ORIGINAL RESEARCH

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Comparison of the Effectiveness of Classical and Single-knot Fascia Closure Methods in Reducing Pain and Tenderness in the Incision Area After Cesarean Section: A Prospective Cohort Study

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ABSTRACT Objective: We compared the effects of single-knot fascia closure technique and classical fascia closure technique on postoperative pain in fascia closure. **Material and Methods:** In this prospective cohort study, 80 term non-obese pregnant women who had no complicated pregnancy and no additional disease, and who were planned for elective cesarean section were included in the study. Classical fascia closure method was applied to one group (n=40) and single-knot fascia closure method was applied to the other group (n=40). In the single-knot fascia closure technique, the suture was threaded down from the upper part of the right fascia corner and the needle was removed from the lower part of the fascia upwards, approximately 0.5 cm behind the left fascia corner. In the classical fascia closure technique, the fascia was closed continuously. Pain was evaluated with visual analogue scale (VAS) at 8th, 24th hours, and 3rd months postoperatively. The cases were followed up for the development of infection, hematoma, seroma, and hernia at the wound site within 3 months postoperatively. **Results:** Wound infection, seroma, hematoma, and hernia did not develop in the postoperative period in both groups. However, VAS values at the 8th and 24th hours and 3rd months were significantly lower in the group in which the single knot fascia closure method was applied. **Conclusion:** The single-knot fascia closure method is an effective and reliable method in reducing postoperative pain after cesarean section.

Keywords: Cesarean section; postoperative pain; single-knot fascia closure; abdominal fascia

Cesarean section is the operation of reaching the uterus by making an open abdominal incision (laparotomy) and finally delivering the fetus through a uterine incision (hysterotomy). The first known cesarean section was performed in 1020 AD, and since then advances in procedural technique have progressed rapidly.[1] More than 1 million cesarean operations are performed each year, and it is the most frequently performed operation in the United States today. The cesarean delivery rate was reported to have increased from 5% in 1970 to 31.9% in 2016.[2] Despite efforts to reduce cesarean rates, it is reported that a significant decrease cannot be expected in at least ten or twenty years.[3]

Cesarean section is actually a complex operation. However, effective and adequate hemostasis, avoidance of tissue ischemia as much as possible and taking measures to prevent infection are essential for wound healing and reduction of subsequent adhesion formation. Various techniques can be used at each step of the cesarean section. Therefore, many factors may play a role in the surgeon's decisions regarding the technique. In this context, it is recommended that these decisions taken by the surgeon be based on evidence. Examples of cesarean section techniques are Pfannenstiel-Kerr, Joel-Cohen, Misgav-Ladach, Modified Misgav-Ladach methods.[4]

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At the beginning of the cesarean section, the first skin incision can be made as a suprapubic transverse or midline vertical incision. The notion that a vertical midline incision provides faster access to the abdominal cavity and disrupts fewer tissue layers and vessels has led it to be recommended as the preferred method for performing an emergency cesarean section.[4] However, the vertical incision may also provide the more visualization possibilities in patients with known severe adhesions. In cases of severe placental invasion and in cases where cesarean hysterectomy is planned, a vertical incision may facilitate access to the hypogastric arteries. However, the most commonly used incision for a cesarean section is the transverse skin incision and is preferred in most cases due to wound healing and patient tolerability. This technique is often used even in emergency cesarean sections, as most surgeons are more experienced in performing a lower segment transverse cesarean section.[5]

Cesarean section is associated with moderate to severe postoperative pain, which may delay recovery and return to activities of daily living. It also disrupts the mother-child bond, affects the psychological health of the mother, and may make breastfeeding difficult.[6,7] In addition, insufficient analgesia in the postoperative period may cause hyperalgesia and persistent postoperative pain.[8] For these reasons, post-cesarean pain is a common problem, and a significant proportion of women report moderate to severe pain.[9] Post-cesarean pain is often undertreated because of unfounded fears that analgesic drugs or interventions may cause maternal and neonatal side effects, and because the severity of post-cesarean pain is often underestimated.[10]

In order to reduce post-cesarean pain, pharmacological treatments are generally emphasized and the efficacy of these agents is compared. In our study, we compared the effects of the classical double-knot continuous fascia closure method and the single-knot continuous fascia closure method on postoperative pain after a cesarean section.

MATERIAL AND METHODS

For our single-center, prospective cohort study, approval was obtained from the Ethics Committee of Fırat University (date: September 16, 2021, no: 13.09.2021-13). The study was conducted in accordance with the Helsinki Declaration principles. The study was performed by the same surgical team at the Fırat University Faculty of Medicine, Gynecology and Obstetrics Clinic.

The sample size of the study consisted of pregnant women who applied to our clinic within 10 months (between October, 2021 and July, 2022) and met the study criteria.

For the study, the first term pregnant women who were able to communicate with each other and who were going to have a cesarean section were determined and a cesarean section was performed under spinal anesthesia at the Fırat University Faculty of Medicine Hospital. Pregnant women were identified in the antenatal clinic, provided a research information sheet, counseled by a researcher, and then written informed consent was obtained.

Age, gravida, parity and body mass indexes (BMI) of all cases were recorded in the study. Eighty term non-obese pregnant women between 37 and 41 weeks were included in the study. Group 1 (G1)=Classical continuous fascia closure technique was applied to 40 pregnant women. Group 2 (G2)=Single-knot fascia closure technique was applied to 40 pregnant women. For the standardization of the study, pregnant women with a history of premature rupture of membranes, a chronic disease such as preeclampsia, hypertension, a large fetus, diabetes, a history of previous cesarean section, presence of uterine anomaly, myomectomy, and other previous abdominal surgery were excluded from the study. Visual analogue scale (VAS) was used for the assessment of pain for 8 hours, 24 hours, and 3 months after surgery. The VAS was recorded by an assistant who was not otherwise involved in the study and was unfamiliar with the study groups. Pain scores between 0 and 10 were selected by patients from VAS charts. A score of 0 means no pain. A score of 10 expresses pain as badly as possible. Spinal anesthesia and routine analgesic procedures were applied to all patients. Postoperative medical analgesia protocol was applied as follows in all our cases:

Single dose spinal anesthesia administration Protocol: To provide block at the T4 level, ED95

dose bupivacaine+opioid (morphine and/or fentanyl) is used with 25-27 G atraumatic spinal needles, preferably from the midline in the sitting position. 0.5% hyperbaric bupivacaine (11.2 mg)+fentanyl (10 µg)+morphine (0.2 mg) were applied.

Pain modulation after C/S with spinal anesthesia: Postoperative 0th hour=100 mg tramadol in 100 cc 0.9% NaCl solution at 50 cc/h infusion rate (single dose).

Post-operative 6 to 24 hours=75 mg dexketoprofen IV push at a daily dose of 2x1

After 24 hours=500 mg paracetamol tablet at a daily oral dose of 2x1

All patients were mobilized at 6 hours after surgery. After the restoration of bowel movements, solid food intake was started. On the 7th day of the operation, the skin sutures were removed and the incision sites were examined for infection and other complications. Wound infection reported in the first 30 days after surgery was defined as the isolation of organisms, any localized pain or tenderness, swelling or redness, following tissue or fluid culture, including evidence of purulent discharge.[11]

After controlling the intra-abdominal foreign body and bleeding, abdominal fascia closure was performed. In both methods, 1-0 vicryl (Ethicon, Inc., Somerville, NJ, USA) suture was used as the suture material. The parietal peritoneum, camper, and scarpa fascia were not closed in both groups and the skin was closed subcutaneously with 3-0 prolene (Ethicon, Inc., Somerville, NJ, USA) suture.

Single-knotted fascia closure technique: We passed the suture with the needle from the top of the right fascia corner to the bottom, and we removed the needle from the bottom of the fascia to the top, about 0.5 cm behind the left fascia corner (Figure 1). Then, we took the free rope extending from the right side to the left side into the continuous suture and proceeded to the right corner (Figure 2). When we reached the right corner, we tied the rope we brought by moving from the left corner with the rope with the free end in the right corner (Figure 3). With this method, there are no knots in the left corner (Figure 4).

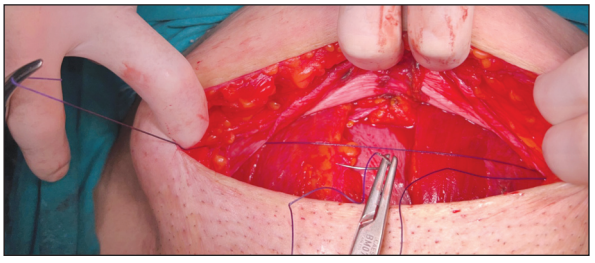

FIGURE 1: After the suture needle is passed down over the right fascia corner, the needle is removed from the left side up under the left fascia, approximately 0.5 cm behind the left fascia corner.

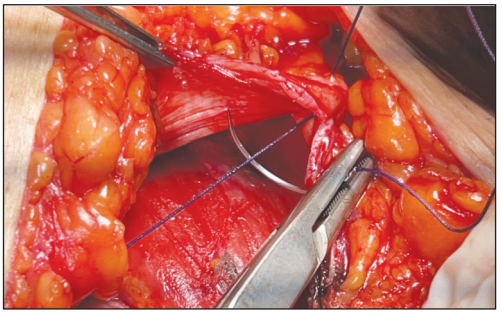

FIGURE 2: The fascia is permanently closed from left to right. The free thread stretching from right to left is taken into the continuous suture.

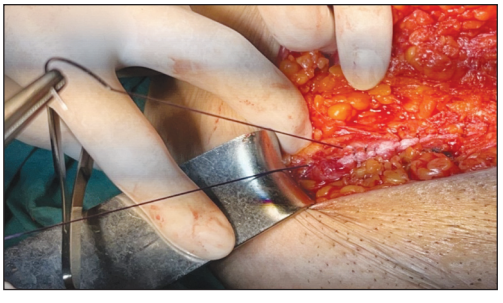

FIGURE 3: The suture that we continue from the left corner to the right corner is tied with the free thread in the right corner.

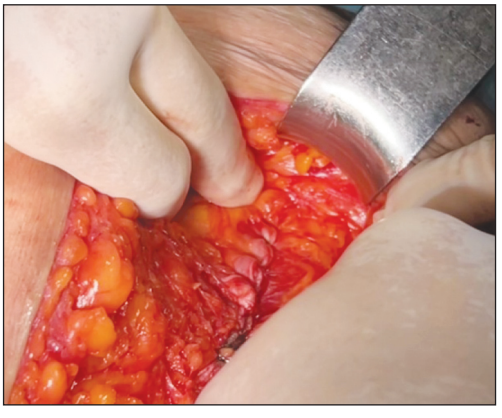

FIGURE 4: No knot in the left fascia corner.

Classical continuous fascia closure technique: The right fascia corner was held with a clamp. The knot was tied by passing a -U- suture through the left fascia corner. With the free rope, the fascia started to be closed continuously from left to right towards the right-side fascia corner. When it came to the right fascia corner, the suture was knotted by passing a -U- suture behind the clamp. In this way, a knot was placed on both fascia corners.

Wound hematoma or seroma formation, defined as a subcutaneous collection of blood or serous fluid, diagnosed clinically or by ultrasound evaluation in the first 30 days after surgery was investigated.[12] After 3 months postoperatively, the patients were re-examined for the presence of an incisional hernia.

STATISTICAL ANALYSIS

Statistical analysis of the data was performed using SPSS 21.0 (IBM Corporation, Armonk, NY, USA) package program. Numerical data were expressed as mean±standard deviation. In data analysis, the distribution of continuous variables was determined by Shapiro-Wilk normality tests. Paired samples t-test was used for the comparison of dependent paired groups, and the independent samples t-test was used for the comparison of independent paired groups. $p<0.05$ was considered significant in all analysis results.

RESULTS

In our study, there was no significant difference in age, gravida, parity, and BMI between the groups. Values for all groups are shown in Table 1. VAS scores at 8 hours (7.525±1.94855 vs 5.95±1.38619; $p<0.001$) and 24 hours (5.75±2.03451 vs 3.275±1.32144; $p<0.001$) postoperatively were significantly lower in Group 2. The VAS score after 3 months (when light pressure was applied to the knot regions) was significantly lower in Group 2 (2.075±1.11832 vs 1.4±0.54538; $p=0.007$). Values for all groups are shown in Table 2.

In the study, cesarean section-related wound infection, seroma, hematoma, and incisional hernia were not detected in both groups in the follow-up 3 months later.

DISCUSSION

In our study, we investigated the effects of the classical continuous fascia closure technique and single-knot fascia closure technique on postoperative cesarean section pain using VAS. As a result of our study, we showed that our single-knot technique causes less pain at the cesarean section site. Postoperative wound infection, wound hematoma, and incisional hernia did not develop in either group.

In our clinical observations, we have seen that patients generally complain of sutures placed on the fascia corners after a cesarean section. In addition, we observed that these knots were not welcomed by the patient and that pain and sensitivity were more in the knotted areas. We thought that reducing the number of knots may cause less postoperative tenderness and pain. Therefore, in our study, we compared the postoperative results of the classical continuous clo-

TABLE 1: Demographic characteristics of both groups.

Parameters	G1 (n=40)	G2 (n=40)	p value
Age (years)	29.247±5.88	30.325±5.785	0.358
Gravida	2.9000±1.72546	3.6500±2.29529	0.064
Parity	1.5750±1.47361	1.9125±1.66265	0.244
BMI (kg/m^2)	29.3765±4.31420	28.3225±4.59120	0.220

G1: Classical continuous fascia closure technique;
G2: Single-knot fascia closure technique; BMI: Body mass index.

TABLE 2: VAS scores of both groups.

VAS scores	G1 (n=40)	G2 (n=40)	p value
Postoperative 8th hour	7.5250±1.94855	5.9500±1.38619	<0.001*
Postoperative 24th hour	5.7500±2.03451	3.2750±1.32144	<0.001*
Postoperative 3rd month	2.075±1.11832	1.4±0.54538	0.007*

*Compared with G1; G1: Classical continuous fascia closure technique; G2: Single-knot fascia closure technique; VAS: Visual analogue scale.

sure of the fascia after cesarean section with Pfannenstiel incision and the single-knot fascia closure technique we applied.

During the cesarean section, the fascia is reached after the skin and subcutaneous tissue are passed through the Pfannenstiel incision. Then the fascia is cut at the midline with a scalpel and this incision is sharply or bluntly extended to the sides.[4] During the cesarean section, the subcutaneous layer is reached after the Pfannenstiel incision is made. This layer is opened by blunt or sharp dissection. One of the points to be noted here is that blood vessels run along this layer. Therefore, it should be aimed to limit the sharp dissection to the midline until the fascia is reached, and then to minimize damage to the blood vessels by blunt dissection laterally. If the blood vessels are cut, hemostasis can be achieved with the careful and meticulous use of cautery.[4]

Before the fascia is closed, the rectus muscles and subfascial tissues are carefully examined to ensure hemostasis, and the fascia is closed without locking with a delayed absorbable suture. Although some surgeons used to close the fascia intermittently, this technique is not widely used today. It has been reported that using monofilament suture instead of braided suture may reduce the risk of infection and hernia formation.[13-15] Despite the closure of the entire fascia incision using a single suture, the methods of using two sutures meeting at the midline did not show any superiority over each other.[16] We also performed the uterine incision by making a lower segment transverse incision with Pfannenstiel incision in all our cesarean section operations.

It has been reported that the location of blood vessels in the fascia region and attention to the protection of these vessels are very important in tissue ischemia and wound healing.[4] In our study, we planned our study considering that as the number of nodes decreases, the blood flow in the tissue will be less affected, therefore the effect of hypoxia on the tissue will be less, and as a result, wound healing will be better. However, we could not perform biochemical or histopathological evaluations that may cause pain in the postoperative period as it would not be ethical. We evaluated postoperative pain with the VAS score. We could not make a more objective pain assessment. The fact that the VAS score is a subjective evaluation constitutes a weak side of our study.

Despite efforts to reduce its prevalence, elective cesarean section still remains the most common elective abdominal surgery. Therefore, even minimal wound-related complications can pose a significant burden for healthcare systems. Therefore, efforts should be made to reduce the impact of wound complications.[17] We also thought that the number of knots could be reduced as a contribution to reducing the pain and tenderness caused by knots in the corners of the abdominal fascia after cesarean section as a wound complication.

Cesarean section is a major surgery performed through an incision in the abdominal wall and uterine wall. Women who have had a cesarean section usually complain of abdominal and incisional pain.[18] However, operative techniques can vary widely among surgeons.[19] In this context, surgical studies on pain reduction methods have generally focused on the effects of skin and subcutaneous tissue closure.[20,21] In order to make an additional contribution to these studies, we investigated the relief of cesarean incision pain by reducing the number of knots in fascia closure.

Incision repair after abdominal surgery is of great importance. Ignoring the aforementioned issue may lead to different complications such as the risk of wound dehiscence, chronic incision pain, sinus infection and incisional hernia, resulting in rehospitalization, and loss of time and money.[22-24] Surgical technique and suture type are the only factors that can be directly controlled by the surgeon and play an important role in wound healing.[23,25] We used 1-0 vicryl suture for fascia closure in our cases in both groups. In both groups, the parietal peritoneum, camper, and scarpa fascia were not closed, and the skin was closed subcutaneously with 3-0 prolene suture. VAS was performed in both groups at the 8th and 24th hours, and 3rd month postoperatively. We found that postoperative cesarean section pain was significantly less in our single-knot fascia closure group, because in our technique, there is no knot in the left corner. When we re-examined our cases 3 months later, we ques-

tioned the tenderness and pain in the knot regions. The cases in our single-knot group generally stated that they felt mild pain only on the right side (the side of the knot). According to VAS scores, we saw a significant decrease in pain and sensitivity in our single-knot group. We think that the knot we placed in the right corner does not create any tension because it does not compress the right fascia corner from above and below, as it does with the -U- sutures that are passed through the fascia corners and tied. This may have contributed to the reduction in postoperative pain.

Women who delivered by cesarean section had a 5 to 20-fold increased risk of peripartum infective complications compared to women who delivered vaginally.[26] Surgical site infections have been reported to occur in approximately 12% of procedures. In addition, wound complications such as hematoma, seroma, and wound dehiscence may complicate post-cesarean recovery. All of these may have adverse effects on maternal health and well-being in the postpartum period, pain in the incision site and abdominal region, the mother's ability and first experience to care for her baby.[27] Peripartum infection, wound hematoma, and seroma did not develop clinically in either of our groups.

Wound complications such as post-surgical wound infection, wound dehiscence, and incisional hernia are common and result in patient suffering and prolonged hospital stay.[28,29] Experimental and clinical evidence indicates that wound dehiscence and incisional hernia are related to the surgical technique used for wound closure.[30-32] Accordingly, the surgeon can to some extent control the risk of wound complications. Although incisional hernia occurrence after cesarean section is likely to be low, it is important to be aware of this complication due to the increasing rates of cesarean section worldwide, especially since the risk of incisional hernia can be reduced.[33] In our cases, wound dehiscence and incisional hernia did not develop in both groups. This supports the fact that the single-knot fascia closure technique we used is comparable and safe to conventional continuous fascia closure.

As the limitations of our study were the limited number of cases and we did not include obese pregnant women in our study, we could not make a recommendation for the use of this technique in obese pregnant women. In addition, we could not ethically perform the histopathological examination of the fascia corners in the postoperative period of both methods. However, this can be evaluated with a planned animal study.

The strength of our study is that the single-knot fascia closure method was defined as the abdominal fascia closure method and it was shown that it could be a feasible method according to the postoperative results.

CONCLUSION

After lower segment cesarean section with a Pfannenstiel incision, the single-knot fascia closure method is significantly more effective in reducing postoperative incision pain compared to the classical fascia closure method.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Remzi Atılgan;* ***Design:*** *Remzi Atılgan;* ***Control/Supervision:*** *Remzi Atılgan;* ***Data Collection and/or Processing:*** *Şehmuz Pala;* ***Analysis and/or Interpretation:*** *Şehmuz Pala;* ***Literature Review:*** *Mesut Ali Halisçelik;* ***Writing the Article:*** *Remzi Atılgan;* ***Critical Review:*** *Ahmet Şenocak;* ***References and Fundings:*** *Bünyamin Çim;* ***Materials:*** *Mesut Ali Halisçelik, Bünyamin Çim.*

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