Single-Layer Closure  | Single-layer closure is a commonly used technique and is relatively simple and quick to perform. It has been shown to be effective in promoting healing of the uterine scar. | Single-layer closure may have a higher risk of scar dehiscence compared to other techniques. |
| Double-Layer Closure | Double-layer closure provides better support and strength to the uterine scar compared to single-layer closure. It may reduce the risk of scar dehiscence. | Double-layer closure may take longer to perform compared to single-layer closure. It may also increase the risk of complications such as infection |
| Two-Layer Closure with an Interlocking Layer | Two-layer closure with an interlocking layer provides additional support and strength to the uterine scar. It may reduce the risk of scar dehiscence. | This technique may be more time-consuming compared to single-layer closure. It requires more suturing and precision in suturing technique. |
| Inverted-U Closure  | Inverted-U closure provides better hemostasis and reduces the risk of scar dehiscence. It may also improve the cosmetic appearance of the scar.  | This technique may be more technically challenging and require more surgical skill. It may also take longer to perform compared to other techniques. |
| Uterosacral Ligament Suspension | Uterosacral ligament suspension provides additional support to the uterine scar and reduces the risk of scar dehiscence. It may improve the long-term outcomes of the surgery. | This technique may be more invasive and require more surgical expertise. It may also carry a risk of injury to the ureters. |
| Single-Layer Closure with Inverting Lembert or Cushing Stitch | Single-layer closure with inverting Lembert or Cushing stitch provides better hemostasis and reduces the risk of scar dehiscence. It may also improve the appearance of the scar. | This technique may be more time-consuming compared to single-layer closure without inverting stitches. It requires more suturing and precision in suturing technique. |
| Two-Layer Closure with Separate Suture Materials  | Two-layer closure with separate suture materials provides better support and strength to the uterine scar. It may reduce the risk of scar dehiscence. | This technique may be more time-consuming compared to single-layer closure. It requires more suturing and the use of different suture materials. |
| Locking Stitch Techniques | Locking stitch techniques provide better support and strength to the uterine scar. They may reduce the suturing time and risk of suture loosening and improve the healing of the scar. | Locking stitch techniques may be more technically challenging and require more surgical skill.  |
| Continuous Barbed Suture | Continuous barbed suture provides better support and strength to the uterine scar. It eliminates the need for knot tying and allows for easier tightening and securing of the sutures. | Continuous barbed suture may be more time-consuming compared to traditional sutures. It may also require specialized training and expertise in its use. |

**Discussion:**

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Uterine suturing techniques after a cesarean section play a crucial role in ensuring optimal wound healing, reducing complications, and promoting successful subsequent pregnancies. Several methods have been developed and studied in this context, including single-layer closure, double-layer closure, two-layer closure with an interlocking layer, Inverted-U closure, uterosacral ligament suspension, single-layer closure with inverting Lembert or Cushing stitch, two-layer closure with separate suture materials, locking stitch techniques, and continuous barbed suture. When comparing these techniques, it is important to consider the specific goals and outcomes desired for each patient. Factors such as the surgeon's expertise, the patient's individual characteristics, and the specific circumstances of the surgery should be taken into account. As it is demonstrated in table 1, each technique has its advantages and disadvantages, and the selection should be tailored to the specific situation.

In terms of efficacy, the references provide limited information on the direct comparison of these techniques. However, studies have shown that various uterine suturing techniques, including double-layer closure, two-layer closure with an interlocking layer, and uterosacral ligament suspension, provide better support and strength to the uterine scar compared to single-layer closure. These techniques may reduce the risk of scar dehiscence and improve the long-term outcomes of the surgery (16). In terms of infection, a study by found that the duration of surgery is a risk factor for postoperative infection, with the infection rate almost doubling with each hour of surgery. Therefore, techniques that minimize the duration of surgery may help reduce the risk of infection (1, 17). Regarding niche formation, which refers to the presence of a hypoechoic area within the myometrium of the lower uterine segment, several studies have investigated the relationship between suturing techniques and niche development (13, 18, 19). A study by Jansson et al. found that uterine compression sutures, such as the B-Lynch suture, may be associated with the formation of niches (20). Another study used ultrasound imaging to identify niche formation and found that the cesarean operation itself regardless of suturing technique carries a higher risk of postoperative complications and longer recovery compared to vaginal delivery due to niche (21). Therefore, it is important to consider the potential risk of niche formation when selecting a suturing technique.

Scar dehiscence, which refers to the disruption or separation of scar tissue remaining from a previous C-section, is another important consideration. Studies by Riyami et al. found that there was no correlation between scar dehiscence and single-layer uterine closure (22, 23). Therefore, further research is needed to fully understand the relationship between suturing techniques and scar dehiscence (24). Lastly, bleeding is a critical factor to consider when comparing suturing techniques. A study by Acar et al. demonstrated a new suturing technique that effectively reduced severe postpartum hemorrhage secondary to uterine atony (25). Although we did not include their method in our review as there is not sufficient information on efficacy or complications of their method. Another study found that uterine compression sutures were more successful in controlling postpartum hemorrhage compared to others. Therefore, it is important to select a uterine compression suturing technique in cases that are at higher risk of bleeding (26).

After an extensive review of the available literature, it is evident that each uterine suturing technique after cesarean section has its advantages and limitations. No single technique emerges as the universally superior choice. Surgeons should consider patient-specific factors, their expertise, and the clinical scenario when selecting the appropriate technique. Future research should focus on large-scale, prospective studies with standardized outcome measures to provide more definitive evidence on the optimal uterine suturing technique. Furthermore, innovative approaches and novel suturing materials should be explored to further improve outcomes and reduce complications in this critical surgical procedure.

**Conclusion:**

Based on data from our systematic review, it is evident that each uterine suturing technique after a cesarean section has its own advantages and disadvantages. While some techniques provide better support and strength to the uterine scar, others may offer improved hemostasis or cosmetic outcomes. However, it is important to note that no single technique is optimal for all patients and situations. Further research is needed to explore new methods and techniques that can address the limitations of existing approaches and improve outcomes for women undergoing cesarean section.

**Ethical Issue:**

There was no ethical issue in this systematic review.

**Conflict of interests:**

There was no conflict of interest in this study.

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