

Classical Versus Double Knots Facia Closure Method During Cesarean Section; Is There a Difference in Pain Sensation or Cosmetic Satisfaction?

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Abstract

Aim: This study aimed to compare two rectus fascia closure techniques used during cesarean section and to evaluate their effects on postoperative pain, analgesic requirement, and cosmetic satisfaction.

Methods: A prospective observational study was conducted including 218 women undergoing cesarean delivery. Participants were allocated into two groups according to the fascia closure method. In the classical continuous technique (Group 1), the fascial edges were grasped with a Kocher clamp and closed with a synthetic absorbable multifilament suture using a single-line knot. In the double-knot technique (Group 2), the fascia was closed with the same suture material beginning from the opposite direction, creating an additional loop, and the two sutures were tied together. Pain was assessed on postoperative days 1 and 10 using the Numeric Rating Scale (NRS). Analgesic consumption during hospitalization was recorded. Cosmetic satisfaction regarding the surgical incision was evaluated using a 10-point scale at 1 and 3 months after surgery.

Results: Baseline demographic and clinical characteristics were comparable between the groups. Postoperative day-1 and day-10 NRS pain scores did not differ significantly ($p>0.05$). However, Group 1 required higher amounts of analgesics compared with Group 2 (NSAIDs: 2.6 ± 1.2 vs. 1.7 ± 0.8 ; paracetamol: 1.1 ± 0.8 vs. 0.8 ± 0.7 ; $p<0.001$). Cosmetic satisfaction scores were significantly higher in Group 2 at both the first and third postoperative months ($p=0.03$ and $p=0.02$, respectively).

Conclusions: The double-knot fascia closure technique results in reduced analgesic requirement and higher cosmetic satisfaction compared with the classical continuous closure method, despite similar postoperative pain levels.

Keywords: Abdominal wound closure techniques; cesarean section; postoperative pain.

1. Introduction

Cesarean section (C-section) refers to the surgical delivery of a baby through incisions made in the mother's abdominal wall and uterus. It remains one of the most frequently performed surgical interventions in obstetrics across both developed and developing nations.¹ Historical records indicate that C-sections have been practiced for over four centuries, although the techniques and approaches have evolved substantially over time.² Currently, there is considerable variation in how the procedure is performed, influenced by both institutional protocols and individual surgeon preferences.

Several components of the C-section procedure are subjects of ongoing clinical investigation. These include methods of skin preparation before surgery, techniques for skin closure after delivery, the choice between blunt or sharp entry into the abdominal cavity, the decision to use single versus double-layer closure of the uterine

incision, and whether to exteriorize the uterus or repair it in situ. Additionally, the practice of closing or leaving the peritoneum open remains debated among clinicians.³⁻⁵

Despite substantial research on these technical variables, the available evidence does not consistently guide healthcare providers on which techniques yield the best outcomes, especially regarding safety, postoperative recovery, and patient satisfaction.⁵

The objective of this study was to evaluate postoperative pain levels and overall patient satisfaction associated with two different fascia closure methods implemented in our clinic during cesarean deliveries.

2. Materials and Methods

All patients who were scheduled for an elective cesarean section

(C-section) via a low transverse skin incision (Pfannenstiel) at our institution in March 2022 and December 2022 were taken into consideration. Patients under 18 years of age, those with a previous suprapubic scar or those who required a vertical incision (e.g., due to placenta previa), and individuals with medical conditions affecting wound healing (such as diabetes, chronic corticosteroid use, a history of radiation to the abdomen or pelvis, or current treatment with immunosuppressant medications) were excluded. Additionally, patients who developed postoperative wound infections, which could impact pain sensation and wound healing, were also excluded. Patients' demographic and other clinical data, including age, body mass index (BMI), obstetric history, education status, smoking status, and C-section indications, were recorded. All variables were entered in a standardized data sheet by a research assistant. The study was conducted in accordance with the Helsinki Declaration principles. The institutional ethics committee approved the study (1812/2022) and all participants provided written informed consent.

Patients were hospitalized the day before the operation. The surgeons who participated in the study were obstetricians or senior residents. All operations were performed under spinal anesthesia. Preoperative and postoperative treatments and interventions were standardized in accordance with the practices of our obstetrics clinic. All patients received antimicrobial prophylaxis with cefazolin within 60 minutes before the start of the operation. The abdomen was entered via a transverse suprapubic skin incision and the surgical steps up to the point of fascia closure were accomplished in a standard fashion. Technical differences such as blunt and sharp dissection, uterus exteriorization vs in situ, or parietal peritoneum closure were left to the surgeon's discretion. The procedures for fascia closure are as follows: In Group I (Classical closure group), the right edge of the fascia was held with a Kocher clamp. The fascia was closed starting from the opposite side in a continuous fashion up to the Kocher clamp, and the knots were tied with the same single suture (Figure1; a-b). In Group II (Double knots group), the right

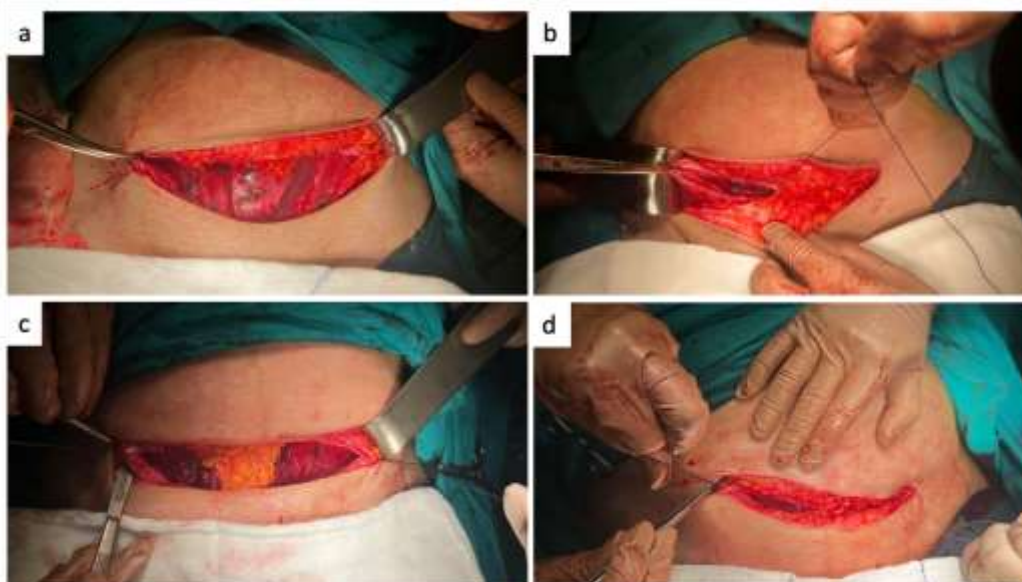
edge of the fascia was fixed with the suture instead of the using Kocher clamp. The fascia was closed from the left to right corner via the second loop. Upon reaching the right corner, the loops from the first suture were tied to the second suture (Figure1; c-d). In both methods, 1-0 vicryl (Ethicon, Inc., Somerville, NJ, USA) suture was used as the suture material. After the incision was irrigated with sterile saline solution, the subcutaneous space was closed if the thickness was 2 cm or more. Skin closure was accomplished with a subcuticular technique using a non-absorbable monofilament suture, which was removed on the 10th day postoperatively. A closed subcutaneous suction drain was not used in any of the patients.

Postoperative pain at and around the incision line was measured on the 1st, and 10th days postoperatively on the NRS (Numeric Rating Scale), with "0" being "no pain" and "10" being "the worst pain imaginable." The 1st measurements were made face-to-face, and the 10th-day evaluation was made via telephone interviews by the same research assistant. A standard analgesic protocol was implemented for all patients. We administer 500 mg of paracetamol intravenously (IV) and nonsteroidal anti-inflammatory drugs (NSAIDs) intramuscularly (IM) for postoperative pain management. We excluded a limited number of cases requiring opioids outside of this protocol, as their inclusion could have influenced pain scores. Paracetamol tablets are recommended for patients after discharge. Accumulative dosages of requested NSAID and paracetamol during the hospital stay were also recorded. All patients were discharged on the second day after surgery by the policy of preventing maternal deaths due to postpartum hemorrhage implemented in our country.

Patient satisfaction with the aesthetic results was assessed using a 10-point scale ranging from 1 (very unsatisfied) to 10 (very satisfied) at the 1st and 3rd months postoperatively. While scoring, patients were asked to score their scars by being reminded of parameters such as color, stiffness, thickness and irregularity. All patients were blinded to which technique was used for facial closure.

Figure 1

Surgical photographs of two different fascia closure methods



a-b; In Group I, the fascia was closed using a continuous synthetic absorbable multifilament suture starting from the opposite side up to the edge of the fascia, which was held in place with a Kocher clamp. The knots were tied with the same suture material ("classical method"). **c-d;** In Group II, the fascia is closed by securing one edge with a knot using the same suture material and starting from the opposite corner with a second loop. Once the edges are approximated, the loop from the first suture was tied to the second suture ("double knots method").

2.1. Statistical analysis

Data were analyzed with IBM SPSS V23 (IBM Corp., Armonk, NY, USA). The normality assumptions were examined with the Kolmogorov-Smirnov test. Mann-Whitney U test was used to compare non-normally distributed data in pairs. Wilcoxon test was used to compare non-normally distributed data within groups according to two dependent times. Pearson chi-square, Yates correction, and Fisher's Exact Test were used to examine categorical variables according to groups. Data are expressed as mean (standard deviation, SD) or median (minimum-maximum), as appropriate. $P < .05$ was considered statistically significant.

3. Results

3.1. Patient Characteristics

Between March and December 2022, a total of 711 patients underwent elective cesarean operations at our obstetrics clinic. Out of these, 471 (%66) had previous suprapubic incisions (repeat cesarean deliveries), six (%0.8) had prior vertical incisions, 13 (%0.1) had diabetes mellitus, and three (%0.004) were under 18 years old; therefore, they were excluded from the study. Among the 218 patients who were eligible, nine (%0.04) were lost to follow-up and did not complete the surveys (four from Group 1 and six from Group 2). Additionally, five (%0.02) patients developed wound infections (two from Group 1 and three from Group 2). As a result, 203 patients were included in the final analysis. The demographic and clinical characteristics of 203 patients in both groups were comparable (Table 1).

Table 1

Demographics by facial closure groups

	Groups		p^*
	Group I(CG) ^a (n:100) median (min-max)	Group II(DKG) ^b (n:103) median(min-max)	
Age	25.5 (16-43)	24 (16-44)	0.6*
Parity	0 (0-4)	0 (0-6)	0.5*
BMI ^c at time of cesarean section	29.6 (17-54)	28(20-50)	0.1*
Educational status	n (%)	n (%)	
•Primary school	30 (29.1)	27 (27)	0,9**
•Middle school	20 (19.4)	21 (21)	
•High school	23 (22.3)	20 (20)	
•University	13 (12.6)	12 (12)	
•Uneducated	17 (16.5)	20 (20)	0.2**
Smoking	1(1)	5 (%4.9)	

^aCG:Classical closure group

^bDKG:Double knots closure group

^cBMI, body-mass index, *Mann-Whitney U test, **Pearson chi-square

3.2. Postoperative Pain

There was no significant difference in pain scores between the groups on the 1st and the 10th postoperative days. The mean NRS scores of both groups were 5.1 on the first postoperative day (5.1±2.2 vs 5.1±2.1). On the 10th day after surgery, NRS scores 2.9±1.7 were in Group I, and 3.1±1.7 were in Group II, respectively ($p>0.05$) (Table 2).

We also assessed pain medication use for all patients in the immediate postoperative period. There were significant differences

in NSAIDs and paracetamol use between groups during the post-cesarean hospitalization. Regardless of the type of drug, patients in Group I required higher doses of pain medication than those in Group II (3.8±1.5 vs 2.5±1.1, respectively $p<0.001$) (Table 3).

3.3. Cosmetic Outcome

Group II had significantly higher aesthetic satisfaction scores than Group I in both measurements, with a mean score of 8.4±1.2 vs. 7.8±1.8 at the end of the first month and 9.2±0.9 vs. 8.8±1.4 at the end of the third month ($p=0.03,0.02$, respectively).

Table 2

Pain scores on the 1st and the 10th postoperative days

	Group I (CG) ^a N:100	Group II (DKG) ^b N:103	p^*
Pain scores	Mean (SD)	Mean (SD)	
Postoperative 1 st day	5.1±2.2	5.1±2.1	0.69
Postoperative 10 th day	2.9±1.7	3.1±1.7	0.58

^aCG:Classical closure group

^bDKG:Double knots closure group

*Mann-Whitney U test

Table 3

Pain medication administered during hospitalization

	Group I (CG) ^a N:100	Group II (DKG) ^b N:103	p^*
Analgesic	Mean (SD)	Mean (SD)	
NSAIDs (IM) ^c	2.6±1.2	1.7 ± 0.8	<0.001
Paracetamol (IV) ^d	1.1±0.8	0.8±0.7	<0.001
Total analgesic use	3.8±1.5	2.5±1.1	<0.001

^aCG:Classical closure group

^bDKG:Double knots closure group

^cNSAIDs:nonsteroidal anti-inflammatory drugs. IM: intramuscular

^dIV: intravenous

*Mann-Whitney U test;

Table 4

Cosmetic satisfaction scores on the 1st and the 3rd postoperative months

	Group I (CG) ^a N:100	Group II (DKG) ^b N:103	p^*
Cosmetic scores	Mean (SD)	Mean (SD)	
Postoperative 1 st month	7.8±1.8	8.4±1.2	0.03
Postoperative 3 rd month	8.8±1.4	9.2±0.9	0.02
p^{**}	<0,001	<0,001	

^aCG:Classical closure group

^bDKG:Double knots closure group

*Mann-Whitney U test, ** Wilcoxon Test

4. Discussion

Fascial closure is critical in abdominal surgery to prevent complications such as fascial dehiscence and wound complications. Options for approximating the fascia in transverse incisions include using a single suture across the entire incision or two sutures starting from opposite corners that meet in the midline or edge of the fascia.⁶ Due to the lack of data from well-designed, long-term surgical studies comparing these techniques, the choice of fascial closure method during cesarean sections ultimately relies on the surgeon's preference. This study aimed to compare the two different fascia closure methods most frequently applied in our clinic regarding pain and cosmetic satisfaction.

The results of our study show that fascial closure with either the classical or double-knot techniques has similar pain scores on the 1st and 10th postoperative days. Although the double-knot group required more pain medication during the hospitalization, we interpreted this result cautiously. First, the necessity for analgesics and the perception of pain in postoperative patients can be attributed to various factors related to each surgical step of cesarean delivery. Published trials comparing various cesarean surgical interventions—such as sharp versus blunt abdominal entry, exteriorization of the uterus for repair versus intra-abdominal repair, and single-layer versus double-layer closure of the uterine incision, as well as closure versus non-closure of the peritoneum—have yielded inconclusive results regarding postoperative pain outcomes.^{7,8} While some studies have suggested that these surgical variations may lead to different results regarding postoperative pain sensation, two large randomized controlled studies did not confirm these findings. In the UK trial on cesarean section techniques (CAESAR), researchers found that the type of closure used for the uterine incision and the decision to close or not close the pelvic peritoneum did not affect analgesic requirements on the third postoperative day or pain scores at hospital discharge.⁹ These findings were also affirmed in the international randomized controlled CORONIS study.¹⁰ However, postoperative pain was not the primary outcome in both multicenter randomized controlled trials. Differences in the type of anesthesia were allowed, and there was no standardization of postoperative pain management. Thus, we conclude that there is inadequate evidence to assert that variations in surgical procedures do not influence analgesic requirements. The observed differences in analgesia needs between the two study groups in our research may be misleading if solely attributed to the fascial closure variable, considering the subjective and deeply personal nature of pain perception. Secondly, pain is a subjective and highly personal experience, which presents difficulties for objective measurement.¹¹ In our study, the research assistant guided the patient during pain scoring, focusing specifically on the pain felt around the incision line. Therefore, comparing the two groups, we consider the patient-reported pain score more reliable than the analgesic requirement.

Fewer studies have investigated abdominal fascia closure techniques for transverse incisions compared to midline incisions.¹² The existing studies primarily focus on the types of suture materials used and whether continuous or interrupted closure methods should be used, particularly regarding infection rates and the development of hernias. Guidelines for standardizing the technique recommended that the fascia be closed using a delayed-absorbable suture in a running, non-locking manner.¹³ Points of variation in the fascial closure of a low transverse incision include the option of employing a single suture to reapproximate the entire incision versus utilizing two sutures that converge at the midline. Currently, there is a lack of sufficient clinical evidence to favor one technique over the other.

In our clinic, surgeons typically employ a single suture technique

using a delayed-absorbable suture in a running, non-locking manner. While using this method, some surgeons prefer to identify the opposite corner of the fascia where the suture will be advanced with a clamp, while others opt to use second suture for this purpose. The second method raises the question of whether the increase in the number of knots may be related to postoperative pain. A prospective cohort study compared the effects of two fascia closure methods—classical fascia closure and single-knot closure—on postoperative pain following cesarean sections.¹⁴ The study found that patients in the single-knot closure group reported lower pain scores on both the first day after surgery and three months later. This reduction in pain scores was attributed to the fewer knots used in the single-knot closure method. In the study, only one knot was placed at one corner of the fascia, which resulted in fewer knots compared to our study.

Healing of fascial wounds triggered by an injury is a coordinated event of many processes and involves three overlapping phases: inflammation, proliferation, and remodeling.¹⁵ All suture materials used for fascial approximation are foreign to the body and can lead to tissue reactions. The severity of these reactions depends on the type, amount, and configuration of the suture used. It has been suggested that an increase in the amount of suture material leads to increased inflammation and pain during wound healing.¹⁶ However, our study does not support this hypothesis. We believe that the tension applied to the fascia impacts postoperative pain more significantly than the amount of suture material used. When sutures are applied too tightly, they can cause tissue strangulation and ischemia, which may lead to increased pain.

Transverse suprapubic incision is preferred in uncomplicated cesarean deliveries. Although this type of incision remains below the bikini line, it can cause itching, pain, tenderness, and significant psycho-social distress in addition to cosmetically disturbing symptoms and loss of function for many patients, especially when scar healing is not satisfactory.¹⁷ Nevertheless, there is a tendency among practitioners to underestimate the impact of scarring and the higher levels of concern among patients regarding postsurgical scarring than their surgeons.¹⁸

It is known that the final appearance of the incision is related to skin closure methods, suturing of the subcutaneous fat tissue, and uncomplicated wound healing in terms of cosmetic and patient satisfaction.¹⁹ Characteristics of an ideal wound closure technique include reduced mechanical tension, providing maximal wound eversion, and absence of skin marks by suture for good skin closure.²⁰ In addition, patient-specific risk factors such as obesity, smoking, diabetes, and the development of complications such as wound infection, hematoma, seroma also negatively affect wound healing.²¹

In our clinic observation, some patients underwent surgery with a transverse incision being retracted at the incision corners, leading to asymmetry in the final appearance. We were interested in investigating whether the two methods of fascial closure contributed to this aesthetically undesirable outcome during the healing process and whether these two fascia closure methods differ in the scar's ultimate healing. Theoretically, inflammation will be more severe in patients using the double knot method due to using more suture material and applying more knots. Therefore, wound healing may be negatively affected. In classical technique, the closure of fascia without needing additional knots makes the closure more expedient and decreases the palpability of the fascia corner postoperatively. However, esthetic satisfaction scores were higher in the double knots group than in the classical group at the end of the first and third months. According to our results, additional knots placed at the opposite corner of the fascia do not have an adverse effect on wound healing, similar to pain scores. Notably, both groups had high aesthetic scores, and the statistical difference does not always

translate to clinical difference. Therefore, our results need to be supported by further studies before they can be considered a practice changer for surgeons using the classic technique.

We acknowledge the potential limitations of our study. First, we employed a numerical rating scale to assess aesthetic satisfaction rather than using standardized and validated scar evaluation tools that incorporate both observer and patient ratings, such as the Patient and Observer Scar Assessment Scale (POSAS) and the Vancouver Scar Scale (VSS).²² This decision was made in consideration of our patient demographic, which primarily consists of individuals from low socioeconomic backgrounds or refugees; many of whom were unable to commit to follow-up visits specifically for aesthetic analysis of their scars. To enhance patient compliance with the study, we opted for a numerical rating scale that could be easily evaluated over the phone.

Second, participants were asked to assess their scars during the first and third months postoperatively. While we recognize that scar remodeling can continue for up to six months after a wound occurs, we chose to limit the follow-up period to three months based on the encouraging results observed during that time, as well as the aforementioned logistical challenges. Lastly, it is important to note that the study was conducted at a large teaching hospital with multiple surgeons performing the procedures, which may have influenced the internal validity of our findings.

5. Conclusion

In conclusion, our study demonstrates no significant difference in postoperative pain scores between the two commonly used fascia closure techniques in surgical practice. However, aesthetic satisfaction was higher when the rectus fascia was closed using the double-knot method. The two techniques compared in this study are those most frequently preferred by our surgical team, and the primary aim was to determine whether any difference exists between these widely used methods. Other fascia closure techniques were beyond the scope of this study and may be evaluated in future research.

Statement of ethics

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Bioethics Committee of the University of Health Science (No 1812/2022).

genAI

No artificial intelligence-based tools or generative AI technologies were used in this study. The entire content of the manuscript was originally prepared, reviewed, and approved by both authors.

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Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author contributions

The authors contributed equally to the article, read and approved the final manuscript.

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